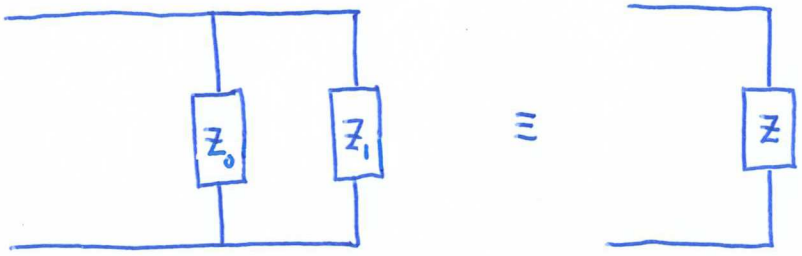
Parallel Impedences



$$Z = \left[\frac{1}{Z_0} + \frac{1}{Z_1}\right]^{-1} = \left[\frac{Z_0 + Z_1}{Z_0 Z_1}\right]^{-1} = \frac{Z_0 Z_1}{Z_0 + Z_1}$$

use: $Z_0 = R_0 + iX_0$, $Z_1 = R_1 + iX_1$

so

$$Z = \frac{(R_0 + iX_0)(R_1 + iX_1)}{R_0 + iX_0 + R_1 + iX_1} = \frac{(R_0R_1 - X_0X_1) + i(R_0X_1 + R_1X_0)}{(R_0 + R_1) + i(X_0 + X_1)}$$

$$= \frac{\left[(R_0R_1 - X_0X_1) + i(R_0X_1 + R_1X_0)\right]\left[(R_0 + R_1) - i(X_0 + X_1)\right]}{\left[(R_0 + R_1) + i(X_0 + X_1)\right]\left[(R_0 + R_1) - i(X_0 + X_1)\right]}$$

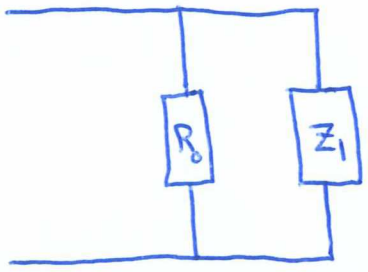
$$= \frac{(R_0R_1 - X_0X_1)(R_0 + R_1) + (R_0X_1 + R_1X_0)(X_0 + X_1) + i\left[(R_0X_1 + R_1X_0)(R_0 + R_1) - (R_0R_1 - X_0X_1)(X_0 + X_1)\right]}{(R_0 + R_1)^2 + (X_0 + X_1)^2}$$

$$D = (R_0 + R_1)^2 + (X_0 + X_1)^2 \qquad \text{(denominator)}$$

$$N_{Re} = (R_0R_1 - X_0X_1)(R_0 + R_1) + (R_0X_1 + R_1X_0)(X_0 + X_1) \qquad \text{(numerator - real)}$$

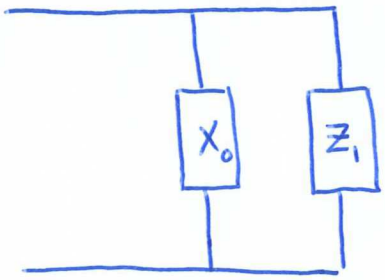
$$N_{Im} = (R_0X_1 + R_1X_0)(R_0 + R_1) - (R_0R_1 - X_0X_1)(X_0 + X_1) \qquad \text{(numerator - imaginary)}$$

Special Cases



$$N_{Re} = R_0 R_1 (R_0 + R_1) + R_0 X_1^2$$

$$N_{Im} = R_0 X_1 (R_0 + R_1) - R_0 R_1 X_1$$



$$N_{Re} = R_1 X_0 (X_0 + X_1) - X_0 X_1 R_1$$

$$N_{Im} = X_0 X_1 (X_0 + X_1) + X_0 R_1^2$$