

Sunday, January 21<sup>st</sup>

## NIST-ARFTG Short Course on Microwave Measurements

Join us for a practical tutorial on microwave measurements for wireless communications! This short course is intended for engineers, graduate students, experienced technicians, or technical managers, and will be a learning experience for anyone who wants to improve their knowledge of precision microwave measurements.

This year, the presentations are focused on four broad areas: (1) Microwave fundamentals and traceable measurements; (2) On-wafer measurements, (3) Noise: High frequency and Low-frequency measurements and applications (4) Nonlinear Measurements. In addition, we plan to host a live question and answer session with a panel consisting of short course instructors.

Day one, for the morning, we focus on Fundamental topics include (1) Microwave Power and Traceability; (2) Updating NIST's Traceability: S-Parameters and Beyond; (3) Modern Network Analyzer Calibration Techniques; and (4) High-Speed Oscilloscopes, What the Manual Doesn't Tell You.

Day one, for the afternoon, we focus on the on-wafer topics include presentations on (5) Traceable On-Wafer Measurements at mm-Wave Frequencies; (6) Fundamentals of Successful Wafer-Level System Calibration at the mm-Wave Frequencies. The Noise Measurements topics include presentation on (7) Microwave Thermal Noise – Measurements and Applications; (8) Low-Frequency Noise Measurements and Applications.

Day two, for the morning, we focus on the Nonlinear measurements the topics include presentation on (9) Measuring Modulation Distortion of Active devices Using a Vector Network Analyzer; (10) Load-Pull metrology and applications; (11) Time-Domain Low-Frequency Active Harmonic Load-Pull As a Tool for verifying the Power amplifier modes operation; (12) Everything You Can Do with Vector Nonlinear Microwave Measurements.

Scheduled instructors include: Aaron Hagerstrom (NIST), Angela Stelson (NIST), Rusty Myers (Keysight Technologies) (tbc), Paul Hale (NIST) (tbc), Uwe Arz (Physikalisch-Technische Bundesanstalt), Andrej Rumiantsev (MPI Corporation), Jean Guy Tartarain (LAAS du CNRS), Gu Dazhen (NIST), Jan Verspecht (Keysight Technologies), Mauro Marchetti (Anteverta-mw), J. Apolinar Reynoso-Hernandez (CICESE), and Patrick Roblin (The Ohio State University).

For questions and suggestions, contact: J. Apolinar Reynoso-Hernández, CICESE, Ensenada, B.C, Mex ([apolinar@cicese.mx](mailto:apolinar@cicese.mx)), the NIST-ARFTG Short Course Coordinator

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## Measurements Fundamentals

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**08:00** Microwave Power and Traceability

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**12:00** Aaron Hagerstrom (NIST)

SC-1

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SC-2 Updating NIST’s Traceability: S-Parameters and Beyond

Angela Stelson (NIST)

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SC-3 Modern Network Analyzers Calibration Techniques

Rusty Myers (Keysight Technologies), TBC

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SC-4 High-Speed Oscilloscopes, What the Manual Does’t Tell You

Paul D. Hale (NIST), TBC

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## On-Wafer Measurements

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**13:00** Traceable On-Wafer Measurements at mm-Wave Frequencies

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**14:45** Uwe Arz (PTB)

SC-5

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SC-6 Fundamentals of Successful Wafer Level Calibration at mm-Wave Frequencies

Andrej Rumiantsev (MPI Corporation)

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## Noise Measurements

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**15:00 –  
17:00**

Microwave Thermal Noise – Measurements and Applications

Gu Dazhen (NIST)

**SC-7**

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**SC-8**

Low-Frequency Noise Measurements and Applications

Jean-Guy Tartarain, LAAS du CNRS

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Monday, January 22<sup>nd</sup>

## NIST-ARFTG Short Course on Microwave Measurements

Nonlinear Measurements	
08:00 — 12:00 SC-9	Measuring Modulation Distortion of Active Devices Using a Vector Network Analyzer  Jan Verspecht (Keysight)
SC-10	Load-Pull Metrology and Applications  Mauro Marchetti (Anteverta-mw)
SC-11	Time-Domain Low Frequency Active Harmonic Load-pull As a Tool for verifying the theory of PA Modes of Operation  J. Apolinar Reynoso-Hernández (CICESE)
SC-12	Everything You Can Do With Vector Nonlinear Microwave Measurements  Patrick Roblin (The Ohio State University)