Problem 3.13

For the low-pass filter in Fig. 3.12 (assuming perfect synchronism) to suppress the undesired SSB wave, the following condition must hold

$f_c > W, f_c$ = carrier frequency, and W = message bandwidth

Justify this condition

Solution

Continuing with the solution to Problem 3.12, we see that the product-modulator output $v(t)$ also contains a scaled version of the original message signal $m(t)$. For positive frequencies,the highest frequency component of $m(t)$ is W, and the lowest frequency of the new upper SSB modulated wave is $2f_c$ - W. For the low-pass filter to reject this SSB modulated wave, we require that $2f_c - W > W$, or simply $f_c > W$. Under this condition, the detector output is

$$v_o(t) = \frac{A_c A'_c}{4} m(t)$$