TOOL: Once a series impedance is simplified to a single (real) resistance, *R*, in series with a single imaginary impedance, *jX*, (1) gives the value of an equivalent single (real) resistance in parallel with a single imaginary impedance.

$$R + jX = \frac{R^2+X^2}{R} \,||\, j\frac{R^2+X^2}{X} \qquad \text{Rectangular form} \quad (1)$$

$$|Z|e^{j\angle Z} = |Z|[\cos(\angle Z) + j\sin(\angle Z)] = \frac{|Z|}{\cos(\angle Z)} \,||\, j\frac{|Z|}{\sin(\angle Z)} \qquad \text{Polar form} \quad (2)$$

VERIF: Verification of formulas (1) and (2).

$$\begin{aligned}
\frac{R^2+X^2}{R} \,||\, j\frac{R^2+X^2}{X} &= (R^2+X^2)\cdot\frac{1}{R} \,||\, j\frac{1}{X} \\
&= (R^2+X^2)\cdot\frac{1}{R+\dfrac{X}{j}} \\
&= (R^2+X^2)\cdot\frac{1}{R+\dfrac{X}{j}}\cdot\frac{R+jX}{R+jX} \\
&= (R^2+X^2)\cdot\frac{R+jX}{R^2+X^2} \\
&= R+jX \qquad \text{Rect} \quad (1)
\end{aligned}$$

$$\begin{aligned}
\frac{|Z|}{\cos(\angle Z)} \,||\, j\frac{|Z|}{\sin(\angle Z)} &= |Z|\cdot\frac{1}{\cos(\angle Z)} \,||\, j\frac{1}{\sin(\angle Z)} \\
&= |Z|\cdot\frac{1}{\cos(\angle Z)+\dfrac{\sin(\angle Z)}{j}} \\
&= |Z|\cdot\frac{1}{\cos(\angle Z)+\dfrac{\sin(\angle Z)}{j}}\cdot\frac{\cos(\angle Z)+j\sin(\angle Z)}{\cos(\angle Z)+j\sin(\angle Z)} \\
&= |Z|\cdot\frac{\cos(\angle Z)+j\sin(\angle Z)}{\cos^2(\angle Z)+j\sin^2(\angle Z)} \\
&= |Z|[\cos(\angle Z)+j\sin(\angle Z)] \qquad \text{Polar} \quad (2)
\end{aligned}$$