UNIT II

AM TRANSMITTERS AND RECEIVERS

GENERATION OF DSB-FC

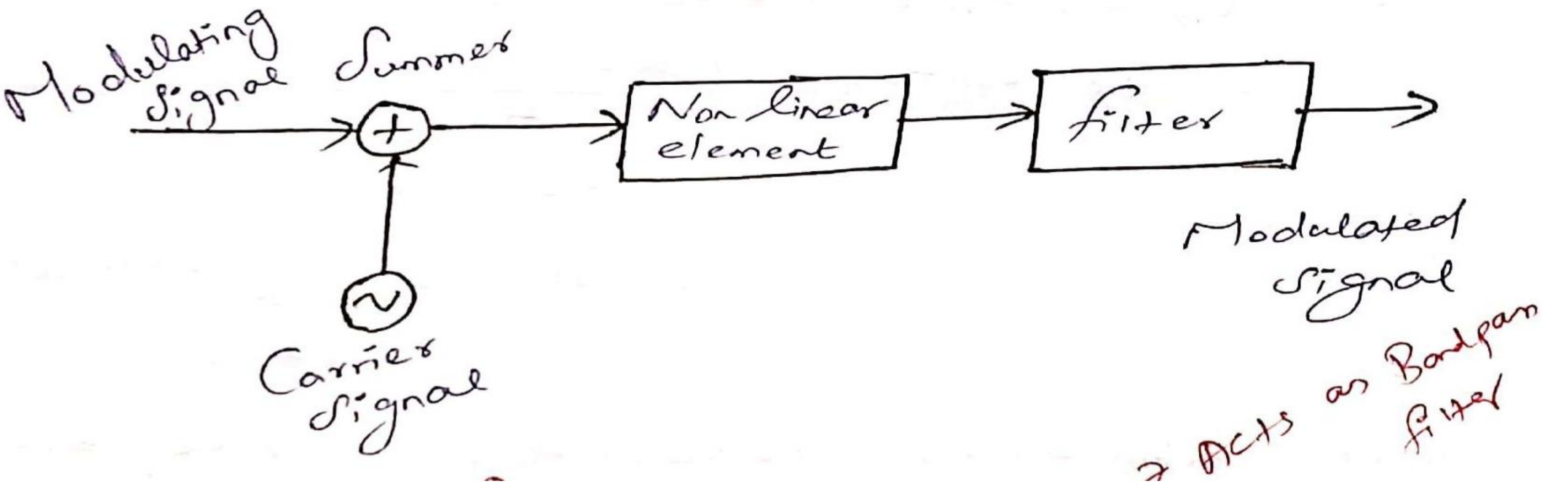
Generation of DSBFC:-

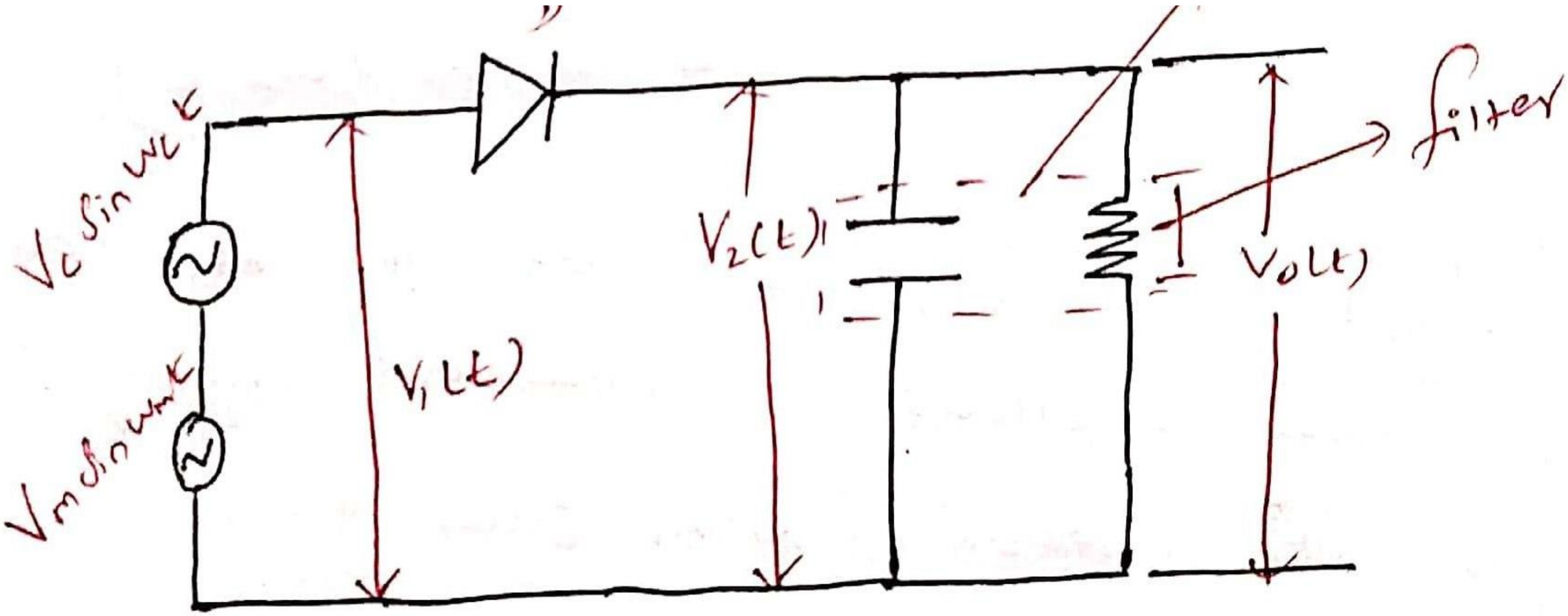
DSBFC - Double Sideband Full Carrier

Non-linear property divided into two types

1. Square law Modulator
2. Balanced Modulator

Square law Modulator





Let us represent

$$V_1(t) = V_m \sin w_m t + V_c \sin w_c t$$

$$V_2(t) = a V_1(t) + b V_1^2(t) + \dots$$

This is the general expression for diode of

Non-linear element

$$V_2(t) = a\left[V_m \sin W_m t + V_c \sin w_c t\right] + b\left[V_m \sin W_m t + V_c \sin w_c t\right]^2$$

$$V_2(t) = aV_m \sin w_m t + aV_c \sin w_c t + bV_m^2 \sin^2 W_m t + bV_c^2 \sin^2 w_c t + 2bV_mV_c \sin W_m t \sin w_c t$$

$$= aV_m \sin W_m t + aV_c \sin w_c t + bV_m^2 \sin^2 W_m t + bV_c^2 \sin^2 W_c t + \frac{2bV_mV_c}{2}\left[\cos(w_c - W_m)t - \cos(w_c + W_m)t\right]$$

$$\because \sin A \sin B = \left[\tfrac{1}{2} \cos(A-B) - \cos(A+B)\right]$$

$$V_2(t) = aV_m \sin \omega_m t + aV_c \sin \omega_c t + bV_mV_c[\cos(\omega_c - \omega_m)t - \cos(\omega_c + \omega_m)t]$$

Band pass filter is tuned to the carrier frequency it allows only side band frequency. Neglecting second & higher order terms

$V_o(t)$ from $V_2(t)$

$$V_o(t) = aV_c \sin \omega_c t + bV_mV_c[\cos(\omega_c - \omega_m)t - \cos(\omega_c + \omega_m)t]$$

Disadvantages of ~~DB~~ DSB-FC:-

(i) power wastage

(ii) Bandwidth inefficient

DSBFC - Carrier does not Conveying any information

Suppressing Carrier - Lot of power saved

Generation of DSB-SC:-

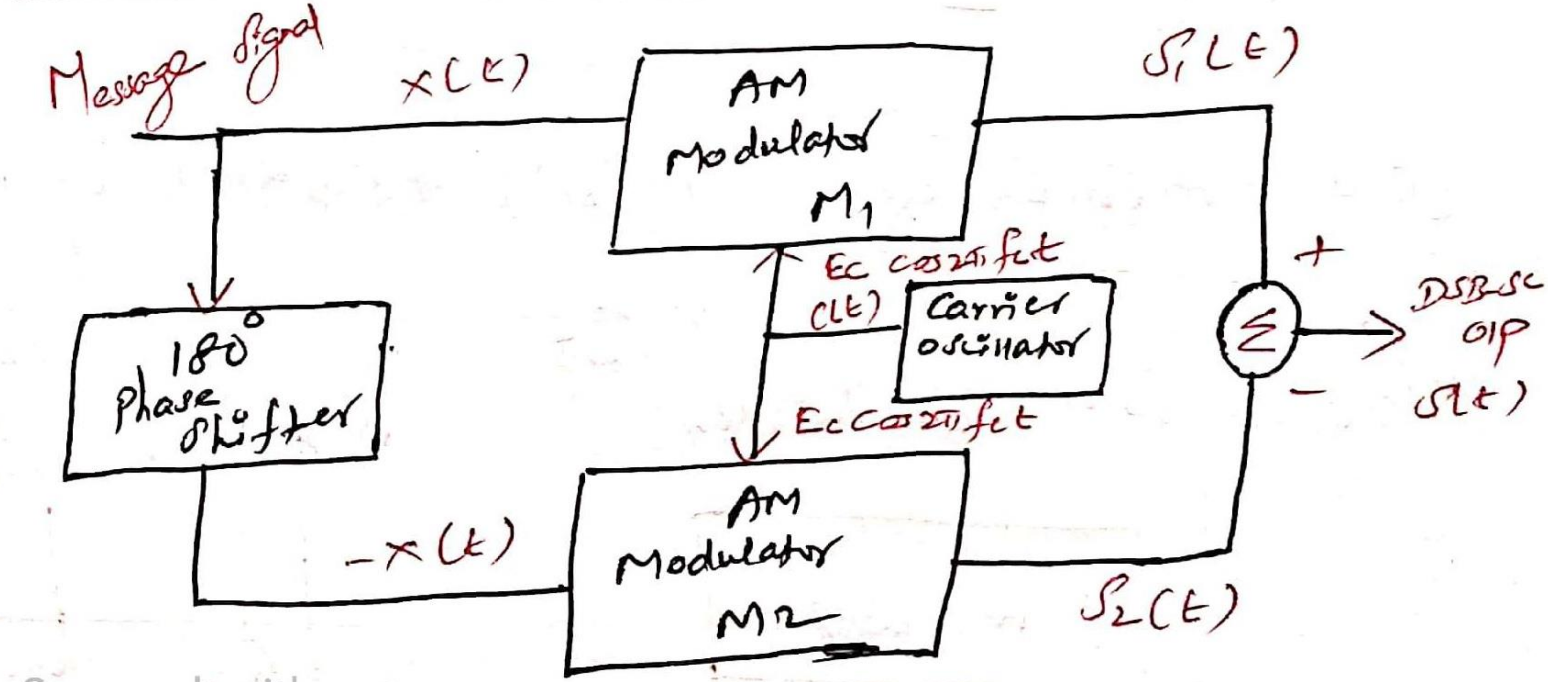
DSB-SC - Double Sideband Suppressed Carrier.

There are two ways

(i) Balanced Modulator

(ii) Ring Modulator (or) Diode Balanced modulator

Balanced Modulator:-



$$s_1(t) = E_c\left[1+mx(t)\right]\cos 2\pi f_c t \quad \text{——— (1)}$$

$$s_2(t) = E_c\left[1-mx(t)\right]\cos 2\pi f_c t \quad \text{——— (2)}$$

<u>Subtractor o/p</u>

$$s(t) = s_1(t) - s_2(t)$$

$$= E_c\left[1+mx(t)\right]\cos 2\pi f_c t - \left[E_c(1-mx(t))\cos 2\pi f_c t\right]$$

$$= E_c \cos 2\pi f_c t + mE_c x(t)\cos 2\pi f_c t - E_c \cos 2\pi f_c t + mE_c x(t)\cos 2\pi f_c t$$

$$= 2E_c m x(t)\cos 2\pi f_c t$$

$$= 2 E_c m E_m \cos 2\pi f_m t \cdot \cos 2\pi f_c t$$

$$x(t) = E_m \cos 2\pi f_m t$$

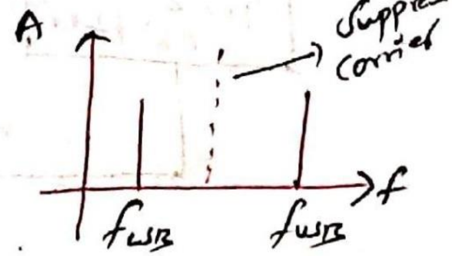
$$= \frac{2 m E_m E_c}{2} \left[\cos 2\pi (f_c + f_m) t + \cos 2\pi (f_c - f_m) t \right]$$

$$S(t) = m E_m E_c \left[\cos 2\pi (f_c + f_m) t + \cos 2\pi (f_c - f_m) t \right]$$

$\downarrow f_{USB}$ $\qquad$ $\downarrow f_{LSB}$

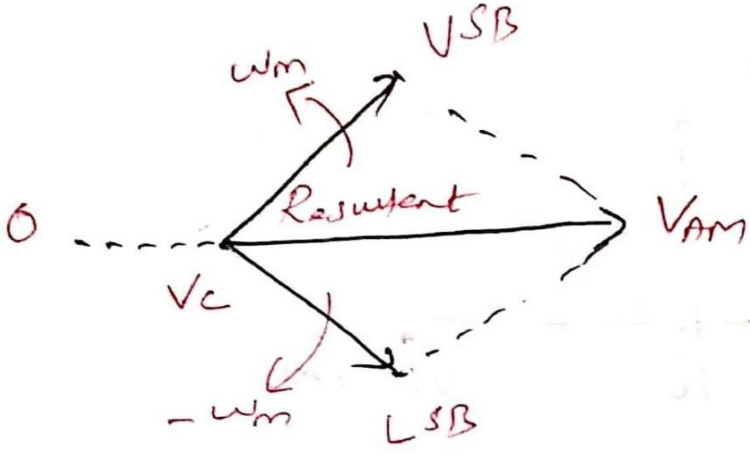
Transmission Bandwidth:-

$$B.W = 2 f_m$$



III-3

Phasor Diagram of DSB-SC AM :-



(i) Assume carrier phasor is reference phasor

(ii) USB anticlockwise

(iii) LSB clockwise

Advantages:-

(i) more efficient in transmitted power Compared to DSB-fc

(ii) It has better signal to noise ratio as Compared to SSB transmission.