Multi-Site DUT to Tester Interfacing for mmWave Devices

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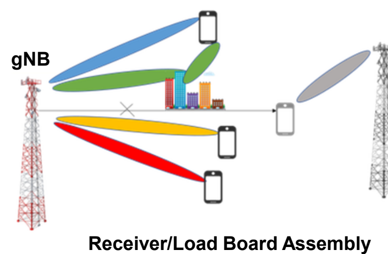
Background

For satellite communications and 5G NR, beamforming is becoming a common method for implementing phased arrays and mmWave antennas.

Production test solutions are now required to support the testing of multi-port, beamforming devices with 5, 9 and even 17 mmWave ports

Device vendors require test solutions that can support multi-site, high-performance VNA test capability.



Receiver/Load Board Assembly

The Challenge

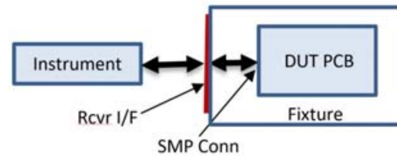
Multi-port, mmWave VNA instrumentation is now available from several vendors. However, addressing the implementation of a multi-port tester / DUT production test interface has largely been ignored by the instrument suppliers.

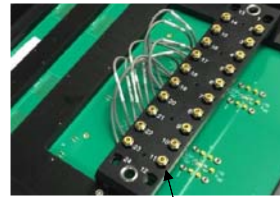
Key requirements:

- Provide a DUT interface that is compatible with wafer probers, device handlers and manual device insertion
- Supports multi-site test capability
- Receiver / tester interface that is reliable and repeatable for performing VNA measurements to 50 GHz

Receiver Interface

- Employs both blind mate 2.92mm SMK connectors for VNA RF tests, and general purpose pogo pin blocks for digital and power connections
- A total of 24 blind mate connectors supports the testing of up to 4, 6 port devices
- The transition from the blind mate connectors to the load board is accomplished via semi-rigid cables that connect to through-hole Mini SMP RF connectors which are part of the load board's assembly





Blind mate connectors

DUT Load Board

- Supports four devices, 5 ports each for packaged test
- Supports both manual and automated insertion
- Load board construction:
  - 10 layers
  - Rogers 3003 laminate
  - Simulation results showed excellent performance to 50 GHz

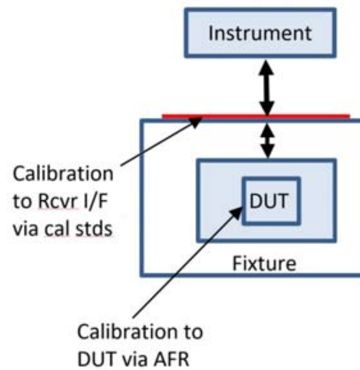
Load Board (Top Side)

Receiver/Load Board Assembly

Tester / DUT Calibration

Ensuring accurate VNA / S-parameter measurements at the DUT requires calibration to a reference plane – ideally at the DUT.

- One-port Automatic Fixture Removal (AFR) method was employed which extracts S-parameters from the open fixture (DUT removed from socket) using time domain gating
- Overall methodology:
  - Initial calibration to the receiver interface using calibration standards
  - Apply the extracted S-parameters from the one-port AFR measurement to move the measurement reference plane from the receiver interface to the DUT interface



Measurements

- S-parameters, S11, S12, S21 and S22
- Intermodulation Distortion
- Gain and phase performance vs programmable gain settings
- Contact Test
- POR Iddq, T/R Off/On Iddq, Sleep Iddq
- SPI Digital Interface
- SPI Addressing
- DUT Register Write/Read Tests

TS-960e-5G Test System with receiver/load board

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