Communication Systems

Lecture - 8

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Frequency Spectrum Of AM wave

The AM wave is equivalent to the summation of three sinusoidal wav, es , one having amplitude E_C and Frequency f_c ($= \omega_c / 2\pi$) the second having amplitude

$mE_c/2$ and frequency ($fc + f_m$) and third having amplitude $mE_c/2$ and frequency ($fc - f_m$) .

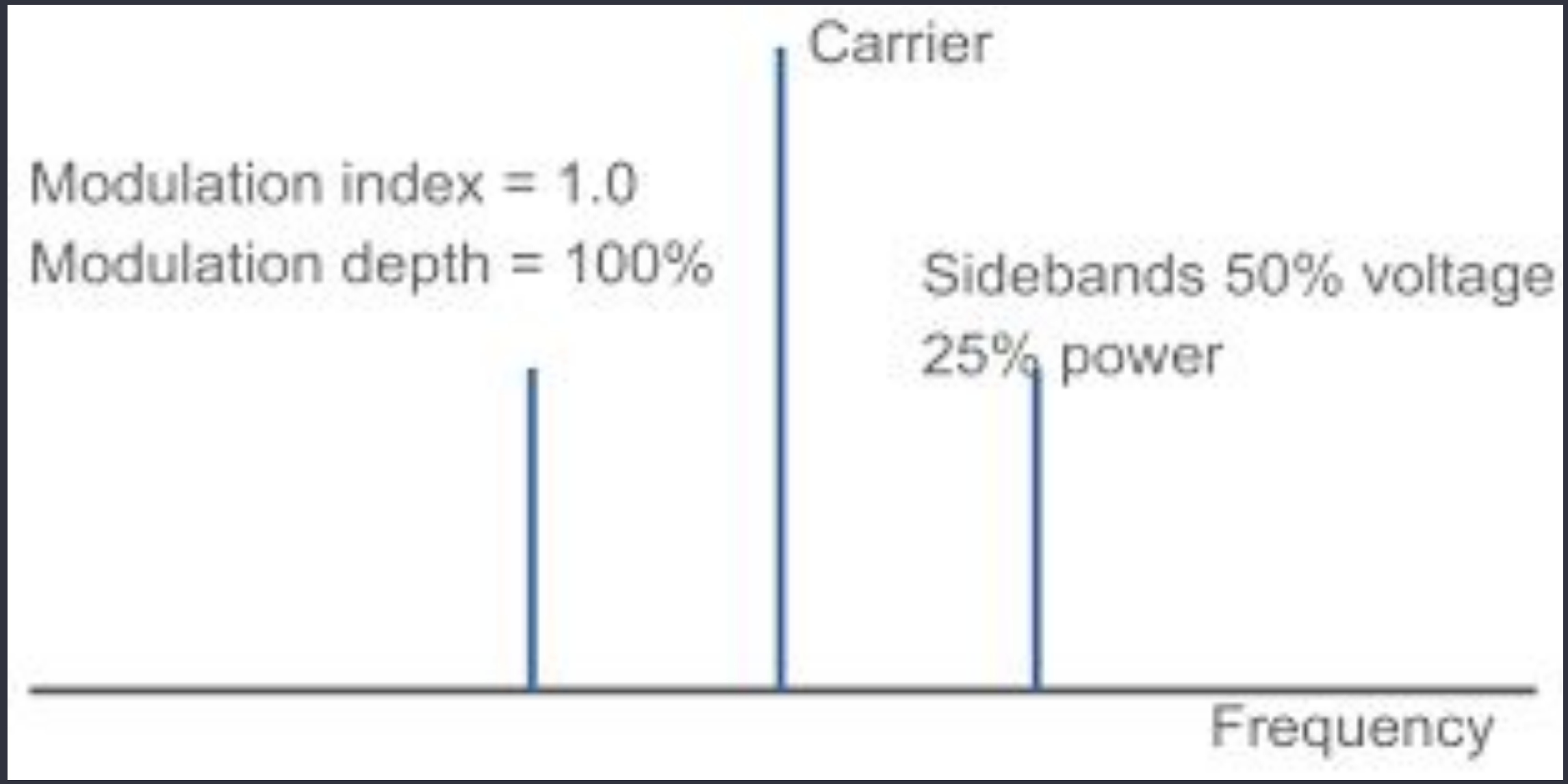
Thus the process of modulation does not change the carrier frequency but produces two new frequencies($fc + f_m$) and ($fc - f_m$) which are called **side band frequencies (SBF)** .

The sum of carrier frequency and modulating frequency, i.e. , (fc + f_m) is called **Upper Side Band (USB)** . The difference between carrier and modulating frequencies is called **Lower Side Band (Width LSB)** .

Band Width : The difference between USB and LSB is called Band (BW).

i.e., (fc + f_m) - (fc - f_m) = 2f .

Since all information is obtained in the two sidebands , the bandwidth required for transmission or reception through amplitude modulation is twice the highest frequency contained in the modulating wave . i.e., BW = $2f_m$ (highest)


Carrier
Modulation index = 1.0
Modulation depth = 100%
Sidebands 50% voltage
25% power
Frequency

Power in AM Waves

The power of a carrier wave is given by

$$P_c = (E_c/\sqrt{2})^2 /R = E_c^2/2R$$

Where R is the resistance in which the power is dissipated .

Total power of Side Band

$$P_S = m^2 E_c^2 /4R = (m^2/2)\, R\, P_c$$

Total Power of Amplitude Wave :

$$P_T = P_c + P_S = E_c^2/2R\ [\,1+ m^2/2\,]$$

Total Power of Amplitude Wave :

$$P_T = P_c + P_S = E_c^2 / 2R \left[1 + m^2 / 2 \right]$$

Fraction of total power carried by side bands

$$P_S / P_T = m^2 / 2 + m^2$$

(a) When m = 0 , power carried by side bands = 0 .

(b) When m =1/2 , power carried side bands = 11.1 % the total power of AM wave (c) When m =1 , power carried side bands = 33.3 % the total power of AM wave

$P_S / P_C = ½ m^2$

Limitations of amplitude modulation :

(i) Noisy reception

(ii) Low efficiency

(iii) Small operating range

(iv) Lack of audio quality