

Digital Voltmeters

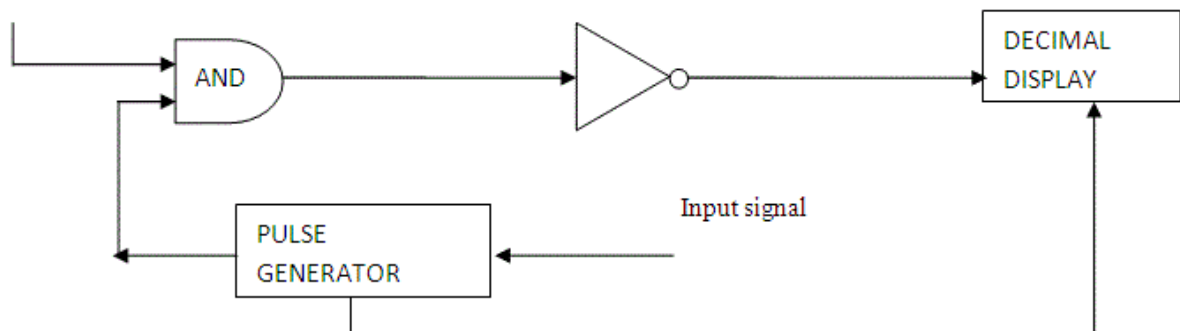
Working Principle of Digital Voltmeter

Voltmeter is an electrical measuring instrument used to measure potential difference between two points. The voltage to be measured may be AC or DC. Two types of voltmeters are available for the purpose of voltage measurement i.e. analog and digital. Analog voltmeters generally contain a dial with a needle moving over it according to the measure and hence displaying the value of the same. With time analog voltmeters are replaced by digital voltmeters due to the same advantages associated with digital systems. Although digital voltmeters do not fully replace analog voltmeters, still there are many places where analog voltmeters are preferred over digital voltmeters. Digital voltmeters display the value of AC or DC voltage being measured directly as discrete numerical instead of a pointer deflection on a continuous scale as in analog instruments.

A digital voltmeter (DVM) displays the value of a.c. or d.c voltage being measured directly as discrete numerals in the decimal number system. Numerical readout of DVMs is advantageous since it eliminates observational errors committed by operators. The errors on account of parallax and approximations are entirely eliminated. The use of digital voltmeters increases the speed with which readings can be taken. Also, the output of digital voltmeters can be fed to memory devices for storage and future computations.

A digital voltmeter is a versatile and accurate voltmeter which has many laboratory applications. On account of developments in the integrated circuit (IC) technology, it has been possible to reduce the size, power requirements and cost of digital voltmeters. In fact, for the same accuracy, a digital voltmeter now is less costly than its analog counterpart. The decrease in the size of DVMs on account of the use of ICs, the portability of the instruments has increased.

Circuit or Block diagram of Digital Voltmeters:



From the above block diagram, the **voltage** to be measured is given to the input signal present in the circuit diagram. And next to this signal is processed onto the pulse generator which generates a train of rectangular pulses by using both analog and digital techniques.


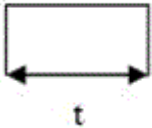
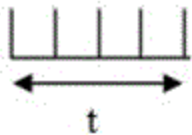
The digital circuitry present inside the pulse generator will control the width and frequency while analog circuitry will control the amplitude, rise time and fall time of the pulse generator. When AND gate is fed with train pulse and rectangular pulse, it will give train pulses with the same duration of that of the rectangular pulse.

Explanation of various blocks:


Input signal: It is basically the signal i.e. voltage to be measured.

Pulse generator: Actually it is a voltage source. It uses digital, analog or both techniques to generate a rectangular pulse. The width and frequency of the rectangular pulse is controlled by the digital circuitry inside the generator while amplitude and rise and fall time is controlled by analog circuitry.

AND gate: It gives high output only when both the inputs are high. When a train pulse is fed to it along with rectangular pulse, it provides us an output having train pulses with duration as same as the rectangular pulse from the pulse generator.

	Train pulse
	Rectangular pulse
	Output of AND gate

NOT gate: It inverts the output of AND gate.

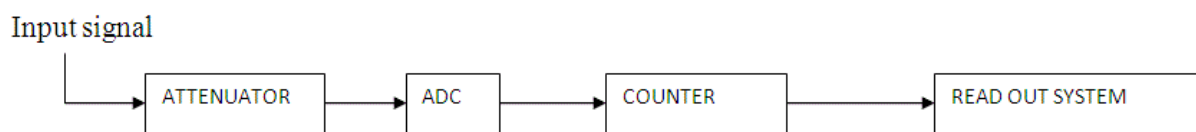
	Output of NOT gate
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Decimal Display: It counts the numbers of impulses and hence the duration and display the value of voltage on LED or LCD display after calibrating it.

Working of a digital voltmeter as follows:

- Unknown voltage signal is fed to the pulse generator which generates a pulse whose width is proportional to the input signal.
- Output of pulse generator is fed to one leg of the AND gate.
- The input signal to the other leg of the AND gate is a train of pulses.
- Output of AND gate is positive triggered train of duration same as the width of the pulse generated by the pulse generator.
- This positive triggered train is fed to the inverter which converts it into a negative triggered train.
- Output of the inverter is fed to a counter which counts the number of triggers in the duration which is proportional to the input signal i.e. voltage under measurement.
- Thus, counter can be calibrated to indicate voltage in volts directly.

The working of digital voltmeter that it is nothing but an analog to digital converter which converts an analog signal into a train of pulses, the number of which is proportional to the input signal. So a **digital voltmeter** can be made by using any one of the A/D conversion methods.



On the basis of A/D conversion method used digital voltmeters can be classified as:

- (i) **Ramp type digital voltmeter**
- (ii) **Integrating type digital voltmeter**
- (iii) **Potentiometric type digital voltmeter**
- (iv) **Successive approximation type digital voltmeter**
- (v) **Continuous balance type digital voltmeter**

Now-a-days **digital voltmeters** are also replaced by digital multimeters due to its multitasking feature i.e. it can be used for measuring current, voltage and resistance. But still there are some fields where separated digital voltmeters are being used.