Test Equipment Solutions Datasheet

Test Equipment Solutions Ltd specialise in the second user sale, rental and distribution of quality test & measurement (T&M) equipment. We stock all major equipment types such as spectrum analyzers, signal generators, oscilloscopes, power meters, logic analysers etc from all the major suppliers such as Agilent, Tektronix, Anritsu and Rohde & Schwarz.

We are focused at the professional end of the marketplace, primarily working with customers for whom high performance, quality and service are key, whilst realising the cost savings that second user equipment offers. As such, we fully test & refurbish equipment in our in-house, traceable Lab. Items are supplied with manuals, accessories and typically a full no-quibble 2 year warranty. Our staff have extensive backgrounds in T&M, totalling over 150 years of combined experience, which enables us to deliver industry-leading service and support. We endeavour to be customer focused in every way right down to the detail, such as offering free delivery on sales, covering the cost of warranty returns BOTH ways (plus supplying a loan unit, if available) and supplying a free business tool with every order.

As well as the headline benefit of cost saving, second user offers shorter lead times, higher reliability and multivendor solutions. Rental, of course, is ideal for shorter term needs and offers fast delivery, flexibility, try-before-you-buy, zero capital expenditure, lower risk and off balance sheet accounting. Both second user and rental improve the key business measure of Return On Capital Employed.

We are based near Heathrow Airport in the UK from where we supply test equipment worldwide. Our facility incorporates Sales, Support, Admin, Logistics and our own in-house Lab.

All products supplied by Test Equipment Solutions include:

- No-quibble parts & labour warranty (we provide transport for UK mainland addresses).
- Free loan equipment during warranty repair, if available.
- Full electrical, mechanical and safety refurbishment in our in-house Lab.
- Certificate of Conformance (calibration available on request).
- Manuals and accessories required for normal operation.
- Free insured delivery to your UK mainland address (sales).
- Support from our team of seasoned Test & Measurement engineers.
- ISO9001 quality assurance.

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SECTION 1
GENERAL INFORMATION

1.1 INTRODUCTION

The Model 195A Digital Multimeter is a fully programmable instrument with 5½ digit resolution. In standard configuration, the Model 195A is capable of DC voltage measurements between 100nV and 1000V on six ranges, 2-terminal and 4-terminal resistance measurements between 100μΩ and 20MΩ on seven ranges and temperature measurements in the range of -220°C and +630°C and between -360°F and +1100°F. The instrument is designed to work with platinum RTD probes, a factor which contributes to high accuracy.

With the optional Model 1950 ACV and AC and DC current option installed, the Model 195A can make TRMS AC voltage measurements between 1μV and 700V on five ranges, TRMS AC current measurements between 1nA and 2A on five ranges and DC current measurements between 100pA and 2A on six ranges. The versatility of the Model 195A DMM is further enhanced by the inclusion of a standard IEEE-488 interface. A highlight of Model 195A operation is its digital calibration feature which allows the user to easily perform calibration from the front panel.

1.2 MODEL 195A FEATURES

Some important Model 195A features include:

1. Standard IEEE-488 Interface. A standard IEEE-488 interface allows the Model 195A to be programmed from a system controller; readings may also be transmitted over the bus to other instrumentation in the talk-only mode.
2. Front Panel Programs. Numerous internal programs to control various operating modes such as digital calibration and IEEE-488 parameters are easily entered from the front panel.
3. Non-Volatile (NV) RAM Storage. A non-volatile RAM stores calibration constants, certain IEEE operating parameters, and line frequency values even when the power is turned off.
4. Digital Calibration. The Model 195A may be easily calibrated by applying an appropriate calibration signal and running the front panel calibration program or by commanding it over the bus. The calibration level may be at full range, or at some value entered from the front panel or over the IEEE bus.
5. Data Storage. A data storage buffer is included to allow up to 100 readings to be internally stored at a user-selected rate. The buffer may be read and controlled from the front panel or over the IEEE-488 bus. In the talk-only mode, the output rate can also be programmed.
6. Front and Rear Panel Input Terminals. Input terminals are duplicated on the front and rear panels to allow easy connections in both bench and rack-mounted situations. The selected set of inputs is controlled by the rear panel switch.
7. Trigger Input and Output. The Model 195A may be triggered to take readings by applying an external trigger pulse or by pushing a front panel button. A separate output pulse, which is active when the instrument completes a reading, is also available on the rear panel.
8. Auto Ranging. The Model 195A includes a fast auto ranging feature for easier measurements.
9. Front Panel Zero. A single front panel zero control allows the user to store a separate zero offset for each measuring function.
10. Filtering. Digital filtering is selectable from the front panel or bus.

Temperature measurement features include:

1. High Accuracy. Because platinum RTD probes have predictable resistance change with temperature and are highly linear, temperature measurements are made with a greater degree of accuracy than is possible with thermistor or thermocouple type probes.
2. Ease of Use. The temperature measuring mode is easily entered from the front panel or over the IEEE bus. Sophisticated software automatically measures the probe resistance and calculates the reading.
3. Dual Scale Temperature Measurements. Temperature readout may be obtained in either °C or °F. Readings are available on the display and over the IEEE bus.
4. Front Panel Calibration. Temperature calibration may be performed from the front panel. Probe errors can be minimized with the calibration procedure.
5. Four Wire Resistance Measurements. Resistance measurements using the 4-wire method minimize the effects of lead resistance.
6. Selectable 3-wire or 4-wire Operation. The instrument may be used with either 3-wire or 4-wire probes; the mode of operation is easily changed from the front panel.

1.3 WARRANTY INFORMATION

Warranty information may be found inside the front cover of this manual. Should it become necessary to exercise the warranty, contact the nearest Keithley representative or the factory to determine the correct course of action. Keithley Instruments maintains service facilities in the United States, West Germany, Great Britain, France, the Netherlands, Switzerland, and Austria. Information concerning the application, operation, or service of your instrument may be directed to the applications engineer at any of these locations. Check the inside front cover of this manual for addresses.

SPECIFICATIONS

DC VOLTS

(5½ Digits)

RANGE	RESOLUTION	INPUT RESISTANCE	ACCURACY†‡ ±(%rdg + counts) 24Hr., 23°±1°C	1 Yr., 18°-28°C	TEMPERATURE COEFFICIENT ±(%rdg+counts)/°C 0°-18°C & 28°-50°C
20mV	100 nV	>1GΩ	0.01+40	0.025+40	0.003+2
200mV	1 μV	>1GΩ	0.01+ 6	0.025+ 6	0.003+0.5
2 V	10 μV	>1GΩ	0.01+ 8	0.020+ 8	0.003+0.5
20 V	100 μV	10MΩ	0.01+ 6	0.030+ 6	0.003+0.5
200 V	1mV	10MΩ	0.01+ 8	0.025+ 8	0.003+0.5
1000 V	10mV	10MΩ	0.01+ 6	0.025+ 6	0.003+0.5

†After pushbutton or bus zeroing.
‡In 4½ digit mode, counts = ±2 (except ±4 on 20mV range after zeroing).
NMRR: Greater than 60dB at 50 or 60Hz.
CMRR: Greater than 120dB at DC and 50 or 60Hz (with 1kΩ in either lead).
MAXIMUM ALLOWABLE INPUT: 1000V peak.
BENCH READING RATE: 5 readings/second.

OHMS

(5½ Digits)

RANGE	RESOLUTION	OUTPUT I short	OUTPUT Vopen	ACCURACY†‡ ±(%rdg + counts) 24Hr., 23°±1°C	1 Yr., 18°-28°C	TEMPERATURE COEFFICIENT ±(%rdg+counts)/°C 0°-18°C & 28°-50°C
20 Ω	100 μΩ	- 2mA	-2V	0.015+25	0.025+25	0.003+2
200 Ω	1mΩ	- 2mA	-2V	0.015+ 7	0.025+ 7	0.003+0.5
2 kΩ	10mΩ	- 2mA	-2V	0.015+ 5	0.022+ 5	0.003+0.5
20 kΩ	100mΩ	- 20 μA	-2V	0.015+ 7	0.025+ 7	0.003+0.5
200 kΩ	1 Ω	- 20 μA	-2V	0.015+ 5	0.022+ 5	0.003+0.5
2MΩ	10 Ω	-200 nA	-2V	0.03 + 7	0.050+ 7	0.015+1
20MΩ	100 Ω	-200 nA	-2V	0.06 + 5	0.100+ 5	0.025+1

†After pushbutton or bus zeroing.
‡In 4½-digit mode, counts = ±2 (except ±4 on 20Ω range after zeroing).
CONFIGURATION: Automatic 2- or 4-terminal.
MAXIMUM ALLOWABLE INPUT: 360V peak or 250V rms.
BENCH READNG RATE: 3 readings/second except 20MΩ range, 1 reading/second.

TEMPERATURE

(5½ Digits)

SPAN	RESOLUTION	4-WIRE ACCURACY[1] ±(%rdg+counts) 1 YR., 18°-28°C	TEMPERATURE COEFFICIENT ±(%rdg+counts)/°C 0°-18°C & 28°-50°C
°C			
-200.00° to 230.00°	0.01°	0.03 + 10	0.003 + 0.4
230.00° to 630.00°	0.01°	0.03 + 40	0.003 + 4
-220.00° to -200.00°	0.01°	0.03 + 40	0.003 + 4
°F			
-328.00° to 446.00°	0.01°	0.03 + 18	0.003 + 0.7
446.00° to 1100.00°	0.01°	0.03 + 72	0.003 + 7
-360.00° to -328.00°	0.01°	0.03 + 72	0.003 + 7

[1] Autorange mode, excluding probe errors.
RTD TYPE: 100Ω platinum; DIN 43 760 or IPTS-68, Programmable alpha and delta
3- or 4-wire.
MAXIMUM LEAD RESISTANCE (each lead): 4-wire: 25Ω.
3-wire: 15Ω.
SENSOR CURRENT: 1.0mA maximum, RMS.
BENCH READING RATE: 1.2 reading per second.
MAXIMUM COMMON MODE VOLTAGE: 500V (42V with Model 1951 connected).
COMMON MODE REJECTION: Less than 0.005°C/volt at DC, 50Hz and 60Hz
(100Ω unbalance, LO driven).
MAXIMUM ALLOWABLE INPUT: 360V peak, 250V rms.

TRMS AC VOLTS (Option 1950)

(5½ Digits)

RANGE	RESOLUTION	ACCURACY (1 Year)† ±(%rdg + counts) 18°-28°C 20Hz-45Hz	45Hz-10kHz	10kHz-20kHz	20kHz-50kHz
200mV*	1 μV	0.8+200	0.3+200	0.7+200	2.0+300
2 V	10 μV	0.8+200	0.3+200	0.7+200	2.0+250
20 V	100 μV	0.8+200	0.3+200	0.7+200	1.5+250
200 V	1mV	0.8+200	0.3+200	0.7+200	1.5+250
700 V	10mV	0.8+200	0.3+200	0.7+200	1.5+250

†In 4½ digit mode, divide count error by 10.
*Above 1mV.
TEMPERATURE COEFFICIENT (0°-18°C & 28°-50°C): Less than ±(0.1 × applicable accuracy specification)/°C.
RESPONSE: True root mean square, AC coupled.
CREST FACTOR (ratio of peak to rms): Up to 3:1 allowable.
INPUT IMPEDANCE: 2MΩ shunted by less than 75pF.
MAXIMUM ALLOWABLE INPUT: 1000V peak, 10^7V•Hz.
BENCH READING RATE: 3 readings/second.
CMRR: Greater than 60dB at DC, 50 or 60Hz (with 1kΩ in either lead).
BANDWIDTH: -3dB at 250kHz typical.

DC AMPS (Option 1950)

(5½ Digits)

RANGE	RESOLUTION	ACCURACY (1 YEAR)†‡ ±(%rdg+counts) 18°-28°C	TEMPERATURE COEFFICIENT ±(%rdg+counts)/°C 0°-18°C & 28°-50°C	MAXIMUM VOLTAGE BURDEN
20 μA	100pA	0.14+40‡	0.01+2	0.03V
200 μA	1nA	0.09+10	0.01+0.5	0.25V
2mA	10nA	0.09+10	0.01+0.5	0.25V
20mA	100nA	0.09+10	0.01+0.5	0.25V
200mA	1μA	0.09+10	0.01+0.5	0.28V
2 A	10μA	0.09+10	0.01+0.5	1 V

†In 4½ digit mode, counts = ±2 (except ±4 on 20μA range after zeroing).
‡After pushbutton or bus zeroing.
OVERLOAD PROTECTION: 2A fuse (250V), externally accessible.
BENCH READING RATE: 5 readings/second.

TRMS AC AMPS (Option 1950)

(5½ Digits)

RANGE	RESOLUTION	ACCURACY (1 YEAR)†* 45Hz-10kHz ±(%rdg+counts) 18°-28°C	TEMPERATURE COEFFICIENT ±(%rdg+counts)/°C 0°-18°C & 28°-50°C	MAXIMUM VOLTAGE BURDEN
200 μA	1nA	0.6+250	0.04+10	0.25V
2mA	10nA	0.6+250	0.04+10	0.25V
20mA	100nA	0.6+250	0.04+10	0.25V
200mA	1 μA	0.6+250	0.04+10	0.28V
2 A	10 μA	0.6+250	0.04+10	1 V

†In 4½ digit mode, divide count error by 10.
*Above 0.5% of range.
RESPONSE: True root mean square, AC coupled.
CREST FACTOR (ratio of peak to rms): Up to 3:1 allowable.
OVERLOAD PROTECTION: 2A fuse (250V), externally accessible.
BENCH READING RATE: 3 readings/second.

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, T5, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT1, C0, E1.
Programmable Parameters: Range, Function, Zero, Integration Period, Averaging, EOI, Trigger, Terminator, Delay*, 100-rdg. Storage, Calibration, Display, Multiplex Off, Status, Service Request, Self Test, Output Format.
*First reading is correct when step input is coincident with trigger.

Conversion Rates (DC Volts):

USEABLE RESOLUTION	INTEGRATION PERIOD	TRIGGER TO FIRST BYTE OUT	MAXIMUM READING RATE†
3½ Digit	3.3 ms	17ms	76
4½ Digit	16.66ms‡	30ms	36
5½ Digit	100 ms	114ms	9

†Readings/second.
‡20ms at 50Hz.
Address Modes: TALK ONLY and ADDRESSABLE.

FRONT PANEL PROGRAMS

0 Clear—Cancels program mode.
1 Non-Volatile RAM Storage—Store programs 3, 4, 5, 6 and 8 data in NVRAM
2 Multiplex—Defeats input amplifier multiplexing.
3 IEEE bus mode—ADDRESSABLE and TALK ONLY entry.
4 Line Frequency—Selects 50Hz or 60Hz operation.
5 Calibration—Performs digital calibration.
6 Temperature—Allows °C and °F temperature measurements.
7 Data Logger—Allows 100-reading storage at 9 programmable rates; also stores highest, lowest and average reading.
8 Diagnostics—Troubleshooting aid and self-test.
9 Trigger—Enables front panel or external triggering.

GENERAL

DISPLAY: Six 0.5" LED digits with decimal point, exponent and polarity. Function and IEEE bus status also displayed.
RANGING: Manual or fast autoranging (150ms per range change on DCV).
ISOLATION: Input LO to IEEE LO or power line ground: 500V max, 5×10^5 V•Hz; greater than $10^9\Omega$ paralleled by 300pF.
WARMUP: 1 hour to rated accuracy.
OPERATING ENVIRONMENT: 0°-50°C, 0% to 80% relative humidity up to 35°C.
STORAGE ENVIRONMENT: -25° to 65°C.
POWER: 105-125V or 210-250V (internal switch selected), 50Hz to 400Hz, 24V•A maximum. 90-110V and 180-220V version available upon request.
CONNECTORS: Analog: Switch selectable front or rear, 5-way gold plated binding posts. **Digital:** Trigger input and Voltmeter Complete output on rear panel, BNCs.
DIMENSIONS, WEIGHT: 127mm high × 216mm wide × 359mm deep (5" × 8½" × 14 1/8 "). Net weight 3.2kg (7 lbs.).

Specifications subject to change without notice.