

Warranty

Our products are designed to be used correctly and with care for the purpose for which they are intended. No liability is accepted by the Tool Connection for incorrect use of any of our products, and the Tool Connection cannot be held responsible for any damage to personnel, property or equipment when using the tools. Incorrect use will also invalidate the warranty.

If applicable, the applications database and any instructional information provided has been designed to offer general guidance for a particular tool's use and while all attention is given to the accuracy of the data no project should be attempted without referring first to the manufacturer's technical documentation (workshop or instruction manual) or the use of a recognised authority such as Autodata.

It is our policy to continually improve our products and thus we reserve the right to alter specifications and components without prior notice. It is the responsibility of the user to ensure the suitability of the tools and information prior to their use.

**RoHS
Compliant**



Note: Dispose of this product at the end of its working life in compliance with the EU Directive on Waste Electrical and Electronic Equipment (WEEE). When the product is no longer required, it must be disposed of in an environmentally protective way. Contact your local solid waste authority for recycling information.



Safety First. Be Protected.



Guarantee

If this product fails through faulty materials or workmanship, contact our service department direct on: **+44 (0) 1926 818186**. Normal wear and tear are excluded as are consumable items and abuse.

**TOOL
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The Complete Connection

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LASER[®]

6550

Insulation Resistance Multimeter CAT III

Instructions



The Laser 6550 is a battery powered insulation tester that meets IEC 10101 CAT III (1000V) and CAT IV (600V).

- Features high voltage insulation resistance test, true RMS, continuity test and diode test.
- Auto ranging, min/max data hold, data logging, LCD backlight and low battery indication
- Specifications: AC/DC volts to 1000v, DCmV TO 600mV, AC/DC amps to 00mA ohms, capacitance, frequency, temperature.
- Insulation test voltages: 50v, 100v, 250v, 500v, 1000v.
- Supplied with test leads and clips, temperature probe, manual, carrying/storage bag, batteries.

**BUTTS OF
BAWTRY**
ESTABLISHED SINCE 1971

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6550 - High Voltage Insulation Tester + Multimeter CAT III & CAT IV

Designed to check insulation on electrical wiring systems, appliances and machinery, and suitable for use on hybrid and electric vehicles. Insulation testers for use in vehicle workshops need to be both physically robust because of the environment in which they are used and to provide accurate diagnostic information. The drive trains of hybrid and electric vehicles can be subject to moisture ingress and carbon deposits, and insulation testing information is particularly useful in these applications. The Laser 6550 can supply 1000V, a voltage level necessary to diagnose a voltage leak in high voltage cables or hybrid motor-generators.

The Laser 6550 also has full multimeter capability, and can be used as a stand-alone instrument or linked wirelessly with a USB interface to a PC or laptop enabling test results to be saved or printed.

Precautions

Improper use of this instrument can cause damage, shock, injury or death. It should only be used by properly qualified and experienced users. Read and understand this instruction leaflet (and in the case of hybrid or electric vehicles, all manufacturer's technical documentation) before operating the instrument.

- Do not work alone.
- Do not exceed the maximum allowable input range of any function. (Refer to table below).
- **Use great care** when making measurements if the voltages are greater than 25V AC rms or 35V DC; these voltages are considered a shock hazard. Use **extreme caution** when working with high voltages.
- Insulation testing: any circuit to be tested **must be switched OFF** and **disconnected** from its power source.
- With hybrid and electric vehicles the high voltage (HV) systems **must be disconnected and isolated** from the batteries before performing any test with the instrument.
- Set functions to the appropriate position before measuring.
- **Never** connect the meter leads across a voltage source while the function switch is in the current, resistance, or diode mode. Doing so can damage the instrument.
- When measuring volts do not switch to current or resistance modes.
- Do not measure DC voltages if a motor on the circuit is being switched ON or OFF. Large voltage surges may occur that can damage the meter.
- **Always discharge** capacitors and remove power from the device under test before carrying out resistance or continuity tests.
- When changing ranges using the rotary function switch, always disconnect the test leads from the circuit under test.
- Do not use the insulation resistance tester near explosive gas, vapour or dust.
- When using the test leads, keep fingers away from the lead contacts. Keep fingers behind the test lead finger guards.
- Immediately after an insulation test, do not touch the test leads or component being tested as there may be residual voltage in the circuit.
- Set the rotary function switch to **OFF** when the meter is not in use and remove the test leads from the instrument.
- Inspect the condition of the test leads and the meter itself for any wear or damage before operating the meter. Repair or replace any wear or damage before use.
- Do not use the insulation resistance tester if the battery indicator shows a low battery - readings may be inaccurate.
- Remove the batteries if the meter is to be stored for long periods.
- Ensure that the insulation resistance tester is switched off when opening the battery compartment.
- Always remove the test leads before replacing the batteries.

Store capacitance:	2000
Enclosure:	Double moulded, waterproof.
Shock (Drop Test):	6.5 feet (2 meters)
Diode Test:	Test current of 0.9mA maximum, open circuit voltage 2.8V DC typical
Continuity Check:	Audible signal will sound if the resistance is less than 35Ω (approx.), test current <0.35mA
Peak:	Captures peaks >1ms
Temperature Sensor:	Requires type K thermocouple (supplied)
Input Impedance@	>10MΩ VDC & >9MΩ VAC
AC Response:	True RMS
AC True RMS:	The term stands for "Root-Mean-Square," which represents the method of calculation of the voltage or current value. Average responding multimeters are calibrated to read correctly only on sine waves and they will read inaccurately on non-sine wave or distorted signals. True RMS meters read accurately on either type of signal.
ACV Bandwidth:	50Hz to 1000Hz
Crest Factor:	≤3 at full scale up to 500V, decreasing linearly to ≤1.5 at 1000V
Display:	40,000 count backlit liquid crystal with bar graph.
Overrange indication:	"OL" is displayed
Auto Power Off:	15 minutes (approximately) with disable feature.
Polarity:	Automatic (no indication for positive); Minus (-) sign for negative
Measurement Rate:	2 times per second, nominal.
Low Battery Indication:	Displayed if battery voltage drops below operating voltage.
Battery:	6 x AA batteries (1.5V).
Fuses:	mA, µA ranges; 0.5A/1000V ceramic fast blow A range; 10A/1000V ceramic fast blow.
Operating Temperature:	41°F to 104°F (5°C to 40°C)
Storage Temperature:	-40°F to 140°F (-20°C to 60°C)
Operating Humidity:	Max 80% up to 87°F (31°C) decreasing linearly to 50% at 104°F (40°C)
Storage Humidity:	<80%
Operating Altitude:	7000ft. (2000metres) maximum.
Safety:	This meter is intended for origin of installation use and protected, against the user, by double insulation per EN61010-1 and IEC61010-1 2nd Edition (2001) to Category IV 600V and Category III 1000V; Pollution Degree 2. The meter also meets UL 61010-1, 2nd Edition (2004), CAN/CSA C22.2 No. 61010-1 2nd Edition (2004), and UL 61010B-2-031, 1st Edition (2003).

Function	Range	Resolution	Accuracy
Resistance:	400Ω	0.01kΩ	± (0.3% reading + 9 digits)
	4kΩ	0.0001kΩ	
	40kΩ	0.001kΩ	
	400kΩ	0.01kΩ	± (0.3% reading + 4 digits)
	4MΩ	0.001MΩ	
Capacitance:	40MΩ	0.001MΩ	± (2.0% reading + 10 digits)
	40nF	0.001nF	± (3.5% reading + 40 digits)
	400nF	0.01nF	
	4μF	0.0001μF	
	40μF	0.001μF	± (3.5% reading + 10 digits)
	400μF	0.01μF	
	4000μF	0.1μF	
Frequency (Electronic):	40mF	0.001mF	± (5% reading + 10 digits)
	40Hz	0.001Hz	
	400Hz	0.01Hz	
	4kHz	0.0001kHz	
	40kHz	0.001kHz	
	400kHz	0.01kHz	± (0.1% reading + 1 digits)
	4MHz	0.0001MHz	
	40MHz	0.001MHz	
Frequency (Electrical):	100MHz	0.01MHz	
	Sensitivity: 0.8V rms min. @ 20% to 80% duty cycle and <100kHz; 5Vrms min @ 20% to 80% duty cycle and > 100kHz.		
	40.00Hz - 10KHz-10KHz	0.01Hz - 0.001KHz	± (1.2% reading + 2 digits)
Duty Cycle:	Sensitivity: 2Vrms		
	0.1 - 9.9%	0.01%	± (1.2% reading + 2 digits)
Temp (type-K):	Pulse width: 100μs - 100ms, Frequency: 5Hz to 150kHz		
	-50 to 1200°C	0.1°C	±(1.0% reading + 2.5°C) ±(1.0% reading +4.5°F) (probe accuracy not included)
4-20mA%:	-25 - 125°C	0.01%	±50 digits
	0mA=-25%, 4mA=0%, 20mA=100%, 24mA=125%		

Meg OHM's

Terminal Voltage	Range	Resolution	Accuracy	Test Current	Short Circuit Current
125V (0%~+10%)	0.125~4.000 MΩ	0.001MΩ	+(2%+10)	1mA @load125kΩ	≤1mA
	4.001~40.00 MΩ	0.01MΩ	+(2%+10)		
	40.01~400.0 MΩ	0.1MΩ	+(4%+5)		
	400.1~4000 MΩ	1MΩ	+(5%+5)		
250V (0%~+10%)	0.250~4.000 MΩ	0.001MΩ	+(2%+10)	1mA @load250kΩ	≤1mA
	4.001~40.00 MΩ	0.01MΩ	+(2%+10)		
	40.01~400.0 MΩ	0.1MΩ	+(3%+5)		
	400.1~4000 MΩ	1MΩ	+(4%+5)		
500V (0%~+10%)	0.500~4.000 MΩ	0.001MΩ	+(2%+10)	1mA @load500kΩ	≤1mA
	4.001~40.00 MΩ	0.01MΩ	+(2%+10)		
	40.01~400.0 MΩ	0.1MΩ	+(2%+5)		
	400.1~4000 MΩ	1MΩ	+(4%+5)		
1000V (0%~+10%)	1.000~4.000 MΩ	0.001MΩ	+(3%+10)	1mA @load1MΩ	≤1mA

NOTE: Accuracy specifications consist of two elements:

- (% reading) – This is the accuracy of the measurement circuit.
- (+ digits) – This is the accuracy of the analogue to digital converter.

Input Protection Limits	
Function:	Maximum Input:
V DC or V AC	1000V DC or AC RMS
mA AC or DC	500mA 1000V fast-acting fuse
A AC or DC	10A 1000V fast-acting fuse (20A for 30 seconds max every 15 minutes)
Frequency, Resistance, Capacitance, Duty Cycle, Diode Test, Continuity	1000V DC or AC RMS
Temperature	1000V DC or AC RMS
Surge Protection: 8kV peak as per IEC 61010	

Controls and Display

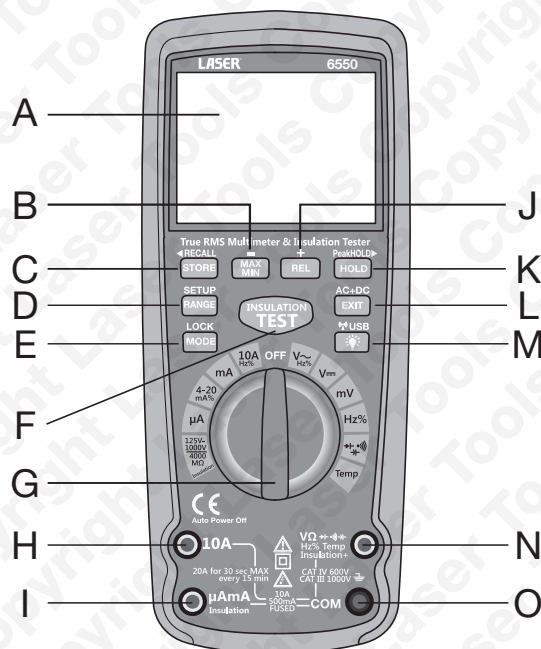


Figure 1

A	LCD display
B	MAX MIN / - button
C	STORE / RECALL
D	Range (setup)
E	MODE
F	Insulation TEST
G	Rotary Function Switch
H	10A input jack
I	μA / mA input jack
J	REL / + button
K	HOLD / Peak HOLD
L	EXIT / AC+DC
M	Backlight / USB
N	Positive input jack
O	COM input jack
P	Tilt stand support
Q	Battery Cover
R	Fuse (500mA 1000V)
S	Fuse (10A 1000V) (inside case)

Battery Compartment

Battery Compartment

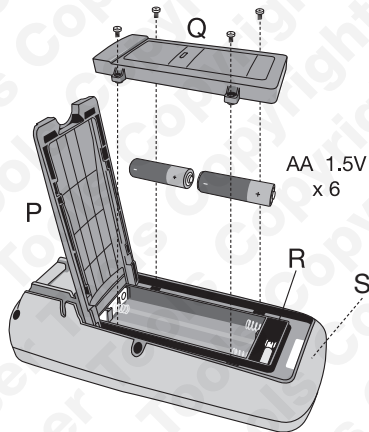


Figure 2

LCD Display Symbols

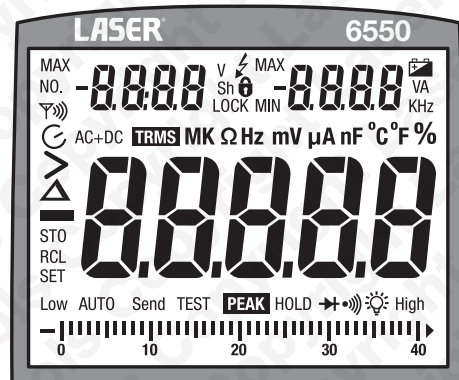


Figure 3

LCD Display Symbols (Figure 3)

MAX	maximum
No.	serial number
	Left auxiliary display
V	Volts
	High Voltage
	LOCK
MIN	minimum
	Right auxiliary display
	Low Battery
A	Amps
K	Kilo (10 ³)
	RF transmitter active
AC	Alternating current
DC	Direct current
TRMS	True RMS
M	Mega (10 ⁶)
Ω	Ohms
Hz	Hertz
m	Milli (10 ⁻³) (volts/amps)
μ	Micro (10 ⁻⁶) (amps/cap)
n	Nano (10 ⁻⁹) (cap)
F	Farads (capacitance)
°C	Degrees Celcius
°F	Degrees Fahrenheit
%	Percent (duty ratio)
S	second
STO	store
RCL	recall
SET	Setup parameter
Low High	Bar Graph
AUTO	Auto ranging
PEAK	Peak hold
HOLD	Display hold
	Diode test
	Continuity tone
	Backlight
	Main digital display
	REL (Relative)


Specifications

Function	Range	Resolution	Accuracy
DC Voltage:	400mV	0.01mV	± (0.06% reading + 4 digits)
	4V	0.0001V	
	40V	0.001V	
	400V	0.01V	
	1000V	0.1V	
AC Voltage:			50 to 1000Hz
	400mV	0.01mV	± (1.0% reading + 7 digits)
	4V	0.001V	
	40V	0.01V	± (1.0% reading + 5 digits)
	400V	0.1V	
	1000V	1V	
AC+DC Voltage:	400mV	0.01mV	± (1.0% reading + 7 digits)
	4V	0.001V	
	40V	0.01V	
	400V	0.1V	
	1000V	1V	
	All AC voltage ranges are specified from 5% of range to 100% of range		
DC Current:	400µA	0.01µA	± (1.0% reading + 3 digits)
	4000µA	0.1µA	
	40mA	0.001mA	
	400mA	0.01mA	
	10A	0.001A	
	(20A: 30 sec max with reduced accuracy)		
AC Current:	400µA	0.01µA	± (1.5% reading + 7 digits) (50 to 1000Hz)
	4000µA	0.1µA	
	40mA	0.001mA	
	400mA	0.01mA	
	10A	0.001A	
AC+DC Current:	400µA	0.01µA	± (1.5% reading + 7 digits) (50/60HZ)
	4000µA	0.1µA	
	40mA	0.001mA	
	400mA	0.01mA	
	10A	0.001A	
	(20A: 30 sec max with reduced accuracy)		
All AC current ranges are specified from 5% of range to 100% of range			

NOTE: Accuracy is stated at 65°F to 83°F (18°C to 28°C) and less than 75% RH.

AC switch according to the calibration of sine wave. It generally increase ±(2% reading + 2% full scale) if non sine wave in the wave crest less than 3.0.

Low Battery Indication:

When the  icon appears alone in the display, the batteries should be replaced.

Note: Do not use the insulation resistance tester if the battery indicator shows a low battery - readings may be inaccurate.

Replacing the Fuses:

To avoid electric shock:


- Ensure that the insulation resistance tester is switched off when opening the battery compartment.
 - Always remove the test leads before replacing the batteries.
1. Refer to **Figure 2**: Remove the battery cover (**Q**) (4 screws) and the batteries.
 2. The 0.5A/1000V fast blow fuse for the 400mA range (**R**) can now be accessed. Gently remove the old fuse and install the new fuse into the holder.
 3. To access the 10A/1000V fast blow for the 20A range (**S**), remove the six screws securing the rear cover. Gently remove the old fuse and install the new fuse into the holder.
 4. Always use a fuse of the proper size and value (0.5A/1000V fast blow for the 400mA range, 10A/1000V fast blow for the 20A range).
 5. Do not operate the instrument until you have replaced and secured the rear cover, batteries and battery cover.

Operating Instructions

- **Always** turn the rotary function switch to the **OFF** position when the instrument is not in use.
- If **OL** appears in the display during a measurement, the value exceeds the range you have selected. Change to a higher range.

DC Voltage Measurements:


NOTE: Do not measure DC voltages if a motor on the circuit is being switched ON or OFF. Large voltage surges may occur that can damage the meter.

1. Set the function switch to the **V DC** position (**V** ).
2. Insert the black test lead banana plug into the negative **COM** jack. Insert the red test lead banana plug into the positive **VΩ** jack.
3. Touch the black test probe tip to the negative side of the circuit. Touch the red test probe tip to the positive side of the circuit.
4. Read the voltage in the display.

AC Voltage, Frequency and Duty Cycle Measurements:

Note: Do not measure AC voltages if a motor on the circuit is being switched ON or OFF. Large voltage surges may occur that can damage the meter.

Note: Risk of Electrocution. The probe tips may not be long enough to contact the live contacts inside some 240V outlets for appliances because the contacts are recessed deep in the outlets. As a result, the reading may show 0 volts when the outlet actually has voltage on it. Make sure the probe tips are touching the metal contacts inside the outlet before assuming that no voltage is present.

1. Set the function switch to the green **V AC Hz%** position (**V**  Hz%).
2. Insert the black test lead banana plug into the negative **COM** jack. Insert red test lead banana plug into the positive **VΩ** jack.
3. Touch the black test probe tip to the neutral side of the circuit. Touch the red test probe tip to the "live" side of the circuit.
4. Read the voltage in the main display and the frequency in the right auxiliary display.
5. Press and hold the **MODE** button for 2 second to indicate "**Hz**".
6. Read the frequency in the main display.
7. Press the **MODE** button to indicate "%".
8. Read the % of duty cycle in the main display.
9. Press EXIT for 2 seconds into the function of AC+DC. Test DC and AC True RMS.

mV Voltage Measurements:

Note: Do not measure mV voltages if a motor on the circuit is being switched ON or OFF. Large voltage surges may occur that can damage the meter.

1. Set the function switch to the **mV** position.
2. Press the **MODE** button to indicate **DC** or **AC**, or in **AC** range press **EXIT** for two seconds and chose **AC+DC**.
3. Insert the black test lead banana plug into the negative **COM** jack. Insert the red test lead banana plug into the positive **VΩ** jack.
4. Touch the black test probe tip to the negative side of the circuit. Touch the red test probe tip to the positive side of the circuit.
5. Read the mV voltage in the display.

DC Current Measurements:

Note: Do not make 20A current measurements for longer than 30 seconds. Exceeding 30 seconds may cause damage to the instrument and/or the test leads.


1. Insert the black test lead banana plug into the negative **COM** jack.
2. For current measurements up to 4000 μ A DC, set the function switch to the **μ A** position and insert the red test lead banana plug into the **μ A/mA** jack.
3. For current measurements up to 400mA DC, set the function switch to the **mA** position and insert the red test lead banana plug into the **μ A/mA** jack.
4. For current measurements up to 20A DC, set the function switch to the **10A HZ%** position and insert the red test lead banana plug into the **10A** jack.
5. Press the **MODE** button to indicate **DC** on the display.
6. Remove power from the circuit under test, then open up the circuit at the point where you wish to measure current.
7. Touch the black test probe tip to the negative side of the circuit. Touch the red test probe tip to the positive side of the circuit.
8. Apply power to the circuit.
9. Read the current in the display.

AC Current, Frequency and Duty Cycle Measurements:


Note: Do not make 20A current measurements for longer than 30 seconds. Exceeding 30 seconds may cause damage to the meter and/or the test leads.

1. Insert the black test lead banana plug into the negative **COM** jack.
2. For current measurements up to 4000 μ A AC, set the function switch to the **μ A** position and insert the red test lead banana plug into the **μ A/mA** jack.
3. For current measurements up to 400mA AC, set the function switch to the **mA** position and insert the red test lead banana plug into the **μ A/mA** jack.
4. For current measurements up to 20A AC, set the function switch to the **10A/HZ/%** position and insert the red test lead banana plug into the 10A jack.
5. Press the **MODE** button to indicate **AC** on the display.
6. Remove power from the circuit under test, then open up the circuit at the point where you wish to measure current.
7. Touch the black test probe tip to the neutral side of the circuit. Touch the red test probe tip to the “live” side of the circuit.
8. Apply power to the circuit.
9. Read the current in the display. In the 10A AC range, and the frequency in the right auxiliary display.
10. Press and hold the **MODE** button to indicate “Hz”.
11. Read the frequency in the display.
12. Momentarily press the **MODE** button again to indicate %.
13. Read the % duty cycle in the display.
14. Press and hold the **MODE** button to return to current measurement.
15. Press **EXIT** for 2 seconds into the function of AC+DC. Test DC and AC True RMS.

PC Wireless Communication:

1. Install and launch the PC software (refer to the HELP utility contained in the software for more details)
2. Plug the wireless receiver into a USB port on the PC or laptop.
3. Press and Hold the **Backlight/USB button (M)** for two seconds to enter **RF wireless transmit** mode.
4. The RF icon  will appear on the display
5. When communication is established, the RF icon on the display will blink and the LED indicator on the receiver will blink.
6. Once per second, the data will be displayed on the PC screen (plotted on the graph and inserted to the data list).
7. Hold the backlight button for two seconds to exit the RF wireless transmit mode.

Sending Stored Data to the PC:

1. Launch the PC software.
2. Press the STORE button for two seconds to enter into data RECALL function.
3. Press the HOLD button for two seconds. The RF transmit icon  will flash while the stored data is sent to the PC.

NOTE: Refer to the HELP utility included in the supplied software program for in-depth software instructions.

Setup:

1. Press and Hold the **RANGE/SETUP** button (**D**) for two seconds to enter the SET function. The first of five settable functions will appear.
2. Press the **RANGE** button to step through the functions a: Alarm High limit buzzer alarm OFF or Value b: Alarm Low limit buzzer alarm OFF or Value c: Auto power off time OFF, 10 to 30 sec d: Button beeper ON/OFF e: Back light time OFF, 10 to 30 sec.
3. Use the **+**, **-**, **◀** and **▶** buttons to select and change conditions and digits.
4. Press the **RANGE/SETUP** button until the meter returns to the normal display to exit this mode.

Alarm Limits:

1. Press and Hold the **SETUP** button for two seconds to enter the High Limit function.
2. Press the **▶** button to select a digit for adjustment
3. Press the **+** or **-** button to adjust the value of the digit
4. Press the **◀** button to turn the alarm OFF.
5. Press the **SETUP** button and repeat the procedure to set the low limit
6. Press the **SETUP** button to step through the other functions and return to the normal operating mode.
7. The meter will “beep” if the measured value is greater than the high limit or lower than the low limit.

AC+DC Testing:

1. In all the measuring modes: VAC, mV(AC), 10A(AC), mA(AC), μ A(AC), press **EXIT** button (**L**) for 2 seconds to enter into AC+DC testing.
2. The precision is the same as AC measure. LCD shows AC+DC signal.
3. Press **EXIT** button again to exit.

HOLD

The hold function freezes the reading in the display. Press the **HOLD** key momentarily to activate or to exit the **HOLD** function.

PEAK HOLD

1. The **Peak Hold** function captures the peak AC or DC voltage or current. The meter can capture negative or positive peaks as fast as 1 millisecond in duration. Momentarily press the PEAK button, "PEAK" and "MAX" will display in left auxiliary display. MIN" will display in right auxiliary display.
2. The meter will update the display each time a lower negative peak occurs.
3. Press the **EXIT** button to exit the **Peak Hold** mode.
4. Auto Power Off feature will be disabled automatically in this mode.

Data Storage:

1. Set the function switch to the measurement function desired.
2. Press the **STORE** button to access the recording interval time set up function.
3. The auxiliary display on the left indicates 0000 **S**, which is the recording sample rate; use the + and - buttons to select the desired sample rate (0 to 255 seconds).
4. Set the sample rate to 0000 **S** for manual recording. In this mode, each press of the **STORE** button will save one measurement reading.
5. Set the sample rate (from 1 to 255 **S**) for automatic recording. In this mode, pressing the **STORE** button will start data recording at the programmed sample rate.
6. The auxiliary display on the left indicates the current storage location (0000 to 9999). New measurements will begin storing into the next available location.
7. Press and hold the **STORE** button for 2 seconds to enter the **RECALL** mode or press **EXIT** to return to the normal operating mode.

Data Storage Recall:

1. Press and hold the **STORE** button for two seconds (if not already done as instructed in step 7 in the above procedure) to enter the **RECALL** function.
2. The auxiliary display on the left will show XXXX (current storage location). The auxiliary display on the right will show XXXX (number of storage locations used).
3. Use the + and - buttons to navigate the storage locations. The value for the selected location is indicated in the main display.
4. Press the **EXIT** button to end the recall session.

Clear All Data:

1. From the **OFF** position, press and hold the **RANGE** button while turning the function switch to any on position
2. Release the **RANGE** button. The memory has been cleared.

Resistance Measurements:

Note: To avoid electric shock, disconnect power to the unit under test and discharge all capacitors before taking any resistance measurements. Remove the batteries and unplug the line cords.

1. Set the function switch to the $\Omega \rightarrow \text{diode symbol}$ position.
2. Insert the black test lead banana plug into the negative **COM** jack. Insert the red test lead banana plug into the positive **V Ω** jack.
3. Press the **MODE** button to indicate Ω on the display.
4. Touch the test probe tips across the circuit or part under test. It is best to disconnect one side of the part under test so the rest of the circuit will not interfere with the resistance reading.
5. Read the resistance in the display.

Continuity Testing:

Note: To avoid electric shock, never measure continuity on circuits or wires that have voltage on them.

1. Set the function switch to the $\Omega \rightarrow \text{diode symbol}$ position.
2. Insert the black lead banana plug into the negative **COM** jack. Insert the red test lead banana plug into the positive **V Ω** jack.
3. Press the **MODE** button to indicate diode symbol and Ω on the display
4. Touch the test probe tips to the circuit or wire you wish to check.
5. If the resistance is less than approximately 35 Ω , the audible signal will sound. If the circuit is open, the display will indicate **OL**.

Diode Test:

1. Set the function switch to the $\Omega \rightarrow \text{diode symbol}$ position.
2. Insert the black test lead banana plug into the negative **COM** jack and the red test lead banana plug into the positive **V Ω** jack.
3. Press the **MODE** button to indicate diode symbol and **V** on the display.
4. Touch the test probes to the diode under test.
5. Forward voltage will typically indicate 0.400 to 0.700V. Reverse voltage will indicate **OL**.
6. Shorted devices will indicate near 0V and an open device will indicate **OL** in both polarities.

Capacitance Measurements:

Note: To avoid electric shock, disconnect power to the unit under test and discharge all capacitors before taking any capacitance measurements. Remove the batteries and unplug the line cords.

1. Set the function switch to the $\Omega \rightarrow \text{diode symbol}$ position.
2. Insert the black test lead banana plug into the negative **COM** jack.
3. Insert the red test lead banana plug into the positive **V Ω** jack.
4. Press the **MODE** button to indicate **F**.
5. Touch the test leads to the capacitor to be tested.
6. Read the capacitance value in the display.

Temperature Measurements:

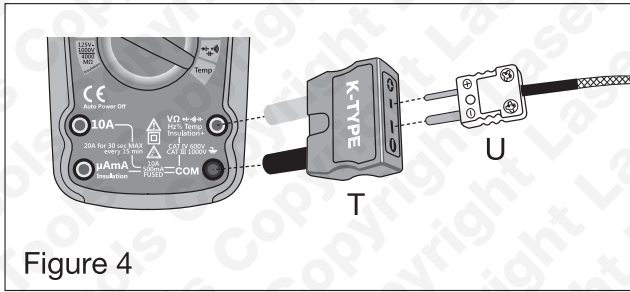


Figure 4

1. Set the function switch to the **Temp** position.
2. Refer to **Figure 4**: Insert the K-Type adaptor (**T**) into the **VΩ** and **COM** jacks. Then insert the Temperature Probe (**U**) into the K-Type adaptor, making sure to observe the correct polarity (narrow blade positive, wide blade negative).
3. Press the **MODE** button to indicate **°F** or **°C**.
4. Touch the Temperature Probe head to the part whose temperature you wish to measure. Keep the probe touching the part under test until the reading stabilizes (about 30 seconds).
5. Read the temperature in the display.

Frequency (Duty Cycle) Measurements (Electronic):

1. Set the rotary function switch to the **Hz %** position.
2. Insert the black lead banana plug into the negative **COM** jack and the red test lead banana plug into the positive **VΩ Hz** jack.
3. Touch the test probe tips to the circuit under test.
4. Read the frequency on the display.
5. Press the **MODE** button to indicate **%**.
6. Read the **%** duty cycle in the display.

4–20mA % Measurements:

1. Insert the black test lead banana plug into the negative **COM** jack.
2. Insert the red test lead banana plug into the **μA/mA** jack.
3. Set the rotary function switch to the **4–20mA %** position.
4. The meter will display loop current as a % with 0mA=–25%, 4mA=0%, 20mA=100%, and 24mA=125%.

Insulation Resistance Measurements:

1. Set the rotary function switch to the **INSULATION** position and press the **RANGE** button to choose one of the voltages displayed in the top left auxiliary digital display.
2. Connect two testing lines to the item to be tested.
3. Push down and hold the **INSULATION TEST (F)** button or press the **LOCK** key (**E**) first and then the **INSULATION TEST** button. Note: if there is any static electricity present in the item being tested and its voltage is over 30V, it will fail and no high-voltage testing will occur, **>30V** will display on the LCD, the symbol ⚡ flashes, and the buzzer will sound. Otherwise it will enter into the formal testing process and the high-voltage will show on the main digital display, the insulation resistance in MΩ is indicated in-phase with the analogue bar graph. On the top right auxiliary digital display, the tested insulation voltage in V (DC) is indicated, the symbol ⚡ flashes and the buzzer tone will sound.

4. Releasing the “TEST” button or pushing down the “TEST” button in the “LOCK “ status will exit from the “LOCK” status and shut-off the testing voltage, simultaneously the resistance value indicated in the main digital display will be held, and the top right auxiliary digital display will still show the status of the insulation voltage for the item tested.
5. Turning the function switch to off or pressing the **EXIT** button will exit from the testing procedure during the process.

Autorangeing / Manual Range Selection:

When the meter is first turned on, it automatically goes into Autoranging. This automatically selects the best range for the measurements being made and is generally the best mode for most measurements. For measurement situations requiring that a range be manually selected, perform the following:

1. Press the **RANGE** key. The **AUTO** display indicator will turn off.
2. Press the **RANGE** key to step through the available ranges until you select the range you want.
3. To exit the Manual Ranging mode and return to Autoranging, press **EXIT**.

Note: Manual ranging does not apply for the Temperature functions.

MAX/MIN:



1. Press the **MAX/MIN** key to activate the **MAX/MIN** recording mode. The display icon MAX will appear. The left auxiliary digital display will display and hold the maximum reading and will update only when a new “max” occurs. The display icon **MIN** will appear. The right auxiliary digital display will display and hold the minimum reading and will update only when a new “min” occurs.
2. To exit **MAX/MIN** mode press **EXIT**.

Relative Mode:

The relative measurement feature allows you to make measurements relative to a stored reference value. A reference voltage, current, etc, can be stored and measurements made in comparison to that value. The displayed value is the difference between the reference value and the measured value. **Note:** Relative mode does not operate in the 4-20mA function.

1. Perform the measurement as described in the operating instructions.
2. Press the **REL** button to store the reading in the display and the **Δ** indicator will appear on the display.
3. Left auxiliary display shows the margin of initial value and the current value.
4. Right auxiliary digital display shows the initial reading. Main digital displays the reading after **REL TEST**.
5. Press the **EXIT** button to exit the relative mode.

Display Backlight:

Press the  button to turn the backlight on. The backlight will automatically turn off after the set time. Press the  button again to exit the backlight on mode.