The Tool Connection Limited Digital Engine Analyser is designed for troubleshooting automotive electrical systems. The testprocedures described in these instructions are some of the more common procedures used by experienced technicians. Many of the test procedures need precautions to avoid accidents that may result in personal injury or damage to the vehicle or test equipment. Take note of the following safety precautions and apply them always.

Precautions:

- Always refer to instructions before use.
- Always refit the test probe covers when finished with meter.
- Observe standard workshop safety procedures when using the tester.
- Do not let the tester get wet or use in damp or wet conditions.

Safety First. Be Protected.

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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 CONNECTION
The Complete Connection

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LASER®

Digital Engine Analyser & Multimeter

Instructions

Features large LCD display with 25mm digital readout.
Measures DC voltage and current, AC voltage and current; and resistance.
For automotive testing it measures duty cycle, engine RPM (tachometer), dwell angle, diode and continuity.
Includes a transistor test function. Also features temperature measurement capability, data hold and auto power off function.
Shock-resisting soft grip case with probe storage and integral stand, suitable for tough workshop conditions.

www.lasertools.co.uk

Specification

Function		Range	Resolution	Accuracy
Volts DC		2V	1mV	+/- 0.5% + 2
		20V	10mV	
		200V	100mV	
		1000V	1V	+/- 0.8% + 3
Volts AC		2V	1mV	+/- 0.8% + 3
		20V	10mV	
		200V	100mV	
		700V	1V	+/- 1.2% + 5
Amps DC		20mA	10µA	+/- 0.8% + 2
		200mA	100µA	+/- 1.2% + 2
		20A	10mA	+/- 2% + 5
Amps AC		20mA	10µA	+/- 1% + 3
		200mA	100µA	+/- 1.8% + 3
		20A	10mA	+/- 3% + 7
OHM		200Ω	0.1Ω	+/- 0.8% + 3
		20KΩ	10Ω	+/- 0.8% + 2
		200KΩ	100Ω	+/- 0.8% + 2
		20MΩ	10KΩ	+/- 1% + 5
Duty Cycle		0.1% - 99.9%	0.1%	+/- 1.5%
Temperature		-20°C - 0°C	1°C	+/- 5% + 5
		0°C - 400°C		+/- 1% + 3
		400°C - 1000°C		+/- 2% + 4
TACH	3 Cyl	500-10,000 RPM	10 RPM	+/- 1.2% + 2
	4 Cyl			
	5 Cyl			
	6 Cyl			
	8 Cyl			
DWELL	3 Cyl	0° - 120°	0.1 °	+/- 1.2% + 2
	4 Cyl	0° - 90°		
	5 Cyl	0° - 72°		
	6 Cyl	0° - 60°		
	8 Cyl	0° - 45°		
Diode		Display reads approx. forward voltage of diode test condition. Forward DC current approx. 1mA, Reverse DC voltage approx. 2.8V.		
Buzzer		Built in - sounds if conductance is less than approx. <30Ω. Test condition circuit voltage approx. 2.8V.		
hFE		0-1000qΩ	Basic polarity current 10mA, Vce 2.8V	
Display		65mm LCD, 25mm character height. Max reading 1999 with annunciators		
Polarity		Automatic '–' is displayed on LCD		
Over-range indication		'1' is displayed on LCD		
Low battery indication		Battery symbol (B) is displayed on LCD		
Operating temperature		0°C to 50°C less than 80% relative humidity up to 35°C less than 70% relative humidity from 35°C to 50°C		
Storage temperature		-15°C to 50°C		
Temperature coefficient		0°C to 18°C and 28°C to 50°C less than 0.1x applicable accuracy specification per °C		
Power		9V alkaline or carbon zinc battery (NEDA 1604)		
Battery life (typical)		100 hours with carbon zinc cells - 200 hours with alkaline cells		
Dimensions		72W x 156L x 37D mm		
Weight		Approx 205g		
Accessories		Safety test leads, crocodile clips, temperature wire probe, operator's instruction leaflet.		

Transistor hFE Measurement

1. Set the **function / range** switch **(D)** to the **hFE** position.
2. Insert the black test lead plug into the COM socket **(J)**.
   Insert the red test lead plug into the mA socket **(G)**.
3. Identify transistor type (PNP or NPN) and identify transistor pins (emitter, base or collector).
4. Connect the transistor to the corresponding positions on the transistor test socket **(E)**.
5. The display will show the approximate gain of the transistor.

RPM (Tachometer) Measurements

1. Set the **function / range switch (D)** to the **TACH x10** position selecting the appropriate engine cylinder setting.
2. Insert the black test lead plug into the COM socket **(J)**.
   Insert the red test lead plug into the multifunction socket **(H)**.
3. Connect the test leads according to the type of ignition system fitted to the vehicle - **(A)** Standard ignition systems: black test lead to earth, red test lead to the negative (-) side of the ignition coil. **(B)** Distributorless ignition systems **DIS:** locate the ignition coil pack which will have will have a wire designated to provide an RPM signal to the car's ECU. *Consult the manufacturer's technical documentation to determine the location of the RPM wire.*
   Then, black test lead to earth, and red test lead to the RPM wire.
4. Multiply the displayed reading 10 times to get the actual RPM.

Dwell Angle Measurement

On conventional contact breaker type ignition systems, the dwell angle is the number of degrees (°) through which the distributor cam rotates while the breaker points are closed.

1. Set the **function / range** switch **(D)** to the **DWELL** position selecting the appropriate engine cylinder setting.
2. Insert the black test lead plug into the COM socket **(J)**. Insert the red test lead plug into the multifunction socket **(H)**.
3. Connect the black test lead to earth, red test lead to the negative (-) side of the ignition coil.
4. When the engine is started the dwell will be displayed.

Note: To reduce the dwell angle reading the points gap must be increased; to increase the dwell angle the points gap must be reduced. Refer to the owner's handbook, workshop manual or other manufacturer's documentation for detailed procedures for dwell settings and adjustments.

Other Functions

Your digital engine analyser and multimeter is also capable of testing various automotive sensors:
• Oxygen (Lambda) sensors • Fuel injectors • Temperature sensors • Position sensors
• Absolute pressure (MAP) • Mass Air Flow (MAF)
Please refer to the manufacturer's technical documentation for detailed descriptions and testing procedures for these sensors.

Replacing the battery and fuse

If the 'low battery alert' **(B)** appears on the digital display it indicates that the battery should be replaced. To replace the battery you must return the product to the dealer from whom you bought it. Similarly, the fuse should not need to be replaced, it will only blow as a result of overload conditions. If the fuse needs to be replaced you must return the product to the dealer from whom you bought it. Do not remove the back of the instrument yourself as this will invalidate the warranty.

Instructions

1. Press **power switch (A)** to switch multimeter on. To conserve the battery, always turn off when the meter is not in use. However the 'auto power off' function will switch the meter off after a period on non-use.
2. The hold **reading button (L)** allows the user to freeze a measurement for later reference. The indicator 'H' will appear in the display. Pressing the hold reading button again will return to normal use.
3. The **function / range** switch **(D)** is a rotary switch that lets you select the function (voltage DC, voltage AC, tachometer [engine RPM], engine dwell angle, current AC, current DC, temperature, duty cycle, continuity, diode test, resistance) and the available ranges within these functions. As the function / range switch is turned, the positive (red) sockets (**F, G & H**) will open and close at the appropriate position on the dial.
   Do not rotate the function / range switch while the test leads are connected to the multimeter - the socket shutters may be damaged.
4. The multimeter is supplied with a wire temperature probe. This is inserted into socket **(K)** and the function / range switch **(D)** turned to the ºC position.

DC Voltage Measurement

(**Caution**: Do not measure DC voltages if a motor or component on the circuit is being switched on and off; large voltage surges can occur that may damage the multimeter.)

1. Set the **function / range** switch **(D)** to the **V DC** position. If unsure which range to select choose a higher range initially. For cars using a 12V electrical system the range would be set to '20' for example.
2. Remove covers from test probe tips and plugs.
3. Insert the black test lead plug into the COM socket **(J)**. Insert the red test lead plug into the multifunction socket **(H)**.
4. Touch the black test probe tip to the negative side of the circuit. Modern cars have negative earth (ground) electrical systems although some classic cars may still be operating with a positive earth system.
5. Touch the red test probe tip to the positive side of the circuit and read the voltage on the display. If the polarity is reversed, the display will show a (-) minus before the value.

AC Voltage Measurement

(**Caution**: Risk of electric shock. The probe tips may not be long enough to contact live parts with a 240V outlet because the contacts are recessed deep in the outlets. **Make sure the probe tips are touching the metal contacts before assuming that no voltage is present.**

Do not measure DC voltages if a motor or component on the circuit is being switched on and off; large voltage surges can occur that may damage the multimeter.)

1. Set the **function / range** switch **(D)** to the **V AC** position. If unsure which range to select choose a higher range initially.
2. Remove covers from test probe tips and plugs.
3. Insert the black test lead plug into the COM socket **(J)**. Insert the red test lead plug into the multifunction socket **(H)**.
4. Touch the black test probe tip to the negative side of the circuit.
5. Touch the red test probe tip to the positive side of the circuit and read the voltage on the display. If the polarity is reversed, the display will show a (-) minus before the value.

DC Current Measurement

(**Caution**: Do not make current measurements on the 20A scale for longer than 10 seconds. Exceeding 10 seconds may cause damage to the meter and/or the test leads and probes.)

1. Insert the black test lead plug into the COM socket **(J)**.
2. For current measurements up to 200mA, set the **function / range** switch **(D)** to the **A AC** position and 200m range; insert the red test lead plug into the milliamps socket (G).
3. For current measurements up to 20mA, set the **function / range** switch **(D)** to the **A AC** position and 20m range; insert the red test lead plug into the milliamps socket **(G)**.
4. For current measurements up to 20A, set the **function / range** switch **(D)** to the **A AC** position and 20 range; insert the red test lead plug into the 20A socket **(F)**.
5. Remove power from the circuit under test, then open up the circuit at the point where you intend to measure current.
6. Connect test leads **in series** with the circuit.
7. Apply power to the circuit and read the display.

AC Current Measurement

(**Caution:** Risk of electric shock. **Do not** measure AC current on any circuit where voltage exceeds 250V AC.

Do not make current measurements on the 20A scale for longer than 10 seconds. Exceeding 10 seconds may cause damage to the meter and/or the test leads and probes.)

1. Insert the black test lead plug into the COM socket **(J)**.
2. For current measurements up to 200mA, set the **function / range** switch **(D)** to the **A AC** position and 200m range; insert the red test lead plug into the milliamps socket **(G)**.
3. For current measurements up to 20mA, set the **function / range** switch **(D)** to the **A AC** position and 20m range; insert the red test lead plug into the milliamps socket **(G)**.
4. For current measurements up to 20A, set the **function / range** switch **(D)** to the **A AC** position and 20 range; insert the red test lead plug into the 20A socket **(F)**.
5. Remove power from the circuit under test, then open up the circuit at the point where you intend to measure current.
6. Connect test leads in series with the circuit.
7. Apply power to the circuit and read the display.

Resistance Measurement

(**Caution**: Risk of electric shock. Disconnect power to the unit under test and discharge all capacitors before taking any resistance measurements, If applicable, remove any batteries.)

1. Set the **function / range** switch **(D)** to the **Ω** position.
2. Remove covers from test probe tips and plugs.
3. Insert the black test lead plug into the COM socket **(J)**. Insert the red test lead plug into the multifunction socket **(H)**.
4. Touch the test probes across the circuit or component under test. Components should be disconnected from their circuit so that the circuit does not interfere with the resistance reading.

Continuity Check

(**Caution:** Risk of electric shock. Never measure continuity on circuits or wires that have voltage on them.)

1. Set the function / range switch **(D)** to the position.
2. Insert the black test lead plug into the COM socket **(J)**. Insert the red test lead plug into the multifunction socket **(H)**.
3. Touch the test probes to the wire or circuit you wish to check.
4. If the wire / circuit has continuity, the audible signal will sound and the symbol will be displayed.

Diode Check

(**Caution:** Risk of electric shock. Do not test a diode that has voltage on it.)

1. Set the **function / range switch (D)** to the position.
2. Insert the black test lead plug into the COM socket **(J)**. Insert the red test lead plug into the multifunction socket **(H)**.
3. Touch the test probes to the diode you wish to test. Note the reading.
4. Reverse polarity by switching probes; Note this reading.
5. The diode can be measured as follows: if one reading shows a value and the other reading shows '**1**', the diode is OK; if both readings display '1' the device is open.

Temperature Measurements

1. Ensure that the positive (red) test lead plug has been removed from the meter.
2. Set the **function / range** switch **(D)** to the °C position.
3. Insert the temperature wire probe adaptor into the temperature probe socket on the meter **(K)**. **Caution:** Ensure the polarity is correct, + and – are marked both on the meter socket and on the temperature wire probe adaptor. Push adaptor firmly into socket.
4. Touch the temperature probe head to the part whose temperature you wish to measure. Keep the probe touching the part until the reading stabilises (about 10 seconds).
5. Remove the temperature wire probe adaptor before changing to another measurement function.

Duty Cycle

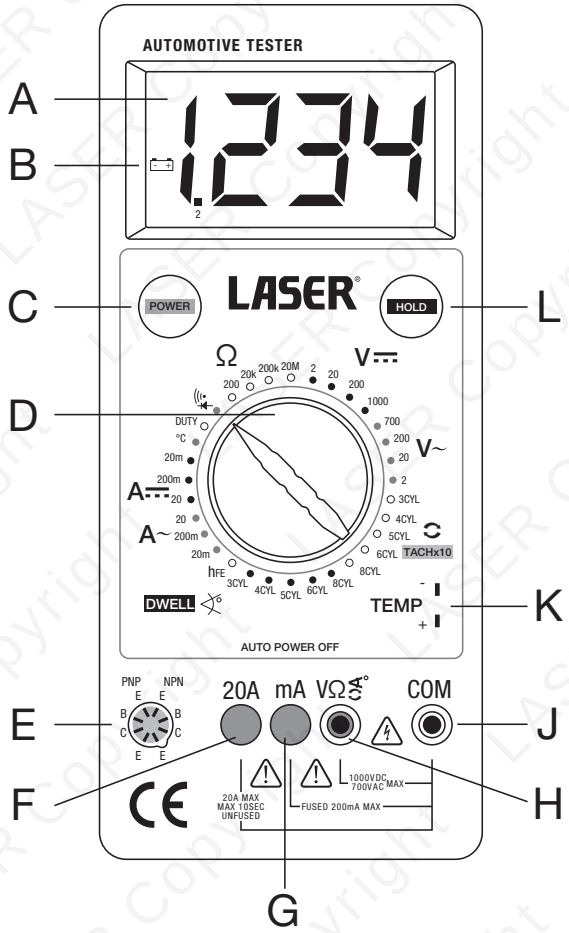
1. Set the **function / range** switch **(D)** to the **DUTY** position.
2. Insert the black test lead plug into the COM socket **(J)**. Insert the red test lead plug into the multifunction socket **(H)**.
3. Connect the negative (black) test probe tip to earth (ground).
4. Connect the positive (red) test probe tip to the signal wire circuit (for example, a fuel injector or fuel mixture control solenoid).

Safety Notes

1. Do not rotate the dial while the meter is connected to a circuit - you may rotate it through a current range, short circuiting the probes and damaging either the meter or the circuit.
2. Do not rotate the dial while the test leads are connected to the multimeter - the positive socket shutters may be damaged.
3. Respect the circuitry you are working on - If you touch exposed metal, or cause a short circuit, or connect to high voltage, you may expose yourself to hazard - or damage the circuit or your meter.
4. Measuring the short circuit current of a battery or power supply is unsafe - it is likely to damage the meter or battery and possibly cause the battery to overheat so much that it may be dangerous.

Notes

On some AC and DC voltage ranges, while the test leads are not connected to a device, the display may show a random reading. This is quite normal and is caused by the high sensitivity to input; the reading will stabilise and give a proper measurement when connected to a circuit.



A	Digital display
B	Low battery alert
C	Power switch (On-Off)
D	Function / Range switch
E	Transistor test socket
F	20A socket (red lead)
G	Milliamps socket (red lead)
H	Multifunction socket (red lead)
J	Common socket (black lead)
K	Temperature probe socket
L	Hold reading