Generation of DSB-SC modulated signal:-

(1)

- A double-sideband suppressed-carrier modulated wave consists simply of the product of the message signal and the carrier wave. A device for ~~acher~~ achieving this requirement is called a <u>product modulator</u>.

In this section, we will discuss two forms of product modulator.

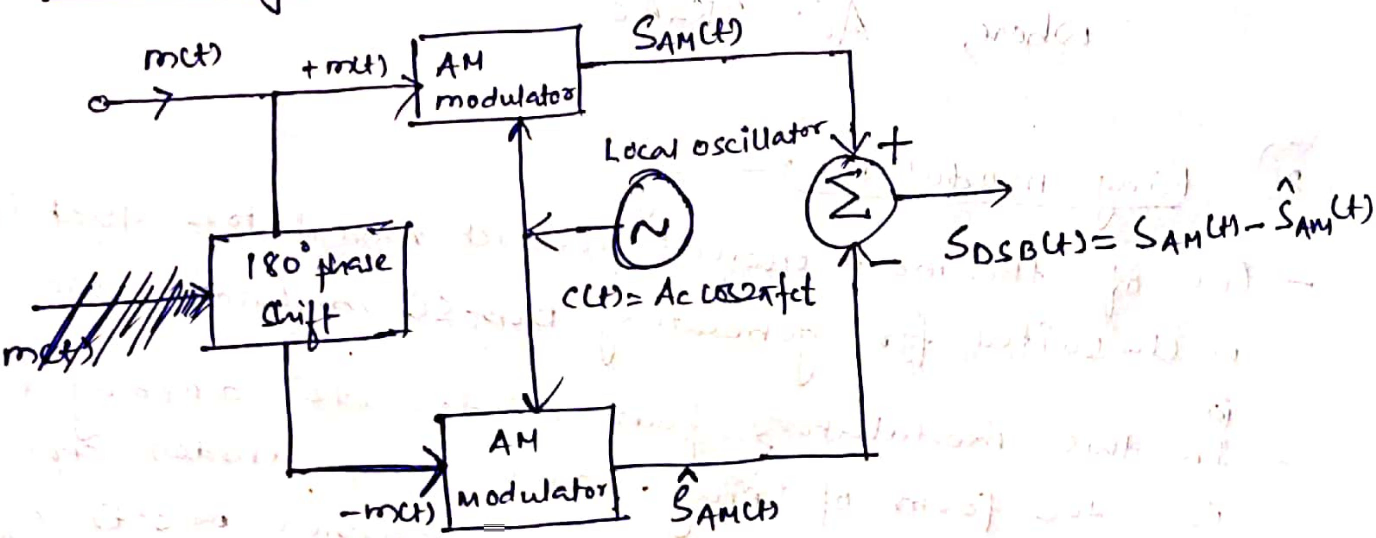
(1) Balanced modulator.

(2) Ring modulator.

(1) Balanced modulator :-

In this modulator, two standard amplitude modulators are arranged in a balanced configuration to suppress the carrier wave.

Block diagram:-



→ we assume that two modulators are identical except for the sign reversal of the ~~modul~~ message signal applied to them.

Now,

$$S_{AM}(t) = A_c\{1+K_a m(t)\}\cos 2\pi f_c t$$

$$\hat{S}_{AM}(t) = A_c\{1-K_a m(t)\}\cos 2\pi f_c t$$

So, $S_{DSB}(t) = S_{AM}(t) - \hat{S}_{AM}(t)$

$$= A_c\{1+K_a m(t)\}\cos 2\pi f_c t - A_c\{1-K_a m(t)\}\cos 2\pi f_c t$$

$$= A_c\cos 2\pi f_c t + A_c K_a m(t)\cos 2\pi f_c t - A_c\cos 2\pi f_c t + A_c k_a m(t)\cos 2\pi f_c t$$

$$= 2A_c K_a m(t)\cos 2\pi f_c t$$

$$\therefore \boxed{S_{DSB}(t) = A_c' m(t)\cos 2\pi f_c t}$$

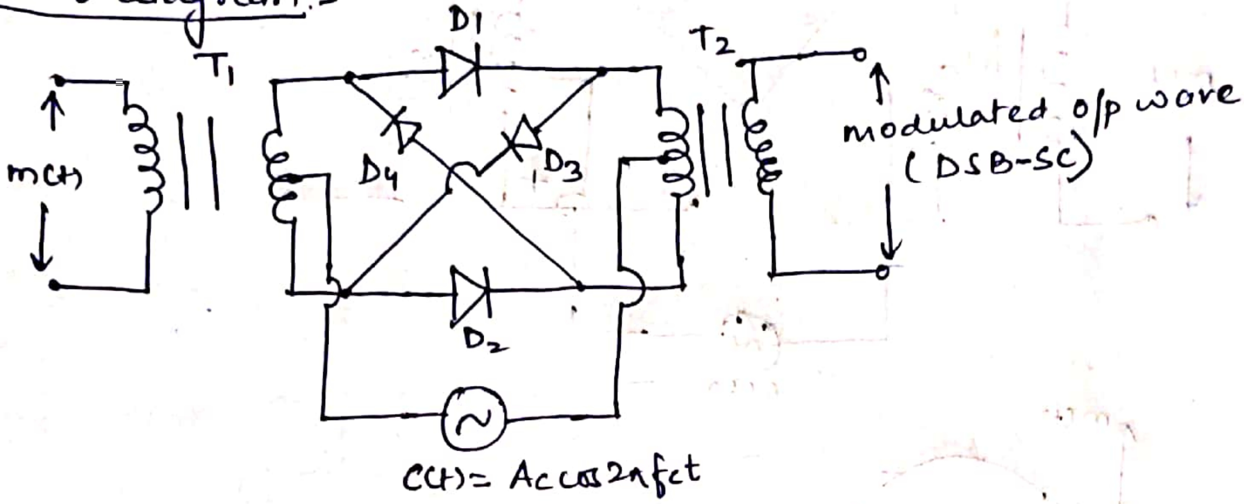
where, $A_c' = 2K_a A_c$

(2) Ring modulator:-

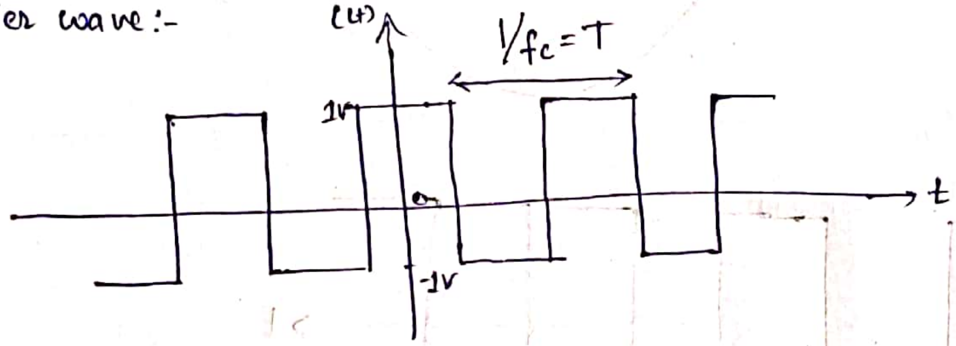
- One of the most usefull product modulators that is well-suited for generating DSB-SC modulated wave.
- In this modulator, four diodes are arranged in the form of ring. and these diodes are controlled by a square-wave carrier c(t) of frequency f_c, which is applied by means of two ~~centre~~- center-tapped transformer.

∴ We assume the diodes are ideal and the transformers are perfectly balanced.

Circuit diagram:-

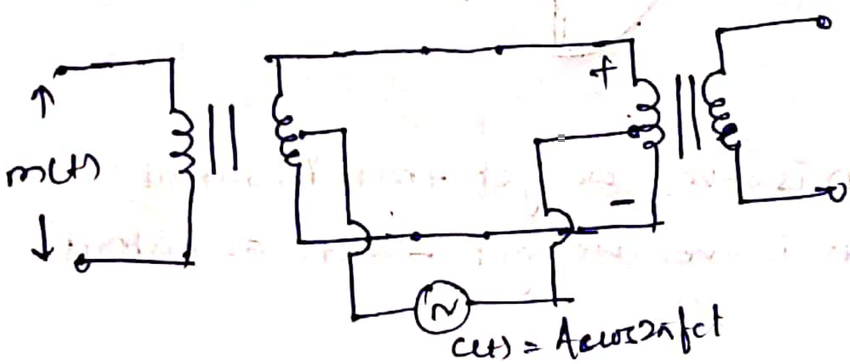


carrier wave:-



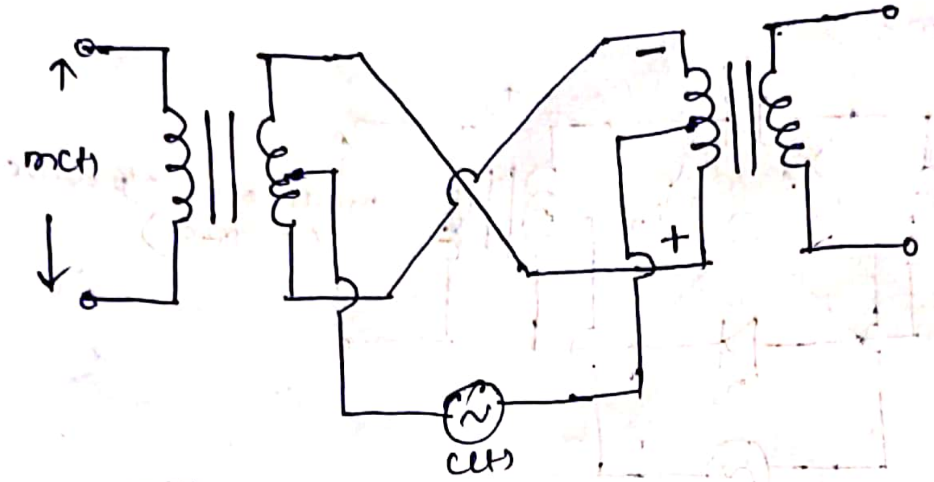
Operation:-

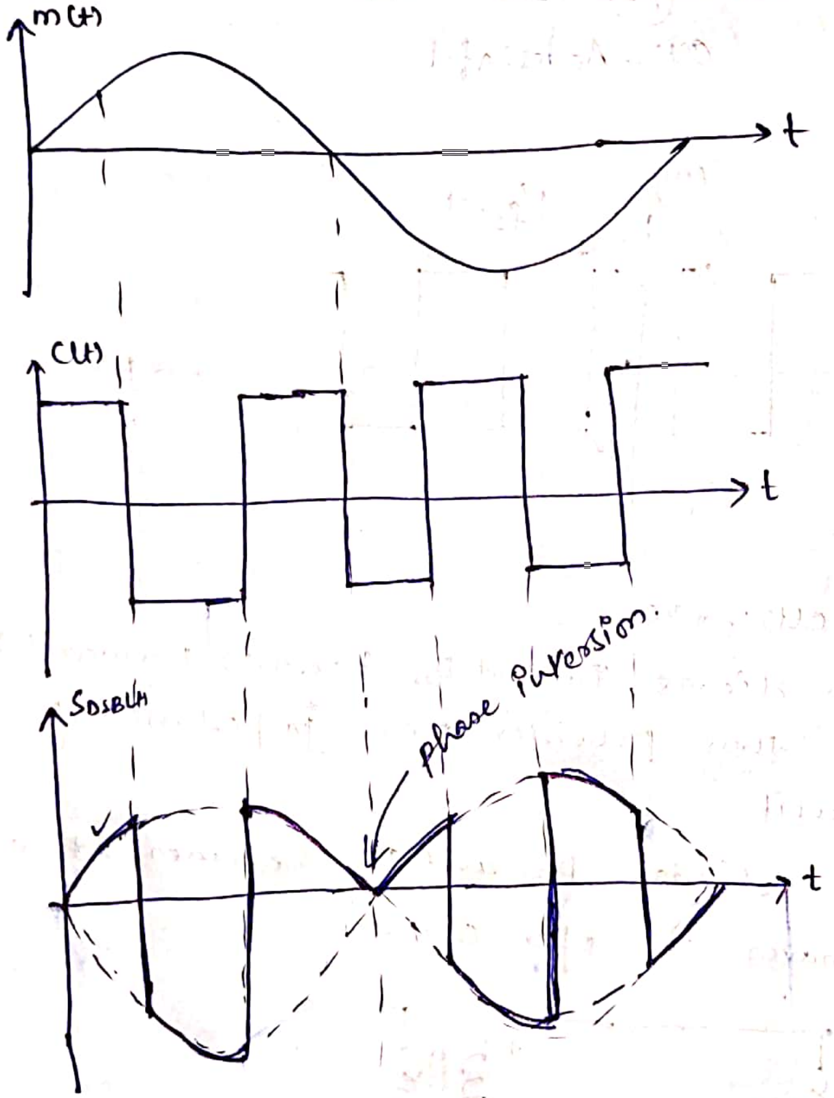
1. When c(t) = +ve
   - both diodes D1 and D2 becomes forward biased and thus provides zero impedance i.e short circuit.
   - Illy, diodes D3 and D4 becomes RB and behaves as open circuit.



2. when $c(t) = -ve$

- both diodes D_3 and D_4 are switched ON (SC)
- diodes D_1 and D_2 are off (OC).





→ Here, when $c(t)$ is +ve, we get $+m(t)$ in output

And, when $c(t)$ is −ve, we get $-m(t)$ as output.

Now, this square-wave carrier c(t) can be expressed by a Fourier series

$$c(t) = \frac{4}{\pi} \sum_{n=1}^{\infty} \frac{(-1)^{n-1}}{2n-1} \cos[2\pi f_c t (2n-1)]$$

Calculating this expression using fourier series, i have already taught in switching modulator section of standard Amplitude modulation.

Therefore, the ring modulator output becomes:-

$$s(t) = c(t)\, m(t)$$

$$= \frac{4}{\pi} \sum_{n=1}^{\infty} \frac{(-1)^{n-1}}{2n-1} \cos[2\pi f_c t (2n-1)] \cdot m(t)$$

– this is the o/p we get at the o/p of second transformer.

→ DSB SC modulators are also called as product modulators and can be showed simply as:-