

707B, 708B Semiconductor Switch Matrix Mainframes (Six-slot and Single-slot Versions)

DATASHEET



The six-slot 707B and single-slot 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 707/707A and 708/708A, 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 707A and 708A, simplifying and minimizing the cost of switch system migration.

Key Features

- Significantly faster command-to-connect speeds than earlier Series 700 mainframes
- 708B mainframe controls a single 8×12 matrix card
- 707B mainframe controls up to six 8×12 matrix cards
- Compatible with the popular plug-in cards designed for the 707A/708A mainframes
- Support for both remote (via LXI, USB, and GPIB interfaces) and manual (via front panel) programming
- Integrates seamlessly with the 4200-SCS for semiconductor I-V and C-V characterization via GPIB interface
- Stores hundreds of switching configurations and channel patterns in non-volatile memory for reuse
- LXI interface supports remote programming and control
- Embedded TSP® processor and TSP-Link Technology interface make it easy to integrate Series 2600B System SourceMeter® SMU instruments into a high speed, self-contained tester
- 14 bits of digital I/O

Faster Command-to-Connect

High performance 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.

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Optimized for Easy Integration with Existing Test Systems

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

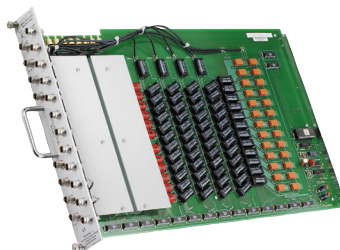
- **7174A Low Current**

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 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 4200-SCS Parameter Analyzer.



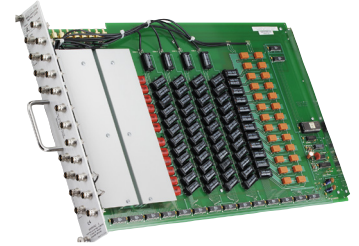
- **7072 Semiconductor**

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 1 pA maximum offset current for sensitive sub-picoamp measurements, and two other paths optimized for measuring C-V characteristics from DC to 1 MHz. Four more high quality signal paths with <20 pA offset current provide for general-purpose signal switching up to 100 nA or 200 V.



- **7072-HV High Voltage Semiconductor Matrix Card:**

Like the 7072, the 7072-HV is designed to handle low level, high voltage, and high impedance signals. It provides two signal paths capable of switching 1300 V 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 1 MHz or for switching low currents with a common ground. Four additional high quality signal paths with less than 20 pA offset current provide for signal switching to 200 V.



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.

In addition, the 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 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 707A and 7174A switch card, the previous industry-standard switching solution.

Suited for Both Lab and Fab

Like their predecessors, the 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 708B supports a single switch card with up to 8 rows and 12 columns (8×12). For applications requiring higher switch counts, the 707B can accommodate up to six 8×12 cards, which can be connected via an internal backplane or jumpers to form larger matrices.

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 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 latency interface to other TSP (Test Script Processor)-based hardware, enabling simple multi-box and multi-instrument software control, as well as simplified test system scaling as new requirements evolve.
- With TSP-Link, there's no need to add external triggers and remote communication cables to individual units because all TSP-Link connected devices can be controlled from a single master unit. Up to 16 707B/708B chassis can be linked together to form a larger switching matrix using TSP-Link. Each mainframe has two TSP-Link connectors to facilitate chaining instruments together. They can also be used to connect 707B/708B semiconductor switch matrix mainframes to other TSP-Link enabled instruments, such as Keithley's Series 2600B System SourceMeter® SMU instruments. Every piece of instrumentation connected via TSP-Link can be controlled by a single master unit, just as though they were all housed in the same chassis.

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.

- For those replacing Keithley's earlier 707A/708A mainframes and who prefer to minimize the levels of changes to their test systems, the 707B and 708B offer a GPIB interface and 707A/708A DDC command emulation capabilities to simplify the migration process. These users can incorporate the "B" models into their test systems without making any changes to their legacy code or hardware interface. However, these users

will not be able to take full advantage of many of the throughput gains that TSP control provides, such as the new GPIB interface that allows you to control additional GPIB-compatible instruments and systems.

- A rear panel Universal Serial Bus (USB) port allows a host computer to communicate with and control the 707B/708B over a USB interface.

Optimized for Easy Integration with Series 2600B-Based Systems

The 707B and 708B are ideal companion products for systems that incorporate Series 2600B instrumentation, such as Keithley's ACS and S530 integrated test systems. 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 7174A) that complements the 2636B's low current sensitivity. The 707B/708B offer test system builders a switch matrix that is fast, scriptable, and works seamlessly with all Series 2600B models.



707B rear panel

Creating test scripts using the 707B/708B with the Series 2600B models is simple with TSP Toolkit Software. TSP Toolkit Software is a scripting tool that includes all the functionality and instrument support of the original Test Script Builder (TSB) software plus many quality-of-life features to improve the development experience including syntax highlighting, autocompletion with in-line command help, and a modern user interface. For more information and to download the extension for use with Visual Studio Code, please visit the [TSP Toolkit Product Page](#).

Ready to Use Instrument Drivers Simplify Programming

Prefer to create your own customized application software? Native National Instruments Labview®, IVI-C, and IVI-COM drivers are available for downloading to simplify the programming process. For the Labview® driver please visit www.ni.com; for IVI drivers please visit www.tek.com.



708B rear panel

Supported Cards

7072	8×12 Semiconductor Matrix 200V, 1A
7072-HV	8×12 HV Semiconductor Matrix 1300V, 0.1A
7173-50	4×12, 2-pole, High-Frequency Matrix Card
7174A	8×12 Low-Current, High-Speed Matrix Card, with 3-lug Triax Row and Column connects

Execution Speed

System Performance¹

Command	channel.close('ch_list') or channel.open('ch_list')			
	Single Command Execution Time (ms)			
Card	Ethernet	GPIO	TSP-Link	USB
7072	15.9	15.9	20.5	15.9
7072-HV	15.9	15.9	20.5	15.9
7173-50	7.9	7.9	11.5	7.9
7174A	1.9	1.9	5.5	1.9

Notes

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 (setups per second)²:

- 7072: ≥65.
- 7072-HV: ≥65.
- 7173-50: ≥160.
- 7174A: ≥815.

Trigger in to Start of Matrix Ready Pulse (DDC Mode)

≤85 μs.

Trigger in to Trigger Out ≤0.5 μs.

Trigger Timer Accuracy ≤0.5 μs.

Notes

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

General

Emulation	707A/708A Device Dependent Commands (DDC). Since the architecture of the 707B/708B differs from the 707A/708A, some commands are different. Refer to notes in the 707B-901 Reference manual for additional details.
Break Before Make	channel.connectrule= channel.BREAK_BEFORE_MAKE or 1.
Make Before Break	channel.connectrule= channel.MAKE_BEFORE_BREAK or 2.
None	channel.connectrule= channel.OFF or 0, the system will close relays as it is able to without adhering to a rule.
IEEE-488	IEEE-488.1 compliant. Supports IEEE-488.2 common commands and status model topology.
USB 2.0 Device (rear panel type B)	Full and high speed, USBTMC compliant.
Digital I/O Interface	
Connector	25-pin female D.
Input/Output Pins	14 open drain I/O bits.
Absolute Maximum Input Voltage	5.25 V.
Absolute Minimum Input Voltage	-0.25 V.
Maximum Logic Low Input Voltage	0.7 V, +850 μ A max.
Maximum Logic High Input Voltage	2.1 V, +570 μ A.
Maximum Source Current (flowing out of Digital I/O bit)	960 μ A.
Maximum Sink Current @ Maximum Logic Low Voltage (0.7 V)	-5.0 mA.
Absolute Maximum Sink Current (flowing into Digital I/O pin)	-11 mA.
5V Power Supply Pin	Limited to 600 mA, solid state fuse protected.
Ethernet	RJ-45 connector, 10/100BaseT, Auto-MDIX.
LXI Compliance	LXI Version 1.2.
Power Supply	707B: 100 V to 240 VAC, 50 Hz-60 Hz, 210 VA max. 708B: 100 V to 240 VAC, 50 Hz-60 Hz, 110 VA max.
Relay Drive	707B: 30 W (6 V at 5.0 A) max. per slot, 162 W (6 V at 27 A) max. for all slots. 708B: 30 W (6 V at 5.0 A) max.
Safety	Conforms to European Union Low Voltage Directive.
Dimensions	707B: 356 mm high \times 432 mm wide \times 574 mm deep (14.0 in \times 17.0 in \times 22.6 in). 708B: 90 mm high \times 432 mm wide \times 574 mm deep (3.5 in \times 17.0 in \times 22.6 in).
Dimensions with Card Installed	707B: 356 mm high \times 432 mm wide \times 612 mm deep (14.0 in \times 17.0 in \times 24.1 in). 708B: 90 mm high \times 432 mm wide \times 612 mm deep (3.5 in \times 17.0 in \times 24.1 in).
Weight	707B: 14.5 kg (32 lbs). 708B: 7.3 kg (16 lbs).
Shipping Weight	707B: 27.2 kg (60 lbs). 708B: 16.4 kg (36 lbs).
Environment	For indoor use only.
Altitude	Maximum 2000 meters above sea level.
Operating	0° - 50°C, 80% R.H. up to 35°C. Derate to 3% R.H./°C, 35° - 50°C.
Storage	-25°C to 65°C. Ordering Information

Ordering Information

707B	Six-slot semiconductor switch mainframe
708B	Single-slot semiconductor switch mainframe
Extended warranty, service, and calibration contracts are available.	

Supplied Accessories

CA-180-4A	CAT 5 Ethernet Crossover Cable, 1 m (3.3 ft)
CA-179-2A	CAT 5 Ethernet Cable, 3 m (10 ft)
C0-7	Line Cord
Rear Fixed Rack Mount Hardware (707B only)	

Available Accessories

CA-126-7A	25-pin Female Digital I/O to 25-pin Male Cable, 3 m (10 ft)
2600-TLINK	Digital I/O to Trigger Link Cable, 1 m (3.3 ft)
7007-1	Double-shielded GPIB Cable, 1 m (3.3 ft)
7007-2	Double-shielded GPIB Cable, 2 m (6.6 ft)
7072	Semiconductor Matrix Card
7072-HV	High Voltage Semiconductor Matrix Card
7072-TRT	Triax Fastening Tool
7079	Rear Slide Rack Mount Kit (for 707B)
7173-50	High Frequency, 2-pole, 4×12 Matrix Card
7174A	Low Current Matrix Card

Software

IVI-COM and IVI-C Driver for C#, VB.NET, Visual C++, VB6, and LabWindows/CVI	
LabVIEW® Driver	
Example TSP® Scripts	
TSP Toolkit Software	

Available Services

707B-3Y-EW	1-year Factory Warranty Extended to 3 Years from date of shipment
707B-5Y-EW	1-year Factory Warranty Extended to 5 Years from date of shipment
708B-3Y-EW	1-year Factory Warranty Extended to 3 Years from date of shipment
708B-5Y-EW	1-year Factory Warranty Extended to 5 Years from date of shipment

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