Advantages Amplitude Modulation (Double sideband – Full Carrier –DSBFC)

1.AM transmitters are less complex .
2.AM receivers are simple, detection is easy .
3.AM receivers are cost efficient .

Applications of AM

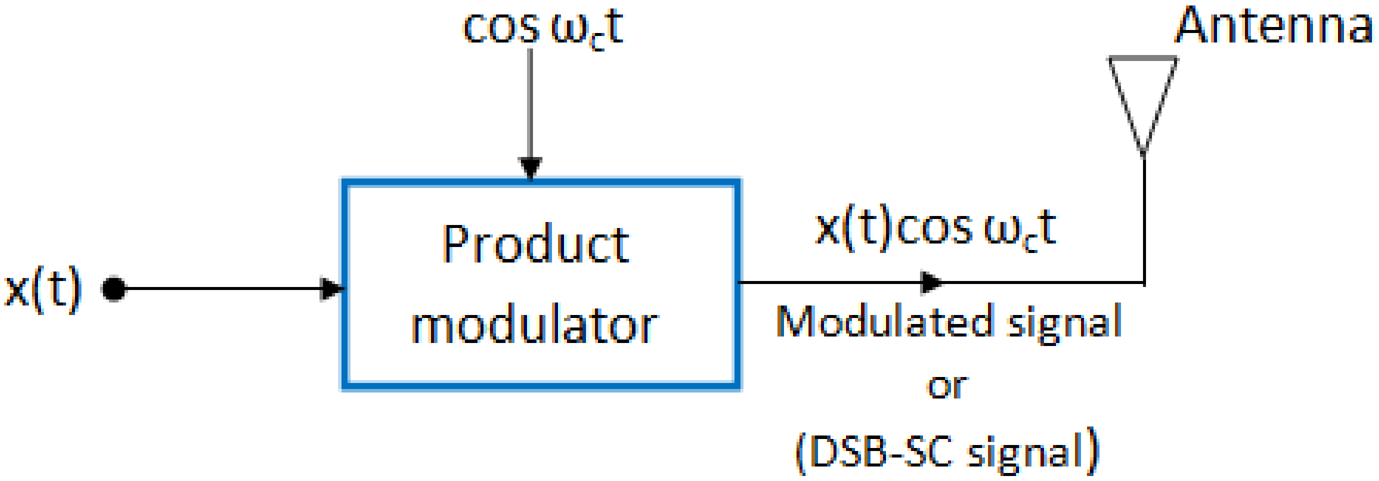
1.Radio broadcasting
2.Picture transmission in a TV system

Disadvantages of Standard Amplitude Modulation

1.Power wastage takes place in DSB-FC transmission
2.DSB-FC system is bandwidth inefficient system
3.AM wave gets affected due to noise

Double Side Band Suppressive Carrier
DSBSC

Block Diagram of DSB-SC



Single Tone DSB-SC Modulation

Time Domain Description: Let a message signal

$$m(t) = A_m \cos 2\pi f_m t$$

Then DSB-SC signal as a function of time is represented by

$$s(t) = A_c m(t) \cos 2\pi f_c t = A_c A_m \cos 2\pi f_m t \cos 2\pi f_c t$$

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

Single Tone DSB-SC Modulation

Time Domain Description

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

Frequency Domain Description:

$$S(f) = \frac{A_c A_m}{4}[\delta(f - f_c - f_m) + \delta(f + f_c + f_m)]$$
$$+ \frac{A_c A_m}{4}[\delta(f - f_c + f_m) + \delta(f + f_c - f_m)]$$

Baseband Signal DSB-SC Modulation

Let the message signal is assumed to be band limited to '*W*' Hz.

Time Domain Description

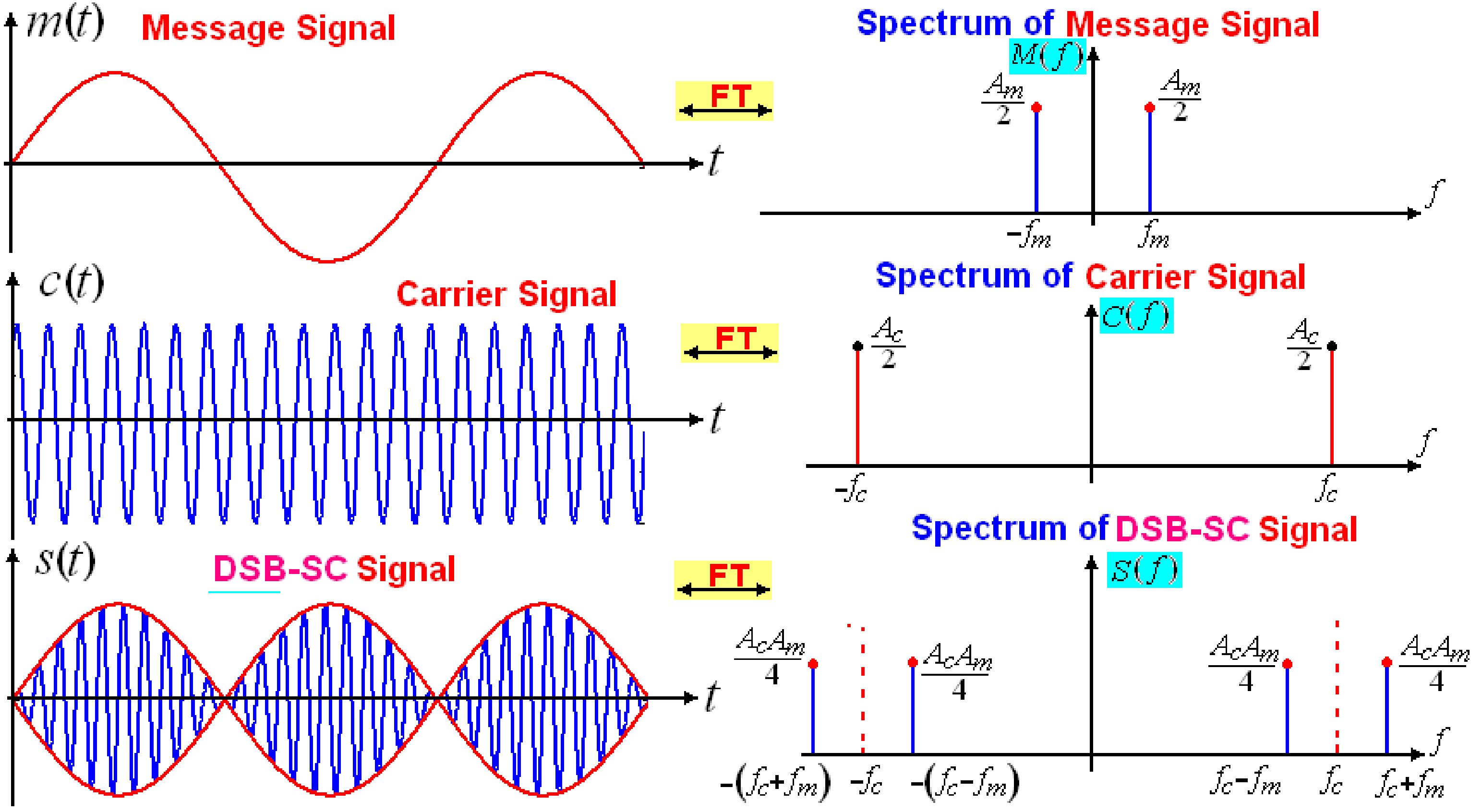
Then the standard form of a DSB-SC modulated signal as a function of time is represented by

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

- Frequency Domain Description

$$S(f) = \frac{A_c}{2}\left[M(f - f_c) + M(f + f_c)\right]$$

Single Tone DSB-SC Modulation and its Spectrum



Power Calculation in DSB-SC AM

Since the carrier is suppressed the total power is

$$P'_{\mathrm{T}} = P_{\mathrm{LSB}} + P_{\mathrm{USB}}$$

$$= \frac{m_{\mathrm{a}}^2 V_{\mathrm{C}}^2}{8R} + \frac{m_{\mathrm{a}}^2 V_{\mathrm{C}}^2}{8R} = \frac{m_{\mathrm{a}}^2 V_{\mathrm{C}}^2}{4R}$$

$$= \frac{V_{\mathrm{C}}^2}{2R}\left[\frac{m_{\mathrm{a}}^2}{2}\right] = \frac{m_{\mathrm{a}}^2}{2} \times P_{\mathrm{C}}$$

Power saving in DSBSC over DSBFC (AM)

$$\text{Power saving} = \frac{P_T - P_T'}{P_T}$$

$$= \frac{\left[1+\dfrac{m_a^2}{2}\right]P_C - \left[\dfrac{m_a^2}{2}.P_C\right]}{\left[1+\dfrac{m_a^2}{2}\right]P_C}$$

$$= \frac{P_C + \cancel{\dfrac{m_a^2}{2}P_C} - \cancel{\dfrac{m_a^2}{2}P_C}}{\left[1+\dfrac{m_a^2}{2}\right]P_C}$$

Power saving in DSBSC over DSBFC (AM)

$$\% \text{ power saving} = \frac{2}{2+m_a^2} \times 100$$

If $$m_a = 1,$$

$$\% \text{ power saving} = \frac{2}{2+1} \times 100$$

$$= \frac{2}{3} \times 100 = 66.7\%$$

$\therefore$ 66.7% of power is saved in DSB-SC AM.

Bandwidth of DSBSC

We know the formula for bandwidth (BW) is

$$BW = f_{max} - f_{min}$$

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

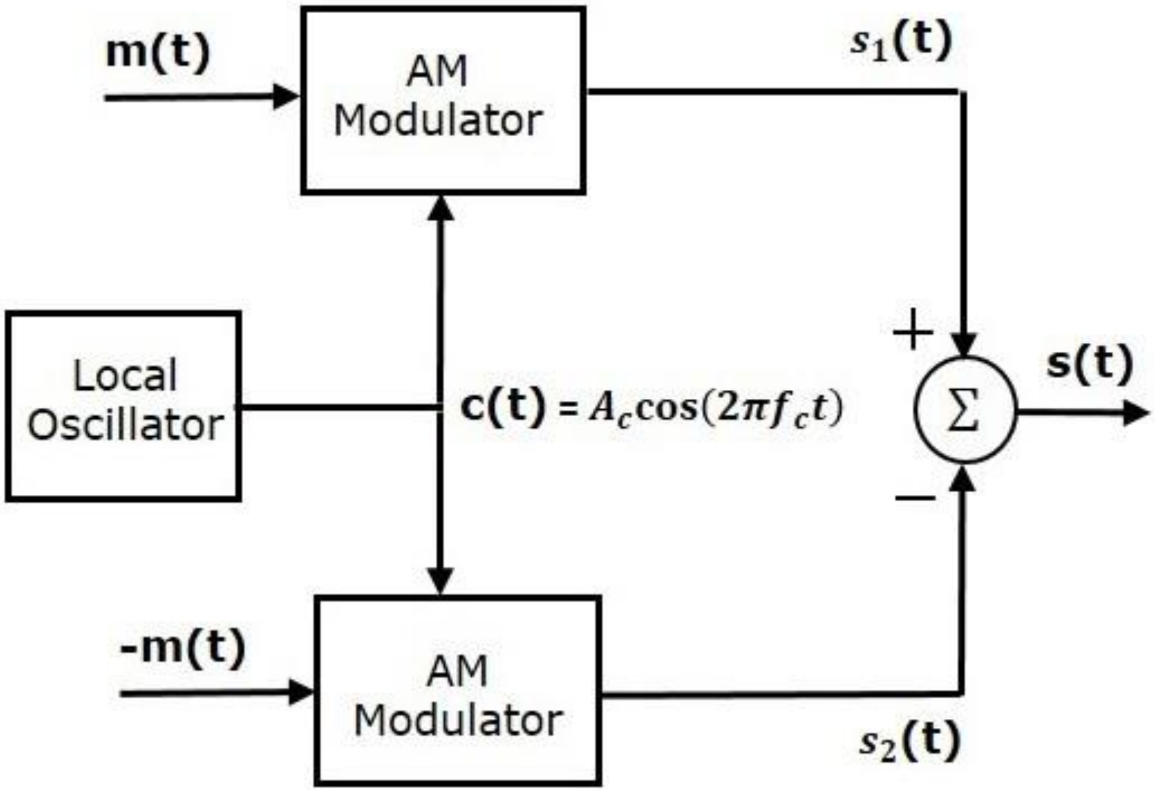
The DSBSC modulated wave has only two frequencies. So, the maximum and minimum frequencies are $fc + fm$ and fc - fm respectively.

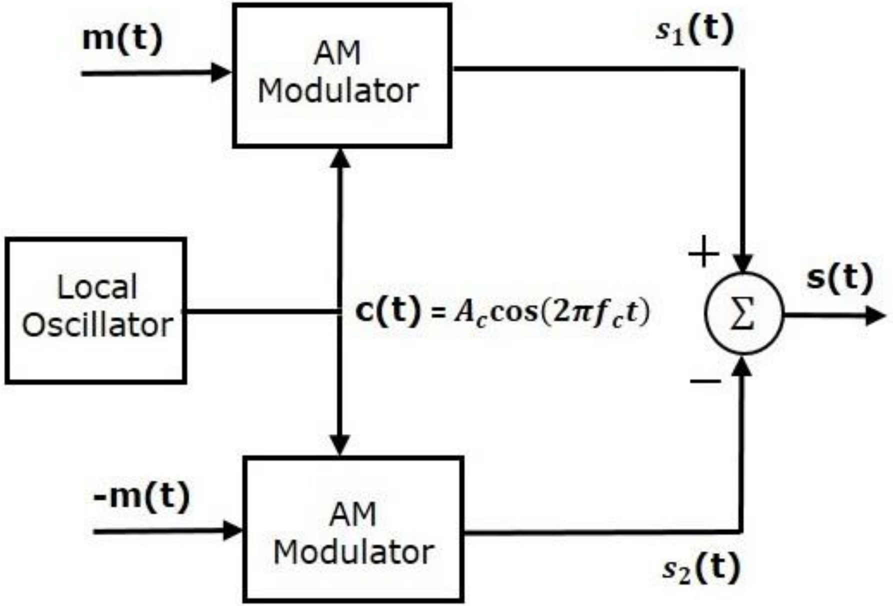
$$\mathrm{BW} = f_c + f_m - (f_c - f_m)$$

$$\Rightarrow \mathrm{BW} = 2\mathrm{f}_\mathrm{m}$$

DSB-SC Generation
(DSB-SC Modulators)

Balanced Modulator





$$s_1(t) = A_c[1 + k_a m(t)]\cos 2\pi f_c t$$

$$s_2(t) = A_c[1 - k_a m(t)]\cos 2\pi f_c t$$

$$s(t) = s_1(t) - s_2(t) = [2k_a A_c \cos 2\pi f_c t]m(t)$$