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AM RECEIVER CIRCUIT FOR DEMODULATION

Electronics & Communication Engg. Dept.

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CUTM

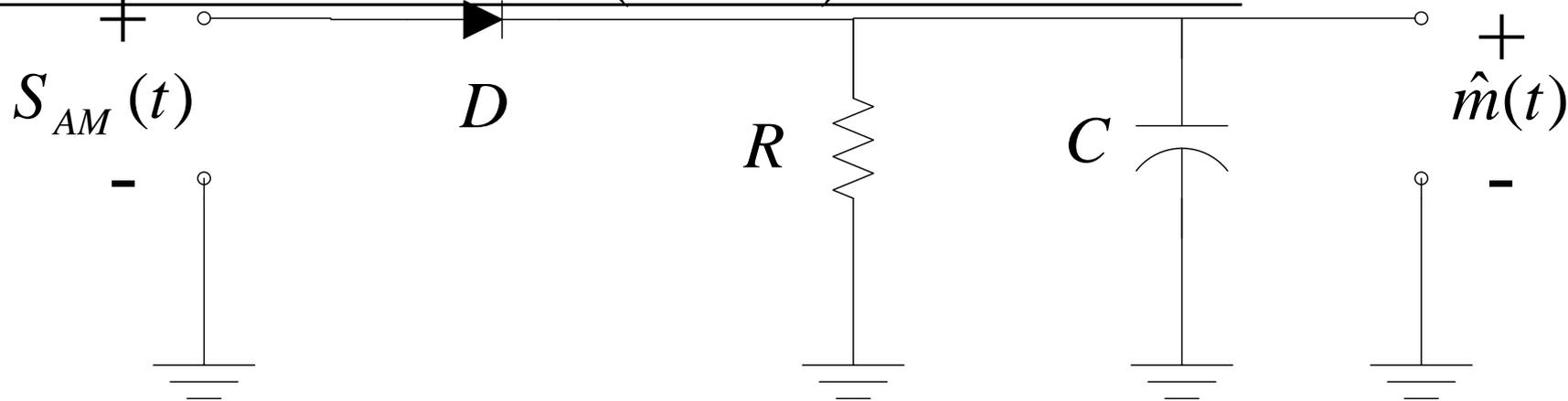
Receivers for AM and DSB

Receivers can be classified into coherent and non-coherent categories.

Definition: If a receiver requires knowledge of the carrier frequency and phase to extract the message signal, then it is called coherent.

Definition: If a receiver does not require knowledge of the phase (only rough knowledge of the carrier frequency) to extract the message signal, then it is called non-coherent.

Non-coherent demodulator (receiver) for standard AM



Peak envelope detector (demodulator)

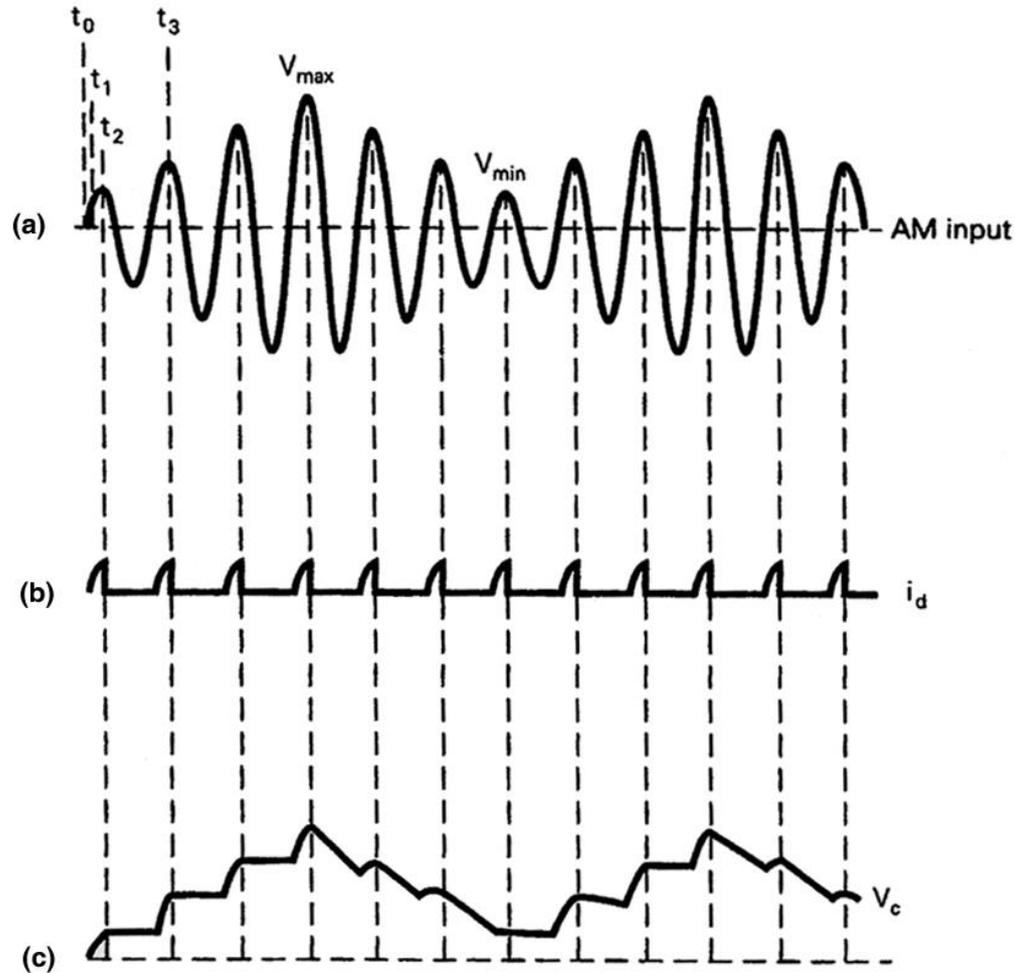
Observations:

- The net effect of the diode is the multiplication (mixing) of the signals applied to its input. Therefore, its output will contain the original input frequencies, their harmonics and their cross products.
- The network is a lowpass filter with a single pole (lossy integrator) that removes most of the high frequencies. R and C have to be judiciously picked so that $\tau = RC$ is neither too short (rectifier distortion) nor too long (diagonal clipping).
- A rule of thumb for choosing τ is based on the highest modulating signal (message) frequency that can be demodulated by a peak envelope detector without attenuation, that is,

$$\tau = \frac{\sqrt{(1/k_a^2) - 1}}{2\pi f_{m(\max)}}, \quad |k_a| < 1$$

where $f_{m(\max)}$ is the maximum modulating signal (message) frequency in Hz.

Let the message signal be described by the sinusoidal tone $m(t) = \cos(2\pi f_m t)$
 Then, the following figures show the types of distortion that can occur when τ is improperly chosen.



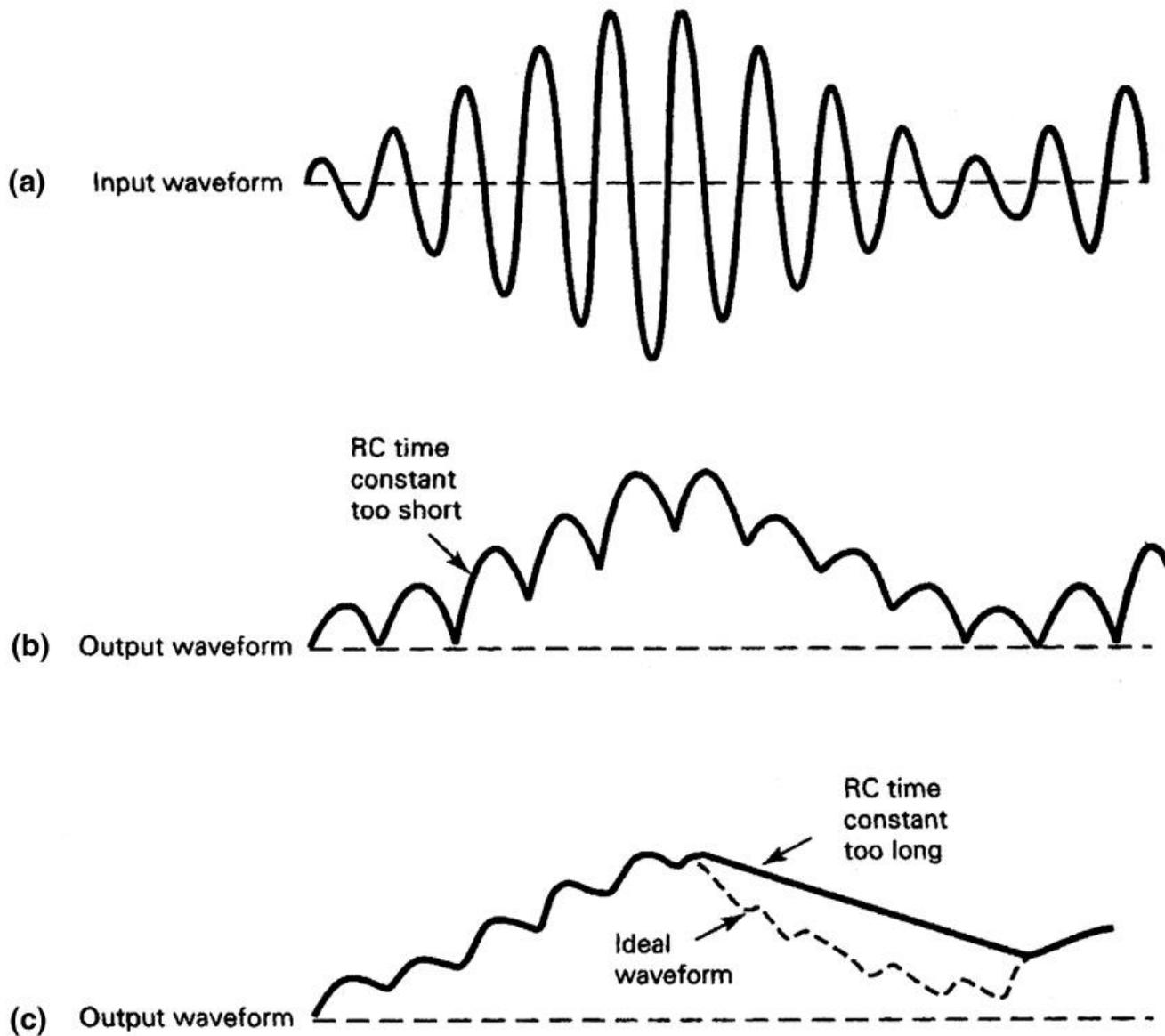
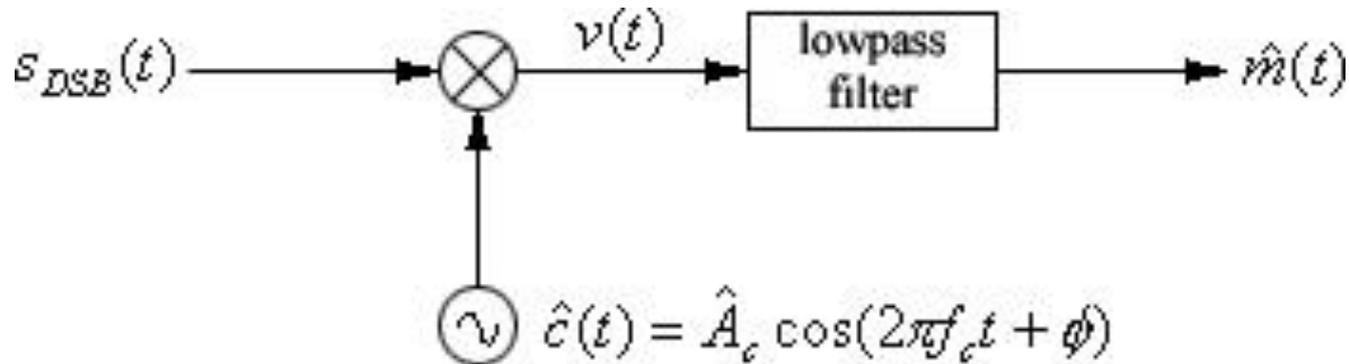


Illustration of rectifier distortion and diagonal clipping

Coherent demodulator for DSB-SC



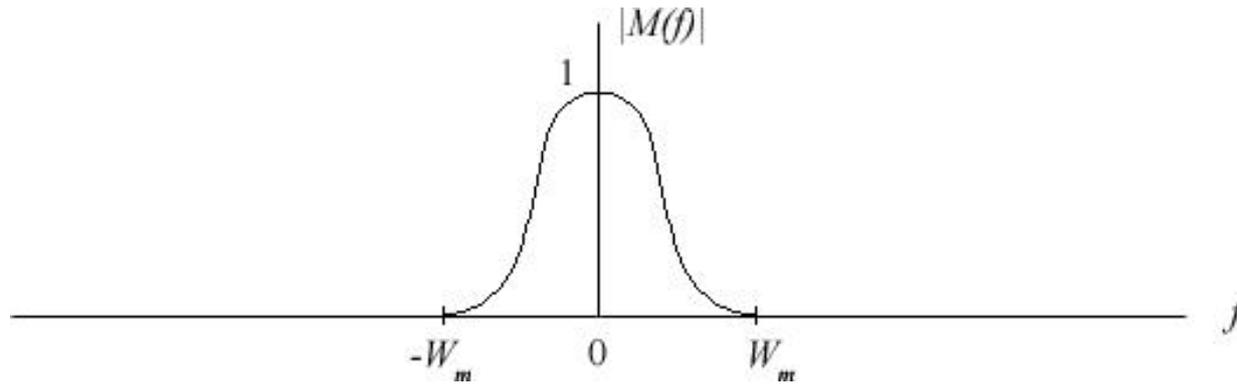
At the output of the mixer,

$$\begin{aligned} v(t) &= \hat{A}_c \cos(2\pi f_c t + \phi) s_{DSB}(t) \\ &= \hat{A}_c \cos(2\pi f_c t + \phi) \cdot A_c m(t) \cos(2\pi f_c t) \\ &= \frac{\hat{A}_c A_c}{2} m(t) [\cos(4\pi f_c t + \phi) + \cos \phi] \end{aligned}$$

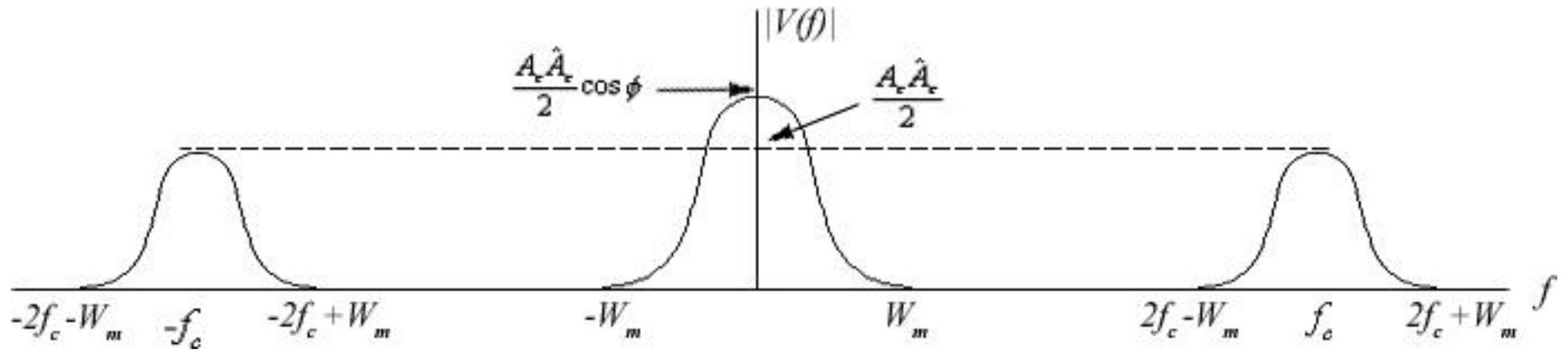
and

$$\begin{aligned} V(f) &= F\{v(t)\} \\ &= \frac{A_c \hat{A}_c}{4} [M(f - 2f_c) + M(f + 2f_c)] + \frac{A_c \hat{A}_c}{2} M(f) \cos \phi \end{aligned}$$

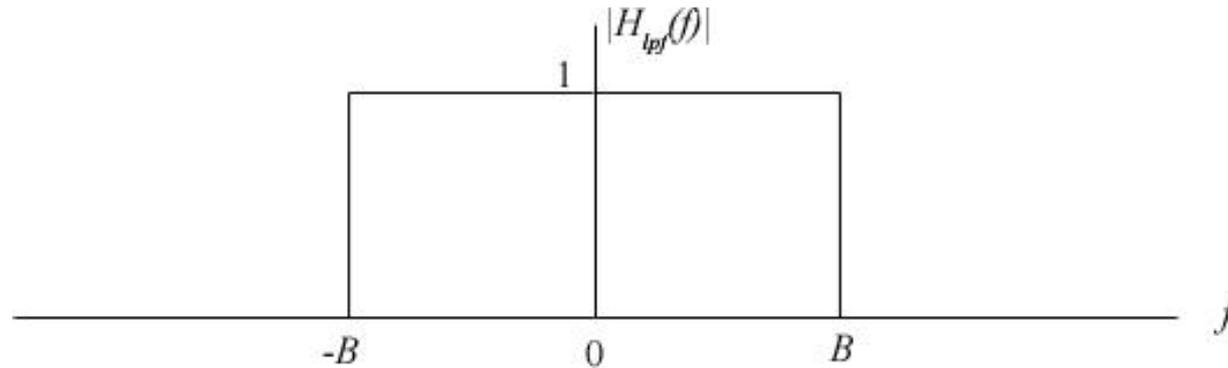
Let the message signal have the following magnitude spectrum



Then, if $f_c > W_m$,

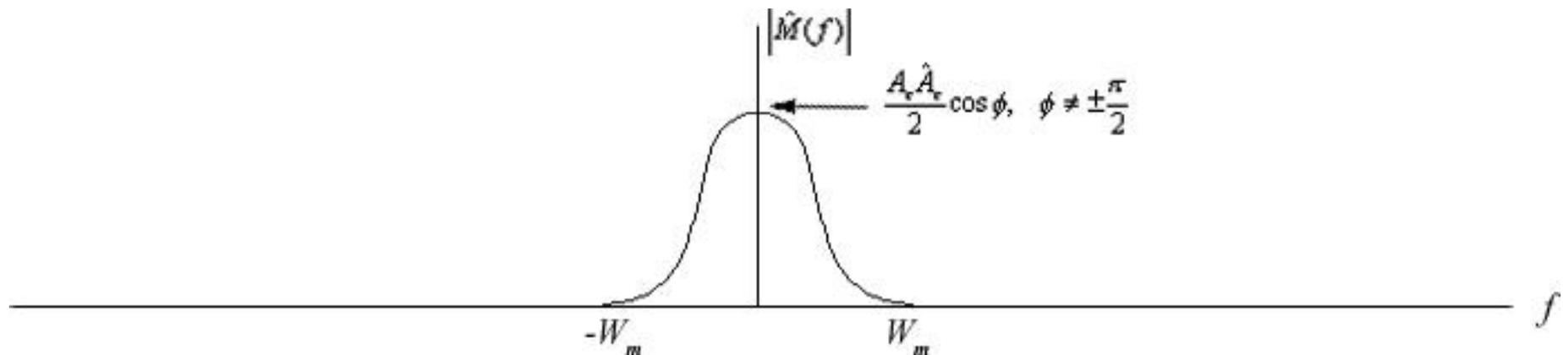


Suppose $H_{lpf}(f)$ is such that



Then, if

$$W_m \leq B < 2f_c - W_m, \quad \hat{M}(f) = \frac{A_c \hat{A}_c}{2} M(f) \cos \phi$$





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