Parallel LCR Resonator S11 rework

$$Z_r = \frac{R_r}{1 + 2iQ_r x}$$

$$Z_r = \frac{R_r}{1 + 4Q_r^2 x^2} - \frac{2iR_r Q_r x}{1 + 4Q_r^2 x^2}$$

$$R_t = \frac{1 + \omega^2 C_c^2 R_l^2}{\omega^2 C_c^2 R_l}$$

$$Q_c = \omega R_t C$$

$$R_t = \frac{Q_c}{\omega C} = \frac{Q_c R_r}{Q_r}$$

$$Z_0 \equiv R_l \to R_t$$

$$S_{11} = \frac{Z_r - R_t}{Z_r + R_t}$$

$$S_{11} = \frac{\frac{R_r}{1+4Q_r^2x^2} - \frac{Q_c R_r}{Q_r} - \frac{2iR_r Q_r x}{1+4Q_r^2x^2}}{\frac{R_r}{1+4Q_r^2x^2} + \frac{Q_c R_r}{Q_r} - \frac{2iR_r Q_r x}{1+4Q_r^2x^2}}$$

Factor out all R_r's

$$S_{11} = \frac{\frac{1}{1+4Q_r^2x^2} - \frac{Q_c}{Q_r} - \frac{2iQ_r x}{1+4Q_r^2x^2}}{\frac{1}{1+4Q_r^2x^2} + \frac{Q_c}{Q_r} - \frac{2iR_r x}{1+4Q_r^2x^2}}$$

factor out $\frac{1}{1+4Q_r^2x^2}$

$$S_{11} = \frac{1 - \frac{Q_c}{Q_r}(1 + 4Q_r^2x^2) - 2iQ_r x}{1 + \frac{Q_c}{Q_r}(1 + 4Q_r^2x^2) - 2iQ_r x}$$

$$S_{11} = \frac{1 - (\frac{Q_c}{Q_r} + 4Q_c Q_r x^2) - 2iQ_r x}{1 + (\frac{Q_c}{Q_r} + 4Q_c Q_r x^2) - 2iQ_r x}$$