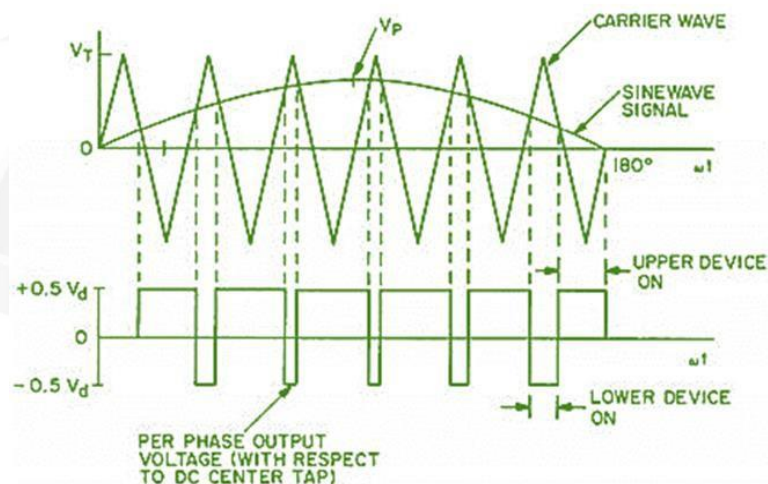


## 2.4 PWM CONTROL: Sinusoidal pulse width modulation (SPWM)

In Sinusoidal Pulse Width Modulation triangular carrier signal is compared with sine wave. Figure below explains the generation of a sinusoidal PWM signal, which finds more applications in industries. The gating signal can be generated by comparing a sinusoidal reference signal with a triangular carrier wave and the width of each pulse varied proportionally to the amplitude of a sine wave evaluated at the center of the same pulse. The output frequency ( $f_o$ ) of the inverter can be found by using the frequency of the reference signal ( $f_r$ ). The rms output voltage ( $v_o$ ) can be controlled by modulation index  $M$  and in turn modulation index is controlled by peak amplitude ( $A_r$ ). The voltage can be calculated by  $V_O = V_s (S_1 - S_4)$ . The number of pulses per half cycle depends on the carrier frequency. The gating signal can be produced by using the unidirectional triangular carrier wave.



**Figure 2.4.1. Multiple pulse width modulation**

[Source: "Power Electronics" by P.S.Bimbra, Khanna Publishers Page: 352]

The frequency of control signal or the modulating signal sets the inverter output frequency ( $f_o$ ) and the peak magnitude of control signal controls the modulation index  $m_a$  which in turn controls the rms output voltage. The area of each pulse corresponds approximately to the area under the sine wave between the adjacent midpoints of off periods on the gating signals. If  $t_{on}$  is the width of  $n$ th pulse, the rms output voltage can be determined by:

$$V_o = V_s \left( \sum_{n=1}^{2p} \frac{2t_{on}}{T} \right)^{1/2}$$

Pulse width modulation is the most commonly used technique to control the output voltage of inverter. In pulse Width Modulation method, a fixed dc input voltage is given to the inverters and a controlled ac output voltage is obtained by adjusting the on and off periods of the inverter components.

PWM is a technique that is used to reduce the overall harmonic distortion THD in a load current. It uses a pulse wave in square form that results in a variable average waveform value, after its pulse width has been modulated.