

Part I

$$\begin{aligned}
 h_0[n] &= h_0^{(2)}[n] * h_{0\uparrow 2}^{(2)}[n] * h_{0\uparrow 4}^{(2)}[n] & \xrightarrow{\mathcal{DTFT}} & H_0(\omega) = H_0^{(2)}(\omega) \cdot H_0^{(2)}(2\omega) \cdot H_0^{(2)}(4\omega) \\
 h_1[n] &= h_0^{(2)}[n] * h_{0\uparrow 2}^{(2)}[n] * h_{1\uparrow 4}^{(2)}[n] & \xrightarrow{\mathcal{DTFT}} & H_1(\omega) = H_0^{(2)}(\omega) \cdot H_0^{(2)}(2\omega) \cdot H_1^{(2)}(4\omega) \\
 h_2[n] &= h_0^{(2)}[n] * h_{1\uparrow 2}^{(2)}[n] * h_{0\uparrow 4}^{(2)}[n] & \xrightarrow{\mathcal{DTFT}} & H_2(\omega) = H_0^{(2)}(\omega) \cdot H_1^{(2)}(2\omega) \cdot H_0^{(2)}(4\omega) \\
 h_3[n] &= h_0^{(2)}[n] * h_{1\uparrow 2}^{(2)}[n] * h_{1\uparrow 4}^{(2)}[n] & \xrightarrow{\mathcal{DTFT}} & H_3(\omega) = H_0^{(2)}(\omega) \cdot H_1^{(2)}(2\omega) \cdot H_1^{(2)}(4\omega) \\
 h_4[n] &= h_1^{(2)}[n] * h_{0\uparrow 2}^{(2)}[n] * h_{0\uparrow 4}^{(2)}[n] & \xrightarrow{\mathcal{DTFT}} & H_4(\omega) = H_1^{(2)}(\omega) \cdot H_0^{(2)}(2\omega) \cdot H_0^{(2)}(4\omega) \\
 h_5[n] &= h_1^{(2)}[n] * h_{0\uparrow 2}^{(2)}[n] * h_{1\uparrow 4}^{(2)}[n] & \xrightarrow{\mathcal{DTFT}} & H_5(\omega) = H_1^{(2)}(\omega) \cdot H_0^{(2)}(2\omega) \cdot H_1^{(2)}(4\omega) \\
 h_6[n] &= h_1^{(2)}[n] * h_{1\uparrow 2}^{(2)}[n] * h_{0\uparrow 4}^{(2)}[n] & \xrightarrow{\mathcal{DTFT}} & H_6(\omega) = H_1^{(2)}(\omega) \cdot H_1^{(2)}(2\omega) \cdot H_0^{(2)}(4\omega) \\
 h_7[n] &= h_1^{(2)}[n] * h_{1\uparrow 2}^{(2)}[n] * h_{1\uparrow 4}^{(2)}[n] & \xrightarrow{\mathcal{DTFT}} & H_7(\omega) = H_1^{(2)}(\omega) \cdot H_1^{(2)}(2\omega) \cdot H_1^{(2)}(4\omega)
 \end{aligned} \tag{1}$$

$$\begin{aligned}
 g_0[n] &= g_0^{(2)}[n] * g_{0\uparrow 2}^{(2)}[n] * g_{0\uparrow 4}^{(2)}[n] & \xrightarrow{\mathcal{DTFT}} & G_0(\omega) = G_0^{(2)}(\omega) \cdot G_0^{(2)}(2\omega) \cdot G_0^{(2)}(4\omega) \\
 g_1[n] &= g_0^{(2)}[n] * g_{0\uparrow 2}^{(2)}[n] * g_{1\uparrow 4}^{(2)}[n] & \xrightarrow{\mathcal{DTFT}} & G_1(\omega) = G_0^{(2)}(\omega) \cdot G_0^{(2)}(2\omega) \cdot G_1^{(2)}(4\omega) \\
 g_2[n] &= g_0^{(2)}[n] * g_{1\uparrow 2}^{(2)}[n] * g_{0\uparrow 4}^{(2)}[n] & \xrightarrow{\mathcal{DTFT}} & G_2(\omega) = G_0^{(2)}(\omega) \cdot G_1^{(2)}(2\omega) \cdot G_0^{(2)}(4\omega) \\
 g_3[n] &= g_0^{(2)}[n] * g_{1\uparrow 2}^{(2)}[n] * g_{1\uparrow 4}^{(2)}[n] & \xrightarrow{\mathcal{DTFT}} & G_3(\omega) = G_0^{(2)}(\omega) \cdot G_1^{(2)}(2\omega) \cdot G_1^{(2)}(4\omega) \\
 g_4[n] &= g_1^{(2)}[n] * g_{0\uparrow 2}^{(2)}[n] * g_{0\uparrow 4}^{(2)}[n] & \xrightarrow{\mathcal{DTFT}} & G_4(\omega) = G_1^{(2)}(\omega) \cdot G_0^{(2)}(2\omega) \cdot G_0^{(2)}(4\omega) \\
 g_5[n] &= g_1^{(2)}[n] * g_{0\uparrow 2}^{(2)}[n] * g_{1\uparrow 4}^{(2)}[n] & \xrightarrow{\mathcal{DTFT}} & G_5(\omega) = G_1^{(2)}(\omega) \cdot G_0^{(2)}(2\omega) \cdot G_1^{(2)}(4\omega) \\
 g_6[n] &= g_1^{(2)}[n] * g_{1\uparrow 2}^{(2)}[n] * g_{0\uparrow 4}^{(2)}[n] & \xrightarrow{\mathcal{DTFT}} & G_6(\omega) = G_1^{(2)}(\omega) \cdot G_1^{(2)}(2\omega) \cdot G_0^{(2)}(4\omega) \\
 g_7[n] &= g_1^{(2)}[n] * g_{1\uparrow 2}^{(2)}[n] * g_{1\uparrow 4}^{(2)}[n] & \xrightarrow{\mathcal{DTFT}} & G_7(\omega) = G_1^{(2)}(\omega) \cdot G_1^{(2)}(2\omega) \cdot G_1^{(2)}(4\omega)
 \end{aligned} \tag{2}$$



















