Introduction

The RF and microwave characteristics commonly used to define the performance of components are typically measured using a vector network analyzer. Since the packages of devices manufactured by Barry Industries, Inc. typically do not have coaxial connectors, the issue of the most appropriate calibration technique to utilize becomes critical. In this paper, the fixtures used and the calibration techniques employed are discussed along with the rationale for their selection.

Problem Description

For components with coaxial connectors, commercially available VNA calibration kits are available. These calibration kits are available with traceability to well known standards agencies such as the National Institute of Standards and Technology (NIST). For devices with packages designed for direct integration with planar transmission lines such as microstrip, stripline, coplanar waveguide (CPW), etc., no such standards have been developed.

Solutions from NIST, Agilent and Anritsu

Direct correspondence with NIST experts has resulted in identification of the TRL calibration as the de-facto standard and the OSLT and its derivatives as the preferred approximations in production environments. The use of OSLT type calibration techniques in production environments instead of the TRL technique is due to the inherent bandwidth limitation of the TRL technique using a given set of calibration standards. Several technical papers authored by NIST personnel relevant to this subject matter are included in an appendix along with a number of application notes from industry leading test equipment vendors.

Implementation of these solutions at Barry Industries, Inc.

DC – 6 GHz Soft Substrate Fixtures

The standard RF test fixtures used at Barry Industries, Inc. feature:

1. .015 inch thick Rogers Duroid 5880 substrate (aluminum backed)
2. .046 inch wide 1 oz copper microstrip trace
3. sma to microstrip launch mounted to aluminum backing material
4. 1 inch length from launcher face to DUT

These fixtures were designed for measurements in the frequency range from DC to 6 GHz. Calibration is affected using the SOLT technique with standards fabricated in-house.

A photograph showing a typical fixture of this design is shown in

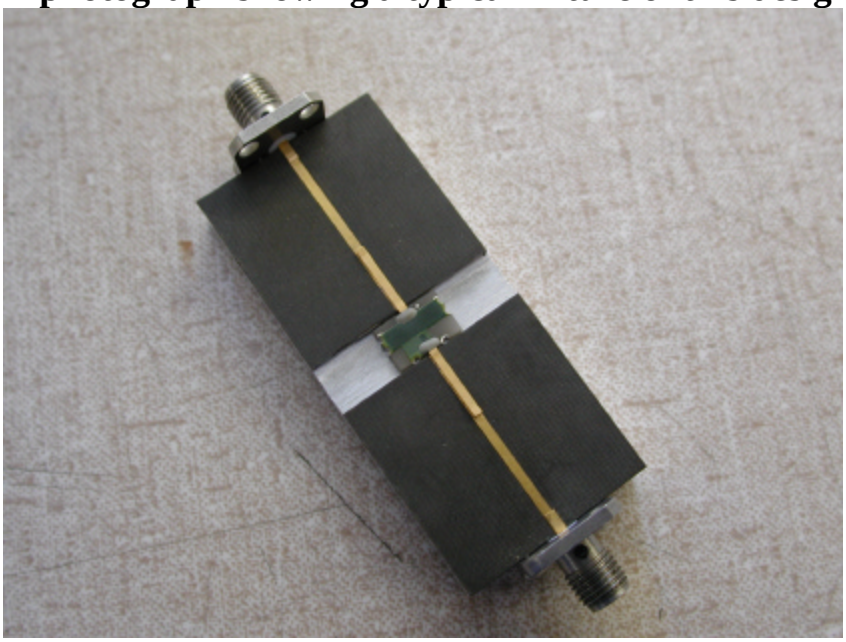


Figure 1

The calibration standards are shown in Figure 2.

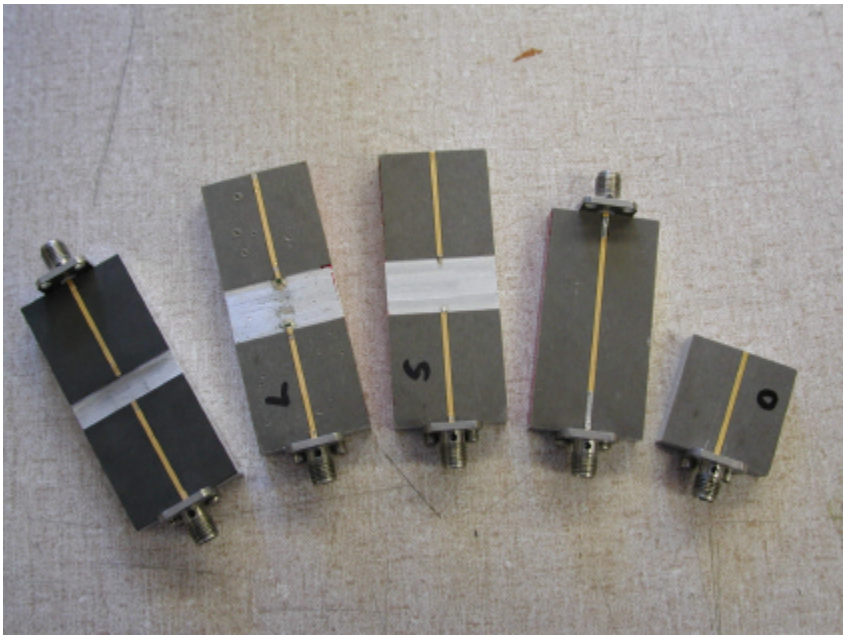
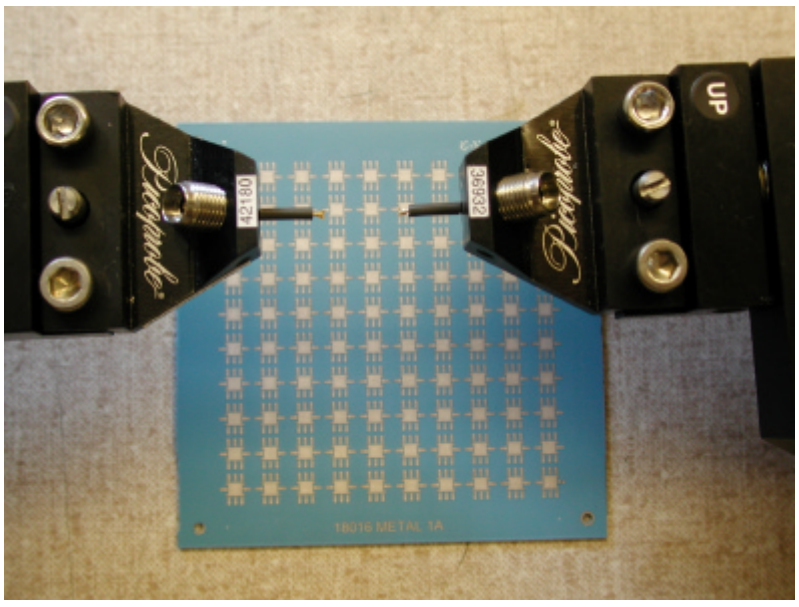


Figure 2

DC – 65 GHz On Wafer Probing (GSG)

The increased use of LTCC technology at Barry Industries, Inc. has resulted in the need to test devices at the wafer level, before singulation. Adoption of wafer probing techniques standard in the semiconductor manufacturing industry was chosen as the most accurate and expedient solution. A typical probing setup is shown in Figure 8. Calibration is again done using either the TRL of SOLT technique as described in the attached references. The SOLT technique, as noted earlier, is often employed due to its inherent broadband characteristics.



Appendix 1 – References

1. D. F. Williams, R. B. Marks, and A. Davidson, "Comparison of On-Wafer Calibrations," *38th ARFTG Conference Digest*, pp. 68-81, Dec. 1991.

2. R. B. Marks and D. F. Williams, "A General Waveguide Circuit Theory," Journal of Research of the National Institute of Standards and Technology, *vol. 97, no.* 5, pp. 533-562, Sep.-Oct. 1992.

3. Agilent, “In-Fixture Measurements Using Vector Network Analyzers”, Application Note AN 1287-9

4. Agilent, “Applying Error Correction to Network Analyzer Measurements”, Application Note AN1287-3

5. Anritsu, “On Wafer Measurements to 110 GHz”, Application Note AN360B/37XXXA/B-1 /SCP-E

6. Anritsu, “What is your measurement accuracy?”, Application Note AN/GIP-C

7. GGB Industries, Inc., “Calibration Substrates”, Flyer