Model 7751/7752/7753 Switching Modules

User's Guide

PA-823 Rev. B / Sept 2003

The Models 7751/7752/7753 can be used with Keithley's Model 2790.

KEITHLEY

Safety Precautions

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

This product is intended for use by qualified personnel who recognize shock hazards and are familiar with the safety precautions required to avoid possible injury. Read and follow all installation, operation, and maintenance information carefully before using the product. Refer to the manual for complete product specifications.

If the product is used in a manner not specified, the protection provided by the product may be impaired.

The types of product users are:

Responsible body is the individual or group responsible for the use and maintenance of equipment, for ensuring that the equipment is operated within its specifications and operating limits, and for ensuring that operators are adequately trained.

Operators use the product for its intended function. They must be trained in electrical safety procedures and proper use of the instrument. They must be protected from electric shock and contact with hazardous live circuits.

Maintenance personnel perform routine procedures on the product to keep it operating properly, for example, setting the line voltage or replacing consumable materials. Maintenance procedures are described in the manual. The procedures explicitly state if the operator may perform them. Otherwise, they should be performed only by service personnel.

Service personnel are trained to work on live circuits, and perform safe installations and repairs of products. Only properly trained service personnel may perform installation and service procedures.

Keithley products are designed for use with electrical signals that are rated Installation Category I and Installation Category II, as described in the International Electrotechnical Commission (IEC) Standard IEC 60664. Most measurement, control, and data I/O signals are Installation Category I and must not be directly connected to mains voltage or to voltage sources with high transient over-voltages. Installation Category II connections require protection for high transient over-voltages often associated with local AC mains connections. Assume all measurement, control, and data I/O connections are for connection to Category I sources unless otherwise marked or described in the Manual.

Exercise extreme caution when a shock hazard is present. Lethal voltage may be present on cable connector jacks or test fixtures. The American National Standards Institute (ANSI) states that a shock hazard exists when voltage levels greater than 30V RMS, 42.4V peak, or 60VDC are present. **A good safety practice is to expect that hazardous voltage is present in any unknown circuit before measuring.**

Operators of this product must be protected from electric shock at all times. The responsible body must ensure that operators are prevented access and/or insulated from every connection point. In some cases, connections must be exposed to potential human contact. Product operators in these circumstances must be trained to protect themselves from the risk of electric shock. If the circuit is capable of operating at or above 1000 volts, **no conductive part of the circuit may be exposed.**

Do not connect switching cards directly to unlimited power circuits. They are intended to be used with impedance limited sources. NEVER connect switching cards directly to AC mains. When connecting sources to switching cards, install protective devices to limit fault current and voltage to the card.

Before operating an instrument, make sure the line cord is connected to a properly grounded power receptacle. Inspect the connecting cables, test leads, and jumpers for possible wear, cracks, or breaks before each use.

When installing equipment where access to the main power cord is restricted, such as rack mounting, a separate main input power disconnect device must be provided, in close proximity to the equipment and within easy reach of the operator.

For maximum safety, do not touch the product, test cables, or any other instruments while power is applied to the circuit under test. ALWAYS remove power from the entire test system and discharge any capacitors before: connecting or disconnecting cables or jumpers, installing or removing switching cards, or making internal changes, such as installing or removing jumpers.

Do not touch any object that could provide a current path to the common side of the circuit under test or power line (earth) ground. Always make measurements with dry hands while standing on a dry, insulated surface capable of withstanding the voltage being measured.

The instrument and accessories must be used in accordance with its specifications and operating instructions or the safety of the equipment may be impaired.

Do not exceed the maximum signal levels of the instruments and accessories, as defined in the specifications and operating information, and as shown on the instrument or test fixture panels, or switching card.

When fuses are used in a product, replace with same type and rating for continued protection against fire hazard.

Chassis connections must only be used as shield connections for measuring circuits, NOT as safety earth ground connections.

If you are using a test fixture, keep the lid closed while power is applied to the device under test. Safe operation requires the use of a lid interlock.

If  or  is present, connect it to safety earth ground using the wire recommended in the user documentation.

The  symbol on an instrument indicates that the user should refer to the operating instructions located in the manual.

The  symbol on an instrument shows that it can source or measure 1000 volts or more, including the combined effect of normal and common mode voltages. Use standard safety precautions to avoid personal contact with these voltages.

The **WARNING** heading in a manual explains dangers that might result in personal injury or death. Always read the associated information very carefully before performing the indicated procedure.

The **CAUTION** heading in a manual explains hazards that could damage the instrument. Such damage may invalidate the warranty.

Instrumentation and accessories shall not be connected to humans.

Before performing any maintenance, disconnect the line cord and all test cables.

To maintain protection from electric shock and fire, replacement components in mains circuits, including the power transformer, test leads, and input jacks, must be purchased from Keithley Instruments. Standard fuses, with applicable national safety approvals, may be used if the rating and type are the same. Other components that are not safety related may be purchased from other suppliers as long as they are equivalent to the original component. (Note that selected parts should be purchased only through Keithley Instruments to maintain accuracy and functionality of the product.) If you are unsure about the applicability of a replacement component, call a Keithley Instruments office for information.

To clean an instrument, use a damp cloth or mild, water based cleaner. Clean the exterior of the instrument only. Do not apply cleaner directly to the instrument or allow liquids to enter or spill on the instrument. Products that consist of a circuit board with no case or chassis (e.g., data acquisition board for installation into a computer) should never require cleaning if handled according to instructions. If the board becomes contaminated and operation is affected, the board should be returned to the factory for proper cleaning/servicing.

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Models 7751/7752/7753 Switching Modules User's Guide

Introduction

The Models 7751, 7752, and 7753 are used with the Model 2790 SourceMeter Switch System. Safety features are integrated into the design of the modules to help safeguard the user and the module. With proper use of the module and the Model 2790 mainframe, risk of ignition is minimal.

The 7751, 7752, and 7753 modules have a built-in programmable constant I-source to perform low resistance measurements. The 7751 and 7753 modules also have a built-in programmable V-source and an I/V converter. These features allow the 7751 and 7753 modules to be used with the Digital Multimeter (DMM) of the Model 2790 to measure high resistance.

NOTE *Details on using the 7751, 7752, and 7753 modules are provided in Sections 1, 2, and 5 of the Model 2790 User's Manual.*

WARNING **It is the responsibility of the user to ensure that external protection is provided, either by an inherently safe electrical barrier and/or a safety barrier around the DUT or airbag, to prevent injury in case of detonation. The user must take additional precautions when working with hazardous voltages. A shock hazard exists when >42V is present in the system.**

WARNING **DO NOT apply external sources to the 7751, 7752, or 7753 module. Only the sources provided in the modules should be used for the test system.**

Switching matrix

The switching matrix provides four banks of input for the DUT. Each bank provides inputs for 4-wire connections. Each bank also has a built-in short available for HIPOT testing. The switching scheme of the matrix provides the versatility needed to use the I-source, V-source (7751 and 7753), and the DMM of the Model 2790.

NOTE *The schematic diagram of the 7751/7752/7753 module is provided in Section 2 of the User's Manual.*

I-source

The programmable I-source of the 7751, 7752, and 7753 modules can be set from 0 to 50mA. The I-source is used with the DMM of the 2790 to measure low resistance (i.e., bridgewires and shunt bars). The I-source has a dry circuit clamp that can be used to measure oxide build-up on the contacts of a shunt bar. The dry circuit clamp limits the test voltage at 20mV to prevent oxide piercing during the measurement.

V-source and I/V converter (7751/7753)

The programmable V-source of the 7751 and 7753 modules can be set from 50 to 500V. The maximum output current for the 7751 V-source is 50µA for rated accuracy, while the 7753 V-source maximum output current is 500µA for rated accuracy. When the V-source and I/V converter are used with the 2790 DMM, high resistance measurements can be performed to test the insulation resistance of an inflator over the following ranges:

- Model 7751: 1MΩ to 1GΩ
- Model 7753: 0.1MΩ to 1GΩ

The V-source can also be used as an independent voltage source. It is typically used with the 7702 module to test multiple DUTs.

NOTE *Details on using the V-source with the 7702 module are provided in Section 3 of the Model 2790 User's Manual.*

Module wiring and installation

The 7751, 7752, and 7753 modules use screw terminals for DUT connections. The screw terminals are accessed by removing the top cover of the module. The quick-disconnect terminal blocks can be pulled off the PC-board to make the connections.

WARNING **When connecting the DUT and before installing (or removing) the module in the mainframe, make sure the Model 2790 is turned off, the line cord is disconnected, and there are no external sources connected to the module or the mainframe.**

CAUTION **Be sure to install only 7751/7753 module covers with the integral heat sink. Also be sure that the thermal conductive pad, located on the voltage source (Figure 1), has not been dislodged or damaged. These thermal components are necessary to assure proper voltage source operation. (Note that earlier 7751 modules do not have the thermal pad or heat sink.)**

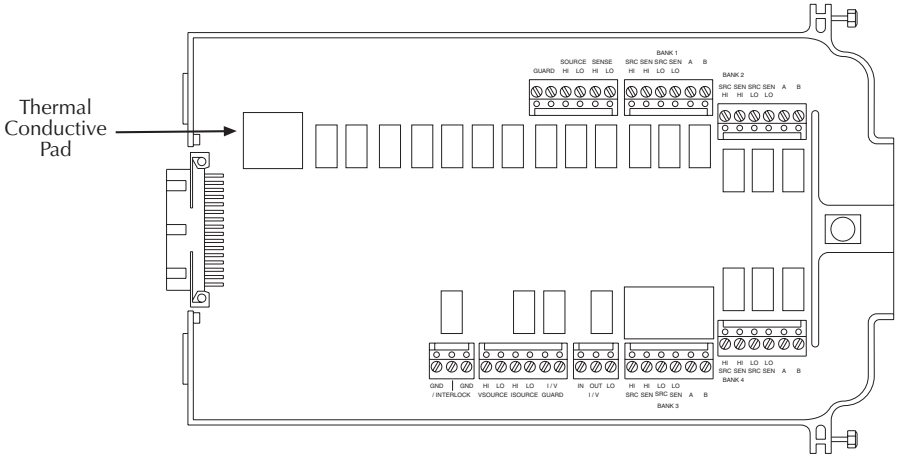
General wiring requirements

Cable wires should be mechanically durable, preferably 20AWG or larger with a high voltage insulation, such as rubber or silicon, that are rated for at least 1000V.

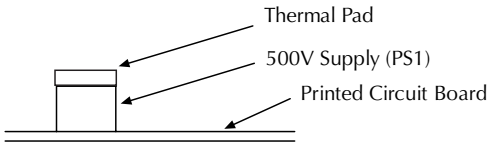
NOTE *Details on making connections to the 7751/7752/7753 module and installing the module in the mainframe are provided in Section 4 of the Model 2790 User's Manual.*

Figure 1
Model 7751/7753 thermal conductive pad location

A) Board location



B) Side view



2790 SourceMeter® Switch System Specifications

7751/7752/7753 SOURCE/SWITCH MODULE SPECIFICATIONS

2790 Resistance Mode Specifications with Cards[2,3]

(Module function accuracy specifications are for 2 years, 23°C, ±5°C)

Source Current	Maximum Resistance	Typ. Open Ckt. Voltage	Accuracy %Rdg + Ohms	Temperature Coefficient (0-18°C & 28-40°C)
50mA	20Ω	5.5V	0.09% + 40mΩ	(0.002%+3mΩ)/°C
20mA	50Ω	5.5V	0.11% + 40mΩ	(0.003%+3mΩ)/°C
10mA	100Ω	5.5V	0.16% + 40mΩ	(0.004%+3mΩ)/°C
(Dry Circuit Ohms 1mA max with 7751, 7752, or 7753 card)				
1mA	10Ω	20mV	1.10% + 40mΩ	(0.026%+3mΩ)/°C

(7751 Only)

Source Voltage	Resistance Range	Max. Short Ckt. Current	Accuracy %Rdg	Temperature Coefficient (0-18°C & 28-40°C)
500V	10MΩ	<1mA	0.8%	0.03%/°C
500V	100MΩ	<1mA	1.1%	0.05%/°C
500V	1GΩ	<1mA	4.0%	0.12%/°C
50V	1MΩ	<1mA	1.1%	0.04%/°C
50V	10MΩ	<1mA	1.1%	0.06%/°C
50V	100MΩ	<1mA	1.6%	0.13%/°C

(7753 Only)

Source Voltage	Resistance Range	Max. Short Ckt. Current	Accuracy %Rdg	Temperature Coefficient (0-18°C & 28-40°C)
500V	1MΩ	<1mA	0.8%	0.02%/°C
500V	10MΩ	<1mA	0.9%	0.03%/°C
500V	100MΩ	<1mA	1.3%	0.10%/°C
500V	1GΩ	<1mA	6.7%	0.27%/°C
50V	0.1MΩ	<1mA	1.1%	0.03%/°C
50V	1MΩ	<1mA	1.1%	0.04%/°C
50V	10MΩ	<1mA	1.3%	0.11%/°C
50V	100MΩ	<1mA	4.5%	0.30%/°C

Current Source Output

Output Level: Programmable 0 to 50mA (Ch. 27).
Programming Resolution: 10µA.
Output Voltage: 5.5V±10% compliance.
Accuracy: 0.06% + 10µA (2 yr Specification).
Settling Time: 1mS to 0.1% of final value (typ).
Temperature Coefficient: (0-18°C & 28-40°C) (0.001%+0.25µA)/°C
Dry Circuit Clamp (Ch. 24): 20mV±10%, Isource ≤1mA

Voltage Source Output (7751/7753 Only)

Output Level: Programmable 50V to 500V (CH. 28).
Programming Resolution: 100mV.
Output Current: (7751) - 50µA maximum for rated accuracy, <1mA typical into short circuit.
(7753) - 500µA maximum for rated accuracy, <1mA typical into short circuit.
Accuracy: 0.5% + 0.13V (2yr Specification).
Settling Time: Rise Time: 50V to 500V step, 0.1% of final value, 250 ms max.
Fall Time: 500V to 50V step, 0.1% of final value, 1000 ms max.
Temperature Coefficient: (0-18°C & 28-40°C) (0.001%+0.005V)/°C
Safety Limit: Current limited maximum current of 1mA.
Cable Discharge (Ch. 20): 100kΩ Shunt
Max Capacitance: 1nF

Current Measure Input (7751/7753 Only)

Range: 7751 (0-50µA), 7753 (0-500µA).
Accuracy: (7751) 0.5% (of reading) + 6nA (2yr Specification).
(7753) 0.5% (of reading) + 60nA (2yr Specification).
Temperature Coefficient: (0-18°C & 28-40°C) (0.02%+0.5nA)/°C
Voltage Burden: <1mV.

Switching Capabilities (Bank 1 – Bank 4)

4 Channels: 1 Form A switch.
8 Channels: 4 4-pole or 8 2-pole signals into DMM or I/V converter.
Contact Check: 4-Wire contact check through internal DMM.
Relay Type: Latching electromechanical.
Actuation Time: <3ms.
Contact Life (typ): $>10^6$ operations at maximum source level.
$>10^8$ operations cold switching.
Contact Resistance: <1 Ohm at end of contact life.
Contact Potential: <±2µV typical per contact pair, ±3µV max.
Connector Type: Plugable screw terminal, #22 AWG wire size.
Isolation Between any two Terminals[1]: >1GΩ, <100pF.
Isolation Between Terminals and Earth[1]: >1GΩ, <200pF.
Isolation Between Channel Groups[1]: >500GΩ, <100pF.
External Common Mode Voltage: 42V between any terminal and chassis. (Connect no external sources.)

7751, 7752, or 7753 Module Notes

[1] Isolation for channels 1-12, only one channel closed at a time, or all channels open.

[2] See User's manual for ohm specifications at sources other than those specified.

[3] All specifications valid for 1 NPLC ADC aperture setting.

System Throughput

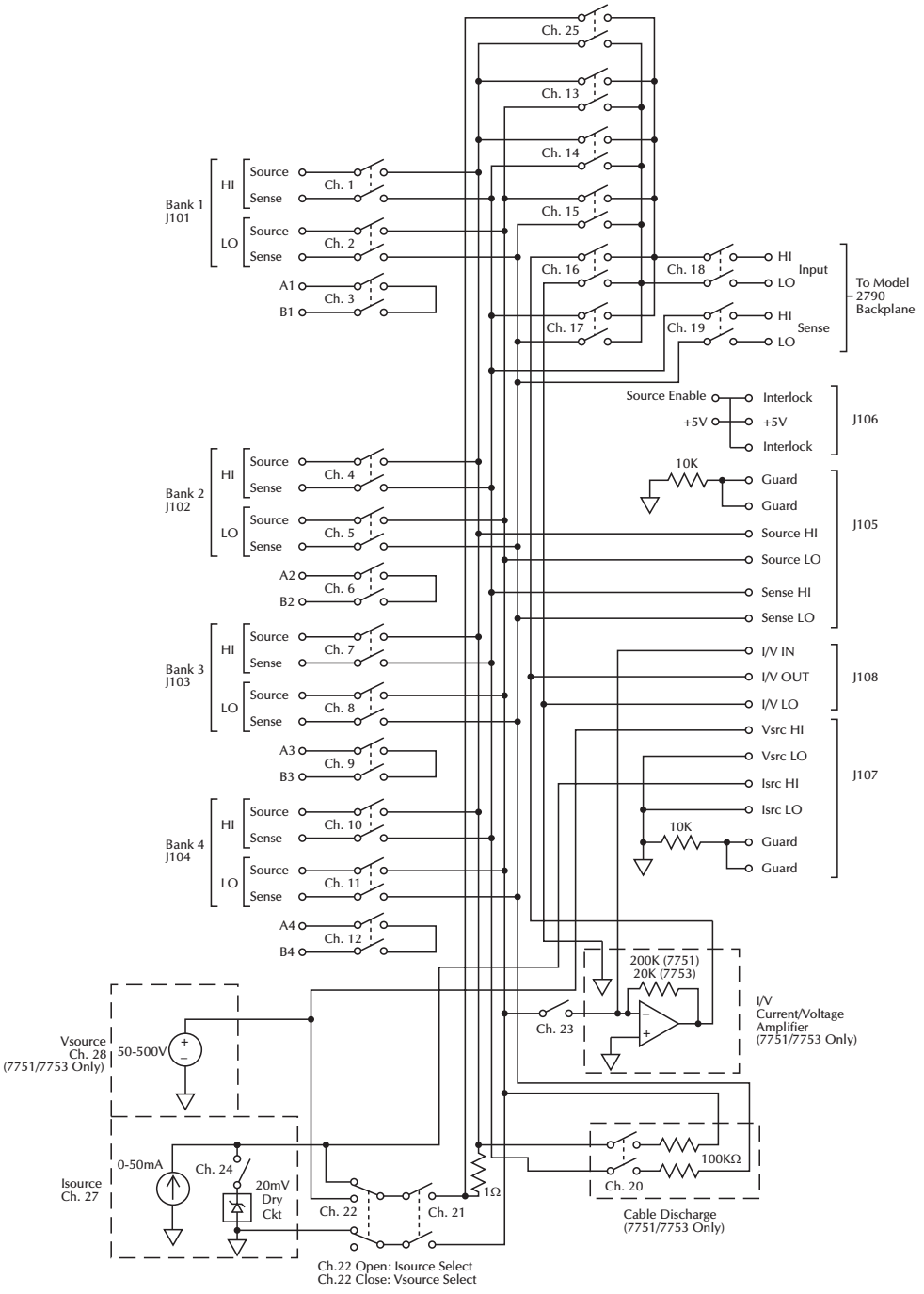
(Connect, source, measure, calculate)
0.01 NPLC, Filter Off, over GPIB Bus
High Ohms (Source V): 13 Rdgs/Sec[1]
Low Ohms (Source I): 9 Rdgs/Sec
1 NPLC, Filter On, Over GPIB Bus
High Ohms (Source V): 11 Rdgs/Sec[1]
Low Ohms (Source I): 7 Rdgs/Sec

System Throughput Notes

1. Reset upon fixed Vsource level, no settling time.

2790 SourceMeter® Switch System Specifications

7751/7752/7753 SOURCE/SWITCH MODULE SPECIFICATIONS



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Rev. D

2790 SourceMeter® Switch System Specifications

2790 MAINFRAME FUNCTION SPECIFICATION

MAINFRAME FUNCTION ACCURACY SPECIFICATIONS ARE FOR 1 YEAR, 23°C±5°C

DC MEASUREMENT SPECIFICATIONS[1]

CONDITIONS: MED (1 PLC)[2] or 10 PLC or MED (1 PLC) with Digital Filter of 10

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

Function	Range	Resolution	Test Current (±5%) or Burden Voltage	Input Resistance or Open Ckt. Voltage[3]	24 Hour[4] 23°C ±1°	90 Day 23°C ±5°	1 Year 23°C ±5°	Temperature Coefficient 0°-18°C & 28°-40°C
Voltage	100.0000 mV	0.1 µV		>10 GΩ	15 + 30	25 + 70	30 + 70	(1 + 5)/°C
	1.000000 V	1.0 µV		>10 GΩ	15 + 6	25 + 7	30 + 7	(1 + 1)/°C
	10.00000 V	10 µV		>10 GΩ	10 + 4	20 + 5	30 + 5	(1 + 1)/°C
	100.0000 V	100 µV		10 MΩ ±1%	15 + 6	45 + 9	55 + 9	(5 + 1)/°C
	1000.000 V[5]	1 mV		10 MΩ ±1%	20 + 6	35 + 9	50 + 9	(5 + 1)/°C
Resistance[6, 8]	100.0000 Ω	100 µΩ	1 mA	6.6 V	20 + 20	80 + 20	100 + 20	(8 + 1)/°C
	1.000000 kΩ	1 mΩ	1 mA	6.6 V	20 + 6	80 + 6	100 + 6	(8 + 1)/°C
	10.00000 kΩ	10 mΩ	100 µA	6.6 V	20 + 6	80 + 6	100 + 6	(8 + 1)/°C
	100.0000 kΩ	100 mΩ	10 µA	12.8 V	20 + 6	80 + 10	100 + 10	(8 + 1)/°C
	1.000000 MΩ	1.0 Ω	10 µA	12.8 V	20 + 6	80 + 10	100 + 10	(8 + 1)/°C
	10.00000 MΩ[7]	10 Ω	Note 7	7.0 V	150 + 6	200 + 10	400 + 10	(70 + 1)/°C
	100.0000 MΩ[7]	100 Ω	Note 7	7.0 V	800 + 30	3000 + 30	3000 + 30	(385 + 1)/°C
Continuity (2W)	1.000 kΩ	100 mΩ	1 mA	6.6 V	40 + 100	100 + 100	100 + 100	(8 + 1)/°C
Current	20.00000 mA	10 nA	<0.2 V		60 + 30	300 + 80	500 + 80	(50 + 5)/°C
	100.0000 mA	100 nA	<0.05 V		100 + 300	300 + 800	500 + 800	(50 + 50)/°C
	1.000000 A	1.0 µA	<0.3 V[9]		200 + 30	500 + 80	800 + 80	(50 + 5)/°C
	3.000000 A	10 µA	<1.0 V[9]		1000 + 15	1200 + 40	1200 + 40	(50 + 5)/°C
Channel (Ratio)[10]	Ratio Accuracy = Accuracy of selected Channel Range + Accuracy of Paired Channel Range							
Channel (Average)[10]	Average Accuracy = Accuracy of selected Channel Range + Accuracy of Paired Channel Range							

Temperature

(Displayed in °C, °F, or K. Exclusive of probe errors.)

Range	Resolution	Accuracy 1 Year (23°C ± 5°C)	Temperature Coefficient 0-18°C & 28°-40°C
4-Wire RTD: (100Ω platinum [PT100], D100, F100, PT385, PT3916, or user type. Offset compensation On.)			
-200°C to 630°C	0.01°C	0.06°C	0.003°C/°C
Thermistor: (2.2kΩ, 5kΩ, and 10kΩ)[18]			
-80°C to 150°C	0.01°C	0.08°C	0.002°C/°C

DC Speed vs. Noise Rejection

Rate	Filter	Readings/s[11]	Digits	RMS Noise 10V Range	NMRR	CMRR[13]
10	50	0.01 (0.08)	6.5	< 1.2 µV	110 dB[12]	120 dB
1	Off	15 (12)	6.5	< 4 µV	90 dB[12]	120 dB
0.1	Off	500 (400)	5.5	< 22 µV	–	80 dB
0.01	Off	2000 (1800)	4.5	< 150 µV	–	80 dB

DC Operating Characteristics[15]

60Hz (50Hz) Operation

Function	Digits	Readings/s		PLCs
DCV, DCI, Ohms (<10M), Thermistor	6.5[11, 15]	5	(4)	10
	6.5[15]	30	(24)	1
	6.5[11, 15]	50	(40)	1
	5.5[11, 15]	100	(80)	0.1
	5.5[15, 16]	250	(200)	0.1
	5.5[16]	480	(400)	0.1
	4.5[16]	2000	(1800)	0.01
4W Ohms (<10M)	6.5[15]	1.4	(1.1)	10
	6.5[15]	15	(12)	1
	5.5[16]	33	(25)	0.1
RTD	6.5[15]	0.9	(0.7)	10
	6.5[15]	8	(6.4)	1
	5.5[15, 16]	18	(14.4)	0.1
Channel (Ratio), Channel (AVG)	6.5[15]	2.5	(2)	10
	6.5[15]	15	(12)	1
	5.5[16]	25	(20)	0.1

2790 SourceMeter® Switch System Specifications

MAINFRAME FUNCTION SPECIFICATION

DC System Speeds[14, 17]

RANGE CHANGES[15]: 50/s (42/s).
FUNCTION CHANGES[15]: 50/s (42/s).
AUTORANGE TIME[15]: < 30ms.
ASCII READINGS TO RS-232 (19.2k BAUD): 55/s.
MAX. INTERNAL TRIGGER RATE: 2000/s.
MAX. EXTERNAL TRIGGER RATE: 375/s.

DC MEASUREMENT CHARACTERISTICS

DC Volts

A-D LINEARITY: 2.0 ppm of reading + 1.0 ppm of range.
INPUT IMPEDANCE:
100mV–10V Ranges: Selectable >10GΩ// with <400pF or 10MΩ ±1%.
100V, 1000V Ranges: 10MΩ ±1%.
INPUT BIAS CURRENT: <100pA at 23°C.
COMMON MODE CURRENT: <500nAp-p at 50Hz or 60Hz.
INPUT PROTECTION: Front, 1000V, Rear, 300V, 7702 card only.

Resistance

MAX 4WΩ LEAD RESISTANCE: 10% of range per lead for 100Ω and 1kΩ ranges; 1kΩ per lead for all other ranges.
OFFSET COMPENSATION: Selectable on 4WΩ, 100Ω, 1kΩ, and 10kΩ ranges.
CONTINUITY THRESHOLD: Adjustable 1 to 1000 Ω.
INPUT PROTECTION: Front, 1000V Source Inputs, 350V Sense Inputs, Rear, 300V, 7702 card only.

DC Current

Shunt Resistors: 100mA–3A, 0.1Ω. 20mA, 5Ω.
Input Protection: 3A, 250V fuse.

DC Notes

[1] 20% overrange except on 1000V and 3A.
[2] Add the following to "ppm of range" uncertainty; 100mV 15ppm, 1V and 100V 2ppm, 100Ω 30ppm, <1MΩ 2ppm, 10mA and 1A 10ppm, 100mA 40ppm.
[3] ±2% (measured with 10MΩ input resistance DMM, >10GΩ DMM on 10MΩ and 100MΩ ranges).
[4] Relative to calibration accuracy.
[5] For signal levels >500V, add 0.02ppm/V uncertainty for portion exceeding 500V.
[6] Specifications are for 4-wire Ω, 100Ω with offset compensation on. With offset compensation on, OPEN CKT. VOLTAGE is 12.8V. For 2-wire Ω add 1Ω additional uncertainty.
[7] Must have 10% matching of lead resistance in Input HI and LO. Test current +0.7µA||10MΩ
[8] Add the following to "ppm of reading" uncertainty when using plug in modules:

	10 kΩ	100 kΩ	1 MΩ	10 MΩ	100 MΩ
7702, 7751, 7752				220 ppm	2200 ppm

[9] Add 1V when used with plug-in modules.
[10] For RATIO, DCV only. For AVERAGE, DCV only. Available with plug-in modules only.
[11] Auto zero off.
[12] For LSYNC On, line frequency ±0.1 %. For LSYNC Off, use 60dB for ≥ 1PLC.
[13] For 1kΩ unbalance in LO lead.
[14] Speeds are for 60Hz (50Hz) operation using factory defaults operating conditions (*RST). Autorange off, Display off, Limits off, Trigger delay = 0.
[15] Speeds include measurements and binary data transfer out the GPIB.
[16] Sample count = 1024, auto zero off.
[17] Auto zero off, NPLC = 0.01.
[18] For lead resistance >0Ω, add the following uncertainty/Ω for measurement temperatures of:

		70°–100°C	100°–150°C
2.2 kΩ	(44004)	0.22°C	1.11°C
5.0 kΩ	(44007)	0.10°C	0.46°C
10 kΩ	(44006)	0.04°C	0.19°C

2790 SourceMeter® Switch System Specifications

MAINFRAME FUNCTION SPECIFICATION

AC MEASUREMENT SPECIFICATIONS[1]

Function	Range	Resolution	All Ranges Calibration Cycle	All Ranges Accuracy: ±(% of reading + % of range), 23°C ±5 °C 3 Hz-10 Hz[13]	10 Hz-20 kHz	20 kHz-50 kHz	50 kHz-100 kHz	100 kHz-300 kHz
Voltage[2]	100.0000 mV	0.1 µV	90 Days	0.35 + 0.03	0.05 + 0.03	0.11 + 0.05	0.6 + 0.08	4.0 + 0.5
	1.000000 V	1.0 µV						
	10.00000 V	10 µV	1 Year	0.35 + 0.03	0.06 + 0.03	0.12 + 0.05	0.6 + 0.08	4.0 + 0.5
	100.0000 V	100 µV						
	750.000 V	1.0 µV						
			(Temp. Coeff.)/°C[3]	0.035 + 0.003	0.005 + 0.003	0.006 + 0.005	0.01 + 0.006	0.03 + 0.01
				3 Hz-10 Hz	**10 Hz-3 kHz**	**3 kHz – 5 kHz**		
Current[2]	1.000000 A	1.0 µA	90 Day/1 Year	0.30 + 0.04	0.10 + 0.04	0.14 + 0.04		
	3.00000[14] A	10 µA		0.35 + 0.06	0.15 + 0.06	0.18 + 0.06		
			(Temp. Coeff.)/°C[3]	0.035 + 0.006	0.015 + 0.006	0.015 + 0.006		
				(3 Hz-500 kHz) (333 ms-2 µs)				
Frequency[4] and Period	100 mV	0.333 ppm	90 Day/1 Year	80 ppm + 0.333 ppm (SLOW, 1s gate)				
	to	3.33 ppm		80 ppm + 3.33 ppm (MED, 100ms gate)				
	750 V	33.3 ppm		80 ppm + 33.3 ppm (FAST, 10ms gate)				

Additional Uncertainty ±(% of reading)

Low Frequency Uncertainty	MED	FAST
20Hz - 30Hz	0.3	—
30Hz - 50Hz	0	—
50Hz - 100Hz	0	1.0
100Hz - 200Hz	0	0.18
200Hz - 300Hz	0	0.10
> 300Hz	0	0

CREST FACTOR[5]:	**1–2**	**2–3**	**3–4**
Additional Uncertainty:	0.05	0.15	0.30

AC MEASUREMENT CHARACTERISTICS

AC Volts

MEASUREMENT METHOD: AC-coupled, True RMS.

INPUT IMPEDANCE: 1MΩ ±2% // by <100pF.

INPUT PROTECTION: 1000Vp or 400VDC, 300Vrms with 7702 module.

AC Current

MEASUREMENT METHOD: AC-coupled, True RMS.

SHUNT RESISTANCE: 0.1Ω.

BURDEN VOLTAGE: 1A <0.3Vrms, 3A <1Vrms. Add 1Vrms when used with 7702 modules.

INPUT PROTECTION: 3A, 250V fuse.

Frequency and Period

MEASUREMENT METHOD: Reciprocal Counting technique.

GATE TIME: SLOW 1s, MED 100ms, and FAST 10ms.

AC General

AC CMRR[6]: 70dB.

MAXIMUM CREST FACTOR: 5 at full-scale.

VOLT HERTZ PRODUCT: <= 8×10^7.

AC OPERATING CHARACTERISTICS[7]

60Hz (50Hz) Operation

Function	Digits	Readings/s	Rate	Bandwidth
ACV, ACI	6.5[8]	2s/Reading	SLOW	3 Hz-300kHz
	6.5[8]	1.4 (1.1)	MED	30 Hz-300kHz
	6.5[9]	4.8 (4)	MED	30 Hz-300kHz
	6.5[9]	35 (28)	FAST	300 Hz-300kHz
Frequency, Period	6.5	1 (1)	SLOW	3 Hz-300kHz
	5.5	9 (9)	MED	30 Hz-300kHz
	4.5	35 (35)	FAST	300 Hz-300kHz
	4.5[10]	65 (65)	FAST	300 Hz-300kHz

2790 SourceMeter® Switch System Specifications

MAINFRAME FUNCTION SPECIFICATION

AC System Speeds[7, 11]

RANGE CHANGES[12]: 4/s (3/s).
FUNCTION CHANGES[12]: 4/s (3/s).
AUTORANGE TIME: < 3s.
ASCII READINGS TO RS-232 (19.2k baud): 50/s.
MAX. INTERNAL TRIGGER RATE: 300/s.
MAX. EXTERNAL TRIGGER RATE: 250/s.

AC Notes

[1] 20% overrange except on 750V and 3A.

[2] Specifications are for SLOW mode and sine wave inputs >5% of range. SLOW and MED are multi-sample A/D conversions. FAST is DETector:BANDwidth 300 with nPLC = 1.0.

[3] Applies to 0°–18°C and 28°–40°C.

[4] Specifications are for square wave inputs only. Input signal must be >10% of ACV range. If input is <20mV on the 100mV range then the frequency must be >10Hz.

[5] Applies to non-sine waves >5Hz and <500Hz. (Guaranteed by design for Crest Factors >4.3)

[6] For 1kΩ unbalance in LO lead.

[7] Speeds are for 60Hz (50Hz) operation using factory defaults operating conditions (*RST). Autorange off, Display off, Limits off, Trigger delay=0. Includes measurement and binary data transfer out GPIB.

[8] 0.01% of step settling error. Trigger delay = 400ms.

[9] Trigger delay = 0.

[10] Sample count = 1024.

[11] DETector:BANDwidth 300 with nPLC = 0.01.

[12] Maximum useful limit with trigger delay = 175ms.

[13] Typical uncertainties. Typical represents two sigma or 95% of manufactured units measure < 0.35% of reading and three sigma or 99.7% < 1.06% of reading.

[14] For signal levels >2.2A, add additional 0.4% to "of reading" uncertainty.

Internal Scanner Speeds:

Into and Out of Memory to GPIB[1]

7702 Scanning DCV: 60/s

Internal Scanner Speed Notes:

[1] Speeds are 60Hz or 50Hz operation using factory default conditions (*RST). NPLC = 0.01. Auto Zero off, Auto Range off, and Display off. Sample count =1024. Includes measurement and binary data transfer out GPIB.

GENERAL SPECIFICATIONS

POWER SUPPLY: 100V / 120V / 220V / 240V.
LINE FREQUENCY: 50Hz to 60Hz and 400Hz, automatically sensed at power-up.
POWER CONSUMPTION: 28VA.
OPERATING ENVIRONMENT: Specified for 0°C to 50°C. Specified to 80% R.H. at 35°C. Altitude up to 2000 meters.
STORAGE ENVIRONMENT: -40°C to 70°C.
BATTERY: Lithium battery-backed memory, 3 years @ 23°C.

EMC: Conforms to European Union Directive 89/336/EEC EN61326-1.
SAFETY: Conforms to European Union Directive 73/23/EEC EN61010-1, CAT I.
VIBRATION: MIL-PRF-28800F Class 3, Random.
WARM-UP: 2 hours to rated accuracy.
DIMENSIONS:
- **Rack Mounting:** 89mm high × 213mm wide × 370mm deep (3.5 in. × 8.375 in. × 14.563 in.).
- **Bench Configuration (with handle and feet):** 104mm high × 238mm wide × 370mm deep (4.125 in. × 9.375 in. × 14.563 in.).

SHIPPING WEIGHT: 6.5kg (14 lbs).
DIGITAL I/O: 2 inputs, 1 for triggering and 1 for hardware interlock. 5 outputs, 4 for Reading Limits and 1 for Master Limit. Outputs are TTL compatible or can sink 250mA, diode clamped to 33V.
EARTH ISOLATION: 500Vpeak, >10GΩ and <150pF any terminal to chassis.
TRIGGERING AND MEMORY:
- **Window Filter Sensitivity:** 0.01%, 0.1%, 1%, 10%, or Full-scale of range (none).
- **Reading Hold Sensitivity:** 0.01%, 0.1%, 1%, or 10% of reading.
- **Trigger Delay:** 0 to 99 hrs (1ms step size).
- **External Trigger Delay:** <2ms.
- **External Trigger Jitter:** <1ms.
- **Memory Size:** 55,000 readings.

MATH FUNCTIONS: Rel, Min/Max/Average/Std Dev/Peak-to-Peak (of stored reading), Limit Test, %, mX + b and m(1/X) +b with user defined units displayed.
REMOTE INTERFACE:
- GPIB (IEEE-488.2) and RS-232C.
- SCPI (Standard Commands for Programmable Instruments)

ACCESSORIES SUPPLIED: User Manual and Reference Manual, Screw Driver.
MODULES SUPPORTED: Models 7751, 7752, and 7702.

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