AM ~~and Super Heterodyne~~

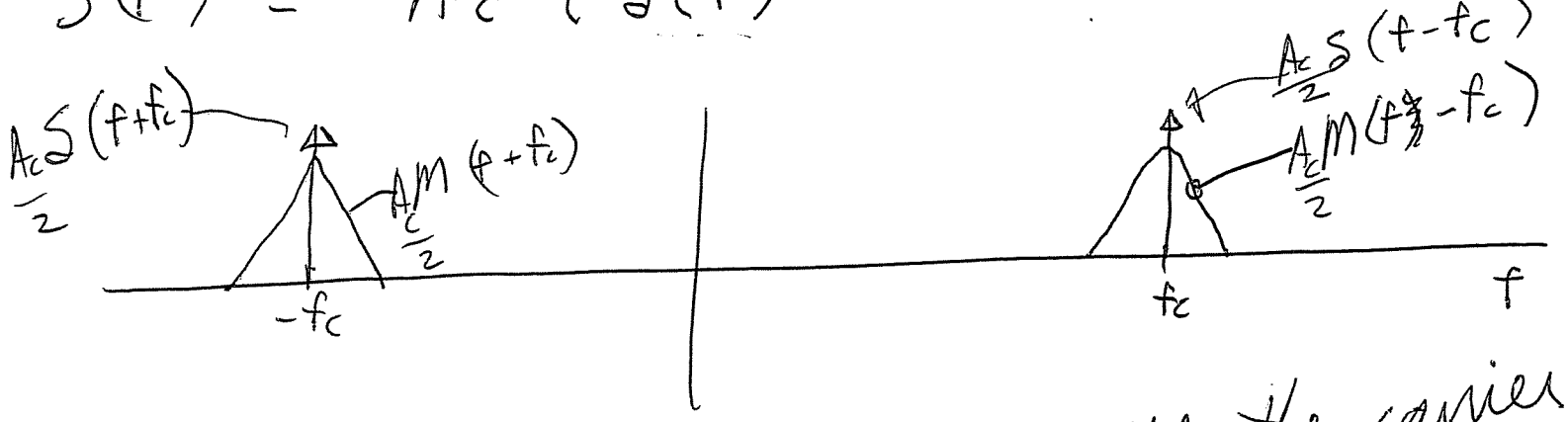
AM Modulation

The AM signal is given by

$$s(t) = A_c \left(1 + m(t)\right) \cos 2\pi f_c t$$

where $m(t) > -1$

$$S(f) = A_c \left(\delta(f) + M(f)\right) * \mathcal{F}\{\cos\}$$



AM does not suppress the carrier

Def: % modulation

let $A_{max} = \max\{A_c(1+m(t))\}$

$A_{min} = \min\{A_c(1+m(t))\}$

% positive modulation $\equiv \dfrac{A_{max} - A_c}{A_c} \times 100 = \max\{m(t)\} \times 100$

% negative modulation $\equiv \dfrac{A_c - A_{min}}{A_c} \times 100 = -\min(m(t)) \times 100$

% modulation

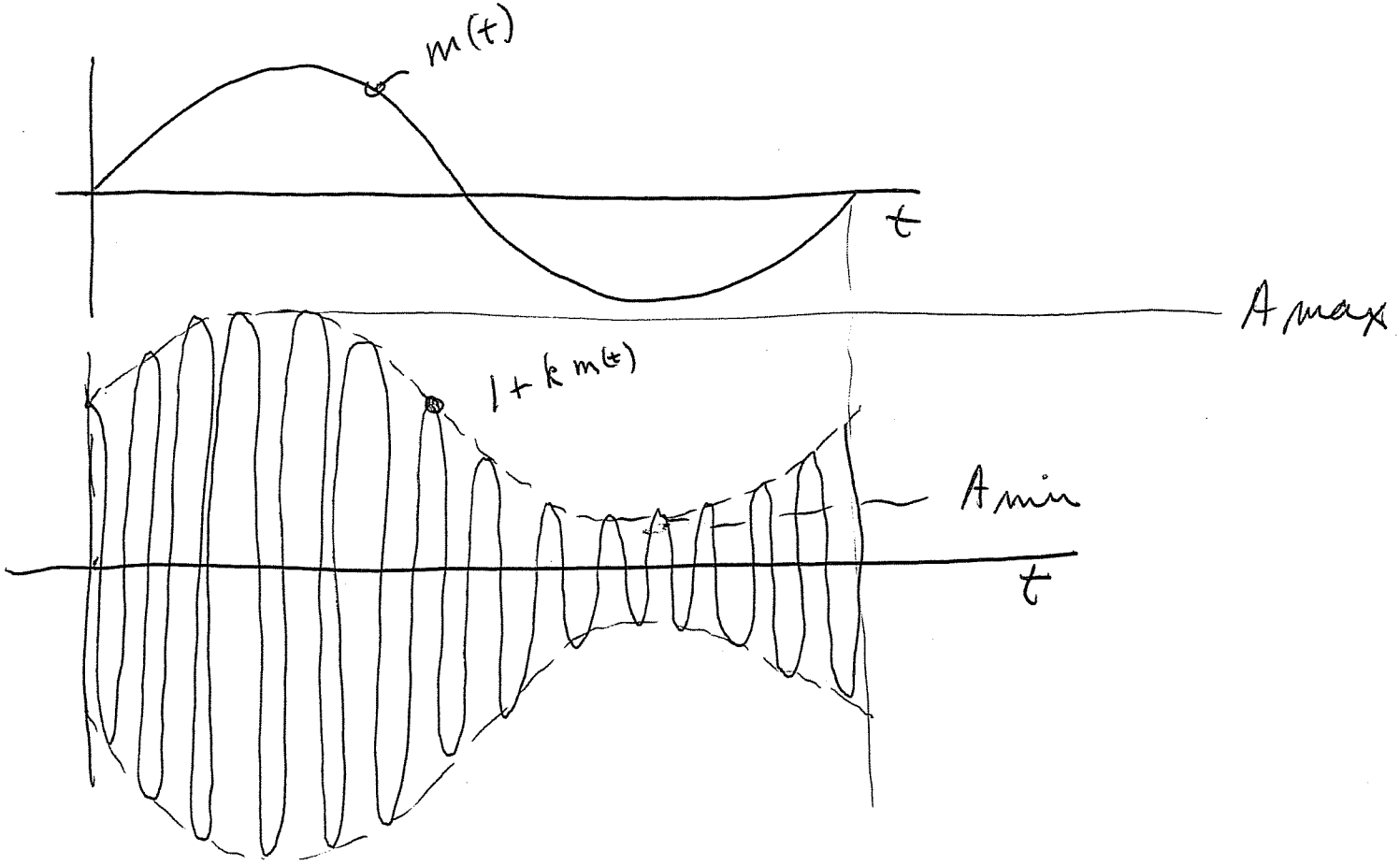
$$\frac{A_{max} - A_{min}}{2A_c} \times 100 = \frac{\max\{m(t)\} - \min\{m(t)\}}{2} \times 100$$

Ex: What is the % mod of

$(1 + k \cos 2\pi f_m t) \cos 2\pi f_c t$ for $k = 1$, $A_c = 1$

$A_{max} = 1 + 1 = 2$, $A_{min} = 1 - 1 = 0$

$$\%\ \text{mod} = \frac{2 - 0}{2} \times 100 = 100\%$$



Modulation efficiency

$$E = \frac{\text{information signal power}}{\text{total power}} \times 100\%$$

$$= \frac{\langle m^2(t) \rangle}{1 + \langle m^2(t) \rangle} \times 100\% \quad \text{for 100\% modulation}$$

The highest possible efficiency is 50% where $m(t)$ is a square wave and at 100% modulation

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Normalized peak envelope power (PEP)

$$P_{pep} = \frac{A_c^2}{2} \left\{ 1 + \max \{ m(t) \} \right\}^2$$

$\frac{A_c^2}{2}$ is the carrier power

$\frac{1}{2} A_c^2 \max (m(t))^2$ is maximum modulation power