



# DIGITAL AUTOMOTIVE ANALYSER/ INSULATION TESTER - HYBRID VEHICLES

MODEL NO: **TA320.V2**

Thank you for purchasing a Sealey product. Manufactured to a high standard, this product will, if used according to these instructions, and properly maintained, give you years of trouble free performance.

**IMPORTANT:** PLEASE READ THESE INSTRUCTIONS CAREFULLY. NOTE THE SAFE OPERATIONAL REQUIREMENTS, WARNINGS & CAUTIONS. USE THE PRODUCT CORRECTLY AND WITH CARE FOR THE PURPOSE FOR WHICH IT IS INTENDED. FAILURE TO DO SO MAY CAUSE DAMAGE AND/OR PERSONAL INJURY AND WILL INVALIDATE THE WARRANTY. KEEP THESE INSTRUCTIONS SAFE FOR FUTURE USE.



Refer to  
instructions

## 1. SAFETY

- ✓ Wear safety eye protection that meets ANSI standards.
- ✓ Operate the vehicle to be tested in a well ventilated area. Exhaust gases are poisonous. If necessary connect the vehicle exhaust to a fume extraction system.
- ✓ Place chocks in front of the drive wheels and never leave the vehicle unattended whilst testing is in progress.
- ✓ Be extra cautious when working in close proximity to the ignition coil, distributor cap, ignition wires and spark plugs. These components create hazardous voltages when the engine is running.
- ✓ Ensure that the handbrake is on and the gearbox is in neutral or 'Park' for automatic transmissions.
- ✓ Keep fire extinguishers nearby that are suitable for petrol/chemical/electrical fires.
- ✓ Keep the analyser clean and in good condition.
- ✓ Remain vigilant when using the code reader on, or near, machinery where there are rotational parts such as belts, pulleys and fans.
- ✓ Remove ill fitting clothing. Remove ties, watches, rings, and other loose jewellery, and contain and/or tie back long hair.
- ✓ Maintain correct balance and footing. Ensure the floor is not slippery and wear non-slip shoes.
- ✓ Keep product surfaces clean and dry.
- \* **DO NOT** attempt to connect or disconnect any test equipment whilst the ignition is on or the engine is running.
- \* **DO NOT** use the analyser if damage is suspected. If suspected damage occurs with the device, have it inspected by qualified service personnel before using it again.
- \* **DO NOT** get the analyser wet or use in damp or wet locations or areas where there is condensation.
- \* **DO NOT** use the analyser for any purpose other than for which it is designed.
- \* **DO NOT** allow untrained persons to use analyser.
- \* **DO NOT** use the analyser when you are tired or under the influence of alcohol, drugs or intoxicating medication.
- \* **DO NOT** operate in a potentially explosive environment/atmosphere.
- **WARNING:** The warnings, cautions and instructions discussed in this instruction manual cannot cover all possible conditions and situations that may occur. It must be understood that common sense and caution are factors which cannot be built into this product, but must be applied by the operator.

## 2. INTRODUCTION

Specially designed for hybrid vehicles and conforms to EN61010 CAT III (1000V) and CAT IV (600V). Unlike other multimeters this unit has an insulation test function that allows testing of the insulation of the high voltage cables and motor generator units found on hybrid vehicles. Can be used as a standalone device or linked wirelessly with a USB interface to a PC or laptop enabling results to be graphed, saved or printed. Supplied with high voltage probes, thermocouple soft storage bag and wireless USB cable. The unit also has the usual functions expected on a high quality multimeter including true RMS (Root-Mean-Square) and IP67 waterproof rating.

### 3. SPECIFICATION

Tach (rpm):..... No  
Dwell: ..... No  
AC Voltage: ..... 400mV, 4V, 40V, 400V, 1000V  
Voltage: ..... 400mV, 4V, 40V, 400V, 1000V  
AC Current: ..... 400µA, 4000µA, 40mA, 400mA, 10A  
DC Current: ..... 400µA, 4000µA, 40mA, 400mA, 10A  
Capacitance: .40nF, 400nF, 4µF, 40µF, 400µF, 4000µF, 40mF  
Frequency: ..... 40Hz-10kHz  
Duty Cycle: ..... 0.1-99.9%  
Pulse Width: ..... 100µs-100ms  
Resistance: ..... 400Ω, 4kΩ, 40kΩ, 400kΩ, 4MΩ, 40MΩ  
Continuity: ..... &lt;35Ω  
Temperature: ..... -50 to +1000°C, -58 to +1832°F  
IR Temperature: ..... No  
Insulation Test: ..... 125V, 250V, 500V, 1000V  
Diode Check: ..... Yes  
Transistor Test: ..... No  
Back Light: ..... Yes  
Bar-Graph Display: ..... Yes  
Display Hold: ..... Yes  
Auto-Ranging: ..... Yes  
Inductive Coupler: ..... No  
PC Interface: ..... Yes  
Digits Height: ..... 20mm  
Auto Power Off: ..... Yes  
Low Battery Indicator: ..... Yes  
Batteries (supplied): ..... 6 x 1.5V AA  
Hi-Impact Case: ..... Yes  
Size (L x W x D): ..... 220 x 95 x 56mm  
PC Compatibility: ..... Windows 2000, XP, Vista, Win7



#### ENVIRONMENT PROTECTION

Recycle unwanted materials instead of disposing of them as waste. All tools, accessories and packaging should be sorted, taken to a recycling centre and disposed of in a manner which is compatible with the environment. When the product becomes completely unserviceable and requires disposal, drain any fluids (if applicable) into approved containers and dispose of the product and fluids according to local regulations.



#### WEEE REGULATIONS

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.



#### BATTERY REMOVAL

Under the Waste Batteries and Accumulators Regulations 2009, Jack Sealey Ltd are required to inform potential purchasers of products containing batteries (as defined within these regulations), that they are registered with Valpak's registered compliance scheme. Jack Sealey Ltd Batteries Producer Registration Number (BPRN) is BPRN00705.

##### TO REMOVE THE BATTERIES:

- 1) Lift the rear support bracket.
- 2) Remove the four cross-head screws from the battery cover.
- 3) Remove the battery cover.
- 4) Remove the batteries.

**Note:** It is our policy to continually improve products and as such we reserve the right to alter data, specifications and component parts without prior notice. Please note that other versions of this product are available. If you require documentation for alternative versions, please email or call our technical team on [technical@sealey.co.uk](mailto:technical@sealey.co.uk) or 01284 757505.

**Important:** No Liability is accepted for incorrect use of this product.

**Warranty:** Guarantee is 12 months from purchase date, proof of which is required for any claim.

Sealey Group, Kempson Way, Suffolk Business Park, Bury St Edmunds, Suffolk. IP32 7AR



01284 757500



01284 703534



[sales@sealey.co.uk](mailto:sales@sealey.co.uk)



[www.sealey.co.uk](http://www.sealey.co.uk)

## Safety Symbols

---



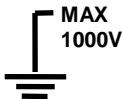
This symbol adjacent to another symbol, terminal or operating device indicates that the operator must refer to an explanation in the Operating Instructions to avoid personal injury or damage to the meter.

**WARNING**

This **WARNING** symbol indicates a potentially hazardous situation, which if not avoided, could result in death or serious injury.

**CAUTION**

This **CAUTION** symbol indicates a potentially hazardous situation, which if not avoided, may result in damage to the product.



This symbol advises the user that the terminal(s) so marked must not be connected to a circuit point at which the voltage with respect to earth ground exceeds (in this case) 1000 VAC or VDC.



This symbol adjacent to one or more terminals identifies them as being associated with ranges that may, in normal use, be subjected to particularly hazardous voltages. For maximum safety, the meter and its test leads should not be handled when these terminals are energized.



This symbol indicates that a device is protected throughout by double insulation or reinforced insulation.

## **PER IEC1010 OVERVOLTAGE INSTALLATION CATEGORY**

### ***OVERVOLTAGE CATEGORY I***

Equipment of OVERVOLTAGE CATEGORY I is equipment for connection to circuits in which measures are taken to limit the transient overvoltages to an appropriate low level.

Note – Examples include protected electronic circuits.

### ***OVERVOLTAGE CATEGORY II***

Equipment of OVERVOLTAGE CATEGORY II is energy-consuming equipment to be supplied from the fixed installation.

Note – Examples include household, office, and laboratory appliances.

### ***OVERVOLTAGE CATEGORY III***

Equipment of OVERVOLTAGE CATEGORY III is equipment in fixed installations.

Note – Examples include switches in the fixed installation and some equipment for industrial use with permanent connection to the fixed installation.

### ***OVERVOLTAGE CATEGORY IV***

Equipment of OVERVOLTAGE CATEGORY IV is for use at the origin of the installation.

Note – Examples include electricity meters and primary over-current protection equipment

## ELECTRICAL SAFETY PRECAUTIONS

This meter has been designed for safe use, but must be operated with caution. The rules listed below must be carefully followed for safe operation.

1. **NEVER** apply voltage or current to the meter that exceeds the specified maximum:


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

2. **USE EXTREME CAUTION** when working with high voltages.
3. **DO NOT** measure voltage if the voltage on the "COM" input jack exceeds 1000V above earth ground.
4. **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 meter.
5. **ALWAYS** discharge filter capacitors in power supplies and disconnect the power when making resistance or diode tests.
6. **ALWAYS** turn off the power and disconnect the test leads before opening the covers to replace the fuse or batteries.

7. **NEVER** operate the meter unless the back cover and the battery and fuse covers are in place and fastened securely.

If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

## Controls and Jacks

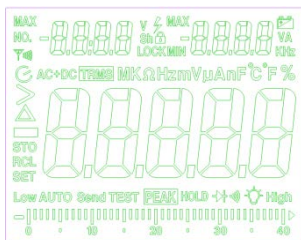
1. 40,000 count LCD display
2. MAX/MIN (-) button
3. STORE(<RECALL) button
4. RANGE(SETUP) button
5. INSULATION TEST button
6. MODE button
7. Function switch
8. mA,  $\mu$ A and 10A input jacks
9. REL(+) button
10. HOLD(PEAKHOLD>) button
11. EXIT(AC+DC) button
12.  Backlight and RF button
13. Positive input jack
14. COM input jack



**Note:** Tilt stand and battery compartment are on rear of unit.

## Symbols and Annunciators

|              |                                      |              |                       |
|--------------|--------------------------------------|--------------|-----------------------|
| •)))         | Continuity                           |              |                       |
| ▶            | Diode test                           |              |                       |
| ⊕            | Battery status                       |              |                       |
| n            | nano ( $10^{-9}$ ) (capacitance)     |              |                       |
| $\mu$        | micro ( $10^{-6}$ ) (amps, cap)      |              |                       |
| m            | milli ( $10^{-3}$ ) (volts, amps)    |              |                       |
| A            | Amps                                 |              |                       |
| k            | kilo ( $10^3$ ) (ohms)               |              |                       |
| F            | Farads (capacitance)                 |              |                       |
| M            | mega ( $10^6$ ) (ohms)               |              |                       |
| $\Omega$     | Ohms                                 | PEAK         | Peak Hold             |
| Hz           | Hertz (frequency)                    | V            | Volts                 |
| %            | Percent (duty ratio)                 | REL          | Relative              |
| AC           | Alternating current                  | AUTO         | Autoranging           |
| DC           | Direct current                       | HOLD         | Display hold          |
| $^{\circ}$ F | Degrees Fahrenheit                   | $^{\circ}$ C | Degrees Centigrade    |
| MAX          | Maximum                              | MIN          | Minimum               |
| No.          | Serial number                        | Y            | RF transmitter active |
| S            | Second                               |              |                       |
|              | left auxiliary display               |              |                       |
|              | right auxiliary display              |              |                       |
| SET          | Set up parameter                     |              |                       |
| AC+DC        | Alternating current + Direct current |              |                       |
| TRMS         | True RMS                             |              |                       |
| STO          | Store                                |              |                       |
| RCL          | Recall                               |              |                       |
| AUTO         | Auto Range                           |              |                       |
|              | Timing symbol                        |              |                       |
|              | Backlight                            |              |                       |
|              | Bar graph                            |              |                       |



## Operating Instructions

**WARNING:** Risk of electrocution. High-voltage circuits, both AC and DC, are very dangerous and should be measured with great care.

1. ALWAYS turn the function switch to the **OFF** position when the meter is not in use.
2. 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

**CAUTION:** 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 green **VDC** 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** 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, DUTY CYCLE) MEASUREMENTS

**WARNING:** Risk of Electrocution. The probe tips may not be long enough to contact the live parts 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.

**CAUTION:** 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.

1. Set the function switch to the green **VAC/Hz/%** position.
2. Insert the black test lead banana plug into the negative **COM** jack. Insert red test lead banana plug into the positive **V** jack.
3. Touch the black test probe tip to the neutral side of the circuit. Touch the red test probe tip to the “hot” 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 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

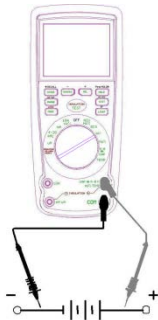
**CAUTION:** Do not measure mV voltages if a motor on the circuit is being switched ON or OFF. Large voltage surges may occur that can damage the meter.

1. Set the function switch to the green 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”

Insert the black test lead banana plug into the negative **COM** jack.

Insert the red test lead banana plug into the positive **V** 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 mV voltage in the display.



## DC CURRENT MEASUREMENTS

**CAUTION:** 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.

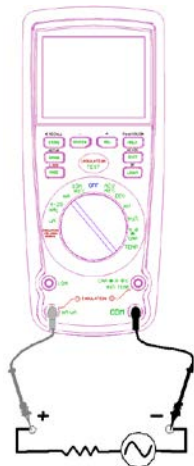
1. Insert the black test lead banana plug into the negative **COM** jack.
2. For current measurements up to  $4000\mu\text{A}$  DC, set the function switch to the yellow  **$\mu\text{A}$**  position and insert the red test lead banana plug into the  **$\mu\text{A}/\text{mA}$**  jack.
3. For current measurements up to  $400\text{mA}$  DC, set the function switch to the yellow  **$\text{mA}$**  position and insert the red test lead banana plug into the  **$\mu\text{A}/\text{mA}$**  jack.
4. For current measurements up to  $20\text{A}$  DC, set the function switch to the yellow  **$10\text{A}/\text{HZ}/\%$**  position and insert the red test lead banana plug into the  **$10\text{A}$**  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, DUTY CYCLE) MEASUREMENTS

**CAUTION:** 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  $4000\mu\text{A AC}$ , set the function switch to the yellow  **$\mu\text{A}$**  position and insert the red test lead banana plug into the  **$\mu\text{A}/\text{mA}$**  jack.
3. For current measurements up to  $400\text{mA AC}$ , set the function switch to the yellow  **$\text{mA}$**  position and insert the red test lead banana plug into the  **$\mu\text{A}/\text{mA}$**  jack.
4. For current measurements up to  $20\text{A AC}$ , set the function switch to the yellow  **$10\text{A}/\text{HZ}/\%$**  position and insert the red test lead banana plug into the  **$10\text{A}$**  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 "hot" side of the circuit.
8. Apply power to the circuit.
9. Read the current in the display. In the  $10\text{AAC}$  range, right auxiliary display frequency.
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.

## RESISTANCE MEASUREMENTS

**WARNING:** 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 green  **$\Omega$  CAP**  position.
2. Insert the black test lead banana plug into the negative **COM** jack. Insert the red test lead banana plug into the positive  **$\Omega$**  jack.
3. Press the **MODE** button to indicate " **$\Omega$** " 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 CHECK

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

1. Set the function switch to the green  **$\Omega$  CAP**  $\rightarrow \rightarrow \rightarrow$  position.
2. Insert the black lead banana plug into the negative **COM** jack. Insert the red test lead banana plug into the positive  **$\Omega$**  jack.
3. Press the **MODE** button to indicate " $\rightarrow \rightarrow \rightarrow$ ," and " **$\Omega$** " 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  $35\Omega$ , the audible signal will sound. If the circuit is open, the display will indicate "**OL**".




## DIODE TEST

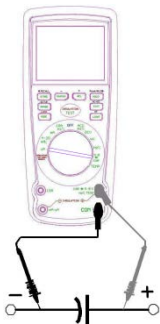
1. Set the function switch to the green  **$\Omega$  CAP** position.
2. Insert the black test lead banana plug into the negative **COM** jack and the red test lead banana plug into the positive **V** jack.
3. Press the **MODE** button to indicate " $\rightarrow$ " and "**V**" on the display.
4. Touch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



## CAPACITANCE MEASUREMENTS

**WARNING:** 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 rotary function switch to the green  **$\Omega$  CAP**  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** jack.
4. Press the **MODE** button to indicate “**F**”
5. Touch the test leads to the capacitor to be tested.  
Read the capacitance value in the Display



## TEMPERATURE MEASUREMENTS

1. Set the function switch to the green Temp position.
2. Insert the Temperature Probe into the input jacks, making sure to observe the correct polarity.
3. Press the MODE button to indicate “ $^{\circ}$ F” or “ $^{\circ}$ 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.



**Note:** The temperature probe is fitted with a type K mini connector. A mini connector to banana connector adaptor is supplied for connection to the input banana jacks.

## FREQUENCY (DUTY CYCLE) MEASUREMENTS (ELECTRONIC)


1. Set the rotary function switch to the green **Hz/%** position.
2. Insert the black lead banana plug into the negative **COM** jack and the red test lead banana plug into the positive **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. Set up and connect as described for DC mA measurements.
2. Set the rotary function switch to the **4-20mA%** position.
3. The meter will display loop current as a % with 0mA=-25%, 4mA=0%, 20mA=100%, and 24mA=125%.

## INSULATION RESISTANCE MEASUREMENTS

- a) Set the rotary function switch to the **INSULATION** position and Press the **RANGE** button to chose one of the voltages displayed in the top left corner.
- b) Connect two testing lines to the item to be tested.
- c) Push down and hold the “TEST” button or press the “LOCK” key first and then the “TEST” button, 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 primary display, the insulation resistance in MΩ is indicated in-phase with the analog bar; on the top right corner display, the



tested insulation voltage in V (DC) is indicated, the symbol “ ⚡ ” flashes and the buzzer will sound.

d) 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 primary display will be held, and the top right corner display will still show the status of the insulation voltage for the item tested.

Turning the function switch to off or pressing the **EXIT** button will exit from the testing procedure during the process.

## **POWER TOOLS AND SMALL APPLIANCES**

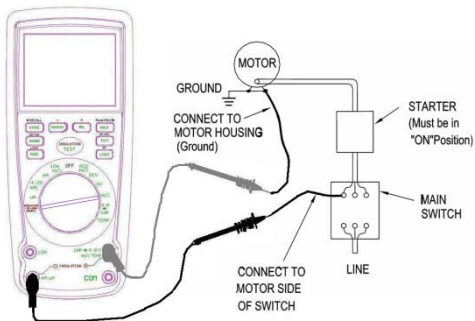
This test would also apply to other similar equipment that has a line cord. For double insulated power tools, the megohmmeter lead shown connected to the housing would be connected to some metal part of the tool (e.g. chuck, blade).

Note: The switch of the device must be in the “ON” position and the main power should be disconnected.

## **MOTORS**

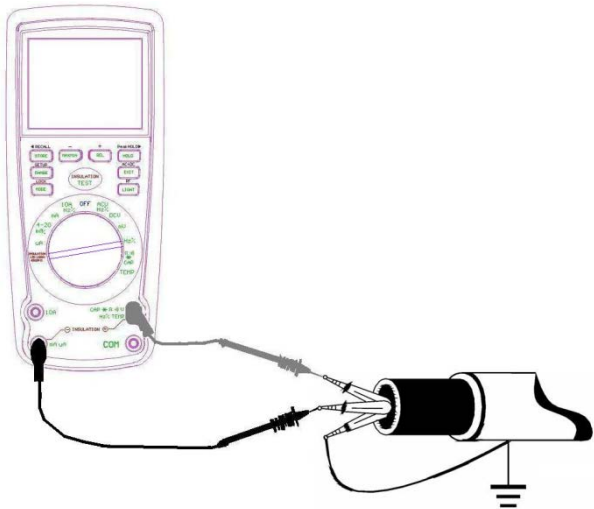
AC-Disconnect the motor from the line by disconnecting the wires at the motor terminals or by opening the main switch. If the main switch is used and the motor also has a starter then the starter must be held, by some means, in the “ON” position. In the latter case, the measured resistance will include the resistance of the motor, wire and all other components between the motor and the main switch. If a weakness is indicated, the motor and other components should be checked individually. If the motor is disconnected at the motor terminals, connect one megohmmeter lead to the grounded motor housing and the other lead to one of the motor leads. DC - Disconnect the motor from the line. To test the brush rigging, field coils and armature

connect one megohmmeter lead to the grounded motor housing and the other lead to the brush on the commutator. If the resistance measurement indicates a weakness, raise the brushes off the commutator and separately test the armature, field coils and brush rigging by connecting one megohmmeter lead to each of them individually, leaving the other connected to the grounded motor housing. The above also applies to DC Generators.



## CABLES

Disconnect the cable from the line. Also disconnect opposite end to avoid errors due to leakage from other equipment. Check each conductor to ground and /or lead sheath by connecting one megohmmeter lead to a ground and /or lead sheath and the other megohmmeter lead to each of the conductors in turn. Check insulation resistance between conductors by connecting megohmmeter leads to conductors in pairs.



## AUTORANGING/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 meter left auxiliary 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 display meter 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 “**REL**” indicator will appear on the display.

3. Left auxiliary display shows the margin of initial value and the current value.  
Right auxiliary display shows the initial reading. Main displays the reading after REL TEST.
4. Press the **EXIT** button to exit the relative mode.

### Display Backlight

Press the  key to turn the backlight on. The backlight will automatically turn off after SET time. Press the **EXIT** button to exit the **backlight on** mode.

### 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

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**. The meter will update the display each time a lower negative peak occurs. **Press the EXIT button to exit the PEAK HOLD mode**. 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 **+** & **-** 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

## PC WIRELESS COMMUNICATION

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

In all the measuring mode VAC, mV(AC), 10A(AC), mA(AC),  $\mu$ A(AC), press button EXIT for 2 seconds to enter into AC+DC testing. The precision is the same as AC measure. LCD shows AC+DC signal. Press button EXIT to exit.

## **LOW BATTERY INDICATION**

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



## Maintenance

**WARNING:** To avoid electric shock, disconnect the test leads from any source of voltage before removing the back cover or the battery or fuse covers.

**WARNING:** To avoid electric shock, do not operate your meter until the battery and fuse covers are in place and fastened securely.

This Meter is designed to provide years of dependable service, if the following care instructions are performed:

1. **KEEP THE METER DRY.** If it gets wet, wipe it dry immediately.
2. **USE AND STORE THE METER IN NORMAL TEMPERATURES.** Temperature extremes can shorten the life of the electronic parts and distort or melt plastic parts.
3. **HANDLE THE METER GENTLY AND CAREFULLY.** Dropping it can damage the electronic parts or the case.
4. **KEEP THE METER CLEAN.** Wipe the case occasionally with a damp cloth. DO NOT use chemicals, cleaning solvents, or detergents.
5. **USE ONLY NEW BATTERIES OF THE RECOMMENDED SIZE AND TYPE.** Remove old batteries so they do not leak and damage the unit.
6. **IF THE METER IS TO BE STORED FOR A LONG PERIOD OF TIME,** the batteries should be removed to prevent damage to the unit.

## BATTERY INSTALLATION

**WARNING:** To avoid electric shock, disconnect the test leads from any source of voltage before removing the battery cover.

1. Turn power off and disconnect the test leads from the meter.
2. Open the rear battery cover by removing 4 screws using a cross head screwdriver.

3. Insert the batteries into battery holder, observing the correct polarity.
4. Put the battery cover back in place. Secure with the screws.

**WARNING:** To avoid electric shock, do not operate the meter until the battery cover is in place and fastened securely.

**NOTE:** If your meter does not work properly, check the fuses and batteries to make sure that they are still good and that they are properly inserted.

## REPLACING THE FUSES

**WARNING:** To avoid electric shock, disconnect the test leads from any source of voltage before removing the meter cover.

1. Disconnect the test leads from the meter.
2. Remove the protective rubber holster.
3. Remove the battery cover (4 screws) and the batteries.
4. Remove the six screws securing the rear cover.
5. Gently remove the old fuse and install the new fuse into the holder.
6. 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).
7. Replace and secure the rear cover, battery and battery cover.

**WARNING:** To avoid electric shock, do not operate your meter until the fuse cover is in place and fastened securely.

## Specifications

| Function  | Range  | Resolution | Accuracy                                  |
|---|--------|------------|---|
| DC Voltage  | 400mV  | 0.01mV     | ± (0.06% reading + 4digits)               |
|   | 4V     | 0.0001V    |   |
|   | 40V    | 0.001V     |   |
|   | 400V   | 0.01V      |   |
|   | 1000V  | 0.1V       | ± (0.1% reading + 5digits)                |
| AC Voltage  |        |            | 50 to 1000Hz                              |
|   | 400mV  | 0.1mV      | ± (1.0% reading + 7digits)                |
|   | 4V     | 0.001V     |   |
|   | 40V    | 0.01V      | ± (1.0% reading + 5 digits)               |
|   | 400V   | 0.1V       |   |
|   | 1000V  | 1V         |   |
| AC+DCVoltage  | 400mV  | 0.1mV      | ± (1.0% reading + 7digits)<br>( 50/60HZ ) |
|   | 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  | 400 $\mu$ A                             | 0.1 $\mu$ A | $\pm$ (1.5% reading + 7 digits)<br>( 50 to 1000Hz ) |
|   | 4000 $\mu$ A                            | 1 $\mu$ A   |   |
|   | 40mA                                    | 0.01mA      |   |
|   | 400mA                                   | 0.1mA       |   |
|   | 10A                                     | 0.01A       |   |
| AC+DCCurrent  | 400 $\mu$ A                             | 0.1 $\mu$ A | $\pm$ (1.5% reading + 7 digits)<br>( 50/60HZ )      |
|   | 4000 $\mu$ A                            | 1 $\mu$ A   |   |
|   | 40mA                                    | 0.01mA      |   |
|   | 400mA                                   | 0.1mA       |   |
|   | 10A                                     | 0.01A       |   |
|   | (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  $\pm$ (2% reading + 2% full scale) if non sine wave in the wave crest less than 3.0.

| Function   | Range         | Resolution       | Accuracy                         |
|------------|---------------|------------------|----------------------------------|
| Resistance | 400 $\Omega$  | 0.01 $\Omega$    | $\pm$ (0.3% reading + 9 digits)  |
|            | 4k $\Omega$   | 0.0001k $\Omega$ | $\pm$ (0.3% reading + 4 digits)  |
|            | 40k $\Omega$  | 0.001k $\Omega$  |                                  |
|            | 400k $\Omega$ | 0.01k $\Omega$   |                                  |
|            | 4M $\Omega$   | 0.001M $\Omega$  |                                  |
|            | 40M $\Omega$  | 0.001M $\Omega$  | $\pm$ (2.0% reading + 10 digits) |


|   |  |                   |   |
|---|--|-------------------|---|
| Capacitance   | 40nF   | 0.001nF           | ± (3.5% reading + 40 digits)                            |
|   | 400nF  | 0.01nF            |   |
|   | 4μF  | 0.0001μF          | ± (3.5% reading + 10 digits)                            |
|   | 40μF   | 0.001μF           |   |
|   | 400μF  | 0.01μF            |   |
|   | 4000μF   | 0.1μF             | ± (5% reading + 10 digits)                              |
|   | 40mF   | 0.001mF           |   |
| Frequency<br>(electronic)   | 40Hz   | 0.001Hz           | ± (0.1% reading + 1 digits)                             |
|   | 400Hz  | 0.01Hz            |   |
|   | 4kHz   | 0.0001kHz         |   |
|   | 40kHz  | 0.001kHz          |   |
|   | 400kHz   | 0.01kHz           |   |
|   | 4MHz   | 0.0001MHz         |   |
|   | 40MHz  | 0.001MHz          | Not specified   |
|   | 100MHz   | 0.01MHz           |   |
| Sensitivity: 0.8V rms min. @ 20% to 80% duty cycle and <100kHz; 5Vrms min @ 20% to 80% duty cycle and > 100kHz. |  |                   |   |
| Frequency<br>(electrical)   | 40.00Hz-10KHz  | 0.01Hz - 0.001KHz | ± (0.5% reading)  |
|   | Sensitivity:2Vrms                                    |                   |   |
| Duty Cycle  | 0.1 to 99.90%  | 0.01%             | ± (1.2% reading + 2 digits)                             |
|   | Pulse width: 100μs - 100ms, Frequency: 5Hz to 150kHz |                   |   |
| Temp<br>(type-K)  | -50 to 1200°C  | 0.1°C             | ±(1.0% reading + 2.5°C)                                 |
|   | -58 to 2192°F  | 0.1°F             | ±(1.0% reading +4.5°F)<br>(probe accuracy not included) |
| 4-20mA%   | -25 to 125%  | 0.01%             | ±50 digits  |
|   | 0mA=-25%, 4mA=0%, 20mA=100%, 24mA=125%               |                   |   |

## Meg OHMS

| Terminal Voltage | Range          | Resolution | Accuracy      | Test Current          | Short circuit current |
|------------------|----------------|------------|---------------|-----------------------|-----------------------|
| 125V(0%~+10%)    | 0.125~4.000 MΩ | 0.001MΩ    | $\pm(2\%+10)$ | 1mA<br>@load1<br>25kΩ | ≤1mA                  |
|                  | 4.001~40.00 MΩ | 0.01MΩ     | $\pm(2\%+10)$ |                       |                       |
|                  | 40.01~400.0 MΩ | 0.1MΩ      | $\pm(4\%+5)$  |                       |                       |
|                  | 400.1~4000 MΩ  | 1MΩ        | $\pm(5\%+5)$  |                       |                       |
| 250V(0%~+10%)    | 0.250~4.000 MΩ | 0.001MΩ    | $\pm(2\%+10)$ | 1mA<br>@load2<br>50kΩ | ≤1mA                  |
|                  | 4.001~40.00 MΩ | 0.01MΩ     | $\pm(2\%+10)$ |                       |                       |
|                  | 40.01~400.0 MΩ | 0.1MΩ      | $\pm(3\%+5)$  |                       |                       |
|                  | 400.1~4000 MΩ  | 1MΩ        | $\pm(4\%+5)$  |                       |                       |
| 500V(0%~+10%)    | 0.500~4.000 MΩ | 0.001MΩ    | $\pm(2\%+10)$ | 1mA<br>@load5<br>00kΩ | ≤1mA                  |
|                  | 4.001~40.00 MΩ | 0.01MΩ     | $\pm(2\%+10)$ |                       |                       |
|                  | 40.01~400.0 MΩ | 0.1MΩ      | $\pm(2\%+5)$  |                       |                       |
|                  | 400.1~4000 MΩ  | 1MΩ        | $\pm(4\%+5)$  |                       |                       |
| 1000V(0%~+10%)   | 1.000~4.000 MΩ | 0.001MΩ    | $\pm(3\%+10)$ | 1mA<br>@load1<br>MΩ   | ≤1mA                  |
|                  | 4.001~40.00 MΩ | 0.01MΩ     | $\pm(2\%+10)$ |                       |                       |
|                  | 40.01~400.0 MΩ | 0.1MΩ      | $\pm(2\%+5)$  |                       |                       |
|                  | 400.1~4000 MΩ  | 1MΩ        | $\pm(4\%+5)$  |                       |                       |

**Note:** Accuracy specifications consist of two elements:

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

|                               |   |
|-------------------------------|---|
| Store capacitance             | 2000  |
| <b>Enclosure</b>              | Double molded, waterproof   |
| <b>Shock (Drop Test)</b>      | 6.5 feet (2 meters)   |
| <b>Diode Test</b>             | Test current of 0.9mA maximum, open circuit voltage 2.8V DC typical   |
| <b>Continuity Check</b>       | Audible signal will sound if the resistance is less than 35Ω (approx.), test current <0.35mA  |
| <b>Peak</b>                   | Captures peaks >1ms   |
| <b>Temperature Sensor</b>     | Requires type K thermocouple  |
| <b>Input Impedance</b>        | >10MΩ VDC & >9MΩ VAC  |
| <b>AC Response</b>            | True rms  |
| <b>AC True RMS:</b>           | 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. |
| <b>ACV Bandwidth</b>          | 50Hz to 1000Hz  |
| <b>Crest Factor</b>           | ≤3 at full scale up to 500V, decreasing linearly to ≤1.5 at 1000V   |
| <b>Display</b>                | 40,000 count backlit liquid crystal with bargraph   |
| <b>Overrange indication</b>   | “OL” is displayed   |
| <b>Auto Power Off</b>         | 15 minutes (approximately) with disable feature   |
| <b>Polarity</b>               | Automatic (no indication for positive); Minus (-) sign for negative   |
| <b>Measurement Rate</b>       | 2 times per second, nominal   |
| <b>Low Battery Indication</b> | “  ” is displayed if battery voltage drops below operating voltage   |



|                              |  |
|------------------------------|--|
| <b>Battery</b>               | 6 x AA batteries   |
| <b>Fuses</b>                 | mA, $\mu$ A ranges; 0.5A/1000V ceramic fast blow A range; 10A/1000V ceramic fast blow  |
| <b>Operating Temperature</b> | 41°F to 104°F (5°C to 40°C)  |
| <b>Storage Temperature</b>   | -4°F to 140°F (-20°C to 60°C)  |
| <b>Operating Humidity</b>    | Max 80% up to 87°F (31°C) decreasing linearly to 50% at 104°F (40°C)   |
| <b>Storage Humidity</b>      | <80%   |
| <b>Operating Altitude</b>    | 7000ft. (2000metres) maximum.  |
| <b>Safety</b>                | This meter is intended for origin of installation use and protected, against the user, by double insulation per EN61010-1 and IEC61010-1 2 <sup>nd</sup> Edition (2001) to Category IV 600V and Category III 1000V; Pollution Degree 2. The meter also meets UL 61010-1, 2 <sup>nd</sup> Edition (2004), CAN/CSA C22.2 No. 61010-1 2 <sup>nd</sup> Edition (2004), and UL 61010B-2-031, 1 <sup>st</sup> Edition (2003) |