

**Beckman Industrial**<sup>™</sup>

**CIRCUITMATE<sup>™</sup> MODELS  
DM23 and DM25L  
DIGITAL MULTIMETERS**

**OPERATORS MANUAL**

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Beckman Industrial Corp. Brea, CA 92621

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## WARRANTY

### 90-Day Limited Warranty

CircuitMate™ Digital Multimeters are warranted in entirety against defects of material or workmanship which develop for any reason whatsoever, except abuse, within a period of 90 days following the date of purchase of the multimeter by the original purchaser. This warranty is extended by Beckman Industrial Corporation only to the original purchaser or original user of the multimeter who must as a **CONDITION PRECEDENT TO WARRANTY COVERAGE AND PERFORMANCE THEREUNDER BY BECKMAN INDUSTRIAL CORPORATION** complete and return the Warranty Registration Card received on purchase of the multimeter.

In the event a defect develops during the warranty period, Beckman Industrial Corporation at their election will repair or replace the multimeter with a new or reconditioned model of equivalent quality. In order to obtain performance of any obligation of Beckman Industrial Corporation under the warranty, the original purchaser or original user must return the defective multimeter postage prepaid along with a handling charge of \$3.00 to:

Instrumentation Products Division  
Beckman Industrial Corporation  
A subsidiary of Emerson Electric Company  
630 Puente St.  
Brea, CA 92621

In the event of replacement with a new or reconditioned model, the replacement unit will continue the warranty period of the original multimeter. The turnaround time for replacement units at the Service Center is typically only two (2) working days.

ANY IMPLIED WARRANTIES ARISING OUT OF THE SALE OF A CIRCUITMATE MULTIMETER, INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE LIMITED IN DURATION TO THE ABOVE STATED 90-DAY PERIOD. BECKMAN INDUSTRIAL CORPORATION SHALL NOT BE LIABLE FOR LOSS OF USE OF THE MULTIMETER OR OTHER INCIDENTAL OR CONSEQUENTIAL DAMAGES, EXPENSES OR ECONOMIC LOSS OR FOR ANY CLAIM OR CLAIMS FOR SUCH DAMAGE, EXPENSES OR ECONOMIC LOSS.

Some states do not allow limitations on how long implied warranties last or the exclusion or limitation of incidental or consequential damages so the above limitations or exclusions may not apply to you.

This warranty gives you specific legal rights and you may also have other rights which vary from state to state.

Beckman Industrial Corporation

Brea, CA

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## WARNINGS AND PRECAUTIONS

*Please read section 2.1 and 2.2, WARNINGS AND PRECAUTIONS*

Even low-level voltages and currents can potentially cause serious injury or even death from electrical shock. Please do not use this or any piece of test equipment without proper training.

## SECTION ONE:

### INTRODUCTION

#### 1.1 Unpacking and Inspection

Upon removing your new Digital Multimeter (DMM) from its packing, you should have the following items:

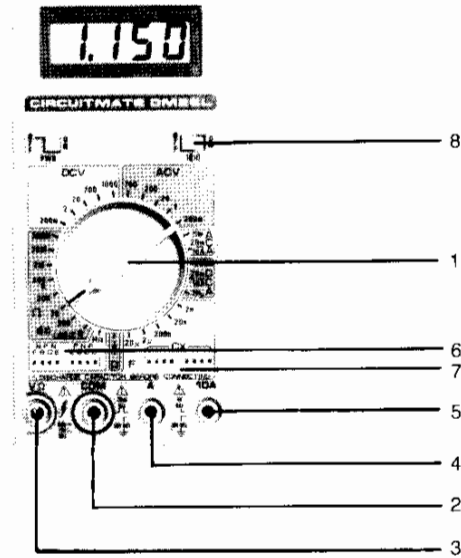
- |                                   |  |
|-----------------------------------|--|
| 1. Digital Multimeter             | 4. Warranty Card                       |
| 2. Test Lead Set (1 black, 1 red) | 5. Operators Manual                    |
| 3. 9-Volt Battery (in meter)      | 6. Two fuses (One spare, one in meter) |

If any of the above items are missing or are received in a damaged condition, please contact the distributor from whom you purchased the unit.

#### 1.2 Familiarization

1. FUNCTION/RANGE SWITCH: Selects the Function and Range desired.
2. COM INPUT TERMINAL: Ground input connector.
3. V- $\Omega$  INPUT TERMINAL: Positive input connector for volts and ohms.
4. A INPUT TERMINAL: Positive input connector for mA measurements (to 200mA).
5. 10A INPUT TERMINAL: Positive input connector for amp measurements (to 10A).
6. TRANSISTOR TEST SOCKETS: Used for transistor hFE measurements.
7. CAPACITOR TEST SOCKETS (DM25L ONLY): Used for capacitance measurements.
8. BEEPER SWITCH (DM25L ONLY): Enables or disables continuity beeper.

NOTE: RANGE OVERLOAD IS INDICATED BY A "1" OR " 1" IN THE DISPLAY WITH ALL OTHER DIGITS BLANKED. IN THIS CONDITION, THE USER MUST TAKE IMMEDIATE STEPS TO REMOVE THE CAUSE OF THE OVERLOAD CONDITION FROM THE METER.



#### Familiarization

1. FUNCTION/RANGE SWITCH
2. COM INPUT TERMINAL
3. V- $\Omega$  INPUT TERMINAL
4. A INPUT TERMINAL
5. 10A INPUT TERMINAL
6. TRANSISTOR TEST SOCKETS
7. CAPACITOR TEST SOCKETS
8. BEEPER SWITCH

## SECTION TWO:

### OPERATION

**⚠** Means PLEASE REFER TO OPERATING INSTRUCTIONS to insure operator safety.

#### 2.1 Warnings

Since injury or death can occur even with low voltages, exercise extreme caution when:

- Measuring voltage above 20 volts.
- Measuring AC mains with inductive loads.
- Measuring AC mains during electrical storms.
- Measuring constant-voltage transformers with open circuit voltage greater than 1000 volts AC.
- Measuring current with open circuit voltage greater than 250 volts.

Measuring voltage which exceeds the limits of the meter may damage the meter and expose the operator to a shock hazard.

Inspect the test leads and all insulation for damage before each use. DO NOT USE IF DAMAGED.

To avoid shock hazard, do not touch probe tips or the circuit under test while power is applied.

#### 2.2 Safety Precautions

1. Exceeding the maximum overload limits can damage the multimeter.
2. When making current measurements, make sure that the multimeter is connected in SERIES with the voltage source and the circuit load. NEVER connect the meter in parallel with the voltage source when measuring current.
3. Use only mild detergent and warm water to clean the meter. Do not use aromatic hydrocarbons or chlorinated solvents.

**2.3 MEASUREMENT SET-UP: Use the following steps before taking any measurement with the meter:**

1. Turn off power to the device under test and discharge all capacitors.
2. Connect the red and black test leads to the appropriate terminals on the meter (black to COM, red to V- $\Omega$  for volts, ohms or logic (DM25L only), A for current to 200mA, or 10A for current to 10 amps).
3. Connect the test leads to the device under test and turn on power.
4. After completing the measurement, turn off power to the device under test and discharge all capacitors, then disconnect the test leads.

#### 2.4 Voltage Measurements

1. Complete steps 1-4 in Section (2.3) above.
2. Set the function/range switch to the desired AC or DC voltage range and note the reading in the display. NOTE: If the magnitude of the voltage is not known, start with the highest range and reduce the setting until a satisfactory reading is obtained.

#### 2.5 Current Measurements

1. Complete steps 1-4 in Section (2.3) above.
2. Set the function/range switch to the desired AC or DC current range, and note the reading in the display. NOTE: If the magnitude of the current is not known, start with the highest range and reduce the setting until a satisfactory reading is obtained.

#### 2.6 Resistance Measurements


1. Complete steps 1-4 in Section (2.3) above.
2. Set the range switch to the desired ohms range and note the result in the display. NOTE: If the magnitude of the resistance is unknown, start with the highest range and decrease the setting until satisfactory resolution is obtained.

**ATTENTION DM25L USERS:** The 2000M $\Omega$  range has a fixed 10-count offset in the reading. When the test leads are shorted together in this range, the meter will display "010." This residual reading must be subtracted from the reading obtained in step 2 when this range is used, in order to obtain the actual resistance value. For example, when measuring 110M $\Omega$ , the display will read 120, from which the 10 residual reading is subtracted to obtain the actual resistance of 110M $\Omega$ .

**BEEPER NOTE:** In the Continuity position the meter will beep when the resistance is below approximately 100 ohms (On the DM25L the beeper switch must be in the on position).

#### 2.7 Diode and Transistor Tests

##### 2.7.1 Diode Tests

1. Complete steps 1-4 in Section (2.3) above.
2. Set the function/range switch to the diode position (  ), and connect the test leads to the diode to be checked (red to anode and black to cathode). If the diode is shunted by a resistor of 1000 ohms or less, it must be removed from the circuit before taking the measurement.

3. Read the forward voltage drop of the diode in the digital display. A typical reading for a good silicon diode is around 700 mV, while a germanium type will indicate approximately 200 mV. A "1" (overrange) indicates an open diode, while a very low reading indicates a shorted diode.
4. Reverse the test lead connections to the diode to perform a reverse-leakage test of the diode. A "1" (overrange) indicates a good diode while a "000" or other low reading indicates a diode with high reverse leakage current or that is shorted.


### 2.7.2 Transistor Tests

Bipolar transistor junctions may be tested in the manner described in (2.7.1) as diode junctions formed by the emitter-base and base-collector junctions. Measurement should also be made between the emitter and collector to determine if a short is present.

### 2.8 Transistor hFE Measurements

1. Transistor must be out of circuit. Set the function/range switch to the hFE position.
2. Plug the emitter, base and collector leads of the transistor into the correct holes in either the NPN or the PNP transistor test socket, whichever is appropriate for the transistor you are checking. Read the hFE (beta, or DC current gain) in the display.

### 2.9 Logic Measurements (DM25L only)

1. Complete steps 1-4 in Section (2.3) above.
2. Set the function/range switch to the logic (  ) position.
3. Connect the black probe to the common buss of the logic circuit to be tested. Connect the red probe to the point to be tested. On a TTL logic 1 the logic "high" indicator will appear. On a TTL logic 0 the logic "low" indicator will appear and the beeper will sound if the beeper switch is in the on position.

### 2.10 Capacitance Measurements (DM25L only)

1. Set the function/range switch to the desired capacitance range.
2. Short the leads of the capacitor to be tested together to insure that there is no charge on the capacitor.
3. Insert the capacitor leads into the capacitor test socket. Note that there are two groups of four holes. One lead must be inserted into one hole of group one, and the other lead must be inserted into one of the holes of group two.
4. Read the capacitance value in the display.

## SECTION THREE:

## OPERATOR MAINTENANCE

### 3.1 Troubleshooting

If there appears to be a malfunction during the operation of the meter, the following steps should be performed in order to isolate the cause of the problem.

1. Check the battery.
2. Review the operating instructions for possible mistakes in operating procedure.
3. Inspect and test the Test Probes for a broken or intermittent connection.
4. Inspect and test the fuse. If it is necessary to replace the fuse, be sure to install one of the proper current value.

### 3.2 Battery and Fuse Replacement

#### WARNING

To prevent electrical shock hazard, turn off the multimeter and any device or circuit under test and disconnect the test leads before removing the battery hatch or the rear cover.

#### 3.2.1 Battery Replacement

1. Remove the battery cover by gently sliding it towards the top of the meter.
2. Remove and disconnect the old battery from the meter and replace with a new unit. Wind the excess lead length once around the battery clip. Install the battery and replace the battery cover.

#### CAUTION

Failure to turn off the multimeter before installing the battery could result in damage to the instrument and to the battery if the battery is connected incorrectly to the multimeter.

#### 3.2.2 Fuse Replacement

1. Remove the battery cover by gently sliding it towards the top of the meter.
2. Remove the old fuse and replace with a 0.8 amp, 250 volt fuse.

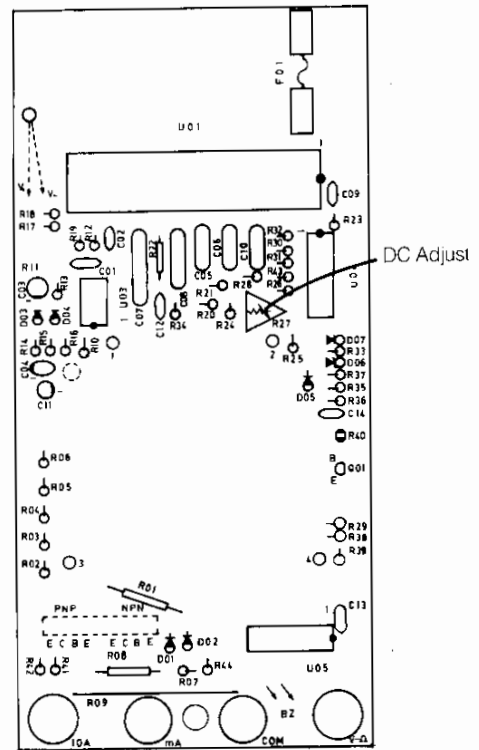
#### WARNING

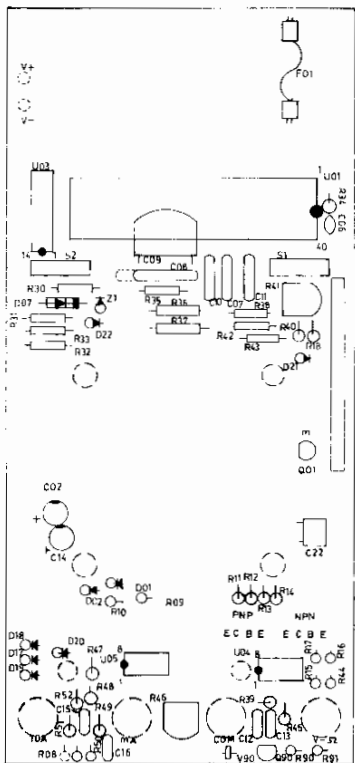
To prevent fire, use only a 0.8 amp, 250 volt replacement fuse.

### 3.4 Calibration

- 1 Perform calibration at  $23 \pm 2^\circ\text{C}$  at a relative humidity of  $\pm 70\%$ . Allow the meter to stabilize at this temperature for at least 30 minutes prior to performing the calibration procedure.
- 2 Turn off the multimeter and any device under test and disconnect the test leads from the meter.
- 3 Remove the battery cover by removing the screw on the top and gently lift it off. Remove the rear case by unscrewing the two screws that secure it to the front case and then gently prying the rear case away from the front case.
- 4 Select the 200mV DC range on the meter. Apply  $190\text{mV} \pm 0.02\%$  to the V- $\Omega$  and the COM input connectors of the meter.
- 5 Adjust R41 as shown to obtain a reading of 190.0 in the digital display.
- 6 Select the 200nF capacitance range on the meter. Connect a 0.1 $\mu\text{F}$ , 0.1% capacitor to the capacitor measurement jacks on the meter.
- 7 Adjust R46 as shown to obtain a reading of  $100.0 \pm 2$  digits in the digital display.
- 8 Disconnect the capacitor from the meter and reinstall the rear case and the battery cover.

### DM23 Component Locations





**SECTION FOUR:  
SERVICE**

**4.1 Warranty Information**

In the United States and Canada, the limited warranty period is 90 days. For further warranty information, or for warranty information in Europe, please contact the following:

**U.S. and CANADA**

Beckman Industrial Corporation  
630 Puente Street  
Brea, CA 92621  
Ph. (714) 671-4855

**EUROPE**

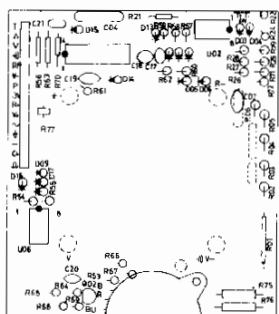
Beckman Industrial Ltd.  
Queensway, Glenrothes  
Scotland  
Ph. (059) 275-3811

**4.2 Warranty Repair**

Any Circuitmate Series DMM claimed to be defective should be returned to Beckman Industrial Corp. with a \$3.00 handling fee within the continental U.S. and \$12.00 in Canada\*. In Europe, please contact the above address for warranty repair information.

**4.3 Nonwarranty Repair**

Any out-of-warranty Circuitmate DMM that is defective, but repairable, may be repaired by an authorized Service Center or by Beckman Industrial Corp. The repaired unit carries a one (1) month warranty. Inside the U.S., the flat-rate factory repair charge is \$30.00 (if payment is included with the meter), or \$35.00 if payment is not received with the meter. In Canada, contact an Authorized Repair Center for out-of-warranty repair charges. In Europe, contact the Scotland address above for out-of-warranty repair information.



#### 4.4 Shipping Instructions

DMM's returned for repair or for calibration should be accompanied by the following information or items: Company name, customers name, address, telephone number, proof-of-purchase (warranty repairs), a brief description of the problem or the service requested, and the appropriate service charge.

Service charges should be remitted in the form of a check, a money order, or a purchase order made payable to Beckman Industrial Corp.

The DMM should be shipped with transportation charges prepaid to the following address.

INSTRUMENTATION PRODUCTS DIVISION  
Beckman Industrial Corporation  
630 Puente Street  
Brea, CA 92621  
ATTN: Customer Service Dept.

The DMM will be returned with the transportation charges paid by Beckman Industrial Corp.

## SECTION FIVE: SPECIFICATIONS

### 5.1 General Specifications

Display

Polarity Indication

Zero Adjustment

Overrange Indication

Low Battery Indication

Display Update Rate

Operating Temperature

Storage Temperature

Accuracy

Power

Battery Life (Typical)

DM23

DM25L

Dimensions (H x W x D)

Weight (including battery)

Accessories

- 3-1/2 digit Liquid Crystal Display (LCD) with a maximum reading of 1999.
- Automatic, positive implied, negative indicated.
- Automatic.
- (1) or (- 1) is displayed.
- (LO BAT) is displayed when the battery voltage drops below operating level.
- 2.5 per second, nominal.
- 0°C to 50°C, 0 to 70% Relative Humidity.
- -20°C to 60°C, 0 to 80% R.H. with battery removed from meter.
- Stated accuracy at 23°C  $\pm$  5°C, less than 75% R.H.
- Standard 9-volt transistor battery, NEDA 1604, JIS 006P, IEC 6F22
- Alkaline                      Carbon-Zinc
- 200 hours                      150 hours
- 100 hours                      70 hours
- 6.3 x 3.0 x 1.4 inches (16.0 x 7.6 x 3.6 cm)
- 11 ounces (311 grams)
- One pair test leads, one spare fuse, battery and Operators Manual.



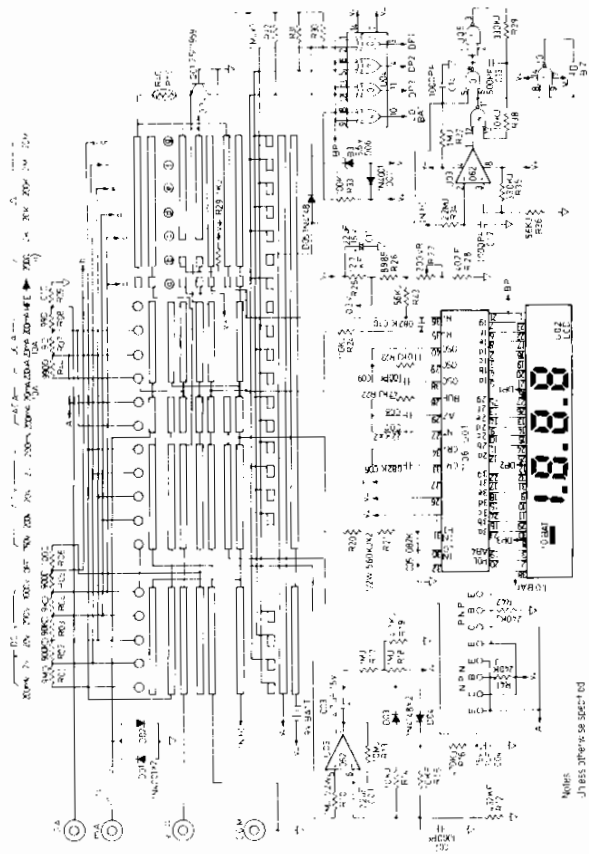
## 5.2 Electrical Specifications

DC Volts	DM23	DM25L
Ranges		
200mV	X	X
2 Volt	X	X
20 Volt	X	X
200 Volt	X	X
1000 Volt	X	X
Accuracy	0.8% reading + 1 digit	
Input		
Impedance	10M $\Omega$	10M $\Omega$
OL Protection		
200mV Range	500VDC/350VAC for 15 seconds	
Other Ranges	1200VDC/850VAC for 60 seconds	
Resolution	100 $\mu$ V	100 $\mu$ V
AC Volts		
Ranges		
200mV	X	X
2 Volt	X	X
20 Volt	X	X
200 Volt	X	X
750 Volt	X	X
Accuracy	1.2% reading + 10 digits	
Input		
Impedance	10M $\Omega$	10M $\Omega$
OL Protection		
200mV Range	500VDC/350VAC for 15 seconds	
Other Ranges	1200VDC/850VAC for 60 seconds	
Resolution	100 $\mu$ V	100 $\mu$ V
DC Amps		
Ranges		
200 $\mu$ A	X	X
20 mA	X	X
200 mA	X	X
10 A	X	X

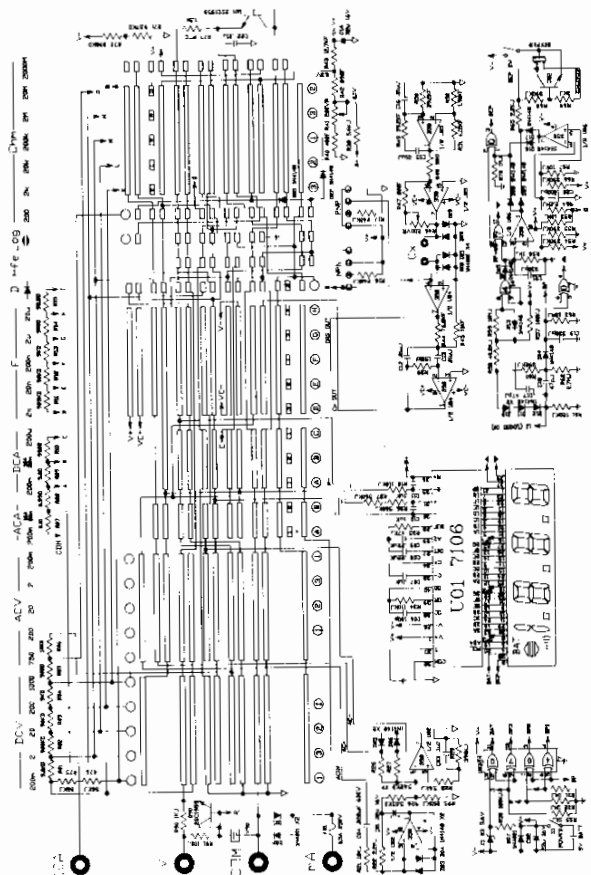
	DM23	DM25L
Accuracy		
10 A Range	2.5% reading + 3 digits	
Other Ranges	1.25% reading + 1 digit	
Voltage Burden		
10 A Range	700mV maximum	
Other Ranges	325mV maximum	
OL Protection	0.8A 250V Fuse	
Resolution	100nA	100nA
AC Amps		
Ranges		
200mA	X	X
20 mA	X	X
10 A	X	X
Accuracy		
10 A Range	+ 3% reading + 4 digits	
Other Ranges	+ 1.8% reading + 4 digits	
Voltage Burden		
10 A Range	700mV maximum	
Other Ranges	325mV maximum	
OL Protection	0.8A 250V fuse	
Resolution	10 $\mu$ A	10 $\mu$ A
Resistance		
Ranges		
200 ohm	X	X
2K ohm	X	X
20K ohm	X	X
200K ohm	X	X
2Meg ohm	X	X
20Meg ohm	X	X
2000Meg ohm		X

	DM23	DM25L
<b>Accuracy</b>		
200 Ohm Range	$\pm 1.2\%$ RDG + 4 digits	
20Meg Ohm Range	$\pm 3.0\%$ RDG + 4 digits	
2000Meg Ohm Range	$\pm 5\%$ (RDG - 10 digits) + 10 digits	
Other Ranges	$\pm 1.2\%$ RDG + 2 digits	
OL Protection	500 VAC/VDC all ranges	
<b>Test Voltage</b>		
200 ohm		
2000Meg Ranges	3.2 max	3.2 max
Other Ranges	0.3 max	0.3 max
<b>Diode Test</b>		
Accuracy	2.0% RDG + 1 digit	
Test Current	1.0 $\pm$ 0.6mA	1.0 $\pm$ 0.6mA
Test Voltage	3.2 max	3.2 max
<b>Continuity Beeper</b>		
Threshold	<100 ohms	<100 ohms
Response Time	<100mS	<100mS
<b>hFE Test</b>		
Emitter-Base Current	13 + 1mA	
Emitter-Collector Current	75mA (momentary)	
Emitter-Collector Voltage (Open Circuit)	2.8 + 0.4 volts	
Range	0 to 1000	

	DM23	DM25L
<b>Logic Test (DM25L only)</b>		
Logic Type		TTL
Input Impedance		120K $\Omega$ $\pm$ 10K
Logic Thresholds		
Logic 1		2.4 $\pm$ 0.2 volts
Logic 0		0.7 $\pm$ 0.2 volts
Frequency Response		20MHz
Pulse Width Detectable		25nS minimum
OL Protection		500VAC/VDC
<b>Capacitance (DM25L only)</b>		
<b>Ranges</b>		
2000pF	—	X
.02 $\mu$ F	—	X
.2 $\mu$ F	—	X
2 $\mu$ F	—	X
20 $\mu$ F	—	X
Accuracy	—	3% Rdg + 10 Dgts
Test Frequency		400hz, $\pm$ 3%
Excitation Voltage		120mV



Notes:  
 1. Values shown are typical  
 2. All resistances are in Ohms  
 3. All capacitors are in picofarads



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