

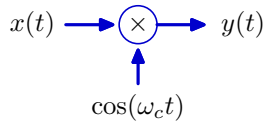
6.3000: Signal Processing

Communications Systems

April 08, 2025

Amplitude Modulation

Multiplication by a sinusoid shifts the frequencies in an input signal.



Compare the frequency representation of the output signal to that of the input signal.

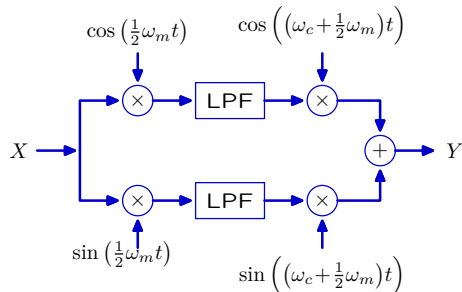
Notice that each frequency in the input is represented twice in the output. (For that reason, this modulation scheme is sometimes called “double side-band.”)

This reduces the number of independent messages that can be transmitted over a particular medium.

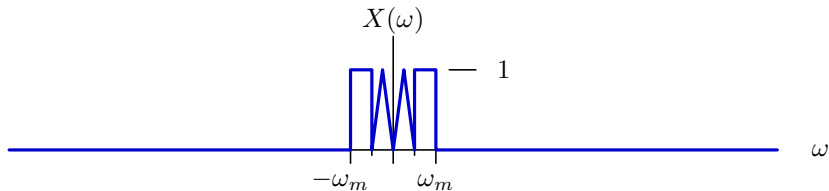
Despite this limitation, this scheme is used in commercial AM radio. It was originally popular because it was easy to decode.

Bandwidth Conservation

Consider the following modulation scheme, where $\omega_c \gg \omega_m$.



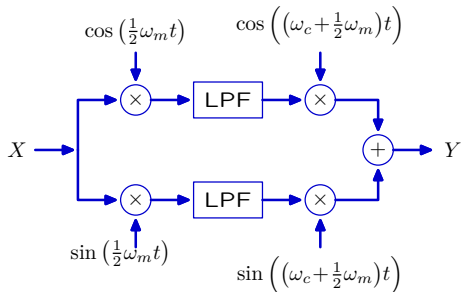
Assume each LPF is ideal, with cutoff frequency $\omega_m/2$, and DC gain of 2. Also assume that the input signal has the following Fourier transform.



Determine $Y(\omega)$.

Bandwidth Conservation

Notice that the frequency components of $Y(\omega)$ are near ω_c (not 0). Thus this scheme could be used to modulate a low frequency signal so that it can be transmitted via a high-frequency medium.



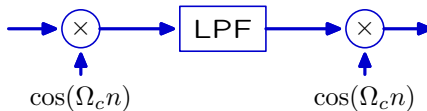
What (if any) advantages would this scheme offer?

Implementing a Bandpass Filter

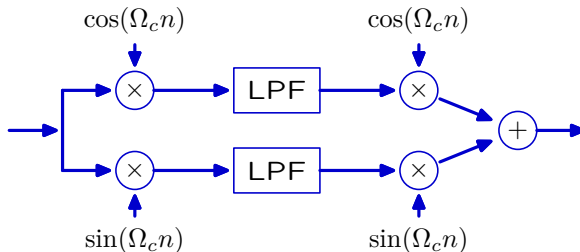
The critical components of many modulation systems include bandpass filters, which are filters that pass only frequencies in a given range.

Which of following systems implement a bandpass filter?

System 1



System 2



System 3

