V – F CONVERTER TYPE INTEGRATING DVM

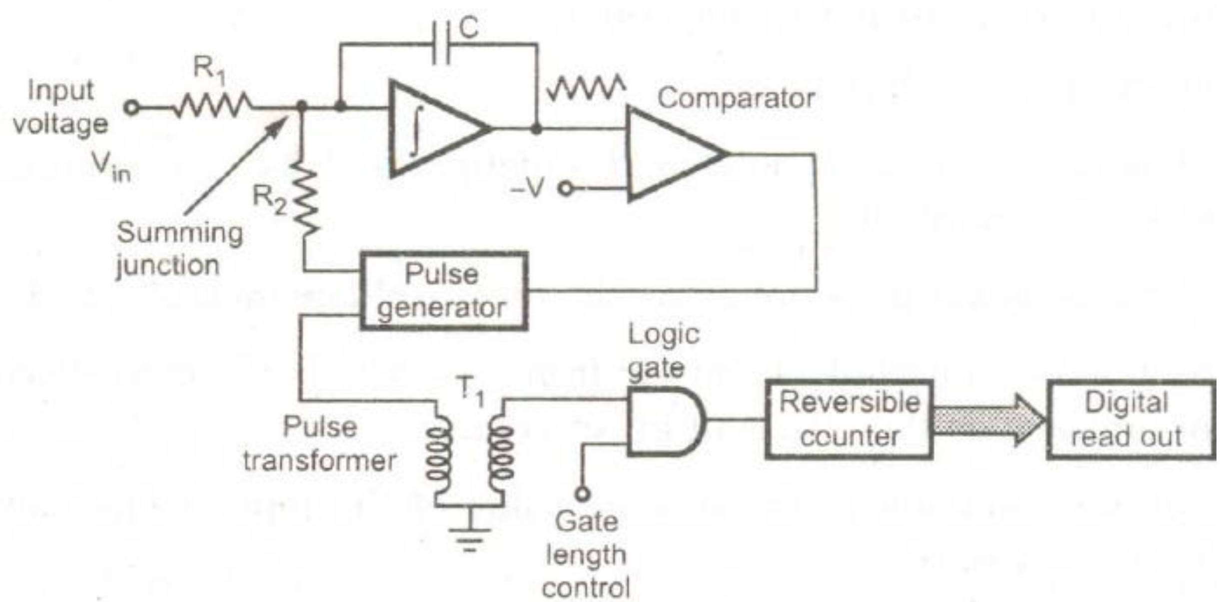
In case of ramp type DVM, the voltage is converted to time. The time and frequency are related to each other. Thus the voltage can be converted to frequency for the measurement purpose. A train of pulses, whose frequency depends upon the voltage being measured, is generated. Then the number of pulses appearing in a definite interval of time is counted . Since the frequency of these pulses is a function of the unknown voltage, the number of pulses counted in that period of time is the indication of the unknown input voltage.

The heart of such integrating type of DVM is the operational amplifier used as an integrator. The input voltage is integrated for a fixed interval. An integration of a constant input voltage results a ramp at the output, the slope of which is proportional to the input voltage. If the input is positive, the output of op-amp is negative going ramp. After some time, the capacitor is discharged to 0, thus output returns back to zero and the next cycle begins. Hence the waveform at the output is a sawtooth waveform as shown in the Fig.

If the input signal is doubled, the number of teeth in the output signal per unit time will be also doubled. Thus the frequency of the output will be doubled. Thus the frequency of the output is proportional to the input voltage. This is nothing but the voltage to frequency conversion.

The sawtooth pulses are finally enter into a reversible counter. The measured value by the reversible counter is finally displayed with the help of digital readout.

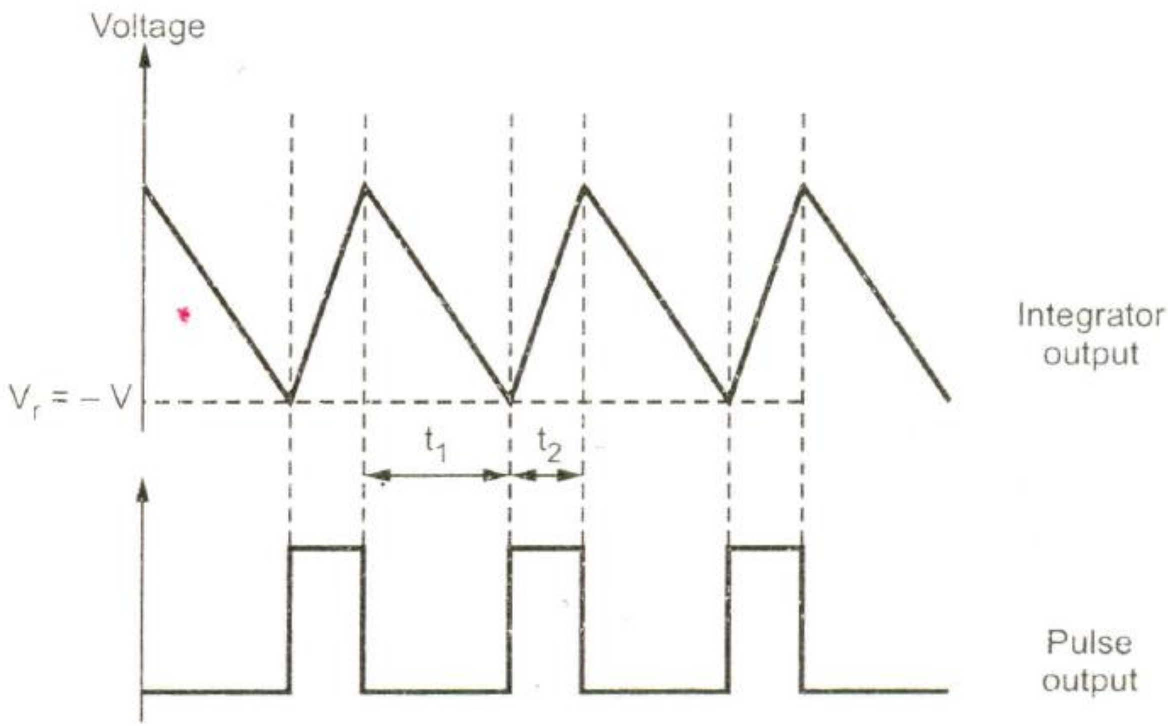
The block diagram of voltage to frequency converter type integrating DVM is shown in the Fig.



Initially output of an integrator is adjusted to zero volts. When the input voltage Vi" is applied, the charging current Vin /Rj flows, which starts the charging of the capacitor C. This produces a ramp at the output. When input voltage is positive, the output ramp is negative going. This ramp is given as one input of a comparator. A -V volts is given as a reference to the second input terminal of a comparator. The negative going ramp and – V volts reference are compared by the comparator. When the ramp reaches to -V volts, the comparator output changes its state. This signal triggers the pulse generator. The function of the pulse generator is to produce a pulse of precision charge content. The polarity of this charge is opposite to that of capacitor charge. Thus the pulse generated by the pulse generator rapidly discharges the capacitor. Hence the output of the op-amp again becomes zero. This process continues so as to get a sawtooth waveform at the output of op-amp. The frequency of such waveform is directly proportional to the applied input voltage. Thus if the input voltage increases, the number of teeth per unit time in the sawtooth waveform also increases i.e. the frequency increases.

Each teeth produces a pulse at the output of the pulse generator so number of pulses is directly related to the number of teeth i.e. the frequency. These pulses are allowed to pass through the pulse transformer. These are applied at one input of the gate. Gate length control signal is applied at the other input. The gate length' may be 0.1 sec, Isec, 20 msec etc. The gate remains open for this much time period.

The wavefoms of integrator output and output of a pulse generator are shown In the Fig



From the analysis of dual slope technique, we can write,

$$V_{in} = V_r \frac{t_2}{t_1}$$

But in this type, both V1 and t2 are constants.

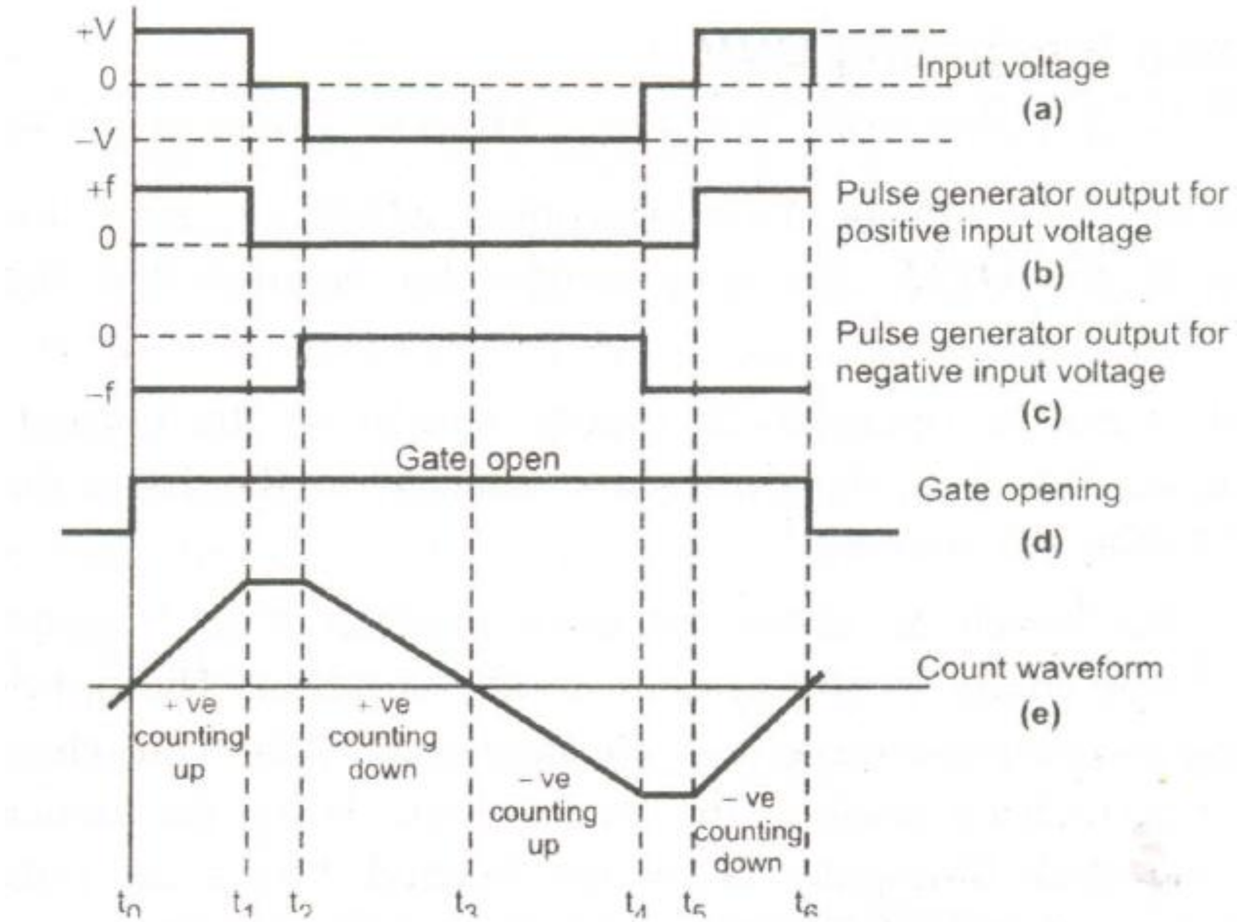
$$K_2 = V_r t_2$$

$$\boxed{V_{in} = K_2\left(\frac{1}{t_1}\right) = K_2(f_o)}$$

Accuracy: The accuracy of voltage to frequency conversion technique depends on the magnitude and stability of the charge produced by the pulse generator. Thus the, accuracy depends on the precision of the charge fedback in every pulse and also on the linearity, between voltage and frequency.

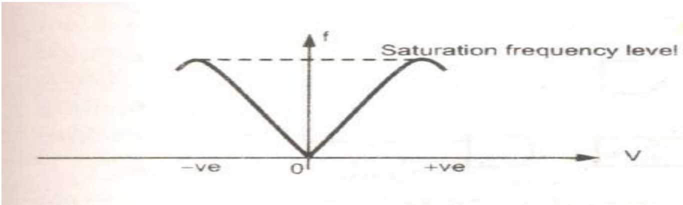
To obtain the better accuracy the rate of pulses generated by the pulse generator is kept equal to,

i) the voltage time integration of the input signal ii) the total voltage time areas of the feedback pulses.



When input voltage polarity is positive i.e. for the periods t (t0 to t1 and t5 to t6 the output of the pulse generator is high. For other time period it is low. This is shown in the Fig . When the input voltage polarity is negative i.e. for the period t 1 to t 4 the output of the pulse generator is high. This is due to other pulse generator used for the bipolar voltages. This is shown in the Fig. For the period t0 to t1, it is positive counting up. For the period t2 to t3 it is positive counting down. For t 3 to t 4 negative counting up while for the period t 5 to t6, it is negative counting down.

Transfer characteristics : The transfer characteristics show the relation between the input voltage and the output frequency. This should be as linear as possible. It remains linear upto a frequency called **saturation frequency.** This is shown in the Fig. The slope of both the positive and negative voltage characteristics must be same.



To increase the operating speed of this type of DVM, the upper frequency can be increased i.e. increasing V/ f conversion rate. But this results into reduced accuracy and design cost of such circuit is also very high. Hence another method in which 5 digit resolution is available, is used to increase the speed of operation. This is the modified version of V/ f integrating type DVM and is called interpolating integrating DVM.

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