

Automated Switching and Integrated Semiconductor Testing



Device designers and engineers around the world have discovered how Keithley switch hardware simplifies integrating C-V and I-V instruments into high-accuracy systems for semiconductor characterization.



Keithley's semiconductor device characterization experts understand the complexities of combining C-V and I-V instruments to create accurate, efficient measurement systems. Keithley has been helping fabs create integrated semiconductor characterization systems for more than a quarter-century. That includes not only merging diverse measurement instruments into complete systems, but also integrating these systems into a fab's overall R&D or production environment.

Keithley supplies fully integrated turnkey semiconductor characterization systems customized to user specifications. For example, the System 86 is a factory-integrated, rack-mounted solution that combines the I-V measurement capabilities of the System 90 with the C-V capabilities of the System 82-WIN, then adds a Model 707A Switch Mainframe with appropriate cards and cables. Optional probes and thermal chucks specified by the user can also be incorporated into the system. When operated with the Metrics-ICS software package, this solution can address most device or material characterization applications. C-V measurement capabilities open the door to new system applications, including:

- Developing and integrating new processes
- Research and development on new materials and device structures
- Post-metalization process characterization
- Device reliability testing
- Analyzing failure mechanisms

- **Factory-integrated semiconductor characterization systems**
- **Superior system-level performance**
- **Compatible with many other manufacturers' instruments and probes**
- **The industry's most accepted switch solutions for semiconductor testing**
- **Widest selection of low leakage, remote sense, high voltage, and high current switch cards**
- **The industry's highest pin-count switch mainframe**
- **Windows-based Metrics-ICS software supports all C-V, I-V, and switching**

QUESTIONS?

1-800-552-1115 (U.S. only)

Call toll free for technical assistance, product support or ordering information, or visit our website at www.keithley.com.

Automated Switching and Integrated Semiconductor Testing



Keithley's fully integrated systems can provide both C-V and I-V measurements on the same DUT with automated switching of instruments.

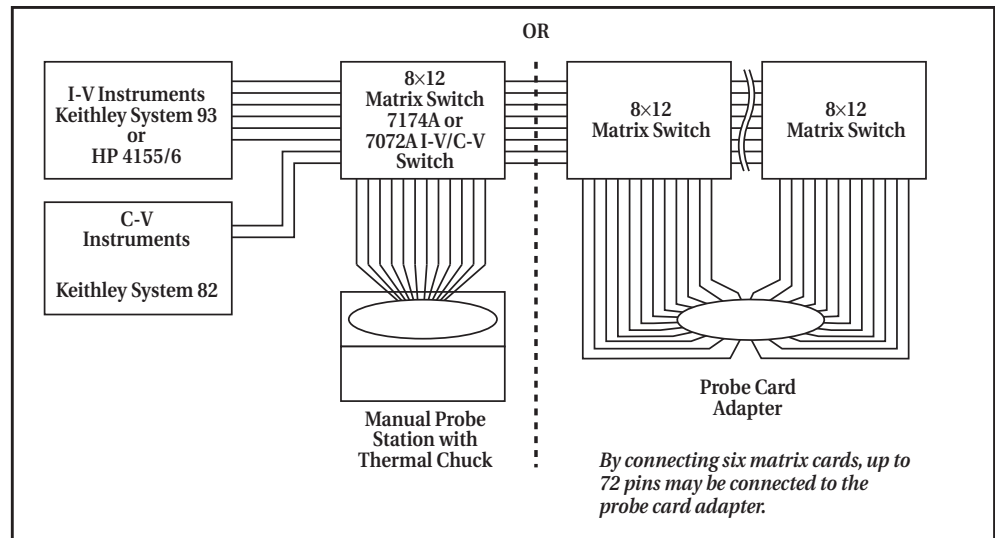
Widest range of C-V and I-V solutions available

Keithley's total system solutions are much more than simply a collection of instruments and cables. Each System 86 is a complete, economical package of hardware, software, and services. It provides:

- Keithley's unique Simultaneous C-V System.
- Fully guarded I-V and 4-terminal remote sense (Kelvin) measurements on each SMU.
- High voltage and current measurements, up to 1100V or 3A.
- Up to six integrated SMUs from a choice of six I-V instruments.
- Switching matrix mainframes for automatic switching between C-V and I-V measurements on the same DUT.
- Switching cards with up to 8 rows \times 72 pins, with the industry's lowest offset current (10fA typical, 100fA max.).

In addition to the measurement hardware, a current Windows-based computer and Metrics-ICS software are typically included for system control.

Matrix switching systems are key elements of Keithley's semiconductor device characterization solutions because they connect the Source-Measure Units (SMUs) and other instruments through the probe to the device under test (DUT). As a result, Keithley systems provide the optimum combination of speed and accuracy for fully-integrated systems.



A single card and a small mainframe (708A) provide an 8 \times 12 matrix for low pin-count applications. A larger mainframe (707A) provides up to 72 pins of high performance matrix switching for higher pin-count applications.

Precision all along the signal path

C-V and I-V testing require precise measurements, often involving currents of less than 1pA, capacitances less than 1fF, and voltages of just a few microvolts. The switching matrix may also have to switch AC signals at frequencies in the MHz range. The switching matrix design must minimize parasitic capacitances and leakage currents to prevent these artifacts from obscuring low level signals.

QUESTIONS?

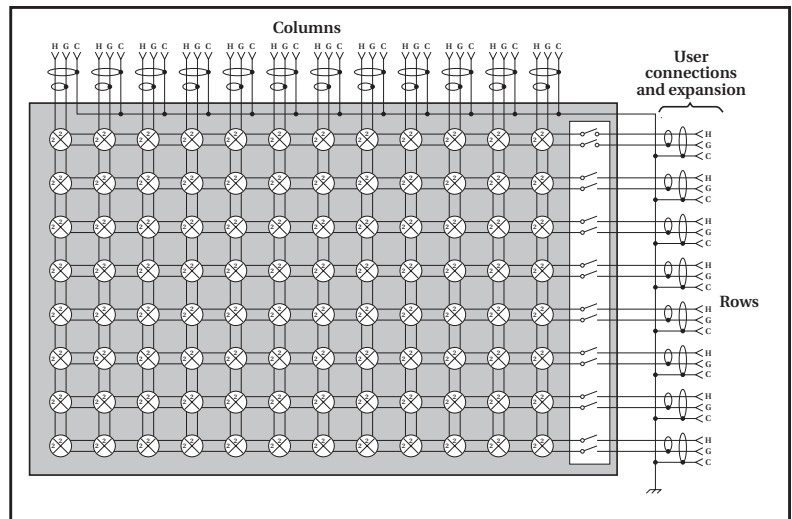
1-800-552-1115 (U.S. only)

Call toll free for technical assistance, product support or ordering information, or visit our website at www.keithley.com.

Automated Switching and Integrated Semiconductor Testing

Keithley's matrix switch mainframes and switch cards have been engineered to control these problems. For example, the Keithley Model 707A Switch Mainframe has three separate analog backplanes, each optimized for a different type of switch card. This allows the use of different card combinations for specific types of tests and eliminates the need for complex harnesses and external wiring. Consequently, stray capacitance and leakage currents are minimized.

The innovative switch and insulation designs used in Keithley cards help reduce signal artifacts. The Model 7174A Low Current Matrix Card is one case in point. This card is designed specifically for high-performance semiconductor characterization applications that use System 93 I-V and System 82-WIN Simultaneous C-V Characterization Systems. These systems often include HP 4155 and 4156 parametric analyzers. In the Model 7174A card's 8 row \times 12 column configuration, both the signal and guard connections are switched at each crosspoint. This allows making remote sense (Kelvin) measurements with up to four SMUs, while enabling a high pin count. Also, offset current is reduced dramatically on all pathways to 100fA (10fA typical). By using guarded triaxial connections and a patented air dielectric design, parasitic capacitance, dielectric absorption, and leakage current have been minimized. In addition to the higher accuracy this card allows, settling times are significantly shorter, allowing measurements to be performed many times faster than with other switching technologies.



The Model 7174A Low Current Matrix Card, with 10fA offset current typical (100fA max.) offers the industry's best low current measurement performance. It is designed for semiconductor research, development, and production applications requiring high quality, high performance switching of I-V and C-V signals.

Keithley's broad range of switching solutions enhances system integration flexibility:

- A choice of four switch mainframes.
- More than 60 switch cards to fit virtually any C-V or I-V test application.
- High capacity — The Model 707A can link up to six cards via its backplane, providing pin configurations of up to 8 rows \times 72 columns.
- Up to five Model 707A mainframes can be cascaded for expansion to a 360-column configuration.
- Most cards can be modified to provide additional instrument connections (for example, six Model 7174A cards can be configured as an 18 \times 60 matrix).

Thirteen different cards are designed specifically for semiconductor characterization applications. Like the 7174A, the Model 7072A card also provides a unique solution for C-V/I-V testing, offering two low leakage (100fA typical) paths, four high isolation general-purpose paths, and two C-V paths. Unlike other cards based on 6 \times 12 matrices that employ multiplexing techniques to provide additional instrument connections, these Keithley semiconductor switching cards offer true 8 \times 12 matrix configurations, allowing up to eight instrument connections at once.



Keithley's Model 707A Mainframe and Model 7174A Switch Card are fully compatible with HP's 4156B Semiconductor Parametric Analyzer. This switching solution offers the industry's best low current performance.

QUESTIONS ?

1-800-552-1115 (U.S. only)

Call toll free for technical assistance, product support or ordering information, or visit our website at www.keithley.com.

Automated Switching and Integrated Semiconductor Testing

Switch Card Selection Guide

Card Family	Card Model	Offset Current	Contact Potential	Max. Volts	Max. Current	Channel Configuration	Contact Configuration	Input Connector
Semiconductor	7174A	<100fA (10fA typical)	—	200V	2A	8x12 Matrix	2 form A	Triax
	7072	<1pA (100fA typical)	<20 μ V	200V	1A	8x12 Matrix	2 form A	Triax
	7072-HV	<1pA	<20 μ V	1300V	1A	8x12 Matrix	2 form A	Triax
	7172	<500fA	<30 μ V	200V	1A	8x12 Matrix	2 form A	Triax
High Frequency	7073	<200pA	<2 μ V	200V	1A	8x12 Matrix	1-pole form A	BNC
	7173-50	<200pA	<15 μ V	30V	0.5A	4x12 Matrix	2 form C	BNC

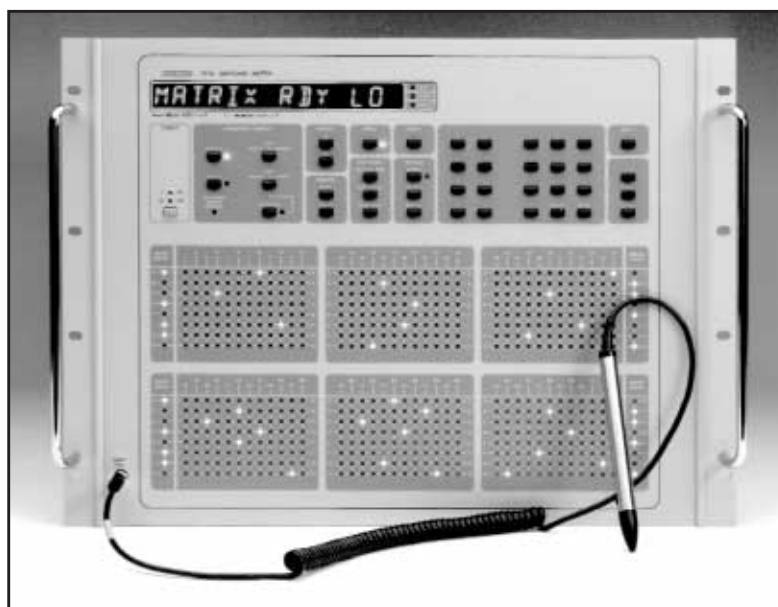
Matrix Switches and Fully Integrated Systems

The Model 707A Switch Mainframe is the basis for many of Keithley's semiconductor switching solutions. It offers:

- Compatibility with a wide range of matrix and multiplexer cards
- The ability to expand in groups of 12 to 360 columns (2880 matrix crosspoints)
- Fast system integration and test program development time
- Analog backplane for automatic switching card interconnect
- 100 setup non-volatile matrix memory

In-Depth C-V/I-V Applications Expertise

Keithley has been a leader in C-V and I-V test technologies for decades. Today, we continue that tradition by providing industry-leading applications support for our instruments and systems. Our Applications staff will work with you every step of the way to select the most appropriate hardware and software configuration for a particular application. Whether the application calls for a single instrument, a variety of instruments to complement an existing equipment configuration, or a comprehensive system solution, a Keithley C-V/I-V specialist can help you choose the equipment and software that provide the optimum combination of speed and accuracy for your application. We can also work with you to optimize the performance of your facility's existing I-V and C-V test solutions, such as instruments supplied by H-P. Our Applications Engineer-



The Model 707A Switching Mainframe

ing department is also available weekdays from 8:00 A.M. to 6:00 P.M. to answer applications questions at our toll-free hotline number: 1-800-348-3735 (USA only).

Most systems are delivered factory-integrated, rack-mounted, and pre-assembled. Our experienced applications engineers are available to help you begin working with systems accurately and efficiently within hours of delivery.

QUESTIONS?

1-800-552-1115 (U.S. only)

Call toll free for technical assistance, product support or ordering information, or visit our website at www.keithley.com.