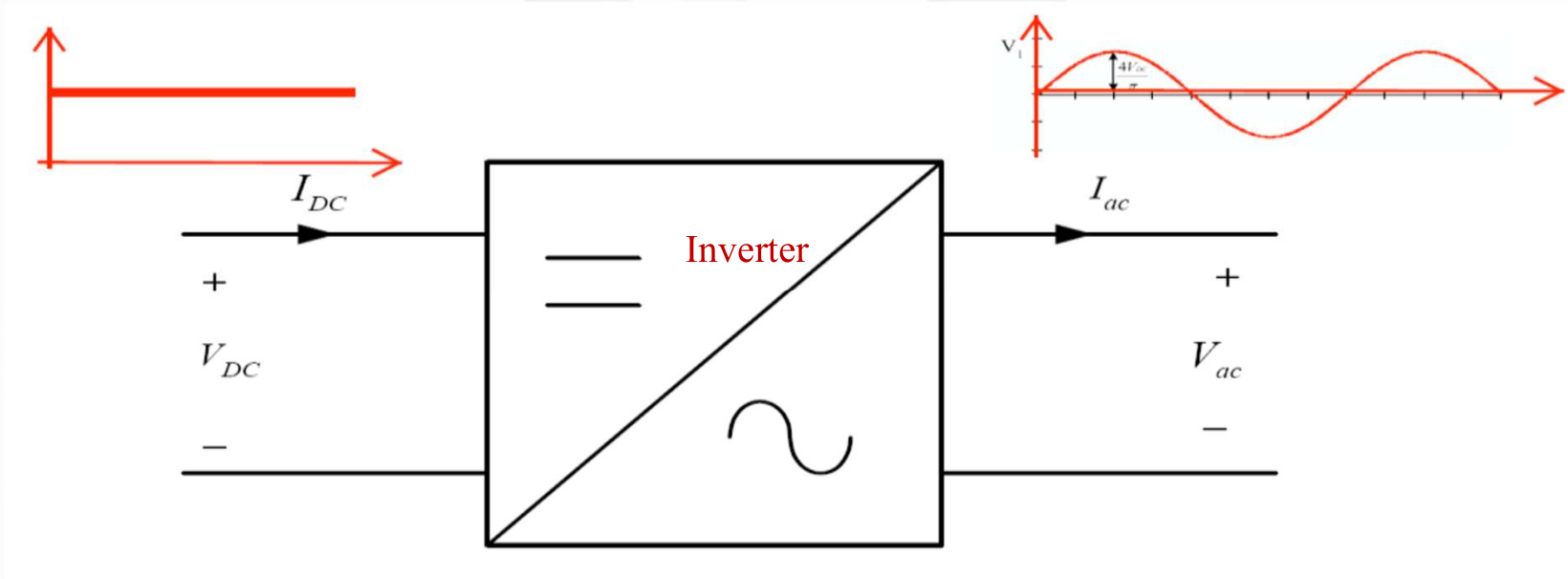
Topics

DC-AC Converters / Inverters
PWM Generation

GALGOTIAS UNIVERSITY

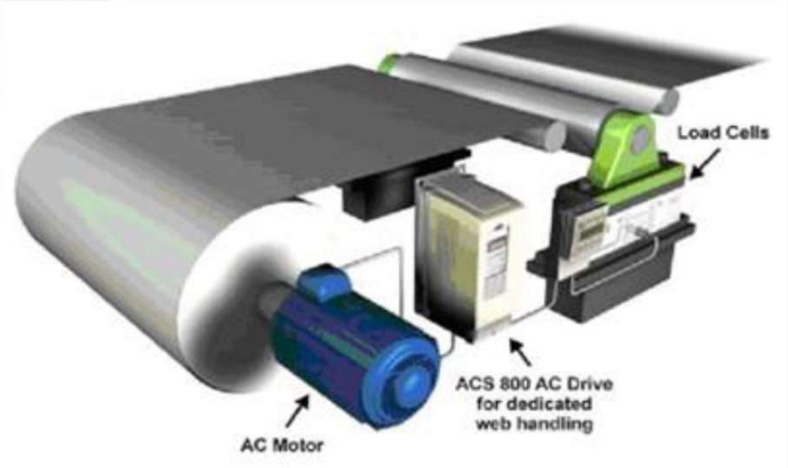
Inverter

Inverters are AC converters used to convert the DC input into a sinusoidal AC output with variable frequency and amplitude.



Applications of Inverter

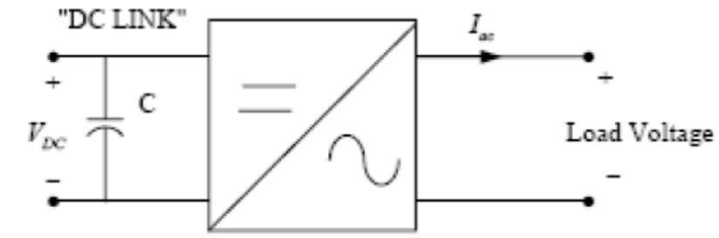
- ✓adjustable-speed ac drives
- ✓Induction heating,
- ✓stand by air-craft power supplies,
- ✓UPS (uninterruptible power supplies) for computers,
- ✓HVDC transmission lines



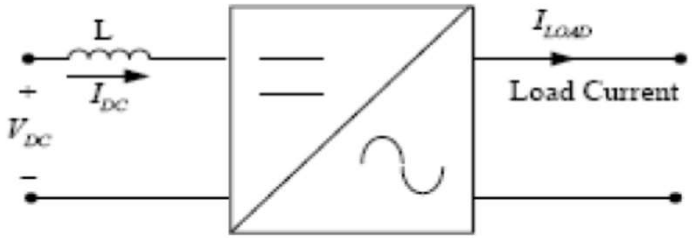
Inverters can be broadly classified into two types;

- ✓ voltage source inverters and
- ✓ current source inverters.
- ✓ Z-Source Inverter

A voltage-source inverter (VSI), is one in which the DC source has small or negligible impedance. In other words, a voltage source inverter has stiff DC voltage source at its input terminals.



A current-source inverter (CSI) is fed with adjustable current from a DC source of high impedance, i.e. from a stiff DC current source. In a CSI fed with stiff current source, output current waves are not affected by the load.



Classification of Inverter based on Output

- Single Phase Inverter
  - Half Bridge Inverter
  - Full Bridge Inverter
- Three Phase Inverter

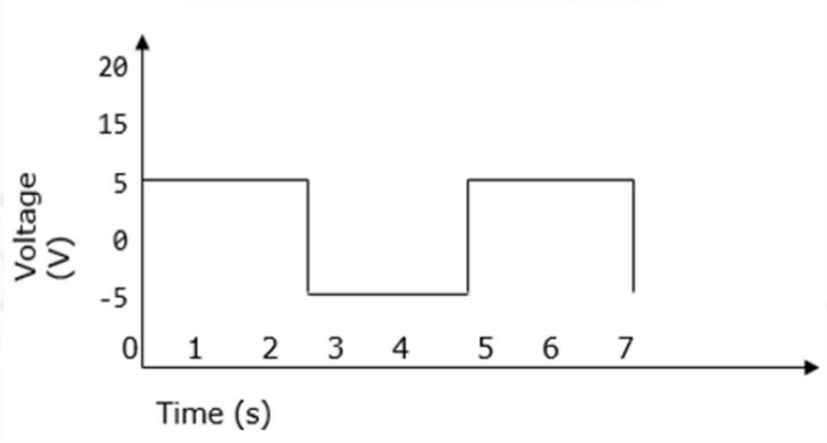
Inverter Switch Control

The inverter output voltage can be shaped based on the switch ON/OFF control that use with the inverter. Thus, two types of switch control can be used which are

- Square Wave Scheme
- Sinusoidal PWM variable width Scheme
- Modified Sinusoidal Waveform PWM
- Multiple PWM

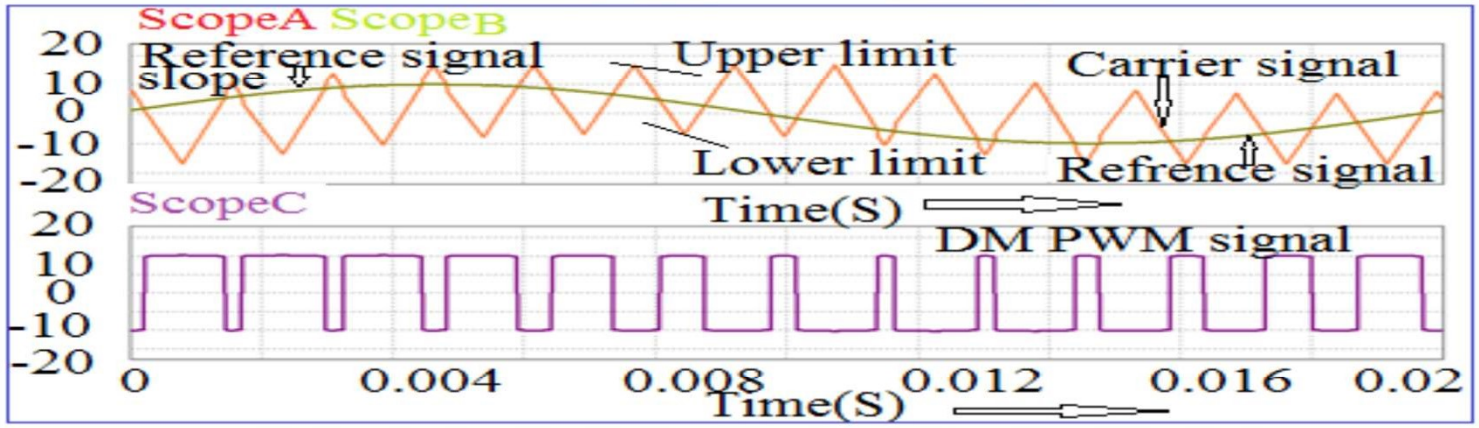
PWM is a technique that is used to reduce the overall harmonic distortion THD in a load current. It uses a pulse wave in rectangular/square form that results in a variable average waveform value f(t), after its pulse width has been modulated. The time period for modulation is given by T. Therefore, waveform average value is given by

$$\bar{y} = \frac{1}{T}\int_0^T f(t)\,dt$$



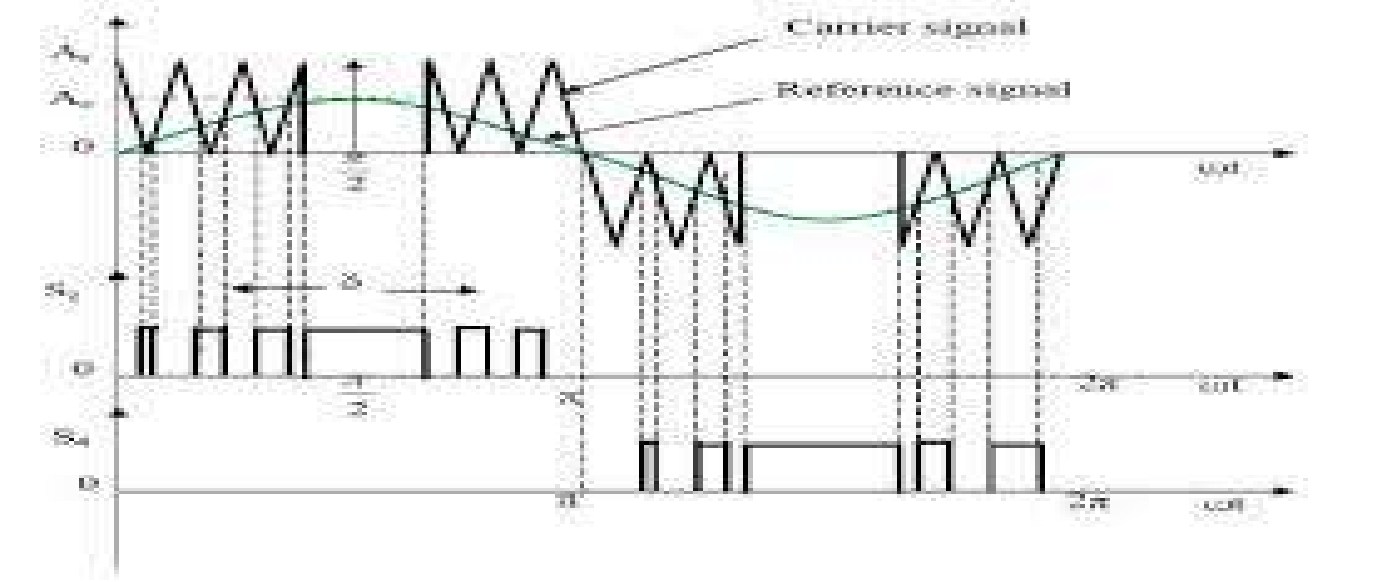
Sinusoidal Pulse Width Modulation

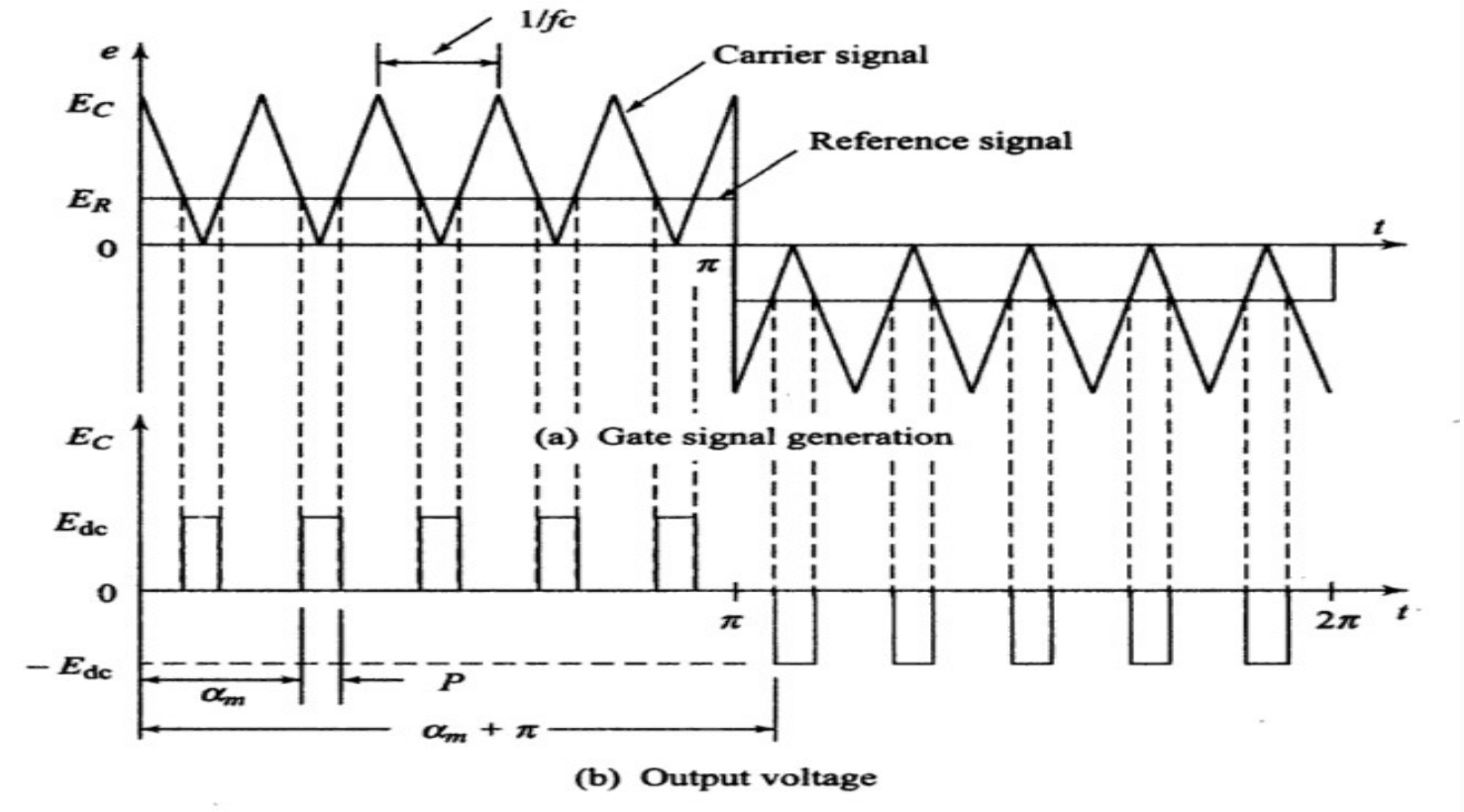
The sinusoidal PWM waveform is obtained by comparing the desired modulated waveform with a triangular waveform of high frequency. Regardless of whether the voltage of the signal is smaller or larger than that of the carrier waveform, the resulting output voltage of the DC bus is either negative or positive.

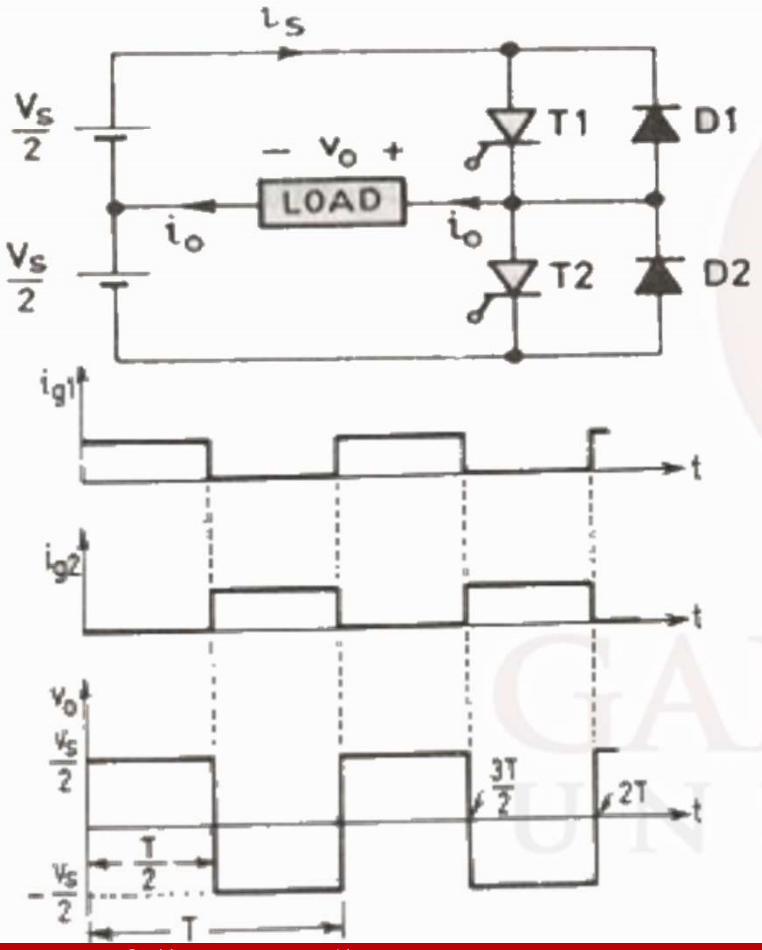


$$modulation\ index, m = \frac{A_m}{A_c}$$

The principle of generating the gate control signal in MPWM technique is two low-frequency modulating signals were compared with a high-frequency triangular carrier signal. One of the modulating signals is a reference to the output voltage to be synthesized. The second modulating signal is 180-degree phase shift of the first modulating signal, but with the same frequency and amplitude. The advantages of the MPWM technique are easy to control and implement.




1/fc
e
Carrier signal
E_C
Reference signal
E_R
0
t
π
E_C
(a) Gate signal generation
E_{dc}
0
π
2π
t
$-E_{dc}$
α_m
P
$\alpha_m + \pi$
(b) Output voltage



Half-bridge inverter

- Also known as the "inverter leg".
- Basic building block for full bridge, three phase and higher order inverters.
- voltage is splitted in the "center point" as half.
- The top and bottom switch has to be "complementary", i.e. If the top switch is closed (on), the bottom must be off, and vice-versa.
- Suitable for low power inverter.

$$V_0 = \frac{a_0}{2} + \sum_{n=1}^{\infty} (a_n \cos(n\omega t) + b_n \sin(n\omega t))$$