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Technical Information

Achieving required system accuracies and precision requires selection of appropriate instruments, creativity in designing test methods, and careful attention to specifications and error terms. Most test system designs are complex enough that it is in the designer’s best interest to minimize the number of uncontrollable variables. To accomplish this, the system switch performance should be tightly specified.

Special consideration should be given to tests that approach the specified limits of accuracy, resolution, or sensitivity of the measurement or sourcing instruments. These generally represent the “most critical test requirements,” and switching should be selected to support these tests. A system designed to perform against the “most critical test requirements” will usually satisfy other test requirements selected to support these tests. A system designed to approach the specified limits of accuracy, resolution, or sensitivity of the measurement or sourcing instruments (source and measure), develop a picture of what type of switch and configuration will be needed. This is likely to be an iterative process as you identify what types of switching equipment are actually available.

Once you have done the groundwork, you are ready to configure the switching for your test system:

• Determine the appropriate switch and switch card configurations
• Select the appropriate switch system
• Select source and measure equipment
• Select cables and/or other accessories
• Identify need for fuses, limit resistors, diodes, etc.
• Determine the uncertainties and compare them with the required accuracies

Switching Configurations

The variety and size of switching configurations available determine the efficiency of the final switching design, including the amount and complexity of cabling and interconnect at the time of system integration. These are the basic building blocks of any switching system.

Figure 1. General Purpose Test System

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Switching and Control

How Do I Specify a Switch System for My Application?

Whether you are designing your own switching system or preparing to contact Keithley’s applications department for assistance, you need to define certain parameters for your test system and understand how you want everything interconnected.

First, define your parameters. This includes:

• Measurements—List all the required measurement types and accuracies.
• Sources—List all the sources required.
• Quantity—List the number of terminals on the DUT and how many devices are involved.
• Signal characteristics—List signal types, levels and frequency, and impedance requirements.
• Speed—What are the speed requirements?

• Environment—Temperature, humidity, etc.
• Communication interface—GPIB, RS-232, Ethernet, USB

Next, sketch the system. Given the number of terminals on the device and the number of instruments (source and measure), develop a picture of what type of switch and configuration will be needed. This is likely to be an iterative process as you identify what types of switching equipment are actually available.

Once you have done the groundwork, you are ready to configure the switching for your test system:

• Determine the appropriate switch and switch card configurations
• Select the appropriate switch system
• Select source and measure equipment
• Select cables and/or other accessories
• Identify need for fuses, limit resistors, diodes, etc.
• Determine the uncertainties and compare them with the required accuracies

Switching Configurations

The variety and size of switching configurations available determine the efficiency of the final switching design, including the amount and complexity of cabling and interconnect at the time of system integration. These are the basic building blocks of any switching system.

Figure 2. Example Switching Configurations

A switching configuration can be described by the electrical property being switched, its mechanical construction, or its function in the test system (Figure 2). These descriptions of the signal paths or electrical interconnects are necessary for laying out and wiring the test system.

A matrix switch (Figure 3) is the most versatile type of system switching. But first, a word on terminology here — Do not confuse a switch matrix (often called a switching mainframe) with a matrix switch. With a matrix switch, any input can be connected to any output, singly or in combination. This helps minimize the need for complex wiring and interconnect systems and can simplify the DUT interface. Although a matrix switch will work in virtually any switching application, it should not necessarily be your first choice of switch configuration.

Figure 3. Matrix Switch

Consider an example where you need to connect four different instruments to ten different test points on a device-under-test. If you need to be able to connect any combination of instruments to any combination of test points at any time, then you do need a matrix switch. But, if you only need to connect one instrument to one test point at any time, then you can combine a four-to-one multiplexer with a one-to-ten multiplexer to make your connections. The multiplexer approach only uses 14 relays, while the full matrix uses 40. If you simply choose a matrix switch for the second example, you will end up paying for 26 relay channels you don’t need. Careful planning can result in a more compact and economical switch system.

Figure 4. Multiplex Switch

Technical information: Switching and control
A multiplex switch (Figure 4) connects one instrument to multiple devices under test or multiple instruments to one device under test. The multiplex switch is useful in combination with matrix or other configurations to expand switching capacity by sharing electrical paths, to provide additional isolation and reduce crosstalk between channels, or to build special configurations.

The isolated switch configuration consists of individual uncommitted relays, often with multiple poles. Isolated switches are not connected to any other circuit, and are therefore free for building very flexible and unique combinations of input/output configurations with the addition of some external wiring. This type of switch can be useful for creating additional isolation between circuits, providing safety interlock, actuating other relays or circuits, or building special topologies such as binary ladders and tree structures.

**Electrical Specifications**

Electrical specifications of the switching cards contribute significantly to the overall performance and signal integrity in the test system. When trying to achieve high accuracy, resolution, and sensitivity or to route high frequency signals, high currents, and high voltages with minimum degradation in the test signal, the electrical performance of the switch card must be known. Match the system's critical test requirements against the specified performance of the switch. If the requirement is to measure a one volt reference to one microvolt, be certain that the contact potential of the switch is not hundreds of microvolts. If switching of power supply voltage is required, be certain that the switch has sufficient current carrying capacity. When measuring resistances of less than one kΩ, be certain the switch will support four-wire measurements.

**Figure 6. Switching Performance Characteristics**

The switching card specifications represent the performance of a single card. If additional cards are connected together, actual performance parameters such as offset current and insertion loss will be a function of the entire system, not just a single card. Each extra card and connecting cable adds some degradation. It may be necessary to characterize the entire system (including switching) in some applications.

**Mainframe Capabilities**

A switching mainframe provides a convenient mechanical and programming environment for Keithley switching cards and can be selected to suit the size of the system. The Model 3706A offers six slots in a full rack 2U high enclosure and is compatible with a growing family of high density and high speed switching cards. For more diverse signal ranges the Models 7001 (two-slot) and 7002 (ten-slot) switch systems are compatible with the full range of more than 30 cards.

For low level semiconductor applications, the Model 707B (six slots) and 708B (one slot) mainframes are compatible with six specialized high density configurations including high speed, low leakage matrix configurations.

**Switching Density**

The high channel capacity Keithley mainframes provide reduces the complexity of a switch application by minimizing the number of mainframes and cards required. The Model 3706A is our highest density switching mainframe offering up to 576 two-wire multiplexer channels in a single 2U high, full rack mainframe. The half-rack 7001 has a capacity of up to 80 two-pole channels, and the ten-slot 7002 can accommodate 400 two-pole channels. The 707B can handle up to 576 channels or matrix crosspoints, while the 708B can accommodate up to 96 channels or crosspoints. The high density cards for each of these mainframes are designed for easy interconnect and wiring.

**Channel Status**

The Series 7000A with its LXI class B compliance offers an elaborate embedded web browser interface for intuitive point and click control and monitoring of all switch positions. The Series 7000 and 700 switch mainframes provide a visual display of each switch position on the front panel.

**Expansion**

The mainframe Models 3706A, 7001, 7002, and 707B each provide an analog backplane that can be used to make connections between cards when building large matrix or multiplexer configurations that require several cards. The backplane eliminates intercard wiring and increases configuration flexibility.
The Series 3700A offers scalable, instrument grade switching and multi-channel measurement solutions that are optimized for automated testing of electronic products and components. The Series 3700A includes four versions of the Model 3706A system switch mainframe along with a growing family of plug-in switch and control cards. When the Model 3706A mainframe is ordered with the high performance multimeter, you receive a tightly integrated switch and measurement system that can meet the demanding application requirements in a functional test system or provide the flexibility needed in stand-alone data acquisition and measurement applications.

Maximizes System Control and Flexibility

To provide users with greater versatility when designing test systems, the Series 3700A mainframes are equipped with many standard features. For example, easy connectivity is supported with three remote interfaces: LXI/Ethernet, General Purpose Interface Bus (GPIB), and Universal Serial Bus (USB). Fourteen digital I/O lines are also included, which are programmable and can be used to control external devices such as component handlers or other instruments. Additionally, system control can be greatly enhanced by using our Test Script Processor (TSP) technology. This technology provides “smart” instruments with the ability to perform distributed processing and control at the instrument level versus a central PC.

High Quality Switching at a Value Price

The Series 3700A builds upon Keithley’s tradition of producing innovative, high quality, precise signal switching. This series offers a growing family of high density and general purpose plug-in cards that accommodates a broad range of signals at very competitive pricing. The Series 3700A supports applications as diverse as design validation, accelerated stress testing, data acquisition, and functional testing.

Model 3706A Mainframe

The Series 3700A includes the base Model 3706A system switch/multimeter mainframe with three options for added flexibility. This mainframe contains six slots for plug-in cards in a compact 2U high (3.5 inches/89mm) enclosure that easily accommodates the needs of medium to high channel count applications. When fully loaded, a mainframe can support up to 576 two-wire multiplexer channels or 2,688 one-pole matrix crosspoints for unrivaled density and economical per channel costs.

High Performance, 7½-digit Multimeter (DMM)

The high performance multimeter option provides up to 7½-digit measurements, offering 26-bit resolution to support your ever-increasing test accuracy requirements. This flexible resolution supplies a DC reading rate from >14,000 readings/second at 3½ digits to 60 readings/second at 7½ digits to accommodate a greater span of applications. The multimeter does not use a card slot, so you maintain all six slots in your mainframe. In addition, the multimeter is wired to the mainframe’s analog backplane, ensuring a high quality signal path from each card channel to the multimeter.

The multimeter supports 13 built-in measurement functions, including: DCV, ACV, DCl, ACI, frequency, period, two-wire ohms, four-wire ohms, three-wire RTD temperature, four-wire RTD temperature, thermocouple temperature, thermistor temperature, and continuity. In addition, the multimeter offers extended low ohms (1Ω) and low current (10µA) ranges. In-rack calibration is supported, which reduces both maintenance and calibration time.

---

### Single Channel Reading Rates

<table>
<thead>
<tr>
<th>NPLC</th>
<th>DCV/2 Wire Ohms</th>
<th>4 Wire Ohms</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>60</td>
<td>29</td>
</tr>
<tr>
<td>0.2</td>
<td>295</td>
<td>120</td>
</tr>
<tr>
<td>0.06</td>
<td>915</td>
<td>285</td>
</tr>
<tr>
<td>0.006</td>
<td>6,200</td>
<td>580</td>
</tr>
<tr>
<td>0.0005</td>
<td>14,100</td>
<td>650</td>
</tr>
</tbody>
</table>
Series 3700A

System Switch/Multimeter and Plug-In Cards

Ordering Information

Mainframes

3706A Six-slot system switch with high performance DMM
3706A-NFP Six-slot system switch with high performance DMM, without front panel display and keypad
3706A-S Six-slot system switch
3706A-SNFP Six-slot system switch, without front panel display and keypad

Plug-in Cards

3720 Dual 1×30 multiplexer card (auto CJC when used with 3720-ST)
3721 Dual 1×20 multiplexer card (auto CJC when used with 3721-ST)
3722 Dual 1×48, high density, multiplexer card
3723 Dual 1×30, high speed, reed relay multiplexer card
3724 Dual 1×30 FET multiplexer card
3730 6×16, high density, matrix card
3731 6×16 high speed, reed relay matrix card
3732 Quad 4×28, ultra-high density, reed relay matrix card
3740 32 channel isolated switch card
3750 Multifunction control card

Accessories Supplied

Test Script Builder
Software Suite CD
Ethernet Crossover Cable (CA-180-3A)
Series 3700A Product CD (includes LabVIEW®, IVI C, and IVI.COM drivers)

Measurement Capability

<table>
<thead>
<tr>
<th>Measurement Capability</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Voltage</td>
</tr>
<tr>
<td>AC Voltage</td>
</tr>
<tr>
<td>DC Current</td>
</tr>
<tr>
<td>AC Current</td>
</tr>
<tr>
<td>Frequency</td>
</tr>
<tr>
<td>Period</td>
</tr>
<tr>
<td>Resistance (2-Wire)</td>
</tr>
<tr>
<td>Resistance (4-Wire)</td>
</tr>
<tr>
<td>Dry Circuit Resistance</td>
</tr>
</tbody>
</table>

Temperature–RTD
-200°C 0 500 1000 1500 2000
Temperature–TC
-200°C
Temperature–Thermistor
-80°C 150°C

Linear scale

Logarithmic scale

Measurement capabilities of the high performance multimeter

ACCESSORIES AVAILABLE

GPIB INTERFACES AND CABLES

<table>
<thead>
<tr>
<th>Accessory</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7007-1</td>
<td>Shielded GPIB Cable, 1m (3.3ft)</td>
</tr>
<tr>
<td>7007-2</td>
<td>Shielded GPIB Cable, 2m (6.6ft)</td>
</tr>
<tr>
<td>KPCI-488LPA</td>
<td>IEEE-488 Interface/Controller for the PCI Bus</td>
</tr>
<tr>
<td>KUSB-488B</td>
<td>IEEE-488 USB-to-GPIB Interface Adapter</td>
</tr>
</tbody>
</table>

DIGITAL I/O, TRIGGER LINK, AND TSP-LINK

<table>
<thead>
<tr>
<th>Accessory</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2600-TLINK</td>
<td>Trigger I/O to Trigger Link Interface Cable, 1m (3.3ft)</td>
</tr>
<tr>
<td>CA-126-1</td>
<td>Digital I/O and Trigger Cable, 1.5m (4.9ft)</td>
</tr>
<tr>
<td>CA-180-3A</td>
<td>CAT5 CrossOver Cable for TSP Link</td>
</tr>
</tbody>
</table>

MULTIMETER CONNECTORS

<table>
<thead>
<tr>
<th>Accessory</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3706-BAN</td>
<td>DMM Adapter Cable, 15-pin D-sub to banana jacks, 1.6m (4.6ft)</td>
</tr>
<tr>
<td>3706-BKPL</td>
<td>Analog Backplane Extender Board, 15-pin D-sub to terminal block</td>
</tr>
<tr>
<td>3706-TLK</td>
<td>Test Lead Kit, includes 3706-BAN and plug-in test lead accessories</td>
</tr>
<tr>
<td>8620</td>
<td>Shorting Plug</td>
</tr>
</tbody>
</table>

RACK MOUNT KIT

<table>
<thead>
<tr>
<th>Accessory</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4288-10</td>
<td>Fixed Rear Rack Mount Kit</td>
</tr>
</tbody>
</table>

SERVICES AVAILABLE

<table>
<thead>
<tr>
<th>Service Description</th>
<th>Mainframe Models 3706A and 3706A-NFP</th>
</tr>
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<tbody>
<tr>
<td>3706A-3Y-EW</td>
<td>1 Year Factory Warranty Extended to 3 Years</td>
</tr>
<tr>
<td>3706A-5Y-EW</td>
<td>1 Year Factory Warranty Extended to 5 Years</td>
</tr>
<tr>
<td>C/3706A-3Y-STD</td>
<td>Calibration Contract, 3 Years, Standard Calibration*</td>
</tr>
<tr>
<td>C/3706A-3Y-DATA</td>
<td>Calibration Contract, 3 Years, Z540 Compliant Calibration with Data*</td>
</tr>
<tr>
<td>C/3706A-3Y-ISO</td>
<td>Calibration Contract, 3 Years, ISO 17025 Accredited Calibration*</td>
</tr>
<tr>
<td>C/3706A-5Y-STD</td>
<td>Calibration Contract, 5 Years, Standard Calibration*</td>
</tr>
<tr>
<td>C/3706A-5Y-DATA</td>
<td>Calibration Contract, 5 Years, Z540 Compliant Calibration with Data*</td>
</tr>
<tr>
<td>C/3706A-5Y-ISO</td>
<td>Calibration Contract, 5 Years, ISO 17025 Accredited Calibration*</td>
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<table>
<thead>
<tr>
<th>Service Description</th>
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<tr>
<td>3706A-S-5Y-EW</td>
<td>1 Year Factory Warranty Extended to 5 Years</td>
</tr>
</tbody>
</table>

SOFTWARE SERVICES

<table>
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<th>Service Description</th>
<th>Mainframe Models 3706A-S and 3706A-SNFP</th>
</tr>
</thead>
<tbody>
<tr>
<td>3706A-S-3Y-EW</td>
<td>1 Year Factory Warranty Extended to 3 Years</td>
</tr>
<tr>
<td>3706A-S-5Y-EW</td>
<td>1 Year Factory Warranty Extended to 5 Years</td>
</tr>
</tbody>
</table>

*Not available in all countries.
TSP Distributed Control Increases Test Speed and Lowers Test Cost

TSP technology enhances instrument control by allowing users the choice of using standard PC control or of creating embedded test scripts that are executed on microprocessors within the instrument. By using TSP test scripts instead of a PC for instrument control, you avoid communication delays between the PC controller and instrument, which results in improved test throughput. Test scripts can contain math and decision-making rules that further reduce the interaction between a host PC and the instrument.

This form of distributed control supports the autonomous operation of individual instruments or groups of instruments and can possibly remove the need for a high level PC controller, which lowers test and ownership costs. This is the same proven TSP technology found in our innovative Series 2600B System SourceMeter® SMU instruments.

TSP-Link Technology for Easy and Seamless System Coordination and Expansion

If your channel density requirements grow or if you need to process more signal types, use TSP-Link Technology to expand your system. The TSP-Link master/slave connection offers easy system expansion between Series 3700A mainframes. You can also use TSP-Link Technology to connect to other TSP-Link enabled instruments such as Series 2600B SourceMeter SMU instruments. Everything connected with TSP-Link can be controlled by the master unit, just as if they were all housed in the same chassis.

This high speed system expansion interface lets users avoid the complex and time consuming task of expanding their remote interfaces to another mainframe. There is no need to add external triggers and remote communication cables to individual instruments, since all TSP-Link connected devices can be controlled from a single master unit.

Test Script Builder Software Suite

Test Script Builder is a software tool that is provided with all Series 3700A instruments to help users easily create, modify, debug, and store TSP test scripts. It supplies a project/file manager window to store and organize test scripts, a text-sensitive program editor to create and modify TSP tests, and an immediate instrument control window to send Ethernet, GPIB, and USB commands and to receive data from the instrument. The immediate window also allows users to see the output of a given test script and simplifies debugging.

Test Script Builder Software Suite

**Version 1.4**

LXI Core 2011 with LXI Clock Synchronization, LXI Timestamped Data, LXI Event Messaging, LXI Event Log.

**Transportable Memory, USB 2.0 Device Port**

All Model 3706A mainframes contain a USB device port for easy transfer of readings, configurations, and test scripts to memory sticks. This port, which is located on the front panel, provides you with easy access to and portability of measurement results. Simply plug in a memory stick and, with a few simple keystrokes, gain access to virtually unlimited memory storage. Additional capabilities include: saving and recalling system configurations and storage for TSP scripts.
Series 3700A System Switch/Multimeter and Plug-In Cards

Embedded Web Server
The built-in Web interface offers a quick and easy method to control and analyze measurement results. Interactive schematics of each card in the mainframe support point-and-click control for opening and closing switches. A scan list builder is provided to guide users through the requirements of a scan list (such as trigger and looping definitions) for more advanced applications. When the mainframe is ordered with the multimeter, additional Web pages are included for measurement configuration and viewing, including a graphing toolkit.

Built-in Web Server Interface

1. Configure your switch channels and measurement functions.
Configure the DMM to make your measurements at the desired speed, resolution, etc. and assign them to the desired channels.

2. Build and run your automated scan list.
The toolkit makes it easy to build and execute an automated sequence of channel-open and channel-close commands and triggered multimeter measurements.

3. Analyze your data. View your results in real-time or historical mode with point-and-click simplicity. Data can be exported directly to your PC in either numerical or graphical formats for presentation or other applications.

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A Greater Measure of Confidence
### Series 3700A System Switch/Multimeter and Plug-In Cards

#### High Performance Multimeter Specifications (Rev. A)

**DC Specifications**

**CONDITIONS:** 1 PLC or 5 PLC.

For <1 PLC, add appropriate “ppm of range” adder from “RMS Noise” table.

Includes rear panel Analog Backplane connector and transducer conversion. Refer to DC Notes for additional card uncertainties.

<table>
<thead>
<tr>
<th>Function</th>
<th>Range</th>
<th>Resolution</th>
<th>Test Current or Burden Voltage</th>
<th>Input Resistance or Open Circuit Voltage</th>
<th>Accuracy: ±(ppm of reading + ppm of range) (ppm = parts per million) (e.g., 10ppm = 0.001%)</th>
<th>Temperature Coefficient 0°~18°C and 28°~50°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage*</td>
<td>100.000000 mV</td>
<td>0.01 µV</td>
<td>&gt;10 GΩ or 10 MΩ ±1%</td>
<td>23°C ±1°C</td>
<td>24 Hour</td>
<td>90 Day</td>
</tr>
<tr>
<td>10.000000 V</td>
<td>0.1 µV</td>
<td>250 ± 10</td>
<td>250 ± 10</td>
<td>250 ± 10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.000000 V</td>
<td>1 µV</td>
<td>500 ± 30</td>
<td>500 ± 30</td>
<td>500 ± 30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100.000000 V</td>
<td>10 µV</td>
<td>1000 ± 60</td>
<td>1000 ± 60</td>
<td>1000 ± 60</td>
<td></td>
<td></td>
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<tr>
<td>Resistance**</td>
<td>1.000000 Ω</td>
<td>0.1 µΩ</td>
<td>10 mA</td>
<td>23°C ±1°C</td>
<td>24 Hour</td>
<td>90 Day</td>
</tr>
<tr>
<td>10.000000 Ω</td>
<td>1 µΩ</td>
<td>500 ± 30</td>
<td>500 ± 30</td>
<td>500 ± 30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.000000 Ω</td>
<td>10 µΩ</td>
<td>3000 ± 150</td>
<td>3000 ± 150</td>
<td>3000 ± 150</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dry Circuit Resistance**</td>
<td>1.000000 Ω</td>
<td>100 mΩ</td>
<td>1 mA</td>
<td>23°C ±1°C</td>
<td>24 Hour</td>
<td>90 Day</td>
</tr>
<tr>
<td>10.000000 Ω</td>
<td>1000 mΩ</td>
<td>100 mA</td>
<td>2000 ± 300</td>
<td>2000 ± 300</td>
<td>2000 ± 300</td>
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<tr>
<td>Continuity (Ω)</td>
<td>10.000000 Ω</td>
<td>1000 mΩ</td>
<td>1 mA</td>
<td>23°C ±1°C</td>
<td>24 Hour</td>
<td>90 Day</td>
</tr>
<tr>
<td>Current*</td>
<td>10.000000 Ω</td>
<td>0.1 µA</td>
<td>2.5 V</td>
<td>23°C ±1°C</td>
<td>24 Hour</td>
<td>90 Day</td>
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</table>

**THERMOCOUPLES (Accuracy based on ITS-90):**

<table>
<thead>
<tr>
<th>Type</th>
<th>Range</th>
<th>Resolution</th>
<th>Simulated reference junction</th>
<th>Using 3720, 3721, or 3724 Cards</th>
<th>Range</th>
<th>Temperature Coefficient 0°~18°C and 28°~50°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>J</td>
<td>−150 to +760°C</td>
<td>0.001°C</td>
<td>0.2°C</td>
<td>1.0°C</td>
<td>−200 to −150°C</td>
<td>1.5°C</td>
</tr>
<tr>
<td>K</td>
<td>−150 to +1372°C</td>
<td>0.001°C</td>
<td>0.2°C</td>
<td>1.0°C</td>
<td>−200 to −150°C</td>
<td>1.5°C</td>
</tr>
<tr>
<td>N</td>
<td>−100 to +1350°C</td>
<td>0.001°C</td>
<td>0.1°C</td>
<td>1.0°C</td>
<td>−200 to −100°C</td>
<td>1.5°C</td>
</tr>
<tr>
<td>T</td>
<td>−100 to +400°C</td>
<td>0.001°C</td>
<td>0.2°C</td>
<td>1.0°C</td>
<td>−200 to −100°C</td>
<td>1.5°C</td>
</tr>
<tr>
<td>E</td>
<td>−150 to +1000°C</td>
<td>0.001°C</td>
<td>0.2°C</td>
<td>1.0°C</td>
<td>−200 to −150°C</td>
<td>1.5°C</td>
</tr>
<tr>
<td>R</td>
<td>+100 to +1500°C</td>
<td>0.001°C</td>
<td>0.2°C</td>
<td>1.0°C</td>
<td>−200 to −150°C</td>
<td>1.5°C</td>
</tr>
<tr>
<td>S</td>
<td>+400 to +1768°C</td>
<td>0.1°C</td>
<td>0.6°C</td>
<td>1.8°C</td>
<td>0 ± 400°C</td>
<td>2.3°C</td>
</tr>
<tr>
<td>B</td>
<td>+1100 to +1820°C</td>
<td>0.1°C</td>
<td>0.6°C</td>
<td>1.8°C</td>
<td>0 ± 400°C</td>
<td>2.3°C</td>
</tr>
</tbody>
</table>

4-WIRE RTD OR 3-WIRE RTD (100Ω platinum [PT100], D100, F100, PT385, PT3916, or user 0Ω to 10kΩ) (Selectable Offset Compensation On or Off):

For 3-wire RTD, dimm.connect=dmm.CONNECT_FOUR_WIRE, 50 Ω lead resistance mismatching in Input HI and LO. Add 0.2°C/0.1 Ω of lead resistance mismatch.

**THERMISTOR:** 2.2 kΩ, 5 kΩ, and 10 kΩ. Not recommended with Model 3724 card. See Model 3724 manual for “Measurement Considerations.”

<table>
<thead>
<tr>
<th>Type</th>
<th>Range</th>
<th>Resolution</th>
<th>Simulated reference junction</th>
<th>Using 3720, 3721, or 3724 Cards</th>
<th>Range</th>
<th>Temperature Coefficient 0°~18°C and 28°~50°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-Wire RTD</td>
<td>−200 to +60°C</td>
<td>0.01°C</td>
<td>0.06°C</td>
<td>0.01°C</td>
<td>0.08°C</td>
<td>0.002°C/C</td>
</tr>
<tr>
<td>3-Wire RTD</td>
<td>−200 to +65°C</td>
<td>0.01°C</td>
<td>0.05°C</td>
<td>0.01°C</td>
<td>0.08°C</td>
<td>0.002°C/C</td>
</tr>
</tbody>
</table>

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A Tektronix Company
### Series 3700A

#### DC SPEEDS vs. RMS NOISE

*Single Channel, 60Hz (50Hz) Operation.*

<table>
<thead>
<tr>
<th>Function</th>
<th>NPLC</th>
<th>Aperture (ms)</th>
<th>Digits</th>
<th>100mV</th>
<th>1V</th>
<th>10V</th>
<th>100V</th>
<th>300V</th>
</tr>
</thead>
<tbody>
<tr>
<td>DCV</td>
<td>5/15</td>
<td>83.3 (100)</td>
<td>7/5</td>
<td>1.0</td>
<td>0.07</td>
<td>0.05</td>
<td>0.7</td>
<td>0.2</td>
</tr>
<tr>
<td></td>
<td>1/15</td>
<td>16.7 (20)</td>
<td>7/5</td>
<td>0.9</td>
<td>0.12</td>
<td>0.1</td>
<td>0.8</td>
<td>0.35</td>
</tr>
<tr>
<td></td>
<td>0.2/5</td>
<td>3.33 (40)</td>
<td>6/4</td>
<td>2.5</td>
<td>0.32</td>
<td>0.3</td>
<td>2.5</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>0.2</td>
<td>3.33 (40)</td>
<td>6/4</td>
<td>13.5</td>
<td>1.7</td>
<td>0.7</td>
<td>3.5</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td>0.065</td>
<td>1.0 (1.2)</td>
<td>5/4</td>
<td>12</td>
<td>3.0</td>
<td>1.5</td>
<td>8.0</td>
<td>3.5</td>
</tr>
<tr>
<td></td>
<td>0.0065</td>
<td>0.100 (0.120)</td>
<td>4/3</td>
<td>55</td>
<td>15</td>
<td>7.0</td>
<td>70</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>0.005</td>
<td>0.083 (0.091)</td>
<td>3/3</td>
<td>325</td>
<td>95</td>
<td>90</td>
<td>900</td>
<td>410</td>
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</table>

#### 2W2 (≤100kΩ)

<table>
<thead>
<tr>
<th>Function</th>
<th>NPLC</th>
<th>Aperture (ms)</th>
<th>Digits</th>
<th>100μA</th>
<th>100μA 1mA-10mA</th>
<th>1A</th>
<th>3A</th>
</tr>
</thead>
<tbody>
<tr>
<td>DCI</td>
<td>5/15</td>
<td>83.3 (100)</td>
<td>7/5</td>
<td>5.5</td>
<td>1.6</td>
<td>1.6</td>
<td>2.9</td>
</tr>
<tr>
<td></td>
<td>1/15</td>
<td>16.7 (20)</td>
<td>7/5</td>
<td>3.5</td>
<td>1.1</td>
<td>1.1</td>
<td>2.2</td>
</tr>
<tr>
<td></td>
<td>0.2/5</td>
<td>3.33 (40)</td>
<td>6/4</td>
<td>50</td>
<td>5.0</td>
<td>3.0</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td>0.2</td>
<td>3.33 (40)</td>
<td>6/4</td>
<td>100</td>
<td>35</td>
<td>12</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td>0.065</td>
<td>1.0 (1.2)</td>
<td>4/3</td>
<td>350</td>
<td>55</td>
<td>20</td>
<td>8.0</td>
</tr>
<tr>
<td></td>
<td>0.0065</td>
<td>0.100 (0.120)</td>
<td>4/3</td>
<td>400</td>
<td>200</td>
<td>40</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>0.005</td>
<td>0.083 (0.091)</td>
<td>3/3</td>
<td>2500</td>
<td>450</td>
<td>250</td>
<td>525</td>
</tr>
</tbody>
</table>

#### 4W2

<table>
<thead>
<tr>
<th>Function</th>
<th>NPLC</th>
<th>Aperture (ms)</th>
<th>Digits</th>
<th>100μA</th>
<th>100μA 1mA-10mA</th>
<th>1A</th>
<th>3A</th>
</tr>
</thead>
<tbody>
<tr>
<td>DCI</td>
<td>5/15</td>
<td>83.3 (100)</td>
<td>7/5</td>
<td>5.5</td>
<td>0.8</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>1/15</td>
<td>16.7 (20)</td>
<td>7/5</td>
<td>3.5</td>
<td>1.1</td>
<td>0.8</td>
<td>0.7</td>
</tr>
<tr>
<td></td>
<td>0.2/5</td>
<td>3.33 (40)</td>
<td>6/4</td>
<td>50</td>
<td>5.0</td>
<td>0.5</td>
<td>0.7</td>
</tr>
<tr>
<td></td>
<td>0.2</td>
<td>3.33 (40)</td>
<td>6/4</td>
<td>100</td>
<td>50</td>
<td>10</td>
<td>6.5</td>
</tr>
<tr>
<td></td>
<td>0.065</td>
<td>1.0 (1.2)</td>
<td>4/3</td>
<td>500</td>
<td>50</td>
<td>15</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td>0.0065</td>
<td>0.100 (0.120)</td>
<td>4/3</td>
<td>750</td>
<td>75</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>0.005</td>
<td>0.083 (0.091)</td>
<td>3/3</td>
<td>7500</td>
<td>450</td>
<td>250</td>
<td>525</td>
</tr>
</tbody>
</table>

#### 4W2 OCMAP

<table>
<thead>
<tr>
<th>Function</th>
<th>NPLC</th>
<th>Aperture (ms)</th>
<th>Digits</th>
<th>100μA</th>
<th>100μA 1mA-10mA</th>
<th>1A</th>
<th>3A</th>
</tr>
</thead>
<tbody>
<tr>
<td>DCI</td>
<td>5/15</td>
<td>83.3 (100)</td>
<td>7/5</td>
<td>5.5</td>
<td>0.8</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>1/15</td>
<td>16.7 (20)</td>
<td>7/5</td>
<td>3.5</td>
<td>1.1</td>
<td>0.8</td>
<td>0.7</td>
</tr>
<tr>
<td></td>
<td>0.2/5</td>
<td>3.33 (40)</td>
<td>6/4</td>
<td>50</td>
<td>5.0</td>
<td>0.5</td>
<td>0.7</td>
</tr>
<tr>
<td></td>
<td>0.2</td>
<td>3.33 (40)</td>
<td>6/4</td>
<td>100</td>
<td>50</td>
<td>10</td>
<td>6.5</td>
</tr>
<tr>
<td></td>
<td>0.065</td>
<td>1.0 (1.2)</td>
<td>4/3</td>
<td>500</td>
<td>50</td>
<td>15</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td>0.0065</td>
<td>0.100 (0.120)</td>
<td>4/3</td>
<td>750</td>
<td>75</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>0.005</td>
<td>0.083 (0.091)</td>
<td>3/3</td>
<td>7500</td>
<td>450</td>
<td>250</td>
<td>525</td>
</tr>
</tbody>
</table>

### RTD SPEEDS vs. NOISE

*1 PLC and 5 PLC Noise are included in RTD Specifications.*

<table>
<thead>
<tr>
<th>Function</th>
<th>NPLC</th>
<th>Aperture (ms)</th>
<th>Digits</th>
</tr>
</thead>
<tbody>
<tr>
<td>OCMAP OFF</td>
<td>5/15</td>
<td>83.3 (100)</td>
<td>7/5</td>
</tr>
<tr>
<td></td>
<td>0.2/5</td>
<td>3.33 (40)</td>
<td>6/4</td>
</tr>
<tr>
<td></td>
<td>0.065</td>
<td>1.000 (0.120)</td>
<td>4/3</td>
</tr>
<tr>
<td></td>
<td>0.005</td>
<td>0.0003 (0.001)</td>
<td>3/3</td>
</tr>
<tr>
<td>OCMAP ON</td>
<td>1/15</td>
<td>16.7 (20)</td>
<td>7/5</td>
</tr>
<tr>
<td></td>
<td>0.2/5</td>
<td>3.33 (40)</td>
<td>6/4</td>
</tr>
<tr>
<td></td>
<td>0.005</td>
<td>0.0003 (0.001)</td>
<td>3/3</td>
</tr>
</tbody>
</table>

### System Switch/Multimeter

- **1k**
- **1–10**
- **10–100**
- **100–1k**

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### Series 3700A Specifications

#### System Switch/Multimeter and Plug-In Cards

**INPUT IMPEDANCE:** 100mV–10V Ranges:
- **MAX. 4W**
- **DCI**
- **Frequency or Period**  
  - 110
  - 10
  - 1

**Buffer Transfer Speed**
- Ethernet
- GPIB
- USB
- **Average for 1000 readings**
  - 2450s
  - 2000s
  - 1800s
- **Average for 1000 readings with timestamp**
  - 2300s
  - 1800s
  - 1600s

<table>
<thead>
<tr>
<th>Card</th>
<th>Command</th>
<th>Ethernet</th>
<th>GPIB</th>
<th>USB</th>
</tr>
</thead>
<tbody>
<tr>
<td>3720, 3721, 3722, 3730</td>
<td>channel close (ch_list) or channel open (ch_list)</td>
<td>5.7</td>
<td>5.8</td>
<td>6.1</td>
</tr>
<tr>
<td>3723, 3724, 3731, 3732</td>
<td>channel close (ch_list) or channel open (ch_list)</td>
<td>2.3</td>
<td>2.4</td>
<td>2.7</td>
</tr>
<tr>
<td>3740</td>
<td>channel close (ch_list 1-28) or channel open (ch_list 1-28)</td>
<td>10.7</td>
<td>10.8</td>
<td>11.1</td>
</tr>
<tr>
<td></td>
<td>channel close (ch_list 29-32) or channel open (ch_list 29-32)</td>
<td>22.7</td>
<td>22.8</td>
<td>23.1</td>
</tr>
</tbody>
</table>

**Series 3700A specifications**

---

**DC MEASUREMENT CHARACTERISTICS**

**DC VOLTS**
- **A-D LINEARITY:** 1.0ppm of reading + 2.0 ppm of range.
- **INPUT IMPEDANCE:** 100mV–10V Ranges: Selectable: >10GΩ/2kΩ, =400kΩ or 10MΩ ±1%. 100V–300V Ranges: 10MΩ ±1%.
- **INPUT BIAS CURRENT:** ≤50pA at 25°C with dmm autozero=dmm.Off or dmm input-univd=dmm.ON.
- **COMMON MODE CURRENT:** ≤500nA p-p for ≤1MHz.
- **AUTOZERO OFF ERROR:** For DCV ±1°C and ≤10 minutes, add ±(8ppm of reading + 5µV).
- **INPUT PROTECTION:** 500V all ranges.
- **COMMON MODE VOLTAGE:** 500V DC or 300Vrms (425V peak for AC waveform) between any terminal and chassis.

**RESISTANCE**
- **MAX. 4kΩ LEAD RESISTANCE:** 5Ω per lead for 1Ω range; 10% of range per lead for 1kΩ–1ΩkΩ ranges. 1kΩ per lead for all other ranges.
- **MAX. 4kΩ LEAD RESISTANCE (DRY CKT):** 0.5Ω per lead for 1Ω range; 10% of range per lead for 1kΩ–100kΩ ranges; 50Ω per lead for 1Ω–2kΩ ranges.
- **INPUT IMPEDANCE:** 1GΩ–10GΩ Ranges: 99kΩ ±1%/≤1µF.
- **100kΩ–2kΩ Ranges:** 10MΩ ±1%/≥0.05µF.
- **OFFSET COMPENSATION:** Selectable on 4kΩ –1Ω–1kΩ ranges.
- **OPEN LEAD DETECTOR:** Selectable per channel. 1.5µA, ±20% sink current per DMM SHI and SLO lead. Default off.
- **CONTINUITY THRESHOLD:** Adjustable to ≤100µΩ.
- **AUTOZERO OFF ERROR:** For 2kΩ ±1°C and ≤10 minutes, add ±(8ppm of reading + 5µΩ) for 1Ω and 5µΩ for all other ranges.
- **INPUT PROTECTION:** 300V all ranges.

---

**DC MEASUREMENT CHARACTERISTICS (continued)**

**DC CURRENT**
- **AUTOZERO OFF ERROR:** For ±1°C and ≤10 minutes, add ±(8ppm of reading + range error).

**THERMOCOUPLES**
- **CONVERSION:** 1.5°C.

**REFERENCE JUNCTION:** Internal, External, or Simulated (Fixed).

**OPEN LEAD DETECTOR:** Selectable per channel. Open >1.5kΩ ±50Ω. Default on.

**COMMON MODE ISOLATION:** 300V DC or 300Vrms (425V peak for AC waveform), >10GΩ and <550pF any terminal to chassis.

**DC NOTES**
1. 20% overrange on DC functions except 1% on 300V range and 5.5% on 5A range.
2. ±5% (measured with 100mA input resistance DMM, >10GΩ DMM on 100mA and 100MΩ ranges). Refer to table for other 2kΩ/4kΩ configurations. For Dry Contact, +20%, <1ppm with dmm off retcompson=ON on 100Ω–2kΩ ranges.

---

**System Switch/Multimeter and Plug-In Cards**

**DMM Connect Relays**
- **Rel Enable**
  - 100Ω ≤ 1Ω: 1Ω ≤ 100MΩ
  - 100Ω ≤ 1Ω: 1Ω ≤ 100MΩ

**Rear Panel Connector**
- **Card**
  - 10kΩ ≤ 100kΩ ≤ 1Ω
  - 100kΩ ≤ 1MΩ ≤ 100MΩ

**Series 3700A Plug-in Cards Operating Environment**
- Specified for 0° to 50°C, ≤70%RH at 5°C.

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### DC NOTES (continued)

9. Includes Analog Backplane 15-pin rear panel connector. For 5721, refer to DC Current table for additional uncertainties.

10. For Lead On, line frequency ±0.1%.

11. For 1kΩ.

12. For LSYNC On.

13. For LSYNC Off.

### AC Specifications

<table>
<thead>
<tr>
<th>Function</th>
<th>Range</th>
<th>Resolution</th>
<th>Calibration Cycle</th>
<th>Accuracy: ±(% of reading + % of range) 23°C ± 5°C</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Voltage</strong></td>
<td>100 mV–100 V</td>
<td>0.1 µV</td>
<td>90 Day (100mV–100V)</td>
<td>3 Hz–5 Hz: 0.0 + 0.05 0.30 + 0.05 0.05 + 0.05 0.11 + 0.05 0.6 + 0.08 4 + 0.5</td>
</tr>
<tr>
<td></td>
<td>1 nA–1 A</td>
<td>1 nA</td>
<td>1 Year (100mV–100V)</td>
<td>5 Hz–10 Hz: 0.03 + 0.05 0.12 + 0.05 0.06 + 0.05 0.30 + 0.05 1.2 + 0.12 6 + 0.6</td>
</tr>
<tr>
<td></td>
<td>10 nA–10 mA</td>
<td>0.1 nA</td>
<td>1 Year (100mV–100V)</td>
<td>10 Hz–20 kHz: 0.04 + 0.06 0.20 + 0.06 0.10 + 0.06 0.5 + 0.08 2.5 + 0.10 12 + 1.0</td>
</tr>
<tr>
<td></td>
<td>100 nA–100 µA</td>
<td>0.01 nA</td>
<td>1 Year (100mV–100V)</td>
<td>20 kHz–50 kHz: 0.05 + 0.08 0.25 + 0.08 0.12 + 0.08 0.6 + 0.11 3 + 0.11 15 + 1.5</td>
</tr>
<tr>
<td></td>
<td>1 µA–1 mA</td>
<td>0.1 µA</td>
<td>1 Year (100mV–100V)</td>
<td>50 kHz–100 kHz: 0.06 + 0.11 0.30 + 0.11 0.15 + 0.11 0.75 + 0.11 3.75 + 3.75 18.75 + 18.75</td>
</tr>
<tr>
<td></td>
<td>10 µA–10 mA</td>
<td>0.1 µA</td>
<td>1 Year (100mV–100V)</td>
<td>100 kHz–300 kHz: 0.07 + 0.12 0.35 + 0.12 0.18 + 0.12 0.9 + 0.12 4.5 + 4.5 22.5 + 22.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Temperature Coeff. /°C</th>
<th>3 Hz–5 Hz</th>
<th>5 Hz–10 Hz</th>
<th>10 Hz–20 kHz</th>
<th>20 kHz–50 kHz</th>
<th>50 kHz–100 kHz</th>
<th>100 kHz–300 kHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>0.00 + 0.00</td>
<td>0.03 + 0.00</td>
<td>0.005 + 0.00</td>
<td>0.0005 + 0.00</td>
<td>0.0000 + 0.00</td>
<td>0.0000 + 0.00</td>
</tr>
<tr>
<td>Current</td>
<td>0.00 + 0.00</td>
<td>0.03 + 0.00</td>
<td>0.005 + 0.00</td>
<td>0.0005 + 0.00</td>
<td>0.0000 + 0.00</td>
<td>0.0000 + 0.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Frequency and Period</th>
<th>Accuracy: ±(ppm of reading + offset ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 Hz–500 kHz</td>
<td>3 Hz–500 kHz</td>
</tr>
<tr>
<td>333 ms–2 μs</td>
<td>3 Hz–500 kHz</td>
</tr>
<tr>
<td>80 + 0.355</td>
<td>(0.25 s gate)</td>
</tr>
<tr>
<td>80 + 0.355</td>
<td>(100 ms gate)</td>
</tr>
<tr>
<td>80 + 553</td>
<td>(10 ms gate)</td>
</tr>
</tbody>
</table>

### ADDITIONAL UNCERTAINTY ±(% of reading)

<table>
<thead>
<tr>
<th>Low Frequency Uncertainty</th>
<th>Detector Bandwidth</th>
<th>Additional Uncertainty ±(% of reading)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 (3 Hz–300 Hz)</td>
<td>10 Hz–10 kHz</td>
<td>5 Hz–10 kHz</td>
</tr>
<tr>
<td>30 Hz–50 Hz</td>
<td>10 Hz–30 Hz</td>
<td>10 Hz–30 Hz</td>
</tr>
<tr>
<td>50 Hz–100 Hz</td>
<td>30 Hz–100 Hz</td>
<td>5 Hz–100 Hz</td>
</tr>
<tr>
<td>100 Hz–200 Hz</td>
<td>300 Hz–500 Hz</td>
<td>100 Hz–200 Hz</td>
</tr>
<tr>
<td>200 Hz–300 Hz</td>
<td>300 Hz–500 Hz</td>
<td>200 Hz–300 Hz</td>
</tr>
<tr>
<td>300 Hz–500 Hz</td>
<td></td>
<td>300 Hz–500 Hz</td>
</tr>
<tr>
<td>&gt;500 Hz</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For ACI or ACV, dmm.autodelay=dmm.ON, best speed is 65 ms. For DCI, dmm.connect=dmm.CONNECT_NONE or 0. For RTD, noise using low thermal 190°C precision resistor.

Includes Model 5721 card accuracies. RMS noise values are typical.

### Additional Information

- Accuracy: ±(% of reading + % of range) 23°C ± 5°C
- Temp. Coeff. /°C
- Accuracy: ±(ppm of reading + offset ppm)
- Additional Uncertainty ±(% of reading)
AC SPEEDS  
Single Channel, 60Hz (50Hz) Operation

<table>
<thead>
<tr>
<th>Detector Bandwidth</th>
<th>NPLC</th>
<th>Aperture (ms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACI / ACV</td>
<td>30</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>500</td>
<td>10.0 ± 20</td>
</tr>
<tr>
<td></td>
<td>500</td>
<td>0.2 ± 0.1</td>
</tr>
<tr>
<td></td>
<td>500</td>
<td>0.06 ± 0.01</td>
</tr>
<tr>
<td></td>
<td>500</td>
<td>0.0005 ± 0.001</td>
</tr>
</tbody>
</table>

AC / ACV

<table>
<thead>
<tr>
<th>Frequency/Period</th>
<th>N/A</th>
<th>10–273</th>
</tr>
</thead>
</table>

AC MEASUREMENT CHARACTERISTICS

AC VOLTS
MEASUREMENT METHOD: AC-coupled, True RMS.
INPUT IMPEDANCE: 1MΩ ± 2% by <150pF.
INPUT PROTECTION: 300VDC or 300Vrms rear inputs or 37xx cards.

AC CURRENT
MEASUREMENT METHOD: AC-coupled, True RMS.

<table>
<thead>
<tr>
<th>Range</th>
<th>3 A</th>
<th>1 A</th>
<th>100 mA</th>
<th>10 mA</th>
<th>1 mA</th>
</tr>
</thead>
</table>
| Shunt Resistance
| guaranteed by design | 0.05 Ω | 0.05 Ω | 1.0 Ω | 10 Ω | 100 Ω |
| Burden Voltage | <1.75 V rms | <0.55 V rms | <0.4 V rms | <150 mV rms | <125 mV rms |
| Burden Voltage | <2.4 V rms | <1.0 V rms | <0.6 V rms | <200 mV rms | <130 mV rms |

INPUT PROTECTION: 3A, 250W fuse.

FREQUENCY AND PERIOD
MEASUREMENT METHOD: Reciprocal Counting technique.
GATE TIME: dmm.aperture=0.273→0.01. Default 0.01s.

AC GENERAL
AC CMRR: ≥70dB.
VOLT·HERTZ PRODUCT: ≤8×10^9 Volt Hz (guaranteed by design). ≤2×10^10 Volt Hz verified. Input frequency verified for ≤3×10^9 Hz.

AC NOTES
1. 20% overrange on AC functions except 1% on 500V and 3.5% on 3A. Default resolution is 5½ digits, maximum usable resolution is 6½ with 7½ digits programmable.
2. Specification are for Detector Bandwidth 3 and sinewave inputs >5% of range. Detector Bandwidth 5 and 30 are multi-sample A/D conversion. Detector bandwidth 300 is a single A/D conversion, programmable from 0.0005PLC to 10PLC. Default condition set to 1PLC.
3. Applies to 0°C–40°C and 28°C–50°C.
4. Specified for square wave inputs. Input signal must be >10% of ACV range. If input is <20mV on the 100mV range then the frequency must be >10Hz. For sinewave inputs, frequency must be >50Hz.
5. Applies to non-sine wave inputs 50Hz–>10kHz. Frequency/Perio
6. For Model 3721, 1mA ACI, add 0.05% to “of reading” uncertainty from 250Hz →10kHz.
7. For Model 3721, 1mA ACI, add 0.05% to “of reading” uncertainty from 250Hz →10kHz.
8. Frequency/Period

Series 3700A specifications

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GENERAL

EXPANSION SLOTS: 6.
POWER LINE: Universal, 100V to 240V.
LINE FREQUENCY: 50Hz and 60Hz, automatically sensed at power-up.
POWER CONSUMPTION: 28VA with DMM and display, up to 140VA with six 37xx cards.
REAL TIME CLOCK: Battery backed, 10 years typical life.
EMC: Conforms to European Union EMC Directive.
SAFETY: Conforms to European Union Low Voltage Directive.
VIBRATION: MIL-PRF-28800F Class 3, Random.
WARM-UP: 2 hours to rated accuracy.
DIGITAL I/O: 25-pin female D-shell.

<table>
<thead>
<tr>
<th></th>
<th>I/O 1–9</th>
<th>I/O 10–14</th>
<th>Vext</th>
</tr>
</thead>
<tbody>
<tr>
<td>I&lt;sub&gt;IN&lt;/sub&gt;, max.</td>
<td>5 mA</td>
<td>250 mA</td>
<td>—</td>
</tr>
<tr>
<td>Absolute V&lt;sub&gt;IN&lt;/sub&gt;</td>
<td>5.25 V to –0.25 V</td>
<td>5.25 V to –0.25 V</td>
<td>5 V to 33 V</td>
</tr>
<tr>
<td>V&lt;sub&gt;IN&lt;/sub&gt; min</td>
<td>2.2 V</td>
<td>2.2 V</td>
<td>—</td>
</tr>
<tr>
<td>V&lt;sub&gt;IN&lt;/sub&gt; max</td>
<td>0.7 V</td>
<td>0.7 V</td>
<td>—</td>
</tr>
<tr>
<td>V&lt;sub&gt;IN&lt;/sub&gt; max at 5mA I&lt;sub&gt;sink&lt;/sub&gt;</td>
<td>0.7 V</td>
<td>0.7 V</td>
<td>—</td>
</tr>
<tr>
<td>V&lt;sub&gt;IN&lt;/sub&gt; max at I&lt;sub&gt;sink&lt;/sub&gt; max</td>
<td>—</td>
<td>2.3 V</td>
<td>—</td>
</tr>
<tr>
<td>V&lt;sub&gt;IN&lt;/sub&gt; min, 0.4mA source</td>
<td>2.7 V</td>
<td>2.4 V</td>
<td>—</td>
</tr>
<tr>
<td>Min V&lt;sub&gt;IN&lt;/sub&gt; pulse</td>
<td>2 µs</td>
<td>10 µs</td>
<td>—</td>
</tr>
<tr>
<td>Min Vo pulse</td>
<td>1 µs</td>
<td>50 µs</td>
<td>—</td>
</tr>
</tbody>
</table>

TRIGGERING AND MEMORY:
Window Filter Sensitivity: 0.01%, 0.1%, 1%, 10%, or full-scale of range (none).
Trigger Delay: 0 to 99 hrs. (1µs step size).
External Trigger Delay: <10µs.
Memory: Up to 650,000 time-stamped readings with Web page disabled. Additional memory available with external “thumb drive.”
Non-volatile Memory: Single user save setup, with up to 75 DMM configurations and ≥600 channel patterns (dependent on name length, DMM function and configuration, and pattern image size). Additional memory available with external “thumb drive.”

MATH FUNCTIONS: Rel, dB, Limit Test, %, 1/x, and mX+b with user defined displayed.
REMOTE INTERFACE:
Ethernet: RJ-45 connector, LXI Class B Version 2, 10/100BT, no auto MDIX.
USB Device (rear panel, type B): Full speed, USBTMC compliant.
USB Host (front panel, type A): USB 2.0, support for thumb drives.
LXI COMPLIANCE: LXI Class B Version 2 with IEEE 1588 precision time protocol.
LXI TIMING (applies to scanning) and SPECIFICATION:
Receive LAN[0–7] Event Delay: n/s (not specified) min., 800µs typ., n/s max.
Alarm to Trigger Delay: 25µs min., 50µs typ., n/s max.
Generate LAN[0–7] Event: n/s min., 800µs typ., n/s max. (minimums are probabilistic and represent a 95% confidence factor).
Clock Accuracy: 25ppm.
Synchronization Accuracy: <150ns (probabilistic and represents a 95% confidence factor).
Timestamp Accuracy: 100µs.
Timestamp Resolution: 20ns.
LANGUAGE: Embedded Test Script Processor (TSP) accessible from any host interface.
Responds to individual Instrument Control Library (ICL) commands. Responds to high-speed test scripts comprised of ICL commands and Test Script Language (TSL) statements (e.g., branching, looping, math, etc.). Able to execute high-speed test scripts stored in memory without host intervention.
IP CONFIGURATION: Static or DHCP.
PASSWORD PROTECTION: 11 characters.
MINIMUM PC HARDWARE: Intel Pentium 3, 800MHz, 512Mbyte RAM, 210Mbyte disk space or better.
OPERATING SYSTEMS/SOFTWARE: Windows® 2000 and XP compatible, supports Web browsers with Java plug-in (requires Java plugin 1.6 or higher). Web pages served by 3706A.
OPERATING ENVIRONMENT: Specified for 0° to 50°C, ≤80%RH at 35°C, altitude up to 2000 meters.
STORAGE ENVIRONMENT: −40° to 70°C.
DIMENSIONS:
Rack Mounted: 89mm high × 483mm wide × 457mm deep (3.5 in. × 19 in. × 18 in.).
Bench Configuration (includes handle and feet): 104mm high × 483mm wide × 457mm deep (4.125 in. × 19 in. × 18 in.).
SHIPPING WEIGHT: 15kg (28 lbs.).

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Series 3700A specifications

SWITCHING AND CONTROL
Plug-in Cards for Series 3700A Mainframes

Specifications for Plug-In Cards
Additional Series 3700A cards are currently in development. For a current list of cards and specifications, visit www.keithley.com.

<table>
<thead>
<tr>
<th>No. of Channels</th>
<th>Card Config.</th>
<th>Type of Relay</th>
<th>Contact Configuration</th>
<th>Max. Voltage</th>
<th>Max. Current Switched</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>60 (Dual 1×30)</td>
<td>Latching</td>
<td>Latching</td>
<td>2 Form A</td>
<td>300 V</td>
<td>1 A</td>
<td>2 independent 1×30 multiplexers. Automatic temperature reference when used with screw terminal accessory (Model 3720-ST)</td>
</tr>
<tr>
<td>40 (Dual 1×20)</td>
<td>Latching</td>
<td>Latching</td>
<td>2 Form A</td>
<td>300 V (ch 1–40), 60 V (ch 41–42)</td>
<td>2 A (ch 1–40), 3 A (ch 41–42)</td>
<td>2 independent 1×20 multiplexers. Automatic temperature reference when used with screw terminal accessory (Model 3721-ST)</td>
</tr>
<tr>
<td>96 (Dual 1×48)</td>
<td>Latching</td>
<td>Latching</td>
<td>2 Form A</td>
<td>300 V</td>
<td>1 A</td>
<td>2 independent 1×48 multiplexers</td>
</tr>
</tbody>
</table>

Plug-in Card Accessories

<table>
<thead>
<tr>
<th>Cables</th>
<th>3720-MTC-1.5, 3720-MTC-3</th>
<th>3721-MTC-1.5, 3721-MTC-3</th>
<th>3722-MTC-1.5, 3722-MTC-1.5/MM, 3722-MTC-3, 3722-MTC-3/MM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Screw Terminal Block</td>
<td>3720-ST</td>
<td>3721-ST</td>
<td></td>
</tr>
<tr>
<td>Connector Kits</td>
<td>3791-KIT78-R</td>
<td>3790-KIT50-R</td>
<td>3792-KIT104-R, 3792-KIT104-R/F</td>
</tr>
<tr>
<td>Tools</td>
<td>3791-CIT</td>
<td>3791-CIT</td>
<td></td>
</tr>
</tbody>
</table>
## Specifications for Plug-In Cards

<table>
<thead>
<tr>
<th>Card</th>
<th>Multiplexer</th>
<th>Matrix</th>
<th>Contact Configuration</th>
<th>Max. Voltage</th>
<th>Max. Current Switched</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>3723</td>
<td>60 (dual 1×30) or 120 single pole (dual 1×60)</td>
<td>6×16</td>
<td>2 Form A</td>
<td>300 V</td>
<td>1 A</td>
<td>2 independent 1×30 multiplexers. Automatic temperature reference when used with screw terminal accessory (Model 3724-ST)</td>
</tr>
<tr>
<td>3724</td>
<td>60 (dual 1×30)</td>
<td>6×16</td>
<td>2 Form A</td>
<td>200 V</td>
<td>1 A</td>
<td>2 independent 1×30 multiplexers. Automatic temperature reference when used with screw terminal accessory (Model 3724-ST)</td>
</tr>
<tr>
<td>3730</td>
<td>1 Form A</td>
<td>Latching electromechanical</td>
<td>1 A</td>
<td>200 V</td>
<td>0.75 A</td>
<td>Columns can be expanded through the backplane or isolated by relays. Relay actuation time of 0.5ms. Columns can be expanded through the backplane or isolated by relays. Banks can be connected together via bank configuration relays to create a single 4×112 or dual 4×56 matrix. Analog backplane relays also included for card to card expansion. Row expansion with 3732-ST-R accessory to create a dual 8×28 or single 16×28 matrix.</td>
</tr>
<tr>
<td>3731</td>
<td>1 Form A</td>
<td>Latching electromechanical</td>
<td>2 Form A</td>
<td>200 V</td>
<td>1 A</td>
<td>32 general purpose independent channels.</td>
</tr>
<tr>
<td>3732</td>
<td>1 Form A</td>
<td>Latching electromechanical</td>
<td>1 Form A</td>
<td>300 VDC/250 VAC (Form A)</td>
<td>0.75 A</td>
<td>32 general purpose independent channels.</td>
</tr>
<tr>
<td>3740</td>
<td>448 crosspoints (Quad 4×28)</td>
<td>28 Form C, 4 Form A</td>
<td>1 Form A</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>3750</td>
<td>40 digital I/O, 4 counter/totalizers, and 2 isolated analog outputs</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
</tr>
</tbody>
</table>

### Accessories

<table>
<thead>
<tr>
<th>Cables</th>
<th>Screw Terminal Block</th>
<th>Connector Kits</th>
<th>Tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>3720-MTC-1.5, 3720-MTC-3</td>
<td>3720-ST, 3723-ST, 3724-ST</td>
<td>3791-KIT78-R</td>
<td>3791-CIT</td>
</tr>
<tr>
<td>3721-MTC-1.5, 3721-MTC-3</td>
<td>3724-ST</td>
<td>3791-KIT78-R</td>
<td>3791-CIT</td>
</tr>
<tr>
<td>3721-MTC-1.5, 3721-MTC-3</td>
<td>3730-ST</td>
<td>3790-KIT50-R</td>
<td>3791-CIT</td>
</tr>
<tr>
<td>3721-MTC-1.5, 3721-MTC-3</td>
<td>3731-ST</td>
<td>3790-KIT50-R</td>
<td>3791-CIT</td>
</tr>
<tr>
<td>3721-MTC-1.5, 3721-MTC-3</td>
<td>3732-ST-C, 3732-ST-R</td>
<td>3790-KIT50-R</td>
<td>3791-CIT</td>
</tr>
<tr>
<td>3721-MTC-1.5, 3721-MTC-3</td>
<td>3740-ST</td>
<td>3790-KIT50-R</td>
<td>3791-CIT</td>
</tr>
<tr>
<td>3721-MTC-1.5, 3721-MTC-3</td>
<td>3750-ST</td>
<td>3790-KIT50-R</td>
<td>3791-CIT</td>
</tr>
</tbody>
</table>

### Contact Information

1.888.KEITHLEY (U.S. only)

www.keithley.com
Dual 1×30 Multiplexer Card
60 differential channels, automatic CJC w/3720-ST accessory

The Model 3720 offers two independent banks of 1×30 two-pole multiplexers. It is ideal for general purpose switching, including temperature measurements. The two banks can automatically be connected to the Series 3700A mainframe backplane and optional DMM through the analog backplane connection relays. This connection allows the mainframe to reconfigure the card to a single 1×60 two-pole multiplexer or to enable card-to-card expansion for even larger configurations.

Other features of the Model 3720 include its ability to be reconfigured to coordinated four-pole operation for additional measurement flexibility. Furthermore, the Model 3720 supports thermocouple-type temperature measurements when used with the Model 3720-ST (screw terminal) accessory providing automatic cold junction compensation (CJC).

The Model 3720 uses two 78-pin male D-sub connectors for signal connections. For screw terminal or automatic CJC, use the detachable Model 3720-ST accessory.

**ACCESSORIES AVAILABLE**

<table>
<thead>
<tr>
<th>Accessory Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5720-MTC-15</td>
<td>78 Pin D-sub Female to Male Cable, 1.5m (5 ft.)</td>
</tr>
<tr>
<td>5720-MTC-3</td>
<td>78 Pin D-sub Female to Male Cable, 3m (10 ft.)</td>
</tr>
<tr>
<td>5720-ST</td>
<td>Screw Terminal Block (required for auto CJC thermocouple measurements)</td>
</tr>
<tr>
<td>5791-CIT</td>
<td>Contact Insertion and Extraction Tool</td>
</tr>
<tr>
<td>5791-KIT78-R</td>
<td>78 Pin Female D-sub Connector Kit (contains 2 female D-sub connectors and 156 solder-cup contacts)</td>
</tr>
<tr>
<td>7401</td>
<td>Type K Thermocouple Wire (100 ft.)</td>
</tr>
</tbody>
</table>

**SERVICES AVAILABLE**

<table>
<thead>
<tr>
<th>Service Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3720-3Y-EW-STD</td>
<td>1-year factory warranty extended to 3 years from date of shipment</td>
</tr>
<tr>
<td>3720-5Y-EW-STD</td>
<td>1-year factory warranty extended to 5 years from date of shipment</td>
</tr>
<tr>
<td>C/3720-5Y-STD</td>
<td>5 (Z540-1 compliant) calibrations within 5 years of purchase*</td>
</tr>
</tbody>
</table>

*Not available in all countries
MULTIPLEXER CONFIGURATION: Two independent 1×30 2-pole multiplexers. Banks can be isolated from the backplane by relays. Card can be configured for 2 and 4 wire.

CONTACT CONFIGURATION: 2 pole form A.

CONNECTOR TYPE: Two 78 pin male D-shells.

MODEL 3720-ST SCREW TERMINAL OPTION: #22 AWG typical wire size with 0.062 inch O.D. 124 conductors maximum. #16 AWG maximum wire size with 0.092 inch O.D. 36 conductors per card maximum.

MAXIMUM SIGNAL LEVEL: Channels 1–60: 300V DC or RMS, 1A switched (2A carry), 60W, 125VA.

COMMON MODE VOLTAGE: 300V DC or RMS between any terminal and chassis.

VOLT-HERTZ LIMIT: 8×10⁷.

CONTACT LIFE: >10⁵ operations at maximum signal level. >10⁸ operations no load.

Differential: 10⁸ Ω, 250 pF

Bank-Bank: 10¹⁰ Ω, 75 pF

Common Mode: 10⁹ Ω, 450 pF

Crosstalk Channel-channel: 300kHz <–60 dB <–55 dB

Bandwidth: 30 MHz 10 MHz

TYPICAL SCANNING SPEEDS:

Switch Only: Sequential scanning, single channel, immediate trigger advance: >120 ch/s.

With Measurements Into Memory:

DCV (10V range) or 2W Ohms (1kΩ range): >110 ch/s.

Thermocouple: >110 ch/s.

3- or 4-Wire RTD: >100 ch/s.

4-Wire Ohms (1kΩ range): >100 ch/s.

ACV (10V range): >110 ch/s.

GENERAL

ACTUATION TIME: 4ms.

TEMPERATURE ACCURACY using Automatic CJC with 3720-ST accessory: 1°C for J, K, T and E types (see mainframe specification for details).

RELAy TYPE: Latching electromechanical.

RELAy DRIVE SCHEME: Matrix.

INTERLOCK: Backplane relays disabled when interlock connection is removed.

OPERATING ENVIRONMENT: Specified for 0° to 50°C. Specified to 70% R.H. at 35°C.

STORAGE ENVIRONMENT: –25° to 65°C.

WEIGHT: 2.5 lbs.


NOTES

1. Open detector enabled during thermocouple measurements. Minimum signal level 10mV, 10µA.

2. 3765A mainframe with all DMM backplane relays disconnected. Maximum two card backplane relays closed.

3. Connections made using 3720-ST accessory.

4. Scanning script local to 3706A mainframe, within same bank, and break before make switching.

5. 3765A mainframe with autorange off, limits off, dmm :autozero=0, dmm :autodelay=0, 4½ digits (NPLC=0.006), for ACV dmm :detectorbandwidth=300, for OHMs dmm :offsetcompensation=off, dmm :opendetector=off. Scanning script local to mainframe, sequential scan within same bank (2 pole) or card (4 pole), and break before make switching.

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www.keithley.com

A Greater Measure of Confidence
Dual 1×20 Multiplexer Card

40 differential channels, automatic CJC w/3721-ST accessory

The Model 3721 offers two independent banks of 1×20 two-pole multiplexers that are ideal for general purpose switching, including temperature measurements. The two banks can automatically be connected to the Series 3700A mainframe backplane and optional DMM through the analog backplane connection relays. This connection allows the mainframe to reconfigure the Model 3721 as a single 1×40 two-pole multiplexer or to enable card-to-card expansion for even larger configurations.

The Model 3721 provides a number of other features. In addition to the 40 channels, two fused channels are supplied for current measurements. Also, the Model 3721 includes dedicated inputs that enable 40 channels of four-wire common side ohms measurements. For thermocouple type measurements, automatic cold junction compensation (CJC) is supported when used with the Model 3721-ST (screw terminal) accessory.

The Model 3721 uses two 50-pin male D-sub connectors for signal connections. For screw terminal or automatic CJC, use the detachable Model 3721-ST accessory.

### ACCESSORIES AVAILABLE

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3721-MTC-1S</td>
<td>50 Pin D-sub Female to Male Cable, 1.5m (5 ft.)</td>
</tr>
<tr>
<td>3721-MTC-3</td>
<td>50 Pin D-sub Female to Male Cable, 3m (10 ft.)</td>
</tr>
<tr>
<td>3721-ST</td>
<td>Screw Terminal Block (required for auto CJC thermocouple measurements)</td>
</tr>
<tr>
<td>5790-KIT50-R</td>
<td>50 Pin Female D-sub Connector Kit (contains 2 female D-sub connectors and 100 solder-cup contacts)</td>
</tr>
<tr>
<td>7401</td>
<td>Type K Thermocouple Wire (100 ft.)</td>
</tr>
</tbody>
</table>

### SERVICES AVAILABLE

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3721-3Y-EW-STD</td>
<td>1-year factory warranty extended to 3 years from date of shipment</td>
</tr>
<tr>
<td>3721-5Y-EW-STD</td>
<td>1-year factory warranty extended to 5 years from date of shipment</td>
</tr>
<tr>
<td>C/3721-3Y-STD</td>
<td>3 (Z540-1 compliant) calibrations within 3 years of purchase*</td>
</tr>
</tbody>
</table>

*Not available in all countries

**Ordering Information**

3721 Dual 1×20 Multiplexer Card
Dual 1×20 Multiplexer Card
40 differential channels, automatic CJC w/3721-ST accessory

MULTIPLEXER CONFIGURATION: Two independent 1×20 2-pole multiplexers. Banks can be connected together via relays creating a single 1×40 multiplexer. Banks can be isolated from the backplane by relays. Card can be configured for four common side Ohms measurement via backplane relays.

CONTACT CONFIGURATION: Two 50 pin male D-shells. Removable screw terminal option.

MAXIMUM SIGNAL LEVEL: Channels 1–40: 500V DC or RMS, 2A switched (3A carry), 60W, 125VA maximum. Channels 41–42: 60V DC or 30V RMS, 2A switched, 60W, 125VA maximum. Fused 3A, 250V RMS.

COMMON MODE VOLTAGE: Channels 1–40: 300V DC or RMS between any terminal and chassis.

VOLT-HERTZ LIMIT: 8×10^7.

CONTACT LIFE: >10^9 operations at maximum signal level. >10^9 operations no load.

TYPICAL SCANNING SPEEDS:
Switch Only: 1, sequential scanning, single channel, immediate trigger advance: >120 ch/s.

With Measurements Into Memory: 2.
DCV (10V range) or 2W Ohms (1kΩ range): >110 ch/s.
Thermocouple: >110 ch/s.
3- or 4-Wire RTD: >100 ch/s.
4-Wire Ohms (1kΩ range): >100 ch/s.
ACV (10V, 400Hz range) or ACA (1A, 400Hz range): >110 ch/s.

NOTES
1. Open detector enabled during thermocouple measurements. Minimum signal level 10mV, 10Ω.
2. 3706A mainframe with all DMM backplane relays disconnected. Maximum two card backplane relays closed.
3. Connections made using 3721-ST accessory.
4. Scanning script local to mainframe, within same bank, and break before make switching.
5. 3706A mainframe with autorange off, limits off, dmm.autorange=0, dmm.autoscale=0, 4-digit, dmm.normalcompensation=off, dmm.opendetector=off, Scanning script local to mainframe, sequential scan within same bank (2 pole) or card (4 pole), and break before make switching.

<table>
<thead>
<tr>
<th>Channel</th>
<th>Single 1×20</th>
<th>Dual 1×20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel Resistance</td>
<td>&lt;1.0 Ω</td>
<td>&lt;1.5 Ω</td>
</tr>
<tr>
<td>Contact Potential (end of contact life)</td>
<td>&lt;±250 pA</td>
<td>&lt;±250 pA</td>
</tr>
<tr>
<td>Offset Current</td>
<td>&lt;±250 pA</td>
<td>&lt;±250 pA</td>
</tr>
<tr>
<td>Isolation</td>
<td>10^6 Ω, 280 pF</td>
<td>10^6 Ω, 530 pF</td>
</tr>
<tr>
<td>Bank-Bank</td>
<td>10^6 Ω, 60 pF</td>
<td>–</td>
</tr>
<tr>
<td>Channel-channel</td>
<td>10^6 Ω, 50 pF</td>
<td>10^6 Ω, 50 pF</td>
</tr>
<tr>
<td>Common Mode</td>
<td>10^8 Ω, 180 pF</td>
<td>10^8 Ω, 180 pF</td>
</tr>
<tr>
<td>Crosstalk Channel-channel</td>
<td>900kHz</td>
<td>&lt;–60 dB</td>
</tr>
<tr>
<td>&lt;–50 dB</td>
<td>1MHz</td>
<td></td>
</tr>
<tr>
<td>&lt;–25 dB</td>
<td>20MHz</td>
<td></td>
</tr>
<tr>
<td>Bandwidth</td>
<td>28 MHz</td>
<td>9 MHz</td>
</tr>
</tbody>
</table>

ACTUATION TIME: 1ms.
TEMPERATURE ACCURACY using Automatic CJC with 3721-ST accessory: 1°C for J, K, T, and E types (see mainframe specification for details).
RELAY TYPE: Latching electromechanical.
RELAY DRIVE SCHEME: Direct.
INTERLOCK: Backplane relays disabled when interlock connection is removed.
OPERATING ENVIRONMENT: Specified for 0° to 50°C.
STORAGE ENVIRONMENT: –25° to 65°C.
WEIGHT: 2.25 lbs.

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A Greater Measure of Confidence
A Tektronix Company
Dual 1×48, High Density, Multiplexer Card
96 differential channels, 300 Volts/1 Amp

The Model 3722 offers two independent banks of 1×48 two-pole multiplexers, which is ideal for applications that require a high channel count. The two banks can automatically be connected to the Series 3700A mainframe backplane and optional DMM through the analog backplane connection relays. This connection allows the mainframe to reconfigure the card as a single 1×96 two-pole multiplexer or to enable card-to-card expansion for even larger configurations. Another feature of this card is the latching electromechanical relays. They can accommodate 300V, 1A switched signal levels.

The Model 3722 uses two 104-pin D-sub connectors for signal connections. A solder style connector kit (Model 3792-KIT104-R) and pre-assembled cables (Model 3722-MTC-1.5 and 3722-MTC-3) are available for card connections.

ACCESSORIES AVAILABLE

<table>
<thead>
<tr>
<th>Accessory Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5722-MTC-1.5</td>
<td>104-pin D-sub Male to Female Cable, 1.5m (5 ft.)</td>
</tr>
<tr>
<td>5722-MTC-1/MM</td>
<td>104-pin D-sub Male to Male Cable, 1.5m (5 ft.)</td>
</tr>
<tr>
<td>5722-MTC-3</td>
<td>104-pin D-sub Male to Female Cable, 3m (10 ft.)</td>
</tr>
<tr>
<td>5722-MTC-3/MM</td>
<td>104-pin D-sub Male to Male Cable, 3m (10 ft.)</td>
</tr>
<tr>
<td>5791-CIT</td>
<td>Contact Insertion and Extraction Tool</td>
</tr>
<tr>
<td>5792-KIT104-R</td>
<td>104-pin Male D-sub Connector Kit (contains 2 male D-sub connectors with housings and 208 solder-cup contacts)</td>
</tr>
<tr>
<td>5792-KIT104-R/F</td>
<td>104-pin Female D-sub Connector Kit (contains 2 female D-sub connectors with housings and 208 solder-cup contacts)</td>
</tr>
</tbody>
</table>

SERVICES AVAILABLE

<table>
<thead>
<tr>
<th>Service Code</th>
<th>Service Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3722-3Y-EW-STD</td>
<td>1-year factory warranty extended to 3 years from date of shipment</td>
</tr>
<tr>
<td>3722-5Y-EW-STD</td>
<td>1-year factory warranty extended to 5 years from date of shipment</td>
</tr>
<tr>
<td>C/3722-3Y-STD</td>
<td>3 (Z540-1 compliant) calibrations within 3 years of purchase*</td>
</tr>
</tbody>
</table>

*Not available in all countries

Ordering Information

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3722</td>
<td>Dual 1×48, High Density, Multiplexer Card</td>
</tr>
</tbody>
</table>

1.888.KEITHLEY (U.S. only)
www.keithley.com

A Greater Measure of Confidence
Dual 1×48, High Density, Multiplexer Card
96 differential channels, 300 Volts/1 Amp

MULTIPLEXER CONFIGURATION: Two independent 1×48 2-pole multiplexers. Banks can be connected together via relays creating a single 1×96 multiplexer. Banks can be isolated from the backplane by relays. Card can be configured for 2- and 4-wire mode.

CONTACT CONFIGURATION: 2 pole form A.

CONNECTOR TYPE: Two 104 pin female D-shells.

MAXIMUM SIGNAL LEVEL: 300V DC or RMS, 1A switched (2A carry), 60W, 125VA.

COMMON MODE VOLTAGE: 300V DC or RMS between any terminal and chassis.

VOLT-HERTZ LIMIT: 8×10^7.

CONTACT LIFE: >10^5 operations at maximum signal level, >10^8 operations no load. 1

Channel Resistance (end of contact life)  
Dual 1×48: <1.5 Ω  
Single 1×96: <2.5 Ω

Contact Potential (differential)  
Dual 1×48: ±1 µV  
Single 1×96: ±2 µV

Offset Current  
Dual 1×48: <100 pA  
Single 1×96: <100 pA

Isolation  
Differential: 5×10^9 W, 50 pF  
Bank-Bank: 10^9 W, 50 pF  
Channel-channel: 10^9 W, 50 pF  
Common Mode: 10^10 W, 200 pF  
Bank-Bank: 5×10^9 W, 400 pF  
Channel-channel: 10^9 W, 50 pF  
Cross-talk Channel-channel: 300kHz, <–65 dB  
1MHz, <–55 dB  
20MHz, <–30 dB  
Bandwidth: 25 MHz, 15 MHz

TYPICAL SCANNING SPEEDS:

Switch Only: Sequential scanning, single channel, immediate trigger advance: >120 ch/s.

With Measurements Into Memory:

DCV (10V range) or 2W Ohms (1kW range): >110 ch/s.
3- or 4-Wire RTD: >100 ch/s.
4-Wire Ohms (1kW range): >100 ch/s.
ACV (10V, 400Hz range): >110 ch/s.

GENERAL

ACTUATION TIME: 4ms.
RELAY TYPE: Latching electromechanical.
RELAY DRIVE SCHEME: Matrix.
OPERATING ENVIRONMENT: Specified for 0° to 50°C. Specified to 70% R.H. at 35°C.
STORAGE ENVIRONMENT: –25° to 65°C.
WEIGHT: 2.5 lbs.

NOTES

1. Minimum signal level 10mV, 10µA.
2. 3706A mainframe with all DMM backplane relays disconnected. Maximum two card backplane relays closed.
3. Scanning script local to 3706A mainframe, within same bank, and break before make switching.
4. 3706A mainframe with autorange off, limits off, dmm.anz[=off], dmm.auto[=off], 4½ digits (NPLC=0.006), for ACV dmm.detector[bandwidth=300], for Ohms dmm.offsetcompensation[=off]. Scanning script local to mainframe, sequential scan within same bank (2 pole) or card (4 pole), and break before make switching.
The Model 3723 offers two independent banks of high speed 1×30 two-pole multiplexers that are ideal for high speed scanning applications. The two banks can automatically be connected to the Series 3700A mainframe backplane and optional DMM through the analog backplane connection relays. This connection allows the mainframe to reconfigure the Model 3723 as a single 1×60 two-pole multiplexer or as a single 1×120 single-pole multiplexer. It also enables card-to-card expansion for even larger configurations.

By using high speed reed relays with actuation times of less than 0.5ms, this card can meet demanding throughput applications. Another feature of the Model 3723 is its single-ended, one-pole mode, which supports up to 120 channels of single-wire measurements.

The Model 3723 uses two 78-pin D-sub connectors for signal connections. For screw terminal connections, use the Model 3723-ST for two- and four-pole configurations or the Model 3723-ST-1 for single-pole applications.
3723

Dual 1×30, High Speed, Multiplexer Card
60 differential channels, long life reed relays

MULTIPLEXER CONFIGURATION: Two independent 1×30 2-pole multiplexers. Banks can be connected together via relay creating a single 1×60 multiplexer. Banks can be isolated from the backplane by relays. Card can be configured for 1-, 2-, and 4-wire.

CONTACT CONFIGURATION: 2 pole form A

CONNECTOR TYPE: Two 78-pin male D-shells.

MODEL 3723-ST SCREW TERMINAL OPTION: #22 AWG typical wire size with 0.062 inch O.D. 124 conductors maximum, #16 AWG maximum wire size with 0.092 inch O.D. 36 conductor per card maximum.

MAXIMUM SIGNAL LEVEL: 200V DC or RMS, 1A switched (1.25A carry), 15W.

COMMON MODE VOLTAGE: 500V DC or RMS between any terminal and chassis.

VOLT-HERTZ LIMIT: 8×10^6

CONTACT LIFE: Reed: >10^9 operations, no load; 10^7 operations @100V, 10mA. EMR: >10^9 operations @ 5V, 10mA. 10^7 operations @ maximum signal level.

TYPICAL SCANNING SPEEDS:
Switch Only: Sequential scanning, single channel, immediate trigger advance: >1000 ch/s.

With Measurements Into Memory: DCV (10V range) or 2W Ohms (1kΩ range): >800 ch/s.
3- or 4-Wire RTD: >450 ch/s.

GENERAL

ACTUATION TIME: <0.5ms.
RELAY TYPE: Dry reed.
RELAY DRIVE SCHEME: Direct.
RELAY DRIVE CURRENT: 10mA.

INTERLOCK: Backplane relays disabled when interlock connection is removed.
OPERATING ENVIRONMENT: Specified for 0° to 50°C. Specified to 70% R.H. at 35°C.
STORAGE ENVIRONMENT: –25° to 65°C.

WEIGHT: 5 lbs.


NOTES
2. 3706A mainframe with all DMM backplane relays disconnected. Maximum two card backplane relays closed.
3. Scanning script local to 3706A mainframe, within same bank, and break before make switching.
4. 3706A mainframe with autorange off, limits off, dmm autozero=0, dmm autopower=0, 4½ digits (NPLC=0.006), for ACV dmm detector bandwidth=500, for OHMs dmm offsetcompensation=off. Scanning script local to mainframe, sequential scan within same bank (2 pole) or card (4 pole), and break before make switching.

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www.keithley.com
3724 Dual 1×30 FET Multiplexer Card

- 60 two-pole or 30 four-pole solid-state channels
- Scanning speeds greater than 1250 channels/second (switch only)
- Optically isolated, solid-state FET relays provide unlimited contact life
- 200V, 0.1A switch/carry signal capacity; 800mW
- Automatic CJC for temperature measurements when used with 3724-ST accessory
- Analog backplane connection relays provide easy bank and card interconnections
- Screw terminal connections provided with removable 3724-ST accessory
- Ideal for maintenance-free, long-life thermocouple temperature measurements

The Model 3724 provides two independent banks of solid-state relays arranged as 1×30 two-pole multiplexers that are ideal for high reliability, high speed multipoint measurement applications including temperature. The two banks can automatically be connected to the Series 3700A mainframe backplane and optional DMM through the analog backplane connection relays. This connection allows the mainframe to reconfigure the card to a single 1×60 two-pole multiplexer or to enable card-to-card expansion for even larger configurations.

The solid-state FET relay technology supports fast switching times with scanning rates of greater than 1250 channels/second and provides unlimited contact life. In addition, the Model 3724 supports thermocouple temperature measurements when used with the Model 3724-ST (screw terminal) accessory providing automatic cold junction compensation (CJC).

The Model 3724 uses two 78-pin male D-sub connectors for signal connections. For screw terminal or automatic CJC, use the detachable Model 3724-ST accessory.

### ACCESSORIES AVAILABLE
- 5720-MTC-15 78-pin female-to-male D-sub Cable Assembly, 1.5m (4.9 ft)
- 5720-MTC-3 78-pin female-to-male D-sub Cable Assembly, 3m (9.8 ft)
- 5724-ST Screw Terminal Block (required for auto CJC thermocouple measurements)
- 5791-CIT Contact Insertion and Extraction Tool
- 5791-KIT78-R 78-pin female D-sub Connector Kit (contains 2 female D-sub connectors and 156 solder-cup contacts)

### SERVICES AVAILABLE
- 3724-3Y-EW-STD 1-year factory warranty extended to 3 years from date of shipment
- 3724-5Y-EW-STD 1-year factory warranty extended to 5 years from date of shipment
- C/3724-3Y-DATA 3 (Z540-1 compliant) calibrations within 3 years of purchase*

*Not available in all countries
3724

Dual 1×30 FET Multiplexer Card
60 differential channels, automatic CJC with 3724-ST accessory

Model 3724 Specifications

MULTIPLEXER CONFIGURATION: Two independent 1×30, 2-pole multiplexers. Banks can be connected together via relay creating a single 1×60 multiplexer. Banks can be isolated from the backplane by relays. Card can be configured for 2- and 4-wire.

CONTACT CONFIGURATION: 2-pole form A.

CONNECTOR TYPE: Two 78-pin male D-shells.

MODEL 3724-ST SCREW TERMINAL OPTION: #22AWG typical wire size with 0.062 inch O.D. 124 conductors maximum. 16 AWG maximum wire size with 0.092 inch O.D. 36 conductor per card maximum.

MAXIMUM SIGNAL LEVEL: 200V DC or 141V RMS between any terminal, 0.1A switched (0.1A carry), 800mW.

COMMON MODE VOLTAGE: 300V DC or RMS between any terminal and chassis.

VOLT-HERTZ LIMIT: 107.

CONTACT LIFE:
Solid State: > unlimited.
EMR (Backplane): >1×108 operations @ 5V, 10mA.
1×105 operations @ max signal level.

Channel Resistance
- Dual 1×30: <64Ω (54Ω @ 23°C)
- Single 1×60: <64Ω (58Ω @ 23°C)

Contact Potential (differential)
- <±10 nA

Isolation
- Differential: 10Ω, 500 pF
- Bank-Bank: 10Ω, 1000 pF
- CH–CH: 10Ω, 125 pF
- Common Mode: 10Ω, 125 pF

Offset Current
- <±10 nA

Crosstalk CH–CH
- 300 kHz: –40 dB
- 1 MHz: –50 dB

Bandwidth
- 2 MHz: 1 MHz

NOTES
1. Connections made using 3724-ST.
2. 3706A mainframe with all DMM backplane relays disconnected. Maximum two card backplane relays closed.
### Dual 1×30 FET Multiplexer Card

60 differential channels, automatic CJC with 3724-ST accessory

#### 3724 Card/3706A Multimeter Condensed Specifications

**TEMPERATURE**
Display in °C, °F, or K. Exclusive of probe errors.
Display in °C, °F, or K. Exclusive of probe errors.

**THERMOCOUPLES (accuracy based on ITS-90)**

<table>
<thead>
<tr>
<th>Type</th>
<th>Range</th>
<th>Resolution</th>
<th>90 Day/1 Year</th>
<th>23°C ± 5°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>J</td>
<td>–150 to +150°C</td>
<td>0.001°C</td>
<td>1.0°C</td>
<td></td>
</tr>
<tr>
<td>K</td>
<td>–150 to +1372°C</td>
<td>0.001°C</td>
<td>1.0°C</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>–100 to +1300°C</td>
<td>0.001°C</td>
<td>1.0°C</td>
<td></td>
</tr>
<tr>
<td>T</td>
<td>–100 to +400°C</td>
<td>0.001°C</td>
<td>1.0°C</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>–150 to +1000°C</td>
<td>0.001°C</td>
<td>1.0°C</td>
<td></td>
</tr>
<tr>
<td>R</td>
<td>+100 to +1768°C</td>
<td>0.1°C</td>
<td>1.8°C</td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>+100 to +1768°C</td>
<td>0.1°C</td>
<td>1.8°C</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>+1100 to +1820°C</td>
<td>0.1°C</td>
<td>1.8°C</td>
<td></td>
</tr>
</tbody>
</table>

**DC SPECIFICATIONS**

**3724 CARD/3706A MULTIMETER UNCERTAINTY SPECIFICATIONS:**

<table>
<thead>
<tr>
<th>Function</th>
<th>Range</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>All</td>
<td>Add 4.5 µV to PPM “of range”</td>
</tr>
<tr>
<td>Resistance</td>
<td>1 kΩ</td>
<td>Add 8 PPM to “of reading”</td>
</tr>
<tr>
<td>Resistance</td>
<td>10 MΩ</td>
<td>Add 250 PPM to “of reading”</td>
</tr>
<tr>
<td>Resistance</td>
<td>100 MΩ</td>
<td>Add 5000 PPM to “of reading”</td>
</tr>
<tr>
<td>Resistance 2-wire</td>
<td>1 kΩ through 100 MΩ</td>
<td>Add 1.2 Ω (with REL) to PPM “of range” Add 6 Ω (without REL) to PPM “of range”</td>
</tr>
<tr>
<td>Resistance 4-wire and Dry Circuit</td>
<td>1 Ω, 10 Ω, and 100 Ω</td>
<td>Ranges Not Available (maximum lead resistance exceeded, see manual for measurement considerations)</td>
</tr>
</tbody>
</table>

**CONDITIONS:** 1 PLC or 5 PLC

**ACCURACY:** ±(ppm of reading + ppm of range) (ppm = parts per million; e.g., 10ppm = 0.001%)

---

**General**

**ACTUATION TIME:** <0.2ms.

**TEMPERATURE ACCURACY USING AUTOMATIC CJC WITH 3724-ST ACCESSORY:** 1°C for J, K, T, and E type (see mainframe specification for details).

**RELAY TYPE:** Optically isolated FET.

**RELAY DRIVE SCHEME:** Direct.

**INTERLOCK:** Backplane relays disabled when interlock connection removed.

**RELAY DRIVE CURRENT:** 4mA.

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

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

**WEIGHT:** 1.13 kg (2.5 lbs.).

**SAFETY:** Conforms to European Union Directive 73/23/EEC, EN61010-1.

**EMC:** Conforms to European Union Directive 2004/108/EC, EN61326-1.

**TYPICAL SCANNING SPEEDS, SWITCH ONLY:**

- Sequential scanning, single channel, immediate trigger advance: >1250 ch/s.
- Typical scanning speeds, with measurements into memory:
  - DCV (10V range) or 1Ω (1kΩ range): >1000 ch/s.
  - Thermocouple: >1000 ch/s.
  - 3-Wire RTD: >1000 ch/s.
  - 4-Wire Ω (1kΩ range): >450 ch/s.
  - ACV (10V, 400Hz range): >1000 ch/s.

**POWER BUDGET INFORMATION:**

- Quiescent Power (mW): 1150.
- Channel Relay Power (mW) Each: 20.
- Backplane Relay Power Consumption (mW) Each: 100.

See Chapter 8 of the Series 3700A user’s manual for more detailed information.

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**NOTES:**

1. Scanning script local to mainframe, within same bank, break before make.
2. 3706A mainframe with auto range off, limits off, dmm autodelay=0, dmm autozero=0, 4½ digits (NPLC=0.06), for ACV dmm detector bandwidth=300, for OHMs dmm offsetcompensation=off, dmm opendetector=off.

Scanning script local to mainframe, sequential scan within same bank (2 pole) or card (4 pole), and break before make switching.

---

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1.888.KEITHLEY (U.S. only)
6×16, High Density, Matrix Card
96 two-pole crosspoints with column expansion relays

The Model 3730 is a two-pole, 6 row by 16 column matrix card. It can connect up to six differential instrument channels to any combination of 16 DUTs (devices under test). Any row can be connected to the Series 3700A mainframe backplane by using the analog backplane connection relays. This allows for easy matrix column expansion. A matrix of up to 6 rows by 96 columns can be supported within a single Model 3706A mainframe (with six Model 3730 cards).

The Model 3730 uses two 50-pin male D-sub connectors for signal connections. For screw terminal connections, use the detachable Model 3750-ST accessory.

ACCESSORIES AVAILABLE

<table>
<thead>
<tr>
<th>Accessory</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3721-MTC-1.5</td>
<td>50 Pin D-sub Female to Male Cable, 1.5m (5 ft.)</td>
</tr>
<tr>
<td>3721-MTC-3</td>
<td>50 Pin D-sub Female to Male Cable, 3m (10 ft.)</td>
</tr>
<tr>
<td>3750-ST</td>
<td>Screw Terminal Block</td>
</tr>
<tr>
<td>3790-KIT50-R</td>
<td>50 Pin Female D-sub Connector Kit (contains 2 female D-sub connections and 100 solder-cup contacts)</td>
</tr>
</tbody>
</table>

SERVICES AVAILABLE

<table>
<thead>
<tr>
<th>Service Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3730-3Y-STD</td>
<td>1-year factory warranty extended to 3 years from date of shipment</td>
</tr>
<tr>
<td>3730-5Y-STD</td>
<td>1-year factory warranty extended to 5 years from date of shipment</td>
</tr>
<tr>
<td>C/3730-3Y-STD</td>
<td>(Z540-1 compliant) calibrations within 3 years of purchase*</td>
</tr>
</tbody>
</table>

*Not available in all countries

Ordering Information

3730 6×16, High Density, Matrix Card
**Matrix Configuration:**
- 6 row by 16 column matrix.
- Columns can be expanded using the backplane or isolated by relays.

**Contact Configuration:**
- 2 pole form A.

**Connector Type:**
- Two 50 pin male D-shells.

**Model 3730-ST Screw Terminal Option:**
- #22 AWG typical wire size with 0.062 inch O.D. 88 conductors maximum.
- #16 AWG maximum wire size with 0.092 inch O.D. 44 conductor per card maximum.

**Maximum Signal Level:**
- 500V DC or RMS, 1A switched (2A carry), 60W, 125VA.

**Common Mode Voltage:**
- 300V DC or RMS between any terminal and chassis.

**Voltage-Hertz Limit:**
- $8 \times 10^7$. 

**Contact Life:**
- >$1 \times 10^5$ operations @ maximum signal level.
- >$1 \times 10^8$ operations no load. 

**Channel Resistance (end of contact life):**
- $<1 \Omega$.

**Offset Current:**
- $<\pm 100 \mu A$.

**Contact Potential (differential):**
- $<\pm 2 \mu V$.

**Isolation:**
- Differential: $10^{12} \Omega$, 250 pF.
- Channel-channel: $10^{10} \Omega$, 75 pF.
- Common Mode: $10^{10} \Omega$, 150 pF.

**Crosstalk Channel-channel:**
- 300kHz: $<-65$ dB.
- 1MHz: $<-55$ dB.
- 20MHz: $<-50$ dB.

**Bandwidth:**
- 27 MHz.

**General:**

**Actuation Time:**
- 4ms.

**Relay Type:**
- Latching electromechanical.

**Relay Drive Scheme:**
- Hybrid Matrix.

**Interlock:**
- Backplane relays disabled when terminal assembly is removed.

**Operating Environment:**
- Specified for 0° to 50°C.
- Specified to 70% R.H. at 35°C.

**Storage Environment:**
- –25° to 65°C.

**Weight:**
- 2.5 lbs.

**Safety:**

**EMC:**

**Notes:**
1. Minimum signal level 10mV, 10µA.
2. Connections made using 3730-ST accessory.
3. 3706A mainframe with all DMM backplane relays disconnected.
The Model 3731 is a two-pole, 6 row by 16 column reed relay matrix card. By using high speed reed relays with actuation times of 0.5ms, this card meets the requirements of demanding throughput applications while offering users the additional benefit of long life, exceeding one billion operations. The card can connect up to six differential instrument channels to any combination of 16 DUTs (devices under test). Any row can be connected to the Series 3700A mainframe backplane by using the analog backplane connection relays. This allows for easy matrix column expansion. A matrix of up to 6 rows by 96 columns can be supported within a single 3706A mainframe (with six Model 3731 cards).

The Model 3731 uses two 50-pin male D-sub connectors for signal connections. For screw terminal connections, use the detachable Model 3731-ST accessory.

### Ordering Information

<table>
<thead>
<tr>
<th>3731</th>
<th>6×16 High Speed, Reed Relay, Matrix Card</th>
</tr>
</thead>
</table>

### ACCESSORIES AVAILABLE

<table>
<thead>
<tr>
<th>Product Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3721-MTC-1.5</td>
<td>50-pin D-sub Female to Male Cable, 1.5m (5 ft.)</td>
</tr>
<tr>
<td>3721-MTC-3</td>
<td>50-pin D-sub Female to Male Cable, 3m (10 ft.)</td>
</tr>
<tr>
<td>3731-ST</td>
<td>Screw Terminal Block</td>
</tr>
<tr>
<td>3790-KIT50-R</td>
<td>50-pin Female D-sub Connector Kit (contains 2 female D-sub connectors and 100 solder-cup contacts)</td>
</tr>
</tbody>
</table>

### SERVICES AVAILABLE

<table>
<thead>
<tr>
<th>Product Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3731-3Y-EW-STD</td>
<td>1-year factory warranty extended to 3 years from date of shipment</td>
</tr>
<tr>
<td>3731-5Y-EW-STD</td>
<td>1-year factory warranty extended to 5 years from date of shipment</td>
</tr>
<tr>
<td>C/3731-3Y-STD</td>
<td>3 (Z540-1 compliant) calibrations within 3 years of purchase*</td>
</tr>
</tbody>
</table>

*Not available in all countries
3731

6×16 High Speed, Reed Relay, Matrix Card
96 two-pole crosspoints with column expansion relays

96 Two-Pole Crosspoints with Column Expansion Relays

- **Matrix Configuration:** 6 row by 16 column matrix. Columns can be expanded using the backplane or isolated by relays.
- **Contact Configuration:** 2-pole form A.
- **Connector Type:** Two 50-pin male D-shells.
- **Model 3731-ST Screw Terminal Option:**
  - Typical wire size: #22 AWG with .062 inch O.D.
  - 88 conductors maximum
  - Maximum wire size: #16 AWG with .092 inch O.D.
  - 44 conductors per card maximum
- **Maximum Signal Level:** 200V DC or peak AC, 1A switched (2A carry), 10W, 10VA.
- **Common Mode Voltage:** 200V DC or peak AC between any signal path to a signal path or ground.
- **VOLT-HERTZ LIMIT:** 8×10^7.
- **Contact Life:**
  - Reed: >10^9 operations no load, >8×10^6 operations @ 100V, 10mA.
  - EMR (Backplane): >10^6 operations @ 5V, 10mA and 10^5 operations @ maximum signal level.

| **6x16** |  
|----------|-----------------|-----------------|-----------------|-----------------|
| Channel Resistance (end of contact life) | <1.5 Ω |  
| Contact Potential (differential) | <±60 µV |
| Offset Current | <±500 pA |
| Isolation |  
| Differential | 3×10^9 Ω, 300 pF |
| Channel-channel | 3×10^9 Ω, 100 pF |
| Common Mode | 3×10^9 Ω, 150 pF |
| Crosstalk Channel-channel |  
| 300kHz | <–60 dB |
| 1MHz | <–50 dB |
| 15MHz | <–20 dB |
| Bandwidth | 19 MHz |

**GENERAL**

- **Actuation Time:** 0.5ms.
- **Relay Type:** Reed.
- **Relay Drive Scheme:** Direct drive.
- **Interlock:** Backplane relays disabled when terminal assembly is removed.
- **Operating Environment:** Specified for 0° to 50°C. Specified to 70% R.H. at 35°C.
- **Storage Environment:** –25° to 65°C.
- **Weight:** 2.2 lbs.
- **EMC:** Compliant with European Union EMC Directive.

**Notes**

1. Connections made using 3731-ST.
2. 5706A mainframe with all DMM backplane relays disconnected.

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The ultra-high density Model 3732 matrix card is comprised of four banks, each with 4 rows by 28 columns of reed relays. This provides 448 single-pole crosspoints for maximum connection versatility in high channel count applications. For even greater flexibility, bank configuration relays are mounted on the card. They offer an automated method of connecting banks to enable two additional matrix configurations: single 4×112 and dual 4×56. This feature allows the matrix size to be easily adapted to existing or future applications. For differential (2-wire) measurements, a two-pole mode can be selected that enables automatic pairing of crosspoints to create a dual 4×28 or single 4×56 configuration. For larger matrix sizes, analog backplane relays are provided that enable rows to connect to the Series 3700A mainframe backplane. This allows, for example, a matrix of up to 4 rows by 672 columns within a single 3700A mainframe using six Model 3732 cards.

The card uses optimized reed relays that offer both low contact potential and low current offset to minimize the switching errors that often accompany this relay technology. Additionally, these relays provide greater signal voltage (200V) and current (1.2A carry) dynamic range while supporting the long life and fast actuation times necessary in many automated test applications.

The Model 3732 uses two 78-pin male D-sub connectors for signal and configuration connections. For screw terminal connections, two accessories are offered. Use the 3732-ST-R for the 16×28 or dual 8×28 matrix configurations. Use the 3732-ST-C for the 4×112, dual 4×56, or base quad 4×28 matrix configurations.
Quad 4×28, Ultra-High Density, Reed Relay Matrix Card

448 one-pole crosspoints with bank configuration and backplane connection relays

Quad 4×28 (1-wire) or Dual 4×28 (2-wire) Matrix Configuration

Matrix Bank 1

Matrix Bank 2

Matrix Bank 3

Matrix Bank 4

Matrix Crosspoint Relay Detail

Matrix Crosspoint Relay Detail

Matrix Crosspoint Relay Detail

Matrix Crosspoint Relay Detail

Analog Backplane Connection Relays

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www.keithley.com

A Greater Measure of Confidence
Quad 4×28, Ultra-High Density, Reed Relay Matrix Card
448 one-pole crosspoints with bank configuration and backplane connection relays

Additional Matrix Configurations Using Bank Configuration Relays

Dual 4×56 (1-wire) or single 4×56 (2-wire) matrix configuration using bank configuration relays

Single 4×112 (1-wire) matrix configuration using bank configuration relays

Additional Matrix Configurations Using the Model 3732-ST-R Screw Terminal Block

Dual 8×28 (1-wire) or single 8×28 (2-wire) matrix configuration using one Model 3732-ST-R screw terminal block

Single 16×28 (1-wire) matrix configuration using one Model 3732-ST-R screw terminal block

1.888.KEITHLEY (U.S. only)
www.keithley.com
Matrix Configuration: Four banks, each with 4 rows by 28 columns of reed relays. Bank configuration and analog backplane relays are included for additional matrix configurations. Banks can be connected together via relays creating dual 4×56 matrices or a single 4×112 matrix. Row expansion is available using optional screw terminal accessories.

Connector Type: Two 78-pin male D-shells.

Model 3732-ST-R Screw Terminal Option: Provides terminal block access and column jumper blocks for extended row configurations including Dual 8×28 (1W), Single 8×28 (2W), and Single 16×28 (1W).

Typical Wire Size: #22 AWG with 0.062 inch O.D., 88 conductors per card maximum.

Maximum Wire Size: #16 AWG with 0.092 inch O.D., 44 conductors per card maximum.

Model 3732-ST-C Screw Terminal Option: Provides terminal block access for Quad 4×28 (1W), Dual 4×28 (2W), Dual 4×56 (1W), Single 4×56 (2W), and Single 4×112 (1W) matrix configurations.

Typical Wire Size: #22 AWG with 0.062 inch O.D., 88 conductors per card maximum.

Maximum Wire Size: #16 AWG with 0.092 inch O.D., 44 conductors per card maximum.

Maximum Signal Level: 200VDC or peak AC, 0.75A switched (1.2A carry), 15W/15VA max. switch power.

Common Mode Voltage: 200VDC or peak AC between any signal path to a signal path or ground.

VOLT-Hertz Limit: 8×10^7.

Contact Life: Reed: >10^9 operations no load, >8×10^6 operations @ 100V, 10mA.

EMR (Backplane): >10^8 operations @ 5V, 10mA at maximum signal level.

Model 3732 Specifications

Model 3732 Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Quad 4×28</th>
<th>Dual 4×56</th>
<th>Single 4×112</th>
<th>Dual 8×28</th>
<th>Single 16×28</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel Resistance (end of life)</td>
<td>&lt;1.5 Ω</td>
<td>&lt;2.0 Ω</td>
<td>&lt;2.5 Ω</td>
<td>&lt;1.6 Ω</td>
<td>&lt;2.0 Ω</td>
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<tr>
<td>Contact Potential (differential)</td>
<td>≤±10 μV</td>
<td>≤±20 μV</td>
<td>N/A</td>
<td>≤±15 μV</td>
<td>N/A</td>
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<tr>
<td>Contact Potential (single ended)</td>
<td>≤±20 μV</td>
<td>≤±40 μV</td>
<td>≤±65 μV</td>
<td>≤±20 μV</td>
<td>≤±20 μV</td>
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<tr>
<td>Offset Current</td>
<td>≤±0.5 mA</td>
<td>≤±1.0 mA</td>
<td>≤±2.0 mA</td>
<td>≤±1.0 mA</td>
<td>≤±2.0 mA</td>
</tr>
<tr>
<td>Isolation</td>
<td>CH-CH: 3×10^10 Ω/150 pF</td>
<td>1.5×10^10 Ω/300 pF</td>
<td>7.5×10^9 Ω/600 pF</td>
<td>2×10^9 Ω/200 pF</td>
<td>1.5×10^9 Ω/300 pF</td>
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<tr>
<td>Common mode: 1.5×10^10 Ω/300 pF</td>
<td>7.5×10^9 Ω/600 pF</td>
<td>2×10^9 Ω/200 pF</td>
<td>1.5×10^9 Ω/300 pF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 MHz</td>
<td>&lt;–26 dB</td>
<td>&lt;–7 dB</td>
<td>&lt;–7 dB</td>
<td>&lt;–7 dB</td>
<td>&lt;–7 dB</td>
</tr>
<tr>
<td>15 MHz</td>
<td>&lt;–7 dB</td>
<td>&lt;–7 dB</td>
<td>&lt;–7 dB</td>
<td>&lt;–7 dB</td>
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<tr>
<td>Bandwidth</td>
<td>15 MHz</td>
<td>15 MHz</td>
<td>15 MHz</td>
<td>15 MHz</td>
<td>15 MHz</td>
</tr>
</tbody>
</table>

Power Budget Information:

Quiescent Power Usage:

<table>
<thead>
<tr>
<th>Mode</th>
<th>Quiescent Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quad 4×28</td>
<td>780 mW</td>
</tr>
<tr>
<td>Dual 4×56</td>
<td>916 mW</td>
</tr>
<tr>
<td>Single 4×112</td>
<td>984 mW</td>
</tr>
<tr>
<td>Dual 8×28</td>
<td>780 mW</td>
</tr>
<tr>
<td>Single 16×28</td>
<td>780 mW</td>
</tr>
</tbody>
</table>

Channel Relay Power Consumption (each): 17mW
Backplane Relay Power Consumption (each): 100mW.

For additional power budgeting information, refer to the Series 5700A Module Schematics and Connections section in the Series 5700A User’s Manual (part no. 57008-900-01).

Actuation Time: 0.6ms.

General

RELAY TYPE: Reed (signal relays), EMR (backplane relays).

RELAY DRIVE SCHEME: Direct drive.

RELAY DRIVE CURRENT: 3mA.

INTERLOCK: Backplane relays disabled when terminal assembly interlock signal removed. When asserted allows system to read and save 1D configuration bits.

EMC: Compliant with European Union EMC Directive.

SAFETY: Compliant with European Union Low Voltage Directive.

Operating Environment: Specified for 0° to 50°C.

Specified to 70% relative humidity at 35°C.

Storage Environment: –25° to 65°C.

Weight: 3.40 lbs (1.54kg).
32-channel Isolated Switch Card
28 Form C relays and 4 high power Form A relays

The Model 3740 offers 28 general-purpose form C channels that are ideal for routing power or other control devices. For higher power applications of up to 7A, four additional high current form A channels are provided.

If any general purpose signal requires routing to the Series 3700A mainframe backplane, terminal blocks are located on the card, which are enabled with jumpers. Custom configurations can be created with the user accessible terminal blocks. For additional protection, an onboard temperature sensor will notify the mainframe when the card’s operating temperature exceeds 70°C, compromising system specifications.

The Model 3740 uses two 50-pin male D-sub connectors for signal connections. For screw terminal connections, use the detachable Model 3740-ST accessory.

### ACCESSORIES AVAILABLE

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>372I-MTC-1.5</td>
<td>50-pin D-sub Female to Male Cable, 1.5m (5 ft.)</td>
</tr>
<tr>
<td>372I-MTC-3</td>
<td>50-pin D-sub Female to Male Cable, 3m (10 ft.)</td>
</tr>
<tr>
<td>3740-ST</td>
<td>Screw Terminal Block</td>
</tr>
<tr>
<td>3790-KIT50-R</td>
<td>50-pin Female D-sub Connector Kit (contains 2 female D-sub connectors and 100 solder cup contacts)</td>
</tr>
</tbody>
</table>

### SERVICES AVAILABLE

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3740-3Y-EW-STD</td>
<td>1-year factory warranty extended to 3 years from date of shipment</td>
</tr>
<tr>
<td>3740-5Y-EW-STD</td>
<td>1-year factory warranty extended to 5 years from date of shipment</td>
</tr>
<tr>
<td>C/3740-3Y-STD</td>
<td>3 (Z540-1 compliant) calibrations within 3 years of purchase*</td>
</tr>
</tbody>
</table>

*Not available in all countries

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1.888.KEITHLEY (U.S. only)
www.keithley.com
32-channel Isolated Switch Card
28 Form C relays and 4 high power Form A relays

RELAY SWITCH CONFIGURATION: 32 general purpose independent channels. 28 channels of Form C switching at 2A and 4 channels of Form A switching at 7A. Relays can be connected to each other and backplane via removable terminal blocks.

CONTACT CONFIGURATION: General Purpose: 1 pole Form C. High Current: 1 pole Form A

CONNECTOR TYPE: Two 50 pin male D-shells

MODEL 3740-ST SCREW TERMINAL OPTION: #22 AWG typical wire size with 0.062 inch O.D. 84 conductors maximum. #16 AWG maximum wire size with 0.092 inch O.D. 44 conductors per card maximum.

MAXIMUM SIGNAL LEVEL: Form C: 300V DC or RMS, 2A switched (3A carry), 60W, 125VA. Form A: 250VAC 7A, 30VDC 7A, 210W.

COMMON MODE VOLTAGE: 300V DC or RMS between any terminal and chassis.

VOLT-HERTZ LIMIT: 8×10^7.

CONTACT LIFE: Form C: >10^5 operations at maximum signal level. >10^6 operations no load. Form A: >10^5 operations at maximum signal level, >5×10^7 operations no load.

CHANNEL RESISTANCE (end of contact life): <0.5Ω.

CONTACT POTENTIAL: ≤±3µV typical per contact.

ISOLATION: Channel-channel: 10^10Ω, <200pF. Common Mode: >10^12Ω, <150pF.

Cross talk (Channel-channel, 50Ω load–50Ω source): 100kHz: <-50dB. 1MHz: <-35dB. 10MHz: <-15dB.

BANDWIDTH: 30MHz.

GENERAL

OVER-TEMPERATURE: Temperature sensor indicates over temperature.

ACTUATION TIME: Form C: 4ms. Form A: 10ms.

RELAY TYPE: Form C: Latching electromechanical. Form A: Nonlatching electromechanical.

RELAY DRIVE SCHEME: Direct.

INTERLOCK: Backplane relays disabled when interlock connection is removed.

OPERATING ENVIRONMENT: Specified for 0° to 50°C. Specified to 70% R.H. at 35°C.

STORAGE ENVIRONMENT: -25° to 65°C.

WEIGHT: 2.5 lbs.


NOTES

1. Minimum signal level 10mV, 10µA.
Multifunction Control Card
40 digital I/O bits, 2 analog output channels, and 4 counters

Use the Model 3750 to monitor and control your automated test system. The flexibility and speed provided by the 40 digital I/O bits, four counters, and two analog outputs make it well-suited for a wide variety of system control applications.

Digital I/O
The Model 3750 offers 40 digital I/O bits arranged in five banks. Each bank is comprised of eight bits each, and each bank can be programmed as either input or output. Digital I/O is often used to control processes and monitor the status of switches, contacts, and other control points. Additional features include scanning capabilities, such as writing a unique output pattern or reading banks of inputs at rates up to 1000 rdgs/second. Also, pattern matching is available, making it ideal for complex event algorithms.

Further versatility is provided by supporting external voltage levels of up to 30V and output current sink levels of 300mA for control of external devices like RF/microwave relays.

Analog Outputs
The two analog outputs of the Model 3750 are designed for general purpose applications such as setpoint control or as bias supplies to your device under test. For maximum utility, these outputs are programmable as voltage (±12V) or current (0–20mA or 4–20mA). A number of protection features are provided, including monitoring for current and/or voltage compliance and the ability to disconnect automatically during fault conditions. Output relays are supplied for each channel, ensuring mechanical isolation between your control device and the analog output.

Counters
Four 32-bit counters are provided with a maximum input rate of 1MHz. Each counter has a gate input that offers precise control of event counting and totalizing for a broad range of system components, such as fixtures, limit switches, pass/fail indicators, revolutions, or time-related quantities. The counters, like the digital I/O, can be used in scanning operations and pattern matching as well as supporting reading rates of up to 1000 rdgs/second.

Self-calibration
When your Model 3706A mainframe is equipped with the high performance multimeter option, hardware and software is provided for self-calibration of analog outputs (voltage and current) and counter thresholds.
Multifunction Control Card
40 digital I/O bits, 2 analog output channels, and 4 counters

Figure 1. Block diagram

Specifications

DIGITAL I/O
CONFIGURATION: 40 bidirectional digital I/O bits arranged in 5 banks of 8 bits each. Each bank can be configured for either input or output capability. 1 bank of I/O is equivalent to 1 system channel.

DIGITAL INPUT SPECIFICATIONS
An internal weak pull-up resistor of approximately 68kΩ is provided on the card for each I/O. This pull-up resistor can be removed via onboard jumper on a channel (8 bit) basis. The pull-up voltage can either connect to the internally supplied 5V or an externally supplied voltage of up to 30V via onboard jumper. An internal 5V supply connection is separately available to run external logic circuits.

DIGITAL INPUT LOGIC LOW VOLTAGE: 0.8V max.
DIGITAL INPUT LOGIC HIGH VOLTAGE: 2V min.
DIGITAL INPUT LOGIC LOW CURRENT: −600µA max @ 0V.
DIGITAL INPUT LOGIC HIGH CURRENT: 50µA max @ 5V.
LOGIC: Positive true.

SYSTEM INPUT MINIMUM READ SPEED: 1000 readings/second.
MAXIMUM EXTERNALLY SUPPLIED PULL-UP VOLTAGE: 30V.
MAXIMUM EXTERNALLY SUPPLIED VOLTAGE TO ANY DIGITAL I/O LINE: Pull-up voltage (5V internal or up to 30V external).

DIGITAL OUTPUT SPECIFICATIONS
Each output has an internal fly-back diode for driving inductive loads. Each output is protected against continuous short circuits and over temperature. An internal 5V supply connection is separately available to run external logic circuits.

DIGITAL OUTPUT LOGIC HIGH VOLTAGE: 2.4V minimum @ Iout = 10mA, sourcing only.
DIGITAL OUTPUT LOGIC LOW VOLTAGE: 0.5V maximum @ Iout = −300mA, sinking only.
MAXIMUM OUTPUT SINK CURRENT: 300mA per output, 3.0A total per card.
LOGIC: Positive true.

SYSTEM OUTPUT MINIMUM WRITE SPEED: 1000 readings/second.
MAXIMUM EXTERNALLY SUPPLIED VOLTAGE TO ANY DIGITAL I/O LINE: Pull-up voltage (5V internal or up to 30V external).
ALARM: Trigger generation is supported for a maskable pattern match or state change on any of channels 1 through 5.
PROTECTION: Optional disconnect (set to inputs) during output fault conditions.
INTERNAL 5V LOGIC SUPPLY: The internal logic supply is designed for powering external logic circuits of up to 50mA maximum. The logic supply is internally protected with a self-resetting fuse. Fuse reset time < 1 hour.

NOTES
1. All channels power up configured as inputs.
2. All channels configured as inputs.
3. All channels configured as outputs.

Figure 2. Simplified I/O schematic
3750

Multifunction Control Card
40 digital I/O bits, 2 analog output channels, and 4 counters

COUNTER/TOTALIZER INPUT
MAXIMUM COUNT: \(2^n - 1\).
MAXIMUM INPUT RATE: 1MHz, rising or falling edge, programmable.
MINIMUM INPUT PULSE WIDTH: 500ns.
INPUT SIGNAL LEVEL: 200mV p-p (minimum), 42V peak (maximum).
THRESHOLD: AC (0V) or TTL logic level.
GATE INPUT: TTL–HI (Gate+), TTL–LO (Gate–) or NONE.
MINIMUM GATE INPUT SETUP TIME: 1µs.
COUNT RESET: Manual or Read + Reset.
SYSTEM INPUT MINIMUM READ SPEED: 1000 readings/second.
ALARM: Trigger generation is supported for a count match or counter overflow on any of channels 6 through 9.

ANALOG VOLTAGE OUTPUT
The isolated analog voltage output is designed for general purpose, low power applications.
OUTPUT AMPLITUDE: \(\pm 12V\) up to 10mA.
OVERLOAD CURRENT: 21mA minimum.
RESOLUTION: 1mV.
FULL SCALE SETTLING TIME: 1ms to 0.1% of output.
DC ACCURACY: \(\pm (\% \text{ of output} + \text{mV})\):
- 1 Year 23°C \(\pm 5\%: 0.15\% + 16mV\).
- 90 Day 23°C \(\pm 5\%: 0.1\% + 16mV\).
- 24 Hour 23°C \(\pm 5\%: 0.04\% + 16mV\).
TEMPERATURE COEFFICIENT: \(\pm (0.02\% + 1.2\text{mV})/\circ\text{C}\).
10mV MAXIMUM UPDATE RATE: 350µs to 1% accuracy. System limited.
OUTPUT FAULT DETECTION: System fault detection is available for short circuit output/current compliance.
ISOLATION: 300V peak channel to channel or channel to chassis.
PROTECTION: Optional disconnect during output fault conditions.
MINIMUM GUARANTEED STABLE CAPACITIVE LOAD: 10nF.

NOTES
1. Programming up to 1% over full scale range is supported.
2. Measured with standard load shown in Figure 3.
3. Measured with >10MΩ input DMM (DCV, filter, 1 PLC rate).
   Warm-up time is 1 hour @ 10mA load with 3750-ST.

ANALOG CURRENT OUTPUT
The isolated analog current output is designed for 0–20mA or 4–20mA unipolar modes of operation.
OUTPUT AMPLITUDE: 0 to 20mA or 4 to 20mA.
COMPLIANCE VOLTAGE: 11V minimum.
MAXIMUM OPEN CIRCUIT VOLTAGE: 16V.
RESOLUTION: 1µA.
FULL SCALE SETTLING TIME: 1ms to 0.1% of output.
DC ACCURACY: \(\pm (\% \text{ of output} + \text{µA})\):
- 1 Year 23°C \(\pm 5\%: 0.15\% + 18µA\).
- 90 Day 23°C \(\pm 5\%: 0.1\% + 18µA\).
- 24 Hour 23°C \(\pm 5\%: 0.04\% + 18µA\).
TEMPERATURE COEFFICIENT: \(\pm (0.02\% + 1.6\text{µA})/\circ\text{C}\).
OUTPUT FAULT DETECTION: System fault detection is available for open circuit output/voltage compliance.
ISOLATION: 300V peak channel to channel or channel to chassis.
PROTECTION: Optional disconnect during output fault conditions.

NOTES
1. Measured with standard load shown in Figure 3.
   Warm-up time is 1 hour with 3750-ST.

Test Circuit for Voltage Output Channels 10 and 11

Test Circuit for Current Output Channels 10 and 11

Figure 3. Standard load test circuits

General
CONNECTOR TYPE: Two 50-pin male D-shells.
OPERATING ENVIRONMENT: Specified for 0°C to 50°C. Specified to 70% R.H. at 35°C.
STORAGE ENVIRONMENT: -25°C to 65°C.
WEIGHT: 1.27kg (2.80 lbs.).
POWER BUDGET INFORMATION:
Quiescent Power: 350mW.
Digital Outputs Each Channel (1 through 5): 325mW.
Analog Channel Each (10 and 11): 820mW.
Totalizer Channel All (6 through 9): 730mW.
Analog channels and counter channels may optionally be turned off to conserve system power.
See Chapter 8 of the Series 3700A user’s manual for more detailed information.

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www.keithley.com
A Greater Measure of Confidence
A Tektronix Company

SWITCHING AND CONTROL
Two-slot high density switch mainframe

Matrix cards are displayed in row-column format. Only the available rows and columns of the card are displayed. Rows are horizontal and columns are vertical.

Matrix crosspoints are entered in row-column format. The first number selects the card, the second is the row, and the third number is the column.

Multiplexer card display. The first row across represents channels 1 to 10. The second row is channels 11 to 20. Only the available channels are displayed.

Scan in any order. A scan does not have to be a contiguous set of channels. Scan forward, backward, or skip channels. Display indicates scanning. As a scan sequence is executed, the display updates to show the scanning action.

Supports industry’s broadest range of signals
• Integrates easily with DMM and SourceMeter® SMU instruments
• Full channel status display
• 2 card slots
• Supports 17 switch/control cards

Switch/Control Mainframe
80-channel

The Model 7001 is a half-rack, high density, two-slot mainframe that supports the widest range of signals in the test and measurement industry. DC switching capabilities from nanovolts to 1100V and femtoamps to 5A, as well as RF and optical switch support, make the Model 7001 a versatile production test tool for a wide array of applications.

Built-in scan control eliminates the need for the computer to control every step of the test procedure. Simply program the 7001 to control channel spacing, scan spacing, and the number of scans. A built-in non-volatile memory stores up to 100 complete switch patterns. You can include these memory locations as part of the scan list.

Up to 80 channels of 2-pole switching. Each slot of the 7001 can accommodate up to 40 channels. This means fewer switch cards are required, reducing the amount of switching hardware needed. Higher density also provides extra capacity and flexibility.

Analog backplane. The 7001’s analog backplane is used by the high density switch cards. The backplane eliminates intercard wiring and increases configuration flexibility. Two cards can be connected through the backplane to create a 1x80 multiplexer, a 4x20 matrix, or a multiplexer/matrix combination that provides matrix row expansion.

Channel status display. See the status of every channel simultaneously. The vacuum fluorescent display of the 7001 shows the open/close status of each channel in the mainframe simultaneously. The graphical display pattern makes it much easier to configure a test system, make modifications, or debug an existing program. The status of the cards in both slots is displayed side by side on the same screen.

Easy to set up and use. The 7001 has a number of built-in features that make it easy to set up, run, change, or modify. It conforms to IEEE-488.2 and SCPI (Standard Commands for Programmable Instruments). All aspects of the instrument can be programmed from the front panel and over the IEEE bus.

Trigger Link. Trigger Link is a high speed trigger bus that provides simple trigger coordination between the Model 7001 and other instruments. This bus eliminates GPIB communication delays during scanning to increase overall system throughput dramatically.

17 switch/control cards available. The 7001 switch cards accommodate a broad range of signals, maintain very high accuracy, and will not degrade signal quality. By minimizing signal errors, these cards will prevent degradation due to offset voltage, isolation resistance, and leakage current.

With its broad range of available cards, the 7001 provides multi-pole switching. Cards such as the 7011 can be used in either 2- or 4-pole configuration. If a card does not have the pole capacity required, the 7001 can still accommodate the application—just select the CARD PAIR function. It allows the channel closures in both slots to be synchronized for up to 8-pole switching.

ACCESSORIES AVAILABLE

<table>
<thead>
<tr>
<th>COMMUNICATION INTERFACES AND CABLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>7007-1 Double Shielded, Premium GPIB Cable, 1m</td>
</tr>
<tr>
<td>7007-2 Double Shielded, Premium GPIB Cable, 2m</td>
</tr>
<tr>
<td>KPCI-488LPA IEEE-488 Interface/Controller for the PCI Bus</td>
</tr>
<tr>
<td>KUSB-488B IEEE-488 USB-to-GPIB Interface Adapter</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RACK MOUNT KITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>4288-1 Single Fixed Rack Mount Kit</td>
</tr>
<tr>
<td>4288-2 Dual Fixed Rack Mount Kit</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TRIGGERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>8501-1 Trigger Link Cable, DIN-to-DIN, 1m</td>
</tr>
<tr>
<td>8501-2 Trigger Link Cable, DIN-to-DIN, 2m</td>
</tr>
<tr>
<td>8503 Trigger Link Cable, DIN-to-dual BNC, 1m</td>
</tr>
<tr>
<td>8505 Male to 2-Female Y-DIN Cable for Trigger Link</td>
</tr>
</tbody>
</table>

SERVICES AVAILABLE

7001-Y-EW 1-year factory warranty extended to 3 years from date of shipment
Switching and Control Mainframe
80-channel

System
CAPACITY: 2 plug-in cards per mainframe.
MEMORY: Battery backed-up storage for 100 switch patterns.
SWITCH SETTLING TIME: Automatically selected by the mainframe for each card.
Additional time from 0 to 9999.999 seconds can be added in 1ms increments.
TRIGGER SOURCES:
- External Trigger (TTL-compatible, programmable edge, 600µs minimum pulse, rear panel BNC).
- Trigger Link.
- Manual (front panel).
- Internal Timer, programmable from 1ms to 9999.999 seconds in 1ms increments.
STATUS OUTPUT: Channel Ready (TTL-compatible signal, rear panel BNC). Low going pulse (10µs typical) issued after relay settling time. For two different switch cards, 7001 will be set to the slowest relay settling time.
SWITCHING SEQUENCE: Automatic break-before-make.
MAINFRAME DIGITAL I/O: 4 open-collector outputs (30V maximum pull-up voltage, 100mA maximum sink current, 10Ω output impedance), 1 TTL compatible input, 1 common.
RELAY DRIVE: 700mA maximum for both card slots.
CARD SIZE: 32mm high × 114mm wide × 272mm long (1½ in × 4½ in × 10¾ in).
CARD COMPATIBILITY: Fully compatible with all 7XXX cards.

Throughput
EXECUTION SPEED OF SCAN LIST:
<table>
<thead>
<tr>
<th>Command</th>
<th>7011 Card</th>
<th>7015 Card</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual Channels</td>
<td>130/second</td>
<td>500/second</td>
</tr>
<tr>
<td>Memory Setups</td>
<td>125/second</td>
<td>450/second</td>
</tr>
</tbody>
</table>

TRIGGER EXECUTION TIME (maximum time from activation of Trigger Source to start of switch open or close):
<table>
<thead>
<tr>
<th>Source</th>
<th>Latency</th>
<th>Jitter</th>
</tr>
</thead>
<tbody>
<tr>
<td>GET</td>
<td>200 µs</td>
<td>~50 µs</td>
</tr>
<tr>
<td>*TRG</td>
<td>5.0 ms</td>
<td></td>
</tr>
<tr>
<td>Trigger Link</td>
<td>200 µs</td>
<td>~13 µs</td>
</tr>
<tr>
<td>External</td>
<td>200 µs</td>
<td>~13 µs</td>
</tr>
</tbody>
</table>

NOTES
1. Rates include switch settling time of cards. 3ms for 7011 and 500µs for 7015 cards.
2. Excluding switch settling time.
3. Assuming no IEEE-488 commands are pending execution.

Analog Backplane
 SIGNALS: Four 3-pole rows (Hi, Lo, Guard). These signals provide matrix and multiplexer expansion between cards within one mainframe.
MAXIMUM VOLTAGE: 250V DC, 250V rms, 350V AC peak, signal path to signal path or signal path to chassis.
MAXIMUM CURRENT: 1A peak.
PATH ISOLATION:
- >10¹⁰ W, <50pF path to path (any Hi, Lo, Guard to another Hi, Lo, Guard).
- >10¹⁰ W, <50pF differential (Hi to Lo or Hi, Lo to Guard).
- >10⁹ W, <75pF path to chassis.
CHANNEL Crosstalk: <–65dB @ 1MHz (50Ω load).
BANDWIDTH: <3dB loss at 100MHz (50Ω load).

IEEE-488 BUS IMPLEMENTATION
MULTILINE COMMANDS: DCL, LLO, SDC, GET, GTL, UNT, UNL, SFE, SPD.
UNILINE COMMANDS: IFC, REN, EOI, SRQ, ATN.
INTERFACE FUNCTIONS: SH1, AH1, T5, TE0, L4, LE0, SR1, RL1, PPO, DCF, DT1, CO, EI.

IEEE-488 Command Execution Time
<table>
<thead>
<tr>
<th>Command</th>
<th>Execution Time¹</th>
<th>Display Off</th>
<th>Display On</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPEN (@ TI)</td>
<td>7.5 ms</td>
<td>8.5 ms</td>
<td></td>
</tr>
<tr>
<td>CLOSE (@ TI)</td>
<td>7.5 ms</td>
<td>8.5 ms</td>
<td></td>
</tr>
<tr>
<td>MEM REC M1</td>
<td>5.0 ms</td>
<td>6.0 ms</td>
<td></td>
</tr>
</tbody>
</table>

NOTES
1. Measured from the time at which the command terminator is taken from the bus to the time at which the relay begins to open or close.

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www.keithley.com

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Model 7001 specifications
**Switch/Control Mainframe**

400-channel

The Model 7002 Switch System is a 10-slot mainframe that supports up to 400 2-pole multiplexer channels or 400 matrix crosspoints. The front panel includes a unique interactive display of channel status for quick programming. Scanning speeds of up to 300 channels per second are possible with the high density switch cards. The wide selection of more than 30 different switch cards makes the 7002 one of the most flexible switching mainframes available.

**Reduce the Size and Cost of Your Switching Application.**

Up to 400 channels of 2-pole switching. A single Model 7002 mainframe can accommodate up to ten 40-channel cards. That's 400 channels in a single full-rack package that is only 178mm high (7 in). This level of density provides some important advantages. First, it reduces the amount of switching hardware required for a given application. Second, it provides high flexibility. The high density cards can be used with the special signal cards to cover all your signal needs for a large application with one mainframe.

Switch a wide range of signals. The 7002 is fully compatible with all 7001 switch cards. From this broad selection of 17 cards, you can assemble a switch configuration that will ensure signal integrity and minimize errors. These cards allow the 7002 to switch DC signals from femtoamps to amps, nanovolts to kilovolts, as well as RF and optical signals.

Analog backplane. The analog backplane used by the high density cards adds configuration flexibility and eliminates intercard wiring. For example, the outputs of a multiplexer card can be connected to the row inputs of a matrix card. Or, the outputs of ten multiplexer cards can be connected to form one large 1×400 multiplexer. Intercard wiring is eliminated by using the analog backplane to form these configurations.

**Faster Test Development**

Unique channel status display. The interactive front panel display helps shorten the time required to configure the 7002 and develop test software. The display indicates the open/close status of each channel in the mainframe. This information is very useful when programming the 7002 and developing application software. Knowing the channel status also helps to verify proper operation during the debug phase.

Light pen programming. An optional light pen provides point and click programming from the front panel. By selecting the desired channels or range of channels, the scan list can be built, matrix patterns created, channels opened or closed, and patterns stored in memory. The 7002's non-volatile memory stores up to 500 complete switch patterns.

Automatic card configuration. When the high density cards are installed, the 7002 automatically configures each slot independently for the proper card. The channel status display on the front panel adjusts to show each card’s capacity and configuration.

Front panel Info key. At the touch of a button, the operator receives context-sensitive, on-line information to help configure the system. This information is displayed on a 52-character alphanumeric display for clear and readable messages. There is no need to refer constantly to the operator’s manual. All information messages, operating instructions, and prompts are available in English, German, and French. Just select the desired language in the configuration menu.

Programmable channel closure restrictions. The 7002 allows specific channels to be locked out from closure. This restriction can be conditional based on the open/close state of other channels or crosspoints. This capability is useful to prevent certain signals from being accidentally connected to high power circuits, for example.

**ACCESSORIES AVAILABLE**

<table>
<thead>
<tr>
<th>COMMUNICATION INTERFACES AND CABLES</th>
<th>RACK MOUNT KITS</th>
<th>TRIGGERING</th>
</tr>
</thead>
<tbody>
<tr>
<td>7007-1 Double Shielded, Premium GPIB Cable, 1m</td>
<td>7002-RMK-1 Fixed Rack Mount Kit</td>
<td>8501-1 Trigger Link Cable, DIN-to-DIN, 1m</td>
</tr>
<tr>
<td>7007-2 Double Shielded, Premium GPIB Cable, 2m</td>
<td>7002-RMK-2 Slide Rack Mount Kit</td>
<td>8501-2 Trigger Link Cable, DIN-to-DIN, 2m</td>
</tr>
<tr>
<td>7078-PEN Programming Light Pen (includes holder)</td>
<td>8503 Trigger Link Cable, DIN-to-dual BNC, 1m</td>
<td></td>
</tr>
<tr>
<td>KPCI-488LPA IEEE-488 Interface/Controller for the PCI Bus</td>
<td>8505 Male to 2 Female V-DIN Cable for Trigger Link</td>
<td></td>
</tr>
<tr>
<td>KUSB-488B IEEE-488 USB-to-GPIB Interface Adapter</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SERVICES AVAILABLE**

| 7002-3Y-EW 1-year factory warranty extended to 3 years from date of shipment |

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[www.keithley.com](http://www.keithley.com)
**7002**

**Switch/Control Mainframe**

400-channel

---

### System Throughput

300 channel per second scanning. The 7002 can scan through up to 300 channels per second. This scan process can be controlled by the internal time base of the 7002 or through external triggers. The scan sequence is controlled by what appears in the scan list. The scan list can include channels, ranges of channels, and memory locations. This approach gives maximum flexibility while obtaining maximum throughput.

### Built-in Scan Control and Trigger Link

The built-in scan control eliminates the need for the computer to control every step of the test procedure. Simply program the 7002 to control the channel spacing, scan spacing, and number of scans. Trigger Link gives you access to six independent hardware trigger lines on a single cable.

---

**THROUGHPUT**

EXECUTION SPEED OF SCAN LIST (channels or memory locations per second):

<table>
<thead>
<tr>
<th>Channels</th>
<th>Memories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Break-Before-Make</td>
<td>OFF 300</td>
</tr>
<tr>
<td>ON 270</td>
<td>189</td>
</tr>
</tbody>
</table>

**TRIGGER EXECUTION TIME** (maximum time from activation of Trigger Source to start of switch open or close):

<table>
<thead>
<tr>
<th>Source</th>
<th>Latency</th>
<th>Jitter</th>
</tr>
</thead>
<tbody>
<tr>
<td>GET1</td>
<td>200 µs</td>
<td>&lt;15 µs</td>
</tr>
<tr>
<td>*TRG2, 3</td>
<td>3.0 ms</td>
<td></td>
</tr>
<tr>
<td>Trigger Link</td>
<td>200 µs</td>
<td>&lt;10 µs</td>
</tr>
<tr>
<td>External</td>
<td>200 µs</td>
<td>&lt;10 µs</td>
</tr>
<tr>
<td>Timer</td>
<td>250 µs</td>
<td></td>
</tr>
</tbody>
</table>

### IEEE-488 COMMAND EXECUTION TIME

<table>
<thead>
<tr>
<th>Command</th>
<th>Execution Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLGS (@1/1)</td>
<td>&lt;8 ms + Relay Settle Time</td>
</tr>
<tr>
<td>OPEN (@1/1)</td>
<td>&lt;8 ms + Relay Settle Time</td>
</tr>
<tr>
<td>MEM REC M1</td>
<td>&lt;9 ms + 2c Relay Settle Time (BBM ON)</td>
</tr>
<tr>
<td></td>
<td>&lt;9 ms + Relay Settle Time (BBM OFF)</td>
</tr>
</tbody>
</table>

**NOTES**

1. Excluding switch settling time.
2. Assuming no IEEE-488 commands are pending execution.
3. Display off.

---

### GENERAL

**DISPLAY**:

**LIGHT PEN OPTION**:
Provides interactive programming of channels, cross points, scan lists, and memory.

**REAR PANEL CONNECTORS**:
IEEE-488, 9-pin DB9 Female; 8-pin micro DIN for Trigger Link; 8-pin micro DIN for Trigger Link expansion; BNC for External Trigger; BNC for Channel Ready

**POWER**:
100V to 240Vrms, 50/60Hz, 110VA maximum.

**EMC**:

**SAFETY**:

**EMI/RFI**:

**ENVIRONMENT**:
Operating: 0°C to 50°C, <80% RH (0°C to 35°C); Storage: −25°C to +65°C.

**DIMENSIONS**:
488mm deep (19 in), 448mm wide (17⅛ in) × 114mm thick (4⅝ in).

**WEIGHT**:
9.1kg (20 lb).

---

**STANDARDS**

CONFORMANCE:

**MULTILINE COMMANDS**:
DC1, LLO, SDC, GET, GTL, UNT, UNL, SPE, SFD.

**UNILINE COMMANDS**:
IFC, BEN, EOI, SQR, ATN.

**INTERFACE FUNCTIONS**:
SH1, AH1, TH, TE1, TL1, LE1, SRI, RL1, PPI, DC1, DT1, C0, E1.

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201
## Selector Guide

Switch Cards for 7001, 7002

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>HIGH DENSITY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7011-C</td>
<td>40</td>
<td>Multiplexer</td>
<td>2 form A</td>
<td>110V</td>
<td>1A</td>
<td>60VA</td>
<td>&lt;1µV</td>
<td>&lt;100pA</td>
<td>2MHz</td>
<td>Connector</td>
<td>Yes</td>
</tr>
<tr>
<td>7011-S</td>
<td>40</td>
<td>Multiplexer</td>
<td>2 form A</td>
<td>110V</td>
<td>1A</td>
<td>60VA</td>
<td>&lt;500nV</td>
<td>&lt;100pA</td>
<td>2MHz</td>
<td>Screw term.</td>
<td>Yes</td>
</tr>
<tr>
<td>7012-C</td>
<td>4×10</td>
<td>Matrix</td>
<td>2 form A</td>
<td>110V</td>
<td>1A</td>
<td>60VA</td>
<td>&lt;1µV</td>
<td>&lt;100pA</td>
<td>2MHz</td>
<td>Connector</td>
<td>Yes</td>
</tr>
<tr>
<td>7012-S</td>
<td>4×10</td>
<td>Matrix</td>
<td>2 form A</td>
<td>110V</td>
<td>1A</td>
<td>60VA</td>
<td>&lt;500nV</td>
<td>&lt;100pA</td>
<td>2MHz</td>
<td>Screw term.</td>
<td>Yes</td>
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<tr>
<td>7013-C</td>
<td>20</td>
<td>Isolated Switch</td>
<td>2 form A</td>
<td>110V</td>
<td>1A</td>
<td>60VA</td>
<td>&lt;1µV</td>
<td>&lt;100pA</td>
<td>10MHz</td>
<td>Connector</td>
<td>Yes</td>
</tr>
<tr>
<td>7013-S</td>
<td>20</td>
<td>Isolated Switch</td>
<td>2 form A</td>
<td>110V</td>
<td>1A</td>
<td>60VA</td>
<td>&lt;500nV</td>
<td>&lt;100pA</td>
<td>10MHz</td>
<td>Screw term.</td>
<td>Yes</td>
</tr>
<tr>
<td>7015-C</td>
<td>40</td>
<td>Multiplexer</td>
<td>2 form A</td>
<td>175V</td>
<td>3.4mA</td>
<td>0.3VA</td>
<td>&lt;5µV</td>
<td>&lt;1nA</td>
<td>500kHz</td>
<td>Connector</td>
<td>Yes</td>
</tr>
<tr>
<td>7015-S</td>
<td>40</td>
<td>Multiplexer</td>
<td>2 form A</td>
<td>175V</td>
<td>3.4mA</td>
<td>0.3VA</td>
<td>&lt;5µV</td>
<td>&lt;1nA</td>
<td>500kHz</td>
<td>Screw term.</td>
<td>Yes</td>
</tr>
<tr>
<td>7018-C</td>
<td>28</td>
<td>Multiplexer</td>
<td>3 form A</td>
<td>110V</td>
<td>1A</td>
<td>60VA</td>
<td>&lt;5µV</td>
<td>&lt;100pA</td>
<td>2MHz</td>
<td>Connector</td>
<td>Yes</td>
</tr>
<tr>
<td>7018-S</td>
<td>28</td>
<td>Multiplexer</td>
<td>3 form A</td>
<td>110V</td>
<td>1A</td>
<td>60VA</td>
<td>&lt;5µV</td>
<td>&lt;100pA</td>
<td>2MHz</td>
<td>Screw term.</td>
<td>Yes</td>
</tr>
<tr>
<td>7035</td>
<td>36</td>
<td>Multiplexer</td>
<td>2 form A</td>
<td>60V</td>
<td>1A</td>
<td>50VA</td>
<td>&lt;1µA</td>
<td>&lt;100pA</td>
<td>10MHz</td>
<td>Connector</td>
<td>Yes</td>
</tr>
<tr>
<td>7056</td>
<td>40</td>
<td>Isolated Switch</td>
<td>1 form A</td>
<td>60V</td>
<td>1A</td>
<td>30VA</td>
<td>&lt;4µV</td>
<td>&lt;100pA</td>
<td>10MHz</td>
<td>Connector</td>
<td>Yes</td>
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<tr>
<td>7111-S</td>
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<td>Multiplexer</td>
<td>1 form C</td>
<td>110V</td>
<td>1A</td>
<td>60VA</td>
<td>&lt;500nV</td>
<td>&lt;100pA</td>
<td>2MHz</td>
<td>Screw term.</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Control</strong></td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>7020</td>
<td>80</td>
<td>Digital I/O</td>
<td>Connector</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>40 inputs/40 outputs</td>
</tr>
<tr>
<td>7020-D+</td>
<td>80</td>
<td>Digital I/O</td>
<td>Connector</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td>40 inputs/40 outputs</td>
</tr>
<tr>
<td>7037-D+</td>
<td>30/20</td>
<td>Isolated/Digital I/O</td>
<td>1 form A</td>
<td>110V</td>
<td>1A</td>
<td>50VA</td>
<td>&lt;4µV</td>
<td>&lt;100pA</td>
<td>10MHz</td>
<td>Connector</td>
<td>Yes</td>
</tr>
<tr>
<td>7065</td>
<td></td>
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<td></td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>Hall Effect measurement buffer card</td>
</tr>
<tr>
<td><strong>HIGH CURRENT</strong></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>7053</td>
<td>10</td>
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# Selector Guide

## Switch Card Accessories

### 7001, 7002, 705, 706 Switch Card Accessories

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A Greater Measure of Confidence

A Tektronix Company
40-channel Multiplexer Cards
Quad 1×10 Multiplexer Configuration

The Model 7011 40-channel multiplexer has four independent banks of 1×10 switching. Each channel is 2-pole. These four banks can be combined for a wide variety of switching configurations—for example, dual 1×20, or 1×30 and 1×30, or one large 1×40. The 7001 mainframe can automatically configure the 7011 to switch 4-pole signals by combining channel pairs. This gives you a dual 1×10 4-pole multiplexer or a single 1×20 4-pole multiplexer.

Each of the four multiplexer outputs on this card connects to the 7001/7002 analog backplane through removable jumpers for even greater flexibility. Two 7011 cards can be used to make a single 1×80 multiplexer with all intercard connections through the backplane. The 7011 multiplexer outputs can also be connected to the rows of the 7012 via the backplane for row expansion.

The Model 7111-S is a form C version of the 7111-S. The 7111-S is a low-voltage, quad 1×10, single-pole form C multiplexer card. The 7111-S assembly consists of a screw terminal connector card and a relay card. External test circuits are wired directly to the screw terminals of the connector card.

These cards automatically configure the 7001 or 7002 mainframe. Two connection options are available, screw terminal for maximum flexibility or a single 96-pin quick disconnect connector.

MULTIPLEX CONFIGURATION: Four independent 1×10 2-pole multiplexer banks or two independent 1×10 4-pole multiplexer banks. Adjacent banks can be connected together. Jumpers can be removed to isolate any bank from the backplane.

CONTACT CONFIGURATION: 2-pole Form A (Hi, Lo) (1-pole form C for 7111-S).

CONNECTOR TYPE:
7011-C: 96-pin male DIN connector.
7011-S and 7111-S: Screw terminal. #16AWG maximum wire size, with 0.092 inch O.D. 28 conductors per card maximum.
#22AWG typical wire size with 0.062 inch O.D. 88 conductors per card maximum.

MAXIMUM SIGNAL LEVEL:
DC Signals: 110V DC between any two pins, 1A switched, 50VA (resistive load). AC Signals: 125V rms and 175V peak, between any two pins, 1A switched, 60VA (resistive load).

COMMON MODE VOLTAGE: 175V peak, any pin to chassis.

CONTACT LIFE: Cold Switching: 10^8 closures. At Maximum Signal Levels: 10^7 closures.

CHANNEL RESISTANCE (per conductor): <1Ω

CONTACT POTENTIAL: 7011-C: <1µV per channel contact pair. 7011-S, 7111-S: <2µV per contact pair. <5µV typical per single contact.

OFFSET CURRENT: <100µA

ACTUATION TIME: 5ms

ISOLATION:
Bank: >10^10, <25pF
Channel to Channel: >10^9, <50pF
Differential: Configured as 1×10: >10^9, <100pF Configured as 1×40: >10^9, <200pF
Common Mode: Configured as 1×10: >10^9, <100pF Configured as 1×40: >10^9, <200pF
CROSSTALK (1MHz, 50Ω Load): Bank: <–40dB. Channel: <–40dB.

INSERTION LOSS (50Ω Source, 50Ω Load): <1dB below 1MHz, <3dB below 2MHz.

RELAY DRIVE CURRENT (per relay): 7011-C, -S: 16mA 7111-S: 28mA

A Greater Measure of Confidence
204
4×10 Matrix Cards

The 7012 provides 4 rows by 10 columns of 2-pole matrix switching. The four rows of this card can be connected to the analog backplane within the 7001 or 7002 to make a larger matrix (4×20) or use it with the 7011 multiplexer card for greater flexibility through row expansion. Each row is connected to the backplane with its own jumpers that can be removed to isolate an individual row from the backplane.

**MATRIX CONFIGURATION:** 4 rows by 10 columns. Jumpers can be removed to isolate any row from the backplane.

**CONTACT CONFIGURATION:** 2-pole Form A (Hi, Lo).

**CONNECTOR TYPE:**
- 7012-C: 96-pin male DIN connector
- 7012-S: Screw terminal, #16AWG maximum wire size, with .092 inch O.D. 28 conductors per card maximum. #22AWG typical wire size with .062 inch O.D. 88 conductors per card maximum.

**MAXIMUM SIGNAL LEVEL:**
- DC Signals: 110V DC between any two pins, 1A switched. 30VA (resistive load).
- AC Signals: 125V rms and 175V AC peak, between any two pins, 1A switched, 60VA (resistive load).

**COMMON MODE VOLTAGE:** 175V peak, any pin to chassis.

**CONTACT LIFE:** Cold Switching: 106 closures. At Maximum Signal Levels: 106 closures.

**CHANNEL RESISTANCE (per conductor):** <1Ω.

**CONTACT POTENTIAL:**
- 7012-C: <1µV per channel contact pair
- 7012-S: <500nV per channel contact pair

**OFFSET CURRENT:** <100pA.

**ACTUATION TIME:** 3ms.

**ISOLATION:**
- Path: >1012, <50pF
- Differential: >1012, <200pF
- Common Mode: >1012, <400pF

**CROSSTALK (1MHz, 50Ω Load):** <–40dB.

**INSERTION LOSS (50Ω Source, 50Ω Load):** <0.1dB below 1MHz, <3dB below 2MHz.

**RELAY DRIVE CURRENT (per relay):** 16mA.

**EMC:** Conforms to European Union Directive 89/336/EEC.


**ENVIRONMENT:**
- Operating: 0° to 50°C, up to 35°C <80% RH. Storage: −25°C to 65°C.

---

**ACCESSORIES AVAILABLE**

**FOR 7012-C**
- 7011-KIT-R 96-pin Female Connector Kit
- 7011-MTC-1 96-pin Mass Terminated Cable, Female to Female, 1m
- 7011-MTC-2 96-pin Mass Terminated Cable, Female to Female, 2m

**FOR 7012-S**
- 7011-KIT-R 96-pin Female Connector Kit
- 7011-MTC-1 96-pin Mass Terminated Cable, Female to Female, 1m
- 7011-MTC-2 96-pin Mass Terminated Cable, Female to Female, 2m

**SERVICES AVAILABLE**

- 7012-C-3Y-EW 1-year factory warranty extended to 3 years from date of shipment
- 7012-S-3Y-EW 1-year factory warranty extended to 3 years from date of shipment

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KEITHLEY
A Tektronix Company
20-channel Isolated Switch Cards

This isolated switch card contains 20 independent channels that can be connected in a wide variety of configurations. Each channel is 2-pole. The isolated switch configuration provides the greatest flexibility because the switches can be connected as needed. Both sides of each 2-pole relay are available for connection.

RELAY SWITCH CONFIGURATION: 20 independent channels of 2-pole switching

CONTACT CONFIGURATION: 2-pole Form A (Hi, Lo).

CONNECTOR TYPE: 7013-C: 96-pin male DIN connector.
7013-S: Screw terminal, #16AWG maximum wire size, with 0.092 inch O.D. 28 conductors per card maximum. #22AWG typical wire size with 0.062 inch O.D. 88 conductors per card maximum.

MAXIMUM SIGNAL LEVEL: DC Signals: 110V DC between any two pins, 1A switched: 30V (resistive load).
AC Signals: 125V rms and 175V AC peak, between any two pins, 1A switched: 60V (resistive load).

COMMON MODE VOLTAGE: 175V peak, any pin to chassis.

CONTACT LIFE: Cold Switching: 10^9 closures.
At Maximum Signal Levels: 10^8 closures.

CHANNEL RESISTANCE (per conductor): <1 W.
OFFSET CURRENT: <5µA per single contact.
CONTACT POTENTIAL: 7013-C: <2µV per channel contact pair (Hi, Lo). <5µV per single contact.
7013-S: <2µV per contact pair (Hi, Lo). <5µV per single contact.
ACTUATION TIME: 3ms.

ISOLATION: Channel to Channel: >10^9Ω, <25pF.
Differential: >10^9Ω, <50pF.
Common Mode: >10^9Ω, <100pF.

CROSSTALK (1MHz, 50Ω Load): <50nV.

INSERTION LOSS (50Ω Source, 50Ω Load): <0.1dB below 1MHz, <3dB below 10MHz.

RELAY DRIVE CURRENT (per relay): 16mA.

EMC: Conforms to European Union Directive 89/336/EEC.


ENVIRONMENT: Operating: 0°C to 50°C, up to 35°C <80% RH.
Storage: –25°C to 65°C.

ACCESSORIES AVAILABLE

FOR 7013-C
7011-KIT-R 96-pin Female Connector Kit
7011-MTC-1 96-pin Mass Terminated Cable, Female to Female, 1m
7011-MTC-2 96-pin Mass Terminated Cable, Female to Female, 2m

FOR 7013-S
7013-ST Extra Screw Terminal Connector Board

40-channel Solid State Multiplexer Cards

Quad 1×10 Configuration

The Model 7015 40-channel solid state multiplexer is designed for multipoint measurement applications that require high reliability and increased scanning speeds. With an MTBF of more than 30,000 hours, the 7015 can handle applications that require continuous use over longer periods of time. The solid state switch technology also provides fast switching times for scanning rates of over 300 channels/measurements per second when used with the 7002/2001 or 7001/2001 combination.

MULTIPLEX CONFIGURATION: 4 independent 1×10 2-pole multiplexer banks or 2 independent 1×10 4-pole multiplexer banks. Adjacent banks can be connected together. Jumpers can be removed to isolate any bank from the backplane.

CONTACT CONFIGURATION: 2-pole Form A (Hi, Lo).

CONNECTOR TYPE: 7015-C: 96-pin male DIN connector.
7015-S: Screw terminal, #16AWG maximum wire size, with 0.092 inch O.D. 28 conductors per card maximum. #22AWG typical wire size with 0.062 inch O.D. 88 conductors per card maximum.

MAXIMUM SIGNAL LEVEL: 175V peak between any two pins, 1A switched: 0.9A maximum, 1×100V max.
COMMON MODE VOLTAGE: 175V peak, any pin to chassis.
CONTACT TYPE: Solid state switch.
CHANNEL RESISTANCE (per conductor): <210Ω.

CONTACT POTENTIAL: 7015-C: <5µV per channel contact pair.
7015-S: <4µV per channel contact pair.
OFFSET CURRENT: <1nA.
ACTUATION TIME: <50µs.

ISOLATION: Bank: >10^9Ω, <25 pF.
Channel to Channel: >10^9Ω, <50 pF.
Differential: Configured as 1×10 >10^9Ω, <100pF.
Configured as 1×40 >10^9Ω, <200pF.
Common Mode: Configured as 1×40 >10^9Ω, <57pF.
Configured as 1×10 >10^9Ω, <110pF.

INSERTION LOSS (50Ω Source, 1MΩ Load): <0.1dB below 250kHz, <3dB below 500kHz.

ACCESSORIES AVAILABLE

FOR 7015-C
7011-KIT-R 96-pin Female Connector Kit
7011-MTC-1 96-pin Mass Terminated Cable, Female to Female, 1m
7011-MTC-2 96-pin Mass Terminated Cable, Female to Female, 2m

SERVICES AVAILABLE

7015-C-3Y-EW 1-year factory warranty extended to 3 years from date of shipment
7015-S-3Y-EW 1-year factory warranty extended to 3 years from date of shipment
28-channel 3-Pole Multiplexer

The Model 7018 28-channel multiplexer has two independent banks of 1×14 switching. Each channel is 3-pole. The two banks can be combined for a variety of different switching configurations. Used separately, they provide a dual 1×14 3-pole configuration. Onboard jumpers can connect the outputs together for a single 1×28 3-pole arrangement. Both the 7001 and 7002 switch systems can use the two banks in parallel for 6-pole operation in a 1×14 configuration.

MUTIPEX CONFIGURATION: 2 independent 1×14 3-pole multiplexer banks or one 1×14 6-pole multiplexer. Jumpers can be removed to isolate any bank from the backplane.

CONTACT CONFIGURATION: 3-pole Form A.

CONNECTOR TYPE: 7018-C: 90-pin male DIN connector.

7018-8: Screw terminal, #16 AWG maximum wire size, with 0.092 inch O.D. 28 conductors per card maximum. #22 AWG typical wire size with 0.062 inch O.D. 90 conductors per card maximum.

MAXIMUM SIGNAL LEVEL: DC Signals: 110 V DC between any two pins, 1A switched, 50 V (resistive load).

AC Signals: 125 V rms or 175 V AC peak, between any two pins, 1A switched, 60 V (resistive load).

COMMON MODE VOLTAGE: 175 V peak, any pin to chassis.

CONTACT LIFE: Cold Switching: 10^6 closures.

At Maximum Signal Levels: 10^6 closures.

CHANNEL RESISTANCE (per conductor): <1 Ω.

CONTACT POTENTIAL: <5 μV per single contact.

OFFSET CURRENT: <100 μA.

ACTUATION TIME: 3 ms.

CROSS TALK (1 MHz, 50 Ω Load): Bank: < – 40 dB.

Channel: < – 40 dB.

ISOLATION: Bank: > 10^9 Ω, < 25 pF.

Channel to Channel: > 10^9 Ω, < 50 pF.

DIFFERENTIAL: Configured as 1×14 > 10^9 Ω, < 100 pF.

Common Mode: Configured as 1×14 > 10^9 Ω, < 400 pF.

Configured as 1×28 > 10^9 Ω, < 650 pF.

INSERTION LOSS: 7018-S: 10 MHz, 50 Ω Load: < 0.2 dB below 10 MHz, < 5 dB below 2 MHz.

RELAY DRIVE CURRENT (per channel): 59 mA. (Maximum of 11 channels on at same time.)

EMC: Conforms to European Union Directive 89/336/EEC.


ACCESSORIES AVAILABLE

FOR 7018-C

7011-KIT-R 96-pin Female Connector Kit

7011-MTC-1 96-pin Mass Terminated Cable, Female to Female, 1 m

7011-MTC-2 96-pin Mass Terminated Cable, Female to Female, 2 m

FOR 7018-S

7018-ST Extra Screw Terminal Connection Board

SERVICES AVAILABLE

7018-C-3Y-EW 1-year factory warranty extended to 3 years from date of shipment

7018-S-3Y-EW 1-year factory warranty extended to 3 years from date of shipment

10MHz 1×4 Multiplexer Card

9 Independent 1×4 2-Pole Multiplexers

The Model 7035 9-Bank Multiplexer Card has nine 1×4 multiplexers. The switch contact configuration for each channel is 2-pole form A. The card’s nine banks can be combined for a wide variety of switching configurations using external connections. This flexibility makes the Model 7035 well-suited for production testing of a variety of telecommunications products and systems and low power portable devices.

MUTIPEX CONFIGURATION: 9 independent 1×4 2-pole multiplexer banks.

CONTACT CONFIGURATION: 2-pole Form A (Hi, Lo).

CONNECTOR TYPE: 90-pin male DIN connector.

96-pin male DIN connector (7011-KIT-R mating connector included).

MAXIMUM SIGNAL LEVEL: 60 V DC, 30 V rms, 42 V peak between any two inputs or chassis, 1A switched, 30 V (resistive load).

CONTACT LIFE: Cold Switching: 10^6 closures.

At Maximum Signal Levels: 10^6 closures.

CHANNEL RESISTANCE (per conductor): <1 Ω.

CONTACT POTENTIAL: <5 μV per single contact pair.

OFFSET CURRENT: <100 μA.

ACTUATION TIME: 3 ms.

CROSS TALK (1 MHz, 50 Ω Load): Bank: < – 40 dB.

Channel: < – 40 dB.

ISOLATION: Bank: > 10^9 Ω, < 25 pF.

Channel to Channel: > 10^9 Ω, < 50 pF.

DIFFERENTIAL: Configured as 1×4 > 10^9 Ω, < 100 pF.

Common Mode: > 10^9 Ω, < 200 pF.

CROSSTALK (1 MHz, 50 Ω Load): Bank: < – 40 dB.

Channel: < – 40 dB.

INSERTION LOSS: 7012 Source, 50 Ω Load: < 0.25 dB below 1 MHz, < 5 dB below 10 MHz.

RELAY DRIVE CURRENT (per relay): 16 mA.

ACCESSORIES AVAILABLE

7011-KIT-R 96-pin Female Connector Kit

SERVICES AVAILABLE

7035-3Y-EW 1-year factory warranty extended to 3 years from date of shipment

Great fit for low frequency telecom test

Ordering Information

7018-C Quad 1×10 Multiplexer with 96-pin Mass Terminated Connector Board

7018-S Dual 1×14 Multiplexer with Screw Terminal Connector Board

7035 9 Bank 1×4 Multiplexer Switching Card

Accessories Supplied

7011-KIT-R 96-pin Female Connector Kit

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Digital I/O Cards
40 Inputs, 40 Outputs

The Model 7020 and 7020-D Digital I/O Interface Cards provide high-density digital input/output capabilities in an easy-to-control form. The 7020 and 7020-D both have 40 independent inputs and 40 independent outputs, so they’re well-suited for monitoring and controlling large automated test applications compactly and cost-effectively. The 7020 provides a 96-pin mass terminated connector. The 7020-D has two heavy duty 50-pin D-sub connectors at the ends of short cables. The D-sub connector version is designed for industrial/production applications where repeated connects/disconnects with external cables are required.

80-bit control – 40 in/40 out
• Input and output protection
• Use internal 5.3V power supply or external power supply

**Ordering Information**

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**Accessories Supplied**

With 7020: 7011-KIT-R 96-pin Female Connector Kit

**Output Channel**

Input Channel

**ACCESSORIES AVAILABLE**

FOR 7020

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<td>7020-D-3Y-EW</td>
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**CONNECTOR:**

7020: 96-pin male DIN connector
7020-D: Cables with 50-pin male and female D-sub connectors
7020-DT: Mass terminated card with D-sub connectors.

**DIGITAL I/O CAPABILITY:** 40 independent inputs, 40 independent outputs.

**OUTPUT SPECIFICATIONS:**

**CONFIGURATION:** 40 open-collector drivers with factory installed 10kΩ pull-up resistors. Pull-up resistors can be removed when driving external pull-up devices. Each driver has an internal flyback diode.

**PULL UP VOLTAGE:** 5.3V internally supplied, external connection provided for user-supplied voltage 25V max. Removal of internal jumper allows use of two different pull-up voltages.

**MAXIMUM SINK CURRENT:** Per Channel: 65mA Per Bank (8 bits): 500mA Per Card: 1A

**CURRENT LIMIT:** Positive Temperature Coefficient circuit protector in series with each output. Output protection resistance <1Ω.

**COLLECTOR-EMITTER SATURATION VOLTAGE:** <0.75V @ 1mA. <1V @ 65mA.

**INPUT SPECIFICATIONS:**

**CONFIGURATION:** 40 inputs with internal 10kΩ pull-up resistors.

**CHARACTERISTICS:**

- Input logic low voltage: 0.8 V max.
- Input logic high voltage: 2 V min.
- Input logic low current: –600 µA max. @ 0V
- Input logic high current: 50 µA max. @ 5V

**MAXIMUM VOLTAGE LEVEL:** 42V peak.
The Model 7036 and 7037-D single-pole relay switching cards are well-suited for configuring automated test systems for portable devices. The Model 7036 offers 40 independent channels of 1-pole Form A switching, while the Model 7037-D provides 30 channels, plus ten independent digital inputs and ten independent digital outputs for control applications. The 7036 provides a 96-pin mass terminated connector. The 7037-D has two heavy duty 50-pin D-sub connectors at the ends of short cables. The D-sub connector version is designed for industrial/production applications where repeated connects/disconnects with external cables are required. The 7037-DT is an extra connector board for the 7037-D card that can be used to upgrade a standard 7037-D to a mass terminated connector.

**MODEL 7036 SPECIFICATIONS**

**RELAY SWITCH SPECIFICATIONS**

RELAY SWITCH CONFIGURATION: 40 independent channels of 1-pole switching.

CONTACT CONFIGURATION: 1 pole Form A.

CONNECTOR TYPE: 96-pin male DIN card connector.

MAXIMUM SIGNAL LEVEL: 60V DC, 50V rms, 42V peak between any two inputs or chassis. 1A switched, 30VA (resistive load).

CONTACT LIFE: Cold Switching: 10^8 closures.

At Maximum Signal Levels: 10^7 closures.

CHANNEL RESISTANCE (per conductor): <1Ω.

CONTACT POTENTIAL: <4µV per contact.

OFFSET CURRENT: <100pA.

ACTUATION TIME: 3ms.

ISOLATION: Channel to Channel: >10^12, <25pF.

Common Mode: >10^12, <100pF.

CROSSTALK (1MHz, 50Ω Load): <0dB.

INSERTION LOSS (50Ω Source, 50Ω Load): <0.3dB below 1MHz, <3dB below 110MHz.

RELAY DRIVE CURRENT (per relay): 16mA.

**MODEL 7037-D SPECIFICATIONS**

**RELAY SWITCH SPECIFICATIONS**

RELAY SWITCH CONFIGURATION: 30 independent channels of 1-pole switching.

CONTACT CONFIGURATION: 1 pole Form A.

CONNECTOR TYPE: Cables with 50-pin male and female D-sub connectors.

MAXIMUM SIGNAL LEVEL: 110V DC, 110V rms, 155V peak between any two inputs or chassis. 1A switched, 30VA (resistive load).

CONTACT LIFE: Cold Switching: 10^8 closures.

At Maximum Signal Levels: 10^7 closures.

CHANNEL RESISTANCE (per conductor): <1Ω.

CONTACT POTENTIAL: <4µV per contact.

OFFSET CURRENT: <100pA.

ACTUATION TIME: 3ms.

ISOLATION: Channel to Channel: >10^12, <25pF.

Common Mode: >10^12, <100pF.

CROSSTALK (1MHz, 50Ω Load): <0dB.

INSERTION LOSS (50Ω Source, 50Ω Load): <0.3dB below 1MHz, <3dB below 100MHz.

RELAY DRIVE CURRENT (per relay): 16mA.

**DIGITAL I/O SPECIFICATIONS**

DIGITAL I/O CAPABILITY: 10 independent inputs. 10 independent outputs.

**ACCESSORIES AVAILABLE**

7011-KIT-R 96-pin Female Connector Kit (included).

7036-MTC-2 Mass Terminated Cable Assembly

**SERVICES AVAILABLE**

7036-3Y-EW 1-year factory warranty extended to 3 years from date of shipment.

7037-D-3Y-EW 1-year factory warranty extended to 3 years from date of shipment.

**SERVICES AVAILABLE**

7036-3Y-EW 1-year factory warranty extended to 3 years from date of shipment.

7037-D-3Y-EW 1-year factory warranty extended to 3 years from date of shipment.

**DIGITAL I/O SPECIFICATIONS**

10 inputs with internal 10kΩ pull-up resistors provided. Input resistors can be set for pull-up or pull-down configuration.

**MAXIMUM VOLTAGE LEVEL:** +42V peak.

**LOGIC:** Positive true.
High Current Scanner Card
10-channel, 2-Pole

The Model 7053 has ten channels and features 5A contacts. The switching is designed to maintain current paths for signals not connected to the output or, when internal jumpers are removed, to provide high input resistance for making voltage measurements. Semiconductor testing, materials research, power supply testing, solar cell measurements, electrochemical applications, and IC testing are among the applications simplified with the Model 7053 High Current Scanner Card.

**Ordering Information**

| 7053 | 10-channel High Current Scanner with Screw Terminal Connections |

**4x5 Low Current Matrix Card**

The Model 7152 is an ideal solution for small to moderate-size matrix systems that require superior performance in DC isolation for measurements of semiconductor parameters and insulating properties of materials. Offset current is <1pA with path isolation >10^{11}Ω. Each matrix crosspoint is a two-pole relay with the ability to switch both signal and guard.

Interconnect, expansion of the matrix, and connection to instruments and devices are easily accomplished using two standard interconnect cable assemblies. The 7152-MTC cables are terminated at both ends with M-series connector blocks for quick expansion between cards and connection to 7152-MTR bulkhead receptacles. 7152-TRX cables are terminated at one end with M-series connectors and at the other end with 3-lug triaxial connector shells for direct connection to electrometers and SMU instruments.

**Ordering Information**

| 7152 | 4x5 Low Current Matrix Card |

**Accessories Available**

- Connector caps

**NEW ACCESSORIES AVAILABLE**

- Pre-Built Cables
  - 7152-MTC-2: Low Noise M-Series to M-Series Cable, 2 ft
  - 7152-MTC-10: Low Noise M-Series to M-Series Cable, 10 ft
  - 7152-TRX-10: Low Noise M-Series to Triax Cable, 10 ft

- M-Series Bulkhead Connectors
  - 7152-KIT: M-Series Plug for custom wiring

**Services Available**

- 7152-1Y-EW: 1-year factory warranty extended to 3 years from date of shipment

**Compatibility**

- Use with 7001 and 7002 switch mainframes

**Specifications**

- **Common Mode Voltage:** 500V peak
- **EMC:** Conforms to European Union Directive 89/336/EEC.
- **Safety:** Conforms to European Union Directive 73/23/EEC (meets EN61010-I/EC 1010).
Building blocks for an economical measurement system

The Model 7065 Hall Effect Card is intended for those who want to assemble their own economical Hall test systems. It also can form the foundation of a Hall Effect system. The sensitivity and capabilities of this card are unmatched by any other system or Hall Effect electronics package.

The Model 7065 is a signal conditioning card designed to buffer test signals from the Hall sample to the measurement instrumentation and to switch current from a source to the sample. When used with Keithley's Model 7001 scanner mainframe, the Model 7065 provides the switching capability to measure Hall voltages as low as 50nV and sample resistances in excess of 10^14Ω.

All the accessories needed to connect the sample holder, scanner, instruments, and controller are included, simplifying connections. The Model 7065 is connected directly to the sample, and all instruments are connected via the IEEE-488 bus to the controller. Examples of resistivity and Hall voltage measurement programs are included in the Model 7065 Instruction Manual.

The Model 7065 can be operated in either a low resistivity or a high resistivity mode. In the high resistivity mode, input impedance is greater than 100TΩ, input bias current is less than 150pA, and output resistance is less than 60Ω. Input voltage ranges in both operating modes is +8V to –8V.

If higher voltage is desired, Keithley recommends using a 6220/6514 system. Cabling and sample connections must be carefully designed to make full use of the Model 7065's capabilities. Refer to Keithley's Low Level Measurements handbook for guidance in designing these connections.

Accessories Supplied

ACCESSORIES SUPPLIED

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4801</td>
<td>Low Noise Input Cable</td>
</tr>
<tr>
<td>7078-TRX-10</td>
<td>3-slot Triax Cable (10 ft.)</td>
</tr>
<tr>
<td>672</td>
<td>2-slot Male to 3-Lug Female Triax Adapter</td>
</tr>
<tr>
<td>7025-10</td>
<td>Triaxial Input Cable (10 ft.) (4 supplied)</td>
</tr>
<tr>
<td>6172</td>
<td>2-slot Male to 3-Lug Female Triax Adapter</td>
</tr>
<tr>
<td>7078-TRX-10</td>
<td>3-slot Triax Cable (10 ft.)</td>
</tr>
<tr>
<td>4801</td>
<td>Low Noise Input Cable</td>
</tr>
</tbody>
</table>

Ordering Information

7065 Hall Effect Card
7001 Switch System

Low Resistivity Mode

INPUT VOLTAGE OPERATING RANGE: +8 to –8V.
INPUT IMPEDANCE: >100TΩ in parallel with <420pF.
INPUT BIAS CURRENT: <100pA.
INPUT VOLTAGE NOISE: <50nV p-p, 0.1 to 10Hz bandwidth.
OUTPUT RESISTANCE: <60Ω.

High Resistivity Mode

INPUT VOLTAGE OPERATING RANGE: +8 to –8V.
INPUT IMPEDANCE: >1012Ω in parallel with <5pF.
INPUT BIAS CURRENT: <150pA.
INPUT VOLTAGE NOISE: <500nV p-p, 0.1 to 10Hz bandwidth.
OUTPUT RESISTANCE: <60Ω.

Configuration

Input characteristics and output matrix configuration for van der Pauw or Hall bar measurements. Input characteristics selectable for either low resistivity or high resistivity samples.
7153

4x5 Low Current Matrix Card
High Voltage

The Model 7153 is designed to switch low level, high voltage, and high impedance signals for applications such as parametric tests on semiconductor devices. The 7153 allows signal levels up to 1300V while maintaining offset current of <1pA (typically 10fA) and path isolation >10^13. Each crosspoint is a 2-pole relay to switch both signal and guard. Interconnect between the matrix and instruments such as the Model 237 SMU is done with the 7153-TRX cable. This cable has an M-series connector for the matrix and five 3-slot male triax connectors at the opposite end. The cable will mate with the row or column connectors of the Model 7153.

MATRIX CONFIGURATION: 4 rows by 5 columns.
CROSSPOINT CONFIGURATION: 2-pole Form A (Signal and Guard).
CONNECTOR TYPE: Miniature coaxial, M-series plug.
RELAY DRIVE CURRENT: 40mA (per crosspoint).
MAXIMUM SIGNAL LEVEL: 1300V between any 2 signal pins or chassis; 200V between signal and Guard. 1A carry/0.5A switched.
CONTACT LIFE: >10^8 closures (cold switching); >5x10^5 (at maximum signal level).
PATH RESISTANCE: <1Ω per contact to rated life.
ACTUATION TIME: <2ms exclusive of mainframe.
ISOLATION: Path: >10^9Ω and <1pF, Differential: >10^8Ω and <100pF, Common Mode: >10^7Ω and <300pF.

Ordering Information
7153 4x5 High Voltage Low Current Matrix Card

7154

High Voltage Scanner Card
10-channel

The Model 7154 switches voltages to 1100V peak or currents to 0.5A. The current carry capacity of each relay contact is 1A. Two-pole relays switch both circuit High and Low for full floating measurements and each input line is fuse protected against current overload. A Guard input common to all channels is provided for shielding or as a Guard driven from a single instrument. Guards may be isolated by removing jumpers installed at each input. Multiple switched guard circuits can be achieved by removing the jumper and connecting circuit Guard to the Low input terminal.

CHANNELS PER CARD: 10
CONTACT CONFIGURATION: 2-pole Form A with user-selectable shield or driven Guard. Each pole is fused using #38AWG magnet wire.
CONNECTOR TYPE: Screw terminals, #16AWG maximum wire size.
RELAY DRIVE CURRENT: 57mA per relay typical.
MAXIMUM SIGNAL LEVEL: 1100V peak, 0.5A DC or rms switched, 1A DC or rms carry, 10Ω.
CONTACT LIFE: >10^8 closures (cold switching); >5x10^7 closures (at maximum signal level).
CONTACT RESISTANCE: <200mΩ initial, 2Ω to rated life.
CROSSTALK: <–50dB at 1MHz, 50Ω load.
INSERTION LOSS: 0.1dB typical (1MHz, 50Ω source; 50Ω load).
3dB BANDWIDTH: 60MHz typical (50Ω load).
OFFSET CURRENT: <1pA (100Ω typical).
CONTACT POTENTIAL: <50μV typical.

ACCESSORIES AVAILABLE
7153-TRX Low Noise M-Series to Triax Cable, 5 ft.

SERVICES AVAILABLE
7154-3Y-EW 1-year factory warranty extended to 3 years from date of shipment.

Ordering Information
7154 High Voltage Scanner Card

1.888.KEITHLEY (U.S. only)
www.keithley.com
Low Current Scanner Card
10-channel

The Model 7158 provides quality low-current switching at an affordable price. The offset current error generated is specified <1pA, with typical performance at <30fA. When used with a voltage source and electrometer or picoammeter, this scanner card can easily automate insulation resistance tests, reverse leakage tests on semiconductor junctions, or gate leakage tests on FETs.

The Model 7158 is designed to maintain the current path even when the channel is deselected. Input connectors are BNC for shielding of the sensitive measurements and for compatibility with low noise coaxial cables such as Keithley accessory cables Models 4801 and 4803. Two outputs are provided to allow for chaining several scanner cards to one measurement instrument, and an isolation relay in the output HI minimizes interaction between cards.

- Channels per card: 10
- Contact configuration: Single pole, simultaneous break and make for signal HI input. Signal LO is common for all 10 channels and output. When a channel is off, signal HI is connected to signal LO.
- Connector type: BNC
- Relay drive current: 100mA per card typical (regardless of channel closures selected).
- Maximum signal level: 30V, 100mA peak (resistive load).

ACCESSORIES AVAILABLE
4801 Low Noise Male to Male BNC Input Cable
4802-10 Low Noise BNC to Unterminated Cable, 10 ft.
4803 Low Noise BNC Cable Kit for 7158

SERVICES AVAILABLE
7158-3Y-EW 1-year factory warranty extended to 3 years from date of shipment

Nanovolt Scanner Card
8-channel, 2-pole

The Model 7168 is an 8-channel, 2-pole card with <30nV of thermal offset. It will switch any one of eight signals to one output in less than 3ms. Channel offset leakage current is <50pA at 23°C. When the 7168 is used with the Model 2182A, the noise and drift performance of the 2182A is not degraded.

- Channels per card: 8
- Configuration: Two poles per channel, input HI and LO
- Connector type: Screw terminal to bare copper printed circuit pad
- Max. signal level: 10V, 50mA peak (resistive load only).
- Contact resistance: <12Ω.
- Contact potential (HI to LO) between channels: <50mV when properly zeroed with supplied leads (see manual for recommended procedure). Typically <60mV without zeroing.
- Contact type: Solid state JFET switch.
- Actuation time: <1ms, exclusive of mainframe.
- Input leakage: <50pA per channel at 23°C.
- Input isolation: >10²Ω, >50pF between any input terminals or between any input terminal and earth.
- Common mode voltage: 50V peak.
- Maximum voltage between any two terminals: 10V.

OPERATING ENVIRONMENT: 0°–40°C, up to 35°C at 70% R.H.
STORAGE ENVIRONMENT: −25° to 60°C.

ACCESSORIES SUPPLIED
2107-4 Low Thermal Input Cable for 2182A (1 supplied)
7168-316 Low Thermal Input Cables for 7166 (8 supplied)

SERVICES AVAILABLE
7168-3Y-EW 1-year factory warranty extended to 3 years from date of shipment
The six-slot Model 707B and single-slot Model 708B Semiconductor Switch Matrix Mainframes extend Keithley’s decades-long commitment to innovation in switch systems optimized for semiconductor test applications. These mainframes build upon the strengths of their popular predecessors, the Models 707A/708A, adding new features and capabilities designed to speed and simplify system integration and test development. New control options and interfaces offer system builders even greater flexibility when configuring high performance switching systems for use in both lab and production environments. Just as important, both new mainframes are compatible with the popular switch cards developed for the Models 707A and 708A, simplifying and minimizing the cost of switch system migration.

Faster Command-to-Connect
High performance Model 707B and 708B semiconductor switch matrix mainframes slash the time from command to connection, offering significantly faster test sequences and overall system throughput than Keithley’s earlier 707A and 708A mainframes.
Semiconductor Switch Matrix Mainframes
Six-slot and Single-slot Versions

Optimized for Easy Integration with Existing Test Systems

To minimize migration issues for current users of Model 707A and 708A mainframes, the Model 707B and 708B are designed for command emulation with Models 707A and 708A. The 707B and 708B also support the popular switch matrix cards developed for the Model 707A and 708A, so there’s no need to purchase new cards to take advantage of the new mainframes:

- **Model 7174A Low Current Matrix Card:** This 8×12 card is designed for semiconductor research, development, and production applications that demand high quality switching of I-V and C-V signals. Its low leakage and minimal dielectric absorption ensure that key device measurements can be performed many times faster than with earlier switching technologies. Its superior low current performance makes it ideal for use with both Models 2635B and 2636B System SourceMeter® SMU Instruments for adding high speed I-V source and measurement capabilities and for accessing the I-V and C-V measurement capabilities of the Model 4200-SCS Parameter Analyzer.

- **Model 7072 Semiconductor Matrix Card:** This 8×12 switch supports the low level and high impedance measurements encountered in semiconductor parametric tests on wafers and devices. It provides two low current paths with just 1pA maximum offset current for sensitive sub-picoamp measurements, and two other paths optimized for measuring C-V characteristics from DC to 1MHz. Four more high quality signal paths with <20pA offset current provide for general-purpose signal switching up to 100nA or 200V.

- **Model 7072-HV High Voltage Semiconductor Matrix Card:** Like the Model 7072, the 7072-HV is designed to handle low level, high voltage, and high impedance signals. It provides two signal paths capable of switching 1300V with less than 1pA of offset current, so it’s ideal for switching the high voltage signals encountered in breakdown measurements or oxide integrity testing. Two paths are optimized for C-V measurements from DC to 1MHz or for switching low currents with a common ground. Four additional high quality signal paths with less than 20pA offset current provide for signal switching to 200V.

- **Model 7173-50 High Frequency, 2-pole, 4×12 Matrix Card:** The Model 7173-50 provides 200MHz bandwidth and a rise time of <2ns. Offset voltage is <15µV per crosspoint, and offset current is <200pA. Its combined AC and DC capabilities make it ideal for mixed-signal applications, such as testing ADCs or DACs, which involve measuring both digital and analog signals.

For additional details and specifications on these cards, refer to their individual data sheets, available on www.keithley.com. A Keithley applications engineer or representative can help you choose the most appropriate card or cards for a specific application.
Semiconductor Switch Matrix Mainframes
Six-slot and Single-slot Versions

In addition, the Models 707B and 708B offer a number of features to ensure their compatibility with Keithley instrumentation already at work in labs and on test floors around the world. For example, these semiconductor switch matrix mainframes are compatible with the Model 4200-SCS semiconductor Parameter Analyzer’s existing matrix driver and GPIB interface, which allows them to become drop-in switch matrix replacements for many applications. The new mainframes also provide electrical performance that correlates closely with that of the Model 707A and Model 7174A switch card, the previous industry-standard switching solution.

Suited for Both Lab and Fab

Like their predecessors, the Models 707B/708B are specifically designed for the requirements of both semiconductor lab and production test environments, delivering ultra low current switching performance using standard triax connectors and cables. For automating smaller test systems with a limited number of pins and instruments, the Model 708B supports a single switch card with up to 8 rows and 12 columns (8×12). For applications requiring higher switch counts, the Model 707B can accommodate up to six 8×12 cards, which can be connected via an internal backplane or jumpers to form larger matrices. Both mainframes also support mixed signal switching for both DC and RF (up to 200MHz) signals.

Choice of Manual Operation or Remote Programming

Both mainframes offer a variety of manual operation and remote programming functions via either the front panel controls or a choice of interfaces. For example, for manual operation, such as when experimenting with a new switching configuration, the updated front panel interface allows labeling switch card rows (instruments) and columns (pins) alphanumerically, which simplifies keeping track of what’s connected to each crosspoint. An LED crosspoint display makes it easy to identify whether a specific channel is open or closed, as well as to determine which slots are occupied and which cards are currently in use. A two-line display shows both error messages and user-defined messages, and displays control menus and open/closed channel messages.

An intuitive navigation/control knob allows scrolling through and opening/closing channels. Key pad controls support scrolling through menus, changing host interface settings, saving and restoring instrument setups, and loading and running factory and user-defined test scripts, etc.

Test system integrators can choose from several instrument communication interfaces and tools for remote programming and control of the Model 707B or 708B:

- TSP-Link Technology is a high speed system expansion and coordination interface that simplifies linking instruments and switches for faster inter-unit communication and control. It provides a high speed, low

The Models 707B and 708B include a built-in Web interface that offers a quick and easy method to control the instrument remotely. Interactive schematics of each card in the mainframe support point-and-click control for opening and closing switches.

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www.keithley.com

A Greater Measure of Confidence
Semiconductor Switch Matrix Mainframes

Six-slot and Single-slot Versions

Semiconductor switch systems simplify debugging from the instrument. The immediate window allows viewing the output of a given test script and TSP code, and an immediate instrument control window to send GPIB commands and receive data and organize test scripts, a text-sensitive program editor (like Visual Basic) to create and modify test scripts. It provides a project/file manager window to store TSB IDE is a programming tool provided on the CD that accompanies each mainframe. It can be used in common with Series 2600B SMU instruments, the Models 707B/708B provide system builders with the advantages of the Keithley Test Script Builder (TSB) Integrated Development Environment (IDE). These mainframes share the same TSP, Lua scripting language, and TSP-Link interface as the Series 2600B and support an ultra low current switch matrix (the Model 7174A) that complements the Model 2636B's low current sensitivity. The Models 707B/708B offer test system builders a switch matrix that is fast, scriptable, and works seamlessly with all Series 2600B models.

In common with Series 2600B SMU instruments, the Models 707B/708B provide system builders with the advantages of the Keithley Test Script Builder (TSB) Integrated Development Environment (IDE). TSB IDE is a programming tool provided on the CD that accompanies each mainframe. It can be used to create, modify, debug, and store TSP scripts. It provides a project/file manager window to store and organize test scripts, a text-sensitive program editor (like Visual Basic) to create and modify test TSP code, and an immediate instrument control window to send GPIB commands and receive data from the instrument. The immediate window allows viewing the output of a given test script and simplifies debugging.

Advantages of TSP® Technology for Switch Throughput

The test script processor (TSP) technology embedded in these upgraded mainframes allows for distributed processing and control rather than relying exclusively on a central PC to direct their operation, increasing test speed and lowering overall test cost. The TSP is a full-featured test sequence engine that allows unprecedented control of the test sequence. In addition to responding to individual ICL commands, it can store a user-defined test script or sequence in memory and execute it on command, which limits the set-up and configuration time for each step in the test sequence and increases throughput by decreasing communication time.

Test scripts are complete test programs based on Lua, an easy-to-use but highly efficient and compact scripting language. Because test scripts can contain any sequence of routines that are executable by conventional programming languages (including decision-making algorithms and control of the digital I/O), the mainframe can manage the operation of entire tests without sending readings back to a PC for use in decision making. The TSP can even access the mainframe’s 14-bit digital I/O on the fly, increasing throughput by allowing instrument and binning equipment such as handlers to run without PC interference. This eliminates delays due to GPIB traffic congestion and greatly improves overall test times.

TSP control allows individual switches and instruments or groups of them to operate autonomously, often eliminating the need for a high-level PC system controller altogether. This same proven TSP technology has already been successfully incorporated into Keithley’s innovative Series 2600B System SourceMeter SMU instruments and Series 3700A Multimeter/Switch System.
### Supported Cards

<table>
<thead>
<tr>
<th>Card</th>
<th>7072-HV</th>
<th>7173-50</th>
<th>7174A</th>
</tr>
</thead>
<tbody>
<tr>
<td>8×12 Low-Current, High-Speed Matrix Card</td>
<td>15.9</td>
<td>7.9</td>
<td>1.9</td>
</tr>
<tr>
<td>4×12, 2-pole, High-Frequency Matrix Card</td>
<td>15.9</td>
<td>7.9</td>
<td>1.9</td>
</tr>
</tbody>
</table>

### Execution Speed

**SYSTEM PERFORMANCE**

<table>
<thead>
<tr>
<th>Command:</th>
<th>7072</th>
<th>7072-HV</th>
<th>7173-50</th>
<th>7174A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Command Execution Time (ms)</td>
<td>15.9</td>
<td>15.9</td>
<td>15.9</td>
<td>15.9</td>
</tr>
<tr>
<td>Ethernet</td>
<td>15.9</td>
<td>15.9</td>
<td>20.5</td>
<td>15.9</td>
</tr>
<tr>
<td>GPIB</td>
<td>15.9</td>
<td>15.9</td>
<td>20.5</td>
<td>15.9</td>
</tr>
<tr>
<td>TSP-Link</td>
<td>7.9</td>
<td>7.9</td>
<td>11.5</td>
<td>7.9</td>
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<tr>
<td>USB</td>
<td>1.9</td>
<td>1.9</td>
<td>5.5</td>
<td>1.9</td>
</tr>
</tbody>
</table>

1. Time between the start of a single digio .writebit (1, 1), channel .close ('ch_list') or channel .open ('ch_list') (which includes relay settle time), and digio .writebit (1, 0) command.

### TRIGGER RESPONSE TIME

#### MAXIMUM TRIGGER RATE (sets per second):

- 7072: ≥600
- 7072-HV: ≥600
- 7173-50: ≥1600
- 7174A: ≥815

#### TRIGGER IN TO START OF MATRIX READY PULSE (DDC Mode): 585µs.

#### TRIGGER IN TO TRIGGER OUT: ≤8.5µs.

#### TRIGGER TIMER ACCURACY: ≤8.5µs.

### NOTES

1. Includes scan .scancount = 100, scan .stepcount ≥3, channel .connectrule = channel .OFF or 0, and relay settle time.

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Model 708B rear panel

---

Model 707B rear panel
New Models 707B and 708B replace Models 707A and 708A

Keithley Instruments recently introduced two new semiconductor switch matrix mainframes: the Model 707B six-slot mainframe and the Model 708B one-slot mainframe. The two new mainframes replace the Models 707A and 708A that were introduced more than 20 years ago. The new models provide important new capabilities and are compatible with the most popular switch cards. The table shows the important differences between the new and old models.

<table>
<thead>
<tr>
<th></th>
<th>New 707/8B</th>
<th>Legacy 707/8A</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPIB/SCI</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Ethernet (LXI)</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>TSP/TSP-Link</td>
<td>✓</td>
<td></td>
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<tr>
<td>Webpage (LXI)</td>
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<td></td>
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<tr>
<td>Light Pen</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Compatible with '7174A, 7072, 7072-HV, '7173-50 switch cards</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Compatible with '7071, '7071-4 switch cards</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

New Models 707B and 708B replace Models 707A and 708A

<table>
<thead>
<tr>
<th></th>
<th>7072</th>
<th>7072-HV</th>
<th>7174A</th>
<th>7173-50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Channels</td>
<td>8×12</td>
<td>8×12</td>
<td>8×12</td>
<td>4×12</td>
</tr>
<tr>
<td>Card Configuration</td>
<td>Matrix</td>
<td>Matrix</td>
<td>Matrix</td>
<td></td>
</tr>
<tr>
<td>Contact Configuration</td>
<td>2 form A</td>
<td>2 form A</td>
<td>2 form A</td>
<td>2 form C</td>
</tr>
<tr>
<td>Max. Voltage</td>
<td>200 V</td>
<td>1300 V</td>
<td>200 V</td>
<td>50 V</td>
</tr>
<tr>
<td>Max. Current</td>
<td>1 A</td>
<td>1 A</td>
<td>2 A</td>
<td>0.5 A</td>
</tr>
<tr>
<td>Max. Power</td>
<td>10 VA</td>
<td>10 VA</td>
<td>10 VA</td>
<td></td>
</tr>
<tr>
<td>Contact Potential</td>
<td>&lt;20 µV</td>
<td>&lt;20 µV</td>
<td>&lt;15 µV</td>
<td></td>
</tr>
<tr>
<td>Max. Offset Current</td>
<td>&lt;1 pA</td>
<td>&lt;1 pA</td>
<td>&lt;100 fA</td>
<td>&lt;200 pA</td>
</tr>
<tr>
<td>Recommended Frequency</td>
<td>15 MHz</td>
<td>4 MHz</td>
<td>30 MHz</td>
<td>200 MHz</td>
</tr>
<tr>
<td>Connection Type</td>
<td>3-lug triax</td>
<td>3-lug triax</td>
<td>5-lug triax</td>
<td>BNC</td>
</tr>
<tr>
<td>CE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Comments</td>
<td>Optimized for semiconductor applications.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>707B-708B Compatible</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>707A-708A Compatible</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

707B, 708B, 707A, 708A Switch Card Accessories

<table>
<thead>
<tr>
<th>Cables</th>
<th>Adapters</th>
</tr>
</thead>
<tbody>
<tr>
<td>7072</td>
<td>7078-TRX-3</td>
</tr>
<tr>
<td>7174A</td>
<td>7078-TRX-3</td>
</tr>
<tr>
<td>7072-HV</td>
<td>7078-TRX-3</td>
</tr>
<tr>
<td>7073</td>
<td>4801</td>
</tr>
<tr>
<td>7173-50</td>
<td>7173-50-CSEP</td>
</tr>
</tbody>
</table>
Semiconductor Matrix Card
8×12

The Model 7072 Semiconductor Matrix Card is designed specifically to handle low-level and high-impedance measurements encountered in semiconductor parametric tests on wafers and devices. This unique design provides two low-current circuits with specified 1pA maximum offset current for sensitive sub-picoamp measurement resolution and two C-V paths for measurement of Capacitance Voltage characteristics from DC to 1MHz. Four additional high-quality signal paths with <20pA offset current provide for general-purpose signal switching up to 100mA or 200V.

Connections are 3-lug triax with the outer shell connected to chassis for safety and noise shielding. The center conductor is fully surrounded by the inner conducting shield, so that fully guarded measurements can be made to achieve higher isolation and to improve measurement speed and accuracy.

Isolation relays on the low-current and C-V paths automatically disconnect unused circuits to achieve minimum interference and peak performance. The 707A or 708A mainframe allows each row (signal path) to be programmed for Break-Before-Make or Make-Before-Break operation.

For applications requiring connections to a large number of devices or test points, the 7072 matrix can be expanded with additional cards. The low-current and C-V rows can be extended to other cards with coaxial jumpers. The other four high-quality signal paths connect directly to the 707A backplane for expansion.

The 707A or 708A mainframe allows each row (signal path) to be programmed for Break-Before-Make or Make-Before-Break operation.

### ACCESSORIES AVAILABLE
- 257-TRX-T: 3-Lug Triax Tee Adapter
- 7078-TRX-BNC: 3-Lug Triax to BNC Adapter
- 7078-TRX-5: 3-Lug Triax Cable, 0.5m (5 ft)
- 7078-TRX-10: 3-Lug Triax Cable, 3m (10 ft)
- 7078-TRX-TBC: 3-Lug Female Triax Bulkhead Connector with Cap

### SERVICES AVAILABLE
- 7072-3Y-EW: 1-year factory warranty extended to 3 years from date of shipment

### ORDERING INFORMATION
- 7072: 8×12 Semiconductor Matrix Card
- **Accessories Supplied**
  - Instruction manual and four SMB expansion cables (CA-54-1)
  - **Matrix Cards (7073-12, 7074-12)**
  - 257-TRX-T: 3-Lug Triax Tee Adapter
  - 7078-TRX-BNC: 3-Lug Triax to BNC Adapter
  - 7078-TRX-5: 3-Lug Triax Cable, 0.5m (5 ft)
  - 7078-TRX-10: 3-Lug Triax Cable, 3m (10 ft)
  - 7078-TRX-TBC: 3-Lug Female Triax Bulkhead Connector with Cap

### CROSSPOINT CONFIGURATION

<table>
<thead>
<tr>
<th>Purpose</th>
<th>General-Purpose (Rows C - F)</th>
<th>Low-Current (Rows A - B)</th>
<th>C-V (Rows G - H)</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFFSET CURRENT:</td>
<td>2-pole Form A</td>
<td>2-pole Form A</td>
<td>1-pole Form A, Common Guard</td>
</tr>
<tr>
<td>Resistance:</td>
<td>&lt;1 μA</td>
<td>&lt;20 μA</td>
<td>&lt;20 μA</td>
</tr>
<tr>
<td>Path isolation:</td>
<td>&gt;10^11 Ω</td>
<td>&gt;10^11 Ω</td>
<td>&gt;10^11 Ω</td>
</tr>
<tr>
<td>Crosstalk:</td>
<td>&lt;50 dB</td>
<td>&lt;50 dB</td>
<td>&lt;50 dB</td>
</tr>
<tr>
<td>1 MHz, 50Ω load (typical):</td>
<td>15 MHz</td>
<td>8 MHz</td>
<td>5 MHz</td>
</tr>
<tr>
<td>3dB Bandwidth (typical):</td>
<td>15 MHz</td>
<td>8 MHz</td>
<td>5 MHz</td>
</tr>
<tr>
<td>Offset Current and Path Isolation Specifications:</td>
<td>&lt;15 ms</td>
<td>&lt;15 ms</td>
<td>&lt;15 ms</td>
</tr>
<tr>
<td>Contact Life:</td>
<td>Cold Switching: 10^6 closures</td>
<td>Cold Switching: 10^6 closures</td>
<td>Cold Switching: 10^6 closures</td>
</tr>
<tr>
<td>Contact Potential:</td>
<td>40μV per crosspoint (Signal to Guard)</td>
<td>40μV per crosspoint (Signal to Guard)</td>
<td>40μV per crosspoint (Signal to Guard)</td>
</tr>
<tr>
<td>Relay Settling Time:</td>
<td>&lt;15 ms</td>
<td>&lt;15 ms</td>
<td>&lt;15 ms</td>
</tr>
<tr>
<td>Environmental:</td>
<td>&lt;400 μV</td>
<td>&lt;400 μV</td>
<td>&lt;400 μV</td>
</tr>
<tr>
<td>Temperature:</td>
<td>0°C to 50°C</td>
<td>0°C to 50°C</td>
<td>0°C to 50°C</td>
</tr>
<tr>
<td>Humidity:</td>
<td>0% to 100%</td>
<td>0% to 100%</td>
<td>0% to 100%</td>
</tr>
<tr>
<td>Voltage:</td>
<td>&lt;100V</td>
<td>&lt;100V</td>
<td>&lt;100V</td>
</tr>
<tr>
<td>Current:</td>
<td>&lt;10A</td>
<td>&lt;10A</td>
<td>&lt;10A</td>
</tr>
<tr>
<td>Power:</td>
<td>&lt;1W</td>
<td>&lt;1W</td>
<td>&lt;1W</td>
</tr>
</tbody>
</table>

**Use with Models 707B, 708B, 707A, and 708A switching matrix mainframes**
High Voltage Semiconductor Matrix Card
8×12

The Model 7072-HV is designed to switch low-level, high-voltage, and high-impedance signals for semiconductor parametric tests on wafers and devices. This unique design provides two signal paths capable of switching 1300V with less than 1pA of offset current. The two C-V paths may be used for measurement of capacitance voltage characteristics from DC to 1MHz or for switching low currents with a common ground. Four additional high quality signal paths with less than 20pA offset current provide for signal switching to 200V.

Connections are 3-lug triax with the outer shell connected to chassis for safety and noise shielding. The center conductor is fully surrounded by the inner conducting shield to provide fully guarded measurements with higher isolation and improved measurement speed and accuracy.

7072-HV Applications
The Model 7072-HV is typically used with the Model 2410 SourceMeter SMU Instrument, Series 2600B SourceMeter SMU Instruments, and the 4200-SCS Parameter Analyzer to address a wide variety of semiconductor device and material characterization needs.

The high voltage signals encountered in breakdown measurements or oxide integrity testing can be easily switched with this matrix card. Signals connected to the High V, Low I paths are automatically isolated from the rest of the card.

For applications requiring connections to a large number of devices or test points, the 7072-HV matrix can be expanded with additional cards. The high voltage and C-V rows can be extended to other cards with coaxial jumpers. The other four high-quality signal paths connect directly to the 707A or 708A backplane for expansion.

**ACCESSORIES AVAILABLE**
- 237-TRX-3 -Lug Triax to BNC Adapter
- 237-TRX-P -Lug Triax Female Bulkhead Connector
- 3-Lug Female Triax Bulkhead Connector with Cap
- 237-TRX-T -Lug Triax Tee Adapter
- 3-Lug Female Triax Bulkhead Connector with Cap

**SERVICES AVAILABLE**
- 7072-HV-3Y-EW 1-year factory warranty extended to 3 years from date of shipment

**EMC:** Conforms to European Union Directive 89/336/EEC.

**ENVIRONMENT:**
- OFFSET CURRENT and PATH ISOLATION Specifications:
  - 25°C, <60% R.H.
  - Operating: 0° to 50°C, up to 35°C at 70% R.H. Storage: −25° to +65°C

**MAXIMUM SIGNAL LEVEL**
- Maximum between any 2 pins or chassis: 1350 V
- Maximum between signal & guard: 10V (0.5A switched, 10VA peak (resistive load))
- Maximum between signal & guard: 10V (0.5A switched, 10VA peak (resistive load))
- CONTACT POTENTIAL: 〈50 μV
- CONTACT POTENTIAL: 〈20 μV
- CONTACT POTENTIAL: 〈40 μV

**CONTACT LIFE:**
- Cold Switching: 〈10¹⁷ closures.
- Warm Switching: 〈10¹⁵ closures.

**CONNECTOR TYPE:**
- Three-lug triaxial (Signal, Guard, Chassis) connections
- Three-lug triax with the outer shell connected to chassis for safety and noise shielding.

**Row Connections and Backplane Expansion**

<table>
<thead>
<tr>
<th>COLUMNS</th>
<th>LOW I Paths To Jumpers</th>
<th>GENERAL PURPOSE Paths To Backplane</th>
<th>C-V Paths To Jumpers</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>C2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>C3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>C4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>C5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>C6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>C7</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>C8</td>
<td>8</td>
<td>8</td>
<td>8</td>
</tr>
</tbody>
</table>

**Path Resistance:**
- (per conductor): <1Ω initial, <3.5Ω at end of contact life.

**RELAY SETTLING TIME:** <15ms.

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

**MAXIMUM SIGNAL LEVEL**
- 1 MHz, 50Ω load (typical): <60 dB
- 3dB BANDWIDTH (typical), 50Ω load: 4 MHz

**CROSSPOINT CONFIGURATION**
- 2-pole Form A
- 2-pole Form A
- 2-pole Form A, Common Guard

**OFFSET CURRENT**
- <1 pA
- <20 pA
- <20 pA

**PATH ISOLATION**
- <=10¹² Ω
- <=10¹⁰ Ω
- <=10⁸ Ω

**CROSSSTALK**
- 0.6 pF
- 1 pF
- 0.4 pF

**Maximum between any 2 pins or chassis:**
- 1350 V
- 200 V
- 200 V

**Maximum between signal & guard:**
- 10V (0.5A switched, 10VA peak (resistive load))
- 200 V
- 200 V
- 200 V

**CONTACT POTENTIAL**
- 〈50 μV
- 〈20 μV
- 〈40 μV

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

**EMC:** Conforms to European Union Directive 89/336/EEC.


**ACCESSORIES AVAILABLE**
- 237-TRX-3 -Lug Triax to BNC Adapter
- 237-TRX-P -Lug Triax Female Bulkhead Connector
- 3-Lug Female Triax Bulkhead Connector with Cap

**SERVICES AVAILABLE**
- 7072-HV-3Y-EW 1-year factory warranty extended to 3 years from date of shipment
7173-50

High Frequency Matrix Card
4x12, Two-pole

The Model 7173-50 combines high frequency performance with excellent DC switching characteristics. It provides 200MHz bandwidth in a 4x12 configuration. Offset voltage is <15µV per crosspoint, and offset current is <200pA. The combined AC and DC capabilities make it ideal for mixed signal applications where both high frequency and low level DC signals must be switched—for example, testing ADCs or DACs, which involves measuring both digital and analog signals.

The Model 7153-50 has a rise time of <2ns. It also features 2-pole switching at each crosspoint—HI and Shield—useful in 4-wire capacitance measurements where it is important to tie the shields of each connection together at the capacitance meter. BNC card connections are compatible with a wide variety of test equipment.

The Model 7173-50-CSEP expansion cables are four 25-inch cables and can expand a switching configuration to include more than one Model 7173-50. One cable is required to expand each row or column connection between adjacent cards. For example, connect the rows of two 7173-50 cards to create a 4x24 matrix or connect the columns to create an 8x12 matrix.

**Ordering Information**

7173-50  4x12, High Frequency Two-pole Matrix Card

**SERVICES AVAILABLE**

7173-50-3Y-EW 1-year warranty extended to 3 years from date of shipment

**Matrix Configuration**

- 4 rows by 12 columns
- CROSSPOINT CONFIGURATION: 2-pole Form C with Row Isolator (HI, LO)
- CHARACTERISTIC IMPEDANCE: 50Ω nominal
- CONNECTOR TYPE: BNC
- MAXIMUM SIGNAL LEVEL: 50V, 5.5A switched, 10VA
- COMMON MODE VOLTAGE: 42V peak (LO to Chassis)
- CONTACT POTENTIAL: 30V, 0.5A switched, 10VA
- CONNECTOR TYPE: BNC
- PATH RESISTANCE:
  - HI: <2.0Ω initial, <0.1Ω at end of contact life
  - LO: <10.0Ω initial, <0.15Ω at end of contact life
- CONTACT POTENTIAL: <15µV per crosspoint (HI to LO)
- RELAY SETTLING TIME: <6ms
- OFFSET CURRENT: <200pA (HI to LO)
- CROSSPOINT CONFIGURATION:
  - 4x36 configuration (3 cards)
  - 4x12 configuration

**AC Performance**

<table>
<thead>
<tr>
<th>Source</th>
<th>1MHz</th>
<th>10MHz</th>
<th>100MHz</th>
<th>200MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crossover:</td>
<td>&lt;0.2dB</td>
<td>&lt;0.4dB</td>
<td>&lt;1.5dB</td>
<td>&lt;3.0dB</td>
</tr>
<tr>
<td>Insertion Loss:</td>
<td>&lt;0.2dB</td>
<td>&lt;0.4dB</td>
<td>&lt;1.5dB</td>
<td>&lt;3.0dB</td>
</tr>
<tr>
<td>VSWR (typical):</td>
<td>1.4</td>
<td>1.7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Closed crosspoint to closed crosspoint

**Isolation (Path):** >10^12, <0.040pF Differential: >10^12, 9400pF nominal

**Common Mode Voltage:** >10^9, <0.040pF

**Rise Time (50Ω load and 50Ω source):** <2ns

**EMC:** Conforms to European Union Directive 89/336/EEC

**SAFETY:** Conforms to European Union Directive 73/23/EEC (meets EN61010-1/IEC 1010)

**Environment:**
- Operating: 0° to 50°C, up to 35°C at 70% R.H.
- Storage: -25° to 65°C

Specifications apply for one 7173-50 with all row isolators in automatic mode.

**Contact Information**

1.888.KEITHLEY (U.S. only)

www.keithley.com
The Model 7174A Low Current Matrix Card is designed for semiconductor research, development, and production applications requiring high quality, high performance switching of I-V and C-V signals. The Model 7174A is ideal for use with Keithley Models 2635B and 2636B System SourceMeter® SMU Instruments, Model 4200-SCS, and the Agilent B1500. The card’s configuration is 8 rows × 12 columns, with signal and guard switched at each crosspoint. Offset current has been reduced dramatically to <100fA on all pathways. Significant reductions in the level of parasitic capacitances in the Model 7174A help speed the process of making low level measurements.

The Model 7174A provides an optimum solution to switching the lower level signals common to today’s semiconductor characterization tests. The card’s low leakage and minimal dielectric absorption ensure that key device measurements can be performed many times faster than with current switching technologies. Connections are 3-lug triax with the outer shell connected to chassis for safety and noise shielding. The center conductor is fully surrounded by the inner conducting shield allowing fully guarded measurements to be made with higher isolation and improved speed and accuracy.

For applications that require making connections to a large number of devices or test points, the Model 7174A matrix can be expanded with additional cards. On-card connectors are provided to connect the rows (column expansion) between other 7174A cards in adjacent slots of the Model 707B switching mainframe. Eight female-to-female cables are provided with each 7174A to simplify expansion. Up to six 7174A cards can be connected in a single 707A switching mainframe to form an 8×72 or 12×60 matrix.

### Ordering Information

**7174A 8×12 High Speed, Low Current Matrix**

**Accessories Supplied**

- Eight row interconnect cables for card to card matrix expansion

### Matrix Configuration

MATRIX CONFIGURATION: Single 8 rows×12 columns. Expanding the columns can be done internally by connecting the rows of multiple 7174A cards together with coax jumpers.

CROSSPOINT CONFIGURATION: 2-pole Form A (Signal Guard).

CONNECTION TYPE: 3-lug triax (Signal, Guard, Chassis).

MAXIMUM SIGNAL LEVEL:
- Pin-to-pin: 100V, 2A carry current.
- Pin to Chassis: 100V.
- Common (Signal to Chassis): 100V.

CONTACT LIFE:
- Cold Switching: 10¹⁰ closures.

OFFSET CURRENT:
- 100fA max., 10fA typical (with 0V applied to inputs and outputs).

ISOLATION:
- Path (Signal to Signal): >2×10⁻¹². Path to Path: >10⁻¹².
- Path (Signal to Chassis): >10⁻¹⁰.
- Path to Ground: >10⁻¹⁰.
- Path to Signal: >10⁻¹⁰.

### Specifications

- **Settling Time:** <2.5s to 400fA (all pathways) after 10V applied (typical).
- **CrossTalk (1MHz, 50Ω Load):** <70dB.
- **Insertion Loss (1MHz, 50Ω Load):** <0.2dB typical.
- **3dB Bandwidth:**
  - (50Ω Load, 50Ω Source): 30MHz typical.
  - (50Ω Load, 50Ω Source): 40MHz typical.
- **Settling Time:** <2ms.
- **EMC:** Conforms to European Union Directive 89/336/EEC.
- **Environment:**
  - Offset Current and Path Isolation Specifications: 23°C, <60% R.H.
  - Operating: 0°C to 50°C, up to 35°C at 70% R.H.
  - Storage: -25°C to +65°C.
- **Maximum Leakage:**
  - Pin to Ground: 0.01pA/V.
  - Pin to Pin: 0.005pA/V.
- **Insulation Resistance:** 6.7×10¹³Ω minimum.
- **Capacitance:** (Guard Driven): Path to Ground: <10pF.
  - Path to Path: 1pF typical.

### Accessories Available

- 237-TRX-T 3-Lug Triax Tee Adapter
- 7078-TRX/TBC 3-Lug Triax to BNC Adapter
- 7078-TRX-X 3-Lug Triax Cable, 0.9m (3 ft.)
- 7078-TRX-10 3-Lug Triax Cable, 3m (10 ft.)
- 7078-TBC 3-Lug Female Triax Bulkhead Connector with Cap

### Services Available

- 7174A-3Y-EW 1-year factory warranty extended to 3 years from date of shipment
The S46 Microwave Switch System is designed to simplify the automated switching needed to test a wide range of telecommunications products and devices. The S46 can control 32 relay contacts in a package as small as a 2U high (3.5 in) full-rack enclosure. Standard configurations make it simple to select a system that meets the specifications of the testing application without the expense of unnecessary switches or other features. This “just what you need and no more” design philosophy allows S46 systems to provide outstanding price/performance value.

The enclosures used in standard S46 configurations can accommodate eight SPDT unterminated coaxial microwave relays and four multi-pole, unterminated, coaxial microwave relays. Any of these multi-pole unterminated relays can be one of the following relay types: SP4T or SP6T. S46 switching systems can be used as multiplexers, matrices, independent relays, or a combination of configurations. To order a standard system, simply select the number of relays and their location on the front panel. As test requirements change, relays can be easily added to the system to create a new switch configuration.

Frequency Range
To accommodate the rapidly evolving test requirements in RF/microwave applications, the S46 has ordering provisions for frequency ranges up to 40GHz. Configuration options include DC to 18GHz, DC to 26.5GHz, and DC to 40GHz.

Simple Operation
The S46 switch system’s 32 control channels can be operated via the IEEE-488 interface bus with a minimal set of instructions. This small instruction set ensures the system can be set up and running quickly. Front panel LEDs indicate the status of all relay contacts continuously to allow the user to monitor system operation easily.

Excellent Microwave Switching Performance
Keithley’s experience and partnerships with leading manufacturers in the microwave relay industry allow Keithley to offer the lowest insertion loss, VSWR, and crosstalk performance specifications available. Low-loss, semi-flexible RF cables are available as accessories to maximize signal integrity.

Maximum System Up-Time and Enhanced System Performance
The S46 controller automatically counts relay contact closures to allow equipment maintenance personnel to assess when the relays are nearing the end of their mechanical life. In this way, preventive maintenance can be performed in a timely way during scheduled shutdowns, avoiding unplanned shutdowns and the resulting loss of production time.

In addition to counting contact closures, the S46 has a portion of its memory available to store S-parameters or calibration constants for each relay contact or each pathway. If a specific performance parameter is critical, such as Voltage Standing Wave Ratio (VSWR) or insertion loss, the parameter can be stored in memory for use in trend analysis between scheduled maintenance shutdowns. Stored parameters can also be used for compensation to enhance accuracy during RF measurements.
System 46

RF/Microwave Switch System
32-channel, Unterminated

Examples of Standard System Switch Configurations

Maximum Configuration: (8) – Untermminated SPDT relays (4) – Utermminated multi-pole relays (SP4T, SP6T).

1.888.KEITHLEY (U.S. only)
www.keithley.com

ACCESSORIES AVAILABLE

CABLING
S46-SMA-0.5 DC–18GHz, Low Loss, Semi-Flex SMA-SMA Cable Assembly, 0.152m (6 in.)
S46-SMA-1 DC–18GHz, Low Loss, Semi-Flex SMA-SMA Cable Assembly, 0.305m (12 in.)
S46-SMA-1.7 DC–18GHz, Low Loss, Semi-Flex SMA-SMA Cable Assembly, 0.518m (20.4 in.)
S46-SMA26-0.5 DC–26.5GHz, Low Loss, Semi-Flex SMA-SMA Cable Assembly, 0.152m (6 in.)
S46-SMA26-1 DC–26.5GHz, Low Loss, Semi-Flex SMA-SMA Cable Assembly, 0.305m (12 in.)
S46-SMA-26-1.7 DC–26.5GHz, Low Loss, Semi-Flex SMA-SMA Cable Assembly, 0.518m (20.4 in.)
TL-24 SMA Cable Torque Wrench

SWITCH KITS
S46-SPDT-KIT Standard Performance 18GHz Untermminated SPDT Relay and Control Cable Assembly
S46-SP4T-KIT Standard Performance 18GHz Untermminated SP4T Relay and Control Cable Assembly
S46-SP6T-KIT Standard Performance 18GHz Untermminated SP6T Relay and Control Cable Assembly
S46-SPDT-KIT-R High Performance 18GHz Untermminated SPDT Relay and Control Cable Assembly
S46-SP4T-KIT-R High Performance 18GHz Untermminated SP4T Relay and Control Cable Assembly
S46-SP6T-KIT-R High Performance 18GHz Untermminated SP6T Relay and Control Cable Assembly
S46-SPDT-KIT-26 High Performance 26.5GHz Untermminated SPDT Relay and Control Cable Assembly
S46-SP4T-KIT-26 High Performance 26.5GHz Untermminated SP4T Relay and Control Cable Assembly
S46-SP6T-KIT-26 High Performance 26.5GHz Untermminated SP6T Relay and Control Cable Assembly
S46-SPDT-KIT-40 High Performance 40GHz Untermminated SPDT Relay and Control Cable Assembly
S46-SP4T-KIT-40 High Performance 40GHz Untermminated SP4T Relay and Control Cable Assembly
S46-SP6T-KIT-40 High Performance 40GHz Untermminated SP6T Relay and Control Cable Assembly
### System 46

#### RF/Microwave Switch System
32-channel, Unterminated

**Multipole relay locations A–D:** Enter a “4” for an SP4T relay or a “6” for a SP6T relay in the required location. Enter a “0” in unused multi-pole locations. There must be digits in all four positions.

**SPDT relay locations 1–8:** Indicate the position number of all locations where an SPDT switch is required. Only locations used are required.

**Example 1: Model Number S46-0604356**

**Example 2: Model Number S46-0440123B**
Includes: SP4T in positions B and C, SPDTs in positions 1, 2, and 3. Frequency range “B,” high performance DC–26.5GHz.

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### Ordering Information

**Specifying Standard S46 Model Numbers**

**Accessories Supplied**
- Power cord, instruction manual, and rack mount kit

---

### System 46 Specifications

**Option**

<table>
<thead>
<tr>
<th>None</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Frequency Range</strong></td>
<td>DC–18 GHz</td>
<td>DC–18 GHz</td>
<td>DC–26.5 GHz</td>
</tr>
<tr>
<td><strong>Connector Type</strong></td>
<td>SMA</td>
<td>SMA</td>
<td>SMA</td>
</tr>
<tr>
<td><strong>Impedance</strong></td>
<td>50Ω</td>
<td>50Ω</td>
<td>50Ω</td>
</tr>
<tr>
<td><strong>Contact Life</strong></td>
<td>2 × 10⁶</td>
<td>1 × 10⁷</td>
<td>1 × 10⁷</td>
</tr>
<tr>
<td><strong>VSWR (max.)</strong></td>
<td>DC–6 GHz: 1.25</td>
<td>DC–6 GHz: 1.20</td>
<td>DC–6 GHz: 1.50</td>
</tr>
<tr>
<td><strong>Insertion Loss (max.) dB</strong></td>
<td>DC–6 GHz: 0.2</td>
<td>DC–6 GHz: 0.2</td>
<td>DC–6 GHz: 0.2</td>
</tr>
<tr>
<td><strong>Isolation (min.) dB</strong></td>
<td>DC–6 GHz: 70</td>
<td>DC–6 GHz: 50</td>
<td>DC–6 GHz: 60</td>
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<tr>
<td><strong>Actuation Time (max.) ms</strong></td>
<td>20</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

**Terminated Relay Specifications**

**SP4T or SP6T Relay Locations**

- All four positions must be listed.
- Enter:
  - 0 = None
  - 4 = SP4T
  - 6 = SP6T

**SPDT Relay Locations**

- Only positions used must be listed.
- Enter:
  - Blank = DC–18GHz,
  - 1–8 = Position Number

**Frequency Range**

- A = DC–18GHz, Standard Performance
- B = DC–26.5GHz, High Performance
- C = DC–40GHz

**Unterminated relay specifications**

- Frequency range: DC–18GHz
- Power cord, instruction manual, and rack mount kit

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**GENERAL**

- **Contact Closure Counters:** 1 counter per channel, up to 10 million counts each, maintained in non-volatile memory.
- **Non-Volatile Storage:** 32 separate locations, each location up to 68 bytes long, for user-definable channel and system parameters.
- **Number of Relay Control Lines:** 32, each open collector driver capable of 300mA sink current (max.).
- **Interface:** GPIB (IEEE-488 2) and SCPI.
- **Indicators:** Power, relay position status, and error LED.
- **Power:** 100–240VAC, 50/60Hz.
- **Maximum Common Mode:** 42V peak, any terminal to earth.
- **Environment:** Operating: 0° to 40°C, up to 80% RH. Storage: –25°C to 65°C.
- **EMC:** Conforms to European Union Directive 89/336/EEC.
- **Safety:** Conforms with European Union Directive 73/23/EEC.
- **Dimensions:** 89mm high × 485mm wide × 370mm deep (3.5” x 19” x 14.56”).
- **Shipping Weight:** 13kg (28 lbs).

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**Contact Closure Counters:**

- 1 counter per channel, up to 10 million counts each, maintained in non-volatile memory.

---

**Contact Closure Counters:**

- 1 counter per channel, up to 10 million counts each, maintained in non-volatile memory.
**System 46T**

RF/Microwave Switch System

32-channel, Terminated

**Terminated Switching Solutions**

If your application requires a terminated configuration, the System 46T will meet your needs. This compact switching system leverages the same design technology of our standard unterminated System 46. This terminated version can accommodate up to eight terminated SPDT coaxial microwave relays and four terminated multi-pole coaxial microwave relays.

**Maximum Flexibility**

In addition to the terminated configurations, the System 46T also has provisions to accommodate up to four transfer switches (DPDT) as well as frequency ranges up to 26.5GHz. Other options include adding unterminated multi-throw and SPDT switches. Please review the Ordering Information section for allowable configurations.

**Simple Operation**

The S46T switch system’s 32 control channels can be operated via the IEEE-488 interface bus with a minimal set of instructions. This small instruction set ensures the system can be set up and running quickly. Front panel LEDs indicate the status of all relay contacts continuously to allow the user to monitor system operation easily.

**Excellent Microwave Switching Performance**

Keithley’s experience and partnerships with leading manufacturers in the microwave relay industry allow Keithley to offer the lowest insertion loss, VSWR, and crosstalk performance specifications available. Low-loss, semi-flexible RF cables are available as accessories to maximize signal integrity.

**Maximum System Up-Time and Enhanced System Performance**

The S46T controller automatically counts relay contact closures to allow equipment maintenance personnel to assess when the relays are nearing the end of their mechanical life. In this way, preventive maintenance can be performed in a timely way during scheduled shutdowns, avoiding unplanned shutdowns and the resulting loss of production time.

In addition to counting contact closures, the S46T has a portion of its memory available to store S-parameters or calibration constants for each relay contact or each pathway. If a specific performance parameter is critical, such as Voltage Standing Wave Ratio (VSWR) or insertion loss, the parameter can be stored in memory for use in trend analysis between scheduled maintenance shutdowns.

**ACCESSORIES AVAILABLE**

<table>
<thead>
<tr>
<th>CABLES, ADAPTERS, TOOLS</th>
<th>SWITCH KITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>7007-1</td>
<td>S46T-MSPD-KIT-26</td>
</tr>
<tr>
<td>Shielded GPIB Cable, 1m (3.3 ft)</td>
<td>Quantity 2, 18GHz Terminated SPDT Relay, Mounting Plate, and Control Cable Assembly</td>
</tr>
<tr>
<td>7007-2</td>
<td>S46T-SPDT-KIT-26</td>
</tr>
<tr>
<td>Shielded GPIB Cable, 2m (6.6 ft)</td>
<td>18GHz Terminated SPDT Relay, Mounting Plate, and Control Cable Assembly</td>
</tr>
<tr>
<td>7712-SMA-1</td>
<td>S46T-SPDT-KIT-26T</td>
</tr>
<tr>
<td>SMA Cable, male to male, 1m (3.3 ft)</td>
<td>18 GHz Terminated SPDT Relay and Control Cable Assembly</td>
</tr>
<tr>
<td>CA-404-B</td>
<td>S46T-SPDT-KIT-26T</td>
</tr>
<tr>
<td>SMA Cable, male to male, RG188 cable, 2m (6.5 ft)</td>
<td>18 GHz Terminated SPDT Relay and Control Cable Assembly</td>
</tr>
<tr>
<td>KPCI-488LPA</td>
<td>S46T-SPDT-KIT-26T</td>
</tr>
<tr>
<td>IEEE-488 Interface/Controller for the PCI Bus</td>
<td>18 GHz Terminated SPDT Relay and Control Cable Assembly</td>
</tr>
<tr>
<td>KUSB-488B</td>
<td>S46T-SPDT-KIT-26T</td>
</tr>
<tr>
<td>IEEE-488 USB-to-GPIB Interface Adapter</td>
<td>18 GHz Terminated SPDT Relay, Mounting Plate, and Control Cable Assembly</td>
</tr>
<tr>
<td>S46-SMA-0.5</td>
<td>S46T-SFP-KIT-26</td>
</tr>
<tr>
<td>DC-18GHz, Low Loss, Semi-Flex SMA-SMA Cable Assembly, 0.152m (6 in.)</td>
<td>18GHz Terminated SPDT Relay, Mounting Plate, and Control Cable Assembly</td>
</tr>
<tr>
<td>S46-SMA-1</td>
<td>S46T-SFP-KIT-26T</td>
</tr>
<tr>
<td>DC-18GHz, Low Loss, Semi-Flex SMA-SMA Cable Assembly, 0.305m (12 in.)</td>
<td>18GHz Terminated SPDT Relay and Control Cable Assembly</td>
</tr>
<tr>
<td>S46-SMA-1.7</td>
<td>S46T-SFP-KIT-26T</td>
</tr>
<tr>
<td>DC-18GHz, Low Loss, Semi-Flex SMA-SMA Cable Assembly, 0.518m (20 in.)</td>
<td>18GHz Terminated SPDT Relay and Control Cable Assembly</td>
</tr>
<tr>
<td>S46-SMA26-0.5</td>
<td>S46T-SFP-KIT-26</td>
</tr>
<tr>
<td>DC-26 GHz, Low Loss, Semi-Flex SMA-SMA Cable Assembly, 0.152m (6 in.)</td>
<td>18GHz Terminated SPDT Relay, Mounting Plate, and Control Cable Assembly</td>
</tr>
<tr>
<td>S46-SMA26-1</td>
<td>S46T-SFP-KIT-26T</td>
</tr>
<tr>
<td>DC-26 GHz, Low Loss, Semi-Flex SMA-SMA Cable Assembly, 0.305m (12 in.)</td>
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<tr>
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</tr>
<tr>
<td>DC-26 GHz, Low Loss, Semi-Flex SMA-SMA Cable Assembly, 0.518m (20 in.)</td>
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<tr>
<td>TL-24</td>
<td>S46T-XFR-KIT-26</td>
</tr>
<tr>
<td>SMA Cable Torque Wrench</td>
<td>18GHz Transfer Switch, Mounting Plate, and Control Cable Assembly</td>
</tr>
</tbody>
</table>

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[www.keithley.com](http://www.keithley.com)

A Greater Measure of Confidence

A Tektronix Company
## System 46T

### RF/Microwave Switch System

32-channel, Terminated

### Ordering Information

**Specifying Standard S46T Model Numbers**

**Accessories Supplied**

- Power cord, instruction manual, and rack mount kit

### Terminated Relay Specifications

<table>
<thead>
<tr>
<th>Frequency Range</th>
<th>S46T-00X0000000</th>
<th>S46T-00A0000000</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONNECTOR TYPE</td>
<td>SMA</td>
<td>SMA</td>
</tr>
<tr>
<td>IMPEDANCE</td>
<td>50Ω</td>
<td>50Ω</td>
</tr>
<tr>
<td>CONTACT LIFE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SP4T, SP6T</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DC–3 GHz</td>
<td>1.20</td>
<td>1.20</td>
</tr>
<tr>
<td>3–8 GHz</td>
<td>1.30</td>
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<tr>
<td>8–12.4 GHz</td>
<td>1.40</td>
<td>1.40</td>
</tr>
<tr>
<td>12.4–18.4 GHz</td>
<td>1.50</td>
<td>1.50</td>
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<tr>
<td>18–26.5 GHz</td>
<td>1.80</td>
<td>1.80</td>
</tr>
<tr>
<td>VSWR (max.)</td>
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<td></td>
</tr>
<tr>
<td>DC–3 GHz</td>
<td>1.20</td>
<td>1.20</td>
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<tr>
<td>3–8 GHz</td>
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<td>18–26.5 GHz</td>
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<td>INSERTION LOSS</td>
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<tr>
<td>DC–3 GHz</td>
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<td>3–8 GHz</td>
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<tr>
<td>12.4–18.4 GHz</td>
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<tr>
<td>ISOLATION (min.)</td>
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<tr>
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<tr>
<td>8–12.4 GHz</td>
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<tr>
<td>12.4–18.4 GHz</td>
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<td>60</td>
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<tr>
<td>18–26.5 GHz</td>
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<td>50</td>
</tr>
<tr>
<td>ACTUATION TIME</td>
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<tr>
<td>(max.) ms</td>
<td>10</td>
<td>10</td>
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<tr>
<td>SPDT</td>
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<tr>
<td>15</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>SP4T, SP6T</td>
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</table>

### Transfer Switch Specifications

<table>
<thead>
<tr>
<th>Frequency Range</th>
<th>S46T-00X0000000</th>
<th>S46T-00A0000000</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONNECTOR TYPE</td>
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<tr>
<td>IMPEDANCE</td>
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<td></td>
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<td>3–8 GHz</td>
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</tr>
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<td>1.70</td>
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<tr>
<td>VSWR (max.)</td>
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<tr>
<td>DC–3 GHz</td>
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<tr>
<td>INSERTION LOSS</td>
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</tr>
<tr>
<td>DC–3 GHz</td>
<td>0.2</td>
<td>0.2</td>
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<tr>
<td>3–8 GHz</td>
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<td>50</td>
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<tr>
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<td></td>
</tr>
<tr>
<td>(max.) ms</td>
<td>15</td>
<td>15</td>
</tr>
</tbody>
</table>

### Applications

- Cellular and cordless phones
- Specialized mobile radios
- Base stations
- Specialized antenna systems
- RF components, including RFICs
- Wireless peripherals, including Bluetooth devices
- Broadband wireless transceivers
- High speed digital communications, including SONET speeds 3Gbps and 10Gbps

### Example 1: Model Number S46T-0AX0000000A

Includes: Terminated SP4T in position B, transfer switch in position D, terminated SPDTs in positions 3 and 4. DC–18GHz frequency range.

### Example 2: Model Number S46T-ABC4UU000000B

Includes: Terminated SP4T in position A, terminated SP6T in position B, two unterminated SPDTs in position C, and unterminated SP4T in position D. Unterminated SPDTs in positions 1 and 2, terminated SPDTs in positions 5, 6, 7, and 8. DC–26.5GHz frequency range.

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