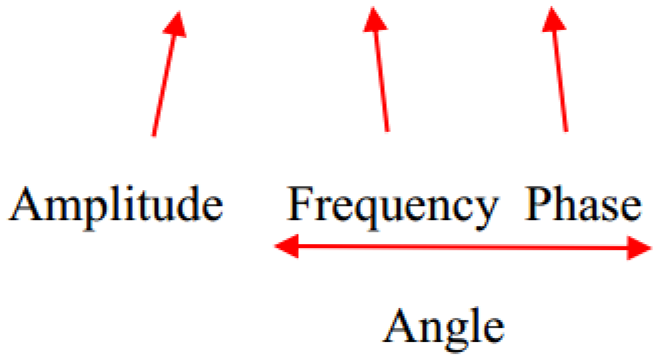
Amplitude Modulation:

The general sinusoidal signal can be written as:

$$\Phi(t) = a(t)cos[\omega_c t + \gamma(t)]$$



In amplitude modulation (AM), ***a(t)*** is changed in proportion to the message

signal. Frequency is constant, phase ***(t)*** = 0 .

Types of AM:

1- Double-Sideband, suppressed Carrier (AM/DSB-SC).

2- Double-Sideband, Large Carrier (AM/DSB-LC) [AM].

3- Single-sideband, suppressed carrier (AM/SSB-SC) [SSB].

4- Vestigial –sideband (AM/VSB).

1- AM/DSB-SC

The AM/DSB-SC signal, assuming proportionality constant =1, is given by:

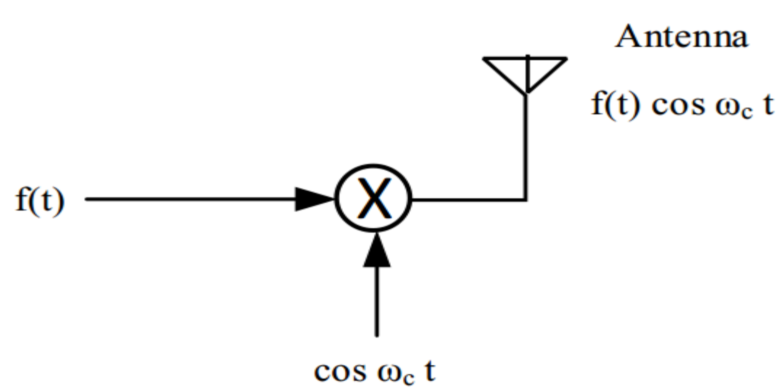
$$\Phi(t)_{DSB/SC} = f(t)cos\omega_c t$$

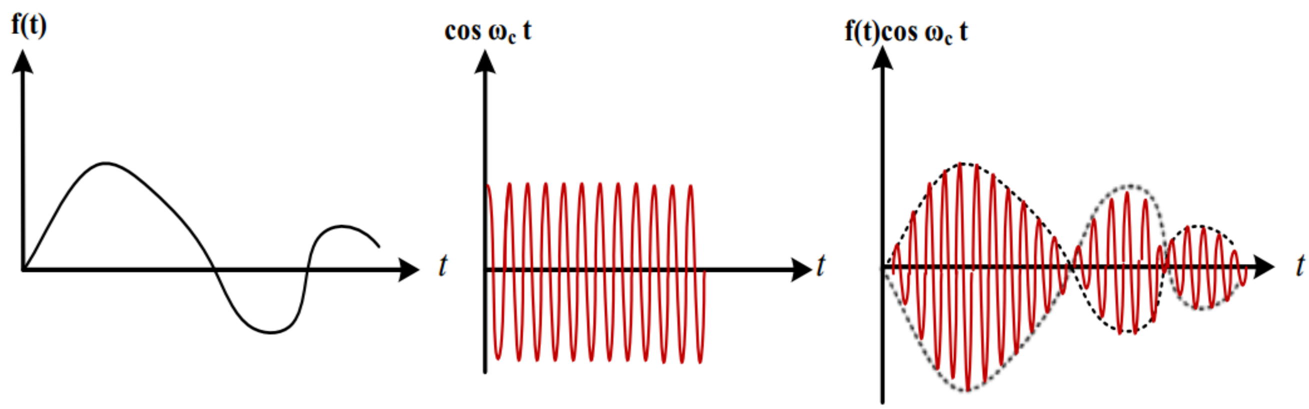
Modulated Signal — Modulating Signal — Carrier Signal

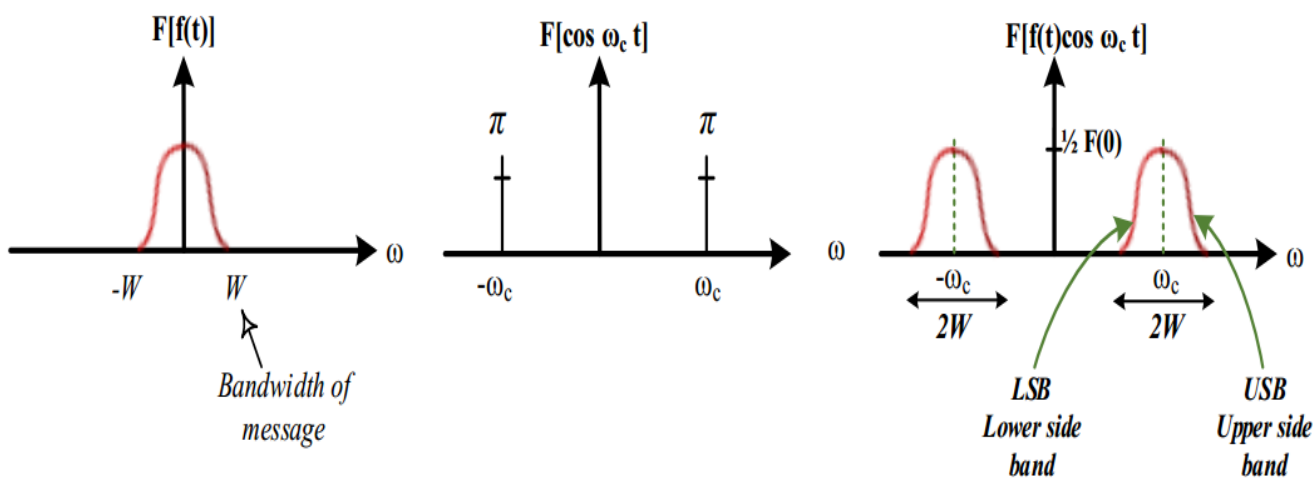
And the spectrum is:

$$\Phi(\omega)_{DSB/SC} = \frac{1}{2}F(\omega - \omega_c) + \frac{1}{2}F(\omega + \omega_c)$$

DSB-SC Transmitter







Notes:

1- No carrier term is presents (carrier is suppressed)

2- $BW_{DSB/SC} = 2W$ rad/sec

3- Above process (multiplication) is called “Frequency conversion” or “frequency mixing”

DSB-SC Receiver

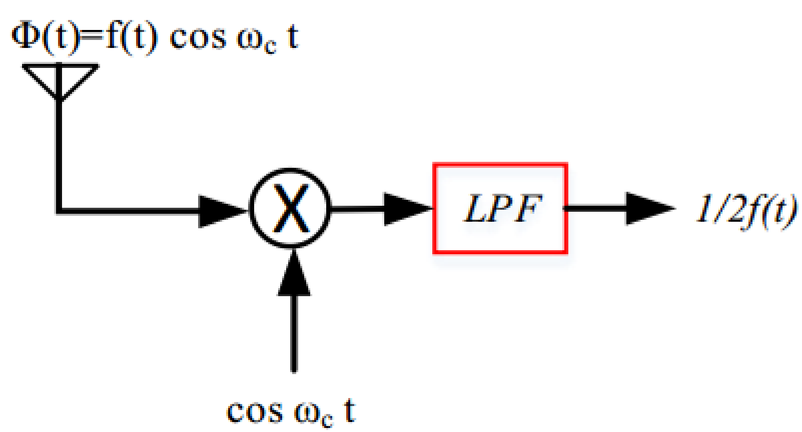
To detect (demodulate) the DSB-SC signal, we multiply it again by cosωct as follows:

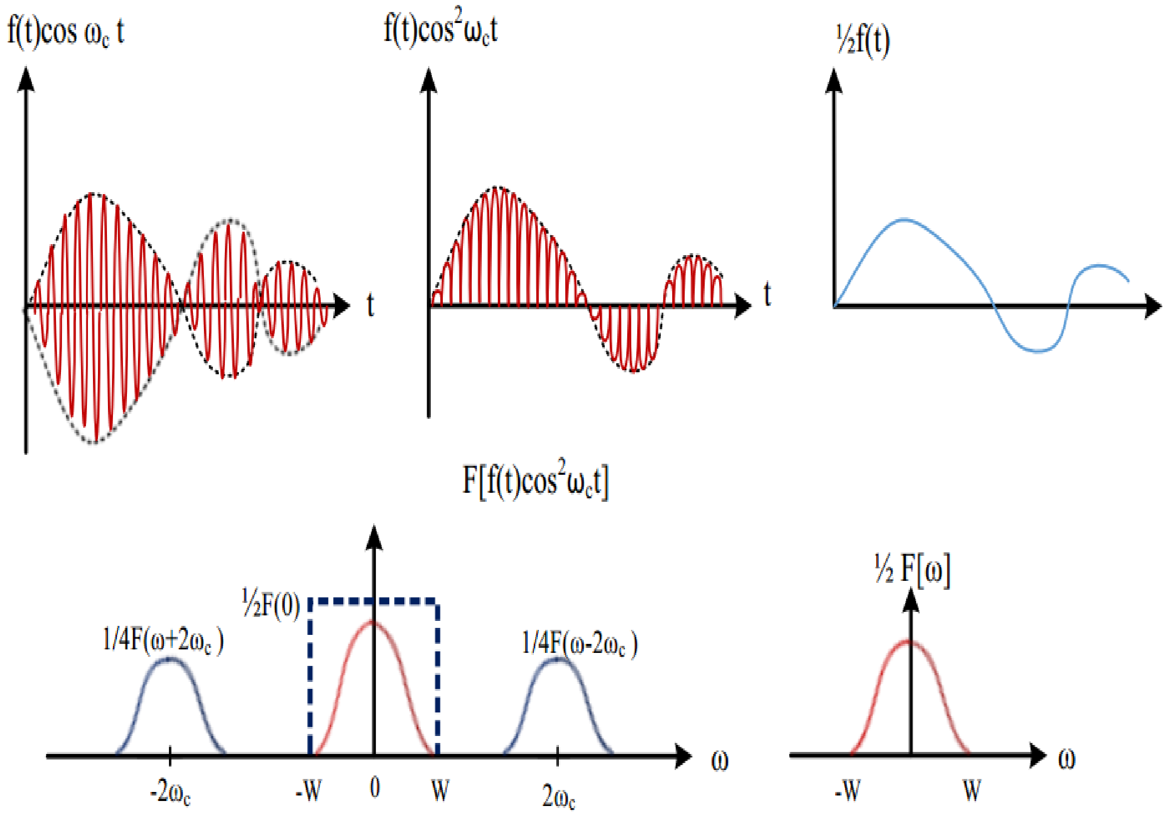
$$\Phi(t)cos\omega_c t = f(t)cos^2\omega_c t$$

$$= \frac{1}{2}f(t) + \frac{1}{2}f(t)cos2\omega_c t$$

$$F[\Phi(t)cos\omega_c t] = F(\omega) + \frac{1}{4}F(\omega - 2\omega_c) + \frac{1}{4}F(\omega + 2\omega_c)$$

Then using LPF of bandwidth W rad/sec we obtain the original signal.





Notes:

1- For LPF will reject the frequency component at $\pm 2\omega c$.

2- For correct detection, it must that:

a) $\omega c \gg W$

b) Both the local oscillator (cos ωct generators) in Tx and Rx are synchronized. (Synchronous detection and coherent detection).