[FAQ]
Mixed-mode S-parameters on the 2-port ENA Network Analyzer using the Equation Editor
Overview

The balance-unbalance conversion function of the fixture simulator can be used to covert the measurement results in an unbalanced DUT state, which are obtained by connecting the DUT to the test port of the ENA, into measurement results in a balanced state.

An ENA with at least three test ports is required to use the balance-unbalance conversion function of the fixture simulator.

The equation editor feature (available from firmware revision 8.01) allows for the calculation of balanced parameters with the 2-port ENA.

This FAQ will provide details on the measurement setup for balanced measurements on the 2-port ENA.
Mixed Mode S-parameters

The S-parameter of a balanced port can be obtained separately for two modes, the differential mode and the common mode. The following figure shows the notation of the S-parameter in balance measurement (mixed mode S-parameter).

Notation for mixed mode S-parameters:

\[ S_{xyAB} = \frac{x \text{ mode signal output on port } A}{y \text{ mode signal input on port } B} \]

\[ \text{Mode} = \begin{cases} \text{s: Single-Ended (Unbalanced)} \\ \text{d: Differential Mode (Balanced)} \\ \text{c: Common Mode (Balanced)} \end{cases} \]

For balanced 2-port device measurements...

Mixed-mode S-parameter Equations:

\[ S_{dd11} = \frac{1}{2} (S_{11} - S_{21} - S_{12} + S_{22}) \]
\[ S_{dc11} = \frac{1}{2} (S_{11} - S_{21} + S_{12} - S_{22}) \]
\[ S_{cd11} = \frac{1}{2} (S_{11} + S_{21} - S_{12} - S_{22}) \]
\[ S_{cc11} = \frac{1}{2} (S_{11} + S_{21} + S_{12} + S_{22}) \]
Measurement Setup Procedure

**Step 1: Open Equation Editor**
Press [Display] > Equation Editor

**Step 2: Enter Equation**
- Step 2-1
  - Enter equation

- Step 2-2
  - Press [Apply], then [Close]

**Step 3: Turn ON equation editor**
- Press [Equation] - ON