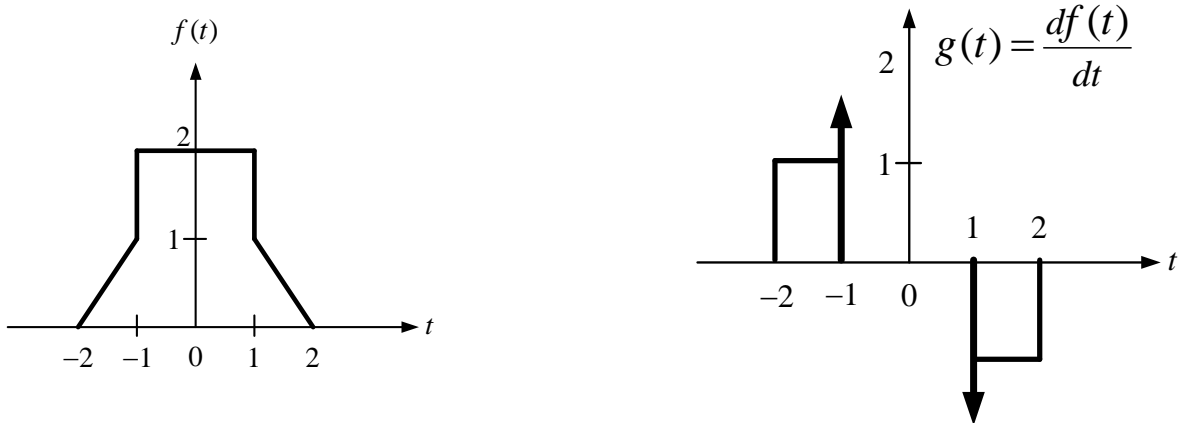


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If $f(t)$ is a periodical function with double sided line spectra as shown below



Using the Fourier Transform Table and Properties:

Find the Fourier Transform of $f(t)$, $F(\omega)$?

solution 1

$$g(t) = \frac{df(t)}{dt} = \text{rect}\left(t + \frac{3}{2}\right) + \delta(t+1) - \text{rect}\left(t - \frac{3}{2}\right) - \delta(t-1)$$

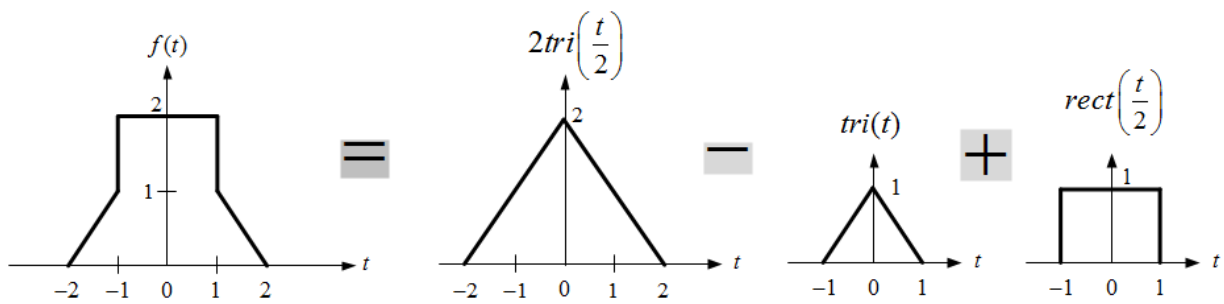
$$\Rightarrow (j\omega)F(\omega) = G(\omega) = \text{sinc}\left(\frac{\omega}{2}\right)e^{j\frac{3\omega}{2}} + e^{j\omega} - \text{sinc}\left(\frac{\omega}{2}\right)e^{-j\frac{3\omega}{2}} - e^{-j\omega}$$

$$\Rightarrow G(\omega) = [e^{j\frac{3\omega}{2}} - e^{-j\frac{3\omega}{2}}] \text{sinc}\left(\frac{\omega}{2}\right) + [e^{j\omega} - e^{-j\omega}] = (j2)\sin\left(\frac{3\omega}{2}\right)\text{sinc}\left(\frac{\omega}{2}\right) + (j2)\sin(\omega)$$

$$\Rightarrow F(\omega) = \frac{G(\omega)}{j\omega} = \frac{(j2)\sin\left(\frac{3\omega}{2}\right)\text{sinc}\left(\frac{\omega}{2}\right) + (j2)\sin(\omega)}{j\omega} = 2 \frac{\sin\left(\frac{3\omega}{2}\right)}{\omega} \text{sinc}\left(\frac{\omega}{2}\right) + \frac{(2)\sin(\omega)}{\omega}$$

$$= 2\left(\frac{3}{2}\right) \frac{\sin\left(\frac{3\omega}{2}\right)}{\left(\frac{3\omega}{2}\right)} \text{sinc}\left(\frac{\omega}{2}\right) + \frac{(2)\sin(\omega)}{\omega} = 3\text{sinc}\left(\frac{3\omega}{2}\right)\text{sinc}\left(\frac{\omega}{2}\right) + 2\text{sinc}(\omega)$$

Solution 2



$$\begin{aligned} F(\omega) &= 2(2)\text{sinc}^2(\omega) - \text{sinc}^2\left(\frac{\omega}{2}\right) + 2\text{sinc}\left(\frac{\omega}{2}\right) \\ &= 4\text{sinc}^2(\omega) - \text{sinc}^2\left(\frac{\omega}{2}\right) + 2\text{sinc}\left(\frac{\omega}{2}\right) \end{aligned}$$