Oscilloscopes

An oscilloscope is a piece of electrical test equipment designed to act like a voltmeter or an ammeter. A multimeter's measurement readout can't change fast enough to deal with modern electronic systems on motor vehicles – the numbers on the screen can't keep up. The answer to this is to use an oscilloscope.

Unlike a voltmeter, oscilloscopes not only show volts or amps but also time. Instead of a digital readout, the results are shown as a graph of volts or amps against time on a screen (as shown in Figure 1.35)

Figure 1.34 Handheld oscilloscope

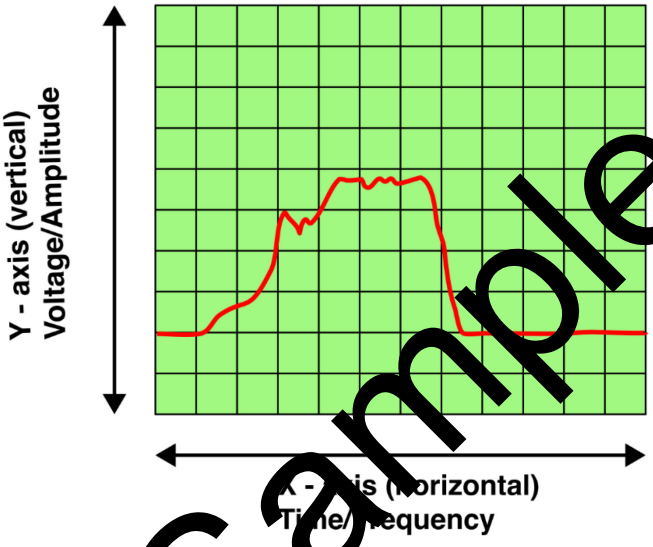
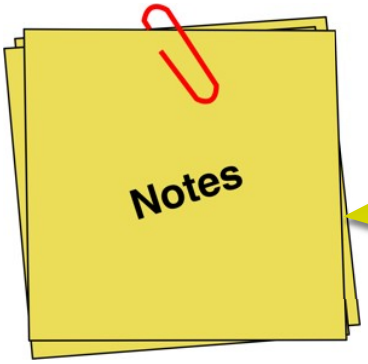


Figure 1.35 An oscilloscope screen

• The graph normally shows voltage or amperage at the side of the screen (on the y-axis) – this axis is often called **amplitude**. Use the scale setting switch in a similar way to the dial on a manual multimeter to choose the amount of volts or amps that are shown on the screen.

- The graph normally shows time across the bottom of the screen (on the x-axis). This axis is often called **frequency**. Use the timescale switch in a similar way to the dial that is used to choose the amount of volts on a multimeter.



An easy way to remember which axis is which on a graph is to say ‘X is across’ (a cross).

Lots of people are put off using oscilloscopes by the large box containing many wires and connectors. They feel that it will be complicated and time consuming to set up, so they don’t bother.

However, to use an oscilloscope for simple electrical testing, you only need two probes – a common and voltage wire – just like a multimeter. To measure amperage, you may need an inductive clamp.

Most of the diagnostic sockets found on oscilloscopes are colour-coded, so after a quick check of the manufacturer's instructions, it should be fairly easy to know where to plug these probes in.

Amplitude – the height of a waveform, measured in volts or amps.

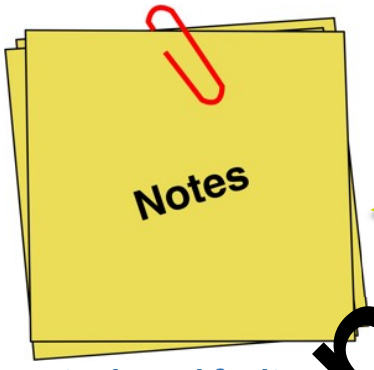
Frequency – the time scale of a waveform (how often something happens).

Using an oscilloscope for electrical testing

How to:

Note: The oscilloscope probes may come in different colours, but for the sake of simplicity we will call them red and black here.

1. Connect the tip of the black lead to a good source of earth, such as the battery terminal, metal bodywork or engine. This will then only leave you with the red wire to worry about.
2. Observing any manufacturers high voltage safety precautions, connect the red probe to the circuit to be tested. (Some oscilloscopes will require the fitting of a resistor known as an attenuator in order to read high voltages).
3. Adjust the scales until you see an image on the screen.
4. After some practice, you will become familiar with the patterns and waveforms created by different vehicle systems.



If you don't know what voltage or timescale to use on an oscilloscope, find out in the same way as you would with a multimeter. Start with the highest setting available and work downwards until you can see an image on the screen.

Scan tools and fault code readers

Faults with many modern vehicle systems would be difficult to diagnose without the aid of a scan tool. The electronic processes that take place within electrical and electronic circuits mean that these systems are being controlled many thousands of times a second, and faults can occur so quickly that you could miss them.

Since the 1980s, manufacturers have been including on-board diagnostic (OBD) systems as part of their vehicle design. The computers that control the vehicle's electrical systems have a self-diagnosis feature. This allows them to detect certain faults and store a code number. Because these electronic control units (ECUs) are monitoring functions, they are able to record intermittent faults and store them in a keep alive memory (KAM) for retrieval by a diagnostic trouble code (DTC) reader.

Figure 1.36 Scan tool

It is a common misunderstanding to think that plugging a fault code reader into the vehicle's OBD system will tell you what the fault is. It actually only points you in the direction of the fault. You must test the system and components to find the fault.

E-OBD

European legislation states that any faults with an engine management system which might lead to excessive exhaust pollutants being released to atmosphere must be stored as a diagnostic trouble code. A standardised list of codes and a diagnostic connector were produced to be used by manufacturers selling cars in Europe. In this way, information was made available to all service and maintenance repair facilities. This system has become known as E-OBD.

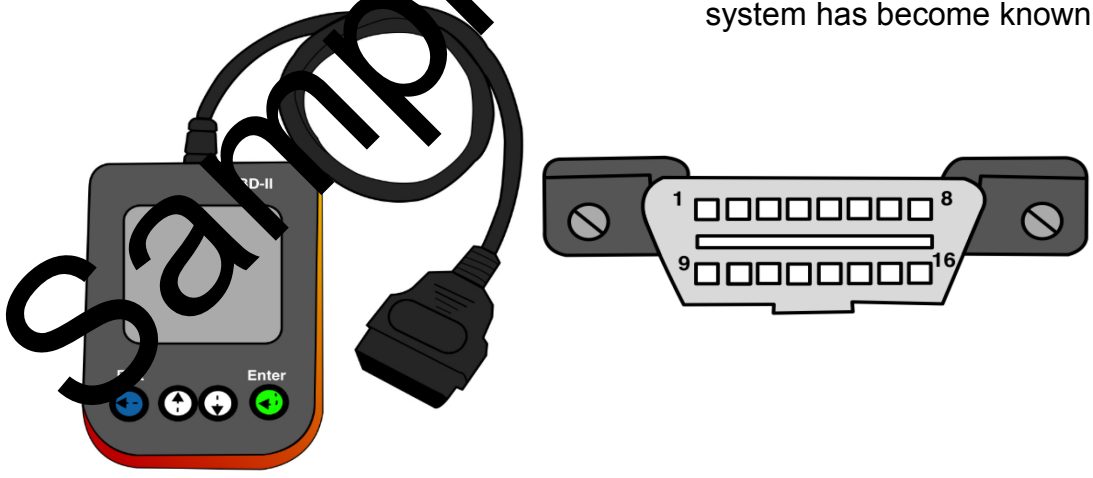


Figure 1.37 A basic E-OBD scan tool and standardised 16-pin diagnostic socket