

SOURCE SPECIFICATIONS¹

Voltage Programming Accuracy (4-wire sense)²

Range	Programming Resolution	Accuracy (1 Year) 23°C ±5°C ±% rdg. + volts	Noise (peak-peak) 0.1Hz – 10Hz
200.000 mV	5 µV	0.02% + 600 µV	5 µV
2.00000 V	50 µV	0.02% + 600 µV	50 µV
20.0000 V	500 µV	0.02% + 2.4 mV	500 µV
200.000 V	5 mV	0.02% + 24 mV	5 mV

TEMPERATURE COEFFICIENT (0°–18°C & 28°–40°C):
±(0.15 × accuracy specification)/°C.

MAX. OUTPUT POWER: 2.2W (four quadrant source or sink operation).

SOURCE/SINK LIMITS: ±21V @ ±105mA, ±210V @ ±10.5mA.

VOLTAGE REGULATION: Line: 0.01% of range.
Load: 0.01% of range + 100µV.

NOISE 10Hz–1MHz (p-p): 10mV.

OVER VOLTAGE PROTECTION: User selectable values, 5% tolerance.
Factory default = None.

CURRENT LIMIT: Bipolar current limit (compliance) set with single value.
Min. 0.1% of range.

Current Programming Accuracy (with remote preamp)

Range	Programming Resolution	Accuracy (1 Year) ¹ 23°C ±5°C ±% rdg. + amps	Noise (peak-peak) 0.1Hz – 10Hz
1.00000 pA	50 aA	1.0 % + 10 fA	5 fA
10.0000 pA	500 aA	0.50 % + 30 fA	10 fA
100.000 pA	5 fA	0.15 % + 40 fA	20 fA
1.00000 nA	50 fA	0.050 % + 200 fA	50 fA
10.0000 nA	500 fA	0.050 % + 2 pA	500 fA
100.000 nA	5 pA	0.050 % + 20 pA	3 pA
1.00000 µA	50 pA	0.050 % + 300 pA	20 pA
10.0000 µA	500 pA	0.050 % + 2 nA	200 pA
100.000 µA	5 nA	0.031 % + 20 nA	500 pA
1.00000 mA	50 nA	0.034 % + 200 nA	5 nA
10.0000 mA	500 nA	0.045 % + 2 µA	50 nA
100.000 mA	5 µA	0.066 % + 20 µA	500 nA

Current Programming Accuracy (without remote preamp)

Range	Programming Resolution	Accuracy (1 Year) ¹ 23°C ±5°C ±% rdg. + amps	Noise (peak-peak) 0.1Hz – 10Hz
1.00000 µA	50 pA	0.035 % + 600 pA	20 pA
10.0000 µA	500 pA	0.033 % + 2 nA	200 pA
100.000 µA	5 nA	0.031 % + 20 nA	500 pA
1.00000 mA	50 nA	0.034 % + 200 nA	5 nA
10.0000 mA	500 nA	0.045 % + 2 µA	50 nA
100.000 mA	5 µA	0.066 % + 20 µA	50 nA

TEMPERATURE COEFFICIENT (0°–18°C & 28°–40°C):
±(0.15 × accuracy specification)/°C.

MAX. OUTPUT POWER: 2.2W (four quadrant source or sink operation).

SOURCE/SINK LIMITS: ±10.5mA @ 210V, ±105mA @ 21V.

CURRENT REGULATION: Line: 0.01% of range.
Load: 0.01% of range + 1fA.

VOLTAGE LIMIT: Bipolar voltage limit (compliance) set with single value.
Min. 0.1% of range.

¹ For sink mode, 1pA to 100mA range, accuracy is ±(0.15% + offset*4).

² Voltage source accuracies are not affected by the remote preamp.

ADDITIONAL SOURCE SPECIFICATIONS

COMMAND PROCESSING TIME: Maximum time required for the output to begin to change following the receipt of :SOURCE:VOLTage|CURRent <nr> command.

Autorange On: 10ms. Autorange Off: 7ms.

OUTPUT SETTling TIME (typical to 10% of final value): <2s, 1pA and 10pA ranges; <50ms, 100pA through 10nA ranges; <5ms, 100nA through 100mA ranges.

OUTPUT SLEW RATE: 30V/ms, any V range, 10mA compliance.

COMMON MODE VOLTAGE: ±42VDC maximum.

4-WIRE SENSE: Up to 1V drop per load lead, 10Ω maximum per sense lead, 100µA range and up. For details on using 4-wire sense with the 10µA range and below, refer to the User's Manual.

OVER TEMPERATURE PROTECTION: Internally sensed temperature overload puts unit in standby mode.

RANGE CHANGE OVerSHOOT: Overshoot into a fully resistive 100kΩ load, 10Hz to 1MHz BW, adjacent ranges, 100mV typical, except 20V/200V range boundary.

MINIMUM COMPLIANCE VALUE: 0.1% of range.

MEASURE SPECIFICATIONS¹

Voltage Measurement Accuracy (4-wire sense)³

Range	Max. Resolution	Input ² Resistance	Accuracy (23°C ± 5°C) 1 Year, ±(%rdg + volts)
200.000 mV	1 µV	>10 ¹⁶ Ω	0.012% + 350 µV
2.00000 V	10 µV	>10 ¹⁶ Ω	0.012% + 350 µV
20.0000 V	100 µV	>10 ¹⁶ Ω	0.015% + 1.5 mV
200.000 V	1 mV	>10 ¹⁶ Ω	0.015% + 10 mV

TEMPERATURE COEFFICIENT (0°–18°C & 28°–40°C):
±(0.15 × accuracy specification)/°C.

ADDITIONAL MEASURE SPECIFICATIONS

OUTPUT SETTLING TIME (typical to 10% of final value): <2s, 1pA and 10pA ranges; <50ms, 100pA through 10nA ranges; <5ms, 100nA through 100mA ranges.

CURRENT NOISE: When observed over 1 minute intervals, peak to peak noise will be within 400aA during 90% of the intervals using Autofilter (5s 10% to 90% rise time), with triax connectors capped, Autozero OFF, Source Delay = 0, on the 1pA range for at least 3 minutes.

Current Measurement Accuracy (2- or 4-wire sense)⁴

Range	Max. Resolution	Voltage Burden ⁵	Accuracy (23°C ± 5°C) 1 Year ±(%rdg + amps)
1.00000 pA	10 aA	< 1mV	1.0 % + 7 fA
10.0000 pA	100 aA	< 1mV	0.50 % + 7 fA
100.000 pA	1 fA	< 1mV	0.15 % + 30 fA
1.00000 nA	10 fA	< 1mV	0.050 % + 200 fA
10.0000 nA	100 fA	< 1mV	0.050 % + 2 pA
100.000 nA	1 pA	< 1mV	0.050 % + 20 pA
1.00000 µA	10 pA	< 1mV	0.050 % + 300 pA
10.0000 µA	100 pA	< 1mV	0.050 % + 2 nA
100.000 µA	1 nA	< 1mV	0.025 % + 6 nA
1.00000 mA	10 nA	< 1mV	0.027 % + 60 nA
10.0000 mA	100 nA	< 1mV	0.035 % + 600 nA
100.000 mA	1 µA	< 1mV	0.055 % + 6 µA

TEMPERATURE COEFFICIENT (0°–18°C & 28°–40°C):
±[(0.15 × accuracy specification) + 1fA]/°C.

INPUT CURRENT: <3fA at 23°C, <40% RH; typically ±0.5fA/°C around 23°C, <40% RH.

Resistance Measurement Accuracy (4-wire sense with remote preamp)

Source I Mode, Auto Ohms

Range	Max. Resolution	Default Test Current	Normal Accuracy (23°C ± 5°C) 1 Year, ±(%rdg + ohms)	Enhanced Accuracy (23°C ± 5°C) ⁷ 1 Year, ±(%rdg + ohms)
<2.00000 Ω ⁶	1 µΩ	—	Source I _{ACC} + Measure V _{ACC}	Measure I _{ACC} + Measure V _{ACC}
2.00000 Ω	100 µΩ	100 mA	0.098% + 0.003 Ω	0.068% + 0.001 Ω
200.000 Ω	1 mΩ	10 mA	0.077% + 0.03 Ω	0.048% + 0.01 Ω
2.00000 kΩ	10 mΩ	1 mA	0.066% + 0.3 Ω	0.040% + 0.1 Ω
20.0000 kΩ	100 mΩ	100 µA	0.063% + 3 Ω	0.038% + 1 Ω
200.000 kΩ	1 Ω	10 µA	0.082% + 30 Ω	0.064% + 10 Ω
2.00000 MΩ	10 Ω	1 µA	0.082% + 300 Ω	0.064% + 100 Ω
20.0000 MΩ	100 Ω	1 µA	0.085% + 1 kΩ	0.067% + 500 Ω
200.000 MΩ	1 kΩ	100 nA	0.085% + 10 kΩ	0.068% + 5 kΩ
2.00000 GΩ	10 kΩ	10 nA	0.085% + 100 kΩ	0.070% + 50 kΩ
20.0000 GΩ	100 kΩ	1 nA	0.085% + 1 MΩ	0.070% + 500 kΩ
200.000 GΩ	1 MΩ	100 pA	0.205% + 10 MΩ	0.185% + 5 MΩ
2.00000 TΩ	10 MΩ	10 pA	0.822% + 100 MΩ	0.619% + 50 MΩ
20.0000 TΩ	100 MΩ	1 pA	2.06% + 1 GΩ	1.54% + 500 MΩ
>20.0000 TΩ ⁶	—	—	Source I _{ACC} + Measure V _{ACC}	Measure I _{ACC} + Measure V _{ACC}

Resistance Measurement Accuracy (4-wire sense without remote preamp)

Source I Mode, Auto Ohms

Range	Max. Resolution	Default Test Current	Normal Accuracy (23°C ± 5°C) 1 Year, ±(%rdg + ohms)	Enhanced Accuracy (23°C ± 5°C) ⁷ 1 Year, ±(%rdg + ohms)
<2.00000 Ω ⁶	1 µΩ	—	Source I _{ACC} + Measure V _{ACC}	Measure I _{ACC} + Measure V _{ACC}
2.00000 Ω	100 µΩ	100 mA	0.098% + 0.003 Ω	0.068% + 0.001 Ω
200.000 Ω	1 mΩ	10 mA	0.077% + 0.03 Ω	0.048% + 0.01 Ω
2.00000 kΩ	10 mΩ	1 mA	0.066% + 0.3 Ω	0.040% + 0.1 Ω
20.0000 kΩ	100 mΩ	100 µA	0.063% + 3 Ω	0.038% + 1 Ω
200.000 kΩ	1 Ω	10 µA	0.082% + 30 Ω	0.040% + 10 Ω
2.00000 MΩ	10 Ω	1 µA	0.082% + 300 Ω	0.042% + 100 Ω
20.0000 MΩ	100 Ω	1 µA	0.085% + 1 kΩ	0.045% + 500 Ω
200.000 MΩ	1 kΩ	100 nA	0.085% + 10 kΩ	0.349% + 5 kΩ

TEMPERATURE COEFFICIENT (0°–18°C & 28°–40°C):
±(0.15 × accuracy specification)/°C.

SOURCE I MODE, MANUAL OHMS: Total uncertainty = I source accuracy + V measure accuracy (4-wire sense).

SOURCE V MODE: Total uncertainty = V source accuracy + I measure accuracy (4-wire sense).

6-WIRE OHMS MODE: Available using active ohms guard and guard sense (mainframe rear panel ONLY). Max. Guard Output Current: 50 mA. Accuracy is load dependent. Refer to manual for calculation formula.

MAINFRAME GUARD OUTPUT RESISTANCE: 0.1Ω in ohms mode.

¹ Speed = 10 PLC, Autofilter ON, properly zeroed and settled.

² Source I mode, I = 0.

³ Voltage measurement accuracy is not affected by the remote preamp.

⁴ Current measurement accuracy is not affected by the remote preamp; however, the 1pA through 100nA ranges are available only when using a preamp.

⁵ 4-wire mode.

⁶ Manual ohms mode only.

⁷ Source readback enabled, offset compensation ON. Source delay must be programmed such that the source is fully settled for each reading.

SYSTEM SPEEDS

MEASUREMENT¹

MAXIMUM RANGE CHANGE RATE: 75/second.

SWEEP OPERATION² READING RATES (rdg/second) FOR 60Hz (50Hz):

Speed	NPLC/Trigger Origin	Measure		Source-Measure		Source-Measure Pass/Fail Test ³		Source-Memory ³	
		To Mem.	To GPIB	To Mem.	To GPIB	To Mem.	To GPIB	To Mem.	To GPIB
Fast	0.01 / internal	2080 (2030)	1210 (1210)	1550 (1515)	1010 (1010)	930 (900)	840 (840)	163 (162)	163 (162)
	0.01 / external	1250 (1200)	1090 (1050)	1030 (990)	920 (920)	860 (830)	780 (780)	161 (160)	161 (160)
Medium	0.10 / internal	505 (433)	505 (433)	465 (405)	465 (405)	390 (343)	390 (343)	132 (126)	132 (126)
	0.10 / external	435 (380)	435 (380)	405 (360)	405 (360)	375 (333)	375 (333)	130 (125)	130 (125)
Normal	1.00 / internal	59 (49)	59 (49)	58 (48)	58 (48)	57 (47)	57 (47)	44 (38)	44 (38)
	1.00 / external	57 (48)	57 (48)	57 (48)	57 (48)	56 (47)	56 (47)	44 (38)	44 (38)

SINGLE READING OPERATION READING RATES (rdg/second) FOR 60Hz (50Hz):

Speed	NPLC/Trigger Origin	Measure	Source-Measure ⁴	Source-Measure Pass/Fail Test ^{3,4}
		To GPIB	To GPIB	To GPIB
Fast	0.01 / internal	256 (256)	83 (83)	83 (83)
Medium	0.10 / internal	181 (166)	73 (70)	73 (70)
Normal	1.00 / internal	49 (42)	35 (31)	34 (30)

COMPONENT HANDLER INTERFACE TIME: ^{3,5}

Speed	NPLC/Trigger Origin	Measure Pass/Fail Test		Source Pass/Fail Test	Source-Measure Pass/Fail Test ⁶
Fast	0.01 / external	1.01 ms	(1.08 ms)	0.5 ms (0.5 ms)	5.3 ms (5.3 ms)
Medium	0.10 / external	2.5 ms	(2.9 ms)	0.5 ms (0.5 ms)	6.7 ms (7.1 ms)
Normal	1.00 / external	17.5 ms	(20.9 ms)	0.5 ms (0.5 ms)	21.7 ms (25.0 ms)

¹ Reading rates applicable for voltage or current measurements. Auto zero off, autorange off, filter off, display off, trigger delay = 0, source auto clear off, and binary reading format.

² 1000 point sweep was characterized with the source on a fixed range.

³ Pass/Fail test performed using one high limit and one low math limit.

⁴ Includes time to re-program source to a new level before making measurement.

⁵ Time from falling edge of START OF TEST signal to falling edge of END OF TEST signal.

⁶ Command processing time of :SOURce:VOLTage|CURRent:TRIGgered <nrf> command not included.

GENERAL

NOISE REJECTION:

	NPLC	NMRR	CMRR
Fast	0.01	—	80 dB
Medium	0.1	—	80 dB
Normal	1	60 dB	90 dB

LOAD IMPEDANCE: Stable into 20,000pF on the 100mA through 100µA ranges, 470pF on the 10µA and 1µA ranges, and 100pF on the nA and pA ranges. Refer to the User's Manual for details on measuring large capacitive loads.

COMMON MODE VOLTAGE: ±42VDC maximum.

COMMON MODE ISOLATION: >10⁶Ω, <1000pF

OVERRANGE: 105% of range, source and measure.

MAX. VOLTAGE DROP BETWEEN INPUT/OUTPUT AND SENSE TERMINALS: 5V. (To meet specified accuracy with 4-wire sense, refer to the User's Manual.)

MAX. SENSE LEAD RESISTANCE: 10Ω for rated accuracy.

SENSE INPUT RESISTANCE: 1MΩ.

MAINFRAME GUARD OFFSET VOLTAGE: 300µV, typical.

PREAMP GUARD OFFSET VOLTAGE: 1mV, typical.

PREAMP GUARD OUTPUT RESISTANCE: 110kΩ.

SOURCE OUTPUT MODES:

- Fixed DC level
- Memory List (mixed function)
- Stair (linear and log)

SOURCE MEMORY LIST: 100 points max.

MEMORY BUFFER: 5,000 readings @ 5½ digits (two 2,500 point buffers). Includes selected measured value(s) and time stamp. Lithium battery backup (3 yr+ battery life).

PROGRAMMABILITY: IEEE-488 (SCPI-1995.0), RS-232, 5 user-definable power-up states plus factory default and *RST.

DIGITAL INTERFACE:

Safety Interlock: Active low input.

Handler Interface: Start of test, end of test, 3 category bits. +5V @ 300mA supply.
Digital I/O: 1 trigger input, 4 TTL/Relay Drive outputs (33V @ 500mA sink, diode clamped).

POWER SUPPLY: 100V–240V rms, 50–60Hz (automatically detected at power up), 100VA max.

WARRANTY: 1 year.

EMC: Conforms with European Union Directive 89/336/EEC EN 55011, EN 50082-1, EN 61000-3-2 and 61000-3-3, FCC part 15 class B.

SAFETY: Conforms with European Union Directive 73/23/EEC EN 61010-1.

VIBRATION: MIL-PRF-28800E, Class 3.

WARM-UP: 1 hour to rated accuracies.

DIMENSIONS: 89mm high × 213mm wide × 370mm deep (3½ in × 8½ in × 14½ in).
Bench Configuration (with handle & feet): 104mm high × 238mm wide × 370mm deep (4¼ in × 9½ in × 14½ in).

Amplifier: 20mm high × 57mm wide × 97mm deep (0.783 in × 2.225 in × 3.75 in).

WEIGHT: 3.45kg (7.61 lbs).

ENVIRONMENT:

Operating: 0°–40°C, 60% R.H. (non-condensing) up to 35°C. Derate 5% R.H./°C. 35°–40°C.

Storage: –25°C to 65°C. Non-condensing humidity.

ACCESSORIES SUPPLIED:

- Model 6430-322-1 Low Noise Triax Cable, 3-slot triax to alligator clips, 20cm (8 in)
- Model 8607 Safety High Voltage Dual Test Leads
- Model CA-186-1 Banana Lead to Screw Terminal Adapter