Series – parallel conversions of LCR circuits

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In some cases a need arises for converting series LCR circuits to parallel ones (and vice versa). This memorandum presents a method to this.

Lets assume a series circuit and first write the expression for Q for it:

$$Q = Xseries/Rseries \qquad (1)$$

Then,

$$Xseries = QRseries \qquad (2)$$

The terminal impedance for the series circuit now becomes:

$$Zseries = Rseries + jXseries = Rseries + jQRseries \qquad (3)$$

The conversion of the series impedance into parallel admittance is:

$$Ypar = 1/Zseries = 1/[Rseries(1 + jQ)] \qquad (4)$$

Separating the real and the imaginary parts:

$$Ypar = 1/[Rseries(1+jQ)]\ [(1 - jQ)/(1 - jQ)] \qquad (5)$$

$$Ypar = [(1 - jQ)/Rseries(1 + Q^2) \qquad (6)$$

$$Ypar = 1/\ Rseries(1 + Q^2) - jQ/\ Rseries(1 + Q^2) \qquad (7)$$

$$Ypar = 1/\ Rseries(1 + Q^2) - jQ/\ [(Xseries/Q)(1 + Q^2)] \qquad (8)$$

$$Ypar = 1/Rpar - j/Xpar \qquad (9)$$

If we now equate the real and imaginary terms of the series and parallel circuit expressions we get:

$$1/Rpar = 1/\ Rseries(1 + Q^2) \qquad (10)$$

or,

$Rpar = Rseries(1 + Q^2)$ (11)

And,

$Xpar = Xseries(Q^2 + 1)/Q^2$ (12)

Further, the Q is:

$Q = \sqrt{[(Rpar/Rseries)-1]}$ (13)