2.4 Time-ratio Control

In the time ratio control the value of the duty ratio, D is varied. There are two ways, which are constant frequency operation, and variable frequency operation.

Constant Frequency Operation

In this control strategy, the ON time, T_{ON} is varied, keeping the frequency , or time period (f=1/T) constant. This is also called as pulse width modulation control (PWM). Two cases with duty ratios, as (a) 0.25 (25%), and (b) 0.75 (75%) are shown. Hence, the output voltage can be varied by varying TON.

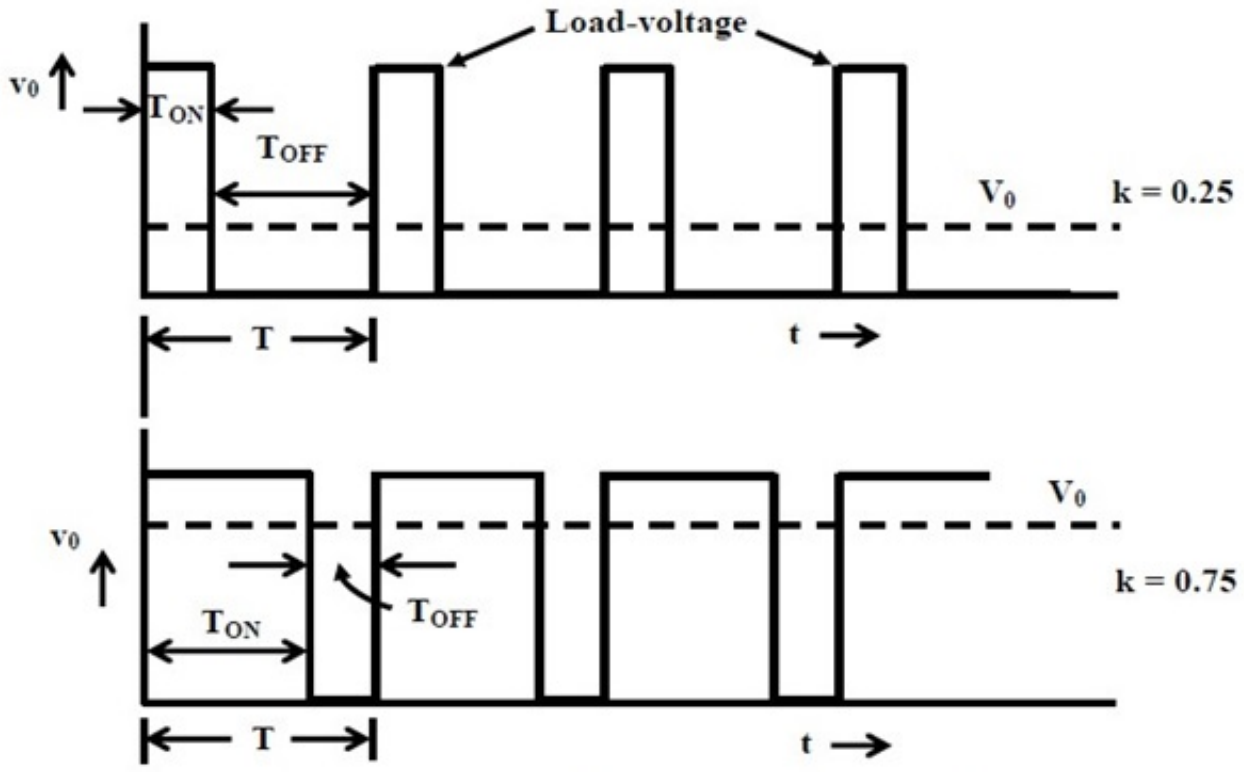

Fig. 2.4.1 : Pulse-width modulation control (constant frequency)

(Source:"Fundamentals of Electrical Drives" by G.K.Dubey,page-122)

Variable Frequency Operation

In this control strategy, the frequency (f=1/T), or time period *T* is varied, keeping either (a) the ON time, constant, or (b) the OFF time, constant. This is also called as *frequency modulation control*. Two cases with (a) the ON time, constant, and (b) the OFF time, constant, with variable frequency or time period are shown in Fig. The output voltage can be varied in both cases, with the change in duty ratio.

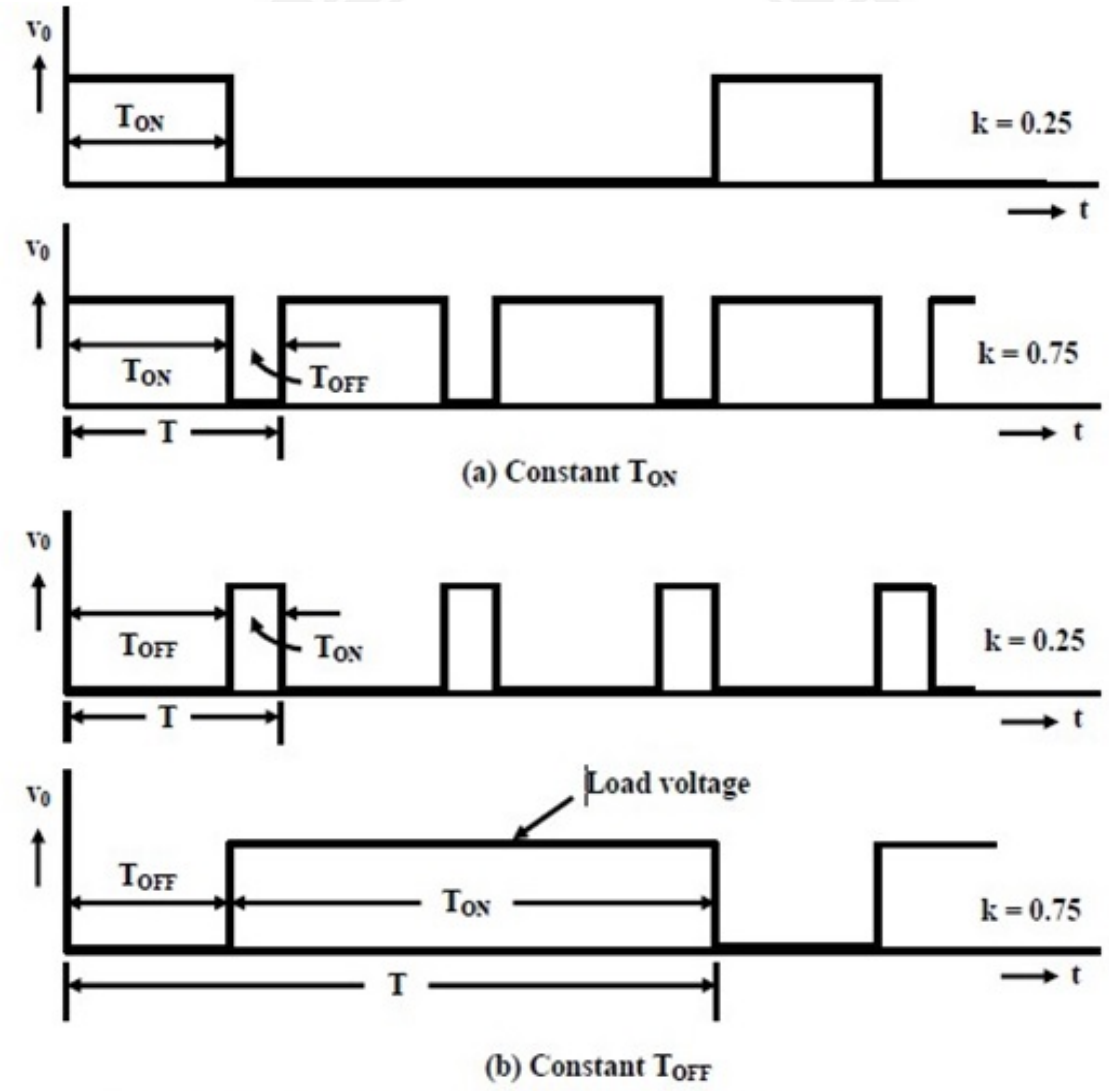

Fig. 2.4.2 : Output voltage waveforms for variable frequency system

(Source:"Fundamentals of Electrical Drives" by G.K.Dubey,page-123)

There are major disadvantages in this control strategy. These are:

(a) The frequency has to be varied over a wide range for the control of output voltage in frequency modulation. Filter design for such wide frequency variation is, therefore, quite difficult.

(b) For the control of a duty ratio, frequency variation would be wide. As such, there is a possibly of interference with systems using certain frequencies, such as signaling and telephone line, in frequency modulation technique.

(c) The large OFF time in frequency modulation technique, may make the load current discontinuous, which is undesirable.

Thus, the constant frequency system using PWM is the preferred scheme for dc-dc converters.

Current Limit Control

As can be observed from the current waveforms for the types of dc-dc converters described earlier, the current changes between the maximum and minimum values, if it (current) is continuous. In the current limit control strategy, the switch in dc-dc converter (chopper) is turned ON and OFF, so that the current is maintained between two (upper and lower) limits.

When the current exceed upper (maximum) limit, the switch is turned OFF. During OFF period, the current freewheels in say, buck converter (dc-dc) through

the diode, , and decreases exponentially. When it reaches lower (minimum) limit, the switch is turned ON. This type of control is possible, either with constant frequency, or constant ON time, . This is used only, when the load has energy storage elements, i.e. inductance, L. The reference values are load current or load voltage. This is shown in Fig. In this case, the current is continuous, varying between and , which decides the frequency used for switching. The ripple in the load current can be reduced, if the difference between the upper and lower limits is reduced, thereby making it minimum. This in turn increases the frequency, thereby increasing the switching losses.

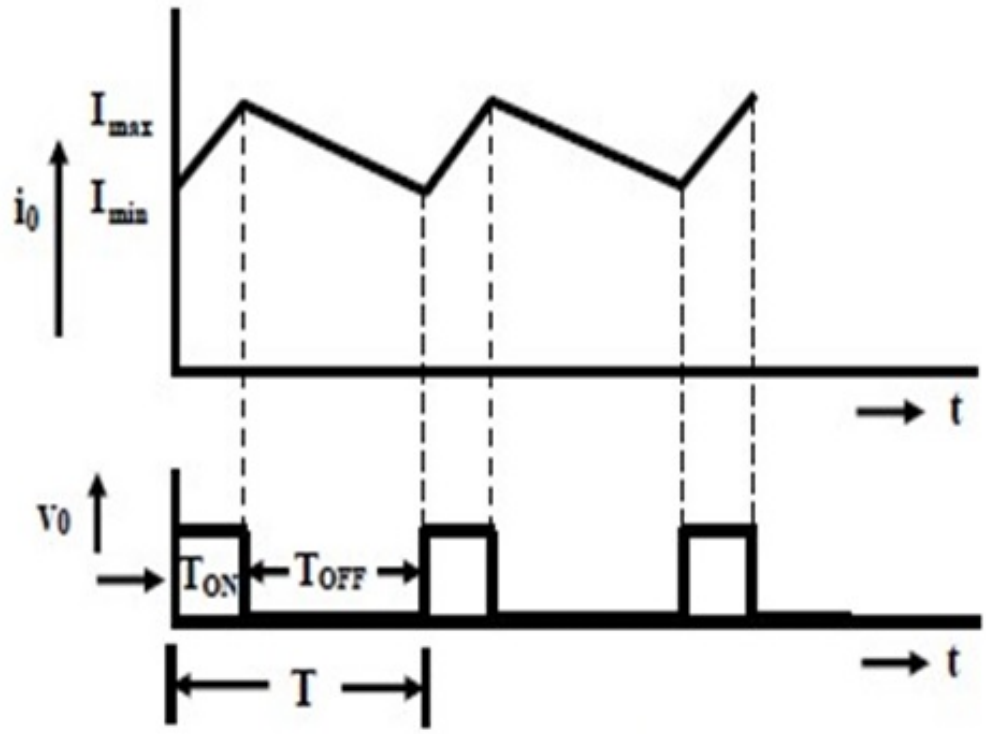

Fig. 2.4.3 : Current limit control

(Source:"Fundamentals of Electrical Drives" by G.K.Dubey,page-125)