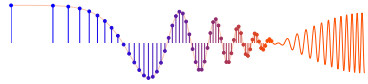

Example 11-7: Magnitude/Phase Symmetries

As another illustration of symmetry, recall that the Fourier transform of $x(t) = e^{-at}u(t)$ is

$$X(j\omega) = \frac{1}{a + j\omega}$$

The magnitude is the square root of the magnitude-squared and the phase is extracted via the arctangent

$$\begin{aligned} |X(j\omega)| &= [X(j\omega)X^*(j\omega)]^{1/2} \\ &= \frac{1}{(a^2 + \omega^2)^{1/2}} = |X(-j\omega)| \end{aligned}$$

$$\angle X(j\omega) = -\arctan\left(\frac{\omega}{a}\right) = -\angle X(-j\omega)$$

The even and odd symmetries of the magnitude and phase given in the above equations are illustrated in the plots in Fig. 11-12. In this case it would have been sufficient to plot the magnitude and phase for $\omega \geq 0$. ■

McClellan, Schafer and Yoder, *Signal Processing First,* ISBN 0-13-065562-7.
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