By (8.38), we have

\[ Z_c = \zeta K(\text{sech}\frac{\pi w}{4h}) = \frac{4 K(\tanh\frac{\pi w}{4h})}{K(k^2)} \]

Using, e.g., (C.64), we can compute and plot this characteristic impedance versus \( w/h \), and the result is shown below.

![Graph showing characteristic impedance versus \( w/h \)]

If \( w/h = 0.1 \), we find \( Z_c = 159.019 \ \Omega \), while if \( w/h = 10 \), \( Z_c = 11.678 \ \Omega \). The maximum impedance is not very high, but the minimum value is quite low. For further comparison, a unit aspect ratio \( (w = h) \) gives a characteristic impedance of \( Z_c = 67.76 \ \Omega \).

If \( w \gg h \), then \( k \ll 1 \), while \( k' \approx 1 \). From (C.65), we have

\[ \frac{K(k')}{K(k)} \approx \frac{2}{\pi} \ln \left( \frac{4}{k} \right) \quad \text{(if } k \ll 1) \]

Thus, for \( w \gg h \),

\[ c \approx \frac{8}{\pi} \ln \left( 4 \cosh \left( \frac{\pi w}{4h} \right) \right) \approx \frac{8}{\pi} \ln \left( 2e^{\frac{\pi w}{4h}} \right) = \epsilon \left( \frac{2w}{h} + \frac{8 \ln 2}{\pi} \right) \]

The first term on the right side of (\( \ast \)),

\[ c_{pp} = \epsilon \left( \frac{2w}{h} \right) \]

is twice the parallel-plate capacitance (8.59) of a stripline above a single ground plane—the capacitance of the strip to the upper ground plane of the triplate in parallel with the capacitance to the lower ground plane. The second term is the fringing capacitance due to field concentration at the edges of the strip, and gives an important correction to the parallel-plate value. For \( w/h = 10 \), the parallel-plate approximation gives \( Z_c \approx \sqrt{\mu \epsilon / c_{pp}} = 12.709 \ \Omega \), about 9\% in error from the exact value. This is not as much error as in the case of ordinary stripline, but is nevertheless significant. When both terms on the right side of (\( \ast \)) are retained, the value of \( Z_c \) obtained agrees with the exact value to 6 decimal places. Even when \( w = h \), equation (\( \ast \)) gives \( Z_c \approx 67.508 \ \Omega \), which differs by less than 0.4\% from the exact value.
A similar derivation for narrow strips \((w/h \ll 1, \text{ or } k' \ll 1, k \simeq 1)\) using (C.66) gives the formula

\[
Z_c \simeq \frac{\zeta}{2\pi} \ln \frac{16h}{\pi w} \tag{**}
\]

from which we find (for \(w/h = 0.1\)) that \(Z_c \simeq 158.998 \, \Omega\), which is in error by only 0.013\%. When \(w = h\), equation (**) gives \(Z_c \simeq 65.852 \, \Omega\), which is in error by less than 3\%. 