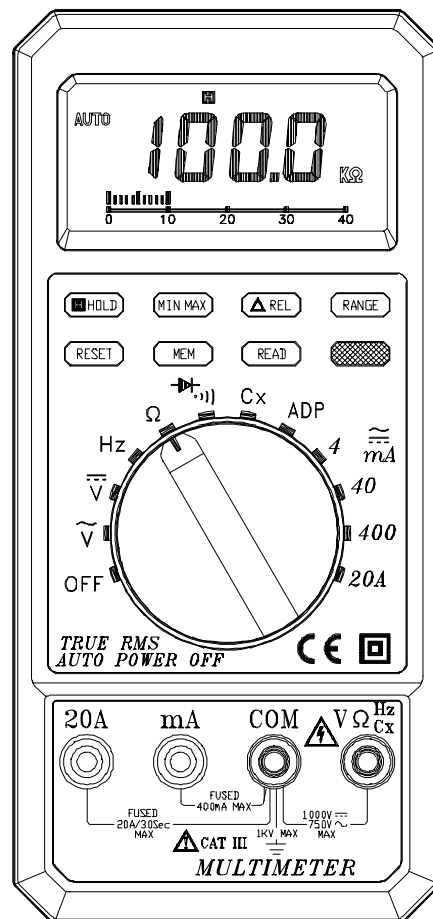




# AUTO-RANGING TRUE RMS MULTIMETER

## TES-2620

# INSTRUCTION MANUAL



TES ELECTRICAL ELECTRONIC CORP.

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# 1. SAFETY INFORMATION

- Read the following safety information carefully before attempting to operate or service the meter.
- To avoid damages to the instrument do not apply the signals which exceed the maximum limits shown in the technical specifications tables.
- Never measure current while the test leads are inserted into the input jacks.
- Do not use the meter or test leads if they look damaged. Use extreme caution when working around bare conductors or bus bars.
- Accidental contact with the conductor could result in electric shock.
- Use the meter only as specified in this manual ; otherwise, the protection provided by the meter may be impaired.
- Read the operating instructions before use and follow all safety information.
- Caution when working with voltages above 60V DC or 30 V AC RMS. Such voltages pose a shock hazard.
- Before taking resistance measurements or testing acoustic continuity, disconnect circuit from main power supply and all loads from the circuit.

## Safety symbols:



Caution refer to this manual before using the meter.



Dangerous voltages.



Meter is protected throughout by double insulation or reinforced insulation.

**When servicing, use only specified replacement parts.**



Comply with EN-61010-1

## 2. FEATURES

- 3-3/4 Digital LCD with Bar-graph
- True RMS on ACV and ACA measurement
- Water- Proof ABS housing
- Auto- Ranging on Volt, Ohm , Current, Frequency, and Capacitance measurement
- Auto-power - off
- Also provides MAX / MIN recording; MEM and READ; REL and data HOLD mode
- Ohms, Diode, Audible continuity, Capacitance range with input Overload protection to 600Vrms
- 20A / 600V high energy fuse protection on 20A AC/DC
- Flip - up stand

## 3 SPECIFICATIONS

### 3-1 General Specifications

Environment conditions : ① Installation Categories II

② Pollution Degree 2

③ Altitude up to 2000 meters

④ Indoor use only

⑤ Relatively humidity 80% max.

⑥ Operation Ambient 0~40°C

Maintenance & Clearing: ① Repairs or servicing not covered in this manual should only be performed by qualified personnel.

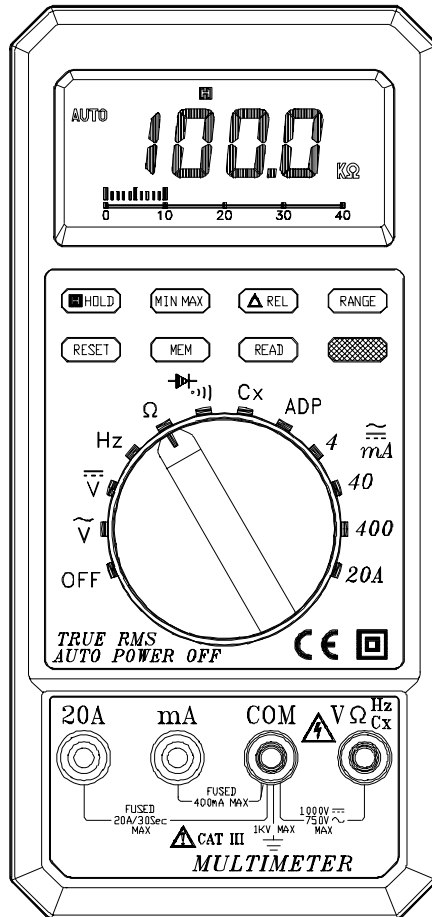
② Periodically wipe the case with a dry cloth. Do not use abrasives or solvents on this instruments.

Operating Principle : Dual slope integration

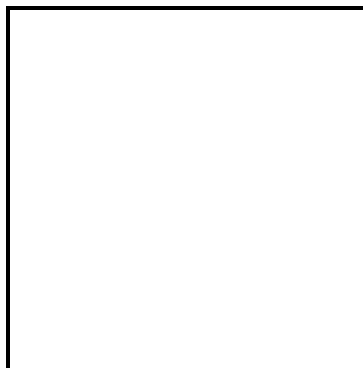
Numerical Display : 3 3/4 digit liquid crystal display (LCD) maximum reading 3999 and Bar-graph indication.

## Unit and Sign Display :

■	Decimal point
AC	Alternating current or voltage
DC	Direct current or voltage
V	Volt
mV	Millivolt ( $1 \times 10^{-3}$ volt )
A	Ampere ( amp ). Current
mA	Milliampere ( $1 \times 10^{-3}$ amp )
$\Omega$	Ohm. Resistance
K $\Omega$	Kilohm ( $1 \times 10^3$ ohm ). Resistance
M $\Omega$	Megohm ( $1 \times 10^6$ ohm ). Resistance
KHz	Kilohertz ( $1 \times 10^3$ cycles / sec ). Frequency
Hz	Hertz ( 1 cycle / sec). Frequency
$\mu$ F	Microfarads ( $1 \times 10^{-6}$ Farad ). Capacitance
nF	Nanofarads ( $1 \times 10^{-9}$ Farad ). Capacitance



Diode



Continuity Beeper

**BT** Low Battery

— Negative polarity

Auto Autorange

Manu Manual Range

△REL Relative Reading

MEM Memory Reading

**H** Date Hold

MIN Minimum Reading

MAX Maximum Reading

- Range Selection : All ranges are measured by single Range Switch operation.
- Over Range Indication : LCD will show a “4” flashing in the highest position accompanied with a continuous beeper.
- Low Battery Indication : The **BT** is displayed when the battery voltage drops below the operating voltage.
- Sampling Rate : 20 times/sec of Bar-graph indication, 2 times/sec of digital display.
- Power Source : 2pcs of “ AA “ 1.5V Battery
- Battery Life : 400hrs approx.
- Polarity : Automatic polarity “ **■** “ displays for negative input
- Operating Temperature : 0°C to 40°C ( 32°F to 104°F )  
and Humidity below 80% RH
- Storage Temperature : -10°C to 60°C ( 14°F to 140°F )  
and Humidity below 70% RH
- Dimensions : 184 (L) × 82 (W) × 42(H) mm
- Weight : Approx. 375g
- Accessories : Test leads , Spare fuse ( 0.5A/250V ) , Battery , Instruction manual, etc.

### 3-2 Electrical Specifications

Accuracies are  $\pm$  (...% of reading + ...digits) at  $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$ , below 80% RH.

DC Voltage : ( Autoranging & Manual range )

Range	Resolution	Accuracy	Input Impedance	Overload Protection
400mV	100uV	0.5%+1	$> 100\text{M}\Omega$	DC1100V AC 800V
4V	1mV		$\approx 11\text{M}\Omega$	
40V	10mV		$\approx 10\text{M}\Omega$	
400V	100mV			
1000V	1V			

AC Voltage ( Autorange & Manual range ) True RMS

Range	Resolution	Accuracy	Input Impedance	Overload Protection	Frequency Response
400mV	100uV	1.2%+5	$\geq 100\text{M}\Omega$	DC1100V AC 800V	50 ~ 60Hz
4V	1mV		$\approx 11\text{M}\Omega$		40 ~ 450Hz
40V	10mV		$\approx 10\text{M}\Omega$		
400V	100mV				
750V	1V	1.5%+5			

※ 400 mV only manual range.

Additional Crest Factor Errors ( non-sinecurve )

Crest Factor	Error ( % of reading )
1-3	1%
3-5	4.5%

※ [ For frequencies at 50/60 Hz, slow AC filter specified for sinecurve input only. ]

※ Response time : 5 seconds max, to rated accuracy in the selected range.



DC Current : ( manual range )

Range	Resolution	Accuracy	Input Impedance	Burden Voltage
4mA	1uA	1%+1	0.5A / 250V fuse	0.45V
40mA	10uA			0.65V
400mA	100uA			1.3V
20A	10mA	1.5%+2	20A / 600V high energy fuse	1.3V

AC Current : (manual range ) True RMS

Range	Resolution	Burden Voltage	Accuracy	Input Impedance	Frequency Response
4mA	1uA	0.45V	1.5%+5	0.5A / 250V fuse	40Hz to 500Hz
40mA	10uA				
400mA	100uA				
20A	10mA	1.3V	2%+5	20A / 600V high energy fuse	

※ Conversion type : AC coupled, TRMS measurement.

Additional Crest Factor Errors ( non-sinecure )

Crest Factor	Error ( % of reading )
1-3	1%
3-5	4.5%


※ [ For frequencies at 50/60 Hz, slow AC filter specified for sinecure input only. ]

※ Response time : 5 seconds max, to rated accuracy in the selected range.

Audible Continuity:

Range	Resolution	Open Circuit Voltage	Continuity Beeper	Overload Protection
	0.1Ω	≤ 0.5V	≤ Approx. 40Ω	600Vrms

Diode Test: (  )

Range	Resolution	Short Circuit Current	Accuracy	Open Circuit Voltage	Overload Protection
	1mV	0.8mA typical	1%+ 2	3V	600Vrms

Capacitance (Cx): (Autoranging & Manual range )

Range	Resolution	Accuracy
4nF	1pF	1.5%+ 20
40nF	10pF	
400nF	100pF	1.5%+ 10
4uF	1nF	
40uF	10nF	

Resistance: ( Autoranging & Manual range )

Range	Resolution	Accuracy	Open Circuit Voltage	Overhead protection
400Ω	100mΩ	0.75%+ 3	≤ 0.5V	600Vrms
4KΩ	1Ω			
40KΩ	10Ω			
400KΩ	100Ω			
4MΩ	1KΩ			
40MΩ	10KΩ	1.5%+ 5		

Frequency (Hz): ( Autoranging )

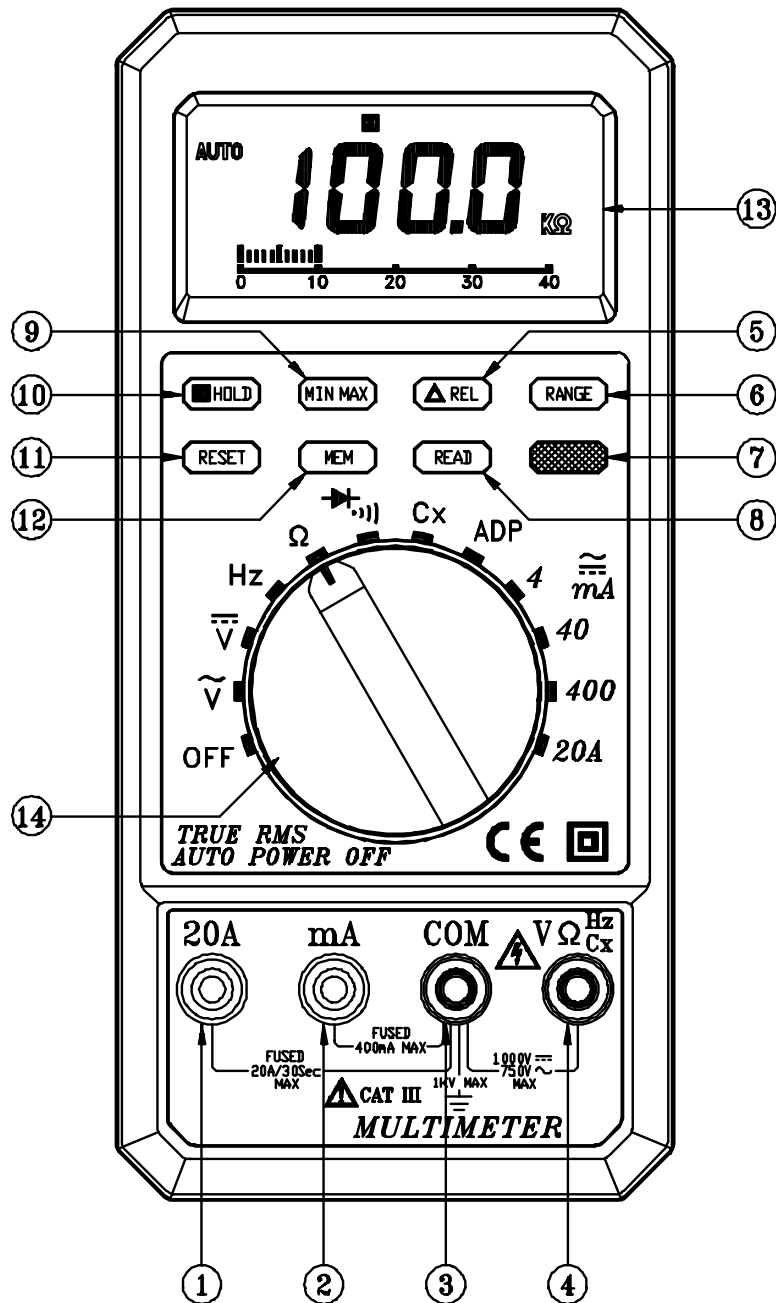
Range	Resolution	Accuracy	Sensitivity
100HZ	0.01HZ	0.1%+ 2	100mV / 1V / 10V (By Range Button Selector )
1KHZ	0.1HZ		
10KHZ	1HZ		
100KHZ	10HZ		
500KHZ	100HZ		

ADP


Function	Input	Resolution	Accuracy	Overhead Protection
ADP	400mV <sub>DC</sub> Full Scale	1 COUNT/0.1mV	$\pm 0.5\%$ of rdg $\pm 2$ LSD	600Vrms

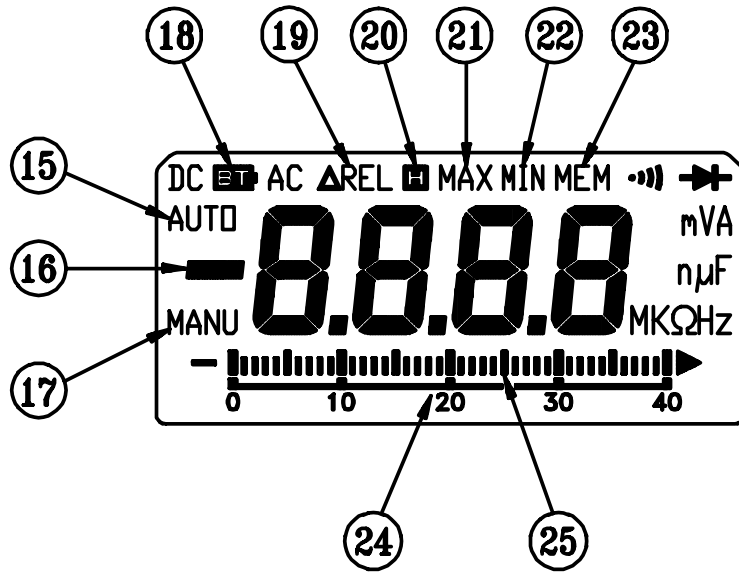
# 4. PARTS & CONTROLS

## 4-1 NAME OF PARTS AND POSITIONS:



1. 20A Measuring Connector  
To connect positive lead ( red test lead ) for current measurement below 20A.
2. mA Measuring Connector  
To connect positive lead ( red test lead ) for current measurement 400mA.
3. COM Measuring Connector  
To connect negative lead ( black test lead ) for voltage, current, resistance, frequency, Diode, continuity, capacitor, ADP measurement.
4.  $V\Omega$ Hz Cx Measuring Connector  
To connect positive lead ( red test lead ) for voltage, resistance, frequency, diode, continuity, capacitor, ADP measurement.
5. Relative Reading Button  
Press  $\triangle$ REL button to enter the Relative mode. Zero the display , and store the displayed reading as a reference value. Press and hold down  $\triangle$ REL button for 2 seconds to exit the Relative mode.
6. Auto-Range & Manual-Range Button  
Press RANGE to select the Manual Range mode and turn off the AUTO annunciator. ( The meter remains in the range it was in when manual range is selected ).  
  
In the Manual Range mode, each time you press RANGE button, the range ( and the input range annunciator ) increases step by step , and a new value is displayed.  
  
If you are already in the highest range, the meter “ wraps around “ to the lowest range. ( In the Frequency counter mode, pressing RANGE manually selects the sensitivity range. ) To exit the Manual Range mode and return to Auto Range mode. Press and hold down RANGE for 2 seconds, the AUTO annunciator turns back on.

7. AC/DC Current Select and Buzzer / Diode function Select and Cancel Auto- Power-OFF function Button:
  - To select function DC or AC current.
  - To select function buzzer or Diode.
  - Cancel Auto-Power-OFF function : Press and Hold down the red button to turn the rotary switch from OFF to any function position about two seconds.
8. Read Button  
Reading out at the storage memory value.
9. Minimum & Maximum Recording Button  
Press MIN/MAX to enter the MIN, MAX Recording mode ( manual range only ). Select the proper range before selecting MIN MAX to ensure that the min/max reading will not exceed the measurement range. Press once to select MIN. Press again to select MAX. and press again to release MIN/MAX recording function.
10. Date Hold (  ) Button  
Press it once to hold the measured value in dark place when reading or recording is difficult, press it again to release the holding status.
11. Reset Button  
Erase memory and reset function.
12. MEM Button  
Press MEM for Recording LCD value and function to memory.
13. LCD Display  
Measured values, unit, symbols, and decimal points are displayed.
14. Range Selector Switch  
For power on and power off and selection of desired range.



15. Auto-range Mode  
Meter is in the autorange mode and will automatically select the range with the best resolution. Meter powers-on in autorange mode.
16. Negative Polarity  
Automatically indicating negative inputs.
17. Manual-range Mode indicator.
18. Low Battery  
As battery power is not sufficient. LCD will display **BT**.
19. Relative Mode indicator.
20. Data Hold indicator.
21. Maximum Value in MAX Recording Mode  
The value displayed is the maximum reading taken since the MAX Recording mode was entered.
22. Minimum Value in MIN Recording Mode  
The value displayed is the minimum reading taken since the MIN Recording mode is entered.
23. Memory Mode indicator.
24. Analog Display Scale.
25. Analog Display.

## 4-2 PRECAUTIONS AND PREPARATIONS FOR MEASUREMENT

- (1) DO NOT attempt to take any voltage or current measurement that maybe exceed the maximum range of this instrument.
- (2) Be sure that battery is correctly placed in the case and connected to the battery snap.
- (3) Make certain the range selected is greater than circuit current or voltage prior to attempting a measurement. Also, Changing range always breaks contact from the circuit with one of the test leads.
- (4) Check the input terminal position for red test lead depending on measurement ranges.
- (5) DO NOT measure anything before the rear cover of Multimeter is not secured.
- (6) When finishing the measurement, Switch off the power.
- (7) Be sure remove the battery when it is not to be used for a long time to avoid leakage problem.
- (8) DO NOT use or store the instrument in a high temperature, high humidity environment.
- (9) DO NOT check resistance in a circuit while power is on or before circuit capacitors are discharged.

## 4-3 DC Voltage Measurements

### **WARNING**

Maximum Input Voltage of DC VOLT Range is 1000VDC. Do not attempt to take any voltage measurement that maybe exceed 1000VDC to avoid electrical shock hazard and / or damage to the instrument.



- (1) Connect red test lead to “ V $\Omega$  “terminal and black test lead to “ COM” terminal.
- (2) Set Range Switch to  $\overline{V}$  range.
- (3) Connect Test Prods of test leads IN PARALLEL to the circuit being measured.
- (4) Read the Voltage value on LCD.

#### 4-4 AC Voltage Measurement ( True RMS Measurement )

### WARNING

Maximum Input Voltage of AC VOLT Range is 750VAC. Do not attempt to take any voltage measurement that maybe exceed 750VAC to avoid electrical shock hazard and / or damage to the instrument.

- (1) Connect red test lead to “V $\Omega$ “ terminal and black test lead to “COM” terminal.
- (2) Set Range Switch to  $\tilde{V}$  range.
- (3) Connect Test Prods of test leads IN PARALLEL to the circuit being measured.
- (4) Read the Voltage value on LCD.

#### 4-5 DC Current Measurement

- (1) Connect red test lead to “ mA “ Terminal for Current measurements up to 400mA. ( For measuring Current between 400mA to 20A, Connect red test lead to “ 20A “ terminal.) Connect black test lead to “ COM “ terminal.

- (2) Set Range Switch to desired A range. and press AC / DC Switch to DC function.
- (3) Cut the power to the circuit being tested and Connect the instrument IN SERIES with the circuit , with the black test lead on the negative  $\ominus$  side and the red lead on the positive  $\oplus$  side being measured.
- (4) Apply power and read the current value on LCD.

#### **4-6 AC Current Measurement ( True RMS Measurement )**

- (1) Connect red test lead to the “mA“ Terminal for Current measurements up to 400mA. ( For measuring Current between 400mA to 20A, Connect red test lead to “20A“ terminal.) Connect black test lead to “ COM “ terminal.
- (2) Set Range Switch to desired A range. And press AC / DC Switch to AC function.
- (3) Cut the power to the circuit being tested and Connect the instrument INSERIES with the circuit ; with the black test lead on the negative  $\ominus$  side and the red lead on the positive  $\oplus$  side being measured.
- (4) Apply power and read the current Value on LCD.

#### **4-7 Capacity Measurement**

- (1) Set Range Switch to capacitor Cx position.
- (2) Insert the capacitor pins into Cx and COM terminal for measurement..
- (3) Press  $\triangle$ REL to zero the display and automatically subtract the residual meter and test lead capacitance.
- (4) Read the capacity on LCD.


## 4-8 Continuity Measurement & Diode test

Press " Red " button to select "  " or "  " function.

### WARNING


Before taking any in-circuit measurement, remove power from the circuit being tested and discharge all capacitors in the circuit.

#### ● CONTINUITY MEASUREMENT

- (1) Connect red test lead to the "  $V\Omega$  " terminal and black test lead to the " COM " terminal.
- (2) Set range switch to the "  " position.
- (3) Remove power from the circuit being tested and discharge all capacitors.
- (4) Connect Test prods of test leads in the circuit being measured.
- (5) When the test lead to the circuit is below  $40\Omega$  It will be indicated by a continuous beeping.

**Note:** Continuity test is available to check open / short of the circuit.

#### ● DIODE TEST

- (1) Connect red test lead to the "  $V\Omega$  " terminal and black test lead to the " COM" terminal.
- (2) Set range switch to the diode test position "  " .
- (3) Connect the red test lead to the anode side and black test lead to the cathode side of the diode being tested.
- (4) Read forward voltage (  $V_f$  ) value on LCD.
- (5) If the test leads are connected rather than according to procedure (4), the digital reading should nearly equal to the reading in the open circuit condition. This can be used for distinguishing anode and cathode poles of a diode.

## 4-9 Resistance Measurement

### WARNING

Before taking any in-circuit resistance measurement, remove power from the circuit being tested and discharge all Capacitors.

- (1) Connect red test lead to “ V $\Omega$  “terminal and black test lead to “ COM” terminal.
- (2) Set Range Switch to  $\Omega$  range.
- (3) Connect Test Lead to the Circuit being measured and read the resistance Value on LCD.

## 4-10 Frequency Measurement

- (1) Set Range Switch to Hz range.
- (2) Connect red test lead to “ V/ $\Omega$ /Hz “ terminal and black test lead to “ COM” terminal.
- (3) Connect Test prods of test leads to the circuit being measured.
- (4) Read the frequency value ( Hz ) on LCD.

## 4-11 TRMS MEASUREMENTS

This model is a True- RMS model. When measuring AC signals, undistorted sine waves are rarely encountered.

On the contrary, the non- sinusoidal waves, triangle and square waves, as well as noise affected waves are very common.




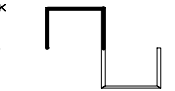
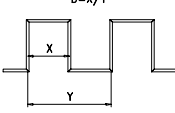
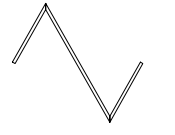
With conventional average- sensing meters, the measurement of such wave forms is impossible because of the great error introduced by the AC/DC half-wave rectifier.

The measurement signal is converted into the average value and then multiplied by 1.11, and displayed as rms value of the sine wave.

If the input differs significantly from a sine wave, the reading is incorrect as a different conversion factor would relate the average value of the signal to its rms value (see table as below).

Correct measurements of non- sinusoidal wave forms can be made directly with the true- RMS models.

The parameter which defines the degree of distortion of the wave form and influences the measurement accuracy is the crest- factor defined as the ratio of the peak value to the rms value.

Input Wave form	Peak value	Vdc +Vac (TRMS)	AC Coupling		Vdc	Crest factor
			Vac	Average value		
Sine wave 	1.414	1.000	1.000	1.000	0	1.414
Full-wave 	1.414	1.000	0.435	0.421	0.900	1.414
Half - wave 	2.000	1.000	0.771	0.764	0.636	2
Square wave 	1.000	1.000	1.000	1.110	0	1
Pulse  $D = X / Y$ $K = \sqrt{D - D^2}$	2.000	$2\sqrt{D}$	2K	2.22K	2D	$\frac{1}{\sqrt{D}}$
Triangle wave 	1.732	1.000	1.000	0.960	0	1.732

## 4-12 Adaptive ( ADP ) Measurement

- (1) Connect the BLACK test lead to the COM terminal and the RED test lead to the “ V- $\Omega$ -ADP “ terminal.
- (2) Set the rotary switch to “ ADP “ position.
- (3) Connect the test leads across the source or load under measurement.

**Note:** *When making ADP measurements, the digital display will indicate 10 counts for every mV<sub>DC</sub> input. e.g.A reading of 100 indicates a 10mV<sub>DC</sub> input.*

## 5. BATTERY & FUSE REPLACEMENT

### WARNING

To prevent electrical hazard or shock, turn off multimeter and disconnect test leads before removing back cover.

### 5-1 Battery Check-Up & Replacement

- (1) As battery power is not sufficient. LCD will display “ **BT** “. Replacement with Two new batteries type 1.5V is required.
- (2) Set Range Switch to “ OFF “ position. Use a screwdriver to unscrew the screw secured on the rear cover. Take out the battery and replace them with two new batteries type 1.5V.
- (3) Place back the rear cover and secure it by a screw.

### 5-2 FUSE Replacement

- (1) Set Range Switch to “ OFF “ position. Use a screwdriver to unscrew the screw secured on rear cover. Take out the open fuse and replace it with a new fuse rate 0.5A/250A ( or 20A/600V ) of fast blow type.
- (2) Place back the rear cover and secure it by a screw.



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