

SECTION 1. GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. The Keithley Model 191 is a 5-1/2 digit, 200,000-count, manual-ranging bench digital multimeter with dc volts and ohms ranges standard. It provides highly accurate, stable, low noise and fast-responding readings from $1\mu\text{V}$ to 1200 volts dc on 5 voltage ranges, and 2 and 4 terminal measurements from 1 milliohm to 20 megohms on 6 resistance ranges. The 191 is capable of 0.0005% resolution and $1\mu\text{V}/1\text{m}\Omega$ sensitivity. In addition, if you purchased the Model 1910 AC Voltage Option, your DMM will provide readings from $10\mu\text{V}$ to 1000 volts ac on 4 ranges. This option may also be purchased later, and field installed.

1-3. Your DMM also has features and advantages that might not be readily apparent. Some of these are:

- 5-1/2 digit LED display with appropriate decimal point - 0.5 inch digits permit monitoring measurements from across the room.
- Pushbutton NULL - eliminates potentiometer zeroing, corrects for lead resistance in 2-wire ohms, bucks out thermal EMF's in low level dc measurements and permits you to measure deviations from a set value. The NULL light indicates that the function is active for operator safety and to lessen the chance of measurement error.

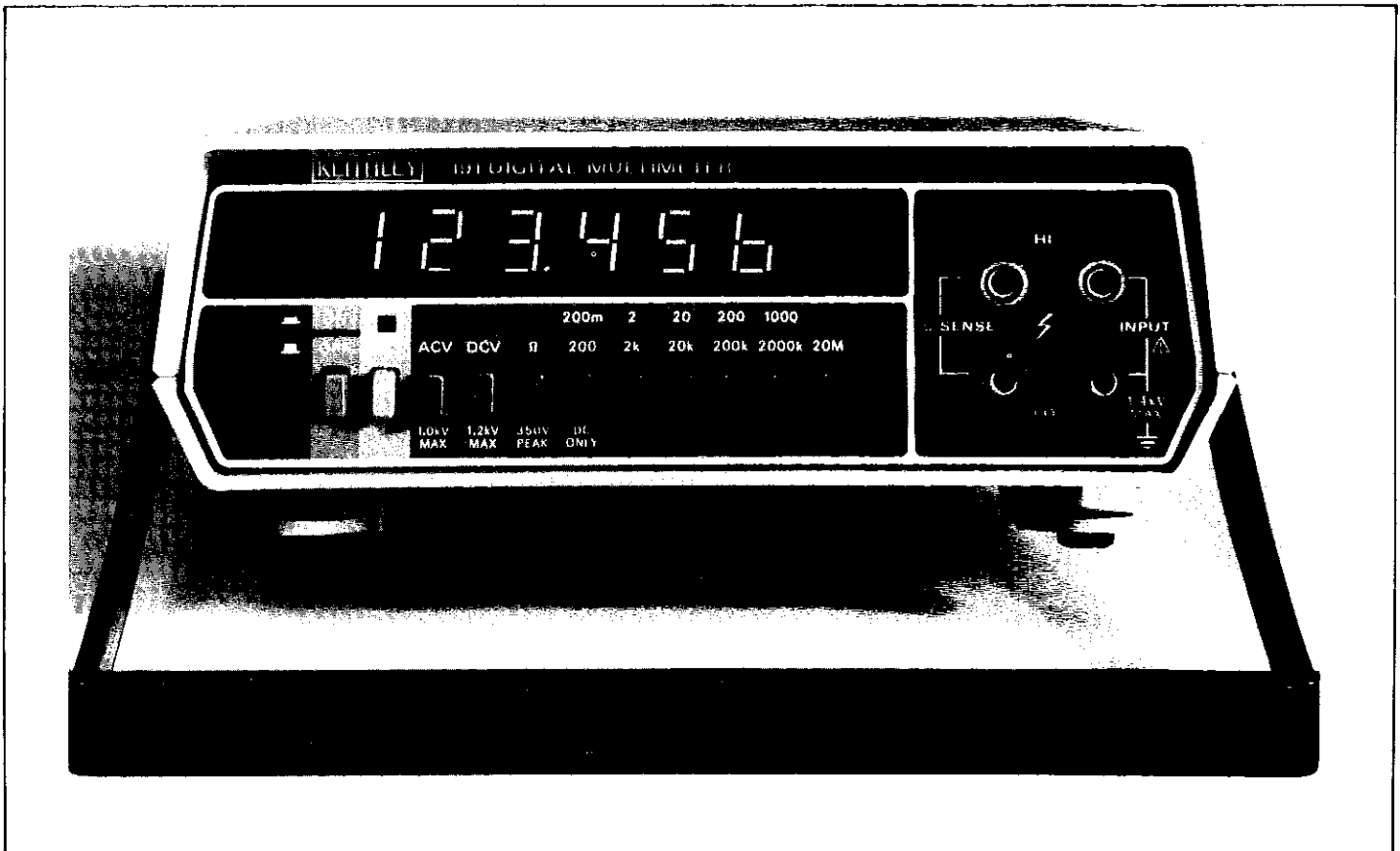


FIGURE 1-1. Model 191 Digital Multimeter

1-3. Continued.

- A Micro-processor based design that provides:
 - A Combination of single slope and charge balance AD conversion - for faster response and better linearity.
 - Automatic non-linear digital filtering - for faster response and reduced noise on the display.
 - A reduction in the number of parts while maintaining high accuracy and speed of measurement - simplifies high accuracy measurements and calibration of the instrument and provides higher mean time between failures.
- -IEEEEE error message indicates improper uses of the instrument - prevents erroneous readings and reduces possibility of injury to the user or damage to the instrument.
- Each range has:
 - Automatic polarity operation - minus sign displayed, positive implied.
 - Effective input overload protection.
 - Overrange indication - polarity and overrange digit displayed.
 - Decimal point positioned by range pushbutton.
- Automatic 2/4 wire ohms operation - saves time and simplifies 2-wire or 4-wire ohms measurements.
- A full line of optional accessories that extend the measurement capability of your Model 191. Some of these accessory models are:
 - 1600 High voltage Probe allows your DMM to measure from 1200V to 40kV dc.
 - 1901 Plug-In Current Adapter allows your DMM to read dc current from 1nA/digit to 2000mA. With the AC Voltage option, it reads from 10nA/digit to 2000mA ac.
 - 1682 High Frequency (RF) Probe allows your DMM to measure from 0.25V to 30V rms ac over a frequency range of 100kHz to 100MHz. It can be used without the AC Voltage Option.
 - 1685 Clamp-On AC Current Probe (when used with AC Voltage Option) allows your DMM to measure from zero to 200A rms ac.

1651 50-Ampere Current shunt allows your DMM to measure from 0-50A dc, and with AC Voltage Option from 10A to 50A rms ac.

NOTE

Refer to Section 4 for more detailed information on these accessories.

1-4. WARRANTY INFORMATION.

1-5. The Warranty is given on the inside front cover of this Instruction Manual. If there is a need to exercise the Warranty, contact the Keithley Representative in your area to determine the proper action to be taken. Keithley maintains service facilities in the United Kingdom and West Germany, as well as in the United States. Check the inside front cover of this Manual for addresses.


1-6. CHANGE NOTICES.


1-7. Improvements or changes to the instrument which occur after printing of the Instruction Manual will be explained on a Change Notice sheet attached to the inside back cover.

1-8. SAFETY SYMBOLS.

1-9. Safety symbols used in this manual are as follows:

IMPORTANT

The  symbol can be found in various places in this Manual. Carefully read the associated CAUTION statements with regard to proper use and handling of the instrument. Damage to the instrument may occur if these precautions are ignored.

This  symbol can be found in various places in this Manual. This symbol indicates those areas on the instrument which are potential shock hazards. Carefully read the associated WARNING statements with regard to proper use and handling of the instrument. Serious personal injury may result if these precautions are ignored.

1-10. SPECIFICATIONS

1-11. Detailed specifications for the Model 191 are given in Table 1-1.

TABLE 1-1
SPECIFICATIONS

DC VOLTAGE

RANGE	MAXIMUM READING	ACCURACY † (% rdg + digits)		TEMPERATURE COEFF. † (% rdg + digits)/°C 0-18°C & 28-50°C	INPUT RESISTANCE	MAXIMUM ALLOWABLE INPUT	SETTLING TIME ‡
		24 Hr 22-24°C	1 Yr 18-28°C				
200mV	199.999	005 + 2d ¹	007 + 3d ¹	0007 + 1.6d	>1000Mohm	1200V ²	0.5 sec ³
2 V	1.99999	004 + 1.5d	007 + 2d	0007 + 0.2d	>1000Mohm	1200V ²	0.5 sec ³
20 V	19.9999	004 + 1.5d	010 + 2d	0008 + 0.2d	10Mohm	1200V ²	0.5 sec ³
200 V	199.999	004 + 1.5d	010 + 2d	0008 + 0.2d	10Mohm	1200V ²	0.5 sec ³
1200 V	1200.00	005 + 1.5d	010 + 2d	0012 + 0.2d	10Mohm	1200V ²	0.5 sec ³

NMRR: > 60dB at 50 & 60 Hz.

CMRR: > 120dB at DC, 50 & 60 Hz (with 1kohm in either lead).

¹With zero set by Null function

²1 minute max., 700 volts continuous

³To within 5 digits of final reading

⁴1.6 sec for input changes < 15 microvolts

RESISTANCE

RANGE	MAXIMUM READING	ACCURACY † (% rdg + digits)		TEMPERATURE COEFF. † (% rdg + digits)/°C 0-18°C & 28-50°C	MAXIMUM OUTPUTS		SETTLING TIME ‡	4-TERMINAL LEAD RESISTANCE ⁴
		24 Hr 22-24°C	1 Yr 18-28°C		I short	V open		
200 ohm	199.999	00e + 2d ¹	012 + 3d ¹	0015 + 2d	4mA	400mV	1 sec ³	1ohm
2kohm	1.99999	00e + 1.5d	012 + 2d	0015 + 0.2d	4mA	4 V	1 sec ³	22ohm
20kohm	19.9999	00e + 1.5d	012 + 2d	0015 + 0.2d	400µA	4 V	1 sec ³	33ohm
200kohm	199.999	00e + 1.5d	012 + 2d	0015 + 0.2d	40 µA	4 V	1 sec ³	225ohm
2000kohm	1999.99	01 + 1.5d	03 + 2d	002 + 0.2d	4 µA	4 V	1 sec ³	330ohm
20Mohm	19.9999	04 + 1.5d	08 + 2d	00e + 0.2d	1 µA	1 V	2 sec ³	2250ohm

CONFIGURATION: 4 terminal or 2-terminal.

MAXIMUM ALLOWABLE INPUT: 360V peak, 250V rms.

¹With zero set by Null function

²To within 5 digits of final reading

³3 sec for input changes < 15 milliohms.

⁴Maximum resistance per lead for additional 1 digit error

AC VOLTAGE (Option 1910)

RANGE	MAXIMUM READING	ACCURACY † (% rdg + digits) (Above 1000 Counts) ²		TEMPERATURE COEFFICIENT † (% rdg + digits) / °C	
		50Hz-20kHz 1 Year 18-28°C	20-50Hz & 20k-100kHz	50Hz-20kHz 0-18°C & 28-50°C	20-50Hz & 20k-100kHz
2V	1.99999	0.10 + 10d	1.0 + 20d	0.015 + 0.5d	0.05 + 0.5d
20V	19.9999	0.10 + 10d	1.0 + 20d	0.015 + 0.5d	0.05 + 0.5d
200V	199.999	0.10 + 10d	1.0 + 20d	0.015 + 0.5d	0.05 + 0.5d
1000V	1000.00	0.15 + 10d ³	1.0 + 20d ³	0.020 + 0.5d	0.05 + 0.5d

RESPONSE: Average, calibrated in rms of a sine wave.

MAXIMUM ALLOWABLE INPUT: 1000V rms sine or DC, 2 x 10⁻⁵V • Hz.

SETTLING TIME: < 1.3 seconds to within 0.05% of final reading for zero to full-scale step input.

CMRR: > 60dB at DC, 50 & 60 Hz. (1kohm in either lead)

INPUT IMPEDANCE: 2Mohm shunted by less than 50pF

¹With input shorted, display reads approximately 20 digits

²50Hz-10kHz.

³20Hz-50Hz & 10kHz-20kHz

GENERAL

NULL: Pushbutton allows zeroing of on scale readings. Front panel annunciator indicates null mode.

DISPLAY: Six 0.5 inch LED digits with appropriate decimal point.

CONVERSION SPEED: 4 readings/second on DC volts.

3 readings/second on ohms.

2 readings/second on AC volts.

POLARITY: Automatic, minus indicated, plus implied.

RANGING: Manual.

OVERLOAD INDICATION: Display indicates polarity and overrange digit only.

INVALID RANGE/FUNCTION SELECTION: Display reads -1EEEE.

ISOLATION: Input LO to power line ground, greater than 1000 megohms shunted by approximately 300 picofarads. Maximum input between LO and power line ground, 1400 volts peak, 5 x 10⁻⁵V • Hz.

WARMUP: 1 hour to rated accuracy.

ENVIRONMENTAL LIMITS:

Operating: 0°C to 50°C, 0% to 80% relative humidity up to 35°C.
Storage: -25°C to 65°C.

POWER: 105-125 or 210-250V (internal switch selected), 90-110V available; 50-60Hz, 25V•A maximum.

INPUT CONNECTORS: 5-way binding posts

DIMENSIONS, WEIGHT: 85mm high x 235mm wide x 275mm deep (3 1/4 in. x 9 1/4 in. x 10 3/4 in.) Net weight 2.3kg (5 lbs.)

ACCESSORIES SUPPLIED: Instruction Manual.

AVAILABLE ACCESSORIES:

Model 1010 Single Rack Mounting Kit

Model 1017 Dual Rack Mounting Kit

Model 1600 High Voltage Probe

Model 1641 Kelvin Test Lead Set

Model 1651 50 Ampere Shunt

Model 1681 Clip-On Test Lead Set

Model 1682 RF Probe

Model 1683 Universal Test Lead Set

Model 1684 Carrying Case

Model 1685 Clamp-On Current Probe

Model 1901 Current Adapter

Model 1910 AC Volts Option

Model 1913 Calibration Cover