ECE-314, Fall 2008
Signals & Systems

Example: Convolution Theorem

Amplitude Modulation:

$$x_{LC}(t) = (1 + k_a m(t)) \cos(\omega_c t)$$

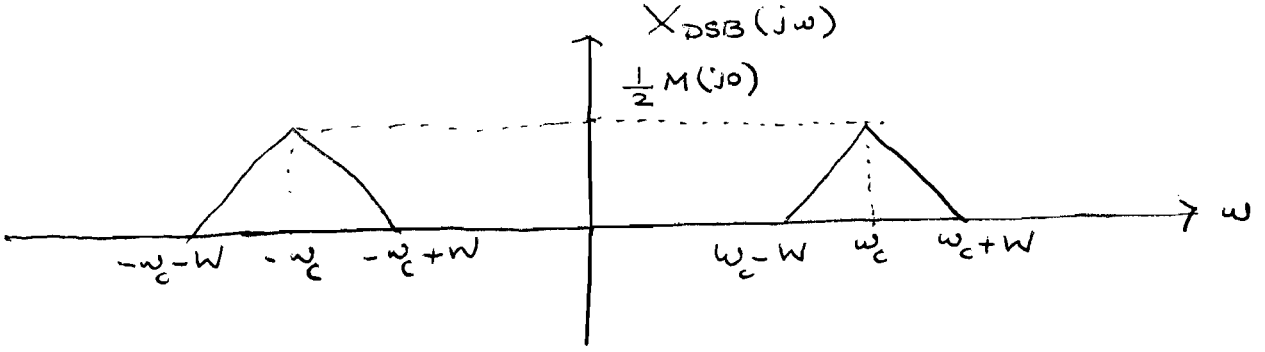
$$x_{DSB}(t) = m(t) \cos(\omega_c t)$$

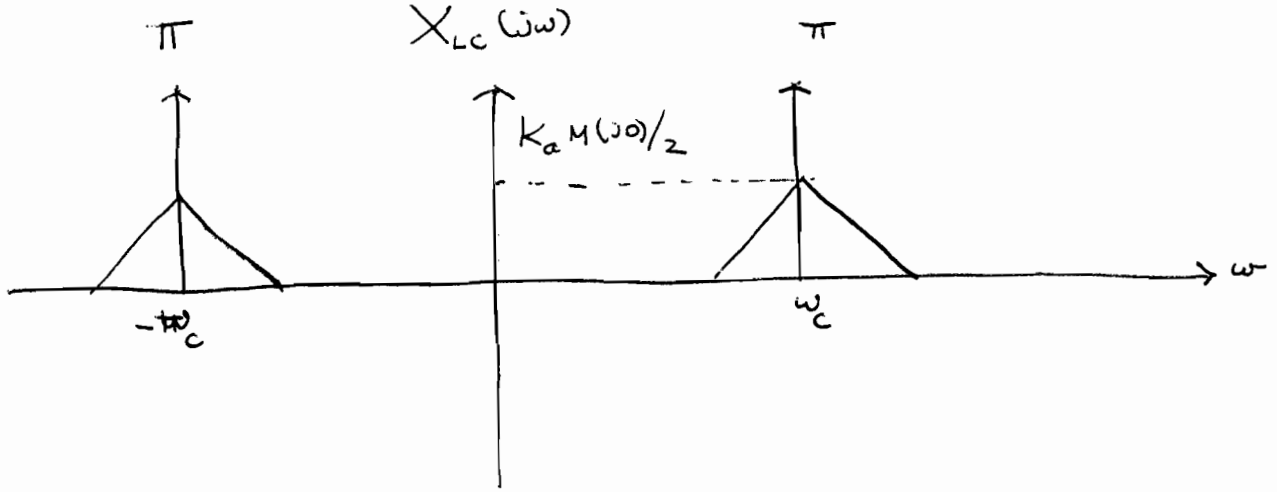
$$X_{DSB}(j\omega) = \frac{1}{2\pi} \{ M(j\omega) * \mathcal{F}\{\cos\omega_c t\} \}$$

$$X_{DSB}(j\omega) = \frac{1}{2\pi} \left\{ M(j\omega) * \pi\{\delta(\omega-\omega_c) + \delta(\omega+\omega_c)\} \right\}$$

$$X_{DSB}(j\omega) = \frac{1}{2} \{ M(j(\omega+\omega_c)) + M(j(\omega-\omega_c)) \}$$

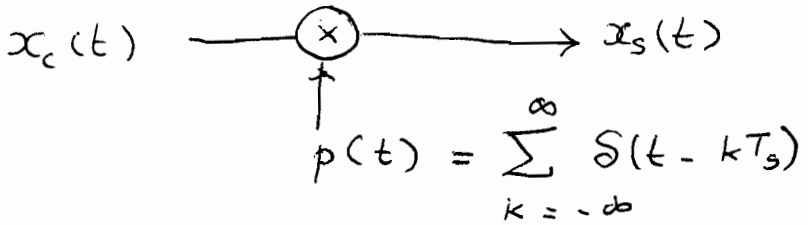
$$X_{LC}(j\omega) = \pi\delta(\omega-\omega_c) + \pi\delta(\omega+\omega_c) + \frac{k_a}{2\pi} \{ \pi M(j(\omega+\omega_c)) + \pi M(j(\omega-\omega_c)) \}$$





- The Large carrier spectrum has a strong camier impulse that is absent in the DSB spectrum
- Commercial AM uses LC mode
- Telephony uses DSB - AB
- Commercial TV uses VSB - AM for audio
- LC - AM requires significant amount of power to transmit carrier.

Sampling :



$$x_s(t) = x_c(t)\, p(t)$$

$$X_s(j\omega) = \frac{1}{2\pi}\left\{ X_c(j\omega) * P(j\omega) \right\}$$

From earlier example:

$$P(j\omega) = \frac{2\pi}{T_s} \sum_{k=-\infty}^{\infty} \delta\left(\omega - k\frac{2\pi}{T_s}\right)$$

$$X_s(j\omega) = \frac{1}{2\pi}\left\{ X_c(j\omega) * \frac{2\pi}{T_s} \sum_{k=-\infty}^{\infty} \delta\left(\omega - k\frac{2\pi}{T_s}\right) \right\}$$

$$X_s(j\omega) = \frac{1}{T_s} \sum_{k=-\infty}^{\infty} X_c\left(j\left(\omega - k\frac{2\pi}{T_s}\right)\right)$$