Signal Sideband Modulation

Introduction

- In the normal AM system, both sidebands and carrier are transmitted.

    This type of system is commonly known as Double Sideband Full Carrier System (DSBFC)

    The carrier of the AM system conveys no information

    The sidebands carry information

        But since they are images of each other, they carry the same information.

Single Sideband Communication

- Since the carrier conveys no useful information, there is no need to transmit.

  To make AM more efficient, the carrier is suppressed.

  When the carrier is removed, the remaining signal contains the upper and lower sidebands.

  - Such a signal is referred to as Double Sideband Suppressed Carrier (DSBSC or DSB).

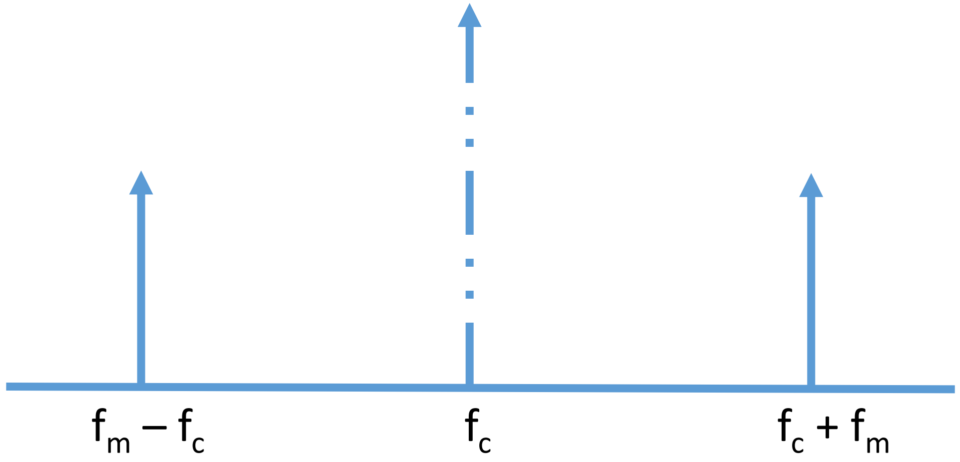
- Again, since the two sidebands of DSB carry the same information, DSB signal is redundant,
  - ie, in DSB, the basic information is transmitted twice.

  There is no need transmitting both signals to convey the information. One of the them can be suppressed.

  The resulting signal is referred to Single Sideband Suppressed Carrier (SSBSC or SSB)

- With this signal, the saved power can be put into the sidebands for stronger signals over longer distances.

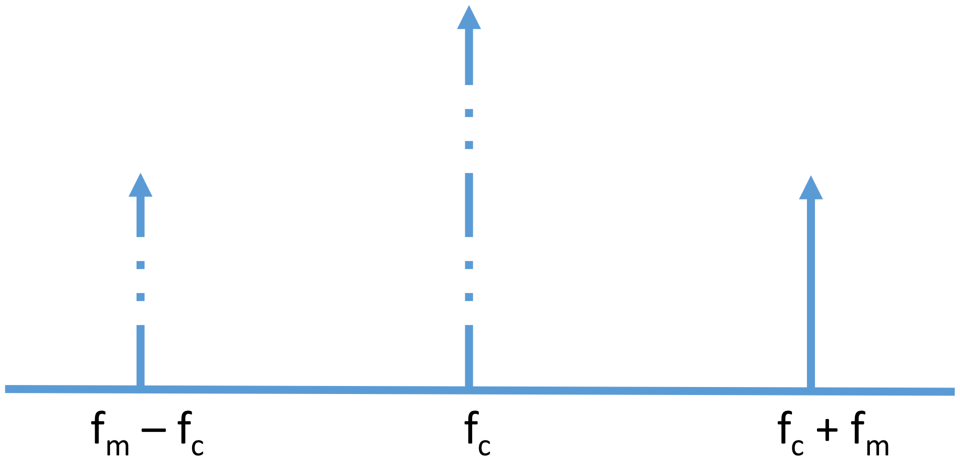
Representation of DSBSC AM



Frequency domain representation
Of a DSB signal

Dotted lines represent signals that are suppressed.

Representation of SSB



Frequency domain representation of a SSB signal

Advantages of SSB over DSB and AM

- Bandwidth conservation
- Power conservation
- No fading
- Noise reduction

- # Disadvantages of SSB

- Complex process
- Compromised transmission Quality
- Complex and precise tuning.

- Calculate the percentage power saving when the carrier is suppressed in an AM wave modulated to a depth of

    a) 100%

    b) 50%

Repeat the same when the carrier and one of the sidebands are suppressed.

i) $P_{total} = P_C \left(1 + \frac{m^2}{2}\right)$

- A) m = 1

$P_{total} = P_C \left(1 + \frac{1^2}{2}\right)$

$= 1.5\ P_C$

Power saving = $\frac{Pc}{1.5Pc}$

= 66.66 %

B) m = 0.5

$P_{total} = P_C \left(1 + \frac{0.5^2}{2}\right)$

$= 1.125\ P_C$

Power saving = $\frac{Pc}{1.125Pc}$

= 88.88 %

- Power saving in SSB (here, the carrier and one sideband are suppressed)

$$\text{Power save} = \frac{\text{Total power} - \text{Power in one sideband}}{\text{Total Power}}$$

a) $m = 1$, $P_{total} = 1.5\ P_C$

$$P_{SB} = P_C \frac{m^2}{4}$$

$$= P_C \frac{1^2}{4} = 0.25P_C$$

$$\text{Power saving} = \frac{1.5Pc - 0.25Pc}{1.5Pc}$$

$= 83.33\ \%$

$m = 0.5$, $P_{total} = 1.125\ P_C$

$$P_{SB} = P_C \frac{m^2}{4}$$

$$= P_C \frac{1^2}{4} = 0.0625P_C$$

$$\text{Power saving} = \frac{1.125Pc - 0.0625Pc}{1.125Pc}$$

$= 94.44\ \%$

A 400W carrier is modulated on a depth of 75%; calculate the total power in the modulated wave in the following forms of AM.

i) Double sideband full carrier (DSBFC)

ii) Double sideband suppressed carrier (DSBSC)

iii) Single sideband suppressed carrier (SSBSC)

i) $P_{DSBFC} = P_C\left(1+\frac{m^2}{2}\right)$

$= 400\left(1+\frac{0.75^2}{2}\right)$

$= 512.5W$

ii) $P_{DSBSC} = P_C\,\frac{m^2}{2}$

$= 400\left(\frac{0.75^2}{2}\right)$

$= 112.5W$

iii) $P_{DSBSC} = P_C\,\frac{m^2}{4}$

$= 400\left(\frac{0.75^2}{2}\right)$

$= 56.25W$