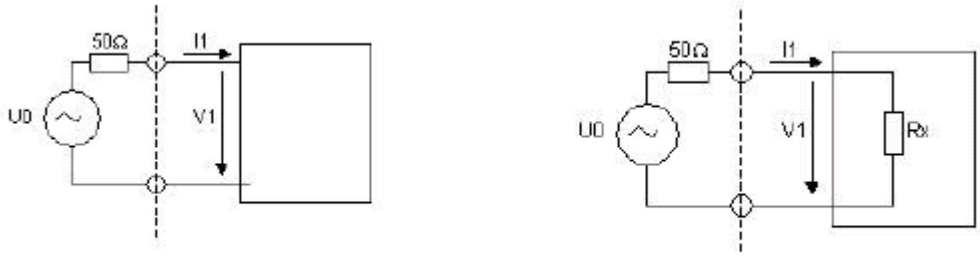
S-Parameter-Rechnung bei ohmschen Lasten

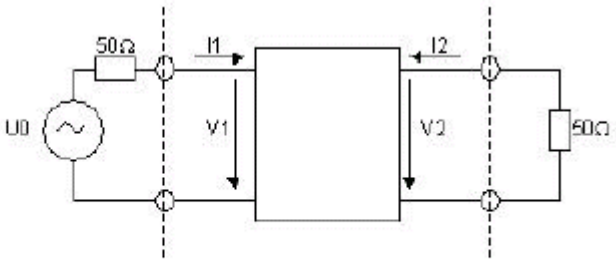
1. One-Port Messung (S11) :



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

$$R_x = 50\Omega * \frac{(1+S11)}{(1-S11)}$$

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

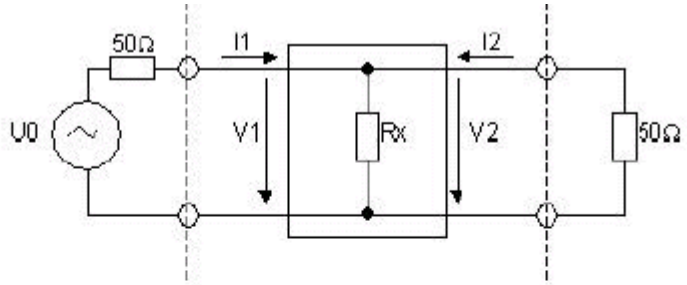


$$a_1 = \frac{V_1 + I_1 * 50\Omega}{2 * \sqrt{50\Omega}} \qquad b_1 = \frac{V_1 - I_1 * 50\Omega}{2 * \sqrt{50\Omega}}$$

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

$$S21 = \frac{b_2}{a_1} \qquad S11 = \frac{b_1}{a_1} \qquad S12 = \frac{b_1}{a_2} \qquad S22 = \frac{b_2}{a_2}$$

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



$$V_1 = \frac{\frac{(R_{Xx} * 50\,\Omega)}{(R_X + 50\,\Omega)}}{50\,\Omega + \frac{(R_x * 50\,\Omega)}{(R_x + 50\,\Omega)}}$$

$$I1 = \frac{V1}{\frac{(R_x * 50\Omega)}{(R_x + 50\Omega)}}$$

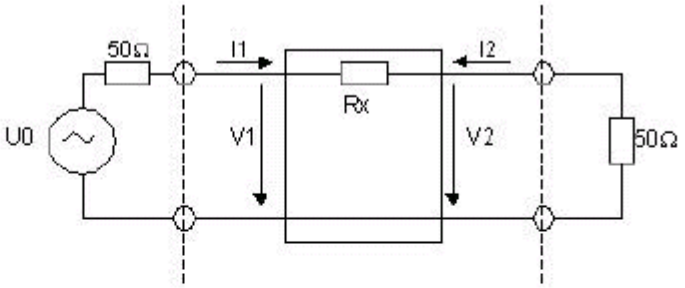
$$V_2 = V_1$$

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

$$S21 = \frac{b_2}{a_1}$$

$$S11 = \frac{b_1}{a_1}$$

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



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

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

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

$$I_2 = -I_1$$

$$S21 = \frac{b_2}{a_1}$$

$$S11 = \frac{b_1}{a_1}$$

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             :   S11 Rx = 49 Ohm oder Rx = 51 Ohm
Two-Port (Shunt) :  S11 Rx = 2475 Ohm
                              S21 Rx = 0,0025 Ohm
Two-Port (Series) : S11 Rx = 1,01 Ohm
                              S21 Rx = 999889 Ohm
```

6. Nützliche Formeln :

$$returnloss\left[dB\right] = -20dB * \log\left|\Gamma\right|$$

$$transmissionloss\left[dB\right] = -10 * \log\left(1 - \left|\Gamma\right|^2\right)$$

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

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