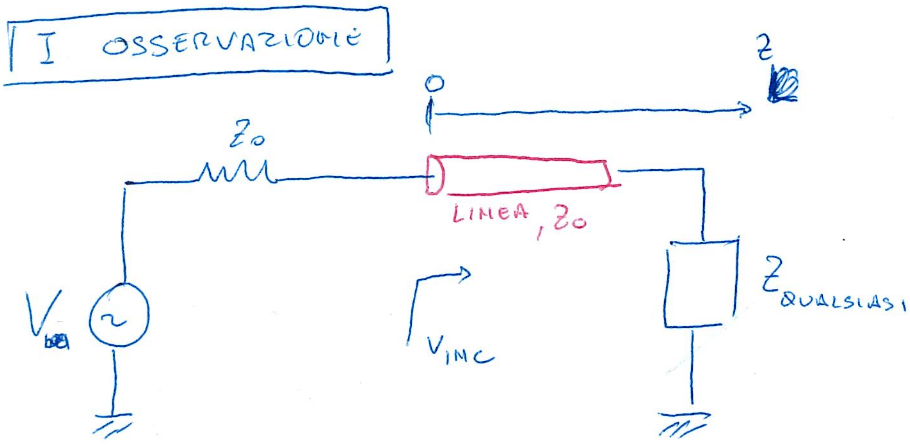
LEGAME FRA LINEE DI TRASMISSIONE E CIRCUITI EQUIVALENTI

I OSSERVAZIONE



COEFF. DI RIFIESSIONE

V_{INC} TENSIONE INCIDENTE SULLA LINEA

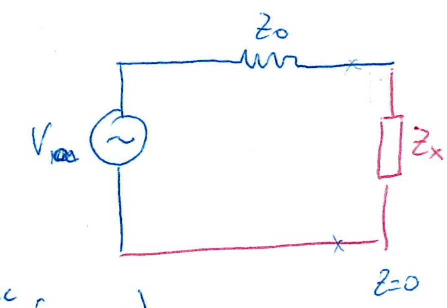
$V(z=0)$ TENSIONE MISURATA a $z=0$ $\qquad V(z=0) = (1+\rho)\, V_{INC}$

V TENSIONE DEL GENERATORE

$\forall$ $Z_{QUALSIASI}$ LA TENSIONE INCIDENTE SULLA LINEA È SEMPRE PARI A $V/2$ SE Z_0 È LA Z caratteristica della linea

DIMOSTRAZIONE

CIRCUITO EQUIVALENTE



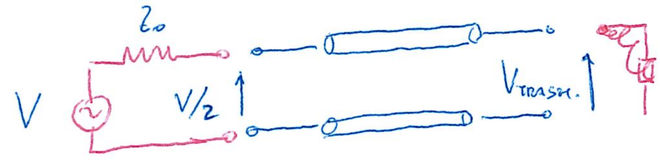
$$\rho = \frac{Z_x - Z_0}{Z_x + Z_0}$$

$$V(z=0) = V \frac{Z_x}{Z_x + Z_0} = V_{INC}(1+\rho)$$

$$= V_{INC} \frac{2 Z_x}{Z_x + Z_0} \Rightarrow 2 V_{INC} = V \qquad \boxed{V_{INC} = \frac{V}{2}}$$

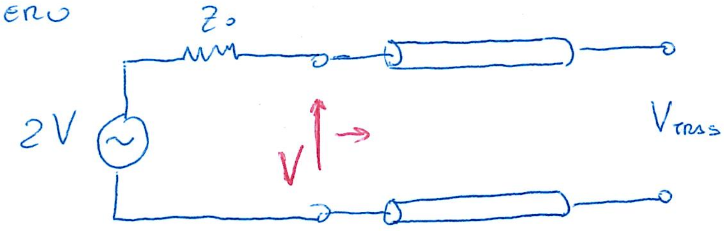
QUINDI

MISURA DI S_{21}:



$$S_{21} = \frac{V_{TRASM}}{V_{INC}} = \frac{2\,V_{TRASM}}{2\,V}$$

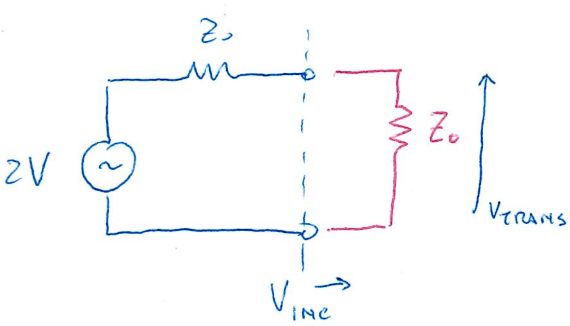
OVVERO



$$S_{12} = \frac{V_{TRAS}}{V}$$

CASO PRATICO

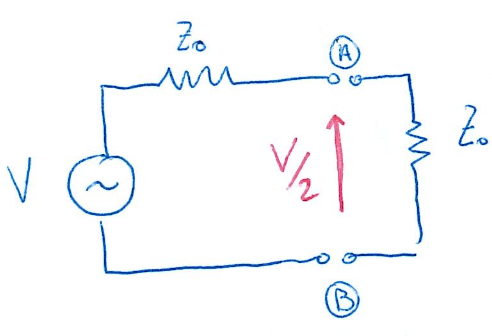
CARICO ADATTATO ⇒ $S_{21} = 1$



$$V_{TRANS} = \frac{2\,V}{2}$$

$$S_{21} = \frac{V_{TRANS}}{V} = 1$$

OVVERO NELLA MANIERA SOLITA DI VEDERE LE COSE

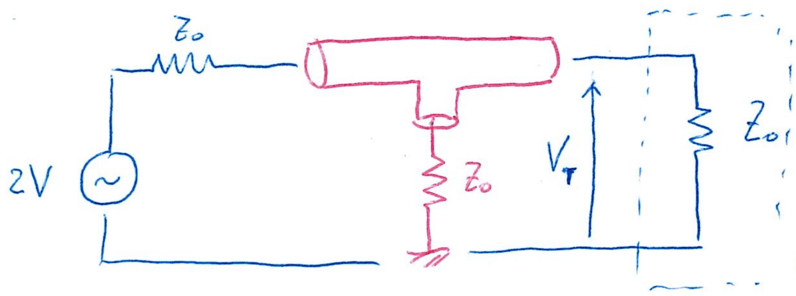


- LA TENSIONE SU Z_0 (V_{AB}) È PROPRIO $V/2$ PERCHÉ NON
- C'È RIFLESSIONE

$$V_{INC} = V_{AB} = V/2$$

ESEMPI UTILI

GIUNZIONE A T: MISURE DI S_{21}



$$S_{21} = \frac{V_T}{V}$$

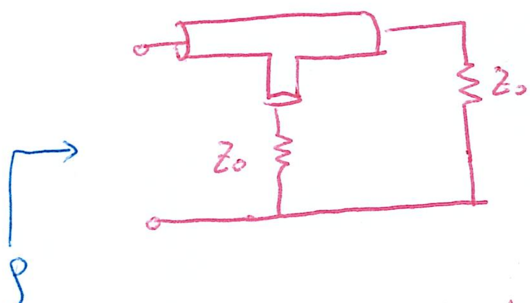
STRUMENTO CALIBRATO

$$V_T = 2V \, \frac{Z_0/2}{Z_0 + Z_0/2} = \frac{2}{3}\,V$$

$$|S_{21}| = \frac{2}{3} = -3{,}522\ \text{dB}$$

PER COMPLETEZZA

GIUNZIONE A T CON DUE CARICHI DA 50 Ω

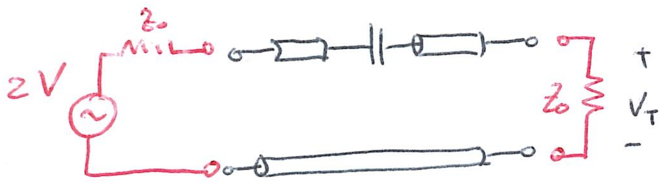


$$\rho = \frac{Z_0/2 - Z_0}{Z_0/2 + Z_0} = -\frac{1}{3}$$

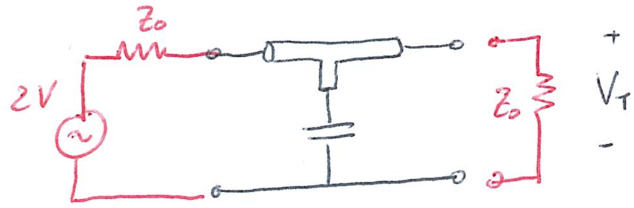
$$\Rightarrow |S_{11}| = \frac{1}{3} = -9{,}542\ \text{dB}$$

S_{12} DI ELEMENTI REATTIVI

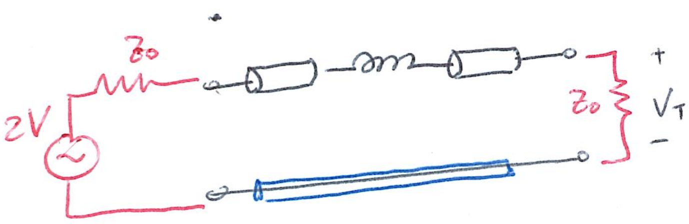
$$S_{12} = V_T / V$$



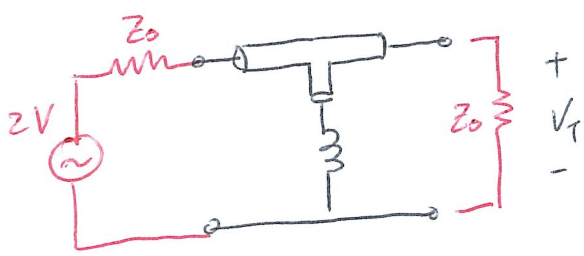
$$S_{12} = \frac{j\,\omega/\omega_0}{1 + j\,\omega/\omega_0} \qquad \omega_0 = \frac{1}{2 Z_0 C}$$



$$S_{12} = \frac{1}{1 + j\,\omega/\omega_0} \qquad \omega_0 = \frac{2}{Z_0 C}$$

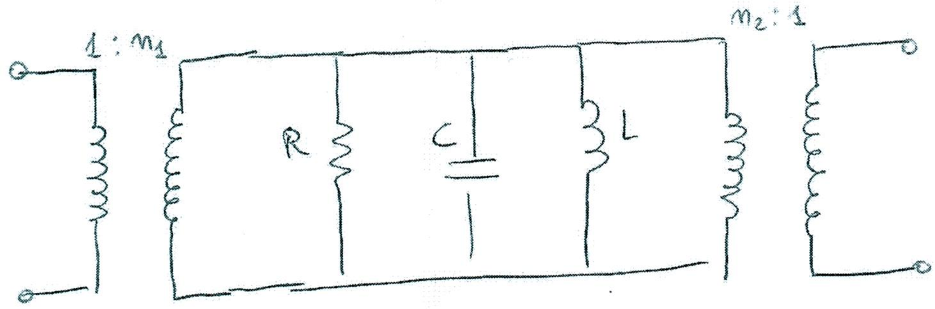


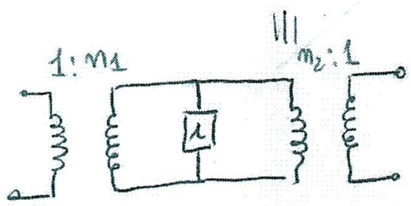
$$S_{12} = \frac{1}{1 + j\,\omega/\omega_0} \qquad \omega_0 = \frac{2 Z_0}{L}$$



$$S_{12} = \frac{j\,\omega/\omega_0}{1 + j\,\omega/\omega_0} \qquad \omega_0 = \frac{Z_0}{2L}$$

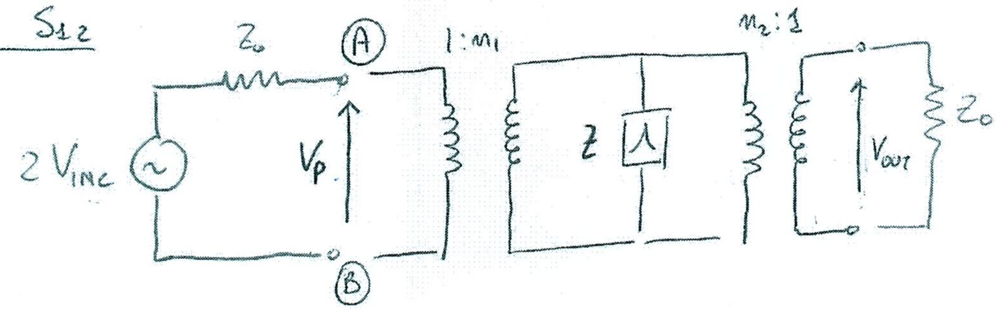
S_{12} CAVITA'





$$Z = \frac{R}{1 + j Q_0 \delta}$$

CALCOLO S_{12}

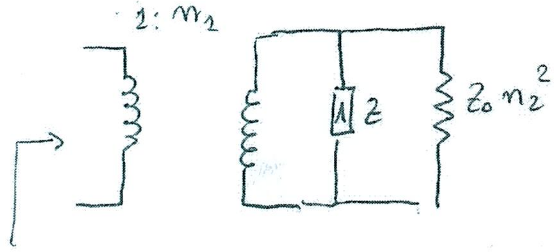


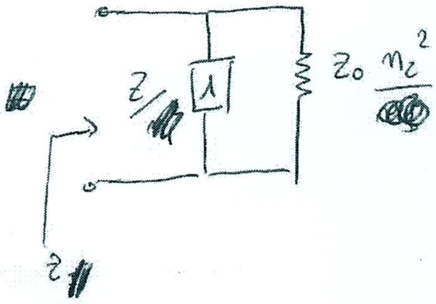
$$V_p = V_{INC}(1+\rho) \qquad V_p = V_{INCIDENTE} + V_{RIFLESSA} \qquad V_{OUT} =$$

$$S_{21} = \frac{V_{OUT}}{V}$$

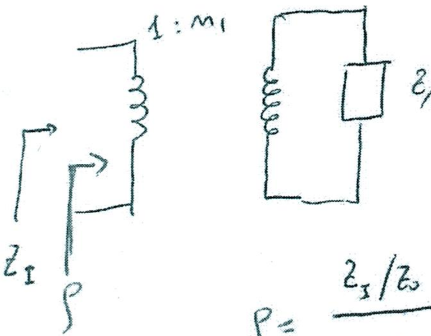
$$V_{OUT} = \frac{V_p n_1}{n_2} = V_{INC}(1+\rho)\frac{n_1}{n_2}$$

$$S_{12} = \frac{V_{OUT}}{V_{INC}} = (1+\rho)\frac{n_1}{n_2} \qquad \rho \text{ COEF. DI RIFLESSIONE @ A-B}$$





$$Z_{\parallel} = \frac{\dfrac{R}{1+jQ_0\delta} \cdot Z_0 n_2^2}{\dfrac{R}{1+jQ_0\delta} + Z_0 n_2^2} = \frac{R}{1+\beta_2+jQ_0\delta} \qquad \text{con } \frac{R}{n_2^2} = \beta_2 Z_0$$



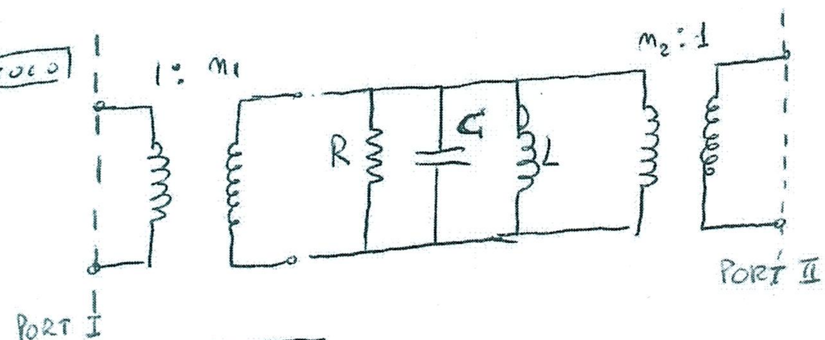
$$Z_I = \frac{R/n_1^2}{1+\beta_2+jQ_0\delta} = \frac{\beta_1 Z_0}{1+\beta_2+jQ_0\delta}$$

$$\rho = \frac{Z_I/Z_0 - 1}{Z_I/Z_0 + 1} = \frac{\beta_1 - 1 - \beta_2 - jQ_0\delta}{1+\beta_1+\beta_2+jQ_0\delta}$$

$$1+\rho = \frac{2\,Z_I/Z_0}{Z_I/Z_0+1} = \frac{2\beta_1}{1+\beta_1+\beta_2+jQ_0\delta}$$

$$S_{12} = (1+\rho)\frac{n_1}{n_2} = \boxed{\frac{2\sqrt{\beta_1\beta_2}}{1+\beta_1+\beta_2+jQ_0\delta}} \qquad \left(\frac{\beta_1 n_1}{n_2} = \frac{R/Z_0}{n_1 n_2} = \sqrt{\beta_1\beta_2}\right)$$

RICAPITOLO



$$S_{12} = \frac{2\sqrt{\beta_1\beta_2}}{1+\beta_1+\beta_2+jQ_0\delta}$$

$$S_{11} = \frac{\beta_1 - 1 - \beta_2 - jQ_0\delta}{1+\beta_1+\beta_2+jQ_0\delta} \qquad \text{con port 2 @ } Z_0$$

$$S_{22} = \frac{\beta_2 - 1 - \beta_1 - jQ_0\delta}{1+\beta_1+\beta_2+jQ_0\delta} \qquad \text{con port I @ } Z_0$$

con l'altra porta aperta

$$S_{11} = \frac{\beta_1 - 1 - jQ_0\delta}{\beta_1 + 1 + jQ_0\delta}$$

$$S_{22} = \frac{\beta_2 - 1 - jQ_0\delta}{\beta_2 + 1 + jQ_0\delta}$$

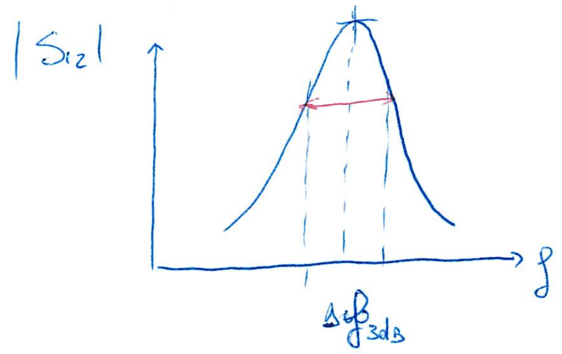
OSSERVAZIONI

$$S_{11}\Big|_{\text{PORTA } Z_0} \neq S_{11}\Big|_{\text{PORTA } 50\,\Omega}$$

$\Rightarrow$ VISTO DALLE MISURE

$$S_{12} = \frac{2\sqrt{\beta_1\beta_2} / 1+\beta_1+\beta_2}{1 + j\dfrac{Q_0}{1+\beta_1+\beta_2}\,\delta} = \frac{2\sqrt{\beta_1\beta_2} / 1+\beta_1+\beta_2}{1 + j\,Q_L\,\delta}$$

$\Rightarrow$ BANDA A 3dB DA $\boxed{Q_L} = \dfrac{\omega_0}{2\,\Delta\omega_{3dB}}$



$\rightsquigarrow$ AUTOMATIC Q MEASUREMENT

ACCOPPIAMENTO SIMMETRICO

$$\beta_1 = \beta_2 = \beta$$

$$S_{12} = \frac{2\beta / 1+2\beta}{1 + j\,Q_L\,\delta}$$

SE $\beta_1, \beta_2 \to 0$ $\quad S_{12} \to 0$