Generation of Amplitude Modulated wave.

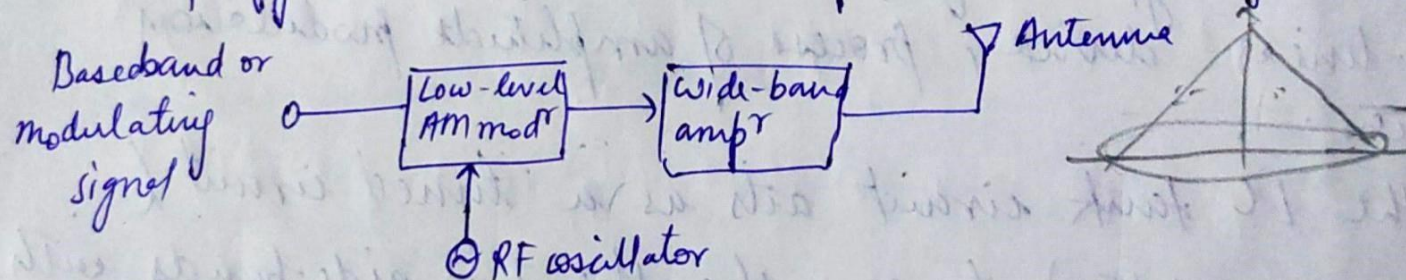
Methods of AM generation is broadly classified as.

1). <u>Low-level AM modulation</u>

→ Modulation is done at low power

→ Due to this power amplifiers are needed to boost AM s/g to required level.

→ AM s/g is then applied to a wide-band ampr to amplify the side-bands of modulated signal.



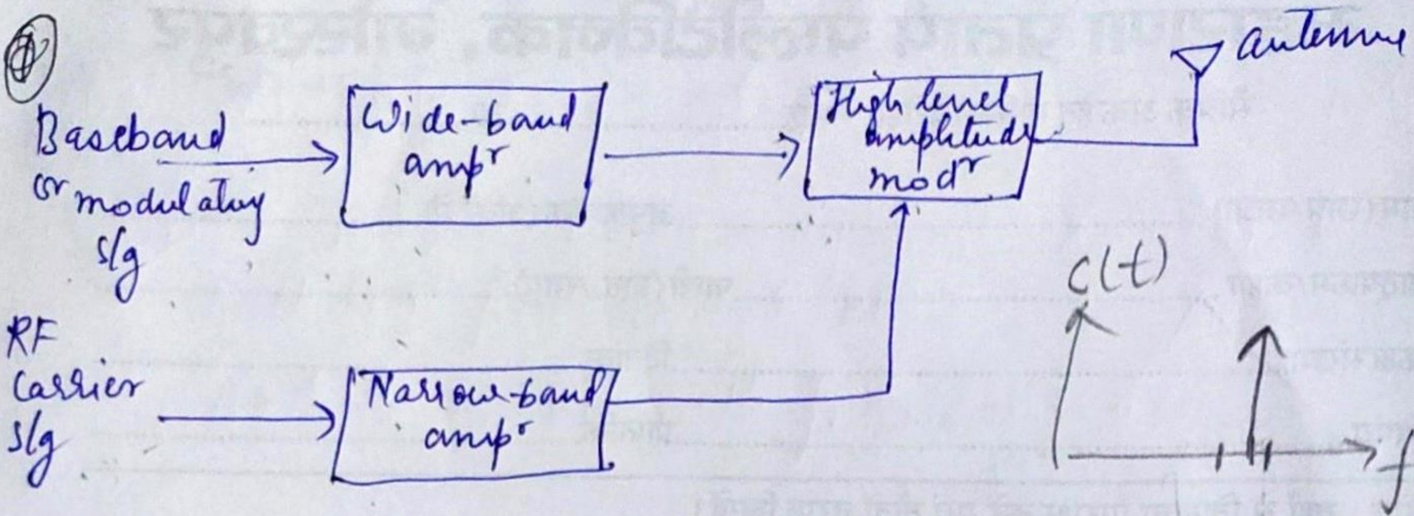
Ex- Square law modulation or Balanced modulator

② High-level Amplitude modulation

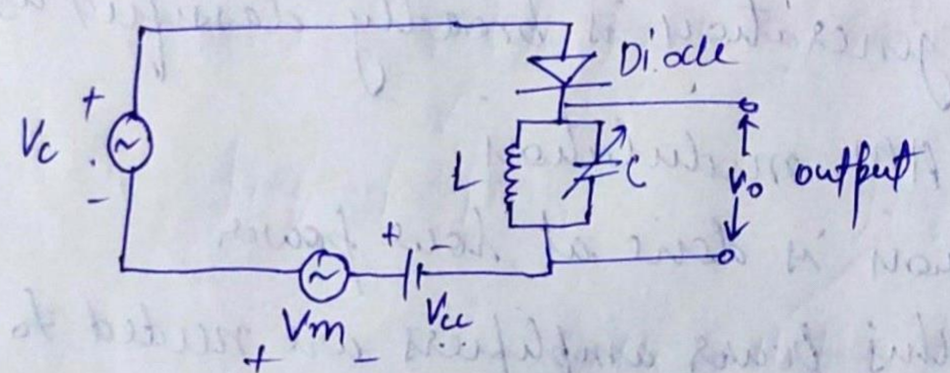
→ Modulation is done at high power levels

→ The baseband s/g and the carrier are firstly amplified using wide-band and narrow-band ampr.

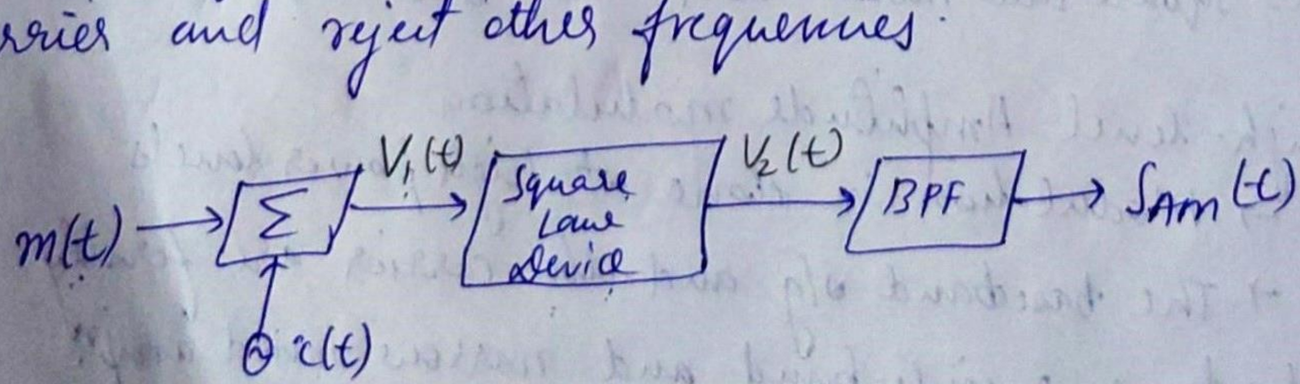
Ex- collector modulation method.



① Square-Law Modulator



→ Vcc is connected to provide operating voltage to the diode.
→ Diode is a non-linear device.
→ The working of the circuit is based upon the fact that when two different frequencies are passed through a non-linear device, process of amplitude modulation occurs.
→ The LC tank circuit acts as a tuned circuit (band-pass filter) to pass the the two side-bands with carrier and reject other frequencies.



A simple block-diagram of Square Law modulator the v-i relation of a non-linear device

$$i = av + bv^2 + cv^3 + \dots$$

Input to the SLD

$$V_1(t) = m(t) + c(t)$$
$$= m(t) + A_c \cos(2\pi f_c t)$$

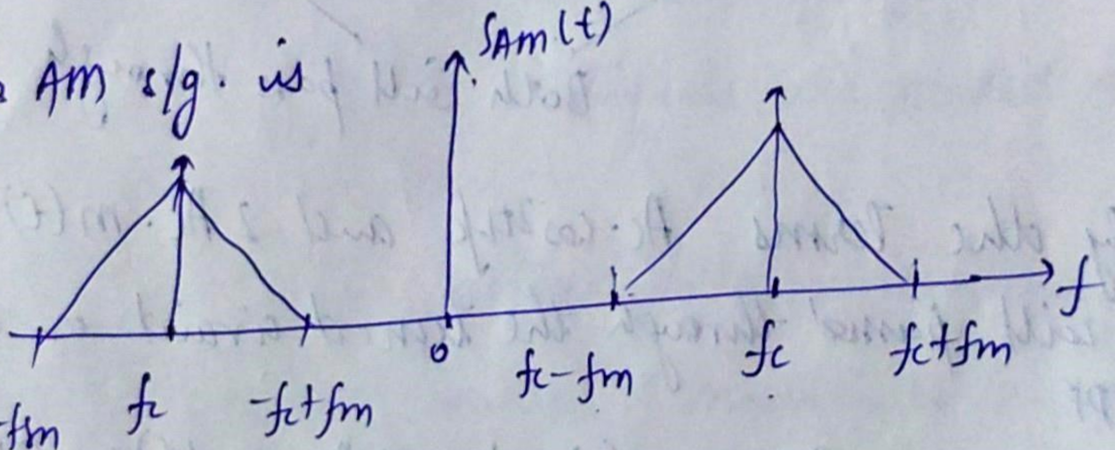
output of the SLD

$$V_2(t) = a_1 V_1(t) + a_2 V_1(t)^2 + a_3 V_1(t)^3 + \dots$$

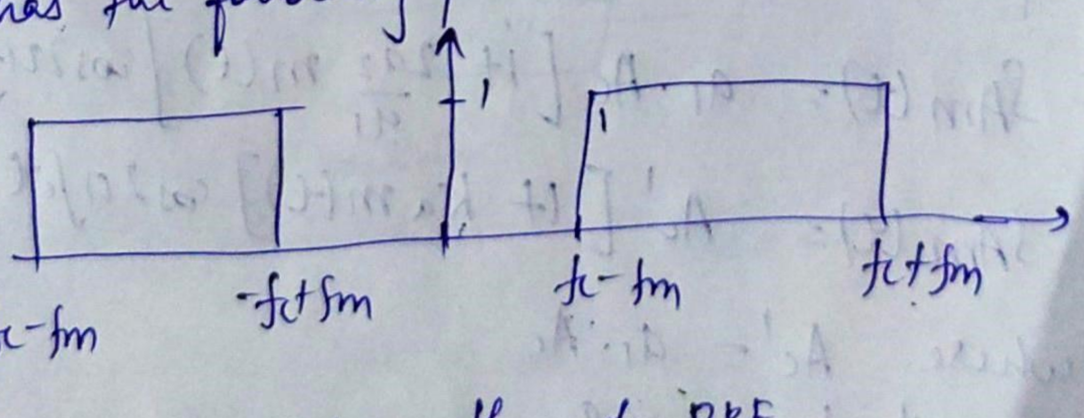
where $a_1, a_2, a_3 \rightarrow$ square law coefficients

$$\Rightarrow V_2(t) = a_1 [m(t) + A_c \cos 2\pi f_c t] + a_2 [m^2(t) + A_c^2 \cos^2 2\pi f_c t + 2 A_c \cdot m(t) \cdot \cos 2\pi f_c t]$$

BW of AM s/g. is



The BPF has the following pass band



so, $m(t)$ will NOT pass through BPF.

$A_c \cos 2\pi f_c t$ will pass through BPF

$m^2(t)$ will NOT pass as $m^2(t) = A_m^2 \cos^2 2\pi f_m t$

$$\cos^2 2\pi f_m t = \frac{1 + \cos 4\pi f_m t}{2} = \frac{1}{2} + \frac{\cos 4\pi f_m t}{2}$$

since $f_c >> f_m$, $2f_m$ will also NOT pass

$A_c^2 \cos^2 2\pi f_c t$ will NOT pass through BPF

since $\cos^2 2\pi f_c t \rightarrow \frac{1+\cos 4\pi f_c t}{2} = \frac{1}{2} + \frac{\cos 2\pi(2f_c)t}{2}$

Now $2f_c > f_c + f_m$, hence component $\cos 2\pi(2f_c)t$ will NOT pass through BPF

and $\frac{1}{2}$ is DC with frequency $= 0$.

$m(t) \cdot A_c \cdot \cos 2\pi f_c t$ will pass throught BPF

as $A_m \cdot A_c \cdot \cos 2\pi f_c t \cos 2\pi f_m t$

$$= \frac{1}{2} \cos 2\pi(f_c + f_m)t + \frac{1}{2} \cos(2\pi(f_c - f_m)t)]$$

freq $= f_c + f_m$ freq $= f_c - f_m$

Both will pass through BPF

So only the terms $A_c \cdot \cos 2\pi f_c$ and $2A_c \cdot m(t) \cos 2\pi f_c t$ will passed through the tuned circuit or the BPF

BPF output $= a_1 A_c \cdot \cos 2\pi f_c t + a_2 \, 2A_c \cdot m(t) \cos 2\pi f_c t$

$$S_{AM}(t) = a_1 \cdot A_c \left[1 + \frac{2a_2}{a_1} m(t)\right] \cos 2\pi f_c t$$

$$S_{AM}(t) = A_c' \left[1 + k_a m(t)\right] \cos 2\pi f_c t$$

where $A_c' = a_1 \cdot A_c$

and $k_a = 2\frac{a_2}{a_1}$