

## **ELECTRONIC TEST EQUIPMENT**

**Electronic test equipment** is used to create signals and capture responses from electronic devices under test (DUTs). In this way, the proper operation of the DUT can be proven or faults in the device can be traced. Use of electronic test equipment is essential to any serious work on electronics systems.

Practical electronics engineering and assembly requires the use of many different kinds of electronic test equipment ranging from the very simple and inexpensive (such as a test light consisting of just a light bulb and a test lead) to extremely complex and sophisticated such as automatic test equipment (ATE). ATE often includes many of these instruments in real and simulated forms.

Generally, more advanced test gear is necessary when developing circuits and systems than is needed when doing production testing or when troubleshooting existing production units in the field

### **Basic equipment**

The following items are used for basic measurement of voltages, currents, and components in the circuit under test.

- Voltmeter (Measures voltage)
- Ohmmeter (Measures resistance)
- Ammeter, e.g. Galvanometer or Milliammeter (Measures current)
- Multimeter e.g., VOM (Volt-Ohm-Milliammeter) or DMM (Digital Multimeter) (Measures all of the above)
- LCR meter - inductance (L), capacitance (C) and resistance (R) meter (measure LCR values)

The following are used for stimulus of the circuit under test:

- Power supplies
- Signal generator
- Digital pattern generator
- Pulse generator

The following analyze the response of the circuit under test:

- Oscilloscope (Displays voltage as it changes over time)
- Frequency counter (Measures frequency)

And connecting it all together:

- Test probes

### **Advanced or less commonly used equipment**

#### **Meters**

- Solenoid voltmeter (*Wiggy*)
- Clamp meter (current transducer)
- Wheatstone bridge (Precisely measures resistance)
- Capacitance meter (Measures capacitance)

- LCR meter (Measures inductance, capacitance, resistance and combinations thereof)
- EMF Meter (Measures Electric and Magnetic Fields)
- Electrometer (Measures voltages, sometimes even tiny ones, via a charge effect)

### *Probes*

A multimeter with a built in clamp facility. Pushing the large button at the bottom opens the lower jaw of the clamp, allowing the clamp to be placed around a conductor (wire). Depending on sensor, some can measure both AC and DC current.

- RF probe
- Signal tracer

### *Analyzers*

- Logic analyzer (Tests digital circuits)
- Spectrum analyzer (SA) (Measures spectral energy of signals)
- Protocol analyzer (Tests functionality, performance and conformance of protocols)
- Vector signal analyzer (VSA) (Like the SA but it can also perform many more useful digital demodulation functions)

- Time-domain reflectometer (Tests integrity of long cables)
- Semiconductor curve tracer

### *Signal-generating devices*

Leader Instruments LSG-15 signal generator.

- Signal generator usually distinguished by frequency range (e.g., audio or radio frequencies) or waveform type (e.g., sine, square, sawtooth, ramp, sweep, modulated, ...)
- Frequency synthesiser
- Function generator
- Digital pattern generator
- Pulse generator
- Signal injector

### **Miscellaneous devices**

- Boxcar averager
- Continuity tester
- Cable tester
- Hipot tester

- Network analyzer (used to characterize an electrical network of components)
- Test light
- Transistor tester
- Tube tester