

DIGITAL INSTRUMENTS

Introduction:

The digital voltmeters generally referred as DVM, convert the analog signals into digital and display the voltages to be measured as discrete numericals instead of pointer deflection, on the digital displays. Such voltmeters can be used to measure a.c. and d.c. voltages and also to measure the quantities like pressure, temperature, stress etc. using proper transducer and signal conditioning circuit. The transducer converts the quantity into the proportional voltage signal and signal conditioning circuit brings the signal into the proper limits which can be easily measured by the digital voltmeter. The output voltage is displayed on the digital display on the front panel. Such a digital output reduces the human reading and interpolation errors and parallax errors. The DVMs have various features and the advantages, over the conventional analog voltmeters having pointer deflection on the continuous scale.

Performance parameters of digital voltmeters:

1. Number of measurement ranges:

The basic range of any DVM is either 1V or 10 V. With the help of attenuator at the input, the range can be extended from few microvolts to kilovolts.

2. Number of digits in readout: The number of digits of DVMs vary from 3 to 6. More the number of digits, more is the resolution.

3. Accuracy: The accuracy depends on resolution and resolution on number of digits. Hence more number of digits means more accuracy. The accuracy is as high upto $\pm 0.005\%$ of the reading.

4. Speed of the reading: In the digital voltmeters, it is necessary to convert analog signal into digital signal. The various techniques are used to achieve this conversion. The circuits which are used to achieve such conversion are called digitizing circuits and the process is called digitizing. The time required for this conversion is called digitizing period. The maximum speed of reading and the digitizing period are interrelated. The instrument user must wait, till a stable reading is obtained as it is impossible to follow the visual readout at high reading speeds.

5. Normal mode noise rejection: This is usually obtained through the input filtering or by use of the integration techniques. The noise present at the input, if passed to the analog to digital converting circuit then it can produce the error, especially when meter is used for low voltage measurement. Hence noise is required to be filtered.

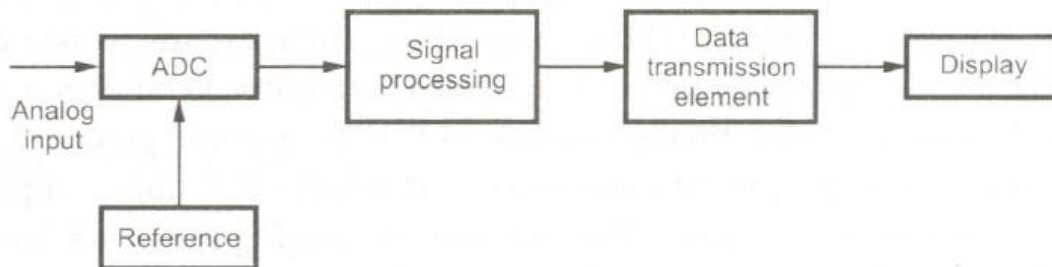
6. **Common mode noise rejection** : This is usually obtained by guarding. A guard is a sheet metal box surrounding the circuitry. A terminal at the front panel makes this 'box' available to the circuit under measurement.

7. **Digital output of several types**: The digital readout of the instrument may be 4 line BCD, single line serial output etc. Thus the type of digital output also determines the variety of the digital voltmeter.

8. **Input impedance** : The input impedance of DVM must be as high as possible which reduces the loading effects. Typically it is of the order of 10^8 ohm.

Block diagram of DVM:

Any digital instrument requires analog to digital converter at its input. Hence first block in a general DVM is ADC as shown in the Fig.



Every ADC requires a reference. The reference is generated internally and reference generator circuitry depends on the type of ADC technique used. The output of ADC is decoded and signal is processed in the decoding stage. Such a decoding is necessary to drive the seven segment display. The data from decoder is then transmitted to the display. The data transmission element may be a latches, counters etc. as per the requirement. A digital display shows the necessary digital result of the measurement.

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