Section 1
Introduction & Specifications

1-1. INTRODUCTION

1-2. This manual comprises eight modular sections. You will find herein up-to-date information for installing, operating and maintaining the Fluke Model 8502A Digital Multimeter. Generally, complete descriptions and instructions are provided for the 8502A mainframe, modules necessary for DC Volts and DC Ratio measurement, and for any optional modules (AC Converter, Ohms Converter, etc.) that you may have ordered with your 8502A. Specifically, each section contains:

1. Section 1 – General description, specifications.

2. Section 2 – Operating instruction, capabilities.

3. Section 3 – Theory of operation, including simplified schematic and functional block diagrams.

4. Section 4 – Maintenance, adjustments and troubleshooting.

5. Section 5 – List of replaceable parts, with parts locators.

6. Section 6 – Option and accessory information, including complete information on any option ordered with the 8502A. As the need arises to broaden your 8502A's capabilities, the most recent information will be included with any options you order.

7. Section 7 – General information (list of abbreviations, federal supply codes, Service Centers, and Sales Respresentatives).

8. Section 8 – Schematic diagrams.

1-3. DESCRIPTION

1-4. The Model 8502A Digital Multimeter is a 6 1/2 digit instrument employing microprocessor control and a bus structure. Memory programming either from the front panel or through a remote interface permits a number of operations to be performed on the measured input before it is displayed. The standard configuration allows for measurement of dc volts in 5 ranges. Four ranges are available for ac volts when either optional ac converter is installed. Resistance can be measured in 8 ranges. Current can be measured in 5 ranges.

1-5. Modular Construction

1-6. Considerable versatility is realized through the 8502A's unique construction. All active components are contained in modules which plug into a mainframe motherboard. This module-motherboard mating, combined with bus architecture and microprocessor control, yields both ease of option selection and reduced downtime.

1-7. Microprocessor Control

1-8. All modules function under direct control of a microprocessor based controller. Each module is addressed by the controller as a memory location. External reference values and offsets can be applied separately, stored in memory, and automatically used as factors in all subsequent readings. Digital filtering utilizes averaged samples for each reading.

1-9. Recirculating Remainder A/D Conversion

1-10. The 8502A adapts Fluke's patented recirculating remainder (R^2) A/D conversion technique to microprocessor control. This combination provides fast, accurate, linear measurements and long-term stability.

1-11. Options and Accessories

1-12. Remote interfaces, AC converters, a current converter and an ohms converter are among the numerous options and accessories available for the 8502A. Refer to Tables 1-1 and 1-2 for complete listings. AC conversion can be accomplished with either an ac averaging module (–01) or a true RMS module (–09A). Any one of three remote interface modules (–05, –06, –07) may be installed at one time; the isolator module (–08A) must then be installed to maintain guarding of analog and high quality busses during remote operations. Maximum interfacing with digital systems is thus realized. Calibration downtime is reduced through the use of a calibration memory module (–04); correction factors may be entered from the front panel, providing automatic correction for further measurements. Analog inputs from a remote position are permitted when Rear Input (Option–17) is installed. Selectable front or rear analog inputs are available with Option –16.

1-13. SPECIFICATIONS

1-14. Mainframe specifications with DC Volts and DC Ratio measurement capability are presented in Table 1-3. Optional function specifications are supplied with the respective option modules and included in Section 6. The table of specifications presented here is divided into three parts:

1. General Specifications.
2. Accuracy.
3. Instrument Operating Characteristics.

Table 1-1. 8502A Options

Option No.	Name	Notes
01	AC/DC Converter (Averaging)	1, 3
02	Ohms Converter	
03	Current Shunts	3
04	Calibration Memory	
05	IEEE Standard 488–1975 Interface	2
06	Bit Serial Asynchronous Interface	2
07	Parallel Interface	2
08A	Isolator	4
09A	AC/DC Converter (True RMS)	1, 3
16	Front–Rear Switchable Input	5
17	Rear Input	

1) Options 01 and 09A cannot be installed simultaneously.
2) Only one of Options 05, 06, and 07 can be installed at any time.
3) For the AC portion of Option 03 to operate, either Option 01 or 09A must be installed.
4) Option 08A must be installed for remote operations.
5) Option 16 must be factory installed.

Table 1-2. 8502A Accessories

Model or Part No.	Name
M04-205-600	Rack Ear Mounting Assembly
M00-260-610	18-inch Rack Slides
M00-280-610	24-inch Rack Slides
80F-5	High Voltage Probe
80F-15	High Voltage Probe
81RF	High Frequency Probe
82RF	High Frequency Probe
KDM1	Keyboard Display Module w/Cable
Y8001	IEEE Std. Cable, 1 Meter Length
Y8002	IEEE Std. Cable, 2 Meter Length
Y8003	IEEE Std. Cable, 4 Meter Length
MIS-7011K*	Extender Assembly
MIS-7190K*	Static Controller
MIS-7191K*	Test Module
MIS-7013K*	Bus Interconnect and Monitor

*For use during service or repair

Table 1-3. Specifications

GENERAL SPECIFICATIONS

DIMENSIONS

	H		L		W
cm	10.8	x	42.5	x	43.2
Inches	4.25	x	16.75	x	17

WEIGHT

	Basic	Fully Loaded
kg	9.1	10.92
Lbs	20	24

OPERATING POWER

Basic Instrument	12 watts	115V ac or 230V ac ±10%
Fully Loaded	24 watts	50–60 Hz

WARM-UP

1 hour to rated accuracy

SHOCK AND VIBRATION

Meets requirements of MIL-T-28800 for Class 5 style E equipment.

TEMPERATURE RANGE

Operating 0°C to 50°C

Non Operating –40°C to 70°C*

**0°C to 50°C operating and non-operating with calibration memory option (–04) installed.*

HUMIDITY RANGE

(Operating to Full Accuracy)

0°C to 18°C	80% RH
18°C to 40°C	75% RH
40°C to 50°C	60% RH

OVERLOAD

LO to Guard	127V max
Guard to Chassis	1000V max
HI Sense to HI Source	127V max
LO Sense to LO Source	127V max
HI Sense to LO Sense	1000V max
HI Source to LO Source	280V max

ACCURACY

Note

The stated accuracies are valid under the following environmental conditions.

Temperature: 18°C to 28°C (Except 24 hour: 22°C to 24°C)

Humidity: ≤75%

Line Regulation: 90V to 110V, 103.5V to 126.5V, or 207V to 253V @ 45 to 66 Hz

DC Volts

Normal Resolution (5 1/2 digits)

Range	Full Scale	Resolution	Accuracy ± (% of Input + Number of Digits)		
			24 Hours	90 Days	1 Year
100 mV	312 mV	1 uV	0.002 + 4	0.003 + 5	0.005 + 8
1 V	2.5 V	10 uV	0.001 + 1	0.002 + 1	0.004 + 1
10 V	20 V	100 uV	0.001 or 1*	0.001 + 1	0.002 + 1
100 V	160 V	1 mV	0.001 + 1	0.002 + 1	0.004 + 1
1000 V	1200 V	10 mV	0.001 + 1	0.002 + 1	0.004 + 1

**Whichever is greater.*

Table 1-3. Specifications (cont)

ACCURACY (Continued)

DC Volts (Continued)

High Resolution (HI RES or CAL – 6 1/2 digits)

Range	Full Scale	Resolution	Accuracy ± (% of Input + Number of Digits)		
			24 Hours	90 Days	1 Year
1 V	2.5 V	1 uV	0.001 + 6	0.002 + 8	0.004 + 9
10 V	20 V	10 uV	0.001 or 6*	0.001 + 8	0.002 + 9
100 V	160 V	100 uV	0.001 + 6	0.002 + 8	0.004 + 9
1000 V	1200 V	1 mV	0.001 + 6	0.002 + 8	0.004 + 9

**Whichever is greater.*

DC Ratio

Ext. Ref. Voltage	Accuracy
±20V to ±40V	±(A + B + 10 ppm)
$\pm V_{min.}$* to ±20V	$\pm\left(A + B + \frac{200\ ppm}{\lvert V_{xref} \rvert}\right)$

A =10V dc Range Accuracy
B =Input Signal Function and Range Accuracy
V_{min} =Minimum Allowable External Reference Voltage
$|V_{xref}|$ =Absolute Value of External Reference Voltage

**The formula for determining V_{min} is included in Instrument Operating Characteristics*

Example Calculations for External Reference Accuracy:

1. Input = + 90.000V, Ext. Ref. Input = 30.000V (+ 15V to Ext. Ref. HI, −15V to Ext. Ref. LO)
   A = .001% + 1 Digit B = .001% + 1 Digit
   Ratio Accuracy = ±(A + B + 10 ppm) = ±(.001% + 1 Digit + .001% +1 Digit + .001% = ±(.003% +2 Digits)
   Reading may be between 3.0003 and 2.9997

2. Input = 1.20000V, Ext. Ref. Input = .12000 (V_{min} for 1V Range)
   A = .001% + 1 Digit, B = .001% + 1 Digit, $\frac{200\ ppm}{V_{xref}} = \frac{.02\%}{.12} = .1667\%$

   Ratio Accuracy = ±.001% + 1 Digit + .001% +1 Digit + .1667%) = ±(.1687% + 2 Digits)
   Reading may be between .998313 and 1.001686.

INSTRUMENT OPERATING CHARACTERISTICS

DC Volts

TEMPERATURE COEFFICIENT (0°C to 18°C and 28°C to 50°C)		INPUT IMPEDANCE	
Range	Temperature Coefficient	Range	Input Impedance
100 mV	± (3 ppm/reading + 0.5 digit)/°C	100 mV	>10,000 MΩ
1V	±(3 ppm/reading +0.1 digit)/ °C	1V	>10,000 MΩ
10 V	± (2 ppm/reading + 0.05 digit)/°C*	10 V	>10,000 MΩ
100 V	± (3 ppm/reading + 0.1 digit)/°C*	100 V	10 MΩ
1000 V	± (3 ppm/reading + 0.05 digit)/°C*	1000 V	10 MΩ
		Guard to Chassis	∞

**For High Resolution Multiply Digits by 10.*

INPUT BIAS CURRENT			
	At time of Cal	30 Days (23°C ± 1°C)	Temperature Coefficient
Bias Current	<± 5 pA	<± 50 pA	± 3 pA/°C

Table 1-3. Specifications (Cont)

INSTRUMENT OPERATING CHARACTERISTICS (Continued)

DC Volts (Continued)

RESPONSE TIME

Digitizing Time			Analog Settling Time Within Voltmeter		
Reading Rate*		Digitizing Time	Filter Mode	Step Input to 0.01% of Change	Step Input to 0.001% of Change
50 Hz line	4 Samples/Rdg	22 ms	Filter, Fast	40 ms	50 ms
	32 Samples/Rdg	162 ms	Bypass	2 ms	20 ms
	128 Samples/Rdg	642 ms	Bypass	2 ms	20 ms
60 Hz line	4 Samples/Rdg	18 ms	Filter, Slow	400 ms	500 ms
	32 Samples/Rdg	136 ms	Bypass	2 ms	20 ms
	128 Samples/Rdg	546 ms	Bypass	2 ms	20 ms

**Number of samples per reading is programmable from 1 (2^0) to 131,072 (2^{17}) in 18 binary steps.*

ZERO STABILITY

Better than 5 μV for 90 days after a one hr. warm-up. Front Panel pushbutton auto zero is provided. The zero correction is stored in memory until power is interrupted or the 8502A is RESET. If calibration memory Option –04 is installed, the zero correction is retained.

OVERLOAD

±1200V DC, 1200V peak to 60 Hz, or 1400V peak above 60 Hz may be applied continuously to any dc range without permanent damage. Maximum common mode rate of voltage rise is 1000V/μsec.

NOISE REJECTION

Normal Mode				Common Mode	
Line/Filter Frequency	4 Samples/ Rdg	32 Samples/ Rdg	128 Samples/ Rdg	True	Effective
50 Hz Fast Filter	60 dB	70 dB	75 dB	100 dB at 60 Hz for 1 KΩ unbalance	Sum of Common Mode Rejection and Normal Mode Rejection
50 Hz Slow Filter	85 dB	90 dB	95 dB		
60 Hz Fast Filter	60 dB	70 dB	75 dB		
60 Hz Slow Filter	90 dB	95 dB	100 dB		

128 SAMPLES/READING

Typical Performance with 60 Hz Line
(Combined digital and analog filtering)

Cusps shown are at multiples of 60 Hz line frequency. Similar cusps (not shown) occur every 7½ Hz.

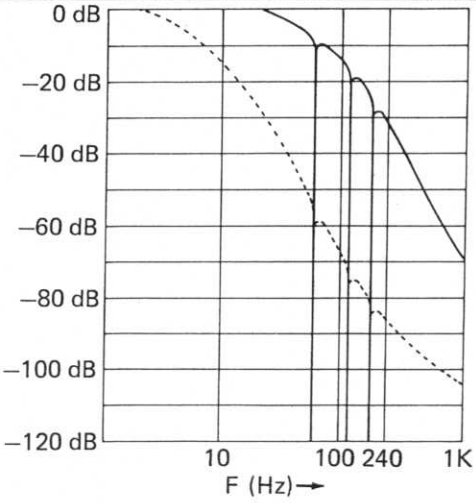

Table 1-3. Specifications (Cont)

INSTRUMENT OPERATING CHARACTERISTICS (Continued)

DC Ratio

INPUT IMPEDANCE	SOURCE IMPEDANCE
Ext Ref HI or LO > 10,000 MΩ relative to Ohms Guard* or Sense LO	Resistive Unbalance (Ext Ref HI to LO) <4 kΩ Total Resistance Sense LO from either HI or LO <20 kΩ
BIAS CURRENT	**OVERLOAD (Ext Ref HI or LO)**
Ext Ref HI or LO relative to Ohms Guard* or Sense LO <5 nA	±180 volts peak, 127V rms (relative to Ohms Guard* or Sense LO) X (360V peak HI to LO)

** Ohms Guard available through rear input (–16 or –17 Option)*

NOISE REJECTION

Normal Mode	Common Mode, All Inputs Driven
Sense Input—Same as dc volts **Ext Ref Input**—dc, line frequency and 2x line frequency >100 dB	**Sense Input**—Same as dc volts **Ext Ref Input**—Line frequency and 2x line frequency, 75 dB

RESPONSE TIME

Settling Time

Sense Input Fast Filter < 50 ms to 0.001% of change
Sense Input Slow Filter < 500 ms to 0.001% of change

Digitizing Time

NOTE
The Sense Input is measured prior to measuring Ext Ref HI and LO.

Ext Ref Input—Each input HI and LO
90 ms at 60 Hz line frequency
107 ms at 50 Hz line frequency

Ext Ref Calibration—12 ms

Sense Input		
Line Volt	**Approx. Rdg. Rate**	**Digitizing Time**
60 Hz	4½ rdg/s	136 ms
	1½ rdg/s	536 ms
50 Hz	3½ rdg/s	162 ms
	1¼ rdg/s	642 ms
60 Hz	4 samples/rdg	18 ms
50 Hz	4 samples/rdg	22 ms

EXT REF VOLTAGE RANGE

Maximum Ext Ref Voltage = ±40V between Ext Ref HI and LO terminals, providing neither terminal is greater than ±20V relative to the Sense LO or Ohms Guard terminals.

Minimum Ext Ref Voltage = ±0.0001V, or $\frac{V_{input}}{10^9}$ (whichever is greater)

MAXIMUM DISPLAY– Ratio, Scaling or Offset Mode = ±1.00000 x 10^9 in all Ranges