Design a microstrip ring hybrid for a 50 Ω system with a design frequency of 2 GHz on Rogers RT/duroid 5880 (1 oz. copper, 1.574 mm board thickness). Draw a fully-labeled top view sketch of design.

Per section 7.8 and Figure 7.42a, we will need $Z_0 = \mathbf{50\ \Omega}$ and

$$\sqrt{2}\,Z_0 = \sqrt{2}\,(50) = \mathbf{70.71\ \Omega}$$

microstrips.

The Rogers RT/duroid 5880 datasheet only gives $\varepsilon_r = 2.20$ (no graph versus frequency).
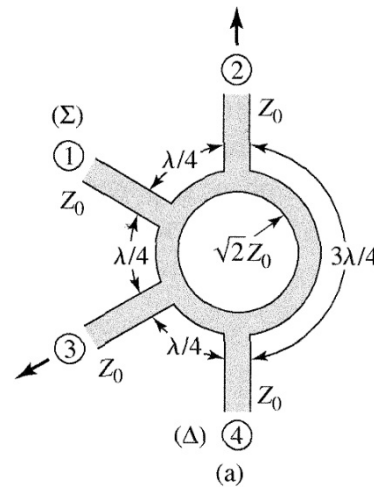

FIGURE 7.42 Three types of hybrid junctions. (a) A ring hybrid, or *rat-race*, in microstrip line or stripline form.

$\boxed{Z_0 = \mathbf{50\ \Omega}}$

From Rogers MWI at 2 GHz on Rogers RT/duroid 5880 (1 oz. copper, 1.574 mm thick)-

$\underline{W_{50} = \mathbf{4.9\ mm}}$. Started with 'Synthesis Width' option and changed to 'Analytical' option to get closer values for 50 Ω, only went to one decimal place for width.

$Z_0 = 70.71 \ \Omega$

From Rogers MWI at 2 GHz on Rogers RT/duroid 5880 (1 oz. copper, 1.574 mm thick)-

$W_{71} = 2.807$ mm $\approx$ 2.8 mm and $\varepsilon_{r,e} = 1.8299$. Started with $W_{50} = 4.9$ mm and used the 'Analytical' option to get width value by trial-n-error.

Use (3.193) to get $v_p = c / \sqrt{\varepsilon_{r,e}} = 2.9979 \times 10^8 / \sqrt{1.8299}$ $\Rightarrow$ $v_{p,71} = 2.216 \times 10^8$ m/s.

$\lambda_{71} = v_{p,71} / f = 2.216 \times 10^8 / 2 \times 10^9 = 110.8086$ mm $\Rightarrow$ $3\lambda_{71}/4 = 83.1$ mm & $\lambda_{71}/4 = 27.7$ mm.

Top View