USER MANUAL

DIGITAL MULTIMETER (TRUE RMS)

Protek B4000

Digital Multimeter (*TRUE RMS*)

Protek

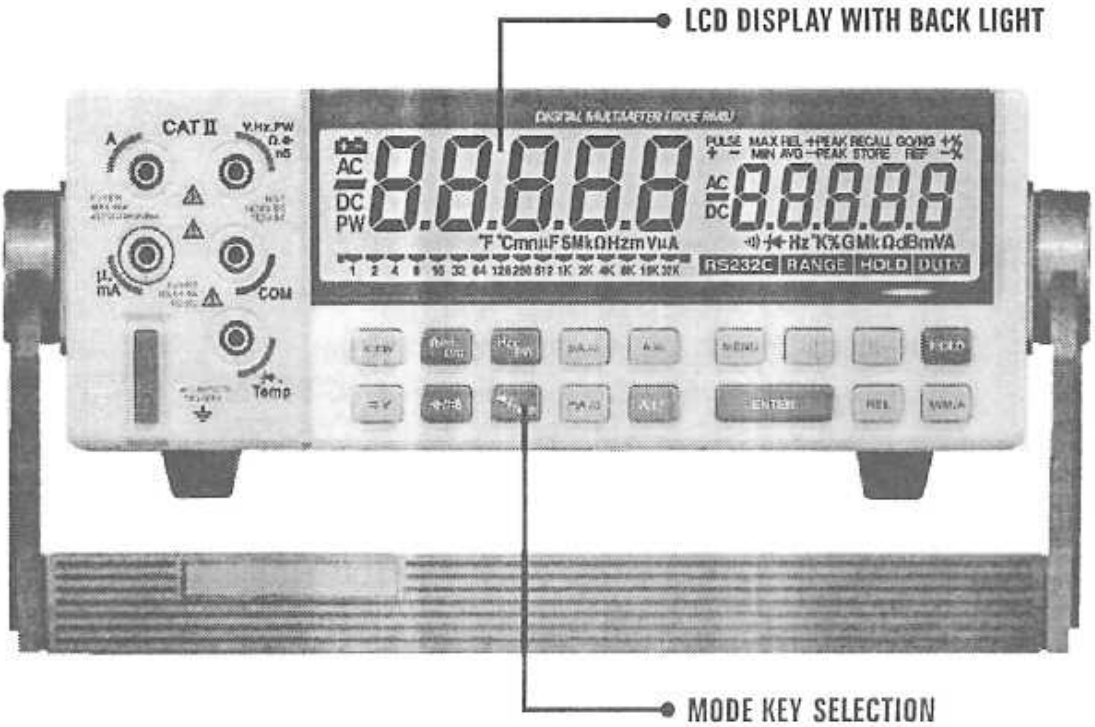
TABLE OF CONTENTS

1. INTRODUCTION

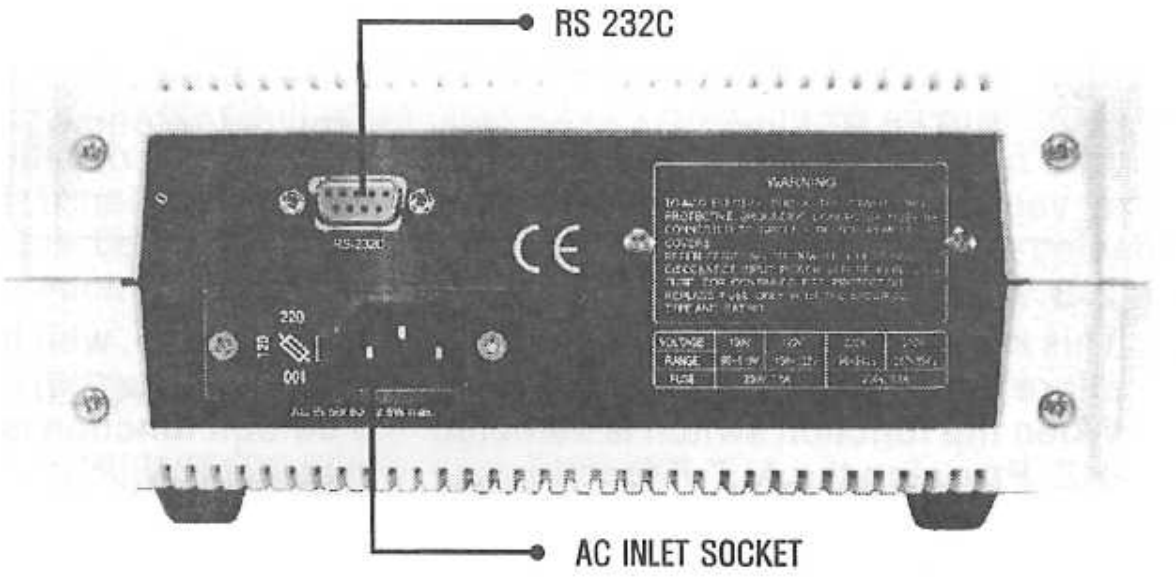
1-1. MAIN FEATURES

1) 0.05% basic accuracy, 50,000 count resolution with 50ms sampling time featuring 4th order delta-sigma along to digital conversion and a variety of useful functions makes the multimeter by far the bench DMM available today.
2) DCmV measurement function has 0.05% accuracy and more than 1Giga ohm of input impedance. A wide 0 to 2500mV full scale measuring range with a Resolution of 10uV enables accurate and precise measurement.
3) Large LCD with 150*34mm of viewing area, a dual 5 digit display, 54 annunciators and an Electro-luminescent back light with an innovative bar-graph based on binary bit expression, which gives immediate perception of minute changes in signal levels and an easy understanding of binary code.
4) Zener diode function for testing Zener diodes from 0 through more than 15V, together with low voltage ohm & conductance (nS) test functions, provides very easy and powerful circuit analysis ability in electronic test and measurement work.
5) Pulse width, Duty cycle & Hz measurement functions, used together with other basic functions, provides very useful testing ability in application such as automotive testing etc.
6) 10 locations of nonvolatile EEPROM permanently stores data without a applied power.
7) Designed for safety and to prevent electrical shock.
8) RS232C computer interface enables data to be captured and transferred to a PC for processing and storage.

1-2. FRONT PANEL LAYOUT

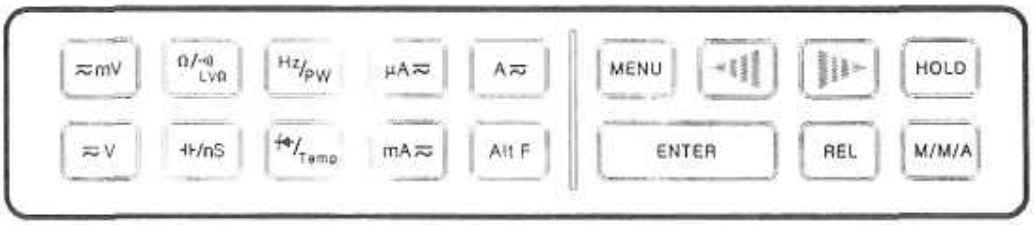


1-3. REAR PANEL LAYOUT



WARNING
READ THE "SAFETY" IN APPENDICES BEFORE USING THE METER

2. Mode Key Function



2-1. HOLD

This key when pressed "freezes" the measurement reading on the LCD, no further updates to the LCD display will happen and the HOLD annunciator turns. Pressing the HOLD key again restores the DMM to normal operation.

2-2. REL

The relative mode allows the operator to measure values with respect to a reference value other than zero. The relative value is computed by the equation: Relative = measured-reference Pressing the REL key enters the measured value on the LCD as the reference and display the REL annunciator. Pressing the Enter key only while in the REL mode updates the Reference Value.

-Press the REL key to enter the measured value on the LCD as the relative value and to display the REL symbol. Pressing the REL key again releases the relative mode and returns the multimeter to the normal mode of operation.

Note

1) The REL mode can only be used for numerical data; it cannot be used for continuity, which displays open or short instead of numbers.
2) The REL mode is especially useful for low ohms measurement, which requires the test lead resistance to be cancelled.

2-3. ALT-F

This key is used for selecting the alternate functions, which share the same position on the function switch (e.g. Hz/PW). When the function switch is selected the default function is HZ. Pressing the ALT-F function key will select PW (pulse width).

2-4. MENU

Pressing this key places the meter in the menu mode. Pressing this key again, the meter will exit from the menu mode and return to the previous operation. Once the meter is in the menu mode, all the menu annunciators appear on the upper portion of the LCD with the flashing cursor over one annunciator. To select the desired menu item, press the (◄) or (►) keys until the flashing cursor is over the desired annunciator, then press the ENTER key to select.

2-5. (◄)

This key is used to select the manual range mode and shift the present measurement range one decimal place to the left. Each time this key is pressed the decimal point will shift one place to the left. Pressing this key in the Menu mode will cause the blinking cursor to move to the left.

2-6. (►)

This key is used to select the manual range mode and shift the present measurement range one decimal place to the right. Each time this key is pressed the decimal point will shift one place to the right.
Pressing this key in the Menu mode will cause the blinking cursor to move to the right.

2-7. ENTER

Pressing the ENTER key executes the function selected by (◄) and (►) Keys as described above in the menu mode. When pressed, the blinking annunciator will stop blinking and all the other menu items will disappear. If however, the "AUTO OFF" and "RS232C" annunciators had been selected previously they will remain on the LCD.

2-8. M/M/A (MAX/MIN/AVERAGE)

The Max, Min or Average capture mode stores the highest, lowest or average of the measured value into memory and displays them on the display. The meter can capture and hold signal level changes 100mS or greater in duration. If a short capture time is required, use the peak detection mode.

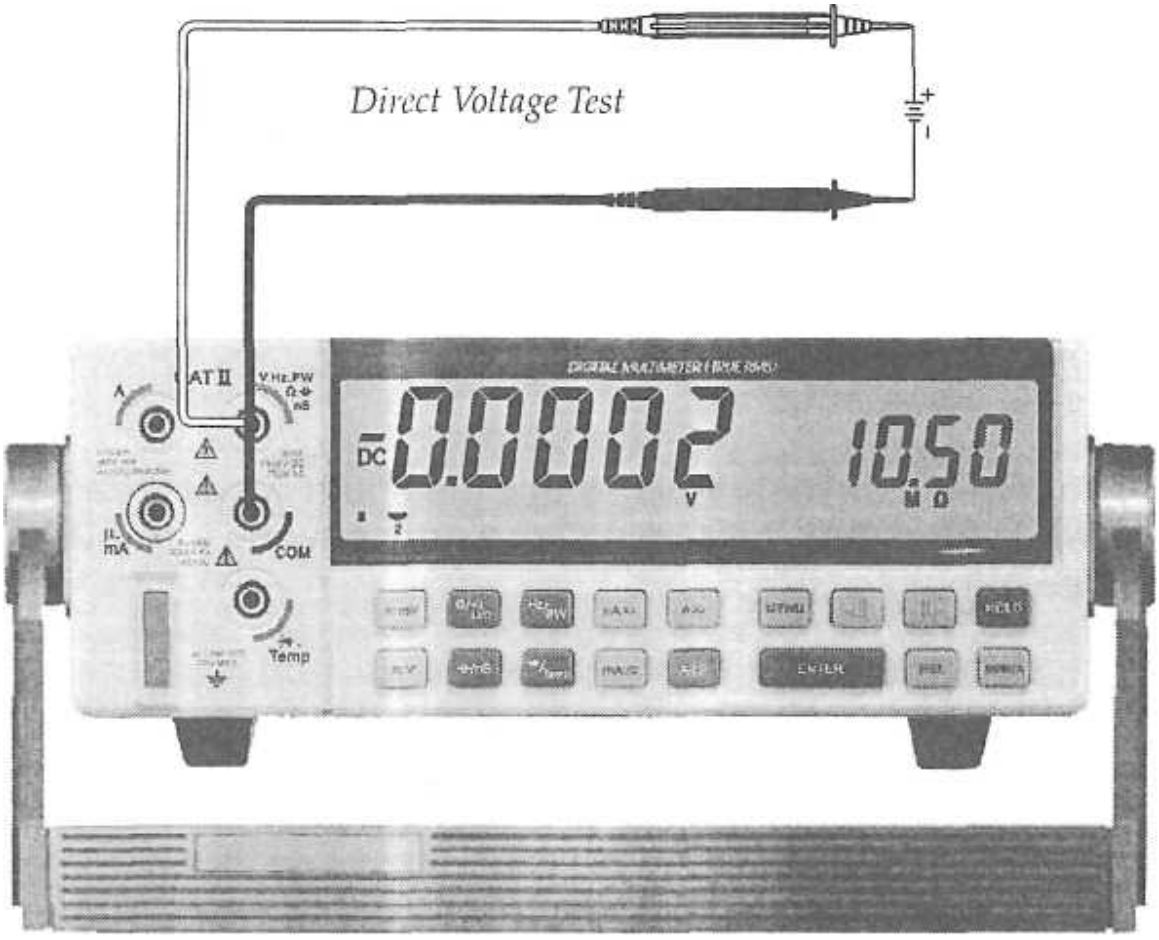
3. OPERATING

3-1. POWER ON/OFF

When the power switch is turned on, all the segments on the LCD display will appear (see Fig 1 on page 29 picture) and the built in buzzer in the meter will sound for 1 second and then normal operation will be started and measurements may be now be obtained according to what the rotary function selector switch has been set to.

3-2. DCV and DCmV

1) Pressing the mV or V function key.
   The LCD screen will spear as shown in fig Nos. 2 and 5 on page 29 of this manual. If the alternate mode (AC or AC+DC) has been selected (as indicated by the LCD Annunciators) press the ALT-F key to select DC.
2) Connect the red and black test leads into the corresponding colored input sockets and then connect the probe end of the test leads to the voltage source to be measured.
3) The LCD will display the measured value along with the corresponding bargraph value.
4) If the measured voltage is too high, the "OL" will appear. In this case, immediately remove the probes from the voltage source and determine the cause of the overload.
5) The right side display will indicate the meter's input impedance value.



3-3. ACV, ACmV, AC+DCV, & AC + DCmV

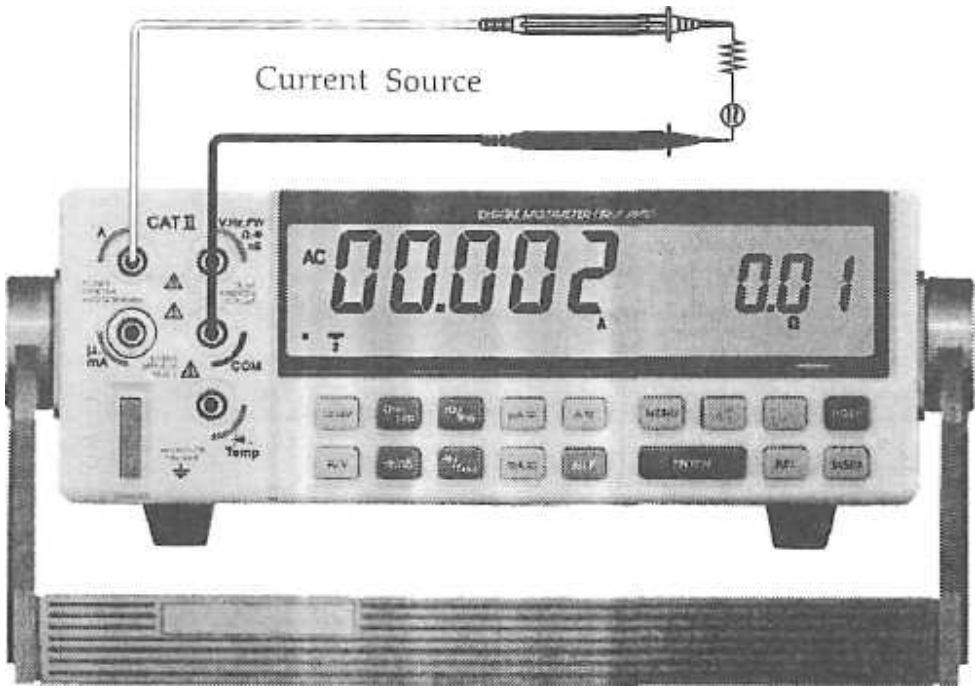
1) Press the mV orV function key, and then press the ALT-F key to display the AC annunciator on the left side of the LCD see fig. 3 & 6 on page 29), Pressing the ALT-F key again will display the annunciators for both AC and DC this isfortheAC + DC true RMS mode. Pressing theALT-F key 3 consecutive times will cycle the meter through the 3 voltage modes (DC, AC, AC+DC).
2) Attach the probe tips to the voltage source.
3) The voltage measurement will appear on the display.
4) The bar graph will display the voltage value as a binary bit expression.
5) If the measured voltage is too high, the measurement range will be changed automatically to the next higher range. When the measured voltage is greater than the highest rang the display will read "OL".
6) The secondary digit display will read the decibel value based on 600 OHM impedance calculated by the following formula. dBm = 20 log (V/0.7746)

3-4. DCuA, DCmA, DCA

1) Select uA, mA or A with the function key.
2) Press the ALT-F key to select DC if necessary.
3) Break the circuit where the current is to be measured.
4) Connect the two test leads to complete the broken circuit.
5) If the measured current is too high, the display will indicate "OL". In this case, the higher current range (mA or A) should be selected.
6) The bar-graph segments will indicate the measured value as a binary sequence.
7) The right side display will show the shunt resister value for calculating the insertion voltage drop caused by meter using the formula V=IR.
8) The "A (Amp)" input terminal allows current measurement continuously up to 5A or within 3 minutes for currents to 10A. Successive high current measurements above 5Arequire 10 minutes of cooling time between measurements.

WARNING

DO NOT MEASURE HIGH CURRENT OF MORE THAN 10A TO AVOID OPENING THE FUSE OR OVER HEATING THE PCB



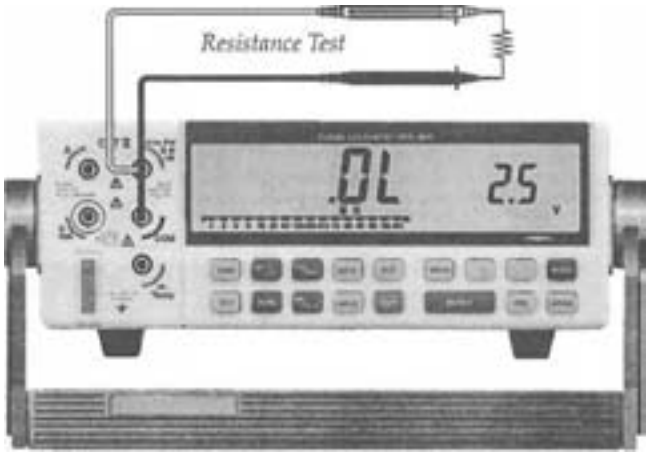
3-5. ACuA, ACmA, ACA, AC + DCuA, AC + DCmA, AC+DCA

1) Select uA, mA or A with the function key. Press the ALT-F key once to select the AC mode. Pressing the ALT-F key again select the AC + DC True rms mode.
2) Use the same procedure as described in section 3-4 (DC current measurements)

3-6. Ohm, CONTINUITY, Lo Volt ohm

1) Press the OHMS function key.
2) If the test leads are opened the display will read "OL" (Ref Picture 8 on page 29)
3) Shorting the test leads will display zero or an extremely low value Resistance Value, this is the test lead resistance.
4) Relative mode is useful to cancel this error by subtracting the test lease Resistance from the measured resistance.
5) The right display read 2.5V if normal Ohms measurement has been selected, 0.25V if Lo Volt Ohms has been selected. These voltage measured resistance value is displayed on the right display.
6) One of these 3 functions may be selected by pressing the ALT-F key.
7) The continuity function is useful for checking for open or short circuits. The resistance value is read on the secondary display while the main display reads either "OPEN" or "SHORT". The buzzer will sound when the display reads "SHORT". Pressing the (◄) or (►) key while in the continuity function increases or decreases continuity measurement range there by increasing or decreasing the resistance value, which turns the buzzer on or off. (See continuity specifications the Appendices).

8) Low Volt Ohms function is useful for accurate resistance measurements in a circuit, which includes semiconductor devices. There is no need to remove the resistor or semiconductor device from the circuit.

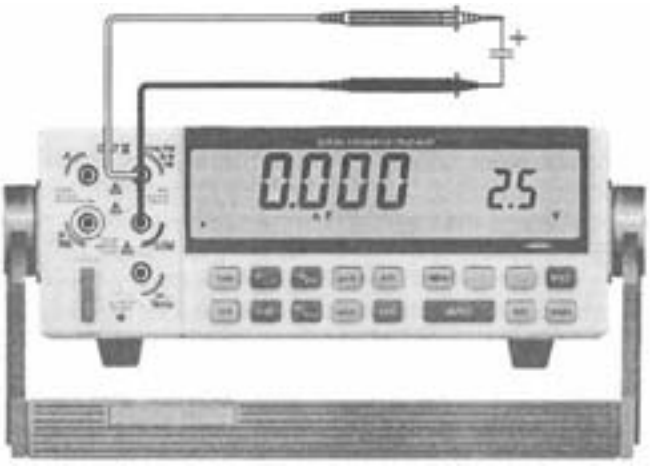


3-7. CAPACITANCE

1) Press the capacitance key.
2) Discharge the capacitor to be measured.
3) Connect the test lead tips to the capacitor.

Note

Capacitors must be measured out of the circuit. If the capacitorto be measured is an electrolytic type with polarity, the Red test lead should be connected to + lead of capacitor and the black to - lead of capacitor.



Note

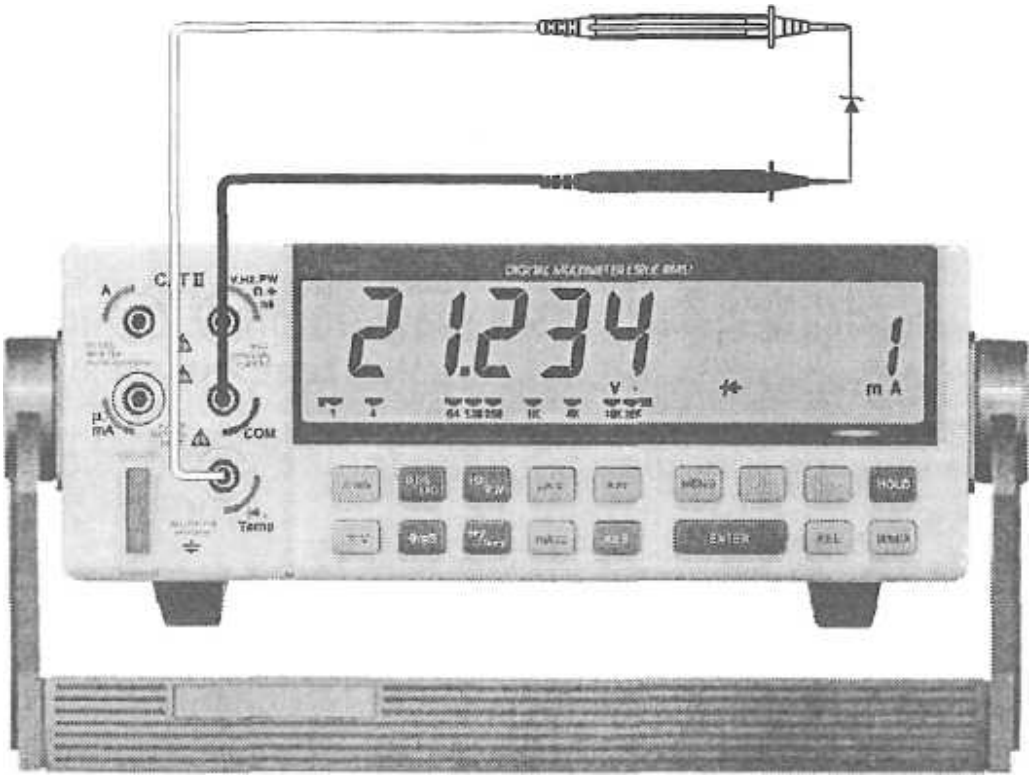
The right display reads the test voltage that the capacitor has charged to in this case the value is 2.5V. the capacitor is then discharged through a resistor circuit with values from 1.5k ohm to 1Mohm depending on the measurements range.

3-8. nS (Conductance)

1) Press the nS key to the capacitance/nS position. Press the ALT-F key once to select the Ns (conductance) function.
2) The right digit display reads the resistance value of the measurement in Giga-ohms, while the primary display reads the conductance value in nano-siemans which is calculated from the equations, S = 1/R. This measurement function is very useful for checking extremely high resistances or leakage properties of insulation materials etc.

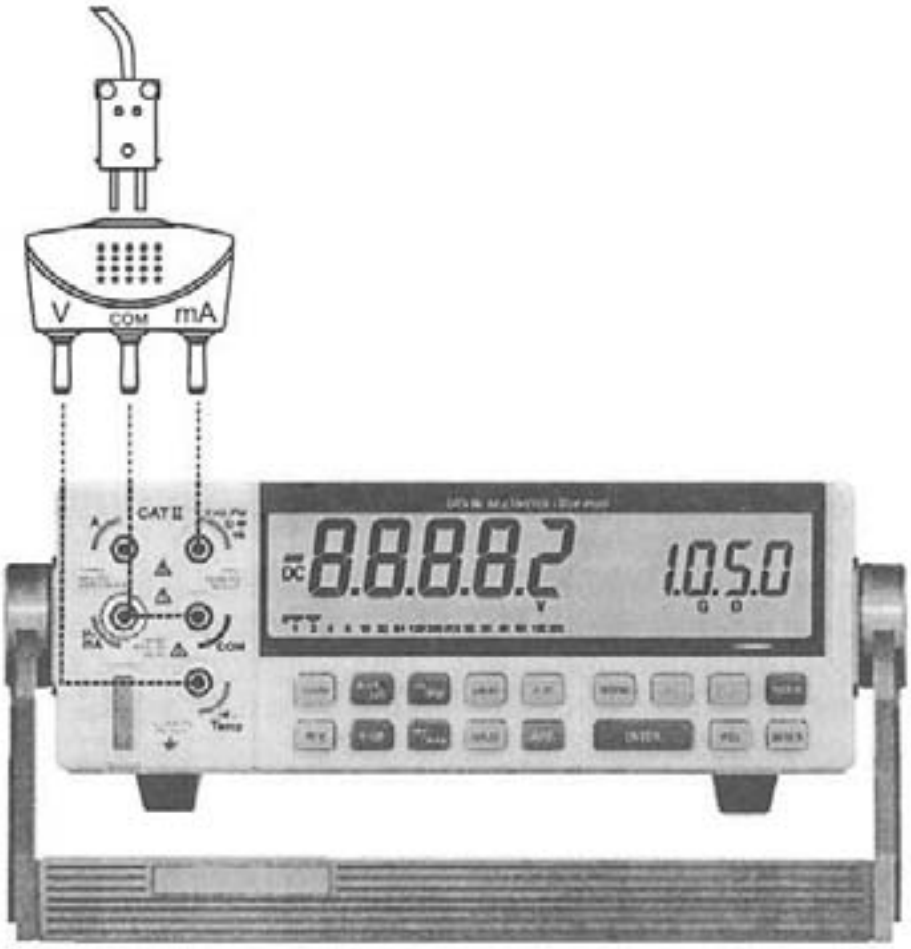
3-9. ZENER DIODE

1) Press the Zener diode/Temp function key. The Zener annunciator will appear on the lower right of the display.
2) With the test leads open the primary display will read about 20V, this is the maximum open circuit test voltage. The right side display will read 1mA, the constant test current. The Zener diode function is very useful for analyzing complex circuits that include semiconductor devices such as ICs, transistor, Zener etc. The Zener diode function has a test voltage much higher than the test voltage in the diode test, which is commonly seen, in most digital multimeters. This function along with Lo Volt Ohms function makes this instrument a powerful tool for various electronic circuit analyses.
3) Connect the black lead tip to the anode of the Zener diode under test and the red lead tip to the cathode. The Zener voltage will be displayed on the LCD. For diode test, connect the black lead tip to cathode of diode and the red lead tip to the anode. The diode's forward voltage drop will be displayed on the LCD.



3-10. TEMPERATURE

1) Press the Zener diode/Temp function key. Press the ALT-F key once for Centigrade, or twice for Fahrenheit measurement.
2) Connect the temp adaptor to the meter V/mA/COMN input sockets as shown in the figure below. (Temp Adaptor and Thermocouple are optional accessories)



3) Connect the thermocouple (K type) to the temp adaptor, observe the polarity.
4) Allow at lease 10 minutes for connectors of temp adaptor to be stabilized for accurate measurements.
5) If no thermocouple is connected to the temp adaptor, the ambient temperature around the adaptor will be measured and displayed.
6) The main display reads the temperature in Centigrade or in Fahrenheit, while the right display read the absolute temperature in degrees Kelvin.

   The following formulae are used for temperature calculation.

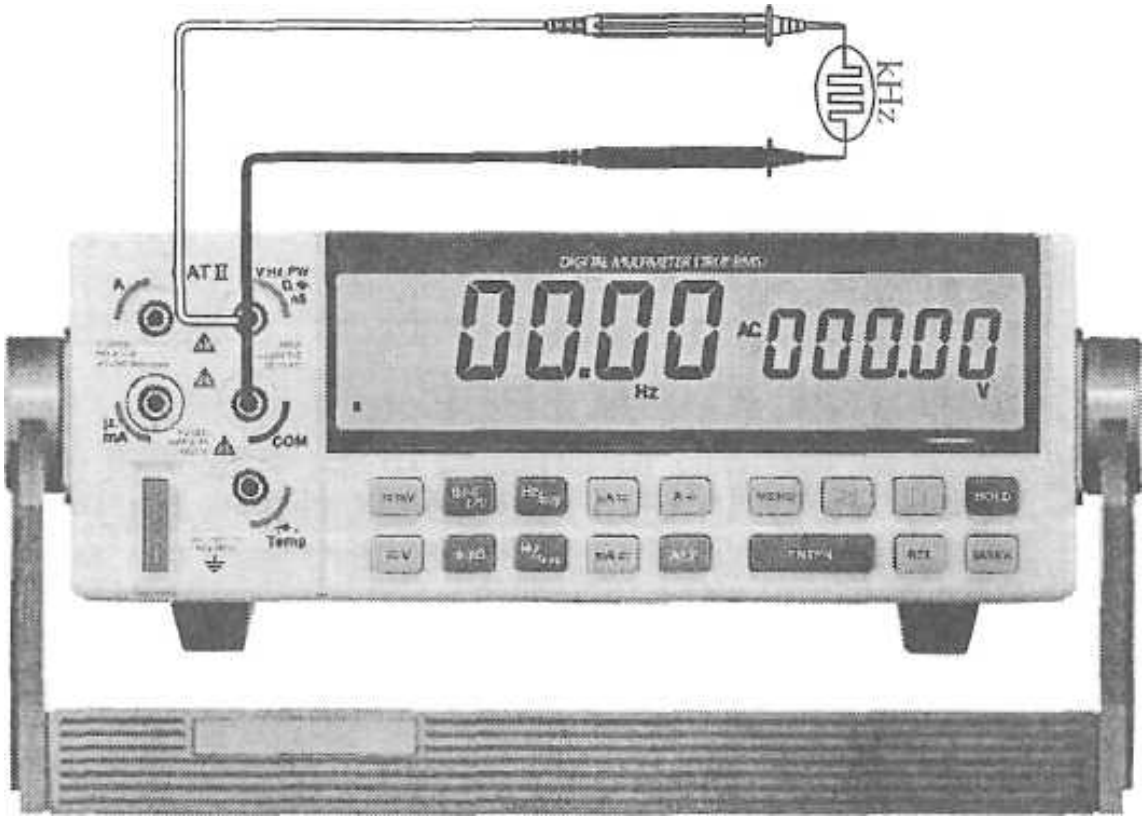
   0°K = 273.1°C 0°C = 32°F 100°C = 212°F
   [°C] = [°K] - 273.1 [°F] = [°C] x 9/5 + 32

   The meter actually measures only the Kelvin degrees (°K) and calculates the Centigrade and Fahrenheit temperature (°C, °F) from the above equations.

7) The Temperature adaptor and thermocouple produces 1 mV per 1°K at the output terminal marked "V". The meter reads 1°K per mV at the "V" input terminal and 0°K for a OV input. Therefore 1000°K is an input signal of 1V. This meter can measure the applied voltage at terminal with an accuracy of 0.05% for an input of 0V through 2.5V. Therefore the total accuracy depends upon the accuracy of the temperature adaptor and thermocouple.

3-11. Hz

1) Press the Hz function key.
2) Attach the test lead tips to signal source to be measured.
3) The main display will read the measured frequency.
4) Right display will read the AC voltage of the signal source. The voltage range of the right display is 0 to 500V with 10mV of resolution.
5) The AC voltage is specified to 20kHz as shown on the AC mV & V specifications on page 27. When the measured frequency exceeds 20kHz, the secondary display is no longer useful due to the attenuation of the signal level.



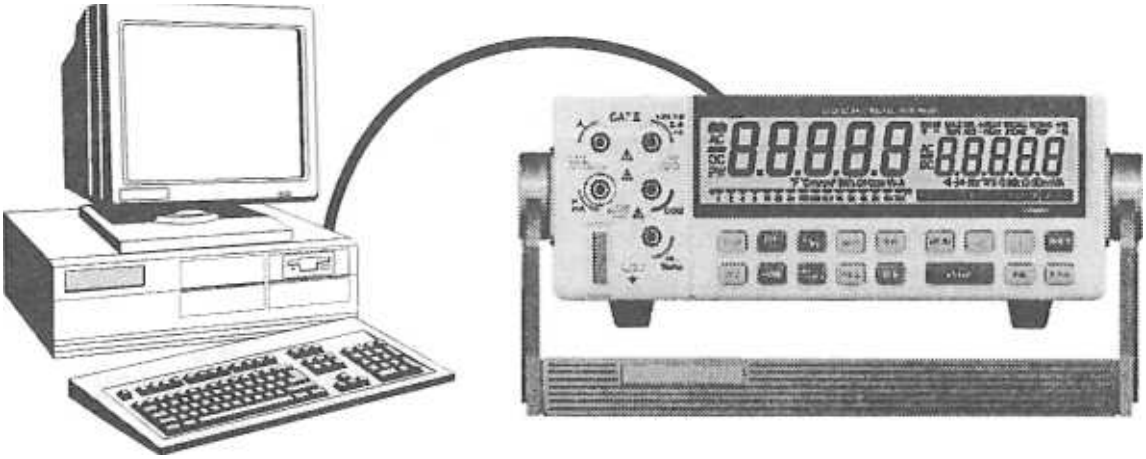
3-12. ±PULSE WIDTH

1) Select the Hz/PW function key. Press the ALT-F key once for positive pulse width measurement or twice for negative pulse width measurement.
2) Connect the test lead tips to the signal source to be measured.
3) The main display will read the measured pulse width.
4) The right side display reads the percent duty cycle.

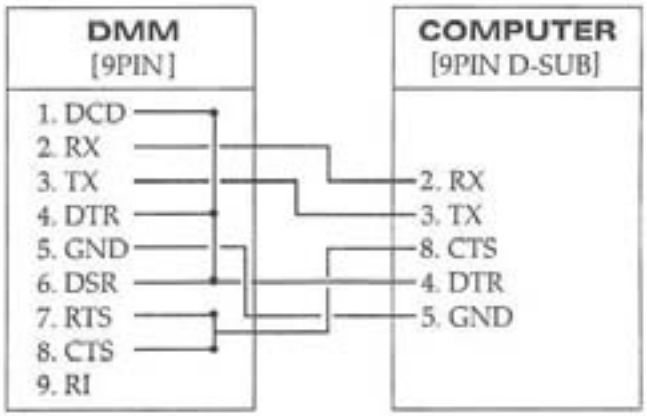
4. RS 232C Interface

4-1. CONNECTION BETWEEN PC AND DM-8241B

Connect the RS232C cable to the built-in Rs232 connector in the meter and to the PC serial port.



4-2. RS232C CABLE & PIN CONNECTION



4-3. COMMUNICATION SPEC

BAUD RATE	9600
DATA BIT	7
STOP BIT	1
PARITY	NONE

4-4. INSTALLATION

The supplied software programs run on IBM PC compatible computers only.

1) Insert the supplied CD ROM into the drive.
2) Type in the following statement from the run command line selected from the START menu if your computer has the WIN 98 operating system D:\setup.exe (Press enter) or double click the My Computer icon on the Windows Desk top and click on the D:CD ROM drive icon then click the setup.exe Icon.
3) Follow the message on the monitor screen. Refer to the read-me file for further details.

4-5. OPERATING

Refer to the help file on the installed software for operating procedure.

5. SPECIAL FUNCTION DESCRIPTION

5-1. BAR GRAPH DISPLAY

This meter has an innovative style of bar graph based on binary bit expression that will indicate a change no matter how small has occurred in the signal level through an easy to understand binary code. The bar-graph segments correspond to the numerical value of the main display's reading. As the input measurement increases, the bar graph segments will increase in a binary sequence. For Example:

1+4+16+128+1024+8192+32768=42133 is shown on the main display.

5-2. MAX/MIN (Ref page 6)

To display the MAX or MIN values,
Press the menu key. Max. Value will be shown on the first display and Min. Value will be shown by pressing twice, and AVG value will be shown by pressing three times (Ref 5-4). Pressing 4th time will be released.

5-3. ±PEAK

The peak detection mode is for capturing high-speed changes in signal level of 5mS or greater in duration. This mode is available only in DCmV, DCV, DCuA, DCmA and DCA. To use this mode press the menu key and move the blinking cursor to + Peak for positive signals or Peak for negative signals with the Right or Left keys then press ENTER. To clear the present value of the peak or to restart the peak detection mode, press the ENTER key only.

5-4. AVERAGE

The AVG function mode is useful for measuring a signal contains ripple, noise or fluctuations. Strictly speaking, this AVG function is different from the average by mathematical definition. More exactly it is a smoothing function, which reduces changes due to ripple or fluctuation by 100 times from the following calculation:

AVG = [sum of previous 100 data measured] / 100

5-5. GO/NG

The GO/NG function provides an easy way to determine if a reading falls within a designated range of values.

The LCD indicates on the primary display if the input value is out of (fail) or within the range (press), which you selected. Before starting the GO/NG function, the tolerance range that an input value will be compared against must be set.

This can be accomplished with the following procedure.

1) Select the mode what you want to measure.
2) Press the menu key.
3) Move the blinking cursor to the GO/NG.
4) Press the ENTER key to select the GO/NG function mode and to enter the input reference value. The display will show the memory address number in the secondary display and the memory contents in the main display used as the reference value.
5) There are 2 ways for inputting the reference value.

Method 1: Direct input of reference value by the following method.

Press the ENTER key for longer than 1sec to modify the contents of the reference memory. The first digit will start blinking. The digit value may be changed by pressing the (◄)/(►) keys. Pressing the ENTER key again will cause the second digit to blink. Press the (◄)/(►) keys to change the digit value as required and then press the enter key. This will make the next digit blink. In the same manner, change its value and likewise for all the remaining digits. After the last digit is entered, the negative sign will blink. Press the (◄)/(►) keys to move the decimal point to appropriate position and then press the enter key. This completes the input of reference value and displays the +% annunciator on the top right of the display and a blinking secondary display. The +% tolerance is enter through the secondary display by pressing the Right/Left keys Pressing the ENTER key will store the + Tolerance value and display the Tolerance annunciator. To enter the % value use the same procedure as for the +% tolerance value. Once the -% tolerance is entered the GO/NO function will start.

Note

1. It will not be operated if the first place of the number is more than 4.
2. Direct input is possible on Add 0 only.

Method 2: Indirect input from one of 10 memories.

The data stored in one of the 10 memory locations can be used as the reference by the following procedure: Perform the Steps 1 through 3 in this section. Press the (◄)/(►) keys to select the memory address number where the reference value is stored, then press the ENTER key. This sets the input reference value. To set the +% and % tolerance use the procedure in step 4 above.

5-6. STORE

Up to 10 measurements can be stored or recalled in memory at any time. Used to store a measurement value in memory.

5-6-1 STORE THE MEASURING VALUE

1) Press the menu key.
2) Press the (◄)/(►) allow keys to position the blinking cursor over the STORE annunciator.
3) Press the ENTER key to select the store mode.
4) Press the (◄)/(►) key to select appropriate memory address. The right side display will show the address number. Pressing the ENTER key stores the displayed measurement reading Note Only numerical data can be stored in memory. OPEN/SHRT Continuity and GO/NG test data cannot be stored in memory.
5) The memories used for this function are nonvolatile type of EEPROM. So the memory contents are not erased when the batteries go dead or replace. The only way to change the data is by writing new data to a location.

5-6-2 STORE THE VALUE MANUALLY

1) Select the mode what you want to measure.
2) Press the menu key.
3) Press the ENTER key to move the blinking cursor over the STORE annunciator.
4) Move the Add you want to store with (◄)/(►) key.
5) Press ENTER key for a second. The first digit will be blinking. Press the (◄)/(►) key to change the digit and press ENTER key and then next digit will be blinking. Change the other value and digits at the same method. Input the last digit, (-) signal will be blinking. To select (+) or (-) cable, Press (◄)/(►) key and ENTER key. And then the first decimal number will be blinking. To move the decimal point to right place, press (◄)/(►) key and ENTER key.

5-7. RECALL

This function recalls data from a memory location that data has been previously stored in: To Recall a memory location:

1) Press the menu key.
2) Move the (◄)/(►) key to position the blinking cursor over recall.
3) Press the ENTER key.
4) Press the (◄)/(►) key to select the desired memory address. The main display will read the contents of the memory indicated by the address number on the secondary display.

6. MAINTENANCE

6-1. GENERAL

1) Do not use abrasives or solvents. Periodically wipe the case with a damp cloth and detergent.
2) Calibrate the meter once a year to maintain the accuracy specified in the attached electrical specification sheet.

6-2. FUSE REPLACEMENT

[Inside Fuse]

1. Replacement A fuse (15A / 600V)

    1) To avoid electrical shock, remove the test leads, and input signal and switch off the meter.
    2) Remove the 4 screws from the back side.
    3) Separate the top case from the button case.
    4) Remove the defective fuse by gently prying loose one end of the fuse and sliding the fuse from the fuse holder.
    5) Install a new fuse of the same size and rating. Ensure that the new fuse is centered in the fuse holder.
    6) Replace the bottom case and reinstall all the screws.

[Outside Fuse]

1. Replacement mA fuse (500mA / 250V)

    1) Press lightly the knob of mA input terminal on the front and separate the knob from the front side to turn to right.
    2) Remove the defective knob and install a new fuse.
    3) Turn the knob to left to install it in mA input terminal.

2. Replace power fuse (200mA / 250V)

    1) Remove power code.
    2) Pick out the fuse holder of AC Inlet with Pinset.
    3) Replace the defective fuse to new one.

6-3. CALIBRATION

1) Turn the power off.
2) Remove the button case by performing steps 1 to 3 of the above for fuse replacement procedure.
3) Turn on the switch for auto calibration located at the top of the main PCB.
4) Replace the top case and reinstall all the screw.
5) Press the power switch.

6) Proceed with the calibration in the order listed on the table below. This calibration should be performed only by qualified service personnel with proper equipment (calibrator, decade resistance/capacitance etc) Note: after completion of the calibration, the power switch be set to off and the auto calibration switch must be returned to the off position.
7) Turn off the power switch.
8) Turn off the display PCB switch after removal top case.
9) Replace the top case and reinstall all the screw.

> **Note**
>
> Check the measured value into the Spec.

10) Auto calibration procedure.

NO.	Functions	INPUT TO APPLY (MAIN DISPLAY)	VALUE SHOWN IN SECONDARY	Related Functions	Equipment	Remark
1	V	5V	4.0 to 5.24	DCV	WAVETEK 9100 CALIBRATOR OR BETTER ACCURACY	
2		50V	40 to 52.4			
3		500V	400 to 524			
4		1000V	800 to 1050			
5		5V 50/60Hz	4.0 to 5.24	ACV		
6		50V 50/60Hz	40 to 52.4			
7		500V 50/60Hz	400 to 524			
8		750V 50/60Hz	600 to 800			
9	mV	500mV	400 to 524	DCmV		
10		2500mV	2000 to 2620			
11		500mV 50/60Hz	400 to 524	ACmV		
12	uA	5000uA	4000 to 5240	DCuA		
13		5000uA 50/60Hz	4000 to 5240	ACuA		
14	mA	500mA	400 to 524	DCmA		
15		500mA 50/60Hz	400 to 524	ACmA		
16	A	10A	8 to 10.5	DCA		
17		10A 50/60Hz	8 to 10.5	ACA	DECADE R, C CAN BE USED.	
18	ohm	No input(open)	20000 to 26200	REE V		
19		No input(open)	2000 to 2620	Low REF. V		
20		5kohm	4.0 to 5.24	ohm		
21		50kohm	40 to 52.4			
22		500kohm	400 to 524			

NO.	Functions	INPUT TO APPLY (MAIN DISPLAY)	VALUE SHOWN IN SECONDARY	RELATED FUNCTIONS	EQUIPMENT	REMARK
23		5Mohm	4.0 to 5.24			
24		50Mohm	40 to 52.4			
25		5kohm	4.0 to 5.24	L.V. ohm		
26		50kohm	40 to 52.4			
27		500kohm	400 to 524			
28		5MohM	4.0 to 5.24			
29		50Mohm	40 to 52.4			
30	Capacitor	50nF	20 to 30	Capacitance		
31		500nF	200 to 300			
32		5uF	2.0 to 3.0			
33		50uF	20to30			

Note

The above procedure is programmed into the u-com IC. In the AUTO CAL mode the primary display shows the range to be calibrated, the secondary display will show the calibration data value. Connect the calibrator to the DMm input. Set the calibrator to the setting listed in "input to apply column" If the range needs to be calibrated press the ENTER key. The display will advance to the next range. If the range is not to calibrated press the (►) key. This will skip the step and the original calibration values will not be changed.

7. APPENDICES

7-1. GENERAL SPECIFICATION

NO.	ITEM	DESCRIPTION
1	AD Conversion	50,000 Count Resolution, 0.05% Basic Accuracy and 50ms of Sampling Time
2	Conditions for Normal Use	<1 Year Calibration Cycle 23+5°C of Ambient Temperature <90%RH of Humidity & Non-condensing
3	Accuracy Expr.	±(% of Reading + Least Significant Digits)
4	Bar-graph	Binary 17 Bit Expression of Main Digit Decimal
5	Polarity Indication	- For Negative, None for Positive
6	LCD Update Rate	0.5 second typ. Except for the Below Functions 1 to 10 second for Hz, PW, capacitance
7	Memory Locations	10 Memories for storing 10 Measured Data values
8	Power Source	AC 100/120/220/230V 50/60Hz
9	Temp. Coefficient	<0.1 x Accuracy Spec. /°C for 0 to l8°C and 28 to 40 °C (32 to 64.4°F and 82.4 to 104°F)
10	Operating Temp.	0 to 40°C (32 to 104°F)
11	Relative Humidity	<90% RH at 0 to 28 °C (32 to 82.4°F), Non Condensing <80% RH at 28 to 40°C(82.4 to l04°F), Non Condensing
12	Storage Temp.	-20 to 60 °C at <70%RH & Non Condense
13	Basic Accessories	Test Leads, User Manual, Power Card
14	Optional Accessories	Temp. Adaptor, RS 232C CD for Win98 & 2000 & XP Temp. Probe (K), RS 232C Cable
15	(H x W x D)	270 x 245 x 95
16	Weight	1.75 kg

7-2. ELECTRICAL SPECIFICATION

1. DCmV & V

FUNCTION	RANGE	ACCURACY	INPUT IMPEDANCE	PROTECTION
DCmV	500.00mV	0.05%+ 5d	>1Gohm	MAX.250VAC or DC (5kohm PTC)
	2500.0mV			
DCV	5.0000V		About 10.5 Mohm	MAX. 1000VDC or 750VAC (10Mohm)
	50.000V		About 10.05 Mohm	
	500.00V		About 10 Mohm	
	1000.0V		About 10 Mohm	

2. ACmV & V

FUNCTION	RANGE	ACCURACY FOR EACH FREQUENCY RANGE				
		50 to 500Hz	UP to 1kHz	UP to 5kHz	UP to 10kHz	UP to 20kHz
AC mV	500.00mV	0.75%+20d for <400mV 1% for >400mV		1.5% for >50mV	2% for >50mV	3% for >50mV
AC V	5.0000 V	0.75% +20d	1% for ACV Level >10% of Full Scale		2% for ACV >10%of Full Scale	Not Specified
	50.000 V					
	500.00 V					
	750.0 V					

Note

1) Input impedance for ACmV: >1Gohm shunted with 100pF typ.
   For ACV: About 10Mohm shunted with 30pF typ.
2) Applicable crest factor: Max. 3 for full scale.
   Additional error and crest factor for various waveforms

WAVE FORM	CREST FACTOR	ADDITIONAL ERROR
SQUARE	1	0.20%
SINE	1.414	0%
TRIANGLE	1.73	0.30%
OTHERS	2	0.50%
	3	1.70%

3) Protection for ACmV: Max 250VAC or DC with 5kohm PTC For ACV: Max 1000VDC or 750VAC with 10Mohm

3. AC+DCmV & V

FUNCTION	RANGE	ACCURACY FOR EACH FREQUENCY RANGE				
		50 to 500Hz	UP to 1kHz	UP to 5kHz	UP to 10kHz	UP to 20kHz
AC+DCmV	500.00mV	1.5%+50d for<300mV 2,0% for >300mV		2.5% for >50mV	3.5% for >50mV	4.5% for >50mV
AC+DC V	5.0000 V	2.0%+50d	2.5% for AC+DC V Level >10% of Full Scale		3.5% for AC+DC V >10%of Full Scale	Not Specified
	50.000 V					
	500.00 V					
	750.0 V					

Note Input impedance, crest factors and protection are the same as those descried in AC mV & AC V.

4. DC CURRENT

FUNCTION	SHUNT	RANGE	ACCURACY	PROTECTION
DC uA	100 ohm	5000.0 uA	0.2%+5d	0.5A/250V Fast Fuse & 22V.M.O. Varistor
DC mA	1 ohm	500.00 mA		
DC A	10 Mohm	10.000 A	0.5%+ 5d	15A/600V Fast Fuse

Note

1) Burden voltage: Test current x (shunt R + Fuse R)
2) The "A" input terminal allows continuous current flow up to 15A. Successive high current measurements above 5A requires lOminutes of cooling time between measurements.

5. AC CURRENT

FUNCTION	RANGE	FREQUENCY	ACCURACY	PROTECTION
AC uA	5000.0 uA	50Hz to 1kHz	0.75%+20d for<40000count 1% for>40000count	0.5A/250V Fast Fuse & 22V M.O. Varistor
AC mA	500.00 mA			
AC A	10.000 A			15A/600V Fast Fuse

Note

1) Burden voltage: Same as in DC current
2) True RMS crest factor: Same as in AC V
3) Frequency response up to 20kHz, the same as ACmV.

6. AC+DC CURRENT

FUNCTION	RANGE	FREQUENCY	ACCURACY	PROTECTION
AC+DC uA	5000.0 uA	DC to 1kHz	1.5%+50d for<30000count 2% for>30000count	0.5A/250V Fast Fuse & 22V M.O.Varistor
AC+DC mA	500.00 mA			
AC A	10.000 A			15A/600V Fast Fuse

Note

1) Burden voltage: Same as in DC current
2) True RMS crest factor: Same as in AC V
3) Frequency response up to 20kHz, the same as those for AC+DCmV.

7. RESISTANCE

RANGE	RESOL.	ACCURACY	OPEN/SHORT	PROTECTION
50.00 ohm	0.01 ohm	1.0%+20d	2.5V/1.7mA	250VAC or DC (500 ohm PTC)
5.0000 kohm	0.1 ohm	0.2% +5d	2.5V/1.7mA	
50.000 kohm	1 ohm		2.5V/240uA	
500.00 kohm	10 ohm		2.5V/25uA	
5.0000 Mohm	100 ohm		2.5V/2.5uA	
50.000 Mohm	1k ohm	1.0%+10d	2.5V/250nA	

Note

When testing high resistance in Mohm range, good Shielding and extremely short test leads is recommended for accurate measurement and for avoiding instability due to external noise.

8. LV ohm(Low Voltage OHM)

RANGE	RESOL.	ACCURACY	OPEN/SHORT	PROTECTION
5.000 kohm	1 ohm	0.5% +5d	0.25V/170uA	250VAC or DC (500 ohm PTC)
50.00 kohm	10 ohm		0.25V /24uA	
500.0 kohm	100 ohm		0.25V/2.5uA	
5.000 Mohm	1k ohm		0.25V / 250uA	
50.00 Mohm	10k ohm	2.5% +10d	0.25V / 25nA	

Note

This LV ohm is very useful function in your checking a complex PCB assembly, because its testing voltage is low enough to treat regard semiconductors as open circuit and therefore you can check exact resistance value of each component without removing semi conductors or breaking the PCB patterns connected to them.

9. NS (CONDUCTANCE)

RANGE	RESOL.	ACCURACY	OPEN/SHORT	PROTECTION
500.0 nS	0.1 nS	3.0%+5d	2.5V / 25 nA	250VAC or DC

Note

1) S = 1/R
   Where S: Siemens, R: Resistance
   500nS corresponds to 2Mohm, 0.1 nS to 10Gohm.
2) Careful attention for shielding from noise in very high resistance.

10. CONTINUITY

RANGE	INPUT	RESPONSE	ACCURACY	PROTECTION
5 kohm	Short	Buzzer On	<5 ohm	250VAC or DC (500 ohm PTC)
	Open	Buzzer Off	>15 ohm	
50 kohm	Short	Buzzer On	< 50 ohm	
	Open	Buzzer Off	> 100 ohm	
500 kohm	Short	Buzzer On	<500 ohm	
	Open	Buzzer Off	> 1 kohm	
5 Mohm	Short	Buzzer On	< 5 kohm	
	Open	Buzzer Off	>10 kohm	

11. ZENER DIODE

RANGE	ACCURACY	TEST CURRENT	OPEN CIRCUIT V	PROTECTION
15.000 V	5% + 10d	1mA	15 to 22V	250VAC or DC (500 ohm PTC)

Note

1) Zener diode voltage from OV up to the open circuit voltage (15 to 22V) can be conveniently measured with 1mA constant current source circuit built in to this meter.
2) This function can be used as constant current source with high accuracy of 1mA ±5% for
compliance voltage of about 20V.

12. Capacitance

RANGE	RESOL.	ACCURACY	TESTING TIME	PROTECTION
5.000 nF	1 pF	5%+10d	1.1 Sec.	250VAC or DC (500 ohm PTC)
50.00 nF	10 pF	2%+10d		
500.0 nF	100 pF			
5.000 uF	1 nF	2%+5d		
50.00 uF	10 nF			
500.0 uF	100 nF	3% + 10d	VARIABLE (1.1 to 10 Sec.)	
5.000 mF	1 uF			

13. Frequency

RANGE	RESOL.	ACCURACY	INPUT IMPEDANCE	PROTECTION
50.00 Hz	0.01 Hz	0.01%+5d	10Mohm//lnF	500VAC or DC (1kV lnF Capacitor Parallel with 10M 1/2W Resistor)
500.0 Hz	0.1 Hz			
50.000 kHz	1 Hz			
500.00 kHz	10 Hz			
5.0000MHz	100 Hz			

Note

1) Sensitivity: Max. 2VAC or 4Vp-p from 5Hz through 5MHz.
2) Secondary display shows AC volt measurement value simultaneously with frequency in main display. The specification for this ACV is shown in the previous item no. 2.

14. Pulse width

RANGE	RESOL.	ACCURACY	INPUT IMPEDANCE	PROTECTION
200.00 ms	10u Sec.	0.1%+5d	10Mohm/1nF	500VAC or DC

Note
Sensitivity: same as for frequency

15. Duty cycle

RANGE	RESOL.	ACCURACY	PULSE WIDTH	PROTECTION
100.00 %	0.01%	0.1% +5d	0.1ms to 200ms	500VAC or DC

16. Temperature

RANGE	RESOL.	RANGE	ACCURACY	PROTECTION
°C	0.1 °C	-20 to 0°C	±3°C	Max.500VAC or DC for V Terminal, 250V AC or DC (500 ohm PTC) for Diode Terminal
		0 to 150°C	±2°C	
		150 to 1200°C	±2%	
°F	0.1 °F	°F= 32+(9/5x°C)		
°K	0.1 °K	°K=°C+273.1		

Note
Temp. Sensor: K-type probe whose accuracy should be added to the above accuracy.

17. Peak ±detection

FUNCTION	ACCURACY	REMARK
DCmA	Less than 10% for peak with >5ms of duration and with >10% of full scale of each range	
DCV		
DCuA		
DCmA		
DCA		

18. Protection

TERMINAL	FUNCTION	MAXIMUM INPUT	PROTECTION DEVICE
V	DCV, ACV	1000VDC or AC Peak	10M 1/2W Resistor
	Hz/Temp.	500VDC or AC RMS	10pF 1kV Capacitor
	Others	250VDC or AC RMS	PTC(500ohm, 5kohm)
u/mA	0.5A DC or AC RMS		0.5A/250V Fast Fuse
10A	10A DC or AC RMS		15A 600V Fast Fuse

7-3. SPECIAL SYMBOLS ON LCD

NO.	FUNCTION	RANGE	SELECTION METHOD	OPERATION KEY
1	DC V	4	AUTO & MANUAL	◁▷
2	AC V	4	AUTO & MANUAL	◁▷
3	AC+DC V	4	AUTO & MANUAL	◁▷
4	DCmV	2	AUTO & MANUAL	◁▷
5	ACmV	1	FIXED	
6	AC+DCmV	1	FIXED	
7	ohm	6	AUTO & MANUAL	◁▷
8	CONTINUITY	4	AUTO & MANUAL	◁▷
9	LV- ohm	5	AUTO & MANUAL	◁▷
10	CAPACITANCE	7	AUTO & MANUAL	◁▷
11	SUSCEPTANCE	1	FIXED	
12	Hz	5	AUTO & MANUAL	◁▷
13	+ PULSE WIDTH	1	FIXED	
14	- PULSE WIDTH	1	FIXED	
15	ZENER DIODE	1	FIXED	
16	TEME(°C)	1	FIXED	
17	TEMP(°F)	1	FIXED	
18	DCuA	1	FIXED	
19	ACuA	1	FIXED	
20	AC+DCuA	1	FIXED	
21	DCmA	1	FIXED	
22	ACmA	1	FIXED	
23	AC+DCmA	1	FIXED	
24	DC A	1	FIXED	
25	AC A	1	FIXED	
26	AC+DC A	1	FIXED	

* Indication for over-range: "OL" on LCD display
* Over-range: In excess of full scale
* Under-range: Under 9% of full scale
* In some special modes such as max, min, avg, REL etc. That means "OL".

7-4. MODE SELECTION BY FUNCTION

NO.	FUNCTIONS	HOLD	RANGE	REL	MAX	MIN	AVG	RS232	PEAK	GO/NG	STORE	RECALL
1	DC V	o	o	o	o	o	o	o	o	o	o	o
2	AC V	o	o	o	o	o	o	o		o	o	o
3	AC+DC V	o	o	o	o	o	o	o		o	o	o
4	DCmV	o	o	o	o	o	o	o	o	o	o	o

NO.	FUNCTIONS	HOLD	RANGE	REL	MAX	MIN	AVG	RS232	PEAK	GO/NG	STORE	RECALL
5	ACmV	o		o	o	o	o	o		o	o	o
6	AC+DCmV	o		o	o	o	o	o		o	o	o
7	ohm	o	o	o	o	o	o	o		o	o	o
8	CONTINUITY	o	o					o				
9	LV-ohm	o	o	o	o	o	o	o		o	o	o
10	CAPACITANCE	o	o	o	o	o	o	o		o	o	o
11	SUSCEPTANCE	o		o	o	o	o	o		o	o	o
12	Hz	o	o		o	o	o	o		o	o	o
13	+ PULSE WIDTH	o			o	o	o	o		o	o	o
14	- PLUSE WIDTH	o			o	o	o	o		o	o	o
15	ZENER DIODE	o		o	o	o	o	o		o	o	o
16	TEMP(C)	o		o	o	o	o	o		o	o	o
17	TEMP.(F)	o		o	o	o	o	o		o	o	o
18	DCuA	o		o	o	o	o	o	o	o	o	o
19	ACuA	o		o	o	o	o	o		o	o	o
20	AC+DCuA	o		o	o	o	o	o		o	o	o
21	DCmA	o		o	o	o	o	o	o	o	o	o
22	ACmA	o		o	o	o	o	o		o	o	o
23	AC+DCmA	o		o	o	o	o	o		o	o	o
24	DC A	o		o	o	o	o	o	o	o	o	o
25	AC A	o		o	o	o	o	o		o	o	o
26	AC+DCA	o		o	o	o	o	o		o	o	o

7-5. SPECIAL SYMBOLS ON LCD

NO.	FUNCTIONS	DESCRIPTION
1		Continuity test mode
2		Zener diode test
3	REL	Relative mode
4	RECALL	Reads the data stored in memory
5	STORE	Stores the measured data into memory
6	RS232C	Serial data interface with computer
7	±PULSE	Indicates the polarity of the pulse being measured in pulse width and duty cycle function.
8	±PEAK	Indicates the polarity of the peak measured in measuring the peak value of voltage or current.

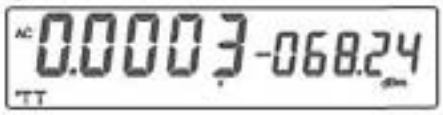
NO.	FUNCTIONS	DESCRIPTION
9	MAX	Maximum value in a measurement.
10	MIN	Minimum value in a measurement.
11	AVG	100 measurements are averaged.
12	GO/NG	Go/no-go test mode
13	REF	Reference value for go/ng test
14	PW	Pulse width test mode
15	RANGE	Indicates manual range mode
16	HOLD	Indicates the data hold key was pressed.
17	DUTY	Duty cycle test
18	dBm	Decibel based on 1mw/600 ohm

7-6. LCD STATUS BY FUNCTIONS

1) Full Display (Power On)

2) DC V

3) AC V



4) AC+DC V

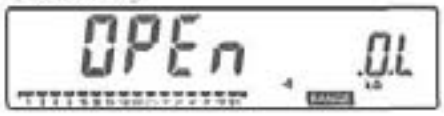
5) DCmV

6) ACmV

7) AC+DCmV

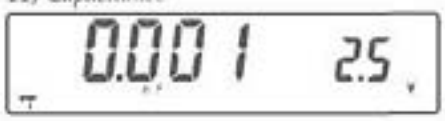
8) ohm

9) Continuity



10) LV ohm

11) Capacitance



12) nS (nano Susceptance)

13) Frequency

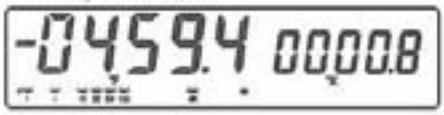
14) + Pulse Width

15) -Pulse Width

16) Zener Diode

17) Temperature (°C)

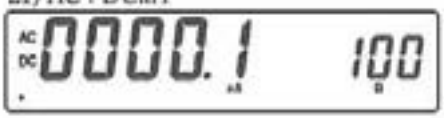
18) Temperature (°F)



19) DCuA

20) ACuA

21) AC+DCuA



22) DCmA

23) ACmA

24) AC+DCmA

25) DC A

26) AC A

27) AC+DC A

7-7. SAFETY

1. Safety: 1000VDC or 750VAC of maximum voltage between terminal, com terminal and earth ground.
   This product meets the safety requirements for a safety class 2 (Reinforced Insulation) and does not require grounding for safety.
2. Installation category: IEC664, over voltage category II
3. Protection
   1) Surge: 8kV peak per EN 61000-4-2
   2) Fuse: F15A H600V fast Fuse for "A" Terminal.
      F0.5A H250V fast Fuse for "mA" Terminal.
      (Both fuses must be replaced by qualified service personnel.)
4. Electrical symbols used here are shown below.

~	AC (ALTERNATING CURRENT)	⚠	CAUTION, RISK OF ELECTRIC SHOCK
⎓	DC (DIRECT CURRENT)	⏚	EARTH GROUND
≂	AC, DC OR AC+DC	⚠	CAUTION, SEE EXPLANATION IN MANUAL
⧈	DOUBLE INSULATION OR REINFORCED INSULATION		

5. Safe operating conditions

   1) Do not measure voltage in excess of 1000V peak.
   2) Observe the maximum input as stated in the specification.
   3) Disconnect the test lead from the test points before changing the meter function and range.
   4) Be careful not to touch the terminals or probe tip when measuring above 60VDC or 25VAC.
   5) Never attempt a voltage measurement with a test lead in the "A" or mA input terminal.
   6) Do not measure more than 10A(which will display "OL" and do not continue measuring high current above 10A for more than 3 minute. To avoid opening fuse and overheating circuits. The successive measurement should be done after more than 10 minutes for cooling down.
   7) Do not attempt a current measurement when the voltage is above 600V.
   8) Remove the test leads before opening the case to avoid electrical shock.
   9) Disconnect the live test lead before disconnecting the common test lead.
   10) Install only the fuses with the specified AMP/VOLT ratings.

PROTOCOL

* First 1 - Byte is composed of 5B(HEX) or "C"(CHAR).
Last 1 - Byte(43rd Byte) is composed of 5D(HEX) or "C" (CHAR).
When this is detected, it means all data on LCD received.

Communication protocol:

Baud rate: 9600bps
Data bit: 7-bit
Stop bit: 1-bit
Parity: No

1-Byte is composed of 7 bits, but effective bits are lower 4 bits. The data of 41 Bytes(162 bits) except first and last Bytes have separate meaning according to each bit.

DM-8241B Communication Protocol (Draft)

1. PROTOCOL (Tx)

High 3bits				Low 4bits				
6th	5th	4th	Contents	3rd	2nd	1st	0	
1st Byte: Start Byte (7AH)								
1	1	1	7A	1	0	1	0	0AH
2ndByte: Measurement Mode								
0	0	0	DC	0	0	0	0	Voltage
0	0	1	AC					
0	1	0	AC +DC					
0	0	0	DC	0	0	0	1	m Voltage (mV)
0	0	1	AC					
0	1	0	AC +DC					
0	0	0	Resistance (ohm)	0	0	1	0	Resistance
0	0	1	Continuity					
0	1	0	Low Voltage Resistance					
0	0	0	Capacitance	0	0	1	1	Capacitance
0	0	1	Siemens (nS)					
0	0	0	Frequency(Hz)	0	1	0	0	Frequency
0	0	1	Pulse Width +					
0	1	0	Pulse Width -					
0	0	0	Diode	0	1	0	1	Temperature
0	0	1	Celsius					
0	1	0	Fahrenheit					

0	0	0	DC	0	1	1	0	u Current(uA)
0	0	1	AC					
0	1	0	AC + DC					
0	0	0	DC	0	1	1	1	m Current (mA)
0	0	1	AC					
0	1	0	AC + DC					
0	0	0	DC	1	0	0	0	Current (A)
0	0	1	AC					
0	1	0	AC + DC					
3rd Byte: (Range Status) (Menu Status)								
0	0	1	1st Range	0	0	0	1	MAX
0	1	0	2nd Range	0	0	1	0	MIN
0	1	1	3rd Range	0	0	1	1	REL
1	0	0	4th Range	0	1	0	0	AVG
1	0	1	5th Range	0	1	0	1	+PEAK
1	1	0	6th Range	0	1	1	0	-REAR
1	1	1	7thRange	0	1	1	1	GO/NG
				1	0	0	0	REF
				1	0	0	1	+ %
				1	0	1	0	-%
				1	0	1	1	Normal/RS232C(4Blinking)
				1	1	0	0	RECALL
				1	1	0	1	STORE
4th-8th Byte: (See Below) (Main Decimal Data)								
4th Byte (Display Status)				0	0	0	0	0
X	0	0	Main Decimal	0	0	0	1	1
X	0	1	Main OL	0	0	1	0	2
X	1	0	Main Digit Off	0	0	1	1	3
0	X	X	Main Plus	0	1	0	0	4
1	X	X	Main Minus	0	1	0	1	5
5th-8th Byte: (No Effect)				0	1	1	0	6
0	0	0	0	0	1	1	1	7
				1	0	0	0	8
				1	0	0	1	9
9th-13th Byte: (See Below) (Sub Decimal Data)								
9th Byte (Display Status)				0	0	0	0	0
X	0	0	Sub Decimal	0	0	0	1	1
X	0	1	Sub OL	0	0	1	0	2
X	1	0	Sub Digit Off	0	0	1	1	3

0	X	X	Sub Plus	0	1	0	0	4
1	X	X	Sub Minus	0	1	0	1	5
10th-13th Byte (No Effect)				0	1	1	0	6
0	0	0	0	0	1	1	1	7
				1	0	0	0	8
				1	0	0	1	9
14th Byte (CONT Result) (Icon Status)								
0	X	0	"OPEN" at Continuity	0	X	X	X	Pixel Icon
0	X	1	"SHRT" at Continuity	1	X	X	X	Blinking Icon
0	0	X	"PASS" at GO/NG	X	0	X	X	Auto Range
0	1	X	"FALL" at GO/NG	X	1	X	X	Manual Range
				X	X	0	X	Hold OFF
				X	X	1	X	Hold ON
				X	X	X	1	RS232C ON
15th Byte: 0 (Blinking Status 4 Store)								
				0	0	0	0	No Blinking
				0	0	0	1	1st Digit Blinking
				0	0	1	0	2nd Digit Blinking
				0	0	1	1	3rd Digit Blinking
				0	1	0	0	4th Digit Blinking
				0	1	0	1	5th Digit Blinking
				0	1	1	0	'-' Sign Blinking
0	0	0	1st Dot Blinking	0	1	1	1	Dot Blinking
0	0	1	2nd Dot Blinking					
0	1	0	3rd Dot Blinking					
0	1	1	4th Dot Blinking					
16th Byte: (Menu Blinking) (address)								
0	0	0	GO / NG	0	0	0	0	0
0	0	1	' + ' PEAK	0	0	0	1	1
0	1	0	'-' PEAK	0	0	1	0	2
0	1	1	RS232C	0	0	1	1	3
1	0	0	RECALL	0	1	0	0	4
1	0	1	STORE	0	1	0	1	5
				0	1	1	0	6
				0	1	1	1	7
				1	0	0	0	8
				1	0	0	1	9

2. PROTOCOL (Rx)

Rx Value	Contents	MICON Execution	Remarks
10H	V Key Occurred	V Measurement	Function Key
11H	mV Key Occurred	MV Measurement	
12H	Ohm Key Occurred	Ohm Measurement	
13H	Cap Key Occurred	Cap Measurement	
14H	Hz Key Occurred	Hz Measurement	
15H	Temp Key Occurred	Temp Measurement	
16H	uA Key Occurred	uA Measurement	
17H	mA Key Occurred	mA Measurement	
18H	A Key Occurred	A Measurement	
21H	ALT Key Occurred	Action by ALT Key	Mode Key
22H	LEFT Key Occurred	Action by LEFT Key	
23H	RIGHT Key Occurred	Action by RIGHT Key	
24H	ENTER Key Occurred	Action by ENTER Key	
25H	MENU Key Occurred	Action by MENU Key	
26H	REL Key Occurred	Action by REL Key	
27H	HOLD Key Occurred	Action by HOLD Key	
28H	MMA Key Occurred	Action by MMA Key	

Warranty

This product is warranted against all defects of material or workmanship which may develop for any reason whatsoever, except abuse, within a period of one year from the date of purchase by the original buyer of user. Any product found defective during the warranty period and returned to the factory will be repaired, adjusted of replaced at no charge to the original purchaser. This warranty does not cover expendable items such as battery or fuse. If the defect has been caused by misuse or abnormal operating conditions, the repair will be billed to the user.