Principle of Communication (BEC-28)

Amplitude Modulation

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UNIT-1

- Overview of Communication system
- Communication channels
- Need for modulation
- Baseband and Pass band signals
- Comparison of various AM systems
- Amplitude Modulation
  - Double side-band with Carrier (DSB-C)
  - Double side-band without Carrier
  - Single Side-band Modulation
  - SSB Modulators and Demodulators
  - Vestigial Side-band (VSB)
  - Quadrature Amplitude Modulator.

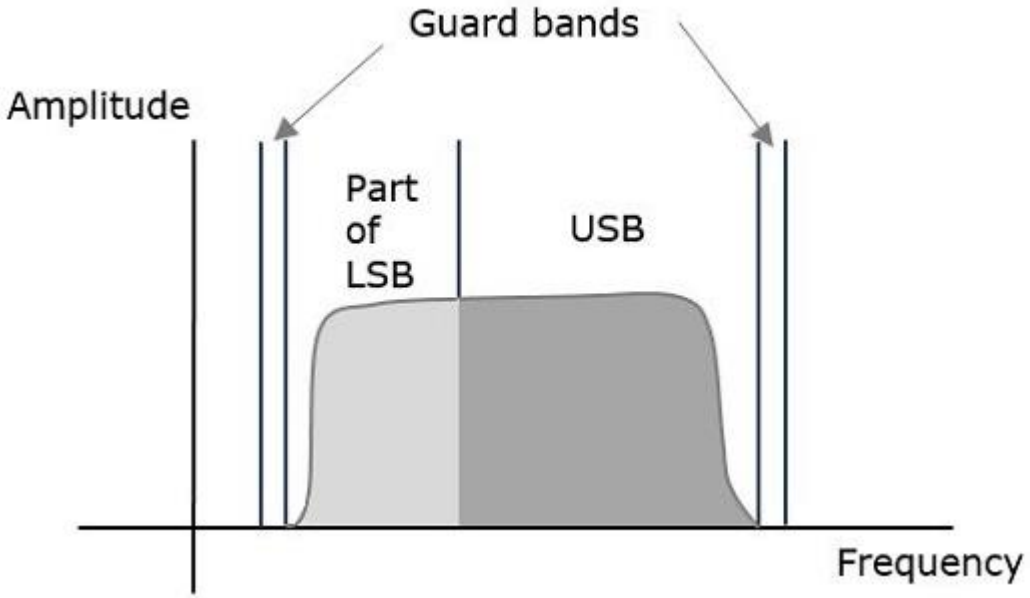
VSBSC

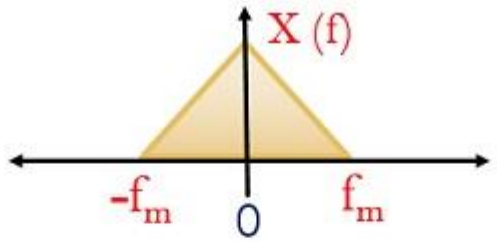
VSBSC MODULATION

- Vestigial Side Band Suppressed Carrier
- With an ideal bandpass filter one sideband frequency component can be obtained.
- practically we may not get the entire sideband frequency component.
- Hence, some information is lost.
- VSBSC Modulation: a part of the signal called as vestige is modulated along with one sideband.
- Along with the upper sideband, a part of the lower sideband is also being transmitted.
- The lower sideband along with a part of the upper sideband.

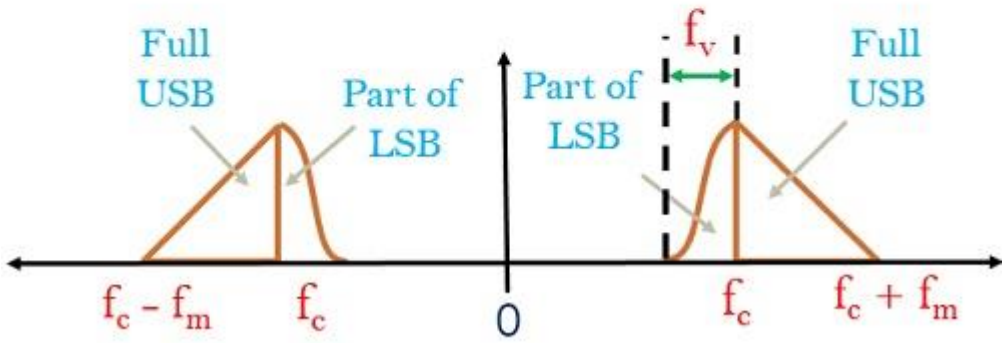
VSBSC MODULATION….

- Frequency Spectrum:





Spectrum of message signal



Spectrum of VSB signal

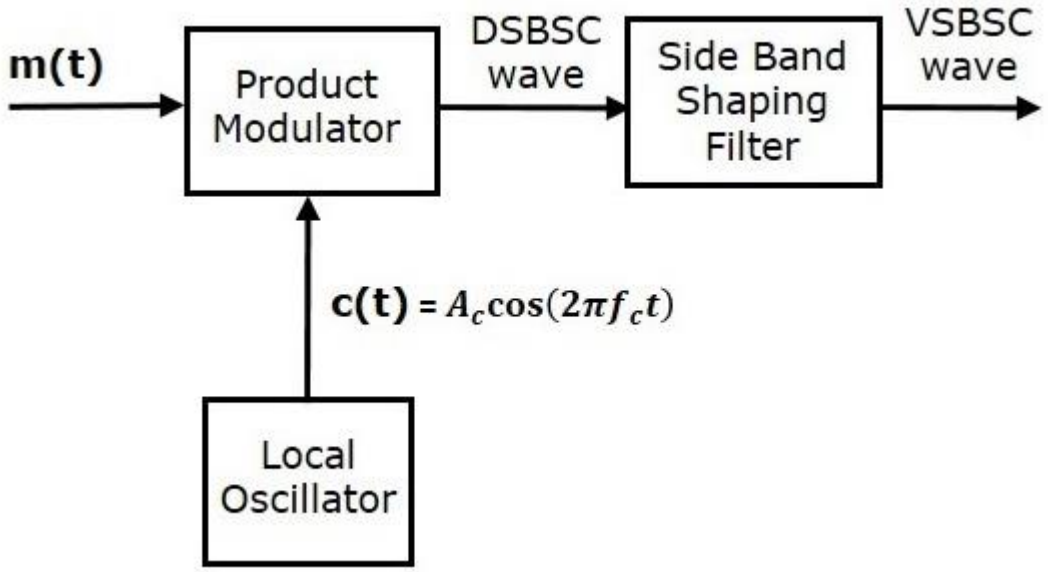
Bandwidth: $f_m + f_v$

VSBSC MODULATION….

- Advantages
  - Following are the advantages of VSBSC modulation.
  - Highly efficient.
  - Reduction in bandwidth when compared to AM and DSBSC waves.
  - Filter design is easy, since high accuracy is not needed.
  - The transmission of low frequency components is possible, without any difficulty.
  - Possesses good phase characteristics.
- Disadvantages
  - Following are the disadvantages of VSBSC modulation.
  - Bandwidth is more when compared to SSBSC wave.
  - Demodulation is complex.
- Application
  - Transmission of television signals.
  - Where, efficient utilization of bandwidth is required.

VSBSC MODULATOR

- Generation of VSBSC wave is similar to the generation of SSBSC wave.



- Output of product modulator: $p(t) = A_c \cos(2\pi f_c t) m(t)$
- Apply Fourier transform:

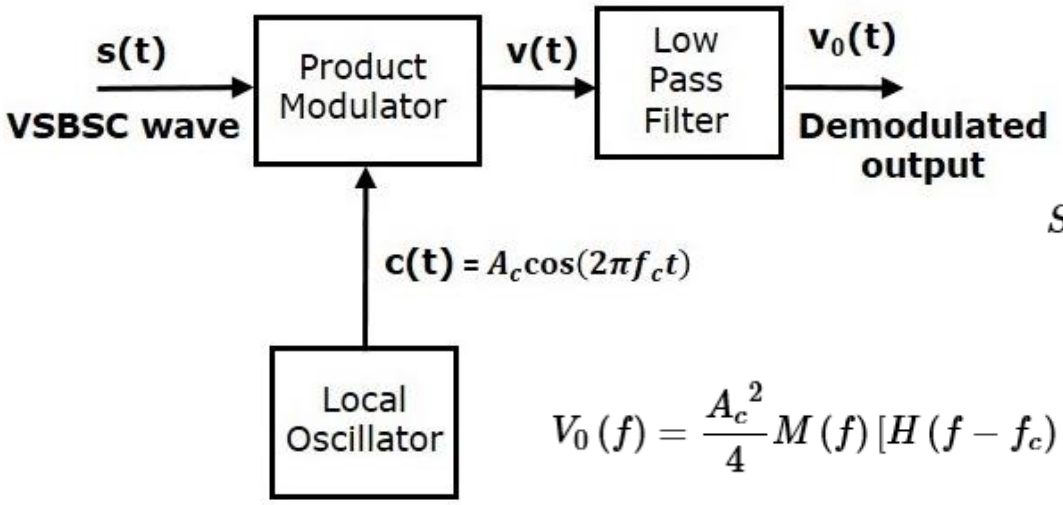
$$P(f) = \frac{A_c}{2}[M(f - f_c) + M(f + f_c)]$$

$$S(t) = P(f)\,H(f)$$

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

VSBSC DEMODULATOR

- Similar to the demodulation of SSBSC wave.
- Same carrier signal (which is used for generating VSBSC wave) is used to detect the message signal.
- Coherent or synchronous detection.



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

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

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

$$\Rightarrow S(f - f_c) = \frac{A_c}{2}[M(f - 2f_c) + M(f)]\, H(f - f_c)$$

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

$$\Rightarrow V(f) = \frac{A_c^2}{4} M(f)\,[H(f - f_c) + H(f + f_c)]$$

$$V_0(f) = \frac{A_c^2}{4} M(f)\,[H(f - f_c) + H(f + f_c)] \quad + \frac{A_c^2}{4}[M(f - 2f_c)\, H(f - f_c) + M(f + 2f_c)\, H(f + f_c)]$$

Thank You