▸ Subject : 2 / 4 / 2019 .

SSB :-

modulated signal have 2 varsions of the signal , one at the LSB and 2 @ the USB .

Double side band → Lower side band (LSB)
↳ upper side band (USB)

* in the SSB , we need to obtain only one side band , either the lower or the higher , we need ideal BPF
it is not avaliable

Vestigial side band (VSB) :-

a practical filter is used such that a full side band with a part from the other side band

(in TV system , VSB is normally used

Frequency Division Multiplexing :- (FDM)

I have a group of signals that I need to transmit from a transmiter of a destination .

↳ So , I need to use FDM

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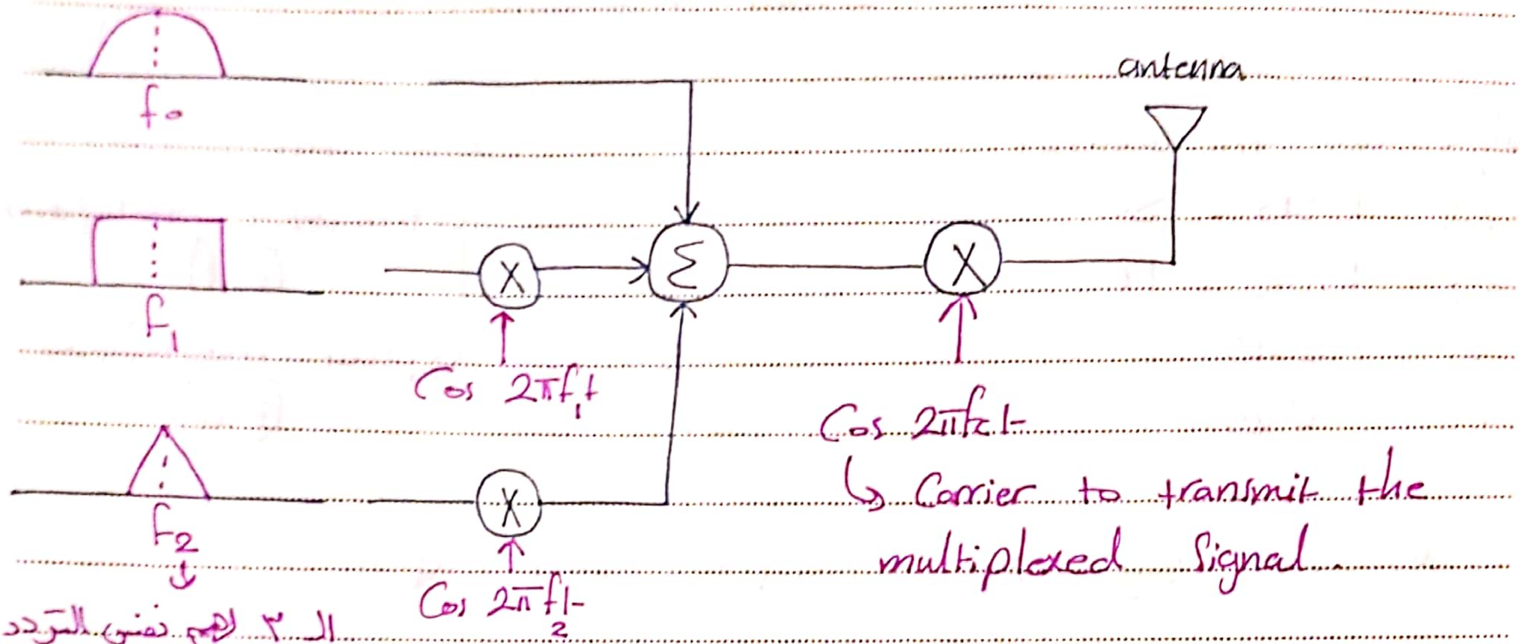
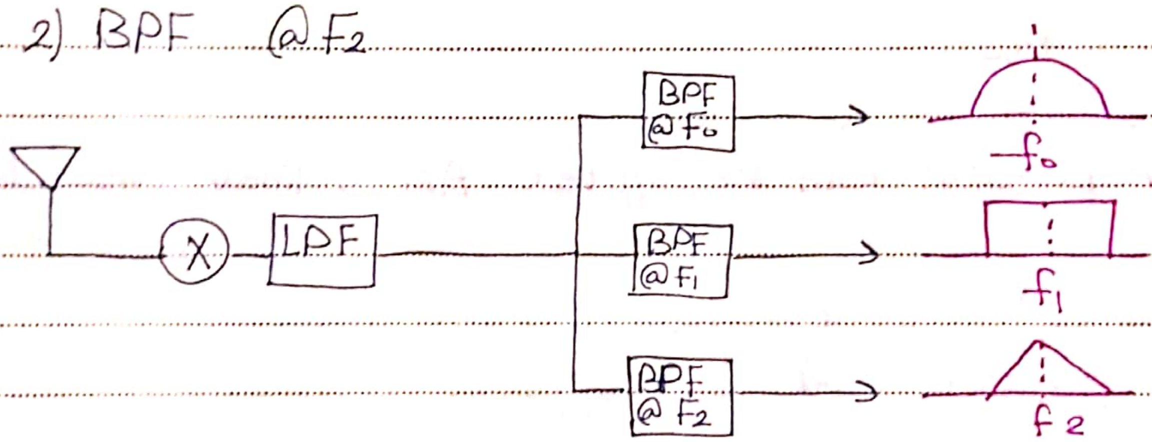


الـ ٣ لهم نفس التردد

-حدث تشويش متغير

* 2 level of modulation :-
1) BPF @ F_1
2) BPF @ F_2



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Subject : 2/4/2019

analog modulation

Amplitude modulation
- DSB - SC
- DSB - LC
- SSB
- VSB

Angle modulation
- Frequency modulation (FM)
- phase modulation (PM)

* message signal $m(t) = A_m(\cos(2\pi f_m t + \phi_m))$

$m_1(t) = A_1 \cos(2\pi f t + \phi)$

$m_2(t) = A_2 \cos(2\pi f t + \phi)$

$m(t) = m_1(t) + m_2(t)$

$= (A_{m_1} + A_{m_2}) \cos(2\pi f t + \phi)$

Since supper position can be applied AM → linear modulation

$\cos(2\pi f_1 t + \phi_1) + \cos(2\pi f_2 t + \phi_2)$

→ supper position can't be applied.

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Angle Modulation :-

any Sinosoidal signal is given by :-

$$S(t) = A \cos [\underset{\text{angle}}{\underline{\theta(t)}}]$$

$$\theta(t) = 2\pi f_c t + \phi_1$$

$$\therefore f_c = \frac{1}{2\pi} \frac{d\,\theta(t)}{dt} .$$

phase modulated signal :-

The phase modulated signal is given by :-

$$\underset{\text{modulated signal}}{S(t)} = A_c \cos (2\pi \underset{\text{carrier freq}}{f_c} t + \underline{k_p\, m(t)}) .$$

the phase of the modulated signal is non linerly varying with message signal

where k_p :- phase sensitivity (rad / volt)

$m(t)$:- message signal.

Frequency Modulation (FM) :- f_c : 88 MHz → 108 MHz.

$$\theta_i(t) = 2\pi \int_0^t f_i(\tau)\, d\tau .$$

frequency is a function of time.

instintanuse frequency

$$f_i = f_c + k_f\, m(t) .$$

the instantneouse frequency is varying with the message signal

$$\therefore \theta_i(t) = 2\pi \int_0^t (f_c + k_f\, m(\tau))\, d\tau$$

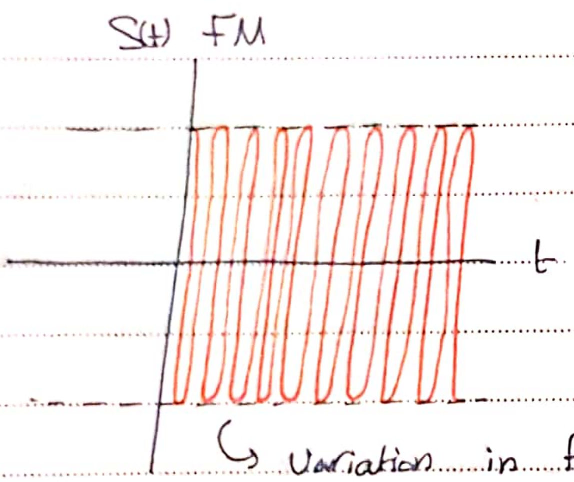
$$= 2\pi \int_0^t f_c \, d\tau + 2\pi \int_0^t k_f \, m(\tau) \, d\tau .$$

$$= 2\pi f_c t + 2\pi k_f \int_0^t m(\tau) \, d\tau$$

∴ The FM signal is given by :-

$$S(t) = A_c \cos(\theta_i(t)) = A_c \cos 2\pi f_c t + 2\pi k_f \int_0^t m(\tau) \, d\tau .$$

S(t) is a modulated signal.



→ FM Modulated signal لو
amplitude كان → ثابت
freq → متغير

* The angle modulated signal is generally given by:
$S(t) = A_c \cos(\theta_i(t))$, and the average power is expressed :

$$P_{av} = \frac{1}{T} \int_{-T/2}^{T/2} s^2(t) \, dt$$

$$= \frac{1}{T} \int_{-T/2}^{T/2} A_c^2 \cos^2(\theta_i(t)) \, dt$$

$$\cos^2(\theta_i(t)) = \frac{1}{2} + \frac{1}{2} \cos(2\theta_i(t)) .$$

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$$\therefore P_{av} = \frac{1}{T}\int_{-T/2}^{T/2}\left(\frac{A_c^2}{2} + \frac{A_c^2}{2}\cos(2\theta_i(t))\right)dt$$

$$= \underbrace{\frac{1}{T}\int_{-T/2}^{T/2}\frac{A_c^2}{2}\,dt}_{\frac{1}{T}\cdot\frac{A_c^2}{2}\cdot T \;=\; \frac{A_c^2}{2}} + \underbrace{\frac{A_c^2}{2T}\int_{-T/2}^{T/2}\cos(2\theta_i(t))\,dt}_{}$$

$\frac{1}{T}\cdot\frac{A_c^2}{2}\cdot T$

$= \frac{A_c^2}{2}$.

The integration of any Sinusoidal Signal over a period $= 0$

$\therefore$ The average Power of the angle modulated signal is $P_{av} = \frac{1}{2}A_c^2$.

where A_c is the amplitude of the modulated signal.

Summery :-

	(PM) Phase modulation	(FM) Frequency modulation.
1) instantious phase $\theta_i(t)$	$\theta_i(t) = 2\pi f_c t + k_p m(t)$	$\theta_i(t) = 2\pi\int_0^t f_i(\tau)\,d\tau$ $= 2\pi f_c t + 2\pi k_f\int_0^t m(\tau)\,d\tau$
2) instantious frequency $f_i(t)$	$f_i = \frac{1}{2\pi}\frac{d\theta_i(t)}{dt}$ $= f_c + \frac{k_p}{2\pi}\frac{d}{dt}m(t)$.	$f_i(t) = f_c + k_f\, m(\tau)$
3) modulated wave form	$s(t) = A_c\cos\theta_i(t)$ $= A_c\cos(2\pi f_c t + k_p m(t))$.	$s(t) = A_c\cos(\theta_i(t))$ $= A_c\cos\left(2\pi f_c t + 2\pi k_f\int_0^t m(\tau)\,d\tau\right)$