Application Note

CASCADE MICROTECH

Innovating Test Technologies®

On-wafer Multiport/Differential Calibration using the Agilent ENA Series Network Analyzer with Cascade Microtech Probing Solution



- Accurate multiport / differential probe calibration and measurements.
- Full 4-port error correction using Dual / Differential calibration standards (ISS's)
- Increased calibration accuracy and repeatability with ENA WaferCal calibration software

System outline

Combining the Agilent's ENA Series Network Analyzer with Cascade Microtech's probing solution (Air Coplanar™ Probes (ACP), ENA WaferCal software, new dedicated Dual/Differential ISS's) you can evaluate on-wafer multiport / differential devices and components accurately.

The ENA Series offers built-in balanced measurements, matching circuit simulation and port characteristics impedance conversion, all of which deliver both multiport and differential component evaluations. The dual tip ACP provides a precisely aligned second signal contact built right into the Air Coplanar tip and connector block. This innovative tip technology provides outstanding compliance and tip visibility which subsequently enables you to precisely contact the balanced port ensuring superior impedance control. Combining these two components along with ENA WaferCal, superior accuracy and repeatability of multiport and differential measurements can be attained.



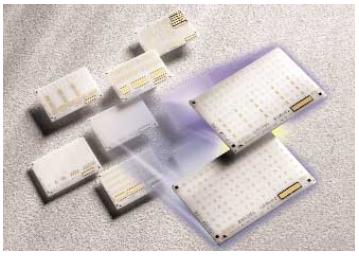


Figure 1 Dual ACP and Dual ISS

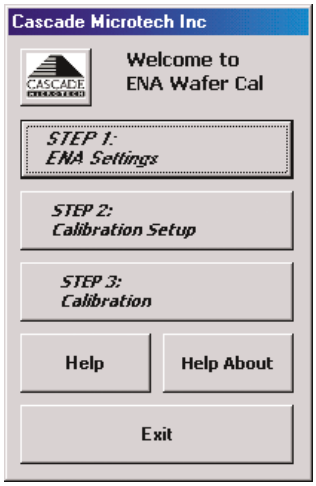
Full 4-port error correction with probe and ISS

The ACP probes, Dual ISS and ENA WaferCal are all critical components to ensure accurate measurements. The impedance standards (open, short, load, thru etc.) are designed to ensure the full-4 port error correction can easily be performed with the dual signal ACP probe (Figure 1). ENA WaferCal is a Cascade Microtech embedded application, fully contained within the ENA network analyzer. The software wizards guide the user through the error prone process of the cal kit setup and the calibration itself. An added benefit is the 10X reduction in the time it would take the user to complete all of the necessary steps from the front panel.

Full 4-port error correction procedure

The procedure for calibration is a follows:
Step 1: Setup stimulus settings on ENA
Step 2: Setup CalKit on ENA
Step 3: Perform calibration
Step 4: Verify calibration

ENAWaferCal enables each of the steps 1 to 3 to be performed ensuring optimum calibration accuracy and repeatability



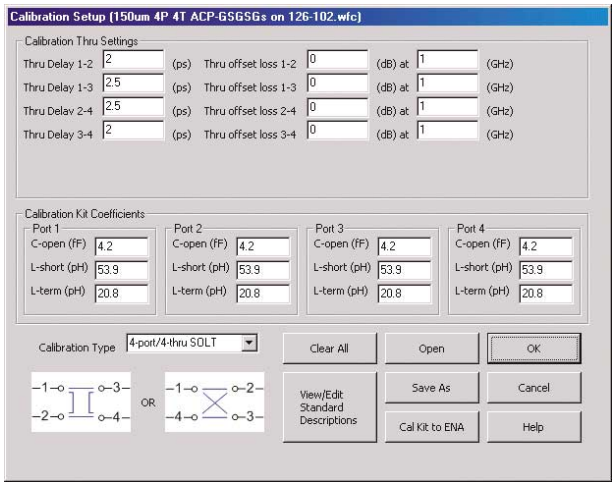


Figure 2 ENA WaferCal ensures calibration accuracy and repeatability with the cal wizard and ISS cal kit database

Copen	Lterm	Lshort	Sthru	LBthru
S1= 4.2	S1=20.8	S1 = 53.9	2.0 ps	2.5ps
S2= 4.2	S2=20.8	S2 = 53.9		

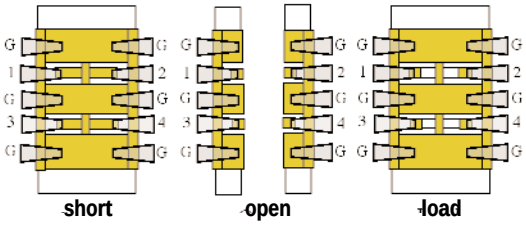
Figure 3 ACP GSGSG 150um pitch cal kit for 126-102 ISS. C values in fF, L values in pH.

Figures 4 and 5 provide an example of how the system could be configured and the specific calibration standards probed to enable a full 4-port on wafer calibration to be performed.

Ports 1 and 3 are connected to the left probe head and ports 2 and 4 to the right probe head. The calibration methodology used is SOLT.

Figure 4 GSGSG S-O-L cal standards

Short-Open-Load calibration



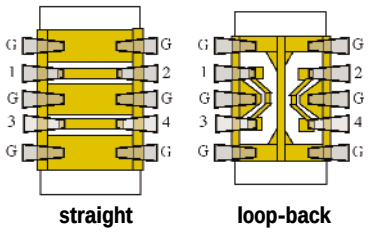


Figure 5 Straight and Loop-back Thru standards

Thru calibration

Typically, a full 4-port calibration would require a total of six thru measurements to be performed.

However, when using ENA WaferCal, only four of the six thru paths are required to be measured during the calibration procedure. Hence, only the two thru standards shown in Figure 5 that are on the ISS are required to meet this requirement. This means that the probes do not need to be reconfigured at any point during the procedure making the procedure much more efficient and repeatable.

The mixed-mode S-parameters for the two port balanced measurement performance (singled-ended ports 1 and 3 and ports 2 and 4 form balanced ports 1 and 2 respectively), can be verified using the straight-thru standard shown in Figure 5. Connect port 1, port 2, port 3, and port 4 as shown with the thru on the ISS, and check the performance of the mixed-mode S-parameters measurement.

The full 4-port error correction methodology described in this application note enables a highly accurate on-wafer balanced device or component measurement to be performed. For more information, please refer to the following literature:

- Agilent ENA series Network Analyzer Product Overview (P/N 5988-3765EN)
- Agilent URL for ENA http://www.agilent.com/find/ena
- Cascade Microtech ISS product guide (P/N DS-803)
- Cascade Microtech ENA WaferCal software (P/N 125-950)
- Cascade Microtech URL http://www.cascademicrotech.com

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