AD8302 Calculations

Initial Equations:

$$\mathbf{Reflection\,Coefficient}\;\Gamma=\frac{Z_L-Z_S}{Z_L+Z_S}\qquad Z_L=\text{load impedance}\qquad Z_S=\text{source impedance}$$

$$\mathbf{Magnitude\ of\ Reflection\,Coefficient}\;\rho=|\Gamma|$$

$$\mathbf{Return\,Loss}(dB)=-20\log_{10}\rho$$

$$SWR=\frac{1+\rho}{1-\rho}$$

$$\mathbf{Mismatch\,Loss}(dB)=-10\log_{10}(1-\rho^2)$$

The AD8302 outputs phase (φ) and return loss (RL), therefore:

$$\rho=10^{\frac{RL}{-20}}$$

We now have a magnitude and phase for the reflection coefficient. We can calculate its real and imaginary parts where $a=\Gamma(real)$ and $b=\Gamma(imaginary)$:

$$a=\rho\cos(\varphi)\quad\text{and}\quad b=\rho\sin(\varphi)$$

To calculate the complex load impedance (Z_L) we use the following:

$$Z_L=\left(\frac{1+\Gamma}{1-\Gamma}\right)Z_S$$

Setting $\Gamma=a+jb$ we get:

$$Z_L=\left(\frac{1+a+jb}{1-a-jb}\right)Z_S$$

Now multiply by its complex conjugate to enable the separation of the real and imaginary parts:

$$Z_L=\left(\frac{1+a+jb}{1-a-jb}\right)\left(\frac{1-a+jb}{1-a+jb}\right)Z_S\quad\text{then}\quad Z_L=\left(\frac{1-a^2-b^2+j2b}{(1-a)^2+b^2}\right)Z_S$$

Using R = Z_L(real) and X = Z_L(imaginary):

$$R=\left(\frac{1-a^2-b^2}{(1-a)^2+b^2}\right)Z_S\quad\text{and}\quad X=\left(\frac{2b}{(1-a)^2+b^2}\right)Z_S$$

The magnitude of the complex load impedance is calculated using:

$$|Z|=\sqrt{((Z_L(real))^2+(Z_L(imaginary))^2)}$$