

# DIGITAL MULTIMETERS & VOLTMETERS

NEW 8860A

IEEE-488

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8860A

## 8860A Digital Multimeter, Versatile

Central to the design concept of this small, new, 5½-digit precision DMM is the fact that it can be expanded at anytime to be a low-cost, fully programmable measurement system simply by installing one of two powerful options.

The first option (-05) sets a new standard for low-cost DMM systems compatible with IEEE Std 488-1978. The second option (-04) saves you even more money when your system needs to have a lot of math power but doesn't need an instrument controller. Either option extends the flexibility of the 8860A to work with a variety of transducers to determine the value of numerous kinds of physical phenomena besides voltage and resistance. Such applications are affordable for the first time for many people.

The basic 8860A is a practical, precision benchtop DMM featuring 5½-digit resolution and 0.01% basic dc accuracy. Ac voltages may be ac- or dc-coupled using a front panel control, and are measured using True RMS circuits. Resistance can be measured to 20 megohms using two- or four-terminal techniques. All function pushbuttons and most others, have annunciator lights to make it easy at all times to know what functions and modes are active. Small, residual dc or resistance errors may be automatically subtracted out of these measurements using the ZERO pushbutton to store the error. Other basic math and memory functions allow you to do hi/lo limit testing, store an offset value to make differential measurements, and store the highest and lowest readings in a series of measurements. A touch of the white NUM shift pushbutton allows you to directly enter and store numerical values in the appropriate data registers. And the numbers may be recalled and displayed when you wish. These basic features remain available in systems applications, too, of course. A BNC connector on the rear panel allows each measurement to be triggered remotely or from a foot switch or automated test fixture.

A detachable Control Keyboard is supplied with Option -04 which resembles the keyboard of a scientific calculator. Measurement/calculation programs are written with this keyboard and stored in a small memory cartridge that plugs into the rear panel. Then, documentation of the results of each program you run is easy when you use a Fluke 2020A Printer.

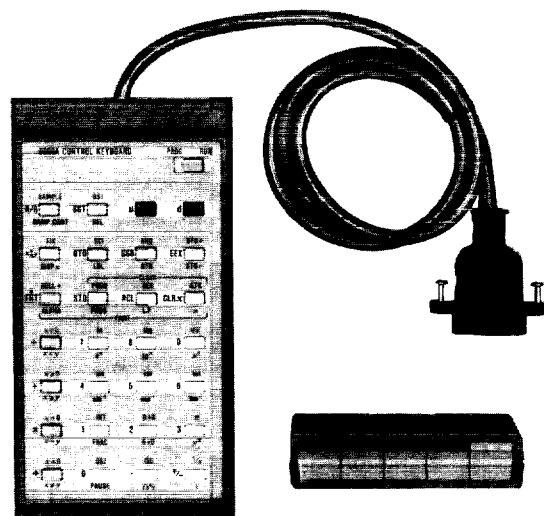
## IEEE-488 Interface Option (-05)

With this interface, all front panel controls are programmable and the DMM can output data at 30 readings per second with 3½-digit resolution, or 2.5 readings per second with 5½-digit resolution. A learn mode sends configuration data to the instrument controller. A talk-only mode is also available and lets you operate the 8860A in systems without controllers. Rack adapters are also available for the 8860A.

## Calculating Controller Option (-04)

A detachable Control Keyboard and one Y8833 Plug-in Memory Cartridge are included with this option. They both plug into the rear panel of the 8860A when the 8860A has the rest of Option -04 installed. A general purpose I/O communications port also is available at the rear panel to use with an instrument printer such as the 2020A (with Option -01) to provide a printed alphanumeric record of data or programs. The I/O port also allows the 8860A to exchange digital data with other sources and to drive control systems, trigger displays or indicators, and perform other tasks related to systems operations. For economy, power, and flexibility this configuration is in a class by itself.

Each Y8833 Memory Cartridge will store up to 100 program steps. The non-volatile cartridges have an internal battery good for at least one year. Programs are very easily written using the 8860A Control Keyboard and you don't need to know any programming language. Each key has a two-digit identifying code that appears as part of the display for each program step. The code is simply the row and column number that defines the position of each key on the keyboard. For example, code 11 identifies the upper lefthand key, labeled SAMPLE above the key.



Option -04 includes detachable Control Keyboard and a Y8833 Memory Cartridge.

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The key labeled "u" shifts the key functions to the upper labels, and the key labeled "d" shifts the functions down, to correspond with the lower labels.

Programming features include conditionals, indirect addressing, editing, display control, and display format control (fixed, scientific, or engineering). The controller has a four-register stack (X, Y, Z, T), eight conditional branch commands, a nested subroutine capability, and four print functions.

Option -04 and -05 cannot be installed in the same 8860A at the same time.

An example of an application might be to determine the power being dissipated in a 200 ohm resistor by measuring the voltage across it:  $P = E^2 \div R$ .

Keystrokes	Display Code	Step No.	
[d] [LBL] [0] [1]	142201	01	Assign label 01 to program
[u] [SAMPLE]	1311	02	Take measurement
[d] [x <sup>2</sup> ]	1444	03	Square the measured value
[2]	02	04	Enter value of resistor in circuit
[0]	00	05	
[0]	00	06	
[÷]	71	07	Divide x <sup>2</sup> by 200
[d] [DISP X]	1421	08	Display result
[GTO] [0] [1]	2201	09	Go back to start of program
	33333		Example measurement (watts)

## Rear Inputs Option (-06)

Recommended for rackmount system applications where all connections are made via the rear panel. The connector duplicates the function of the front panel input jacks, which are disconnected when the option is ordered.

## DC External Reference Option (-07)

A rear panel connector provides a means of comparing an unknown dc voltage with an externally-applied dc reference voltage and displaying a precise ratio of the two.

## Specifications

### DC Voltage

**Ranging:** Fully automatic or manual.

**Input Polarity:** Automatic selection and display

### Input Characteristics

Ranges	Input Resistance	Resolution		
		5½ Digits	4½ Digits	3½ Digits*
200 mV 2V	10,000 MΩ	1 μV 10 μV	10 μV 100 μV	100 μV 1 mV
20V 200V 1000V	10 MΩ	100 μV 1 mV 10 mV	1 mV 10 mV 100 mV	10 mV 100 mV 1V

\*Requires Option -04 or -05

**Maximum Input:** 1000V peak from Hi to Lo; 500V peak from Lo to earth; 30V peak from Lo to Guard

**Input Bias Current:** <100 pA at 23°C

**Zero Stability:** 10 μV for 90 days, after 1 hour warm-up

**Common Mode Rejection:** >130 dB at 50 Hz or 60 Hz line, using 5½-digit resolution and no filter and with ≤1 kΩ in either lead. >150 dB with guard

**5½-Digit Accuracy:** ±(% of Input + Digits)\*

Ranges	18°C to 28°C		
	24 Hours	90 Days	1 Year
200 mV 2V, 20V, 200V, 1000V	0.004+3 0.004+2	0.008+3 0.008+3	0.01+3 0.01+3

\*Using front panel zero

**5½-Digit Settling Time:** <30 ms with no filter, <300 ms with filter, to 0.01% of input step size

**5½-Digit Normal Mode Rejection:** >60 dB with no filter, >100 dB with filter, 50 Hz or 60 Hz

**4½- and 3½-Digit Accuracy:** ±(% of Input + Digits)\*

Ranges	18°C to 28°C		
	4½ Digits		3½ Digits**
	90 Days	1 Year	1 Year
All	0.01+2	0.015+3	0.1+1

\*Using front panel zero

\*\*Requires Option -04 or -05

**4½-Digit Settling Time:** Same as for 5½ digits

**4½-Digit Normal Mode Rejection:** Same as for 5½ digits

**3½-Digit Settling Time:** <5 ms with no filter, <250 ms with filter, to 0.1% of input size

**3½-Digit Normal Mode Rejection:** None with no filter, >40 dB with filter, 50 Hz to 60 Hz

### AC Voltage (True RMS)

**Ranging:** Fully automatic or manual

**Input Impedance:** 10 MΩ, ≤70 pF

**Coupling Modes:** AC or AC+DC

**Ranges:** 200 mV, 2V, 20V, 200V, 700V

**Bandwidth:** -3 dB at 1 MHz, typical

**Resolution:** Same as for dc voltage

**Crest Factor:** 3 at full range, increasing down range

**Settling Time:** <550 ms to 0.2% of input step size

**5½-Digit Accuracy for AC Mode:** ±(% of Input + Digits)

Frequency**	Ranges**	18°C to 28°C		
		% of Input	Plus Digits	
			90 Days	1 Year
20 Hz to 50 Hz	200 mV	0.25	150	150
	>200 mV	0.25	70	150
50 Hz to 10 kHz	200 mV	0.15	150	150
	>200 mV	0.15	70	150
10 kHz to 50 kHz	200 mV	0.7	150	300
	>200 mV	0.4	150	300
50 kHz to 100 kHz	200 mV	2.5	—	350
	>200 mV	1.0	—	350
100 kHz to 300 kHz	All	8.0	—	700

\*From 0.5% of range, except 1% of range to full range for 200 mV range. For AC+DC mode, add 0.1% of reading and 50 digits

\*\*Limited to 700V rms, 1000V peak, 2 x 10<sup>7</sup> volt-hertz product, whichever is less

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## 4½-Digit Accuracy for AC Mode: ±(% of Input + Digits)

Frequency**	Ranges**	18°C to 28°C		
		% of Input	Plus Digits	
			90 Days	1 Year
20 Hz to 50 Hz	200 mV	0.25	15	15
	>200 mV	0.25	10	13
50 Hz to 10 kHz	200 mV	0.15	15	15
	>200 mV	0.15	10	13
10 kHz to 50 kHz	200 mV	0.7	18	33
	>200 mV	0.4	18	33
50 kHz to 100 kHz	200 mV	2.5	—	38
	>200 mV	1.0	—	38
100 kHz to 300 kHz	All	8.0	—	73

\*From 0.5% of range to full range, except 1% of range to full range for 200 mV range. For AC+DC mode, add 0.1% of reading and 5 digits

\*\*Limited to 700V rms, 1000V peak, or 2x10<sup>-7</sup> volt-hertz product, whichever is less

## Resistance

**Ranging:** Fully automatic or manual

**Configuration:** 2- or 4-terminal

**Open Circuit Voltage:** <6V

**Maximum Input:** 300V dc or peak ac

## Input Characteristics

Ranges	Resolution			Current Through Unknown
	5½-Digits	4½-Digits	3½-Digits	
200Ω	1 mΩ	10 mΩ	100 mΩ	1 mA
2 kΩ	10 mΩ	100 mΩ	1Ω	1 mA
20 kΩ	100 mΩ	1Ω	10Ω	100 μA
200 kΩ	1Ω	10Ω	100Ω	10 μA
2 MΩ	10Ω	100Ω	1 kΩ	1 μA
20 MΩ	100Ω	1 kΩ	10 kΩ	100 nA

## 5½-Digit Accuracy: ±(% of Input + Digits)\*

Ranges	23°C±1°C	18°C to 28°C	
	24 Hours	90 Days	1 Year
		200Ω	0.008+4
2k, 20k, 200 kΩ	0.006+2	0.01+2	0.013+2
2 MΩ	0.01+3	0.014+3	0.017+3
20 MΩ	0.07+3	0.09+3	0.10+3

\*Using front panel zero

## 4½ and 3½-Digit Accuracy: ±(% of Input + Digits)\*

Ranges	18°C to 28°C		
	4½ Digits		3½ Digits
	90 Days	1 Year	1 Year
200Ω through 2 MΩ	0.01+2	0.02+3	0.1+1
20 MΩ	0.1+2	0.14+3	0.3+1

\*Using front panel zero

## Settling time\*

Ranges	5½ & 4½ Digits		3½ Digits	
	Filter	None	Filter	None
200Ω to 20 kΩ	<300 ms	<100 ms	<300 ms	<15 ms
200 kΩ	<1.1s		<800 ms	
2 MΩ	<650 ms		<500 ms	<70 ms**
20 MΩ	<6.8s	<1.5s**	<4.5s	<600 ms**

\*To 0.01% of step size for 5½- and 4½-digit display. To 0.1% of step size for 3½-digit display

\*\*For these ranges, the filter mode is recommended. This will reduce the effects of noise pickup common to all high impedance measurements.

## Option Specifications

**External Reference (Option) (-07)**

**Reference Range:** ±1.0V dc to 11.0V dc

**Display:** 10(V<sub>in</sub> ÷ V<sub>ref</sub>)

**Input Resistance:** 1 MΩ between Ext Ref Hi and Ext Ref Lo, 1.5 MΩ between Ext Ref Lo and Input Lo

**Maximum Input:** ±11V dc between the Hi and Lo reference terminals and ±11V dc between input Lo and either of the reference terminals

**5½-and 4½-Digit Accuracy:** ±(0.01% of V<sub>ref</sub> + 2 digits) ÷ 0.1V<sub>ref</sub>

**3½-Digit Accuracy:** ±(2 digits ÷ 0.1V<sub>ref</sub>)

## General Specifications

### Measurement Rates

Display	Line Frequency	Integration Time	Rdgs/s
5½ Digits	50 or 60 Hz	100 ms	2.5
4½ Digits	60 Hz	16 ms	15
	50 Hz	20 ms	12.5
3½ Digits*	50 or 60 Hz	2 ms	≈30

\*With Option -04 or -05

**Temperature Coefficient:** ±0.1 x applicable accuracy specification per °C, outside specified temperature range

**Shock and Vibration:** MIL-T-28800B, Class 4

**Temperature:** 0°C to 50°C, operating; -40°C to +75°C, non-operating

**Relative Humidity:** ≤80% to 35°C; ≤70% to 50°C

**Power:** 100, 120, 220, or 240V ac ±10%, 50 or 60 Hz, 17W max  
**Size:** 13.1 cm H x 20.5 cm W x 32.7 cm D (5.15 in x 8.05 in x 12.85 in)

**Weight:** 3.39 kg (7.48 lb)

**Included:** Operator's manual, calibration manual, service manual, test leads, power cord

## Model

February 1982 prices

8860A Digital Multimeter .....\$1395

## Options

8860A-04\* Calculating Controller ..... 550  
8860A-05\*\* IEEE-488 Interface ..... 295  
8860A-06 Rear Input (only) ..... 50  
8860A-07 DC External References ..... 75

\*Includes one Y8833 Memory Cartridge

\*\*May not be installed at same time as Option-04

## Accessories

2020A\* Universal Printer w/Opt -001 ..... 1050  
2020A\*\* Universal Printer w/Opt -003 ..... 1110  
Y7203\*\*\* 2 ft PTI Ribbon Cable ..... 45  
Y2016 7" Rack Adapter, Single ..... 80  
Y2017 7" Rack Adapter, Dual ..... 80  
Y8001 1m Cable for IEEE-488 ..... 85  
Y8002 2m Cable for IEEE-488 ..... 95  
Y8003 4m Cable for IEEE-488 ..... 105  
Y8100 DC or AC Current Probe ..... 199  
Y8140 Slim Test Leads ..... 18  
Y8833 Memory Cartridge ..... 50  
80J-10 Current Shunt ..... 30  
80K-6 High Voltage Probe ..... 45  
80T-150C Temperature Probe, °C ..... 120  
83RF 100 MHz RF Probe ..... 49  
85RF 500 MHz RF Probe ..... 85

\*For 8860A with Option -04 installed

\*\*For 8860A with Option -05 installed

\*\*\*Y7203 or Y7204 required with Printer Option -001