

TENMA®



True RMS Digital Bench Multimeter










Model: 72-1016

IMPORTANT SAFETY INFORMATION

Please read these instructions carefully before use and retain for future reference.

- This meter is designed to meet IEC61010-1, 61010-2-032, and 61010-2-033 in Pollution Degree 2, Measurement Category (CAT I 1000V, CAT II 600V, CAT III 300V) and double Insulation.
- When using electrical appliances basic safety precautions should always be followed.
- Please operate according to this manual, otherwise the protection provided by the device will be impaired or fail.
- There are no user-serviceable parts in this product. Refer servicing to qualified personnel.
- Use only the test leads supplied or the protection may be impaired.
- Check the test leads, probe and case insulation condition before using. If you find any breakage, damage or abnormality, or you consider the device is broken, stop using the device immediately.
- When using the test probes, keep your fingers behind the finger protection rings.
- Ensure all inputs are less than the range selected otherwise it may cause electrical shock or meter damage.
- Take caution when voltages are above 60V DC and 30V AC rms.
- Do not use the meter with the battery or fuse covers removed.
- Do not adjust the range selector during measurement.
- Replace the batteries as soon as the low battery indicator appears on the display.
- Remove dead batteries from the meter or if it is not going to be used for a long time.
- Never mix old and new batteries together, or different types of batteries.
- Never dispose of batteries in a fire, or attempt to recharge ordinary batteries.
- Before replacing the battery, turn off the meter and disconnect all the test probes
- To prolong battery life turn off the meter after use.








ELECTRICAL SYMBOLS GUIDE

 AC or DC	 Ground	 Double insulated
 Warning	 Low battery	 Continuity test
 Diode test	 Capacitance test	 Fuse

WHAT'S INCLUDED

- Bench type digital multimeter.
 - Installation guide and computer interface software (CD-ROM).
 - Operating manual.
 - Power cord.
 - Alligator clips (1 pair).
 - Multi purpose socket.
 - Temperature probe.
 - Test leads (1 pair).
 - RS232 interface cable.
 - USB interface cable.
- } Stored in compartment in the back of the unit.

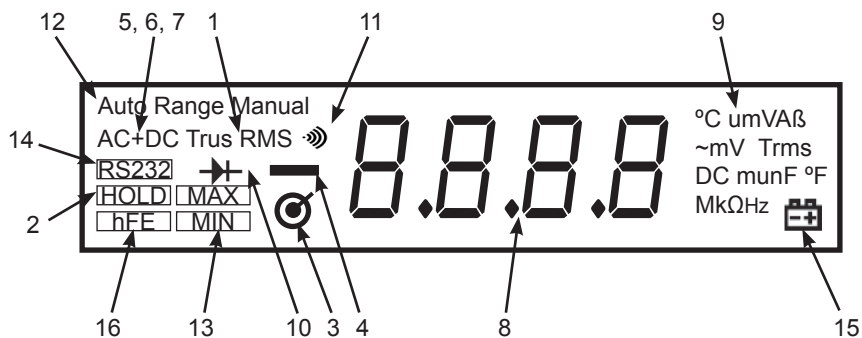
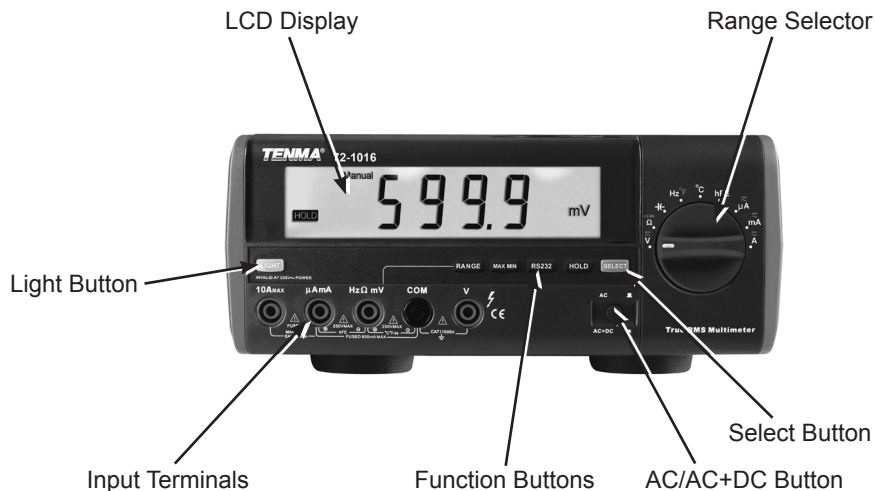
FUNCTIONS

Range Selector Positions	Function
V 	AC and DC voltage measurement
	Continuity test
	Diode test
Ω	Resistance measurement
	Capacitance test
Hz	Frequency measurement
°F	Temperature in fahrenheit
°C	Temperature in celsius
hFE	Transistor test
μ A 	AC or DC current measurement 0.1 μ A to 5999 μ A
mA 	AC or DC current measurement 0.01mA to 599.9mA
A 	AC or DC current measurement 0.01A to 10.00A




Function buttons	Operation performed
POWER	Turn the power on and off
LIGHT	Turn display back light on and off
SELECT	Switches between AC and DC measurement
	Switches between continuity, diode & resistance measurement
	Switches between frequency and Farenheit temperature
HOLD	To enter or exit range hold in any mode
RANGE	Switch between manual and auto ranging
RS232C	Turn on or off the serial port interface without changing setting
MAX/MIN	Records max or min values. Steps display through high and low
AC AC+DC	Selects AC or AC+DC measurement

OPERATING PARAMETERS

- Ambient temperature : 0°C ~ 40°C.
- Relative humidity : $\leq 75\%$ @ 0°C ~ 30°C, $\leq 50\%$ @ 31°C ~ 40°C
- Maximum operating altitude 2000m
- Maximum Display : Digital: 5999
- Measurement Speed : Updates 2-3 times/second
- Polarity display : Automatic



Number	Symbol	
1	True RMS	Indicator for true rms value
2	HOLD	Data hold active
3	⊙	Sleep mode enabled
4	—	Negative reading
5	AC	Ac voltage or current
6	DC	DC votage or current
7	AC+DC	AC+DC measurement
8	OL	Input value too high for selected range
9	Ω, kΩ, MΩ	Ohm unit of resistance measurement
		Kiloohm unit of resistance measurement
		Milliohm unit of resistance measurement
	A, mA, µA	Amp unit of current measurement
		Milliamp unit of current measurement
		Microamp unit of current measurement

Number	Symbol	
9	V, mV	Volts unit of measurement
		Millivolt unit of measurement
	F, mF μF, nF	Farad unit of measurement
		Millifarad unit of measurement
		Microfarad unit of measurement
	°C, °F	Nanofarad unit of measurement
		Centigrade temperature measurement
		Fahrenheit temperature measurement
	Hz, kHz MHz	Hertz unit of frequency measurement
		Kilohertz unit of frequency measurement
Megahertz unit of frequency measurement		
β	Transistor test	
10		Diode test
11		Continuity test sounder
12	Auto Range Manual	Indicates auto or manual range setting
13	MAX MIN	Maximum or minimum value display
14	RS232	Data output in progress
15		The battery is low - replace as soon as possible
16	hFE	Transistor test selected

OPERATION

DC or AC Voltage Measurement

Warning: To avoid personal injury, or damage to the meter from electric shock, please do not attempt to measure voltages higher than 1000V although readings may be obtained.

To measure DC/AC voltage, connect the meter as follows:

- Insert the red test lead into the V terminal and the black test lead into the COM terminal.
- If the measured value is less than 600mV, insert the red test lead into mV terminal instead and press RANGE button to select manual range 600.0mV mode, the LCD displays “MANUAL” and “mV”.
- Set the rotary switch to V $\overline{\sim}$; press SELECT button to select DC or AC measurement mode.
- Connect the test leads across with the object being measured. The measured value shows on the display. AC measurement displays True RMS value.
- Press AC/AC+DC button to measure AC+DC voltage's true RMS.
- When DC/AC voltage measurement has been completed, disconnect the connection between the test leads and the circuit under test.

Note: In each range, the meter has an input impedance of 10MΩ except 600mV range has 3000MΩ. This loading effect can cause measurement errors in high impedance circuits. If the circuit impedance is less than or equal to 10kΩ, the error is negligible (0.1% or less).

DC or AC Current Measurement

Warning: Before connecting the meter in series with the circuit under test, be sure power the circuit is off. If the fuse burns out during measurement, the meter may be damaged and there is risk of personal injury to the operator.

Use correct terminals, function, and range for the measurement. When the test leads are connected to the current terminals, do not connect in parallel across any circuit.

To measure current, do the following:

- Insert the red test lead into the μA mA terminal and the black test lead into the COM terminal.
- Set the rotary switch to an appropriate measurement position in μA $\overline{\sim}$, mA $\overline{\sim}$ or A $\overline{\sim}$, press SELECT button to select AC or DC measurement mode.
- Connect the test leads in series with the object being measured. The measured value shows on the display.
- AC measurement displays True RMS value.
- Press AC/AC+DC button to measure AC+DC current's true RMS

Note: If the value of current to be measured is unknown, use the maximum measurement position, and reduce the range step by step until a satisfactory reading is obtained.

- Each measurement time of high current (>5A) should be less than 10 seconds and the interval time between 2 measurements should be greater than 15 minutes.
- When current measurement is complete, disconnect the test leads from the circuit under test.

Measuring Resistance

Warning: To avoid damage to the meter or to the devices under test, disconnect circuit power and discharge all the high-voltage capacitors before measuring resistance.

To avoid possible injury, please do not attempt to input voltages higher than 60V DC or 30V AC.

To measure resistance, connect the meter as follows:

- Insert the red test lead into the Ω terminal and the black test lead into the COM terminal.
- Set the rotary switch to Ω \rightarrow and press SELECT button to select Ω measurement mode.
- Connect the test leads across with the object being measured. The measured value shows on the display.

Note: When measuring low resistances, the test leads and internal wiring will add approximately 0.2 ~ 0.5 Ω of error. To obtain accurate readings in low-resistance, short-circuit the test lead beforehand and record the reading obtained, call this reading as X. Then use the equation: measured resistance value (Y) – (X) = accurate readings of resistance.

- If reading with shorted test leads is not < 0.5 Ω , check for loose test leads or possible incorrect function selection.
- When measuring high resistance (>1M Ω), it is normal to take several seconds to obtain a stable reading.
- The LCD displays OL indicating open-circuit or the resistor value is higher than the maximum range of the meter.
- When resistance measurement has been completed, disconnect the connection between the test leads and the circuit under test.

Continuity Test

Warning: To avoid damage to the meter or to the devices under test, disconnect circuit power and discharge all the high-voltage capacitors before testing for continuity. To avoid personal injury, please do not attempt to input voltages higher than 60V DC or 30V AC.

To test for continuity, connect the meter as below:

- Insert the red test lead into the Ω terminal and the black test lead into the COM terminal.
- Set the rotary switch to $\Omega \rightarrow \rightarrow \rightarrow$ and press SELECT button to select $\rightarrow \rightarrow$ measurement mode.
- Connect the test lead across with the object being measured. The buzzer sounds if the resistance of a circuit under test is $< 70\Omega$, the circuit is in good condition. The buzzer does not sound if the resistance of a circuit under test is $>70\Omega$, the circuit is broken.
- The measured value shows on the display and the unit is Ω .

Note: In continuity mode, the resistance range is 600Ω , and the open circuit voltage is approximately 1.2V.

- When continuity testing has been completed, disconnect the connection between the test leads and the circuit under test.

Diode Test

Warning: To avoid possible damage to the meter and to the device under test, disconnect circuit power and discharge all high-voltage capacitors before testing diodes. To avoid personal injury, please do not attempt to input voltages higher than 60V DC or 30V AC.

- Perform the diode test to check diodes, transistors, and other semiconductor devices. The diode test sends a current through the semiconductor junction, and then measures the voltage drop across the junction. A good silicon junction drops between 0.5V and 0.8V.

To test a diode out of a circuit, connect the meter as follows:

- Insert the red test lead into terminal and the black test lead into the COM terminal.
- Set the rotary switch to $\Omega \rightarrow \rightarrow \rightarrow$ and press SELECT button to select $\rightarrow \rightarrow$ measurement mode.
- For forward voltage drop readings on any semiconductor component, place the red test lead on the component's anode and place the black test lead on the component's cathode. The measured value shows on the display.
- Note Connect the test leads to the proper terminals as said above to avoid error display. The LCD will display OL indicating diode being tested is open or polarity is reversed. The unit of diode is Volt (V), displaying the forward voltage drop readings.
- Open circuit voltage is around 2.7V.
- When diode testing is completed, disconnect the test leads from the device under test.

Capacitance Measurement

Warning: To avoid damage to the meter or to the equipment under test, disconnect circuit power and discharge all high-voltage capacitors before measuring capacitance. Use the DC Voltage function to confirm that the capacitor is discharged. To measure capacitance, connect the meter as follows:

- Insert the red test lead into the HzΩmV terminal and the black test lead into the COM terminal.
- Set the rotary switch to \overline{f} .

Note: The Meter displays a fixed value which is the value of the meters own internal circuitry. To ensure accuracy, it is necessary to subtract this value from the displayed value when measuring small capacitors.

- Connect the test leads across with the object being measured. The measured value shows on the display.
- The multi-purpose socket can be used instead of test leads. Insert the capacitor being tested into the corresponding input terminal of the multi-purpose socket. This will provide a more accurate reading when measuring small capacitor values.
- When measuring capacitance values larger than 600uF, it is normal for the meter to require some time to stabilize.
- The LCD displays OL indicating the tested capacitor is shorted or it exceeds the maximum range.
- When capacitance measurement has been completed, disconnect the test leads from the device under test.

Frequency Measurement

Warning: To avoid the risk of personal injury, do not attempt to measure frequency with voltage higher than 30V RMS.

To measure frequency, connect the meter as follows:

- Insert the red test lead into the Hz terminal and the black test lead into the COM terminal.
- Set the rotary switch to Hz[°]F and press SELECT button to select Hz measurement mode.
- Connect the test leads across with the object being measured. The measured value shows on the display.
- When frequency measurement is complete, disconnect the test leads from the circuit under test.

Note: When making frequency measurements, the measured signal “a”, must fall within the following voltage level:

10Hz ~ 1MHz	150mV ≤ a ≤ 30V rms
> 1MHz ~ 10MHz	300mV ≤ a ≤ 30V rms
> 10MHz ~ 50MHz	600mV ≤ a ≤ 30V rms
> 50MHz	Unspecified

Temperature Measurement

To measure temperature, connect the meter as follows:

- Set the rotary switch to °C to measure degree celsius temperature or Hz°F and press SELECT button to select °F measurement mode to measure Fahrenheit.
- Insert the multi-purpose socket into the corresponding Hz and COM terminal.
- Insert the temperature probe to the corresponding input terminal of the multi-purpose socket. Take care to ensure that proper polarity is observed when connecting to this socket.
- Place the temperature probe to the object being measured. The measured value shows on the display after few seconds.

Note

The testing environment must be between 18°C to 28°C to ensure accuracy especially when measuring low temperature. Different reading may be obtained when testing room environment under short or open circuit situation, then short-circuited reading shall be considered as the correct reading.

- The included point contact temperature probe can only be used under 230°C.
- For any measurement higher than that, the rod type temperature probe must be used instead.
- When temperature measurement has been completed, disconnect the connection between the temperature probe, multi-purpose socket and the circuit under test and remove the multi-purpose socket from the input terminal.

Measuring Transistor

To measure transistor, connect the meter as follows:

- Insert the multi-purpose socket into the μ mA and Hz input terminal.
- Set the rotary switch to hFE.
- Insert the NPN or PNP type transistor to be tested into the corresponding input terminals of the multipurpose socket.
- The measured nearest transistor value shows on the display.
- When transistor measurement has been completed, remove the tested transistor from the multi-purpose socket and remove the multi-purpose socket from the input terminal.

Operation of Hold Mode

Warning: To avoid possibility of electric shock, do not use hold mode to determine if circuits are without power. The hold mode will not capture unstable or noisy readings. The hold mode is applicable to all measurement functions.

- Press HOLD to enter hold mode.
- Press HOLD again to exit hold mode and the meter displays the present measurement value.
- In hold mode, H is displayed.

The POWER Button

This is a self-lock switch used to turn on or off the power meter. It is located at the rear of the meter. "I" indicates power on, while "O" indicates power off.

The SELECT Button

Some positions of the rotary selector have more than one function. This button is used for selecting the second function.

Turning on the Display Backlight

Warning: In order to avoid the hazard arising from mistaken readings in low light situations, please use display backlight function.

- Press LIGHT button to turn the display backlight on.
- Press LIGHT button again to turn the display backlight off.
- When using the AC power, the display backlight always stays on.

The RANGE Button

- Press RANGE to enter the manual ranging mode.
- Press and hold RANGE for over 1 second to return to autoranging.

The MAX MIN Button

MAX MIN recording mode captures and stores the maximum and minimum input value detected.

To use the MAX MIN mode as follows:

- Press MAX MIN to display the highest reading (MAX is shown on display).
- Press MAX MIN again to display the lowest reading (MIN is shown on display).
- Press and hold MAX MIN for over 1 second to exit the MAX MIN mode.


AC/AC+DC Button

- It is used to select measuring AC or AC+DC when measuring AC. Press it only at the AC voltage or current measuring mode which is at the rotary switch positions $V\sim$, $mV\sim$, $\mu A\sim$, $mA\sim$ or $A\sim$. "+DC " will be displayed when it is pressed under DC measurement mode.

POWER INPUT Switch

- It is used to select AC 220V/50Hz or DC 6pcs of 1.5V battery (R14) to power on the meter. It is located at the rear of the meter.

Sleep Mode

- The meter will automatically enter the sleep mode after approximately 10 minutes of inactivity to preserve battery life. The last value will be stored.
- The meter can be activated by pressing the POWER button off and then on or pressing the HOLD button, it will display the last measurement value before it entered sleep mode and under the HOLD mode.
- Turning the rotary switch can also activate the meter however, it will start from the switch selected function and it will not display the last measurement value before it entered sleep mode.
- To disable the sleep mode function, press MAX MIN, RANGE, or RS232 button while turning on the meter the  symbol disappears.

RS232 Button



Press RS232 button to enter or exit data link mode.

- In RS232C serial port data link mode, the hold and MAX MIN mode cannot output to the computer, the computer will only display the current value.
- In RS232C serial port data link mode, sleep mode function will be disabled. +DC, hFE and β cannot be output to the computer.

SPECIFICATION

DC Voltage			
Range	Resolution	Accuracy	Overload Protection
600mV	0.1mV	$\pm(0.6\%+2)$	1000V Input impedance At 600mV range : ~ >3000M Ω At all other ranges: ~ 10M Ω
6V	0.001V	$\pm(0.3\%+2)$	
60V	0.01V		
600V	0.1V		
1000V	1V	$\pm(0.5\%+3)$	
AC Voltage			
600mV	0.1mV	40Hz-50kHz: (0.6%+5)	1000V Input impedance At 600mV range : ~ >3000M Ω At all other ranges: ~ 10M Ω
		>50kHz-100kHz: (1%+5)	
6V	0.001V	40Hz-1kHz: (0.6%+5)	
		>1kHz-10kHz: (1.0%+5)	
		>10kHz-100kHz: (3%+5)	
60V	0.01V	40Hz-1kHz: (0.6%+5)	
		>1kHz-10kHz: (1.5%+5)	
		>10kHz-20kHz: (3%+5)	
		>20kHz-100kHz: (8%+5)	
600V	0.1V	40Hz-1kHz: (0.6%+5)	
		>1kHz-10kHz: (3.5%+5)	
1000V	1V	40Hz-1kHz: (1.2%+3)	
		>1kHz-3kHz: (3%+3)	
DC Current			
600 μ A	0.1 μ A	(0.5%+3)	Fuse 500mA, 250V fast type, f5x20mm
6000 μ A	1 μ A		
60mA	0.01mA		
600mA	0.1mA	(0.8%+3)	
10A	10mA	(1.2%+3)	Fuse 10A, 250V fast type, f5x20mm.
AC Current			
600 μ A	0.1 μ A	40Hz~10kHz: (1.0%+5) >10kHz~15kHz: (2%+5)	Fuse 500mA, 250V, fast type, 5x20mm.
6000 μ A	1 μ A		
60mA	0.01mA		
600mA	0.1mA	40Hz~10kHz: (1%+5) >10kHz~15kHz: (3%+5)	
10A	10mA	40Hz~5kHz: (2.0%+6)	Fuse 10A, 250V, fast type, 5x20mm.

Resistance				
Range	Resolution	Accuracy		Overload Protection
600Ω	0.1Ω	± (0.8%+3) + test lead short circuit resistance value		250V rms
6kΩ	0.001kΩ			
60kΩ	0.01kΩ			
600kΩ	0.1kΩ	± (0.5%+2)		
6mΩ	0.001MΩ	± (0.8%+2)		
60MΩ	0.01MΩ	± (1.2%+3)		
Capacitance				
6nF	0.001nF	± (2.5%+5)		250V rms
60nF	0.01nF			
600nF	0.1nF	± (2%+5)		
6μF	0.001μF			
60μF	0.01μF			
600μF	0.1μF	± (3%+4)		
6mF	0.001mF	± (5%+4)		
Frequency				
6kHz	0.001kHz	± (0.1%+3)		250V rms
60kHz	0.01kHz			
600kHz	0.1kHz			
6MHz	0.001MHz			
60MHz	0.01MHz			
Temperature				
°C	1°C	-40°C~0°C	± (8%+5)	250V rms
		>0°C~400°C	± (1%+7)	
		>400°C~1000°C	± (2%+10)	
°F	1°F	-40°F~32°F ± (8%+5)		
		>32°F~752°F ± (1.5%+5)		
		>752°F~1832°F ± (2.5%+5)		

Continuity Test			
Range	Resolution	Overload Protection	Remarks
	1Ω	250V rms	Open circuit voltage approximate -1.2V. When circuit disconnected with resistance value >30, buzzer does not sound. When circuit is in good connection with resistance value 70 buzzer sounds continuously
Diode Test			
	10mV	250V rms	Open circuit voltage approximate 2.7V. Working current approximate 1mA.
Transistor			
hFE	1β	Fuse 200mA, 250V fast type, 5x20mm. Fuse 500mA, 250V fast type, 5x20mm	Vce 2.2V bo 10μA 1000β MAX

MAINTENANCE


Cleaning

- Periodically wipe the case with damp cloth and mild detergent. Do not use abrasives or solvents for cleaning.
- Clean the measurement probe tips occasionally, as dirt on the probes can affect reading accuracy.
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Replacing the fuses

- Press the POWER button to turn the meter off, disconnect the power cord and remove all connections from the terminals.
- Fuse 1: Remove the screws from the power socket at the rear of the meter. Remove the fuse by gently prying one end loose, then take out the fuse from its holder. Refit a replacement fuse.
- Fuse 2 and 3: Open the accessories compartment at the top of the front cover, then open the fuse compartment to replace fuse 2 and 3. Remove the fuse by gently prying it loose from its holder. Install the replacement fuse.
- Fuse 4: It is located on the PCB. Remove the fuse by gently prying one end loose, then take out the fuse from its holder. Then install the replacement fuse.
- Use ONLY replacement fuses with the identical type and specification as follows and make sure the fuse is inserted firmly in the holder.
- Fuse 1: 200mA, 250V, fast type, 5x20mm (AC220V)
- Fuse 2: 10A, 250V, fast type, 5x20 mm (A)
- Fuse 3: 500mA, 250V, fast type, 5x20 mm (μA, mA)
- Fuse 4: 200mA, 250V, fast type, 5x20 mm (hFE)

Replacing the Battery

Warning: To avoid false readings, replace the battery as soon as the battery indicator “” appears when using battery to power on the meter.

- Press the POWER to turn the meter off and remove all connections from the terminals.
- Open the accessories compartment at the top of the front case.
- Open the battery compartment inside the accessories compartment.
- Remove all the batteries from the battery compartment.
- Replace the battery with new 6pcs of 1.5V battery (R14).
- Refit the battery compartment cover and also the accessories compartment cover.

RS232C and USB Serial Port

To use 72-1016 Interface Program, you need the following hardware and software:
An IBM PC or equivalent computer with 80486 or higher processor and monitor with screen resolution of 600 x 800 pixels or better.

Microsoft Windows 95 or newer.

At least 8MB of RAM.

At least 8MB free hard drive space.

Access to a local or network CD-ROM.

A free serial port.

A mouse or other pointing device supported by Windows.

Default of RS232C serial port for communication is set as:

Baud Rate: 19200

Start bit: 1

Stop bit: 1

Data bits: 7

Parity: Odd

Setting of USB Serial Ports

Using the CD provided with the meter, install the USB serial port driver & computer interface software before connecting the meter and computer.

Check for the USB Serial port shown in the Control Panel => System => Device Manager. Make sure to connect the meter to the computer with the same port.



INFORMATION ON WASTE DISPOSAL FOR CONSUMERS OF ELECTRICAL & ELECTRONIC EQUIPMENT

These symbols indicate that separate collection of Waste Electrical and Electronic Equipment (WEEE) or waste batteries is required. Do not dispose of these items with general household waste. Separate for the treatment, recovery and recycling of the materials used. Waste batteries can be returned to any waste battery recycling point which are provided by most battery retailers. Contact your local authority for details of the battery and WEEE recycling schemes available in your area.

