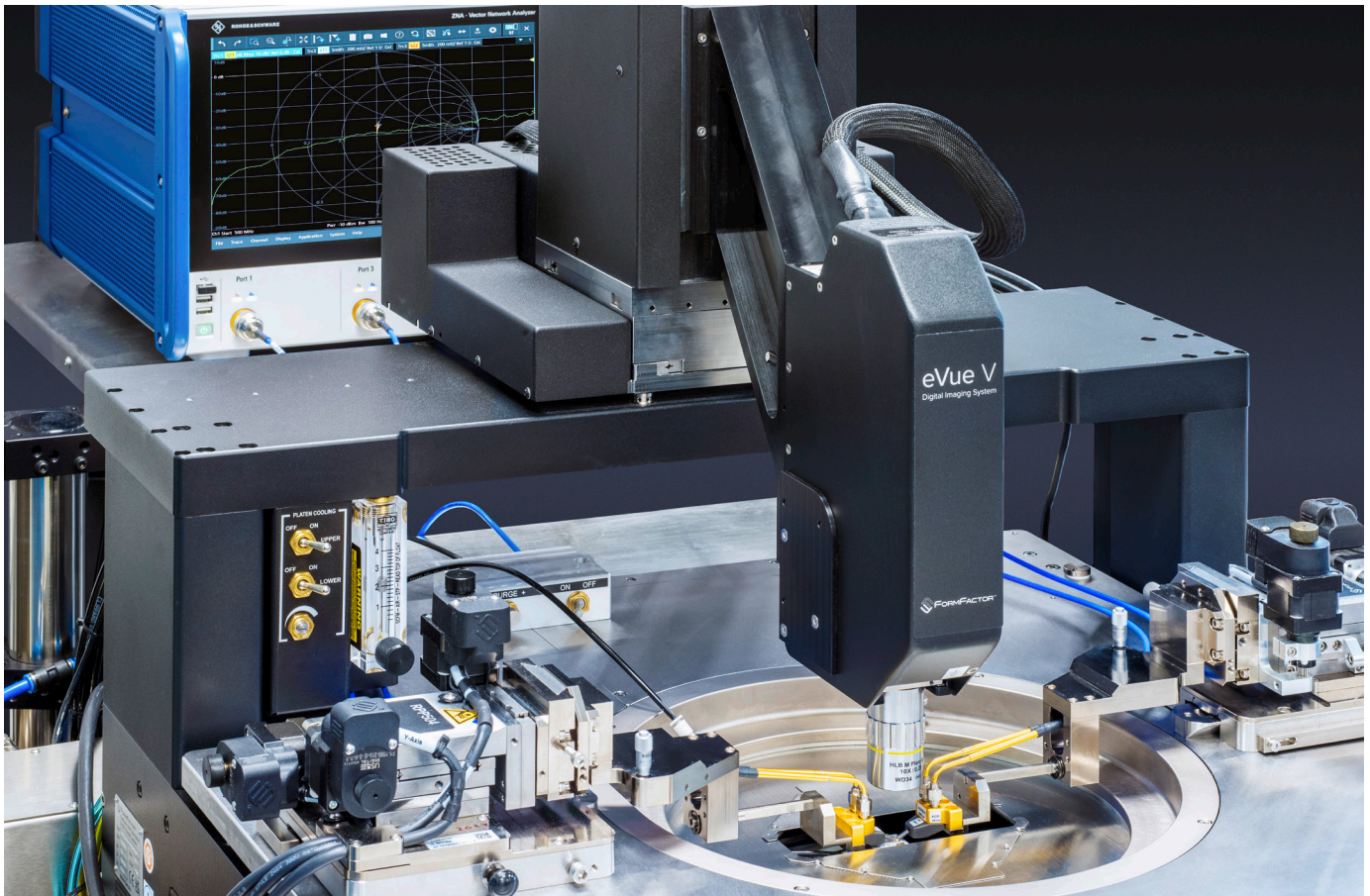


HIGH FREQUENCY MODAL CALIBRATION BENEFITS FOR DIFFERENTIAL ON-WAFER MEASUREMENTS

Crosstalk on differential measurements with ground-signal-signal-ground (GSSG) RF probes can severely compromise measurement accuracy. A new calibration method greatly reduces the effects.



Your task

RF probes help accurately test and validate differential on-wafer components such as antennas, filters and amplifiers. The probes help with on-wafer testing during early design validation and reduce packaging need while enabling rapid prototyping and development. The probes are also

vital when designing and testing next generation components for satellite communication systems, where high-frequency bands offer increased bandwidth and capacity. Such measurements are generally essential to advancing telecommunications, defense and space exploration technologies.

Application Card | Version 01.00

ROHDE & SCHWARZ

Make ideas real

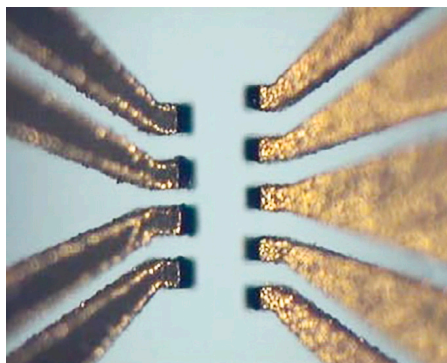


If a DUT uses a differential topology to improve EMI performance and process variation resilience, a ground-signal-signal-ground (GSSG) probe should be used instead of a ground-signal-ground-signal-ground (GSGSG) probe since GSSG probes take up less space on a wafer. However, compensating for crosstalk effects between the two signal lines of an RF probe is not possible, reducing overall measurement accuracy and potentially compromising the performance of the final system design. This application card describes a calibration method to characterize and compensate for crosstalk.

RF probe solution

A suitable vector network analyzer (VNA) is a core element of reliable and precise RF measurements. The R&S®ZNA from Rohde&Schwarz is a precise and versatile advanced VNA that excels in crosstalk detection and on-wafer measurements. Its exceptional dynamic range and measurement accuracy is crucial for detecting and analyzing subtle crosstalk effects in RF circuits. The R&S®ZNA can perform the multiport measurements needed for the comprehensive analysis of complex signal interactions on wafer-level devices. Characterization of differential pairs is more accurate and measurement errors are fewer. A user-friendly interface and automation process streamline the testing process for greater efficiency and fewer human errors. The R&S®ZNA also supports a wide frequency range and is suitable for various RF applications; from telecommunications to semiconductor testing. Overall, robust R&S®ZNA performance and advanced features make the VNA ideal for reliable and precise crosstalk detection and on-wafer measurements.

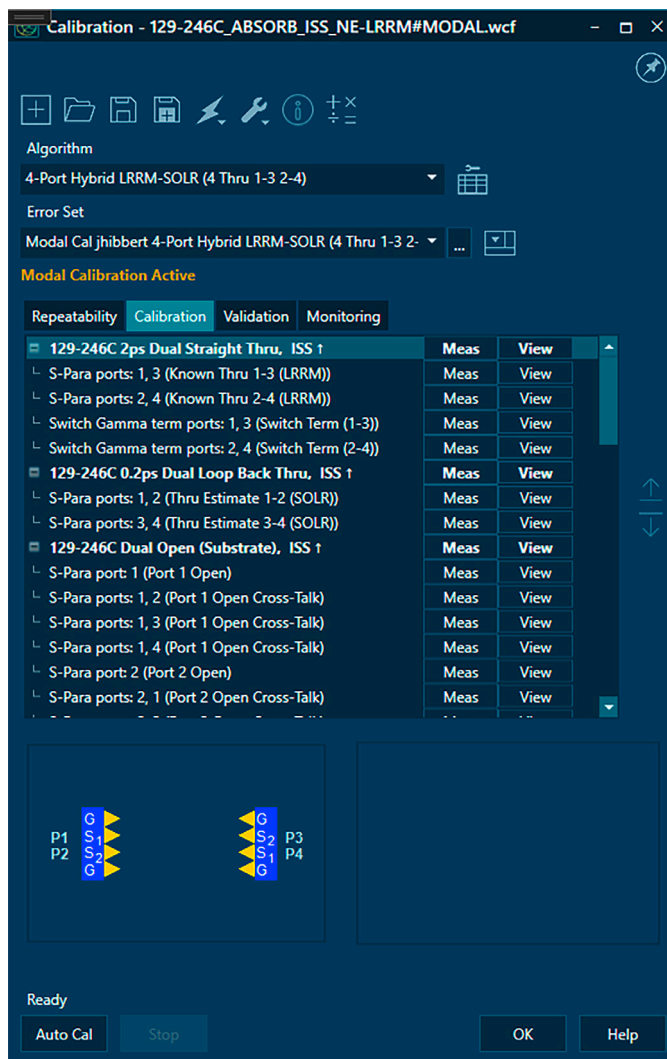
GSSG probe (left) and GSGSG probe (right)



The FormFactor SUMMIT200 is a high-end 200 mm probe station for fully automated testing over multiple wafers. In automated testing, motorized positioners allow probes to be moved without any user interaction. The IceShield permits measurements at temperatures as low as -55°C in a convenient open environment; the TopHat has maximum EMI shielding and extends this temperature range down to -60°C .

The modal calibration integrated into WinCal 5.1 software conveniently characterizes and corrects for intra-probe crosstalk. The method uses the same short, open, load, through (SOLT) standards commonly used in calibration. WinCal automatically acquires the additional measurements required for crosstalk correction during the normal calibration flow for one-click calibration.

WinCal 5.1 supporting modal calibration method



Measurement results

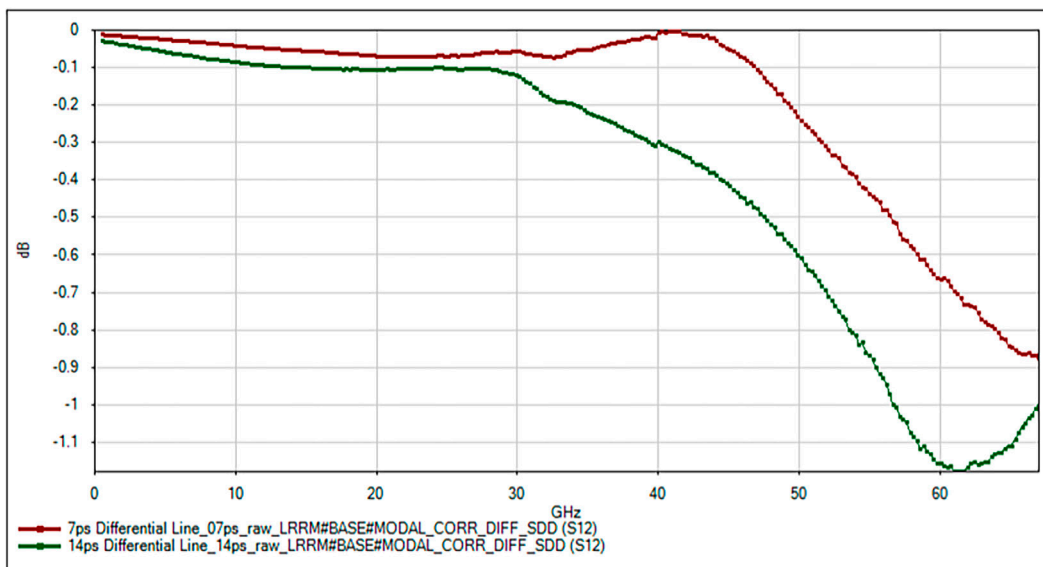
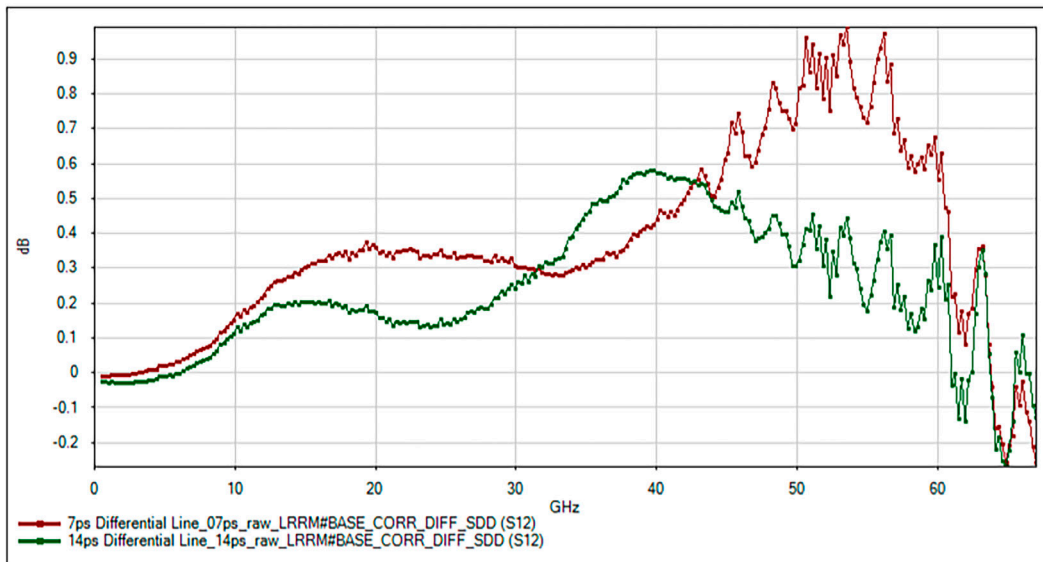
The measurement plots below show the 7 ps and 14 ps differential transmission line measurements on FormFactor 129-246 impedance standard substrates (ISS). The data has been converted to mixed-mode representation to help with interpretation. S_{dd21} is shown here to ease interpretation.

Transmission line measurements with conventional corrections (no crosstalk) are jagged and unphysical at higher frequencies. However, modal calibration cleans things up for physically plausible data.

Key features of the joint solution of FormFactor Inc. and Rohde & Schwarz

FormFactor and Rohde & Schwarz offer a complete solution that combines a R&S®ZNA vector network analyzer, a FormFactor SUMMIT200 probe station and WinCal 5.1 software for a cutting-edge platform with accurate differential on-wafer RF measurements. The R&S®ZNA allows precise multiport analysis, with exceptional dynamic range and wide frequency coverage. The FormFactor SUMMIT200 probe station enables high-throughput over-temperature testing across wafers. Modal calibration with WinCal 5.1 enhances measurement integrity by automatically compensating for intra-probe crosstalk in a one-click workflow. Together, the trio gives engineers reliable, efficient and physically accurate characterization of differential components.

Measurement results



Service at Rohde & Schwarz
You're in great hands

- ▶ Worldwide
- ▶ Local and personalized
- ▶ Customized and flexible
- ▶ Uncompromising quality
- ▶ Long-term dependability

Rohde & Schwarz

The Rohde&Schwarz technology group is among the trail-blazers when it comes to paving the way for a safer and connected world with its leading solutions in test&measurement, technology systems and networks&cybersecurity. Founded more than 90 years ago, the group is a reliable partner for industry and government customers around the globe. The independent company is headquartered in Munich, Germany and has an extensive sales and service network with locations in more than 70 countries.

www.rohde-schwarz.com

Sustainable product design

- ▶ Environmental compatibility and eco-footprint
- ▶ Energy efficiency and low emissions
- ▶ Longevity and optimized total cost of ownership

Certified Quality Management

ISO 9001

Certified Environmental Management

ISO 14001

Rohde & Schwarz training

www.training.rohde-schwarz.com

Rohde & Schwarz customer support

www.rohde-schwarz.com/support



R&S® is a registered trademark of Rohde&Schwarz GmbH&Co. KG

Trade names are trademarks of the owners

PD 3610.2275.92 | Version 01.00 | December 2025 (ja)

High frequency modal calibration benefits for differential on-wafer measurements

Data without tolerance limits is not binding | Subject to change

© 2025 Rohde&Schwarz | 81671 Munich, Germany