Technical Brief

Technique Verifies LRRM Calibrations for GaAs Measurements

With the recent availability of the NIST (National Institute of Standards and Technology) calibration procedure and software, the high-frequency community can now compare on-wafer calibrations to a NIST Benchmark GaAs TRL calibration. This technique allows traceability of a calibration, rather than traceability of the individual calibration standards. Earlier work with the NIST had established the improved accuracy resulting from load inductance compensation (see Figure 1).

Cascade Microtech recently demonstrated the outstanding accuracy and repeatability of *automated* LRRM (line-reflect-reflect-match) calibrations *with load-inductance compensation* compared with NIST's benchmark.

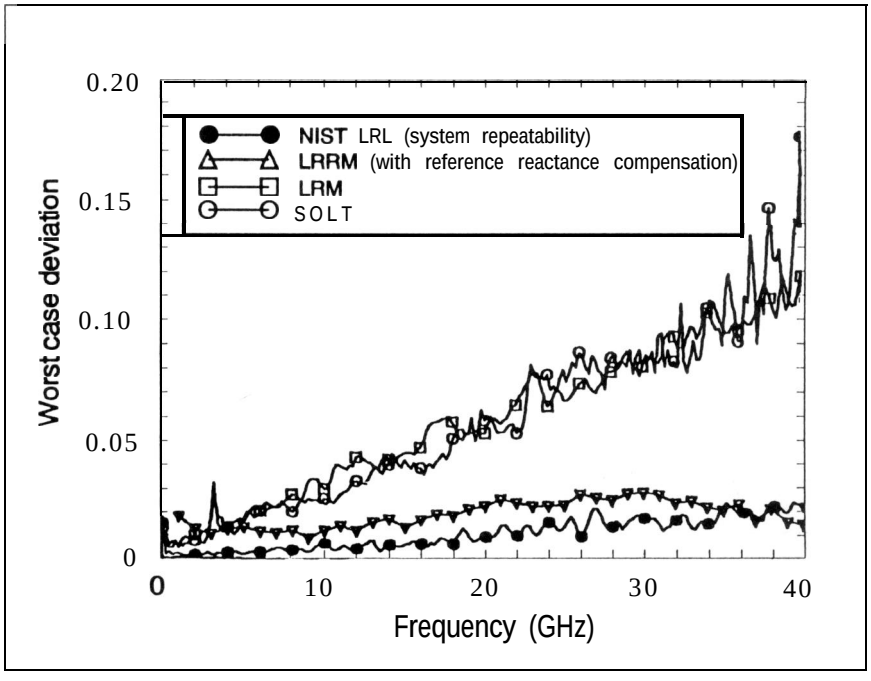


Figure 1. Comparison of LRRM calibration to NIST benchmark calibration.

Verification Procedure

To compare the LRRM technique with NIST's benchmark TRL method, use Cascade's Summit Series semi-automatic probe station, which is capable of $\pm 2\,\mu m$ probe placement repeatability. The integrated prober control software allows probe station and VNA control, alignment of the calibration standards, and automatic load-inductance compensation. Use Cascade's alumina-based impedance standard substrate (ISS) for the test. To establish the benchmark, use NIST's calibration standards and DEEMBED and VERIFY software programs.

Example Verification Results

Figures 2 and 3 show typical results for an LRRM with load inductance compensation verification experiment. These results are expressed as a worst-case error bound for the calibration as calculated by the NIST verification software. Figure 2 demonstrates the excellent accuracy and repeatability of the automated calibrations to 40 GHz. This represents an order of magnitude improvement over the

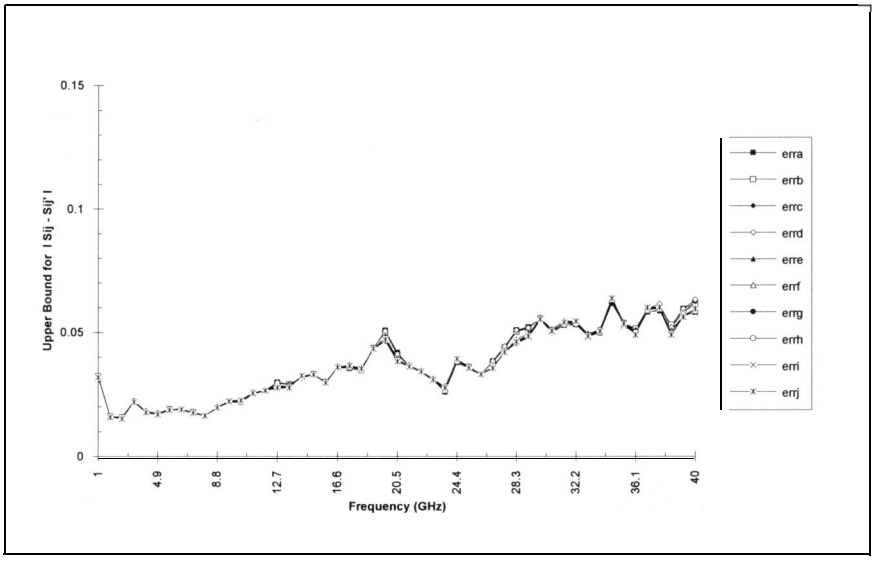


Figure 2. Worst-case S-parameter error bounds for ten calibrations on a single set of standards.

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repeatability achieved with manual calibrations. Figure 3 illustrates the reproduceability of calibration accuracy using different standards on the same ISS.

Instrument drift and ISS alignment are important factors that can adversely affect verification experiments. The Cascade system provides calibration stability information that allows the impact of these factors to be qualified. Figure 4 illustrates the change in calibration stability for a typical verification experiment involving 20 automatic calibrations.

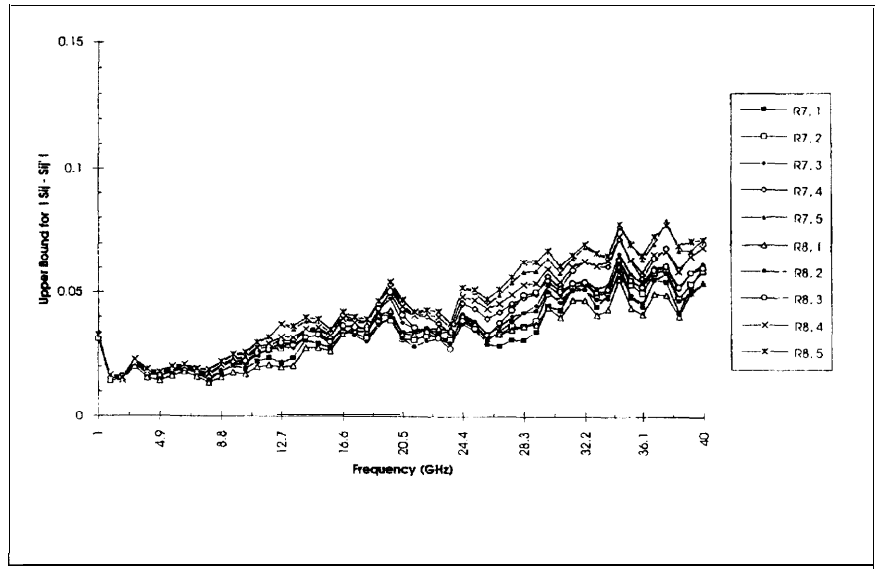


Figure 3. Worst-case S-parameter error bounds for 10 calibrations on 10 sets of standards.

Summary

These results can be achieved:

- Excellent calibration accuracy and reproducibility with Cascade's alumina ISS and the LRRM calibration method with load inductance compensation as compared to a NIST GaAs TRL calibration.
- Automatic calibrations with the Cascade probe station are an order of magnitude more repeatable then manual calibrations.
- The impact of instrument drift on calibration accuracy can be minimized with Cascade's calibration stability test.

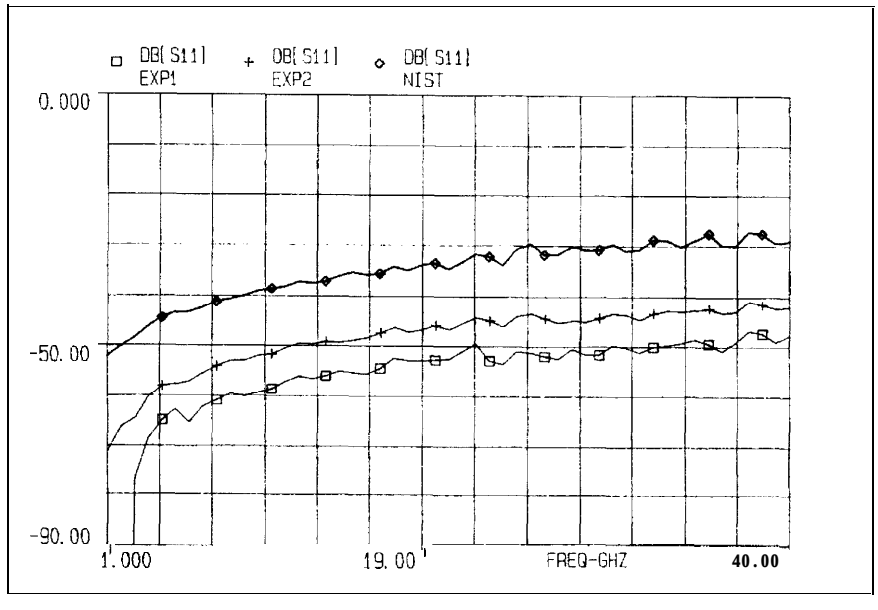


Figure 4. Cascade's probing system features calibration stability checks, giving users confidence in LRRM calibrations and overall measurement accuracy.

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