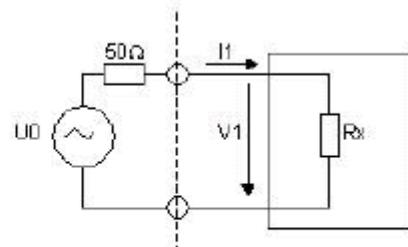
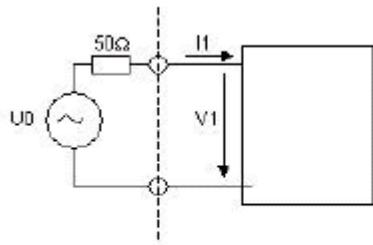


S-Parameter-Rechnung bei ohmschen Lasten

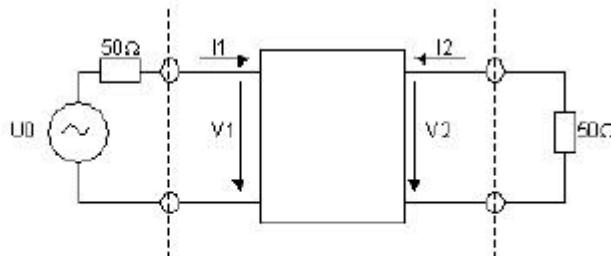
1. One-Port Messung (S11) :



$$S_{11} = \frac{b_1}{a_1} = \frac{\frac{V_1 - 50\Omega}{I_1}}{\frac{V_1 + 50\Omega}{I_1}} = \frac{R_x - 50\Omega}{R_x + 50\Omega}$$

$$R_x = 50\Omega * \frac{(1 + S_{11})}{(1 - S_{11})}$$

2. Two-Port Messung (S11 & S21) :

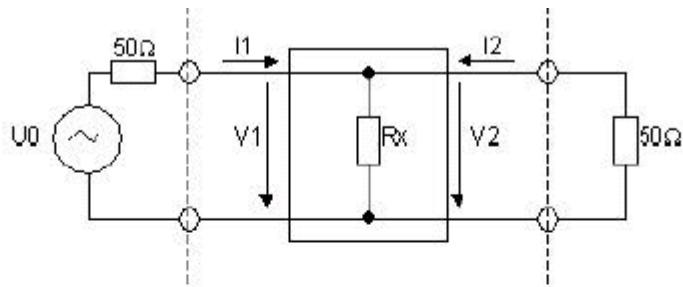


$$a_1 = \frac{V_1 + I_1 * 50\Omega}{2 * \sqrt{50\Omega}} \quad b_1 = \frac{V_1 - I_1 * 50\Omega}{2 * \sqrt{50\Omega}}$$

$$a_2 = \frac{V_2 + I_2 * 50\Omega}{2 * \sqrt{50\Omega}} \quad b_2 = \frac{V_2 - I_2 * 50\Omega}{2 * \sqrt{50\Omega}}$$

$$S_{21} = \frac{b_2}{a_1} \quad S_{11} = \frac{b_1}{a_1} \quad S_{12} = \frac{b_1}{a_2} \quad S_{22} = \frac{b_2}{a_2}$$

3. Two-Port Messung (S11 & S21) - Shunt :



$$V_1 = \frac{(R_{x_1} * 50\Omega)}{(R_x + 50\Omega)}$$

$$V_1 = \frac{50\Omega + (R_x * 50\Omega)}{(R_x + 50\Omega)}$$

$$I_1 = \frac{V_1}{(R_x * 50\Omega)}$$

$$I_1 = \frac{(R_x + 50\Omega)}{(R_x + 50\Omega)}$$

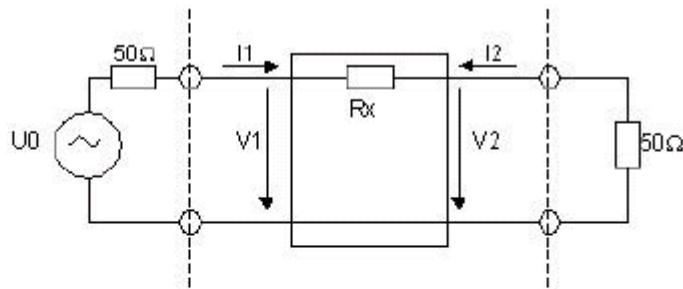
$$V_2 = V_1$$

$$I_2 = -\frac{V_2}{50\Omega}$$

$$S_{21} = \frac{b_2}{a_1}$$

$$S_{11} = \frac{b_1}{a_1}$$

4. Two-Port Messung (S11 & S21) - Series :



$$V_1 = \frac{R_x + 50\Omega}{R_x + 100\Omega}$$

$$I_1 = \frac{V_1}{R_x + 50\Omega}$$

$$V_2 = \frac{50\Omega}{R_x + 100\Omega}$$

$$I_2 = -I_1$$

$$S_{21} = \frac{b_2}{a_1}$$

$$S_{11} = \frac{b_1}{a_1}$$

5. Messgrenzen eines Network-Analyzers bei ohmschen Lasten :

Als Beispiel nehmen wir den TenTec-VNA mit seinen Datenblatt-Grenzen von - Max. Rückflussdämpfung 40dB - Max. Durchflussdämpfung 80dB

Welche ohmschen Lasten könnte man hiermit noch messen ?

One-Port : $S_{11} \text{ Rx} = 49 \text{ Ohm}$ oder $\text{Rx} = 51 \text{ Ohm}$

Two-Port (Shunt) : $S_{11} \text{ Rx} = 2475 \text{ Ohm}$
 $S_{21} \text{ Rx} = 0,0025 \text{ Ohm}$

Two-Port (Series) : $S_{11} \text{ Rx} = 1,01 \text{ Ohm}$
 $S_{21} \text{ Rx} = 999889 \text{ Ohm}$

6. Nützliche Formeln :

$$\text{returnloss}[dB] = -20dB * \log|\Gamma|$$

$$\text{transmissionloss}[dB] = -10 * \log(1 - |\Gamma|^2)$$

$$\Gamma(rho) = \frac{(R_{Last} - 50\Omega)}{(R_{Last} + 50\Omega)}$$

From:

<https://www.elektronikfriedhof.de/> - **dg1sfj.de**



Permanent link:

<https://www.elektronikfriedhof.de/doku.php?id=funk:messtechnik:sparam>

Last update: **2025/01/19 14:03**