Amplitude Modulation (AM)

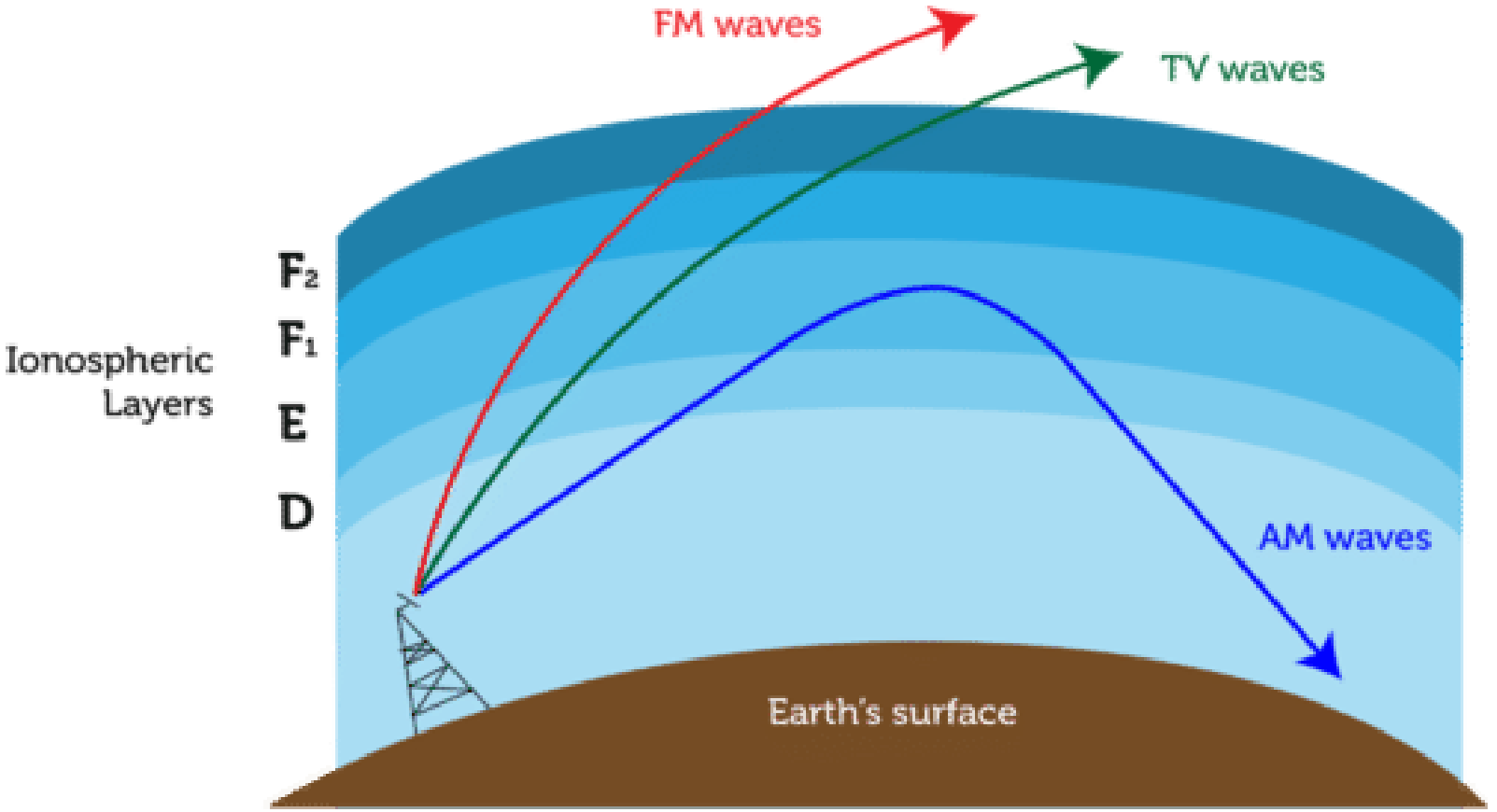
- Amplitude Modulation is the process of varying amplitude of the high frequency carrier signal inaccordance with the instantaneous amplitude of the low frequency message signal

- Carrier signal changes linearly with the message signal

- Advantages:
  - Easy generation and recovery of signals
  - Less bandwidth requirement of FM
  - Coverage area is high
  - Cheaper

- Disadvantages:
  - Wastage of power
  - Wastage of bandwidth
  - Noise interference is more
  - Less efficient

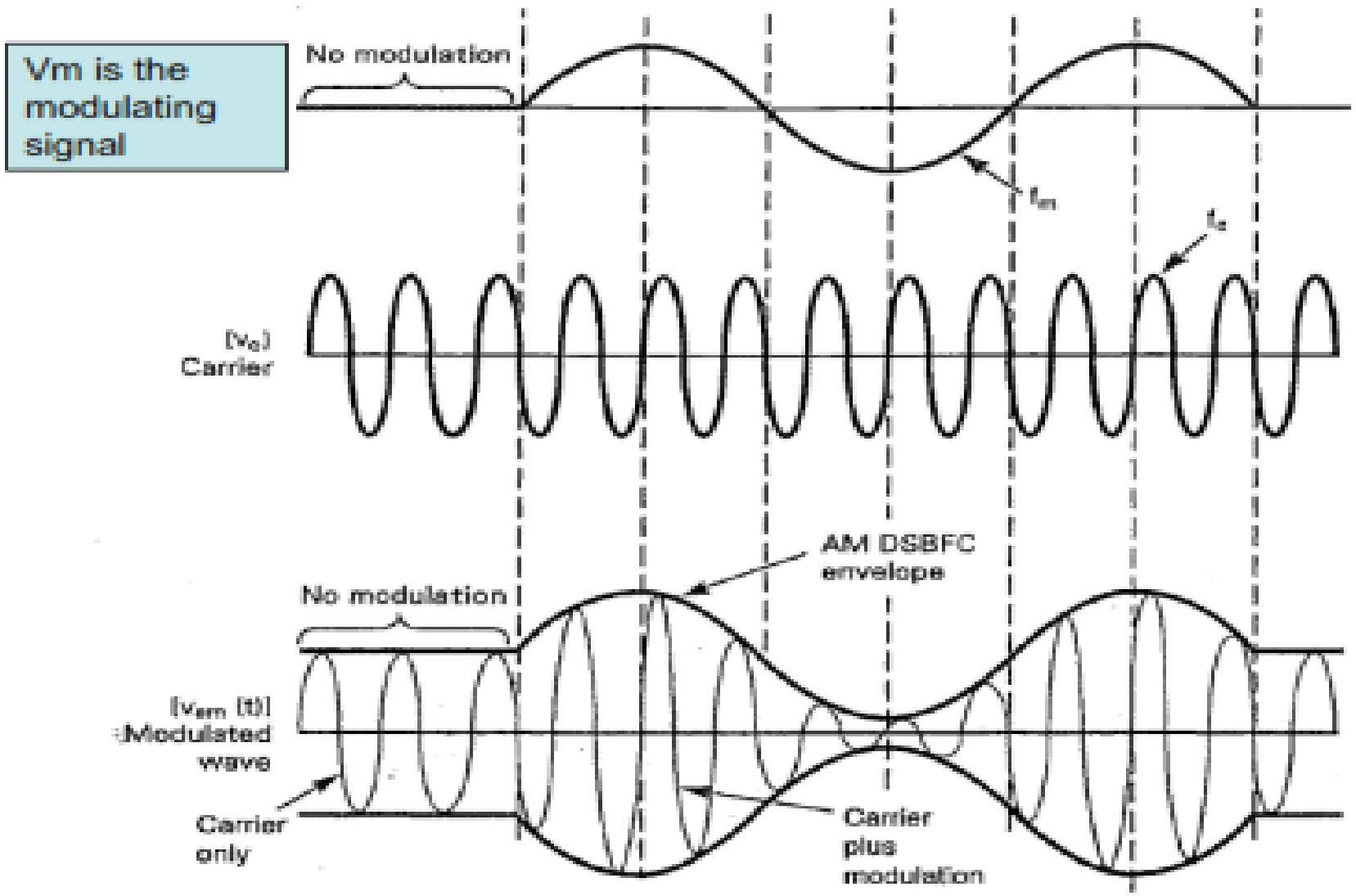
Why AM travels longer distance than FM?



Types of AM

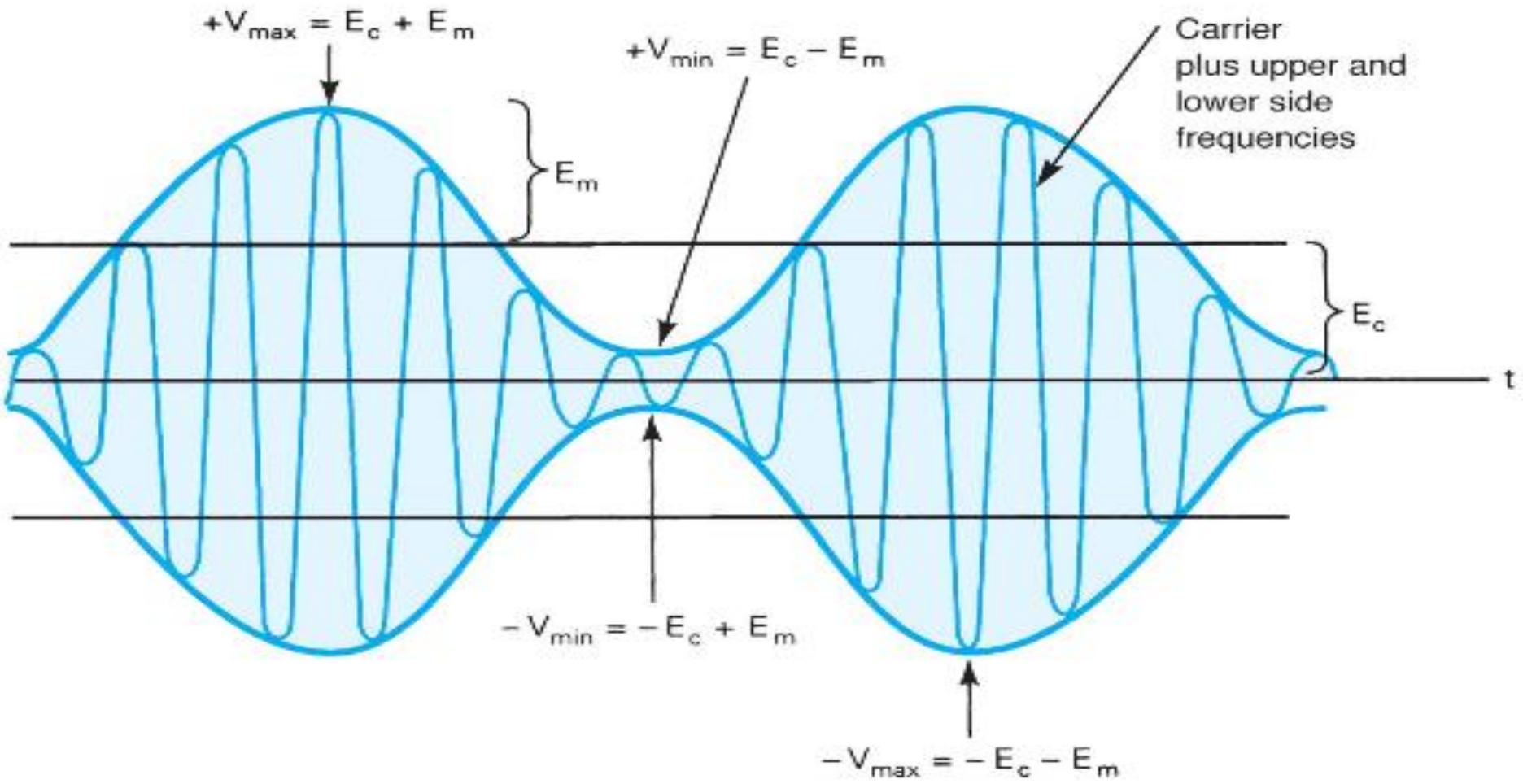
- DSBFC – Double Side Band Full Carrier (Simple AM)
- DSBSC – Double Side Band Suppressed Carrier
- SSBFC – Single Side Band Full Carrier
- SSBSC – Single Side Band Suppressed Carrier
- VSB – Vestigial Side Band

AM Envelope


Vm is the modulating signal
No modulation
f_m
f_c
$[v_c]$ Carrier
AM DSBFC envelope
No modulation
$[v_{am}(t)]$ Modulated wave
Carrier only
Carrier plus modulation

Modulation index & Percent Modulation

$$m = \frac{E_m}{E_c}$$



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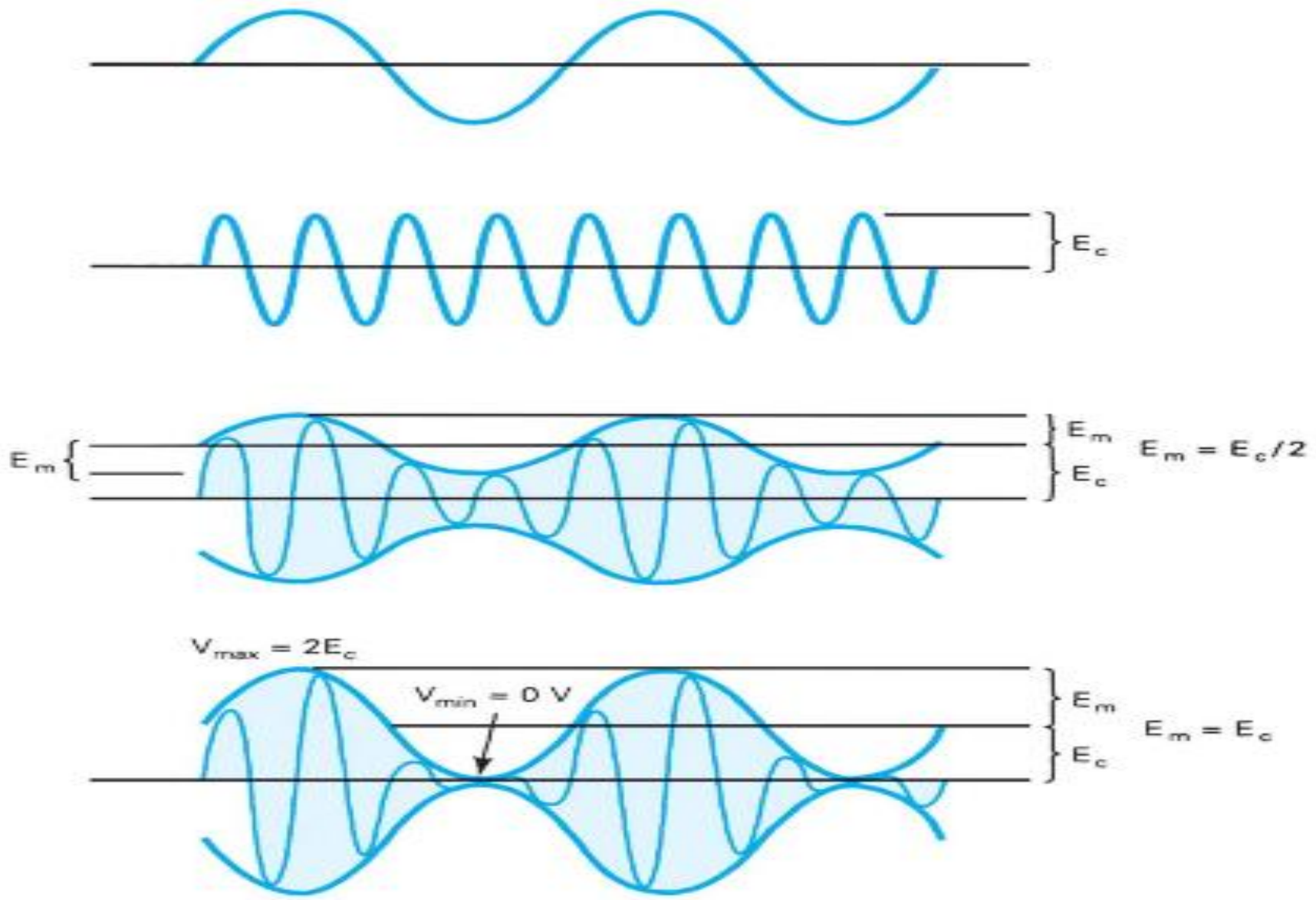
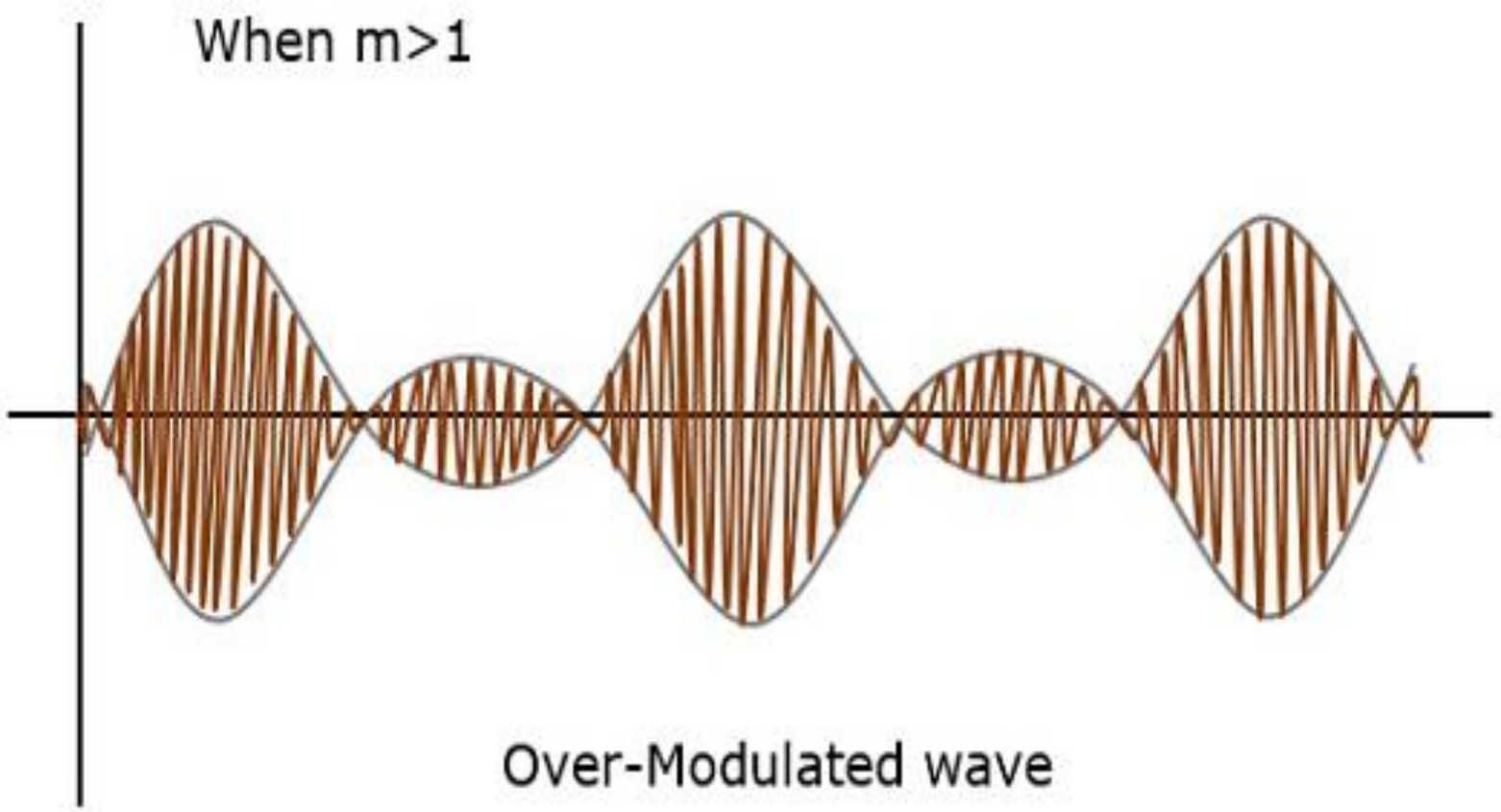


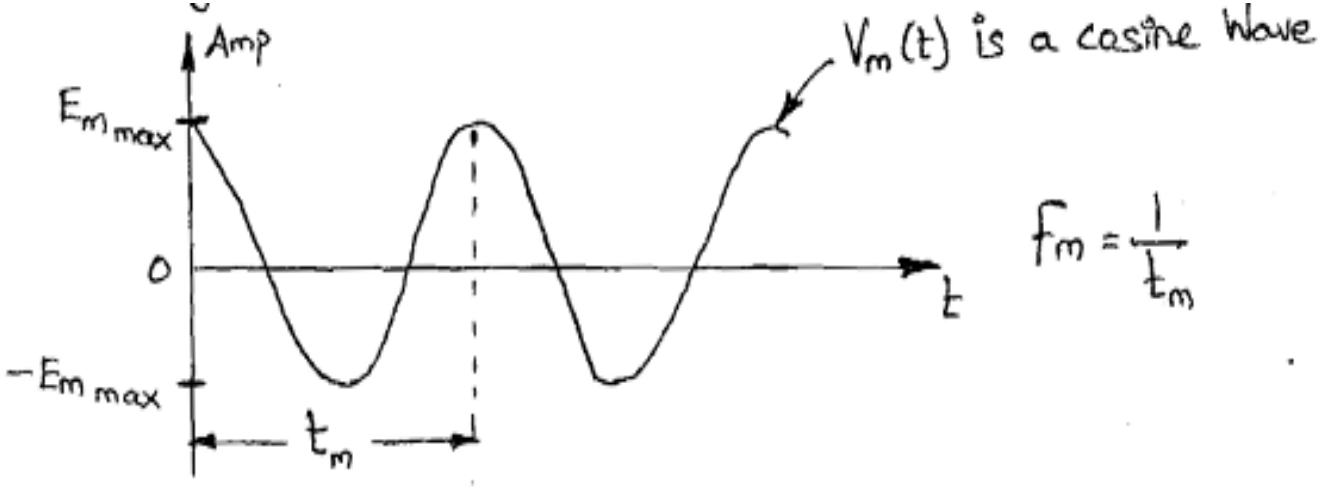
Over Modulation



Frequency spectrum of AM wave

- Let the modulating signal is mathematically expressed as

$$V_m(t) = E_m \cos(2\pi f_m t + \phi_m) \text{ ------ (1)}$$



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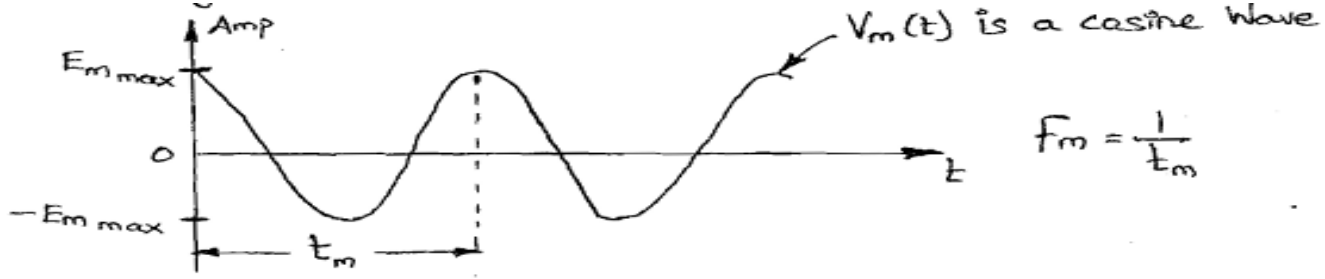
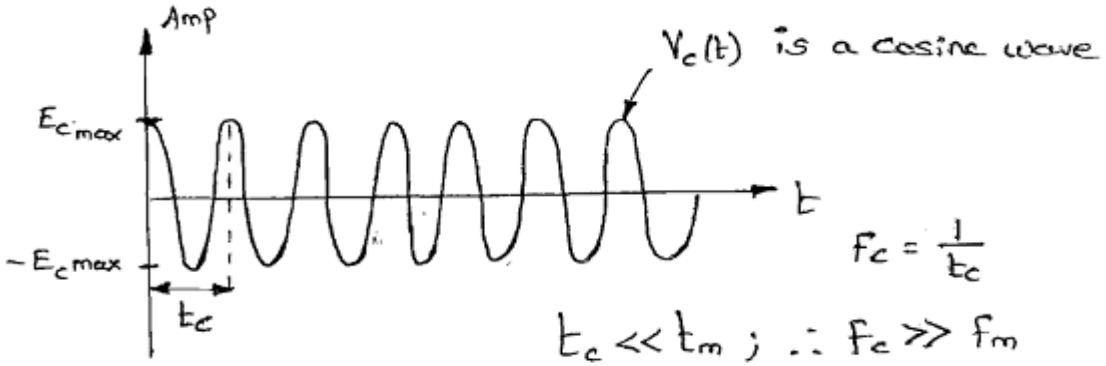


- Let the carrier signal is mathematically expressed as

$$V_c(t) = E_c \cos(2\pi f_c t + \phi_c) \text{ ------(2)}$$



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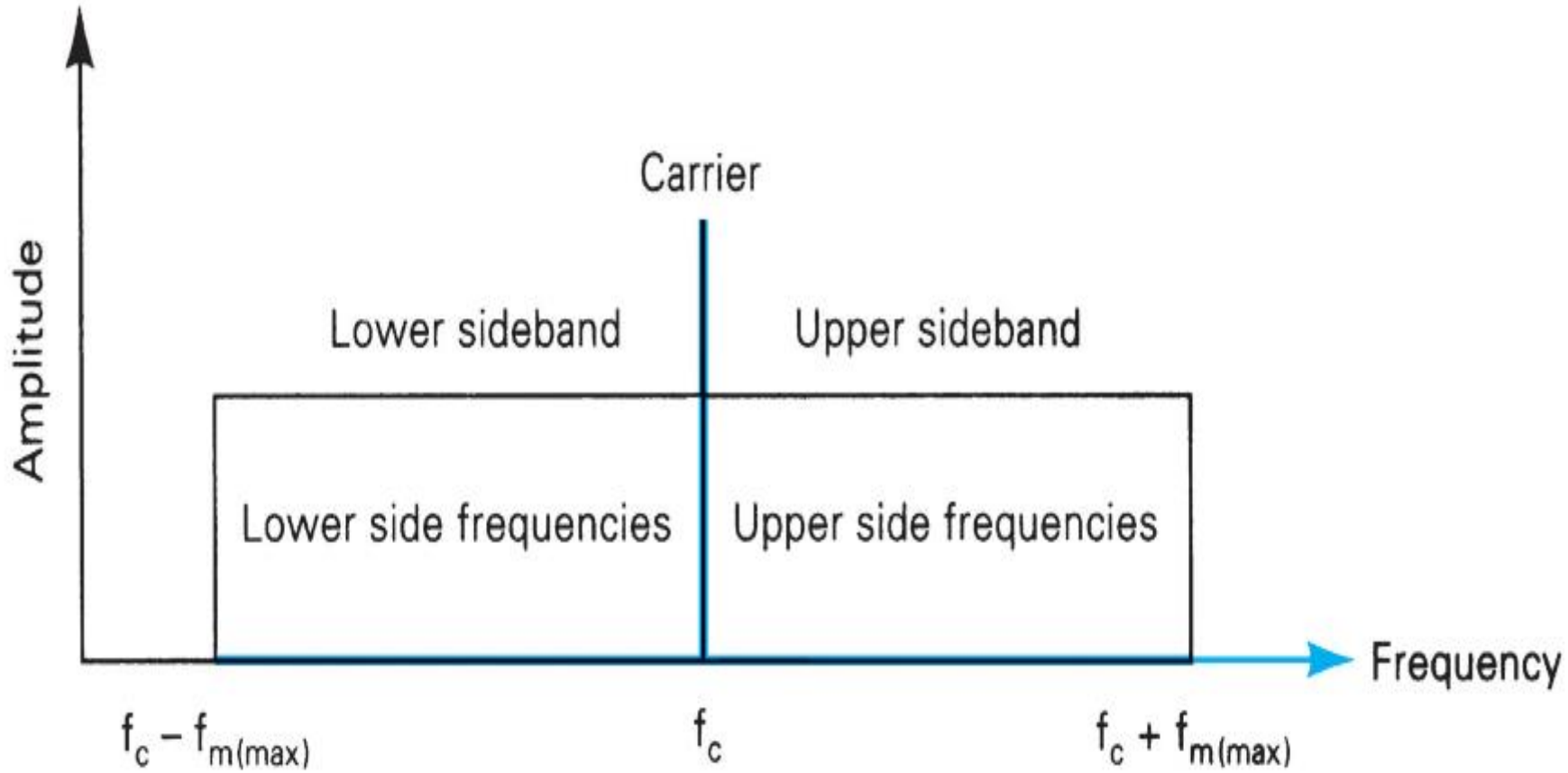
$$V_{AM}(t) = E_c \cos 2\pi f_c t + \frac{mE_c}{2}\cos 2\pi(f_c + f_m)t +$$

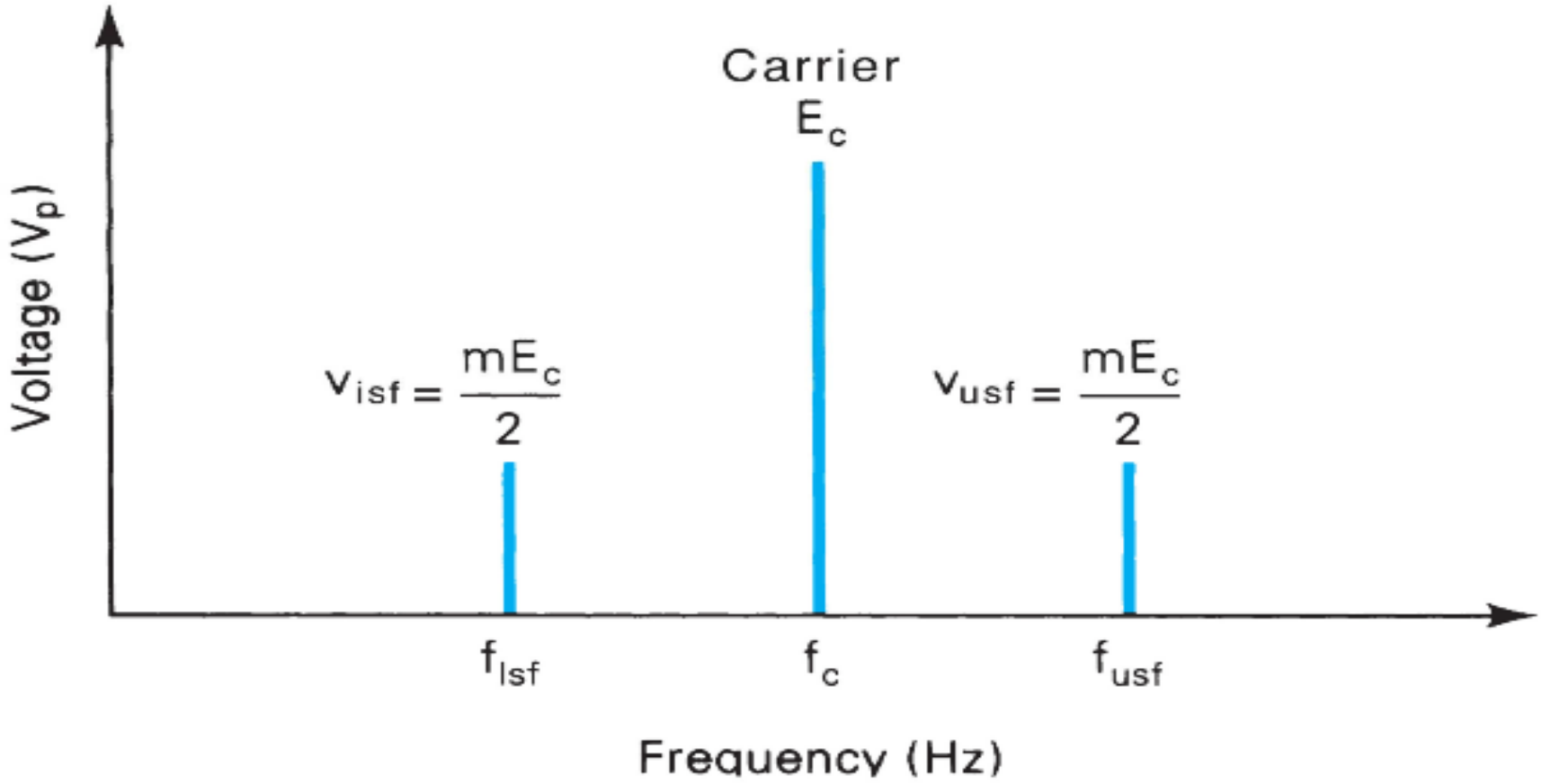
$$\frac{mE_c}{2}\cos 2\pi(f_c - f_m)t \text{ -----(8)}$$

- The above equation is called AM equation or AM voltage distribution or AM frequency spectrum equation
- First term is carrier, second term is USB and third term is LSB

Frequency spectrum of AM wave



Voltage spectrum of AM wave



AM bandwidth

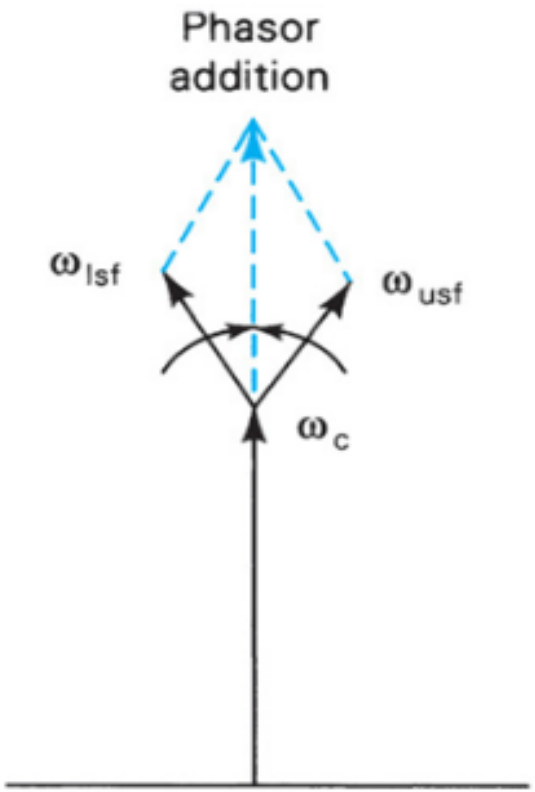
- The bandwidth required to transmit AM signal is mathematically expressed as

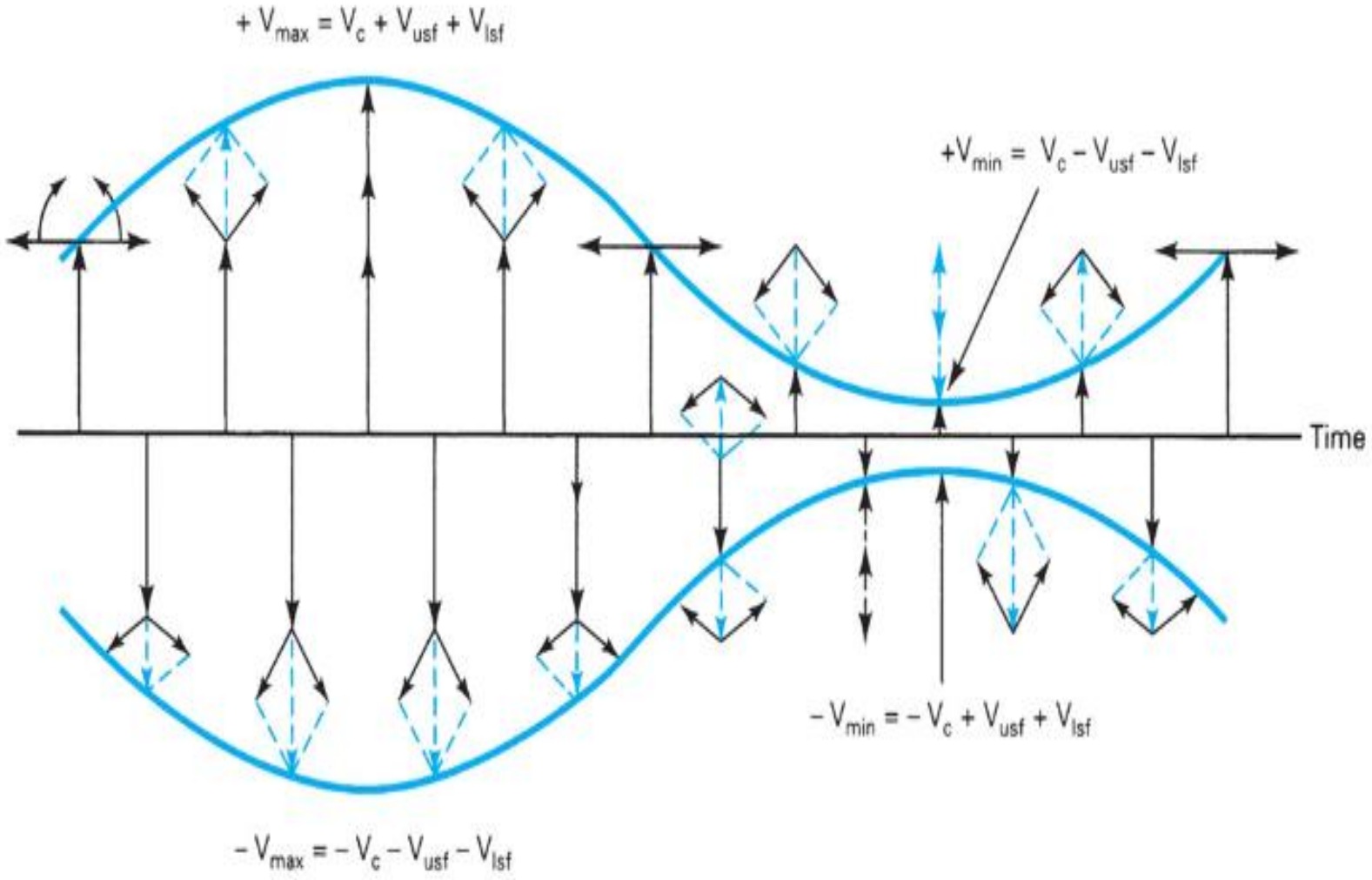
$$BW = f_U - f_L$$

$$= (f_c + f_m) - (f_c - f_m)$$

$$= 2 f_{m,\max}$$

Phasor diagram





http://www.learnabout-electronics.org/ac_theory/ac_ccts_53.php