TTH3A4 - Sistem Komunikasi

Telkom University

Signal Space

Prodi S1 Teknik Telekomunikasi
Fakultas Teknik Elektro
Universitas Telkom

School of Electrical Engineering

Tujuan Pembelajaran

- Memahami dan menjelaskan konsep Kinerja pada AM
- Mengetahui kinerja berbagai jenis modulasi AM (SSB, DSB-SC, DSB-FC)

School of Electrical Engineering

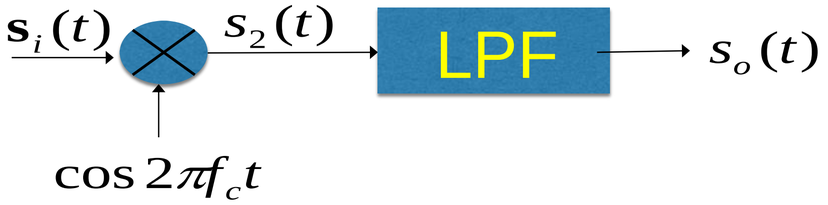
Outline

- Pendahuluan

Daya Sinyal SINGLE SIDE BAND

- Sinyal diterima diasumsikan USB :

$$\mathbf{s}_i(t) = A\cos 2\pi(f_c + f_m)t$$



- Maka :

$$\mathbf{s}_2(t) = A\cos 2\pi(f_c + f_m)t.\cos 2\pi f_c t$$

$$\mathbf{s}_2(t) = \frac{A}{2}\cos 2\pi(2f_c + f_m)t + \frac{A}{2}\cos 2\pi f_m t$$

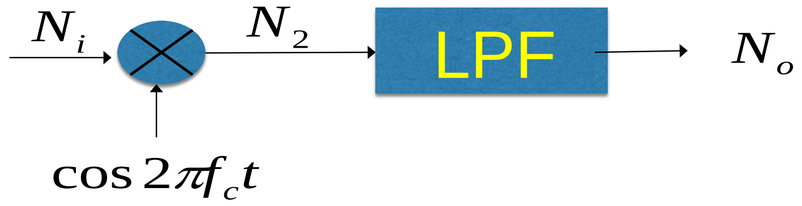
$$\mathbf{s}_o(t) = \frac{A}{2}\cos 2\pi f_m t$$

- Daya :

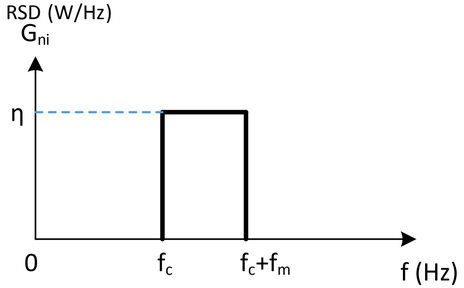
$$S_i = \frac{A^2}{2} \qquad S_o = \frac{\left(\frac{A}{2}\right)^2}{2} = \frac{A^2}{8} \longrightarrow \frac{S_o}{S_i} = \frac{A^2/8}{A^2/2} = \frac{1}{4} \longrightarrow S_o = \frac{1}{4}S_i$$

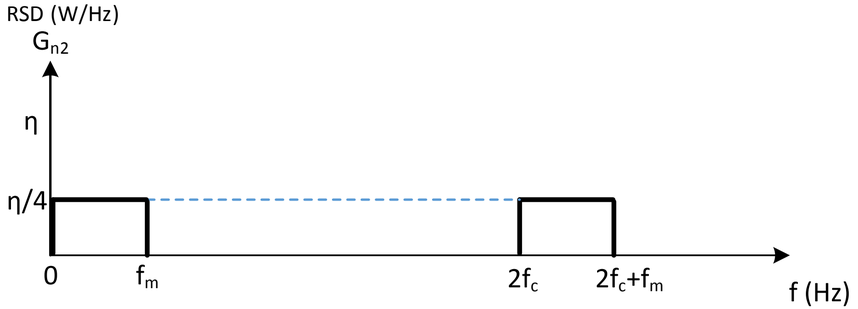
Daya Noise SINGLE SIDE BAND

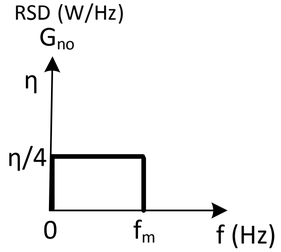
- Rapat spectral daya noise pada input : η_i



- Rapat spectral daya dan daya noise :







$$N_i = \eta f_m$$

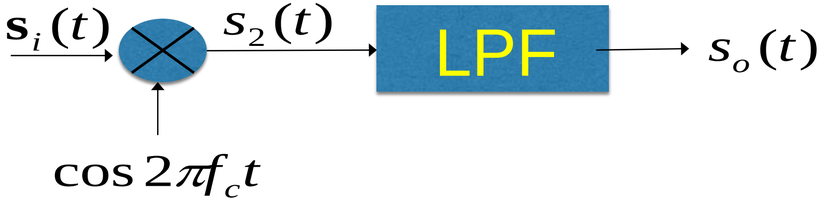
$$N_o = \frac{\eta f_m}{4}$$

- Maka :

$$\frac{S_o}{N_o} = \frac{S_i / 4}{\eta f_m / 4} = \frac{S_i}{\eta f_m}$$

Daya Sinyal Double SIDE BAND-SC

- Sinyal diterima :



$$\mathbf{s}_i(t) = A\cos 2\pi f_c t \cos 2\pi f_m t = \frac{A}{2}\cos 2\pi(f_c + f_m)t + \frac{A}{2}\cos 2\pi(f_c - f_m)t$$

- Maka :

$$\mathbf{s}_2(t) = A\cos 2\pi f_m t \cos 2\pi f_c t \cos 2\pi f_c t = A\cos 2\pi f_m t\left(\frac{1}{2} + \frac{1}{2}\cos 2\pi(2f_c)t\right)$$

$$\mathbf{s}_2(t) = \frac{A}{2}\cos 2\pi f_m t + \frac{A}{4}\cos 2\pi(2f_c + f_m)t + \frac{A}{4}\cos 2\pi(2f_c - f_m)t$$

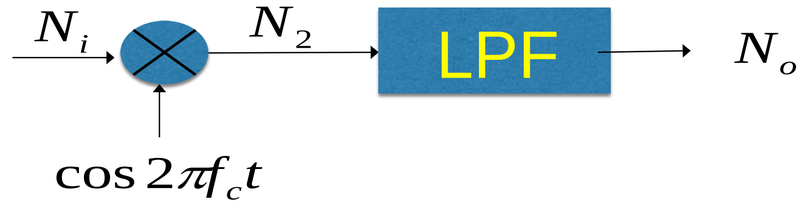
$$\mathbf{s}_o(t) = \frac{A}{2}\cos 2\pi f_m t$$

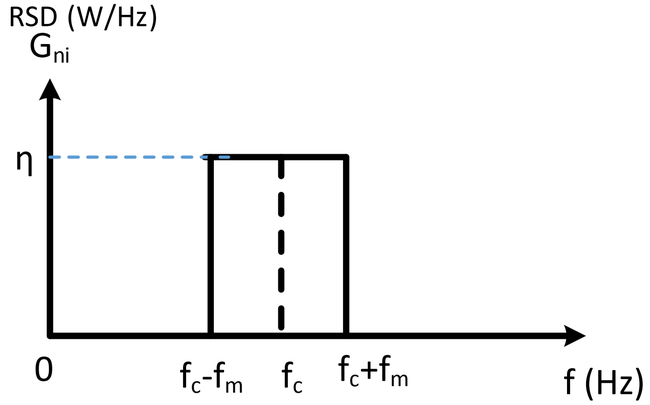
- Daya :

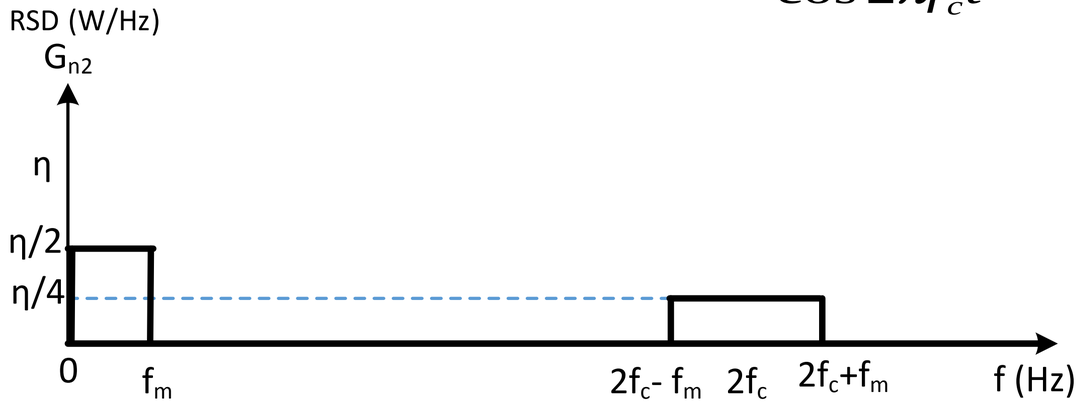
$$S_i = \frac{A^2}{8} + \frac{A^2}{8} = \frac{A^2}{4} \qquad S_o = \frac{\left(\frac{A}{2}\right)^2}{2} = \frac{A^2}{8} \longrightarrow \frac{S_o}{S_i} = \frac{A^2/8}{A^2/4} = \frac{1}{2} \longrightarrow S_o = \frac{1}{2}S_i$$

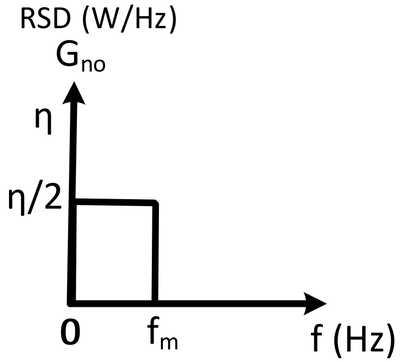
Daya Noise DOUBLE SIDE BAND-SC

- Rapat spectral daya noise pada input : η_i
- Rapat spectral daya dan daya noise :









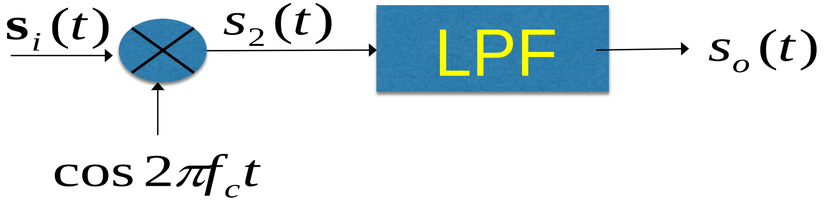
$$N_i = 2\eta f_m$$

$$N_o = \frac{\eta f_m}{2}$$

- Maka :

$$\frac{S_o}{N_o} = \frac{S_i / 2}{\eta f_m / 2} = \frac{S_i}{\eta f_m}$$

Daya Sinyal Double SIDE BAND-FC



- Sinyal diterima :

$$\mathbf{s}_i(t) = A_c[1+m(t)]\cos 2\pi f_c t$$
$$\mathbf{s}_i(t) = A_c \cos 2\pi f_c t + A_c m(t)\cos 2\pi f_c t$$

- Daya sinyal input: $S_i = \frac{A_c^2}{2} + \frac{A_c^2 m^2(t)}{2} = \frac{A_c^2[1+m^2(t)]}{2}$
- Maka :

$$\mathbf{s}_2(t) = [A_c \cos 2\pi f_c t + A_c m(t)\cos 2\pi f_c t]\cos 2\pi f_c t = \frac{A_c}{2} + \frac{A_c}{2}\cos 2\pi(2f_c)t + \frac{A_c m(t)}{2} + \frac{A_c m(t)}{2}\cos 2\pi(2f_c)t$$

- Keluaran LPF dan dengan menghilangkan komponen DC:

$$\mathbf{s}_o(t) = \frac{A_c m(t)}{2}$$

- Daya sinyal output:

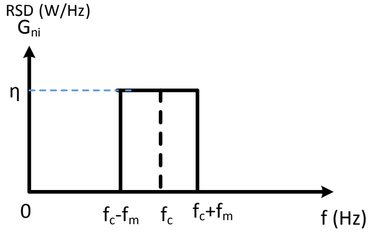
$$S_o(t) = \frac{A_c^2 \overline{m^2(t)}}{4}$$

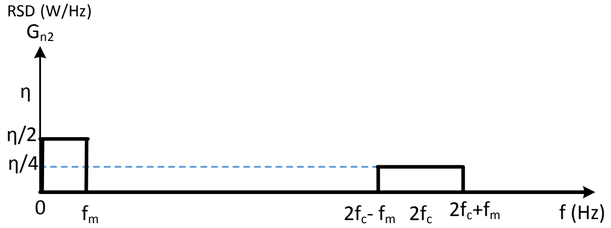
$$\frac{S_o}{S_i} = \frac{A_c^2 \overline{m^2(t)}/4}{A_c^2[1+\overline{m^2(t)}]/2} = \frac{\overline{m^2(t)}}{2[1+\overline{m^2(t)}]}$$

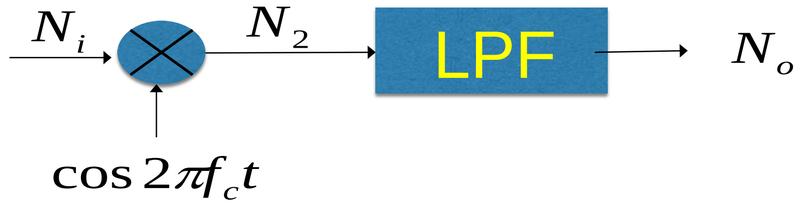
$\overline{m^2(t)}$ Adalah daya rata-rata sinyal m(t)

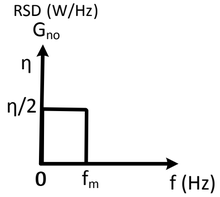
Daya Noise DOUBLE SIDE BAND-FC

- Rapat spectral daya noise pada input : η_i
- Rapat spectral daya dan daya noise :









$$N_o = \frac{\eta f_m}{2}$$

$$N_i = 2\eta f_m$$

- Maka :

$$\frac{S_o}{N_o} = \frac{\overline{m^2(t)}}{2\left[1+\overline{m^2(t)}\right]} \frac{S_i}{\eta f_m / 2}$$

$$\boxed{\frac{S_o}{N_o} = \frac{\overline{m^2(t)}}{1+\overline{m^2(t)}} \frac{S_i}{\eta f_m}}$$

Daya Noise DOUBLE SIDE BAND-FC

Jika m(t) adalah sinyal sinusoidal $m(t) = A_m \cos 2\pi f_m t$

$$\mathbf{s}_i(t) = A_c[1 + m\cos 2\pi f_m t]\cos 2\pi f_c t$$

Maka

$$m^2(t) = \frac{m^2}{2}$$

$$\frac{S_o}{N_o} = \frac{\overline{m^2(t)}}{1 + \overline{m^2(t)}} \frac{S_i}{\eta f_m} = \frac{m^2/2}{(1 + m^2/2)} \frac{S_i}{\eta f_m}$$

$$\frac{S_o}{N_o} = \frac{m^2}{2 + m^2} \frac{S_i}{\eta f_m}$$

FIGURE OF MERIT

Jika kita nyatakan $N_m = \eta f_m$

Dan Figure of Merit γ

$$\gamma = \frac{S_o / N_o}{S_i / N_M}$$

Modulasi	So/No	Figure of Merit γ
SSB-SC	$\frac{S_o}{N_o} = \frac{S_i}{\eta f_m}$	1
DSB-SC	$\frac{S_o}{N_o} = \frac{S_i}{\eta f_m}$	1
DSB-FC	$\frac{S_o}{N_o} = \frac{\overline{m^2(t)}}{1+\overline{m^2(t)}} \frac{S_i}{\eta f_m}$	$\frac{\overline{m^2(t)}}{1+\overline{m^2(t)}}$
DSB-FC dg sinyal sinusoidal	$\frac{S_o}{N_o} = \frac{m^2}{2+m^2} \frac{S_i}{\eta f_m}$	$\frac{m^2}{2+m^2}$

Terima kasih
dan selamat belajar.