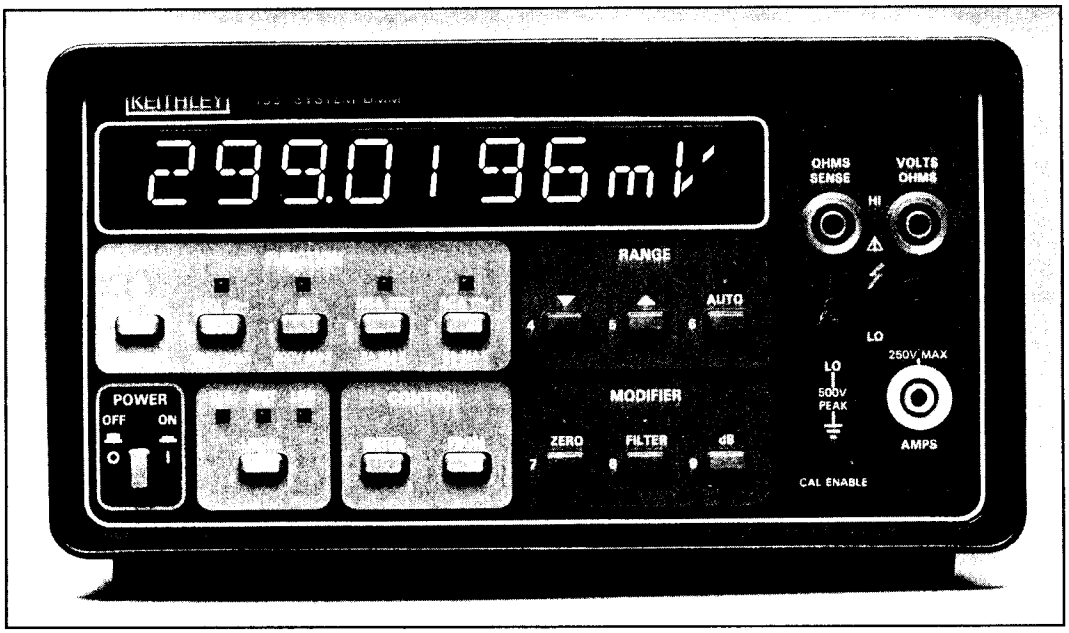
6½-Digit Multimeter 196



- 100nV, 100μΩ, 1nA sensitivities
- Up to 1000 readings/second
- Offset compensated Ω
- 10ppm linearity

IEEE-488

ORDERING INFORMATION

196
System DMM (3½- to 6½-Digit) with Instruction Manual, Model 1751 Safety Test Leads

This product is available with an Extended Warranty. See page 239 for complete ordering information, or call **1-800-552-1115 (U.S. only).**

ACCESSORIES AVAILABLE

TEST LEADS
1681 Clip-On Test Lead Set
1751 Safety Test Leads
1754 Safety Universal Test Lead Kit
5806 Kelvin Test Leads

CABLES
7007-1 Shielded IEEE-488 Cable, 1m (3.2 ft)
7007-2 Shielded IEEE-488 Cable, 2m (6.5 ft)
7008-3 IEEE-488 Digital Cable, 0.9m (3 ft)
7008-6 IEEE-488 Digital Cable, 1.8m (6 ft)

PROBES/SHUNT
1301 Temperature Probe
1600A High Voltage Probe
1651 50A Current Shunt
1682A RF Probe
1685 Clamp-On Current Probe

RACK MOUNT KITS
1019A-1 Single Fixed Rack Mount Kit
1019A-2 Dual Fixed Rack Mount Kit
1019S-1 Single Slide Rack Mount Kit
1019S-2 Dual Slide Rack Mount Kit

See page 179 for descriptions of all accessories.

The fully IEEE-488 programmable Model 196 System DMM packages high resolution, high sensitivity, and high measurement speed into a compact half-rack enclosure. All five basic functions (DCV, ACV, DCA, ACA, and ohms) as well as programmability are standard.

Resolve 1/3 ppm

Whether developing and testing the next generation of components which have tighter tolerances and increased sensitivities, or researching a low level phenomenon, you need high levels of resolution and sensitivity in your DMM. The Model 196 meets your needs with a 6½-digit, 3,000,000 count display. At full scale the last digit represents a very small ⅓ppm.

Detect Small Changes

The 196 provides excellent sensitivity in not only voltage and resistance but also current. You can resolve 1μV in 3 volts, 1mΩ in 3kΩ, and 10nA in 3mA. In addition to high resolution, basic 90-day DCV accuracy is 30ppm.

Enhance Measurement Quality

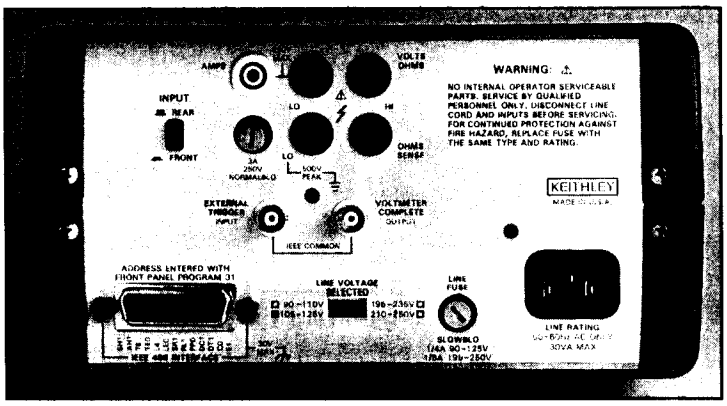
Special features enable you to obtain the most from the 196's resolution and sensitivity. Eliminate thermal effects that can create errors in low level resistance measurements with offset compensated ohms. Control the programmable digital filtering levels to compensate for external noise. Eliminate offsets with the programmable ZERO function. Independent zero and filter levels can be established for each function; the 196 stores these parameters separately.

High Speed for High Throughput

Capture low frequency phenomena of any wave shape at 1000 readings/second at 3½-digit resolution. At 4½-digit resolution acquire 333/second. In system applications the 196 can be triggered to take 200/second at 3½ digits. When reading speeds exceed the rate at which they can be handled over the IEEE-488 bus, readings can be stored in the 196's 500-reading buffer.

Eases the System Integration Task

Keithley's exclusive TRANSLATOR software enables you to substitute your own mnemonics for the 196's device-dependent command strings. The mnemonics use fewer characters, making your code more readable and reducing bus activity. TRANSLATOR also provides emulation capability which lets you upgrade your system by using the 196 to replace an older DMM without making major changes to your software. The TRANSLATOR commands are retained in non-volatile memory, so the 196 needs to be programmed only once.



196 6½-Digit Multimeter

DC VOLTS (6½ Digits)			ACCURACY[1] ±(%rdg +counts)			TEMPERATURE COEFFICIENT ±(%rdg +counts)/°C
RANGE	RESO-LUTION	INPUT RESISTANCE	24 Hr.,[2] 23° ±1°C	90 Days, 18°–28°C	1 Year, 18°–28°C	0°–18° & 28°–50°C
300 mV	100 nV	>1 GΩ	0.0020 + 20[3]	0.005 + 20[3]	0.008 + 20[3]	0.0006 + 10
3 V	1 µV	>1 GΩ	0.0013 + 10	0.003 + 20	0.0038 + 20	0.0004 + 1
30 V	10 µV	11 MΩ	0.0015 + 10	0.006 + 20	0.008 + 30	0.0013 + 3
300 V	100 µV	10.1MΩ	0.003 + 10	0.009 + 20	0.009 + 30	0.0013 + 1

[1]For 5½-digit accuracy, divide count error by 10. For 4½-digit accuracy, count error is 5 (except 15 on 300mV range). For 3½-digit accuracy, count error is 5.

[2]Relative to calibration standards.

[3]When properly zeroed.

ANALOG SETTLING TIME: <1ms (<2ms on 300mV range), to 0.01% of step change.

CMRR: >120db at DC, 50Hz or 60Hz (±0.05%) with 1kΩ in either lead.

NMRR: >60db at 50Hz or 60Hz (±0.05%).

LINEARITY: Linearity is defined as the maximum deviation from a straight line between the readings at zero and full range: 10ppm of range for 3V–300V ranges; 15ppm of range for 300mV range; at 23°C ±1°C.

MAXIMUM ALLOWABLE INPUT: 300V rms, 425V peak, whichever is less.

TRMS AC VOLTS (5½ Digits)		ACCURACY[1] ±(%rdg + counts) 1 Year, 18°–28°C				
RANGE	RESOLUTION	20Hz–50Hz[2]	50Hz–200Hz[2]	200Hz–10kHz[2]	10kHz–20kHz[2]	20kHz–100kHz[3]
300 mV	1 µV	2 + 100	0.3 + 100	0.15 + 100	0.4 + 200	2.0 + 300
3 V	10 µV	2 + 100	0.3 + 100	0.15 + 100	0.3 + 200	1.5 + 300
30 V	100 µV	2 + 100	0.3 + 100	0.15 + 100	0.4 + 200	1.5 + 300
300 V	1mV	2 + 100	0.3 + 100	0.15 + 100	0.4 + 200	1.5 + 300

db (Ref. = 1V):	ACCURACY ±db 1 Year, 18°–28°C		
INPUT	20Hz–20kHz	20kHz–100kHz	RESOLUTION
–34 to +49 db (20mV to 300V)	0.2	0.4	0.01 db
–54 to –34 db (2mV to 20mV)	1.1	3[4]	0.01 db

[1]For 4½-digit accuracy, divide count error by 10. For 3½-digit accuracy, count error is 5. In 3½- and 4½-digit modes, specifications apply for inputs >200Hz.

[2]For sinewave inputs >2,000 counts.

[3]For sinewave inputs >20,000 counts.

[4]Typical.

RESPONSE: True root mean square, AC coupled.

CREST FACTOR (ratio of peak to rms): Up to 3:1 allowable.

NON-SINUSOIDAL INPUTS: For fundamental frequencies <1kHz, crest factor <3, add 0.25% of reading to specified accuracy for 300mV and 3V ranges; add 0.6% of reading to specified accuracy for 30V and 300V ranges.

INPUT IMPEDANCE: 1MΩ shunted by <120pF.

3db BANDWIDTH: 300kHz typical.

MAXIMUM ALLOWABLE INPUT: 300V rms, 425V peak, 10^7V•Hz, whichever is less.

SETTLING TIME: 1 second to within 0.1% of change in reading.

TEMPERATURE COEFFICIENT (0°–18°C & 28°–50°C): <±(0.1 × applicable accuracy specification)/°C below 20kHz, ±(0.2×) for 20kHz to 100kHz.

CMRR: >60db at 50Hz or 60Hz (±0.05%) with 1kΩ in either lead.

DC AMPS (5½ Digits)		ACCURACY[1] ±(%rdg +counts)	MAXIMUM VOLTAGE
RANGE	RESO-LUTION	1 Year, 18°–28°C	BURDEN
300 µA	1 nA	0.09 + 20	0.4 V
3 mA	10 nA	0.05 + 10	0.4 V
30 mA	100 nA	0.05 + 10	0.4 V
300 mA	1 µA	0.05 + 10	0.5 V
3 A	10 µA	0.09 + 10	2 V

[1]4½-digit count error is 20. 3½-digit count error is 5.

MAXIMUM ALLOWABLE INPUT: 3A, 250V.

OVERLOAD PROTECTION: 3A fuse (250V), accessible from rear panel.

TEMPERATURE COEFFICIENT (0°–18°C & 28°–50°C): <±(0.1 × applicable accuracy specification)/°C.

TRMS AC AMPS (5½ Digits)		ACCURACY[1] ±(%rdg + counts) 1 Year, 18 –28 C		MAXIMUM VOLTAGE
RANGE	RESO-LUTION	20Hz–45Hz	45Hz–10kHz	BURDEN
300 µA	1 nA	2 + 100	0.9 + 100	0.4 V
3 mA	10 nA	2 + 100	0.6 + 100	0.4 V
30 mA	100 nA	2 + 100	0.6 + 100	0.4 V
300 mA	1 µA	2 + 100	0.6 + 100	0.5 V
3 A	10 µA	2 + 100	0.6 + 100	2 V

db (Ref. = 1mA):	ACCURACY ±db 1 Year, 18°–28°C	
INPUT	20Hz–10kHz	RESOLUTION
–34 to +69 db (20µA to 3A)	0.2	0.01 db
–54 to –34 db (2µA to 20µA)	0.9	0.01 db

[1]For sinewave inputs >2000 counts. For 4½-digit accuracy, divide count error by 10. For 3½-digit accuracy, count error is 5. In 3½- and 4½-digit modes, specifications apply for sinewave inputs >200Hz.

RESPONSE: True root mean square, AC coupled.

CREST FACTOR (ratio of peak to rms): Up to 3:1 allowable at 2/3 full scale.

NON-SINUSOIDAL INPUTS: Specified accuracy for fundamental frequencies <1kHz, crest factor <3.

SETTLING TIME: 1 second to within 0.1% of change in reading.

MAXIMUM ALLOWABLE INPUT: 3A, 250V.

OVERLOAD PROTECTION: 3A fuse (250V) accessible from rear panel.

TEMPERATURE COEFFICIENT (0°–18°C & 28°–50°C): <±(0.1 × applicable accuracy specification)/°C.

IEEE-488 BUS IMPLEMENTATION

MULTILINE COMMANDS: DCL, LLO, SDC, GET, GTL, UNT, UNL, SPE, SPD.

UNILINE COMMANDS: IFC, REN, EOI, SRQ, ATN.

INTERFACE FUNCTIONS: SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT1, C0, E1.

PROGRAMMABLE PARAMETERS: Range, Function, Zero, Integration Period, Filter, EOI, Trigger, Terminator, Delay, 500-Reading Storage, Calibration, Display, Multiplex, Status, Service Request, Self Test, Output Format, TRANSLATOR.

FRONT PANEL PROGRAMS

0	Menu
2	Display Resolution
4	mX + b
5	Hi/Lo/Pass
6	Multiplex On/Off
30	Save Setup
31	IEEE-488 Address
32	Line Frequency
33	Self Test
34	Set m, B Constants
35	Set Hi/Lo Limits
36	Digital Calibration
37	Reset to factory default conditions
Ω	Offset Compensation
ZERO	Zero Modify
FILTER	Filter Constants
db	db Reference

GENERAL

RANGING: Manual or autoranging.

MAXIMUM READING: 3,029,999 counts in 6½-digit mode.

ZERO: Control subtracts on-scale value from subsequent readings or allows value to be programmed.

CONNECTORS: Analog: Switch selectable front or rear, safety jacks. **Digital:** TRIGGER input and VOLTMETER COMPLETE output on rear panel, BNCs.

WARM-UP: 2 hours to rated accuracy.

DISPLAY: 10, 0.5-in alphanumeric LED digits with decimal point and polarity. Function and IEEE-488 bus status also indicated.

ISOLATION: Input Lo to IEEE Lo or power line ground: 500V peak. 5×10^5 max. V•Hz product. $>10^9\Omega$ paralleled by 400pF.

DATA MEMORY: 1 to 500 locations, programmable. Measurement intervals selectable from 1ms to 999999ms or triggered.

BENCH READING RATE: 5 readings/second (2/second on 30MΩ and 300MΩ ranges).

FILTER: Weighted average (exponential). Programmable weighting, 1 to 1/99.

OPERATING ENVIRONMENT: 0°–50°C, 0%–80% relative humidity up to 35°C; linearly derate 3% RH/°C, 35°C–50°C (0%–60% RH up to 28°C on 300MΩ range).

STORAGE ENVIRONMENT: -25° to +65°C.

POWER: 105–125V or 210–250V, rear panel switch selected, 50Hz or 60Hz, 30VA max. 90–110V and 180–220V versions available upon request.

DIMENSIONS, WEIGHT: 127mm high × 216mm wide × 359mm deep (5 in × 8½ in × 14⅛ in). Net weight 3.7kg (8 lb).

ACCESSORIES SUPPLIED: Model 1751 Safety Test Leads, instruction manual.

OHMS (6½ Digits)

RANGE	RESOLUTION	NOMINAL I-SHORT	ACCURACY[1] ±(%rdg +counts) 24 Hr.,[5] 23° ±1°C	90 Days, 18°–28°C	1 Year, 18°–28°C	TEMPERATURE COEFFICIENT ±(%rdg + counts)/°C 0°–18° & 28°–50°C
300 Ω[2]	100 μΩ	1.7 mA	0.0025+20[3]	0.008+20[3]	0.010+20[3]	0.001 + 7
3 kΩ[2]	1 mΩ	1.7 mA	0.0025+20	0.005+20	0.007+20	0.001 + 1
30 kΩ[2]	10 mΩ	160 μA	0.0025+20	0.005+20	0.007+20	0.001 + 1
300 kΩ	100 mΩ	50 μA	0.006 +20	0.020+20	0.021+20	0.004 + 1
3 MΩ	1 Ω	5 μA	0.007 +20	0.020+20	0.021+20	0.004 + 1
30 MΩ	10 Ω	0.5 μA	0.06 +50	0.1 +50	0.1 +50	0.030 + 1
300 MΩ[4]	1 kΩ	0.5 μA	2.0 +5	2.0 +5	2.0 +5	0.30 + 1

[1]For 5½-digit accuracy, divide count error by 10. For 4½-digit accuracy, count error is 5 (except 15 on 300Ω range). For 3½-digit accuracy, count error is 5.

[2]4-wire accuracy, 300Ω-30kΩ ranges.

[3]When properly zeroed.

[4]Resolution on 300MΩ range is limited to 5½ digits.

[5]Relative to calibration standards.

CONFIGURATION: Automatic 2- or 4-wire. Offset compensation available on 300Ω-30kΩ ranges, requires proper zeroing. Allowable compensation of ±10mV on 300Ω range and ±100mV on 3kΩ and 30kΩ ranges.

MAXIMUM ALLOWABLE INPUT: 300V rms, 425V peak, whichever is less.

OPEN CIRCUIT VOLTAGE: 5.5V maximum.

LINEARITY: Linearity is defined as the maximum deviation from a straight line between the readings at zero and full range: 20ppm of range for 300Ω–30kΩ ranges, at 23°C ±1°C.

MAXIMUM READING RATES[1]

DCV, DCA, ACV, ACA READINGS/SECOND

RESOLUTION	Continuous into Internal Buffer MUX: Off	On	External Trigger into Internal Buffer MUX: Off	On	Triggered via IEEE-488 Bus MUX: Off	On
3½-Digit	1000	1000	237	80	112	58
4½-Digit	333	333	145	63	91	49
5½-Digit	35 (29)	9 (7½)	40 (33)	9 (7½)	35 (29)	9 (7½)
6½-Digit[2]		9 (7½)		0.3 (¼)		0.3 (¼)

OHMS READINGS/SECOND

RESOLUTION	Continuous into Internal Buffer MUX: Off	On	External Trigger into Internal Buffer MUX: Off	On	Triggered via IEEE-488 Bus MUX: Off	On
3½-Digit	53	25	57	25	37	23
4½-Digit	43	20	47	21	30	19
5½-Digit	16 (13)	9.5 (7½)	18 (15)	9.5 (7½)	15 (12½)	9.5 (7½)
6½-Digit[2]		9 (7½)		0.3 (¼)		0.3 (¼)

Offset Compensated Ohms: Rates are 0.5 × normal mux on ohms rates.

[1]Reading rates are for on-range on-scale readings with internal filter off, for 3V, 3kΩ, and 3mA ranges. 6½- and 5½-digit rates are for 60Hz operation. Values in parentheses are for 50Hz operation.

[2]Internal filter on.