

Section I  
INTRODUCTION

The Series 2000 Digital Multimeter is the first implementation of a new concept in digital instrumentation. It features: TRI-PHASIC<sup>TM</sup> A/D Conversion, ISO-Polar<sup>TM</sup> Reference Generation, and Ratiohm<sup>TM</sup> Resistance Measurements.

The new design concepts have resulted in a marked increase in technical performance at radically reduced cost.

Every Series 2000 Digital Multimeter includes full capabilities for:

- Auto-Ranging for all measurements, which automatically selects the range scale of highest resolution for the input signal (Manual ranging is also included);
- BCD Outputs, which remain latched between conversions and which are available for remote data output;
- Overload Indicator, which enables the system user to reject invalid measurement indications;
- Remote Control, which enables the system user to trigger measurement cycles according to his needs and to change the range on external command.

The measurement functions incorporated in each Model are listed below. The complete specifications for the 5-1/2 and 4-1/2 digit models are reproduced in the tabular data that follows.

5-1/2 Digit 2500 Series

Model	DC Volts	AC Volts	Ohms	DC Ratio
→ 2540	X	X	X	X
2535	X	X		X
2530	X		X	X
2520	X			X

4-1/2 Digit Series

Model	DC Volts	AC Volts	Ohms	DC Ratio
2440	X	X	X	X
2435	X	X		X
2430	X		X	X
2420	X			X

Scope of Instruction Manual for MODEL 2500

This Instruction Manual for Model 2500 DMM contains the general description, principles of operation, operating and maintenance procedures, reference schematics, and parts lists.

NOTICE

The information contained herein is derived in part from proprietary and patent data of the Data Precision Company and its presentation in this Instruction Manual is solely for the assistance of equipment operating and maintenance personnel. Publication of this information does not convey any rights to reproduce or to use the information for any purpose other than in connection with the installation, operation, and maintenance of the equipments described herein.

SPECIFICATIONS MODEL 2500 DMM

AC Volts

Nominal Range	Overrange	Resolution
1.00000	1.19999	10 $\mu$ V
10.0000	11.9999	100 $\mu$ V
100.000	119.999	1 mV
1000.00*	1000.00*	10 mV

\*See maximum voltage limitation, below

**Input Impedance** (all ranges): 1 megohm in parallel with 100pF or less.

**Sensing & Calibration:** True-Average sensing, calibrated in RMS of sinewave.

**Accuracy** (6 months, 23°C  $\pm$ 5°C): See curve and specific ratings below.

**Temperature Coefficient** (0°C to 50°C, all ranges):  
 30Hz - 1kHz ( $\pm$ 0.005% rdg.  $\pm$ 0.002% f.s.)/ $^{\circ}$ C  
 1kHz - 10kHz ( $\pm$ (0.005 x freq. in kHz)% rdg.  $\pm$ 0.002% f.s.)/ $^{\circ}$ C  
 10kHz - 100kHz ( $\pm$ 0.05% rdg.  $\pm$ 0.002% f.s.)/ $^{\circ}$ C

**Maximum Input Voltage** (sinewave RMS):  
 30Hz to 10kHz: 500V  
 above 10kHz: decreases linearly to 100V at 100kHz

**Settling Time** (to settle within  $\pm$ 0.05% of final reading for a full-scale step input): 2.5 seconds.

DC Volts

Nominal Range	Overrange	Resolution	Input Impedance	Maximum Voltage
$\pm$ 1.00000	$\pm$ 1.19999	10 $\mu$ V	> 1,000 megohms	1000V
$\pm$ 10.0000	$\pm$ 11.9999	100 $\mu$ V	> 1,000 megohms	1000V
$\pm$ 100.000	$\pm$ 119.999	1mV	10 megohms	1000V
$\pm$ 1000.00	$\pm$ 1000.00	10mV	10 megohms	1000V

**Accuracy** (all ranges, including overrange):  
 24 hours, 23°C  $\pm$ 1°C  $\pm$ 0.004% rdg  $\pm$ 0.001% f.s.  $\pm$ 1 l.s.d.  
 6 months, 23°C  $\pm$ 5°C  $\pm$ 0.007% rdg  $\pm$ 0.001% f.s.  $\pm$ 1 l.s.d.  
 Add  $\pm$ 0.00001% rdg/Volt.

**Temperature Coefficient** (0°C to 50°C, all ranges):  
 ( $\pm$ 0.001% rdg  $\pm$ 0.0002% f.s.)/ $^{\circ}$ C

**Common-Mode Rejection Ratios** (minimum):  
 at DC, 160dB with 1000 $\Omega$  source-impedance unbalance  
 at 60Hz, 120 dB with 1000 $\Omega$  source-impedance unbalance

**Common-Mode Voltage:** 250V DC (or AC peak) maximum.

**Normal-Mode Rejection Ratio:** 60dB at 10Hz and all integral multiples thereof.

OPTION A1:

Nominal Range	Overrange	Resolution	Input Impedance	Maximum Voltage
$\pm$ 1000000	$\pm$ 1199999	1 $\mu$ V	> 1,000 megohms	1000V

**Accuracy:**  
 24 hours, 23°C  $\pm$ 1°C  $\pm$ 0.005% rdg  $\pm$ 0.004% f.s.  $\pm$ 1 l.s.d.  
 6 months, 23°C  $\pm$ 5°C  $\pm$ 0.008% rdg  $\pm$ 0.004% f.s.  $\pm$ 1 l.s.d.

**Temperature Coefficient** (0°C to 50°C):  
 ( $\pm$ 0.001% rdg  $\pm$ 0.001% f.s.)/ $^{\circ}$ C

Ohms

Nominal Range	Overrange	Resolution	Max Test Current
1.00000k $\Omega$	1.19999k $\Omega$	10 milliohms	1 mA
10.0000k $\Omega$	11.9999k $\Omega$	100 milliohms	100 $\mu$ A
100.000k $\Omega$	119.999k $\Omega$	1 Ohm	10 $\mu$ A
1.00000 meg $\Omega$	1.19999 meg $\Omega$	10 Ohms	1 $\mu$ A
10.0000 meg $\Omega$	11.9999 meg $\Omega$	100 Ohms	0.1 $\mu$ A

**Configuration:** True four-wire.

**Maximum Open Circuit Voltage:** 6.2 Volts.

**Accuracy** (6 months, 23°C  $\pm$ 5°C):  
 1k $\Omega$ /10k $\Omega$ /100k $\Omega$  ranges  $\pm$ 0.007% rdg  $\pm$ 0.001% f.s.  $\pm$ 1 l.s.d.  
 1 meg  $\Omega$  range  $\pm$ 0.02% rdg  $\pm$ 0.002% f.s.  $\pm$ 1 l.s.d.  
 10 meg  $\Omega$  range  $\pm$ 0.2% rdg  $\pm$ 0.01% f.s.  $\pm$ 1 l.s.d.

**Temperature Coefficient** (0°C to 50°C):  
 1k $\Omega$ /10k $\Omega$ /100k $\Omega$  ranges ( $\pm$ 0.001% rdg  $\pm$ 0.0004% f.s.)/ $^{\circ}$ C  
 1 meg  $\Omega$  range ( $\pm$ 0.005% rdg  $\pm$ 0.0004% f.s.)/ $^{\circ}$ C  
 10 meg  $\Omega$  range ( $\pm$ 0.02% rdg  $\pm$ 0.005% f.s.)/ $^{\circ}$ C

**Settling Time** (to settle to within  $\pm$ 0.01% fo final reading):  
 1k $\Omega$ /10k $\Omega$ /100k $\Omega$  ranges 0.1 sec.  
 1 meg  $\Omega$  range 0.4 sec  
 10 meg  $\Omega$  range 3.1 sec.

**Settling Time** in seconds for any resistance = 0.1 + 0.3 x Resistance in Megohms.

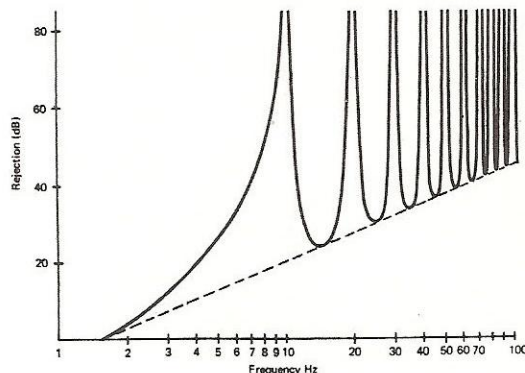


Figure 1-1. Common Mode Rejection

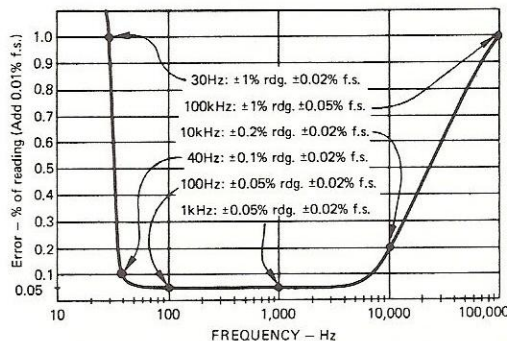


Figure 1-2. Series 2000 DMM AC-Volt Accuracy

## SPECIFICATIONS MODEL 2500 DMM (Continued)

## DC Ratio

Selected Range	Nominal Range	Overrange	Actual Display*
1	±1.00000:1	±1.19999:1	±1.19999
10	±1.00000:1	±1.19999:1	±11.9999
100	±10.0000:1	±11.9999:1	±119.999
1000	±100.000:1	±119.999:1	±1199.99

\*Displayed Ratio is 10 times true ratio

## Accuracy:

24 hours, 23° ±1°C:

$$[\pm 0.004\% \text{ rdg} \pm 0.001\% \text{ f.s.} \pm 1 \text{ l.s.d.}] \times \frac{10}{\text{Actual Ref. Voltage}}$$

6 months, 23°C ±5°C:

$$[\pm 0.008\% \text{ rdg} \pm 0.001\% \text{ f.s.} \pm 1 \text{ l.s.d.}] \times \frac{10}{\text{Actual Ref. Voltage}}$$

## Temperature Coefficient (0°C to 50°C, all ranges):

$$[\pm 0.001\% \text{ rdg} \pm 0.0002\% \text{ f.s.}] \times \frac{10}{\text{Actual Ref. Voltage}} / ^\circ\text{C}$$

## Voltage Coefficient of Ratio: ±0.00001% rdg/Volt

## Voltage Range:

Input Signal: 0 to ±1000V

Reference Signal: +1V to +11V

## Reference Input Impedance: 100k Ω

Common-Mode Rejection Ratio: Same as DC Volts

Normal Mode Rejection Ratio: Same as DC Volts

## Interface &amp; Application Specifications

## Signal Interfaces.

*Data Outputs* (DTL/TTL compatible) BCD 1-2-4-8 coded, positive true.

Logic ONE: &gt; +2.4V

Logic ZERO: &lt; +0.4V sink for 4mA

Polarity output, ONE = Positive polarity

*State Outputs* (DTL/TTL compatible)

Range in use = ZERO: &lt; +0.4V sink for 4mA

Inactive ranges = ONE: &gt; +2.4V

End of Conversion is transition from ZERO to ONE.

## Control Inputs.

*Range.* Each range is selected by the grounding of the appropriate line, through switch contacts or grounded transistor.*External Trigger*

Positive pulse 2.4 volts with a pulse width of &gt;1μsec, and &lt;100 msec will initiate a read command. The command will cause the instrument to perform one measurement. The reading will remain in the memory until a new external trigger pulse is initiated.

*Trigger Enable Input* (applying logic "0" inhibits conversion in all trigger modes):

Logic "1" &gt; +2.4V

Logic "0" &lt; +0.4V sink for 40mA

*Input Power:* 105V–125V AC (or 210–250V AC) at 47–430Hz, less than 12 Watts. Line-voltage range is selected by rear-panel switch.

## Environment.

*Temperature Ranges:* Operating, 0°C to +50°C

Storage, -25°C to +80°C

*Humidity:* 95% RH max, 0°C to +40°C

80% RH max, +40°C to +50°C

*Overall Dimensions:* 3½" high, 8½" wide, and 12" deep, including panel controls and connectors.*Weight:* 8 pounds net, 10 pounds packed for domestic shipment.*Stand:* Adjustable, removable, tilt-up stand provided for best viewing in bench use.



SPECIFICATIONS MODEL 2400 DMM

DC Volts

Nominal Range	Overrange	Resolution	Input Impedance	Maximum Voltage
±1.0000	±1.1999	100µV	> 1,000 megohms	1000V
±10.000	±11.999	1mV	> 1,000 megohms	1000V
±100.00	±119.99	10mV	10 megohms	1000V
±1000.0	±1000.0	100mV	10 megohms	1000V

Accuracy (all ranges, including overrange):  
 24 hours, 23°C ±1°C ±0.004% rdg ±1 l.s.d.  
 6 months, 23°C ±5°C ±0.007% rdg ±1 l.s.d.  
 Add ±0.00001% rdg/Volt.

Temperature Coefficient (0°C to 50°C, all ranges):  
 (±0.001% rdg ±0.0005% f.s.)/°C

Common-Mode Rejection Ratios (minimum):  
 at DC, 160dB with 1000Ω source-impedance unbalance  
 at 60Hz, 120dB with 1000Ω source-impedance unbalance

Common-Mode Voltage: 250V DC (or peak AC) maximum.

Normal-Mode Rejection Ratio: 60dB at 10Hz and all integral multiples thereof.

OPTION B1:

Nominal Range	Overrange	Resolution	Input Impedance	Maximum Voltage
±1.0000	±1.1999	10µV	> 1,000 megohms	1000V

Accuracy:  
 24 hours, 23°C ±1°C ±0.005% rdg ±1 l.s.d.  
 6 months, 23°C ±5°C ±0.01% rdg ±1 l.s.d.

Temperature Coefficient (0°C to 50°C):  
 (±0.001% rdg ±0.001% f.s.)/°C

AC Volts

Nominal Range	Overrange	Resolution
1.0000	1.1999	100µV
10.000	11.999	1mV
100.00	119.99	10mV
1000.0*	1000.0*	100mV

\*See maximum voltage limitation, below

Input Impedance (all ranges): 1 megohm in parallel with 100pF or less.

Sensing & Calibration: True-Average sensing, calibrated in RMS of sinewave.

Accuracy (6 months, 23°C ±5°C): See curve and specific ratings below.

Temperature Coefficient (0°C to 50°C, all ranges):  
 30Hz - 1kHz (±0.005% rdg ±0.002% f.s.)/°C  
 1kHz - 10kHz (±0.005) × freq. in kHz) % rdg ±0.002% f.s.)/°C  
 10kHz - 100kHz (±0.05% rdg ±0.002% f.s.)/°C

Maximum Input Voltage (sinewave RMS):  
 30Hz to 10kHz: 500V  
 above 10kHz: decreases linearly to 100V at 100kHz

Settling Time (to settle within ±0.05% of final reading for a full-scale step input): 2.5 seconds.

Ohms

Nominal Range	Overrange	Resolution	Max Test Current
1.0000k Ω	1.1999k Ω	100 milliohms	1mA
10.000k Ω	11.999k Ω	1 Ohm	100µA
100.00k Ω	119.99k Ω	10 Ohms	10µA
1.0000 meg Ω	1.1999 meg Ω	100 Ohms	1µA
10.0000 meg Ω	11.9999 meg Ω	1000 Ohms	0.1µA

Configuration: True four-wire.

Maximum Open Circuit Voltage: 6.2 Volts.

Accuracy (6 months, 23°C ±1°C):  
 1kΩ/10kΩ/100kΩ ranges ±0.007% rdg ±1 l.s.d.  
 1 megΩ range ±0.02% rdg ±1 l.s.d.  
 10 megΩ range ±0.25% rdg ±1 l.s.d.

Temperature Coefficient (0°C to 50°C):  
 1kΩ/10kΩ/100kΩ ranges (±0.002% rdg ±0.0004% f.s.)/°C  
 1 megΩ range (±0.005% rdg ±0.0004% f.s.)/°C  
 10 megΩ range (±0.02% rdg ±0.005% f.s.)/°C

Ohms (Continued)

Settling Time (to settle to within ±0.01% of final reading):  
 1kΩ/10kΩ/100kΩ ranges 0.1 sec.  
 1 megΩ range 0.4 sec.  
 10 megΩ range 3.1 sec.

Settling Time in seconds for any resistance = 0.1 + 0.3 × Resistance in Megohms.

DC Ratio

Nominal Range	Overrange	Actual Display*
±1.0000:1	±1.1999:1	±1.1999
±1.0000:1	±1.1999:1	±11.999
±10.000:1	±11.999:1	±119.99
±100.00:1	±119.99:1	±1199.9

\*Displayed ratio is 10 times true ratio.

Accuracy:  
 24 hours, 23°C ±1°C:  
 [±0.004% rdg ±1 l.s.d.] ×  $\frac{10}{\text{Actual Ref. Voltage}}$   
 6 months, 23°C ±5°C  
 [±0.007% rdg ±1 l.s.d.] ×  $\frac{10}{\text{Actual Ref. Voltage}}$

Temperature Coefficient (0°C to 50°C, all ranges):  
 [±0.001% rdg ±0.0005% f.s.] ×  $\frac{10}{\text{Actual Ref. Voltage}}$ /°C

Voltage Coefficient of Ratio: Add 0.00001% rdg/Volt.

Voltage Range:  
 Input Signal: 0 to ±1000V  
 Reference Signal: +1V to +11V

Reference Input Impedance: 100kΩ  
 Common-Mode Rejection Ratio: Same as DC Volts  
 Normal Mode Rejection Ratio: Same as DC Volts

Interface & Application Specifications

Signal Interfaces.  
 Data Outputs (DTL/TTL compatible) BCD 1-2-4-8 coded, positive true.  
 Logic ONE: > +2.4V  
 Logic ZERO: < +0.4V sink for 4mA  
 Polarity output, ONE = Positive polarity  
 State Outputs (DTL/TTL compatible)  
 Range in use = ZERO: < +0.4 sink for 4mA  
 Inactive ranges = ONE: > +2.4V  
 End of Conversion is transition from ZERO to ONE.

Control Inputs.  
 Range: Each range is selected by the grounding of the appropriate line, through switch contacts or grounded transistor.  
 External Trigger:  
 Positive pulse 2.4 volts with a pulse width of >1µsec, and <100 msec will initiate a read command. The command will cause the instrument to perform one measurement. The reading will remain in the memory until a new external trigger pulse is initiated.

Trigger Enable Input (applying logic "0" inhibits conversion in all trigger modes):  
 Logic "1" > +2.4V  
 Logic "0" < 0.4V sink for 40mA

Input Power: 105V-125V AC (or 210-250V AC) at 47-430Hz, less than 12 Watts. Line-voltage range is selected by rear-panel switch.

Environment.  
 Temperature Ranges: Operating, 0°C to +50°C  
 Storage, -25°C to +80°C  
 Humidity: 95% RH max, 0°C to +40°C  
 80% RH max, +40°C to +50°C

Overall Dimensions: 3½" high, 8½" wide, and 12" deep, including panel controls and connectors.  
 Weight: 8 pounds, net, 10 pounds packed for domestic shipment.  
 Stand: Adjustable, removable, tilt-up stand provided for best viewing in bench use.