

Additional Learning Material

Digital Instruments for Measurement

1 Digital Multimeters

Digital multimeters are instruments capable of measuring both alternating and direct voltage, alternating and direct current, resistance and other electrical parameters and displaying them in a LCD or LED readout. The basic circuit inside is that of a digital voltmeter and the parameter to be measured is converted to a scaled voltage form. The key process inside all these multimeters is analog to digital conversion and depending on the ADC used digital multimeters can be categorised. Nonetheless, the one that is commonly used in digital multimeters is the successive approximation type ADC.

1.1 Working

In successive approximation type of ADC the input voltage is compared with an internal voltage generated from the count in the Successive Approximation Register. Initially the MSB of the register is set to 1 and others to 0, the internal DAC converts this into its equivalent analog value and passes to an analog comparator for comparing with the signal voltage. If the signal value is less than the internal voltage MSB is reset to 0, otherwise it is left to 1 and then proceeds with same set of operation for the next most significant bit. When all bits have been tested the equivalent digital value stored in the SAR is passed on as the output.

The resolution of a multimeter is often specified in the number of decimal digits resolved and displayed. If the most significant digit cannot take all values from 0 to 9 it is termed a fractional digit. For example, a multimeter which can read up to 19999 (plus an embedded decimal point) is said to read 4 digits. By convention, if the most significant digit can be either 0 or 1, it is termed a half-digit; if it can take higher values without reaching 9 (often 3 or 5), it may be called three-quarters of a digit. A 5 digit multimeter would display one "half digit" that could only display 0 or 1, followed by five digits taking all values from 0 to 9. Such a meter could show positive or negative values from 0 to 199,999. A 3 digit meter can display a quantity from 0 to 3,999 or 5,999, depending on the manufacturer.

1.2 Parts of a Multimeter

- Display: The LCD screen present on the upper portion of the multimeter displays four or more digits and also shows negative value if necessary. Some multimeters have illuminated display for better viewing in low light situations.
- Ports:
 - COM: It stands for common and is considered as the negative connection of a circuit. Generally the black colour probe is inserted into COM port.
 - mA Ω : This port allows the measurement of current (up to 200 mA), voltage and resistance and is considered the positive connection of a circuit. Generally the red colour probe is inserted into mA Ω port.
- Probes: Different types of probes available on multimeter are: Banana to Alligator Clips, Banana to IC Hook, Banana to Tweezers