An Integrated Approach for More Accurate, Wafer-Level Parameter Measurements

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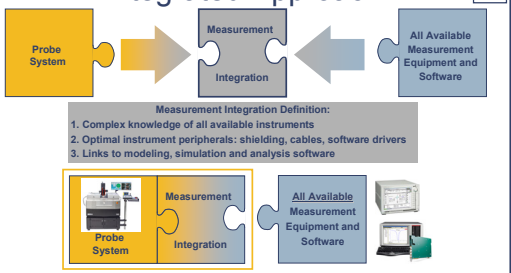
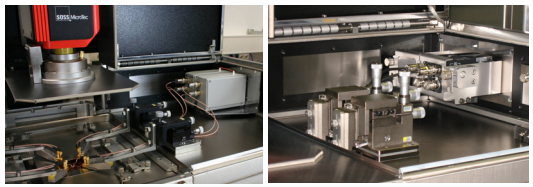
1 Motivation

- Today's semiconductor device designs require better measurement accuracy
  - Shrinking dimensions
  - Decreasing voltage and current
  - Higher operating frequencies
- New measurement methods and instrumentation are used but difficult and complex to implement at wafer-level

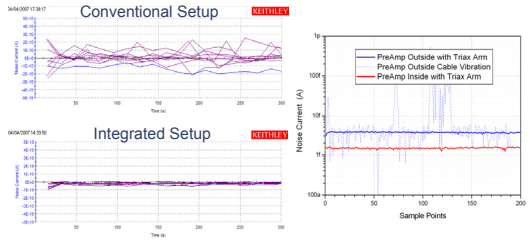
2 Integrated Approach



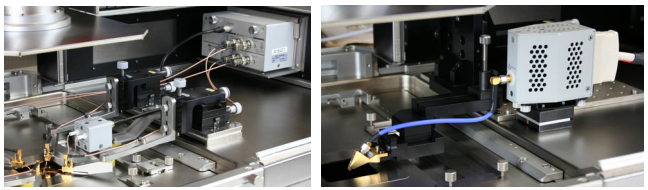
3 I-V Measurements



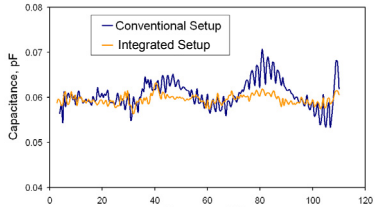
- ASU/Pre-Amp integrated into probe system
- Minimized cable length



4 C-V/Pulsed I-V/NBTI Measurements

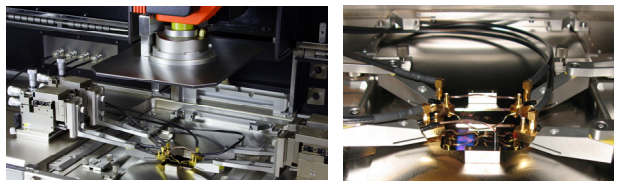


- Ground-Switch Unit and Remote Sense Unit integrated into shielded probe system
- Cable lengths reduced and/or optimized
- NBTI Setup with optimized cable: length 180mm, capacitance 15 pF

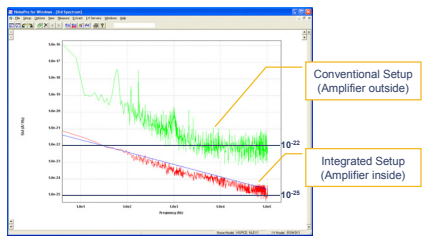


Advanced I-V Method with Agilent 4294A
~26% improvement up to 110 MHz

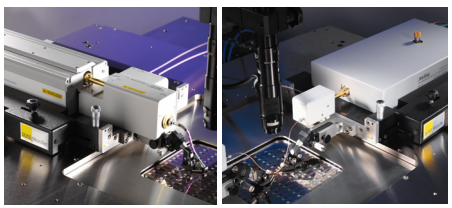
5 Low-Frequency Flicker-Noise (1/f) Measurements



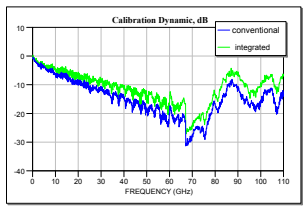
- Low-Noise Amplifier integrated into system
- Cables designed without additional adapters
- Efficient common grounding concept implemented at probes



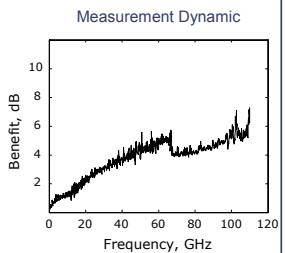
6 S-Parameter Measurements up to 110 GHz



- Cable lengths reduced for better measurement dynamic
- Dedicated, wafer-level calibration method: LRM+



PNA 110 GHz system, input power : -17 dBm
reference plane : 1 mm cable output
standards : Agilent 1 mm coaxial cal kit
measurements : short, load, thru



7 Conclusion

- An integrated approach increases accuracy in device characterization and reliability test
  - Measure down to test equipment's resolution
  - Shorter cables lower overall system error
  - Complex measurements
- Higher accuracy for more efficient model extraction to reduce design iterations

8 Authors

Dr. Botho Hirschfeld is responsible for the segment Device Characterization, Modeling and Reliability for the Test Systems division at SUSS MicroTec, which includes responsibility for SUSS MicroTec's ProbeShield technology. After receiving his degree in Electrical Engineering from the Technische Universität Dresden (Dresden Technical University), he joined SUSS MicroTec in 1996. During the following years he completed his doctoral studies at TU Dresden in the field of IC packaging. Botho has held various positions including product engineer and direct sales.

Dr. Stojan Kanev holds a doctoral degree in Electronic and Electrical Engineering from the Technische Universität Dresden (Dresden Technical University). He joined SUSS MicroTec in 1995 within the Test Division's product management group and has held various positions since. After launching the ProbeShield technology products in 1996, he quickly moved into the sales organization and eventually became manager of the direct sales channel covering strategic regions of Europe. Since 2005, Stojan has held the World Wide Director of Marketing and Product Management position for the Test Systems Division.

Joshua M. Preston is currently the Marketing Group Manager for the Test Systems division at SUSS MicroTec in Dresden, Germany. Joshua has authored and edited several published articles and other documents on the topic of wafer-level test. Prior to SUSS, he worked in strategic marketing in the Automotive, Industrial and Multimarket group at Infineon Technologies. Joshua, originally from the USA, holds an M.B.A. degree from the Handelshochschule Leipzig (Leipzig Graduate School of Management) and a B.S. *cum laude* in Economics from the University of Idaho.

Andrej Rumiantsev was born in Minsk, Belarus in 1972. He received an Engineering degree (with highest honors) in Telecommunication Systems and the Specialist degree in Electrical Engineering from the Belarusian State University of Informatics and Radio Electronics in Minsk, Belarus, in 1994 and 1997 respectively. Since 2001, he has been employed at SUSS MicroTec Test Systems in Dresden, Germany as a RF and Microwave Application Specialist and Application Group manager. His current research interests include an accuracy improvement of calibration and wafer-level measurement techniques for RF and Microwave semiconductor device.

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