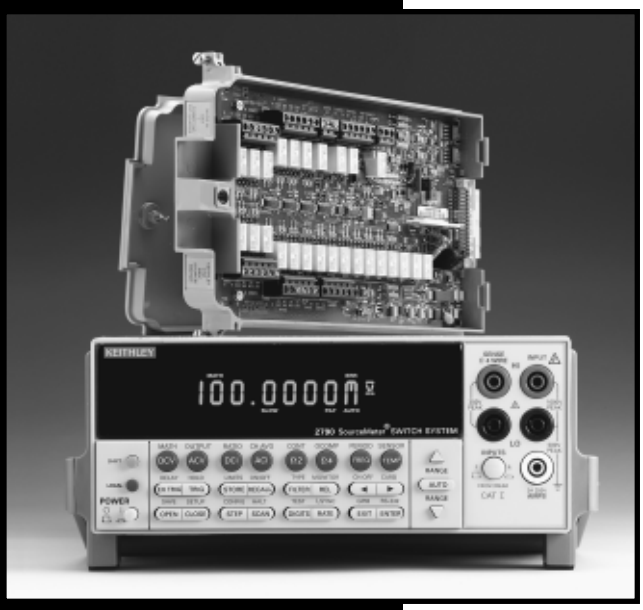
2790

SourceMeter® Airbag Test System



- **Single-instrument solution for continuity and hi-pot type leakage resistance measurements**
- **Programmable constant V source (50–500V) supports high speed, high resistance measurements**
- **Programmable constant I source (0–50mA) with dry circuit clamp helps prevent device stress or damage during low resistance measurements**
- **Modular architecture adapts easily to single or dual inflator testing and to single or dual position test stands and mixed device/signal applications**
- **Expandable multiplexer channels for multipin applications**
- **Included 6½-digit DMM with wide functionality and broad measurement ranges**
- **Intelligent automation support and easy integration with external test hardware**
- **GPIB, RS-232, and digital I/O interfaces for flexible controller options**
- **SCPI programmable for simple code development and future extensions**
- **2-year calibration cycle of modules minimizes maintenance costs and system downtime**

The Model 2790 SourceMeter Switch System is a high voltage, multichannel resistance measurement solution that speeds and simplifies electrical checks of airbag inflators and a variety of other automotive electrical test applications. It is the only commercial instrument that combines all the sourcing, measurement, and signal routing capabilities required to measure insulation resistance and conductor continuity in one compact, affordable package. Through the use of plug-in source/switch modules, the Model 2790 provides programmable high voltage and low current sourcing, plus multichannel switching support. This unique combination of capabilities establishes a new standard for price and performance in airbag inflator and other test applications.

Measure Extreme Resistances with Constant Current or Constant Voltage

The Model 2790 uses the forced constant-current method to measure resistances less than 1kΩ. In this technique, the instrument sources a constant current (I) to the resistance and measures the resulting voltage (V). The amount of current sourced is programmable from 0–50mA. Resistance (R) is calculated (and displayed) using the known current and measured voltage (R = V/I). A 20mV dry circuit clamp is available at sourcing levels up to 1mA for preserving the oxide layers on connectors and other components.

For the 1MΩ to 1GΩ resistance ranges, the forced constant-voltage method is used to measure high resistance. This technique optimizes settling speed and reduces noise, allowing faster, high quality insulation resistance measurements. In addition, by applying high voltages (50–500V), the Model 2790 stresses a dielectric while simultaneously measuring its insulation resistance.

In addition to the resistance measurement functions available through the plug-in source/switch modules, the Model 2790's built-in DMM allows it to make a full range of high precision resistance measurements, as well as AC/DC voltage and current, frequency, and temperature measurements. These DMM functions are available through either front panel jacks or through the addition of a Model 7702 40-channel scanner module. In addition to the shorts/open testing performed with the standard Model 7751, 7752, and 7753 switch/control modules, a wide range of supporting measurements can be made. These supporting measurements simplify creating integrated test solutions for hybrid applications, such as testing complex automotive seating systems, which increasingly combine airbag inflators and seatbelt pre-tensioners, as well as seat heaters, switches, motors, etc.

Newly Enhanced Memory Pattern Test Sequencer

The memory pattern test sequencer allows the mainframe to store and execute pre-programmed test sequences for increased testing throughput. Test setups can be stored as unique memory locations and either recalled by number as needed or scanned in sequence to maximize the number of tests per unit time without command transfer delays due to communication or controller.

Match the System Configuration to the Application

The Model 2790 is available in a variety of configurations to match specific application requirements:

- The **Model 2790-H** is a single-module system designed for both low current and high voltage ohms (10MΩ to 1GΩ) applications. This "base" system provides all the capabilities needed for electrical testing of either single- or dual-stage

ACCESSORIES AVAILABLE

MODULES	
7702	40-Channel General Purpose Multiplexer Module
7751	High Voltage Source/Switch Module
7752	Low Voltage, Current-Source-Only Source/Switch Module
7753	1MΩ High Voltage Source/Switch Module (The Model 2790 supports only one Model 7753.)
COMMUNICATION INTERFACES AND CABLES	
KPCI-488	GPIB/IEEE-488 Interface for the PCI bus
7008-3, -6	Low Cost Shielded GPIB Cable, 0.9m (3 ft) or 1.8m (6 ft)
7009-5	Shielded RS-232 Cable
SOFTWARE	
TestPoint	Test Development Software
RACK MOUNT KITS	
4288-1, -2	Single or Dual Fixed Rack Mount Kit
OTHER	
2790-EW	1 Year Extended Warranty
8503	Trigger Link Cable to 2 Male BNC Connector
8681	Miniature 4-Wire RTD, 100Ω

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Multichannel resistance measurements for airbag inflator, harness, and connector testing

DMMs, DATA ACQ./SWITCH SYSTEMS

Multichannel resistance measurements for airbag inflator, harness, and connector testing

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SourceMeter® Airbag Test System

Ordering Information

2790-A	**1MΩ single-module system for low and high voltage/ resistance applications**
2790-H	**Single-module system for low and high voltage/resistance applications**
2790-HH	**Two-module system for low and high voltage/resistance applications**
2790-HL	**Two-module system for separating high and low voltage/resistance applications**
2790-L	**Single-module system for low voltage/ resistance-only programmable current applications**
7702	**40-Channel Differential Multiplexer**

Accessories Supplied

Reference and user manuals on CD-ROM, AC line power cord, mini flathead screwdriver.

APPLICATIONS

- **Automotive airbag inflator/ module electrical functional tests**
- **Seatbelt pre-tensioner actuator/ module functional electrical check**
- **High speed parallel soak dual inflator or dual test station electrical check**
- **Pinched wire high voltage insulation resistance testing in automotive seats, avionics, etc.**
- **Multipin connector/harness continuity and leakage resistance measurements**
- **Multicontact/switch dry circuit continuity and leakage tests**
- **Automotive power/fuse center continuity and leakage resistance characterization**
- **PCB/PWB and general purpose short/open circuits testing**

inflators in single position test stands (for example., test stands that test only one single- or dual-stage airbag at a time).

- The **Model 2790-A**, which is similar to the Model 2790-H, enables high voltage ohms measurements down to 1MΩ.
- The **Model 2790-HH** is configured for applications that require parallel testing or high voltage "soaking." Like the Model 2790-H, it is designed for both low current and high voltage ohms applications and can test either single- or dual-stage inflators. However, with two plug-in modules, it also has the capacity to test two inflators at once, maximizing test throughput.
- The **Model 2790-HL** is designed for applications where it is preferable to segregate high voltage sourcing/ohms measurement and low current sourcing/ohms measurement into two separate modules. This design was developed for use in combination testing applications, such as inflator electrical checks of safety steering wheel or seat assemblies that also include switch or other ancillary device tests.
- The **Model 2790-L** is configured for low voltage source/ohms-only measurement applications, such as continuity-only testing of side/seat airbags and seatbelt pre-tensioners or other programmable I-source resistance applications in which high voltage resistance testing is not required but precise control of source current is.
- With the addition of a Model 7702 40-channel differential multiplexer module (part of the Integra family of switch/measure solutions), the **Model 2790-A, -H, or -L + Model 7702** opens the door to higher channel count applications, such as hi-pot/continuity testing of connectors, harnesses, and power distribution devices up to 500V (internally sourced) up to 40 channels.

Broad Range of Measurement Capabilities

The Model 2790's built-in DMM can make a wide variety of general purpose measurements:

- DC voltage measurements from 0.1μV to 1000V
- AC voltage measurements from 0.1μV to 750V
- DC current measurements from 10nA to 3A
- AC current measurements from 1μA to 3A
- 2-wire resistance measurements from 100μΩ to 120MΩ
- 4-wire resistance measurements from 100μΩ to 120MΩ
- Frequency measurements from 3Hz to 500kHz
- Period measurements from 333ms to 2μs
- Temperature measurements from -200°C to 630°C (thermistors and 4-wire RTDs)

Additional features of the Model 2790 mainframe include:

- Set-up storage—Up to four instrument setups can be saved and recalled.
- Offset-compensated ohms—A two-measurement process for 4-wire ohms to cancel the effects of thermoelectric EMFs. Available for the 100Ω, 1kΩ, and 10kΩ ranges.
- Math—m/X+b, mX+b, percent, and four special math functions provide convenient manipulation of raw readings.
- Relative—Null offsets establish baseline values.
- Ratio and channel average—Ratio and average calculations for two switching module channels (7702).
- Buffer—Store up to 55,000 readings in the internal buffer.
- Limits—Two sets of high and low reading limits to test devices.
- Digital I/O port—Five digital limit test output lines to control external circuitry. An external trigger input can also be accessed at this port.
- Trigger Link—Separate connector with input and output signals.
- Monitor—The Model 2790 can monitor a selected channel. A scan can be triggered to start when the monitor detects that a reading limit has been reached (7702).
- Remote interface—Model 2790 can be controlled using the IEEE-488 interface (GPIB) or the RS-232 interface.

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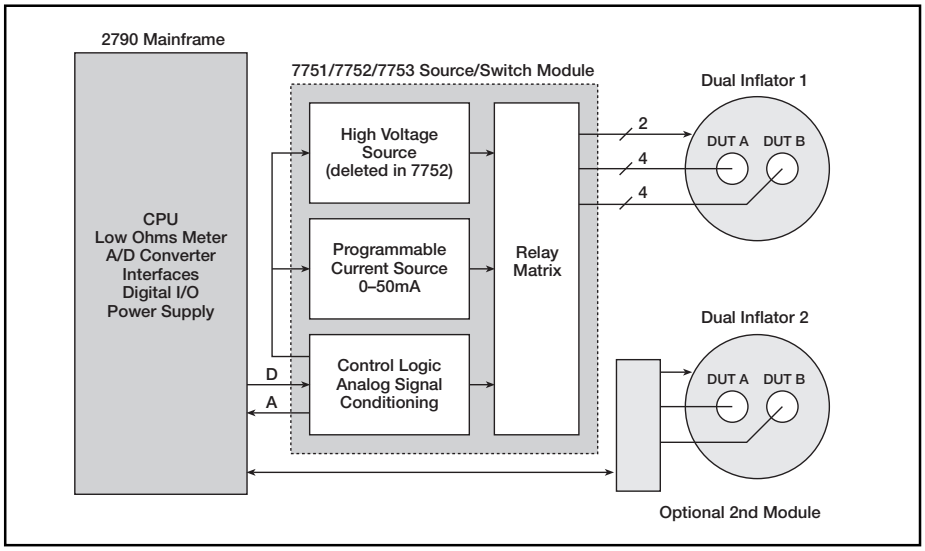
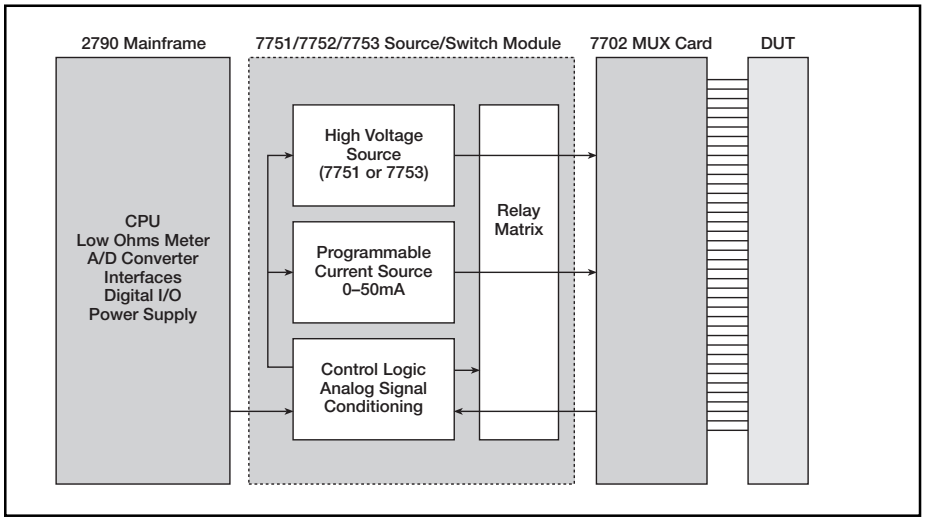
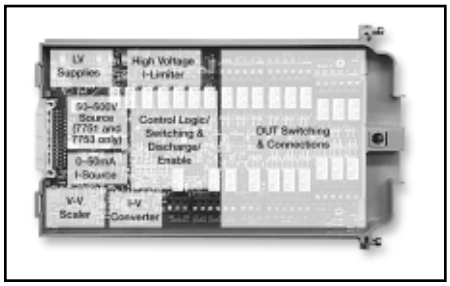
Example Application – Dual Stage Airbag Inflator Testing–One or Two



Example Application – 40-Channel Wiring Harness Testing





Three new source/switch plug-in modules provide the Model 2790 with programmable high voltage and low current sources, connection switching, and signal conditioning circuitry.

Model 2790 Benefits

- **High functional integration**—Sourcing, measurement, and signal routing functions are tightly integrated in one compact enclosure. This high level of integration helps system integrators save rack space, minimize the time needed for system configuration and maintenance, and improve test throughput without sacrificing system accuracy.
- **Enhanced device protection**—Compared to higher powered alternatives, the Model 2790's inherently lower power sources minimize the possibility of damaging sensitive devices under test through accidental overpowering. Automatic cold switching and active cable discharge circuitry reduce the chances for device damage still further, while the high precision DMM and A/D converter ensure high resolution and measurement accuracy.
- **Reliability**—The design of the Model 2790 is based on a proven Keithley technology platform. With a two-year calibration cycle for the module functions, it requires minimal maintenance over the life of the production test line. Its modular mainframe and plug-ins architecture makes module verification and calibration fast and convenient, simply by exchanging modules.
- **Value**—In addition to being a complete solution for airbag inflator testing and related applications, the Model 2790's fully functional, 6½-digit DMM supports a wide variety of general purpose DC and AC measurements.

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	TYPICAL OPEN CIRCUIT VOLTAGE	ACCURACY (4W) ±(% rdg. + ohms)	TEMPERATURE COEFFICIENT (0–18°C & 28–40°C) ±(%rdg. + ohms)/°C
50 mA	20 Ω	5.5 V	0.09% + 2 mΩ	0.002% + 3 mΩ
20 mA	50 Ω	5.5 V	0.11% + 5 mΩ	0.003% + 3 mΩ
10 mA	100 Ω	5.5 V	0.16% + 10 mΩ	0.004% + 3 mΩ
(Dry Circuit Ohms 1mA max with 7751, 7752, or 7753 card)				
1 mA	10 Ω	20 mV	1.10% + 50 mΩ	(0.026% + 3 mΩ)/°C

(7751 Only)

SOURCE VOLTAGE	RESISTANCE RANGE	MAXIMUM SHORT CIRCUIT CURRENT	ACCURACY ±(% rdg.)	TEMPERATURE COEFFICIENT (0–18°C & 28–40°C) ±(%rdg.)/°C
500 V	10 MΩ	<1 mA	0.8%	0.03%
500 V	100 MΩ	<1 mA	1.1%	0.05%
500 V	1 GΩ	<1 mA	4.0%	0.12%
50 V	1 MΩ	<1 mA	1.1%	0.04%
50 V	10 MΩ	<1 mA	1.1%	0.06%
50 V	100 MΩ	<1 mA	1.6%	0.13%

(7753 Only)

SOURCE VOLTAGE	RESISTANCE RANGE	MAXIMUM SHORT CIRCUIT CURRENT	ACCURACY ±(% rdg.)	TEMPERATURE COEFFICIENT (0–18°C & 28–40°C) ±(%rdg.)/°C
500 V	1 MΩ	<1 mA	0.8%	0.02%
500 V	10 MΩ	<1 mA	0.9%	0.03%
500 V	100 MΩ	<1 mA	1.3%	0.10%
500 V	1 GΩ	<1 mA	6.7%	0.27%
50 V	0.1 MΩ	<1 mA	1.1%	0.03%
50 V	1 MΩ	<1 mA	1.1%	0.04%
50 V	10 MΩ	<1 mA	1.3%	0.11%
50 V	100 MΩ	<1 mA	4.5%	0.30%

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 year 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) (2 year specification).
SETTLING TIME: **Rise Time:** 50V to 500V step, 0.1% of final value, 250ms max.
Fall Time: 500V to 50V step, 0.1% of final value, 1000ms 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.
MAXIMUM CAPACITANCE: 1nF.

CURRENT MEASURE INPUT (7751/7753 Only)

RANGE: 7751: 0–50μA. **7753:** 0–500μA.
ACCURACY: 7751: ±(0.5% of reading + 6nA) (2 year specification).
7753: ±(0.5% of reading + 60nA) (2 year 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: Four 4-pole or eight 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 (typical): $>10^6$ operations at maximum source level.
$>10^8$ operations cold switching.
CONTACT RESISTANCE: <1Ω 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/s[1].
Low Ohms (Source I): 9 rdgs/s.

1 NPLC, FILTER ON, OVER GPIB BUS: **High Ohms (Source V):** 11 rdgs/s[1].
Low Ohms (Source I): 7 rdgs/s.

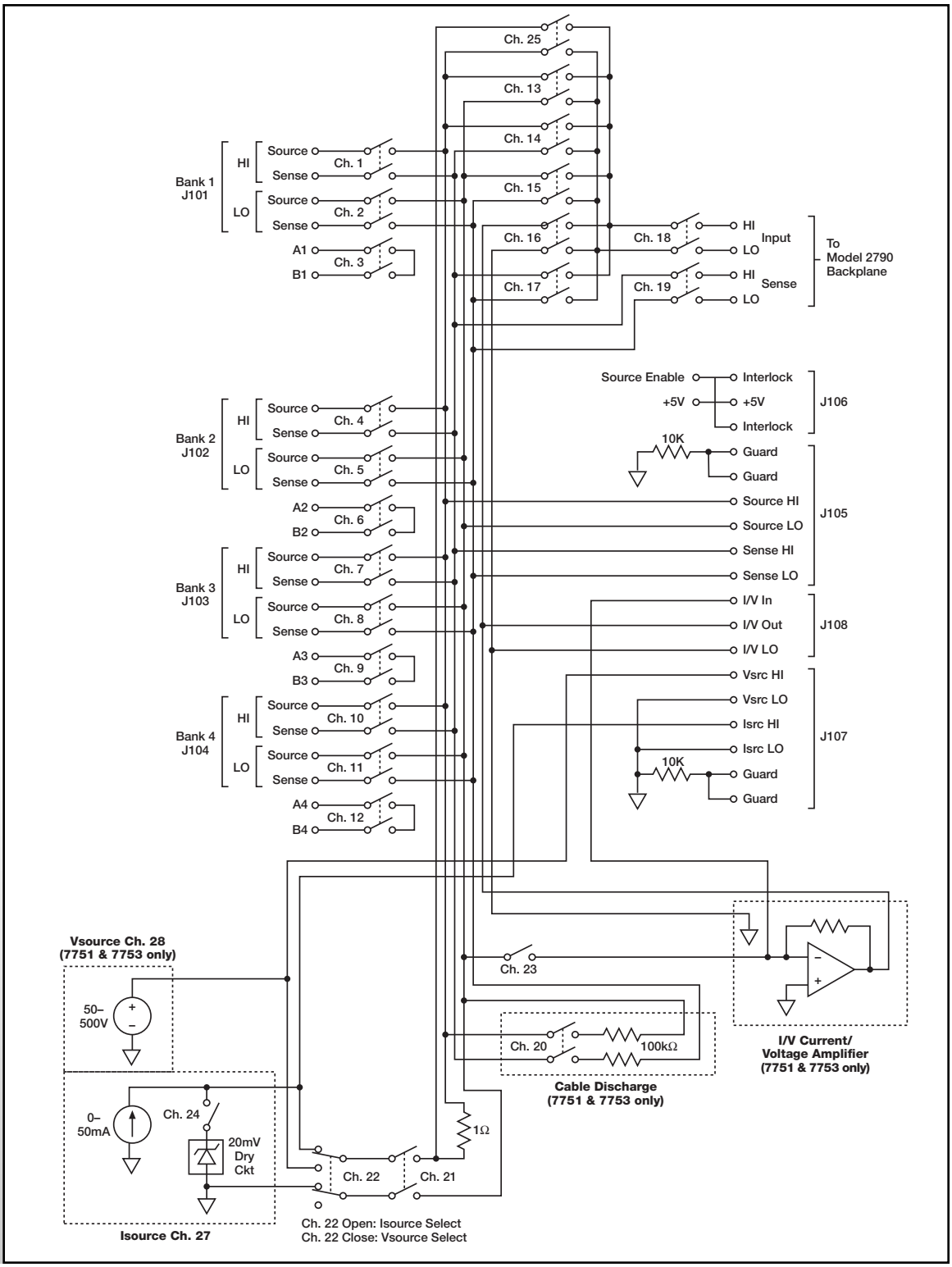
SYSTEM THROUGHPUT NOTES

1 Reset upon fixed Vsource level, no settling time.

BASIC AIRBAG TEST SEQUENCE THROUGHPUT

(Body Pin + Bridgewire Continuity = Shorting Clip + Insulation Resistance)
0.55/0.97 seconds for single/dual stage DUT w/scan (sequential) memory patterns.
1.0/2.0 seconds for single/dual stage DUT w/recall (random access) memory patterns.
1.1/1.7 seconds for single/dual stage DUT discrete control w/GPIB I/O.
(Sequence times are totals @ 1 line cycle integration for rated accuracy.)

Source/Switch Module Functional Diagram



2790 SourceMeter® Airbag Test System

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], 10 PLC. or MED (1 PLC) with Digital Filter of 10.

FUNCTION	RANGE	RESOLUTION	TEST CURRENT (±5%) OR BURDEN VOLTAGE	INPUT RESISTANCE OR OPEN CIRCUIT VOLTAGE[3]	ACCURACY ±(ppm of reading + ppm of range) (ppm = parts per million, e.g., 10ppm = 0.001%) 24 Hour[4] 23°C ±1°	90 Day 23°C ±5°	1 Year 23°C ±5°	TEMPERATURE COEFFICIENT ±(ppm of reading + ppm of range)/°C 0°–18°C & 28°–40°C
Voltage	100.0000 mV	0.1 µV		>10 GΩ	15 + 30	25 + 70	30 + 70	(1 + 5)
	1.000000 V	1.0 µV		>10 GΩ	15 + 6	25 + 7	30 + 7	(1 + 1)
	10.00000 V	10 µV		>10 GΩ	10 + 4	20 + 5	30 + 5	(1 + 1)
	100.0000 V	100 µV		10 MΩ ±1%	15 + 6	45 + 9	55 + 9	(5 + 1)
	1000.000 V[5]	1 mV		10 MΩ ±1%	20 + 6	35 + 9	50 + 9	(5 + 1)
Resistance[6, 8]	100.0000 Ω	100 µΩ	1 mA	6.6 V	20 + 20	80 + 20	100 + 20	(8 + 1)
	1.000000 kΩ	1 mΩ	1 mA	6.6 V	20 + 6	80 + 6	100 + 6	(8 + 1)
	10.00000 kΩ	10 mΩ	100 µA	6.6 V	20 + 6	80 + 6	100 + 6	(8 + 1)
	100.0000 kΩ	100 mΩ	10 µA	12.8 V	20 + 6	80 + 10	100 + 10	(8 + 1)
	1.000000 MΩ	1.0 Ω	10 µA	12.8 V	20 + 6	80 + 10	100 + 10	(8 + 1)
	10.00000 MΩ[7]	10 Ω	Note 7	7.0 V	150 + 6	200 + 10	400 + 10	(70 + 1)
	100.0000 MΩ[7]	100 Ω	Note 7	7.0 V	800 + 30	3000 + 30	3000 + 30	(385 + 1)
Continuity (2W)	1.000 kΩ	100 mΩ	1 mA	6.6 V	40 + 100	100 + 100	100 + 100	(8 + 1)
Current	20.00000 mA	10 nA	<0.2 V		60 + 30	300 + 80	500 + 80	(50 + 5)
	100.0000 mA	100 nA	<0.05 V		100 + 300	300 + 800	500 + 800	(50 + 50)
	1.000000 A	1.0 µA	<0.3 V[9]		200 + 30	500 + 80	800 + 80	(50 + 5)
	3.000000 A	10 µA	<1.0 V[9]		1000 + 15	1200 + 40	1200 + 40	(50 + 5)
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	6.515	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)	6.515	2.5	(2)	10
	6.5[15]	15	(12)	1
	5.5[16]	25	(20)	0.1

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.

2790 MAINFRAME FUNCTION SPECIFICATION

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: <500nA p-p at 50Hz or 60Hz.

INPUT PROTECTION: Front, 1000V, Rear, 300V, 7702 card only.

RESISTANCE

MAXIMUM 4WΩ LEAD RESISTANCE: 10% of range per lead for 100Ω and 1kΩ ranges; 1kW per lead for all other ranges.

OFFSET COMPENSATION: Selectable on 4WΩ, 100Ω, 1kΩ, and 10kΩ ranges.

CONTINUITY THRESHOLD: Adjustable 1 to 1000Ω.

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

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
CURRENT[2]				3 Hz–10 Hz	10 Hz–3 kHz	3 kHz–5 kHz		
	1.000000 A	1.0 μA	90 Day/1 Year	0.30 + 0.04	0.10 + 0.04	0.14 + 0.04		
	3.00000 A[14]	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		
FREQUENCY[4] AND PERIOD				(3 Hz–500 kHz) (333 ms–2 μs)				
	100 mV to 750 V	0.333 ppm	90 Day/1 Year	80 ppm + 0.333 ppm (SLOW, 1s gate)				
		3.33 ppm		80 ppm + 3.33 ppm (MED, 100ms gate)				
		33.3 ppm		80 ppm + 33.3 ppm (FAST, 10ms gate)				

Additional Uncertainty ±(% of reading)

LOW FREQUENCY UNCERTAINTY	MED	FAST
20 Hz– 30 Hz	0.3	—
30 Hz– 50 Hz	0	—
50 Hz–100 Hz	0	1.0
100 Hz–200 Hz	0	0.18
200 Hz–300 Hz	0	0.10
>300 Hz	0	0

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

2790 SourceMeter® Airbag Test System

AC MEASUREMENT CHARACTERISTICS

AC VOLTS

MEASUREMENT METHOD: AC coupled, true RMS.

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

INPUT PROTECTION: 1000V peak or 400V DC, 300V rms with 7702 module.

AC CURRENT

MEASUREMENT METHOD: AC coupled, true RMS.

SHUNT RESISTANCE: 0.1Ω.

BURDEN VOLTAGE: 1A <0.3V rms, 3A <1V rms. Add 1V rms 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: $\leq 8 \times 10^7$.

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

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.

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

MODULES SUPPORTED: Models 7751, 7752, and 7702.

POWER SUPPLY: 100V/120V/220V/240V.

LINE FREQUENCY: 50Hz to 60Hz and 400Hz, automatically sensed at power-up.

POWER CONSUMPTION: 28VA.

BATTERY: Lithium battery-backed memory, 3 years @ 23°C.

WARRANTY: 1 year.

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.

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), RS-232C, SCPI (Standard Commands for Programmable Instruments)

WARM-UP: 2 hours to rated accuracy.

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.

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).

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.

KEITHLEY

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