

# Vector Network Analysis with SDR

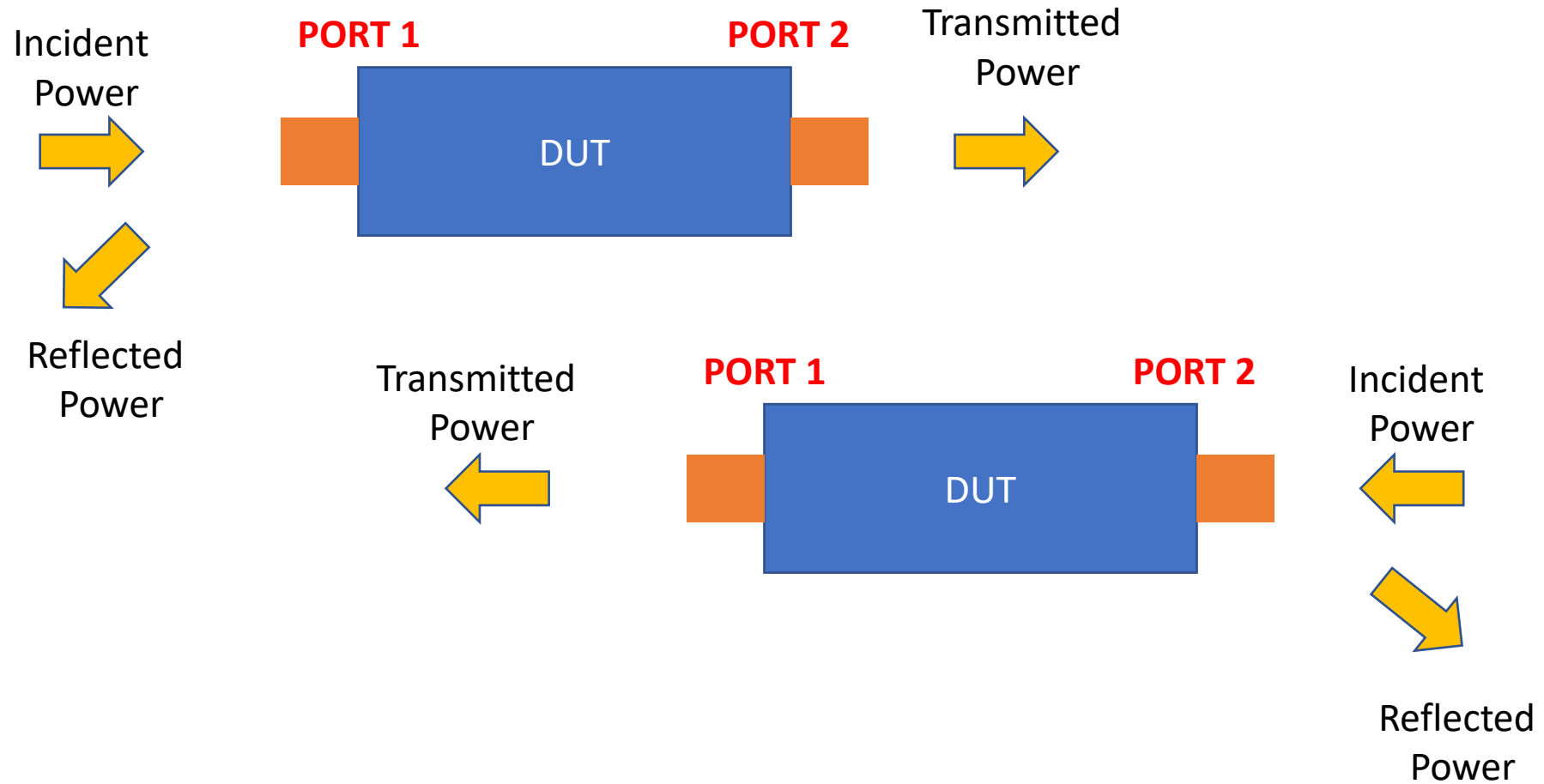
*Is it even possible?*

Tomas Gotthans

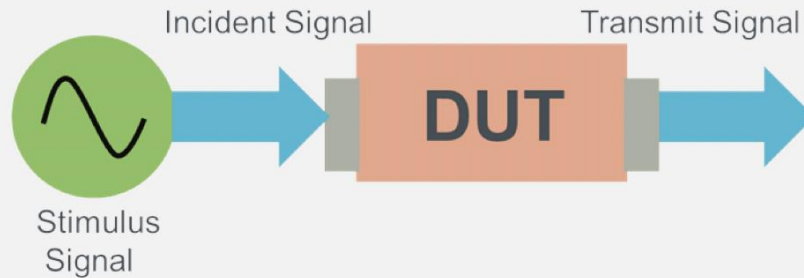
1.4.2022



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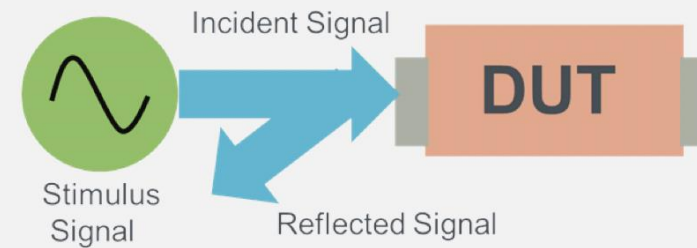


## Transmission Measurements

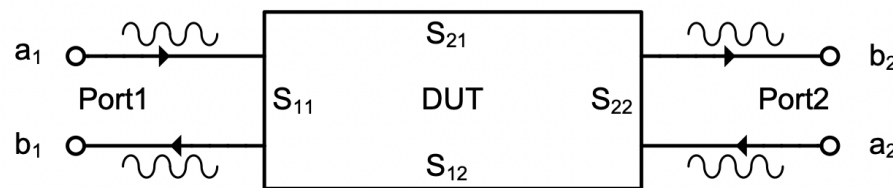


- Transmission Coefficients ( $S_{21}$ ,  $S_{12}$ )
- Gain
- Insertion Loss/Phase
- Electrical Length/Delay
- Group Delay

## Reflection Measurements



- Reflection Coefficients ( $S_{11}$ ,  $S_{22}$ )
- Return Loss
- VSWR (Voltage Standing Wave Ratio)
- Impedance ( $R+jX$ )



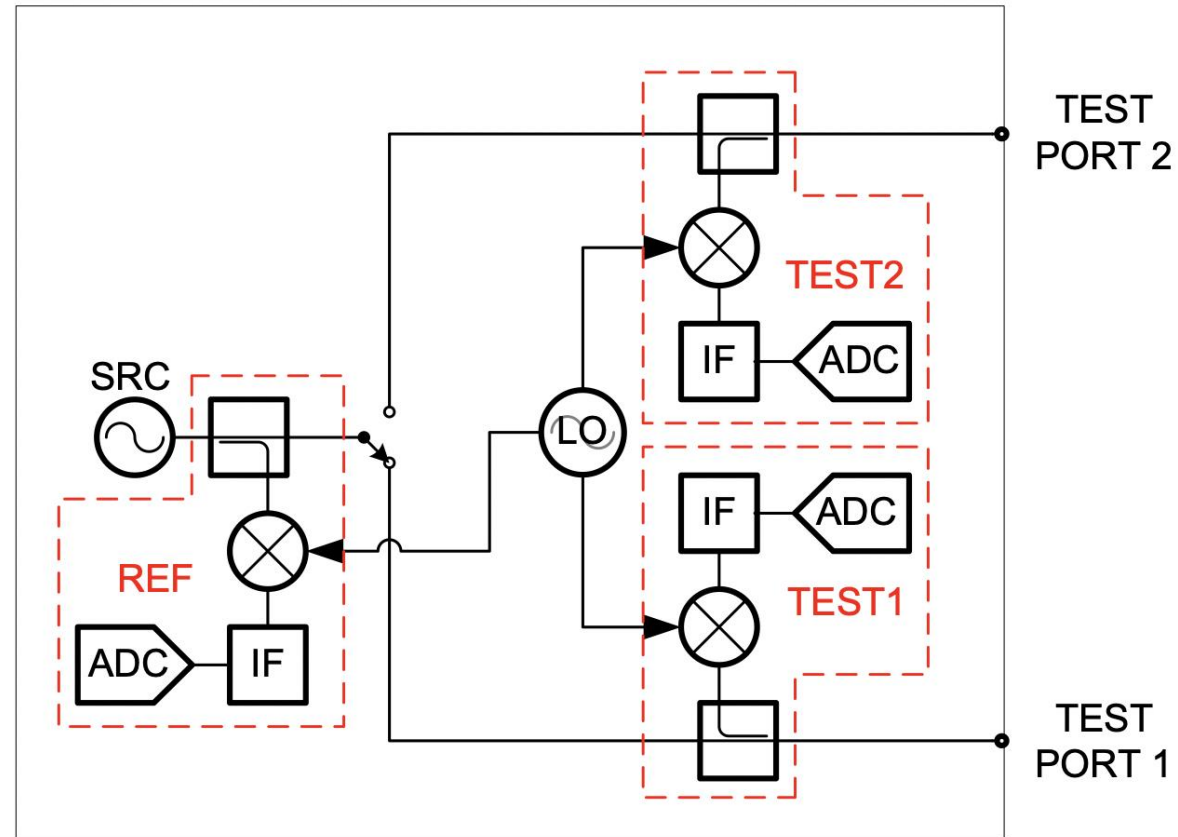
$$S_{11} = \left. \frac{b_1}{a_1} \right|_{a_2=0}$$

$$S_{12} = \left. \frac{b_1}{a_2} \right|_{a_1=0}$$

$$S_{21} = \left. \frac{b_2}{a_1} \right|_{a_2=0}$$

$$S_{22} = \left. \frac{b_2}{a_2} \right|_{a_1=0}$$

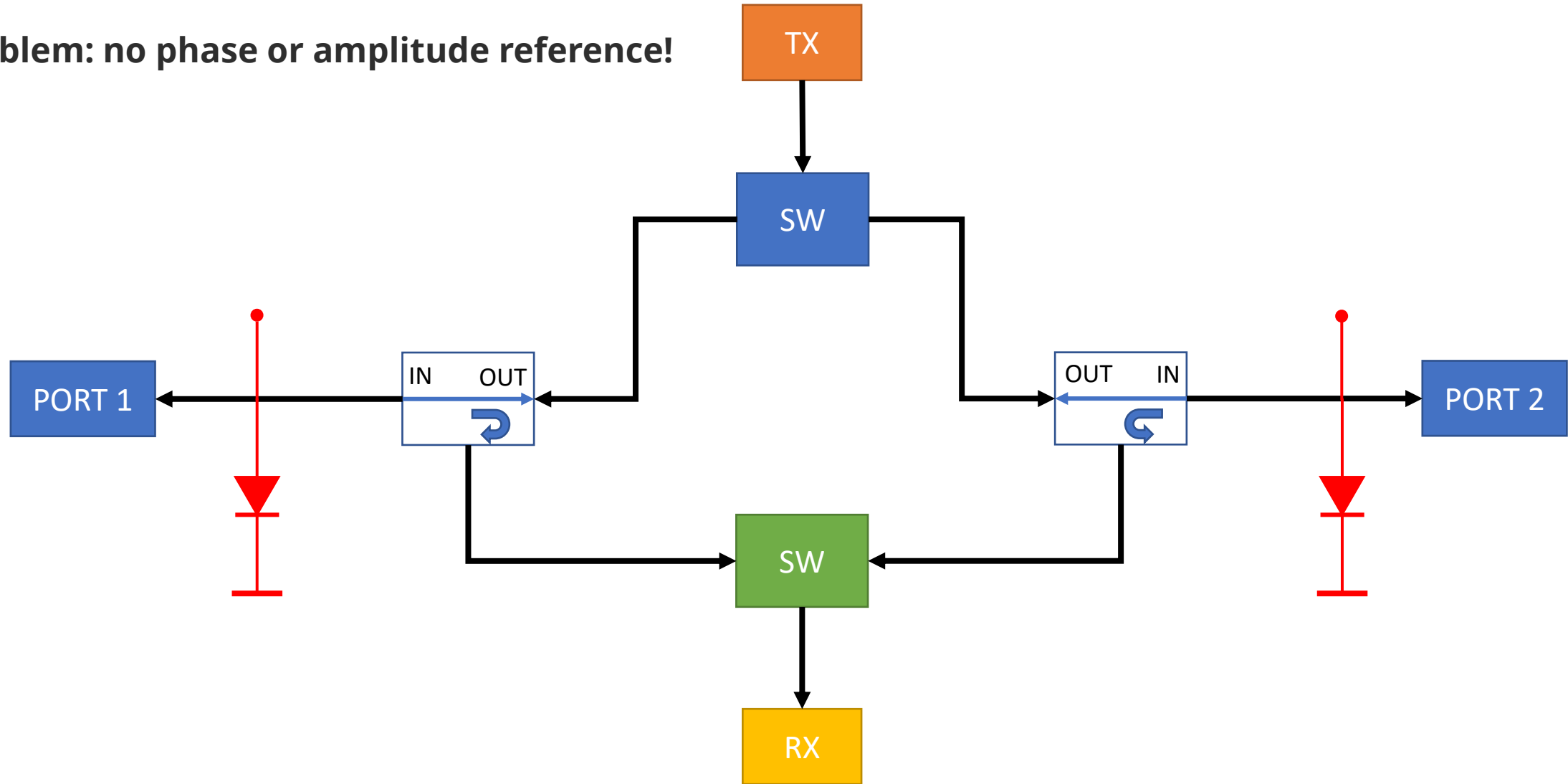
# VNA Full S-parameter



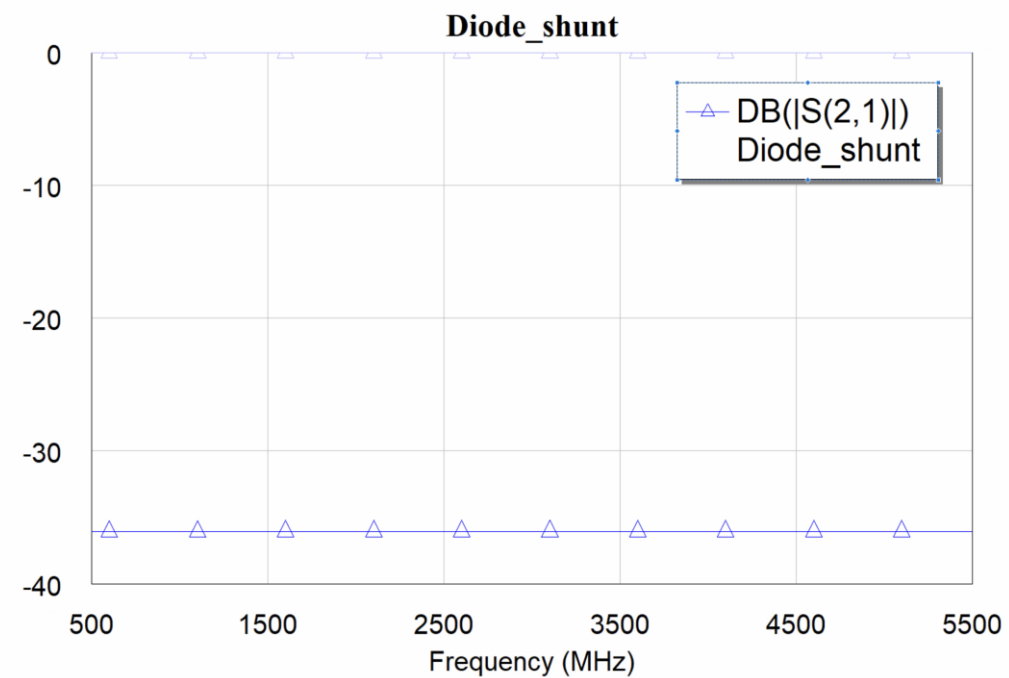
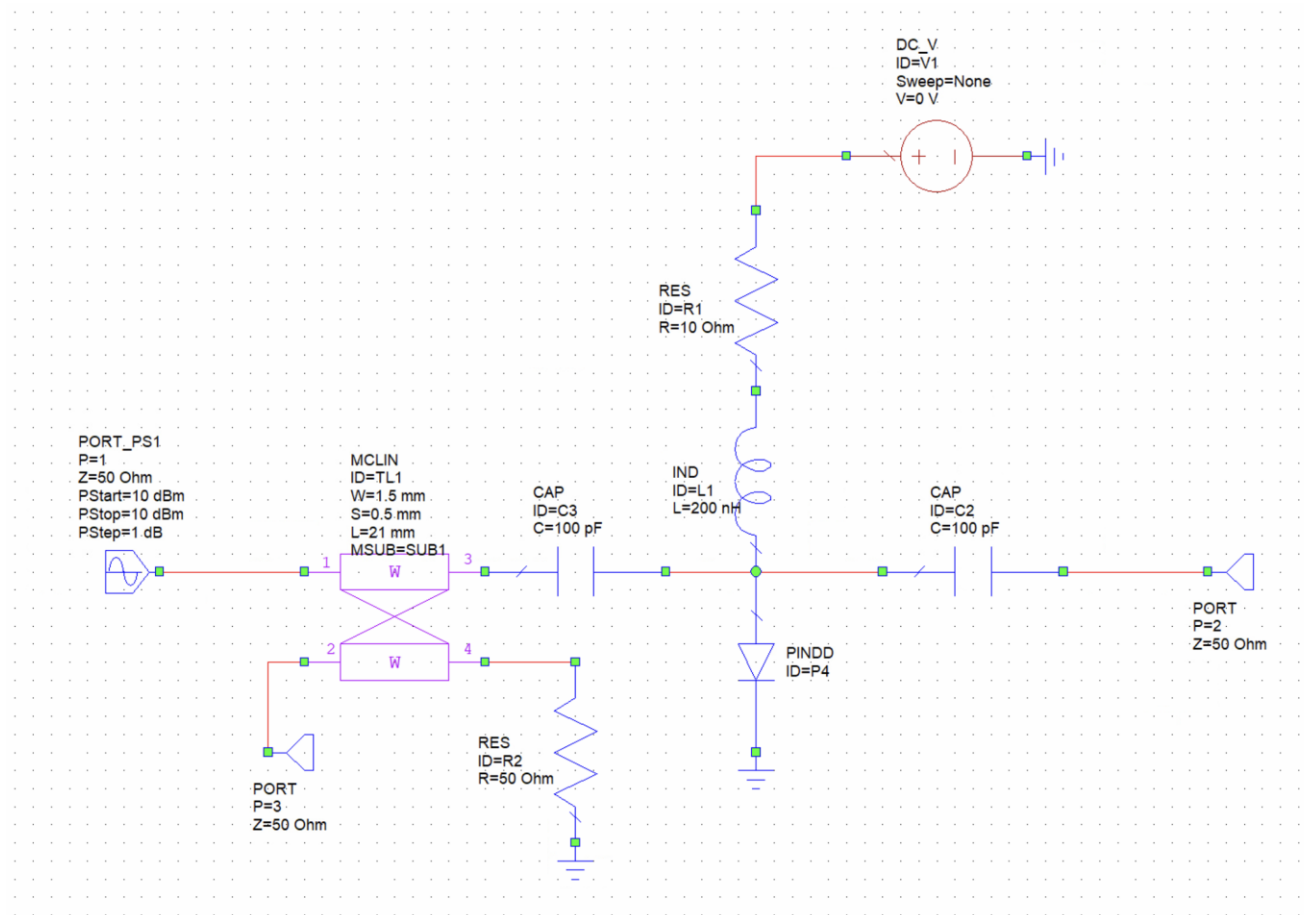
Can we use 2 port (RX and TX) SDR as a VNA for full S-parameter measurements?

# VNA 2 Port Full S-parameter

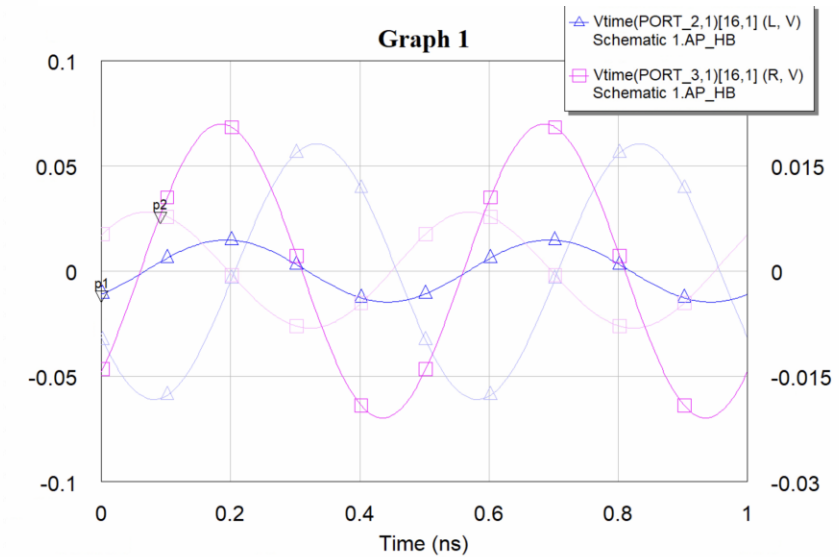
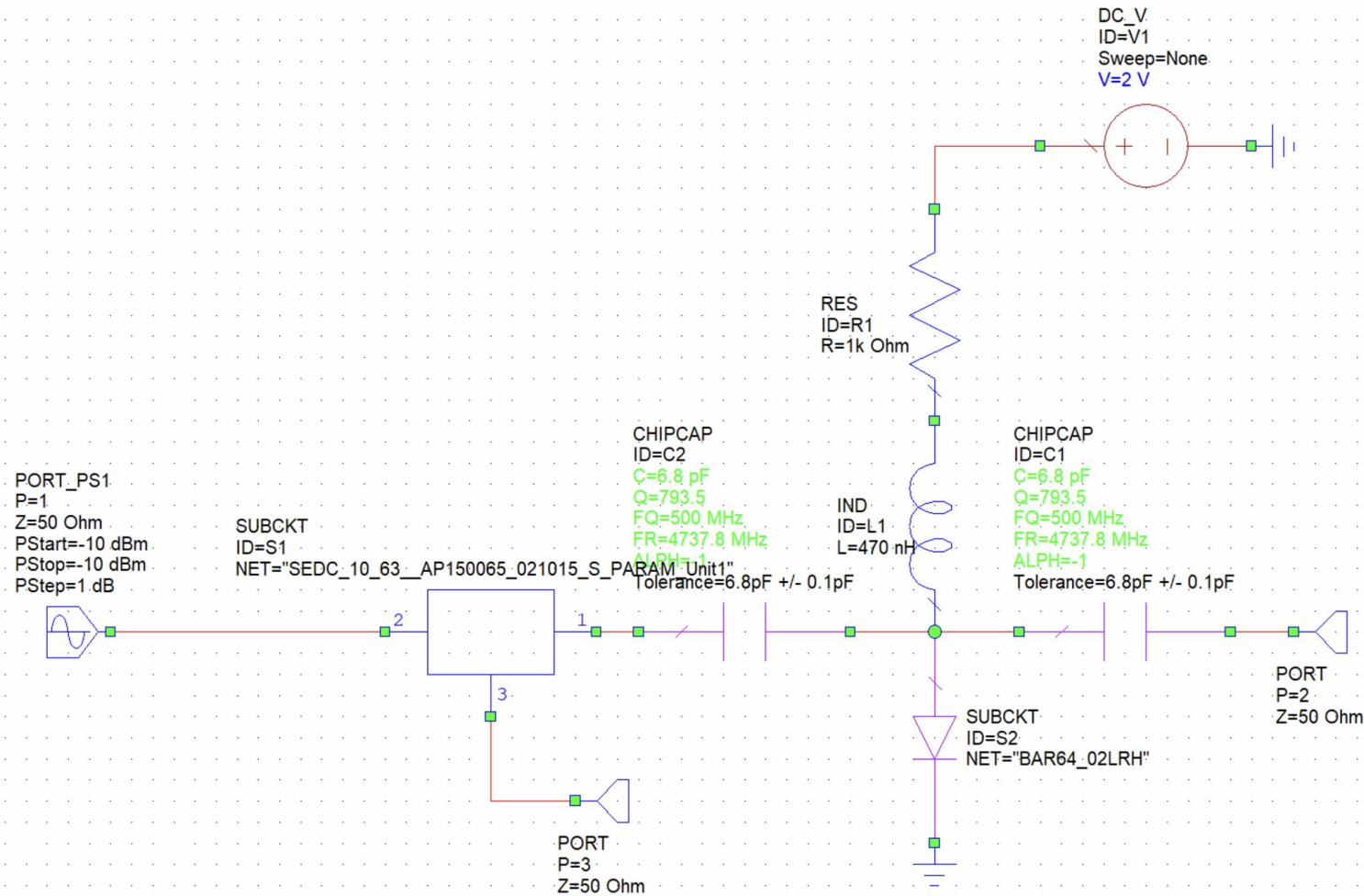
Problem: no phase or amplitude reference!



# VNA Shunt Test

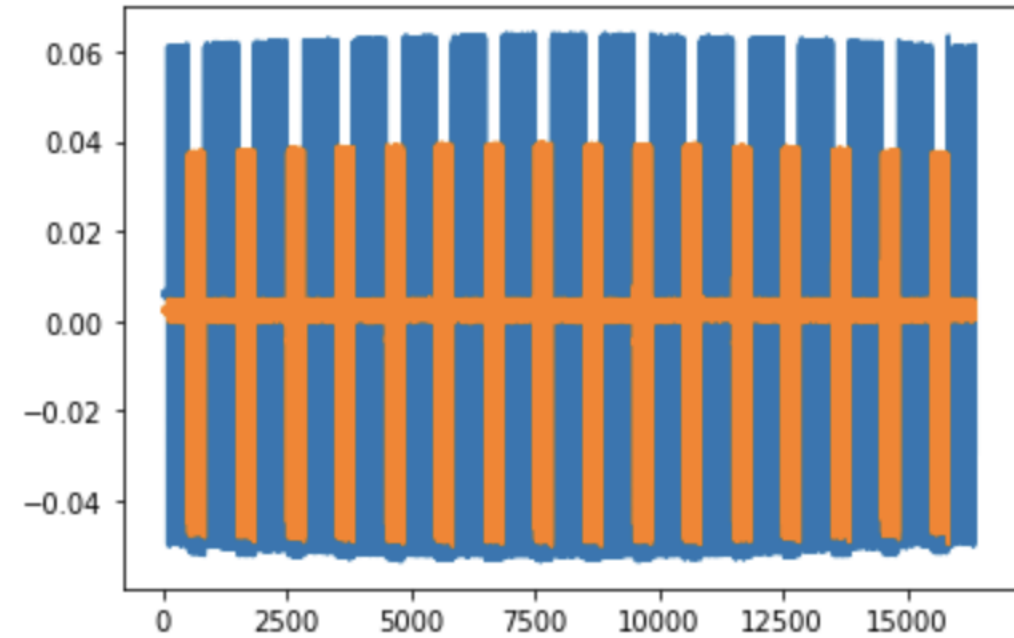
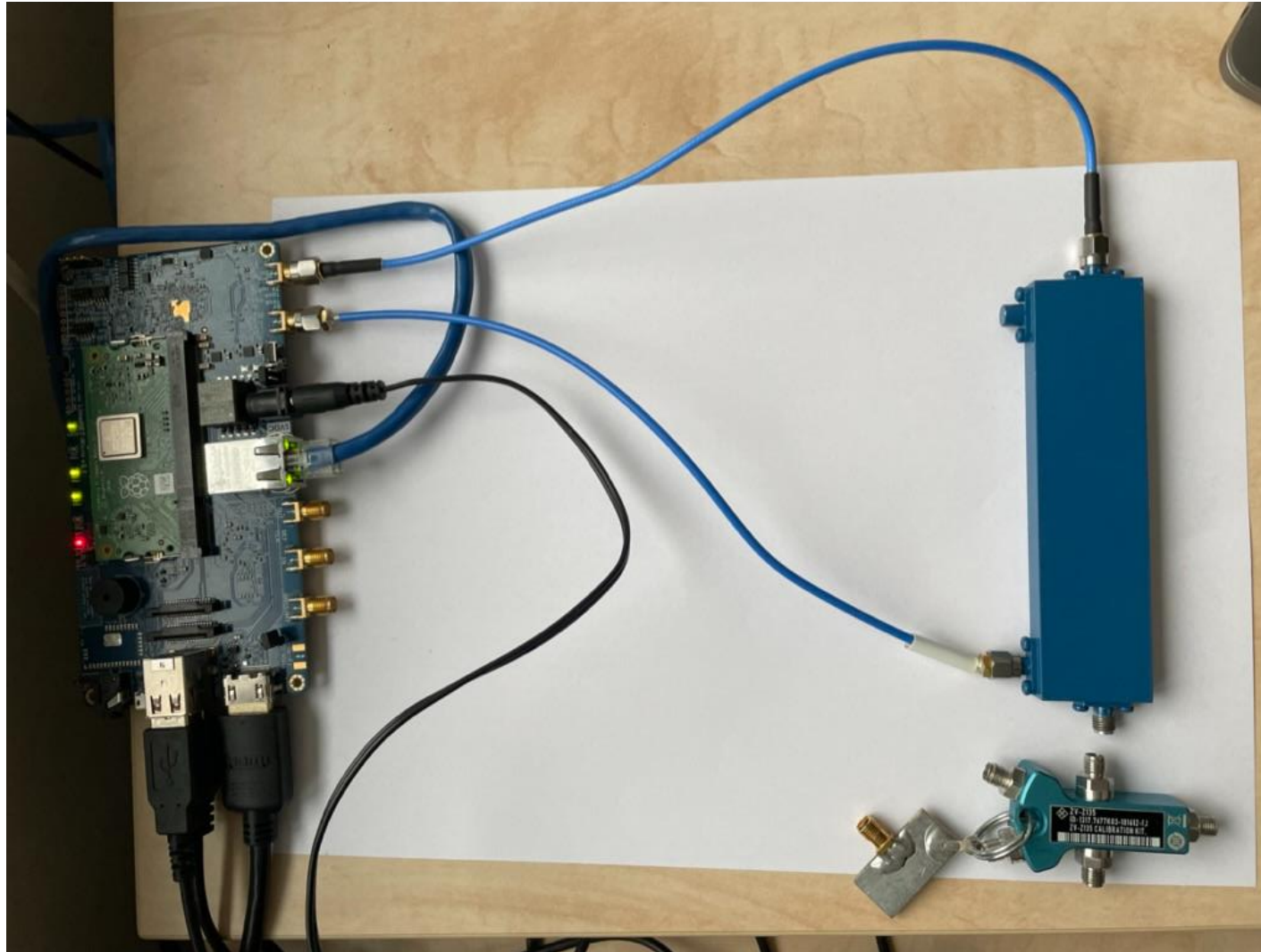


# VNA Shunt – Real components



[https://cz.mouser.com/datasheet/2/1030/SEDC-10-63\\_2b-1701116.pdf](https://cz.mouser.com/datasheet/2/1030/SEDC-10-63_2b-1701116.pdf)

# VNA Testing with SDR and Directional Coupler



A ton of calibrations is needed!



# Thank you

gotthans@vutbr.cz



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