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Comparison of Source Match Measurements

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Outline

What is Equivalent Source Match

Splitters are used in direct comparison systems for power sensor calibration. The equivalent source match is a parameter of a splitter.

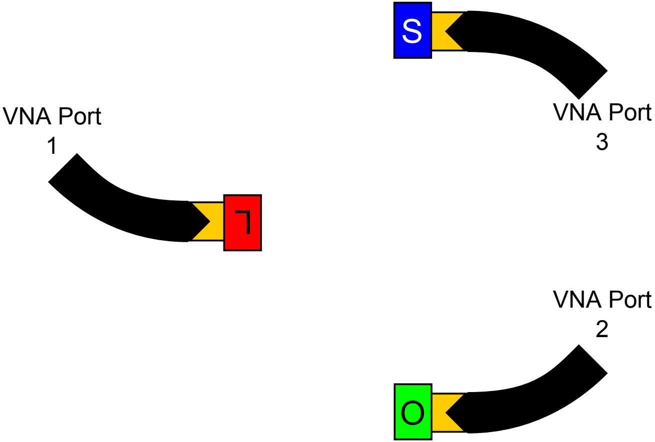
$$\Gamma_G = S_{33} - \frac{S_{23}S_{31}}{S_{21}}$$

Motivation

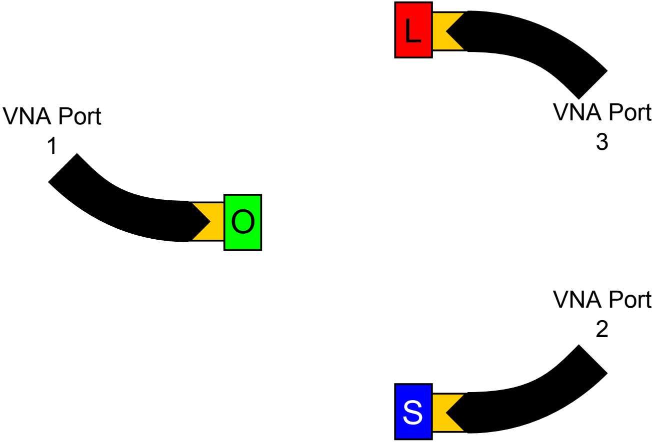
Several different methods for measuring Γ_G exist:

- How well do they match up?
- What are the uncertainties?
- Which equipment and measurement effort is needed?

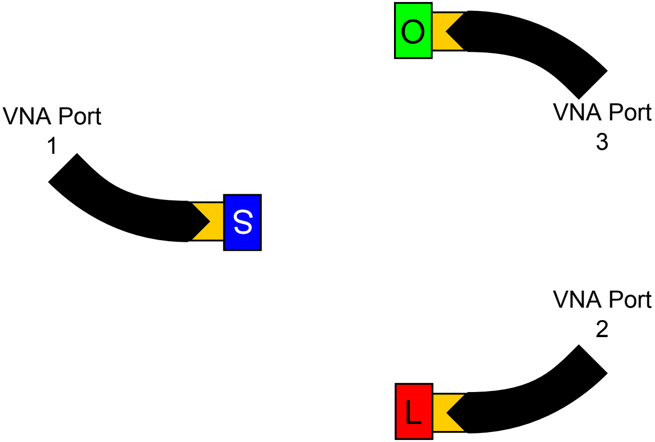
Measurements for 3-Port Method



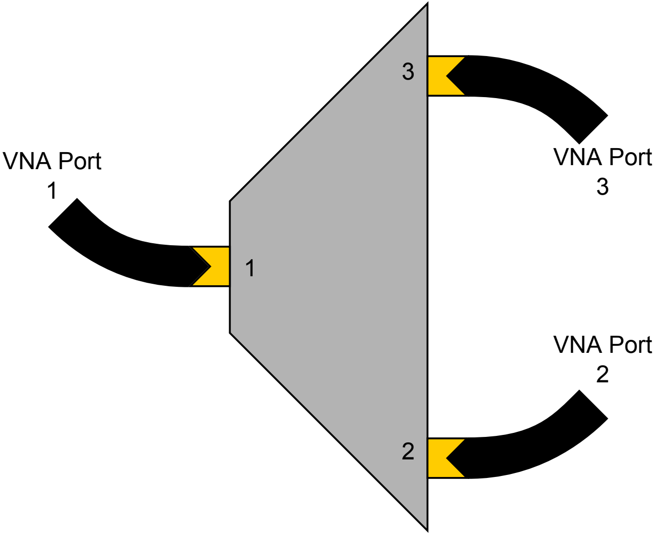
Measurements for 3-Port Method



Measurements for 3-Port Method



Measurements for 3-Port Method



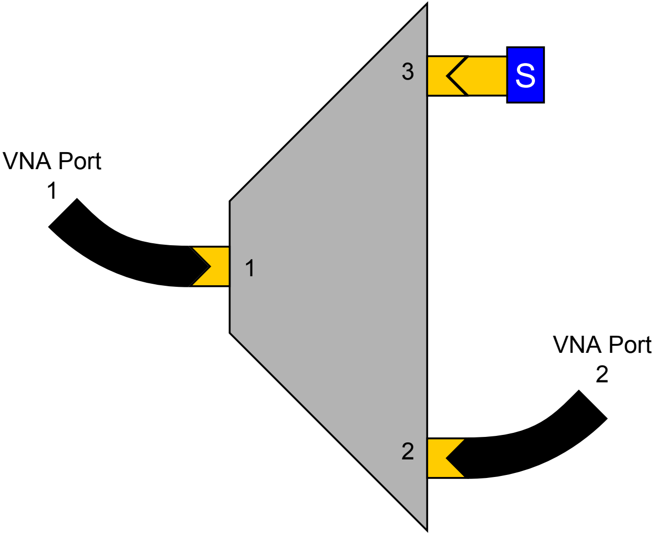
Data Processing

1. Compute 1-port error coefficients
2. Use splitter for unknown thru at ports 1-2 and 1-3
3. Compute all S-parameters of splitter and Γ_G

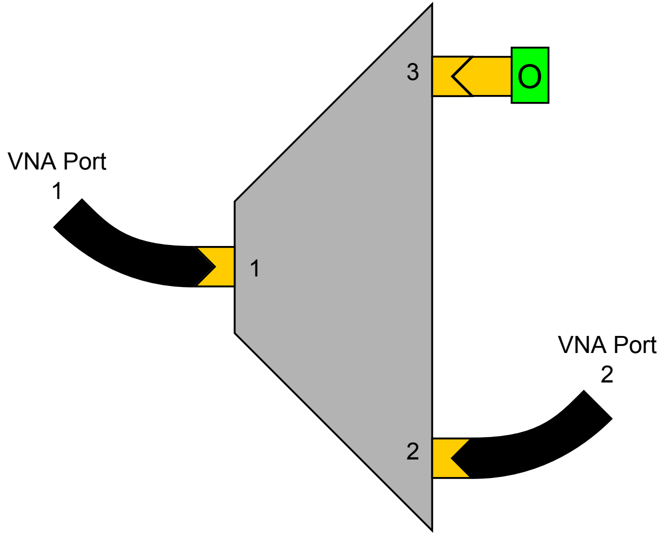
Comments

- Requires 12 connections
- Requires expensive 3-Port VNA
- Requires cable movement
- Yields all S-parameters, all Γ_G, and all tracking terms

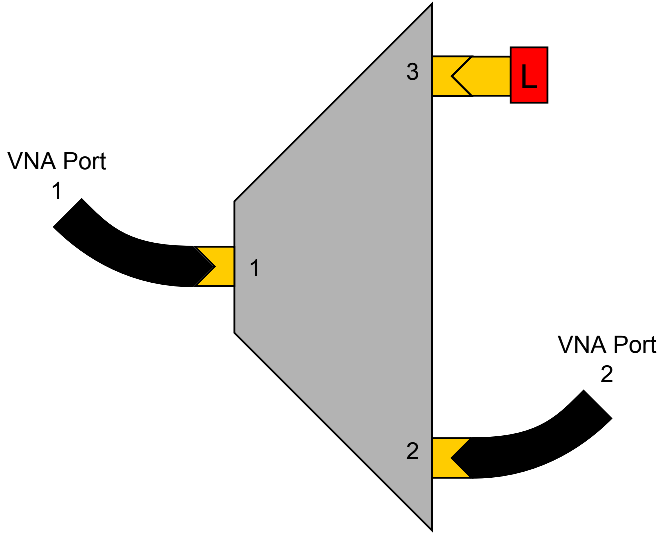
Measurements for Juroshek Method



Measurements for Juroshek Method



Measurements for Juroshek Method



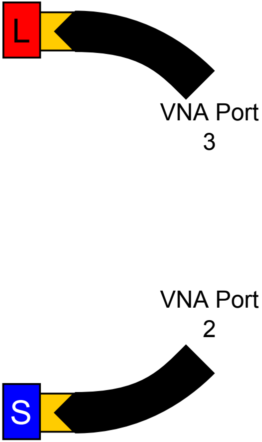
Data Processing

1. Convert S-parameters $J_{33} = \frac{S_{11}}{S_{21}}$
2. Do 1-Port cal with converted S-parameters
3. Source match equals equivalent source match $\Gamma_G = e_{11}$

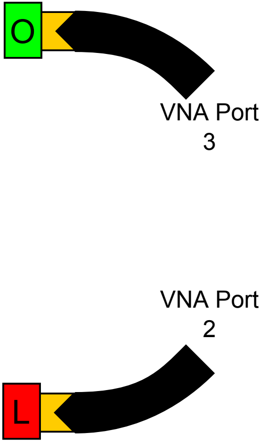
Comments

- Requires only 5 connections
- Works with 2-port VNA
- No cable movement
- Yields only Γ_G of one port

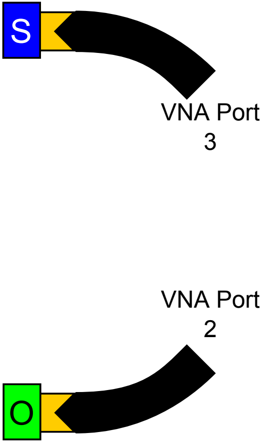
Measurements for 2-Port Method



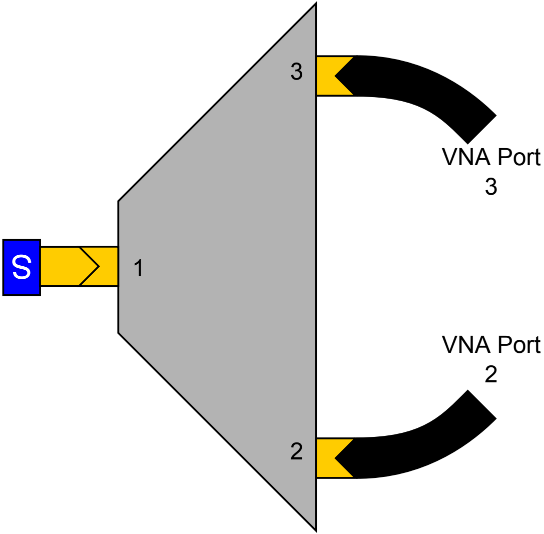
Measurements for 2-Port Method



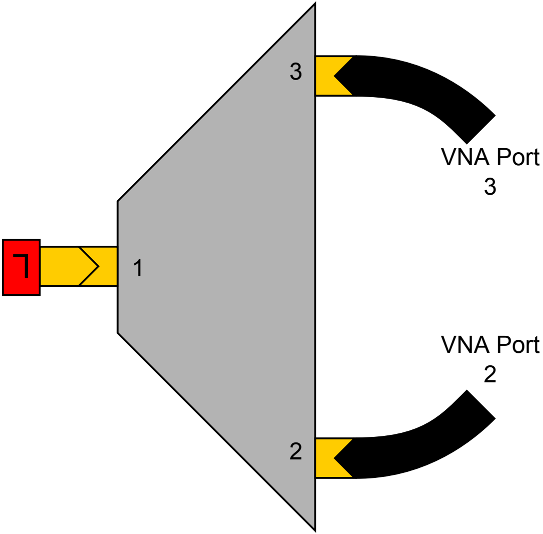
Measurements for 2-Port Method



Measurements for 2-Port Method



Measurements for 2-Port Method



Data Processing

1. Do 1-Port cal at each port
2. Perform unknown thru with splitter
3. $\Gamma_G = \frac{S_{33L}S_{23S} - S_{33S}S_{23L}}{S_{23S} - S_{23L}}$

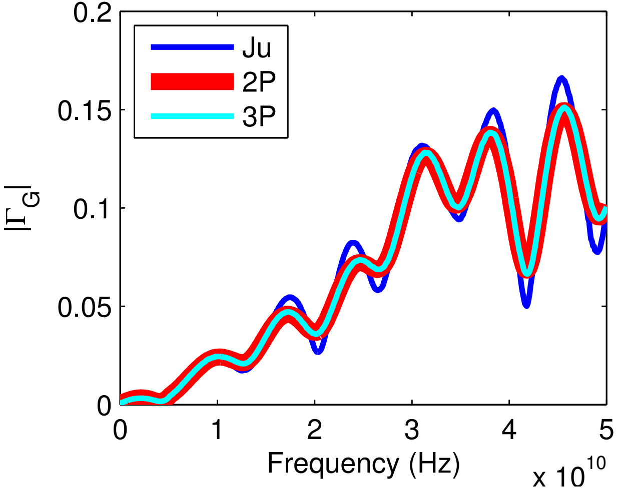
Comments

- Requires 10 connections
- Works with 2-port VNA
- Requires cable movement
- Yields Γ_G for each port and tracking ratio

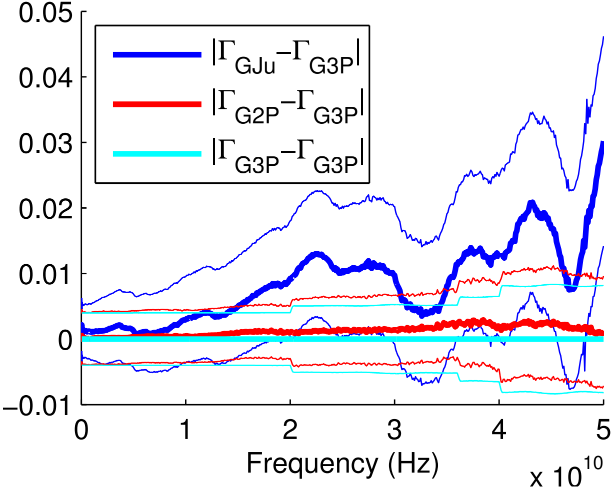
VNA Tools II

VNA Tools II supports Juroshek, 3-Port and 2-Port technique. All methods work with linear uncertainty propagation.

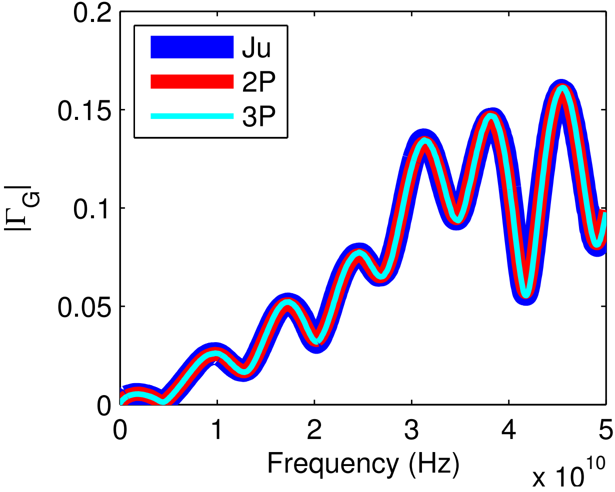
Results with Generic Definition



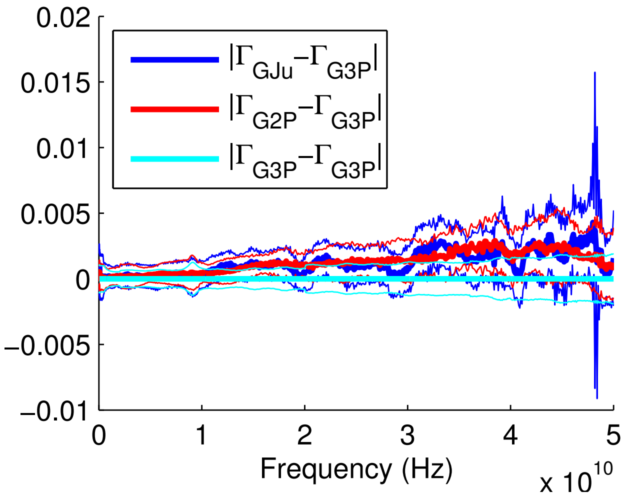
Uncertainties with Generic Definition



Results with Connector Effect



Uncertainties with Connector Effect



Conclusion

- Including the connector in the standard definition improves agreement
- METAS characterized standards have smaller uncertainty
- Juroshek puts high demands on noise and linearity of VNA
- 2-Port and 3-Port method yield comparable results