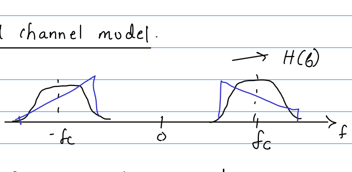
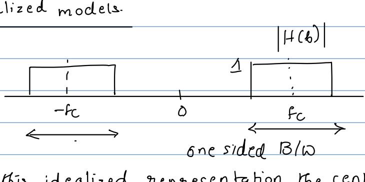
Passband channel model.



1) $H(f)$ is symmetric around 0.
2) centre freq f_c but an actual channel response need not be symmetric around f_c.

Idealized models.

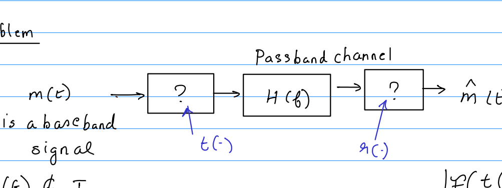


phase response is linear.

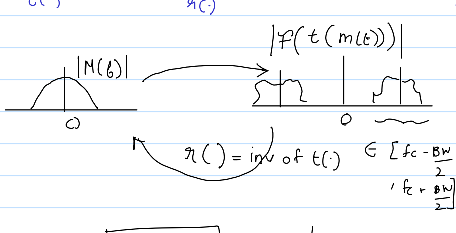
e.g. 100 MHz
one sided B/W = 2 MHz

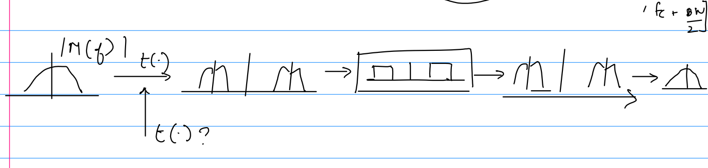
for this idealized representation the center frequency is a point of symmetry for $|H(f)|$.

Our problem



1) $m(t) \notin I$
2) $t(m(t)) \in I$





1) multiplication of $m(t)$ with a sinusoid.
2) changing freq/phase of a sinusoid as a function of $m(t)$.

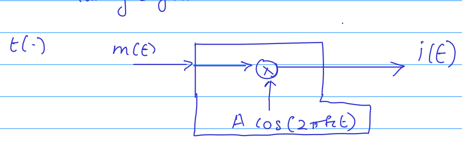
$$\text{Sinusoid} = A\cos(2\pi f t + \phi)$$

one or more properties are changed/modulated.
1) and 2) are modulation techniques.

$A\, m(t) \underbrace{\cos(2\pi f_c t)}_{\text{carrier signal}}$ → amplitude modulation

→ modulated signal

modulating signal



Is this LTI? Not LTI ⇒ cannot use $X(f)H(f) = Y(f)$!

$I(f)$?

$$i(t) = A\,m(t)\cos(2\pi f_c t)$$

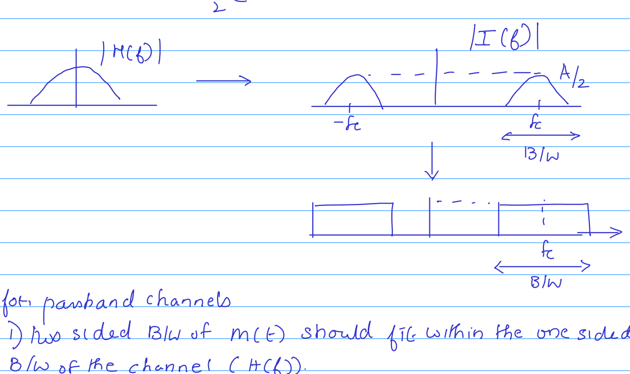
we use: $m(t) \xrightarrow{\mathcal{F}} M(f)$

$$m(t)e^{j2\pi f_c t} \longrightarrow M(f-f_c)$$

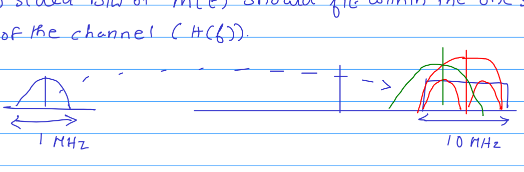
$$\int m(t)e^{-j2\pi(f-f_c)t}\,dt$$

$$i(t) = A\,m(t)\cdot\left(\frac{e^{j2\pi f_c t} + e^{-j2\pi f_c t}}{2}\right)$$

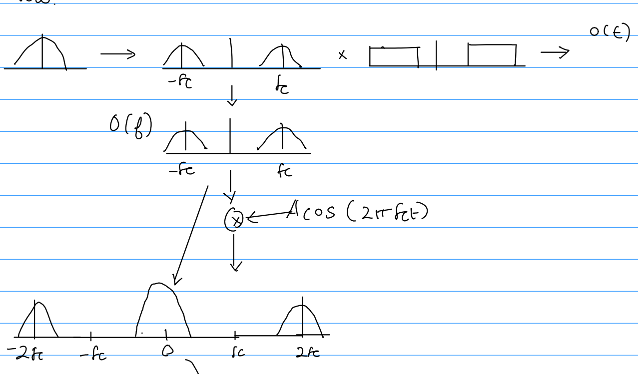
$$\Rightarrow I(f) = \frac{A}{2}\left[M(f-f_c) + M(f+f_c)\right]$$



for passband channels
1) two sided B/W of $m(t)$ should fit within the one sided B/W of the channel ($H(f)$).

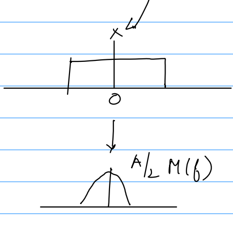


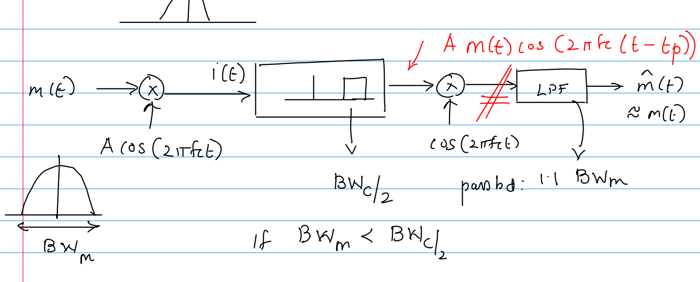
Now:



$$\frac{A}{2}\left[M(f-f_c) + M(f+f_c)\right] \rightarrow \frac{A}{4}M(f-2f_c) + \frac{A}{4}M(f+2f_c)$$

$$+ \underbrace{A/_2\, M(f)}$$





If $BW_m < BW_c/_2$

where does one get $\cos(2\pi f_c t)$-s from?
generated by the transmitter and receiver separately
Local oscillators.