

**Beckman Industrial**<sup>™</sup>

*An Affiliate of Emerson Electric Co.*

DM23, DM25<sub>XL</sub> & DM27<sub>XL</sub>  
Digital Multimeters

**Operator's Manual**

## **ONE YEAR LIMITED WARRANTY**

Beckman Industrial Digital Multimeters are warranted against defects in parts, material and workmanship within a period of one year following the date of purchase of the multimeter by the original buyer. This warranty is extended by Beckman Industrial only to the original buyer or original user of the instrument who must present proof of purchase at time of warranty service.

In the United States any instrument claimed to be defective during the warranty period should be returned with proof of purchase to Beckman Industrial's Factory Service Center with a handling fee.

ANY IMPLIED WARRANTIES ARISING OUT OF THE SALE OF A BECKMAN INDUSTRIAL DIGITAL MULTIMETER, INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED IN DURATION TO THE ABOVE STATED ONE YEAR PERIOD. MANUFACTURER SHALL NOT BE LIABLE FOR LOSS OF USE OF THE MULTIMETER OR OTHER INCIDENTAL OR CONSEQUENTIAL DAMAGES, 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.

### **CERTIFICATION**

Beckman Industrial certifies that this instrument was thoroughly tested and inspected and found to meet its published specifications when shipped from the factory.

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## WARNINGS AND PRECAUTIONS

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*Please read section 3.1 and 3.2,*

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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.

Exceeding the maximum overload limits can damage the multimeter and expose the operator to a shock hazard. Be aware that individual ranges and functions have different overload limits. Check the specifications (Section Two) for specific overload limits.

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# SECTION ONE: INTRODUCTION

## 1.1 Unpacking and Inspection

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

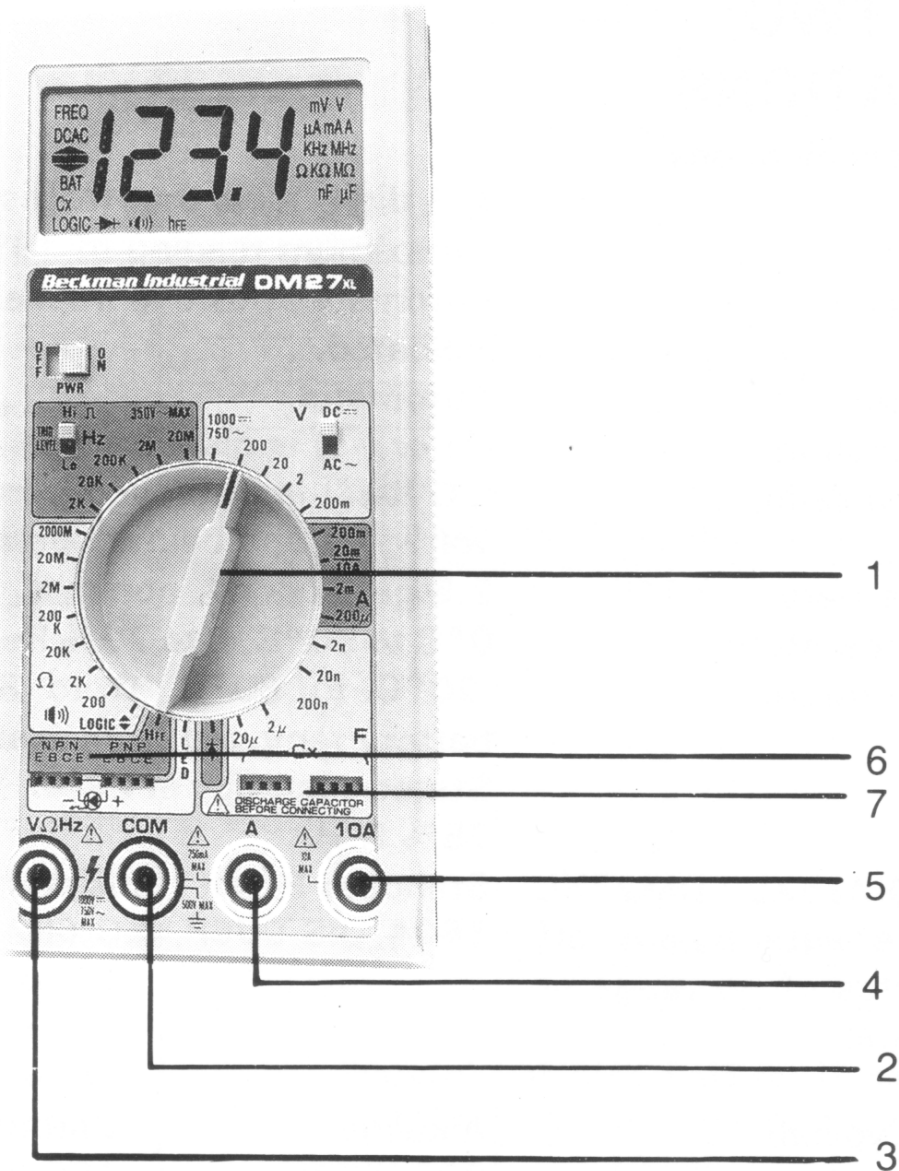
1. Digital Multimeter
2. Test Lead Set (1 black, 1 red)
3. 9-Volt Battery (in meter)
4. Warranty Card
5. Operators Manual
6. Two fuses (One spare, one in meter)

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 (DM25XL + DM27XL): Used for capacitance measurements.
8. BEEPER SWITCH (DM25XL): 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

# SECTION TWO: SPECIFICATIONS

## 2.1 General Specifications Display

Polarity Indication

Zero Adjustment

Overrange Indication

Low Battery Indication

Display Update Rate

Operating Temperature

Storage Temperature

Accuracy

Power: That DM25XL / DM27XL have complete auto power off after 45 minutes of no range or function change.

Battery Life (Typical)

DM23

DM25XL

DM27XL

Dimensions (H x W x D)

Weight (including battery)

Accessories

3-½ 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 ± 5°C, less than 75% R.H.

Standard 9-volt transistor battery, NEDA 1604, JIS 006P, IEC 6F22

Alkaline

200 hours

100 hours

100 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 Operator's Manual.

Carbon-Zinc

150 hours

70 hours

50 hours

## 2.2 Electrical Specifications

	DM23	DM25XL	DM27XL
<b>DC Volts</b>			
<b>Ranges</b>			
200mV	X	X	X
2V	X	X	X
20V	X	X	X
200V	X	X	X
1000V	X	X	X
<b>Accuracy</b>	0.8% RDG ± 1 dgt		
<b>Input Impedance</b>	10MΩ	10MΩ	10MΩ
<b>OL Protection</b>	500VDC / 350VAC RMS for 15 seconds 1200VDC / 850VAC RMS for 60 seconds		
200mV Range			
Other Ranges			
<b>Resolution</b>	100μV	100μV	100μV
<b>AC Volts</b>			
<b>Ranges</b>			
200mV	X	X	X
2V	X	X	X
20V	X	X	X
200V	X	X	X
750V	X	X	X
<b>Accuracy</b>	1.2%RDG ± 3 dgts (50Hz-500Hz)		
<b>Input Impedance</b>	10MΩ	10MΩ	10MΩ
<b>OL Protection</b>	500VDC / 350VAC RMS for 15 seconds 1200VDC / 850VAC RMS for 60 seconds		
200mV Range			
Other Ranges			
<b>Resolution</b>	100μV	100μV	100μV
<b>DC Amps</b>			
<b>Ranges</b>			
200μA	X	X	X
2mA			X
20mA	X	X	X
200mA	X	X	X
10A	X	X	X
<b>Accuracy</b>	2.5% RDG + 3 dgts 1.25% RDG + 3 dgts		
10A Range			
Other Ranges			
<b>Voltage Burden</b>	700mV maximum 325mV maximum		
10A Ranges			
Other Ranges			
<b>OL Protection</b>	0.8A 250V Fuse		
<b>Resolution</b>	100nA	100nA	100nA

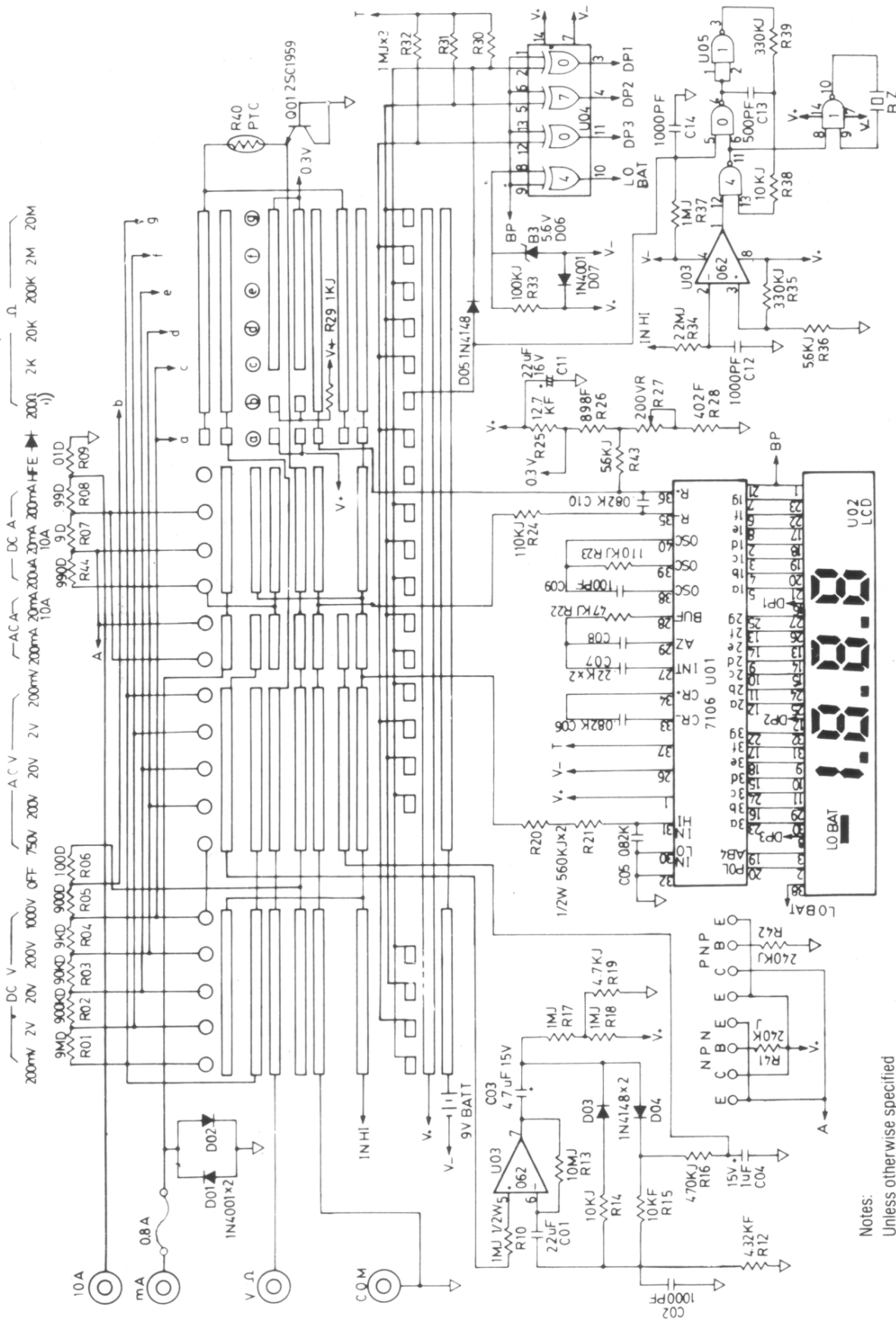
	DM23	DM25XL	DM27XL
<b>AC Amps</b>			
<b>Ranges</b>			
200 $\mu$ A			X
2mA			X
20mA	X	X	X
200mA	X	X	X
10A	X	X	X
<b>Accuracy</b>	3% RDG + 4 dgts (50Hz - 500Hz) 1.8%RDG + 4 dgts (50Hz - 500Hz)		
10A Range			
Other Ranges			
<b>Voltage Burden</b>	700mV maximum 325mV maximum		
10A Range			
Other Ranges	0.8A 250V Fuse		
<b>OL Protection</b>			
<b>Resolution</b>	10 $\mu$ A	10 $\mu$ A	10 $\mu$ A
<b>Resistance</b>			
<b>Ranges</b>			
200 $\Omega$	X	X	X
2K $\Omega$	X	X	X
20K $\Omega$	X	X	X
200K $\Omega$	X	X	X
2M $\Omega$	X	X	X
20M $\Omega$	X	X	X
2000M $\Omega$		X	X
<b>Accuracy</b>	1.2%RDG + 4 dgts 3% RDG + 4 dgts		
200 $\Omega$ Range			
20M $\Omega$ Range	5% (RDG -10 dgts) + 10 dgts		
2000M $\Omega$ Range	1.2% RDG + 2 dgts		
Other Ranges	500VDC / 500VAC RMS all ranges		
<b>OL Protection</b>			
<b>Test Voltage</b>	3.2V maximum 3.2V maximum 0.3V maximum		
200 $\Omega$ Range			
2000M $\Omega$ Range			
Other Ranges			



	DM23	DM25XL	DM27XL
<b>Diode Test</b>			
Range	2K $\Omega$	2V	2V
Resolution	1 $\Omega$	1mV	1mV
Accuracy	2.0%RDG + 1dgt	1.2%RDG + 1dgt	1.2%RDG + 1dgt
Test Current	1.0mA $\pm$ 0.6mA	1.5mA $\pm$ 0.6mA	1.5mA $\pm$ 0.6mA
Test Voltage	3.2V maximum		
<b>Continuity Beeper</b>			
Threshold		< 50 $\pm$ 25 $\Omega$	
Response Time		< 100ms	
<b>hFE Test</b>			
Emitter-Base Current		10 $\mu$ A $\pm$ 2 $\mu$ A	
Emitter-Collector Current		< 10mA	
Emitter-Collector Voltage (Open Circuit)		2.8V $\pm$ 0.4V	
Range		0 to 1000	
<b>Logic Test</b> (DM25XL & DM27XL)			
Logic Type		TTL	
Input Impedance		120K $\Omega$ $\pm$ 10K $\Omega$	
Logic Thresholds			
Logic 1		2.7V $\pm$ 0.7V	
Logic 0		0.7V $\pm$ 0.4V	
Frequency Response		20MHz	
Pulse Width Detectable		25nS Minimum	
OL Protection		500VDC / 500VAC RMS	
<b>Capacitance</b> (DM25XL & DM27XL)			
Ranges			
2000pF		X	X
0.02 $\mu$ F		X	X
0.2 $\mu$ F		X	X
2 $\mu$ F		X	X
20 $\mu$ F		X	X
Accuracy		3% RDG + 10dgt	
Test Frequency		400Hz $\pm$ 3%	
Excitation Voltage		120mV	

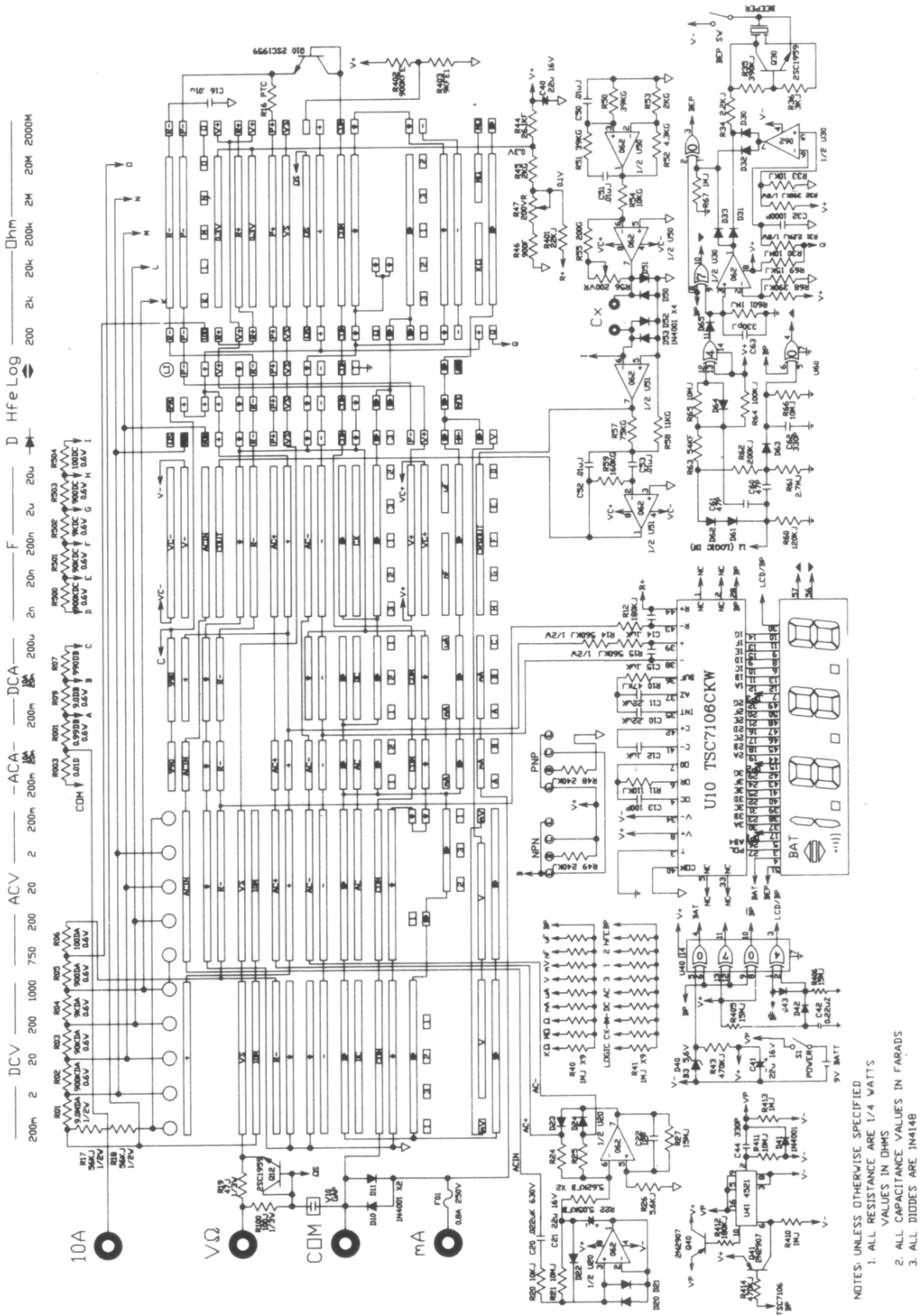
	DM23	DM25XL	DM27XL
Frequency (DM27XL)			
Ranges			
2KHz			X
20KHz			X
200KHz			X
2MHz			X
10MHz (Trigger Low)			X
20MHz (Trigger High)			X
Accuracy			
Trigger Low			1.0% RDG + 1 dgt
Trigger High			1.5% RDG + 1 dgt
Effective Reading			10-1999 dgts
Sensitivity			
Trigger Low			
2KHz to 2MHz ranges			100mVrms
2MHz to 10MHz			
(on 20MHz range)			200mVrms
Trigger High			
2KHz to 2MHz ranges			1.6Vp - 10Vp
2MHz to 15MHz			
(on 20MHz range)			1.6Vp - 5Vp
15MHz to 20MHz			
(on 20MHz range)			1.6Vp - 3.2Vp
Coupling			
Trigger Low			AC
Trigger High			DC
OL Protection			500VDC/350VAC RMS

# 2.3 DM23 Schematic Diagram



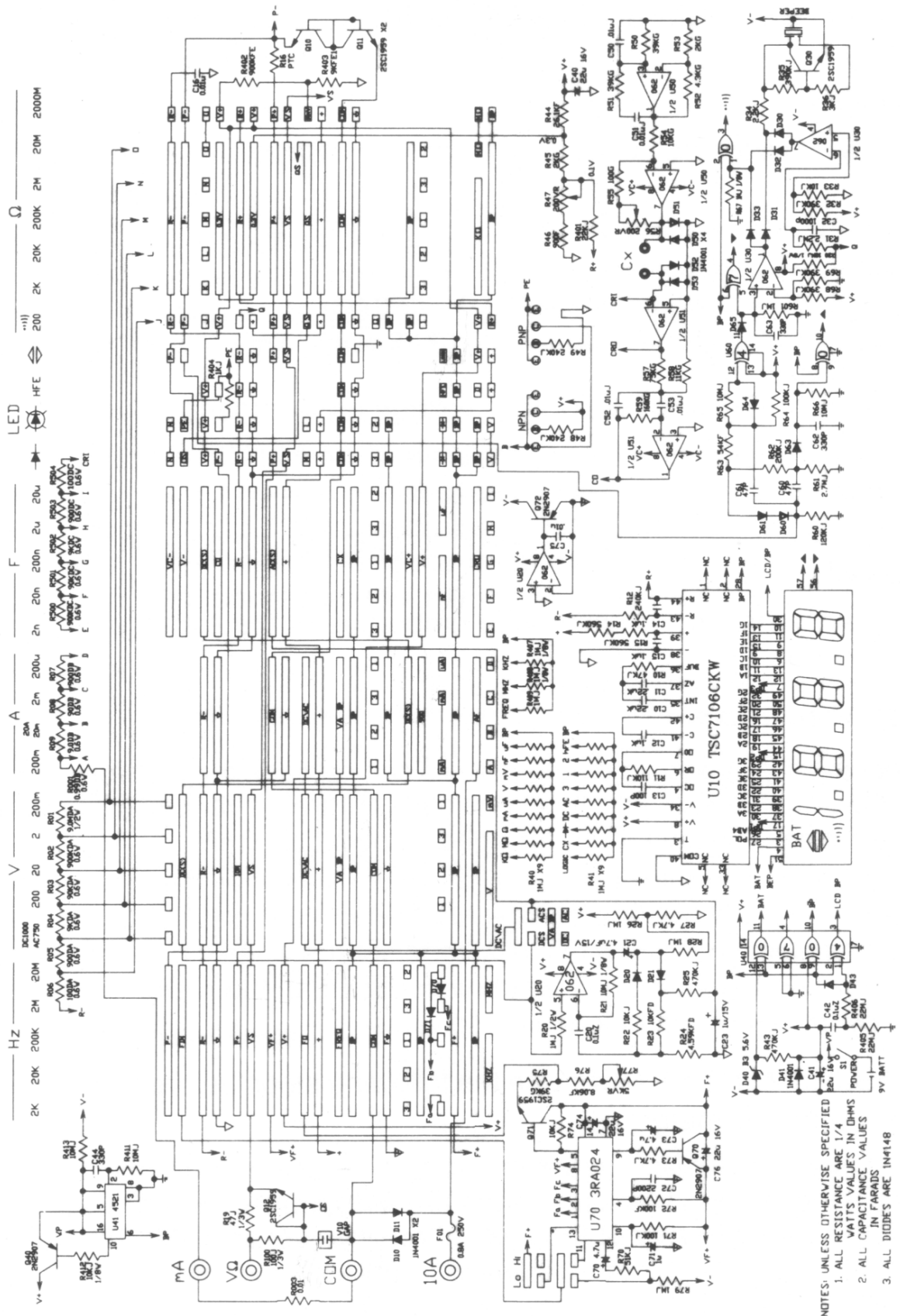
- Notes:
- Unless otherwise specified
  - 1. All resistance values in ohms
  - 2. All capacitance values in microfarads

# 2.4 DM25XL Schematic Diagram



- NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTANCE ARE 1/4 WATTS
  2. ALL CAPACITANCE VALUES IN FARADS
  3. ALL DIODES ARE IN4148

# 2.5 DM27XL Schematic Diagram



NOTES: UNLESS OTHERWISE SPECIFIED  
 1. ALL RESISTANCE VALUES ARE 1/4  
 2. ALL CAPACITANCE VALUES  
 IN FARADS  
 3. ALL DIODES ARE IN4148

## SECTION THREE:

### OPERATION

⚠ Means PLEASE REFER TO OPERATING INSTRUCTIONS to ensure operator safety.

#### 3.1 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.

#### 3.2 Safety Precautions

1. Exceeding the maximum overload limits can damage the multimeter. Be aware that individual ranges and functions have different overload limits. Check the specifications (Section Two) for specific overload limits.
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.

#### 3.3 MEASUREMENT SET-UP: Use the following steps before taking any measurements 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, frequency (DM27XL only) or logic (DM25XL + DM27XL), 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.

### 3.4 Voltage Measurements

1. Complete steps 1-4 in Section (3.3) 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.

### 3.5 Current Measurements

1. Complete steps 1-4 in Section (3.3) 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.

### 3.6 Resistance Measurements


1. Complete steps 1-4 in Section (3.3) 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 DM25XL + DM27XL 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 (200 ohm range) the meter will beep when the resistance is below 50 ohms (+/- 25 ohms). On the DM25XL the beeper switch must be in the on position.

### 3.7 Diode and Transistor Tests

#### 3.7.1 Diode Tests

1. Complete steps 1-4 in Section (3.3) 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 700mV, while a germanium type will indicate approximately 200mV. 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.


### 3.7.2 Transistor Tests

Bipolar transistor junctions may be tested in the manner described in (3.7.1) 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.

### 3.8 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.

### 3.9 Logic Measurements (DM25XL + DM27XL)

1. Complete steps 1-4 in Section (3.3) 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.

### 3.10 Capacitance Measurements (DM25XL + DM27XL)

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.



### 3.11 Frequency Measurements (DM27XL only)

1. Complete steps 1-4 in Section (3.3).
2. Switch the trigger level to high or low depending on the desired sensitivity:

#### SENSITIVITY

TRIG HI	1.6Vpeak-10Vpeak for 2K to 2MHz Ranges
(TTL or CMOS $\square$ only)	1.6Vpeak-5Vpeak for 2M to 15MHz on 20MHz Range
	1.6Vpeak-3.2Vpeak for 15M to 20MHz on 20MHz Range
TRIG LOW	100mVrms for 2K to 2MHz Ranges
(Any wave type)	200mVrms-3.5Vrms for 2M to 10MHz Ranges

3. Set the range switch to the desired frequency range and note the result in the display. NOTE: If the magnitude of the frequency is unknown, start with the highest range and decrease the setting until satisfactory resolution is obtained.
4. The frequency ranges have overload protection to 500VDC / 350VAC RMS. DO NOT EXCEED THIS LIMIT. Serious personal injury may result.

### 3.12 LED Test (DM27XL only)

To test a LED, follow these steps:

1. LED must be out of circuit. turn meter on and set function / range switch to the LED position.
2. Plug the LED into the holes marked for LEDs, making sure to have the anode in the hole marked "+" and cathode in hole marked "-".
3. A good LED will light up.

## **SECTION FOUR: OPERATOR MAINTENANCE**

### **4.1 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.

### **4.2 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.

#### **4.2.1 Battery Replacement**

1. Remove the battery cover by gently sliding it towards the top of the meter. after removing the screw.
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.

#### **4.2.2 Fuse Replacement**

1. Remove the battery cover by gently sliding it towards the top of the meter. after removing the screw.
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.

## **SECTION FIVE: SERVICE INFORMATION**

### **5.1 Factory Service**

Read the warranty statement at the front of this manual before requesting warranty or nonwarranty repairs.

#### **5.1.1 Shipping Instructions**

A multimeter returned for calibration or repair should be shipped with the following information or items: your company name (if applicable), your name, address, telephone number, proof of purchase (for warranty repairs), a description of the problem encountered or service required, and the appropriate \$3.00 shipping / handling charge.

Remit shipping / handling charges in the form of a check or money order, payable to Beckman Industrial. Ship the multimeter in a sturdy box with shipping charges prepaid to the following address:

For USA:	For UK:	For Canada:
Beckman Industrial Corp.	Beckman Industrial, Ltd.	(See list of
3883 Ruffin Rd, Suite A	Queensway, Glenrothes, Fife	service centers)
San Diego, CA 92123	Scotland KY7-5PU, United Kingdom	

**ATTN: Instrument Repair**

The multimeter will be returned with the shipping charge paid by Beckman Industrial Corp. For questions in North America, contact the Instrument Repair Dept. at (619)495-3310

#### **5.1.2 Service and Shipping Instructions Other than USA, UK and Canada**

Contact your local Beckman Industrial Corp. dealer or distributor where the multimeter was purchased or refer to the list of Service Centers.

**Beckman Industrial Corporation**

Instrumentation Products Division

An Affiliate of Emerson Electric Co.

3883 Ruffin Rd., San Diego, CA 92123-1898

(619) 495-3200 FAX: (619) 268-0172 TLX: 249031

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