DVT Solutions, LLC
Giga Probes

Procedure to verify the accuracy of differential de-embedding probe models using the ISBNN VNA Test Verification Board

To verify the GigaProbes differential probe model's accuracy, make an insertion loss measurement from the "probe to connector trace" on the ISBNN Test Verification Board (see Figure 1). These boards are available from DVT Solutions (gigaprobes.com) in bandwidths of 40 GHz, 50 GHz, 70 GHz, and 110 GHz.

The following procedure demonstrates how to use this insertion loss measurement from the "probe to connector traces" on the ISB40 40 GHz board to validate the accuracy of the DVT40 probe de-embedding file developed with AtaiTec ISD software (see [In-Situ De-embedding (ISD) - AtaiTec]).

1. Setup
   - Use a DVT40 40 GHz differential probe and a 40 GHz VNA with differential calibration.
   - Connect the DVT40 probe to the VNA's differential port using a probe positioner.
   - Place the probe on the differential "probe pads to connector trace" on the ISB40 board.
   - Attach cables to the VNA's second differential port and make a 40 GHz insertion loss measurement.
2. Raw Measurement
   - This measurement corresponds to the green insertion-loss plot in Figure 2.
   - The raw insertion loss measurement to 40 GHz may show some resonances at higher frequencies due to the high input impedance of the probe.
   - These resonances last about 50-75 ps but are mostly mitigated by applying de-embedding.
3. Verification
   - Save the real-time measurement from the probe pads to the connector trace to the VNA memory.
   - Load this measurement on the VNA screen as a reference.
   - Ensure the probe remains on the traces, and the measurements should overlap. If they do not, the probe might have moved off the trace.
4. De-embedding
   - Load the DVT40 probe de-embedding file ("DVT40 probe model.S4p") from the zip file into the VNA.
   - Apply this de-embedding file to the real-time green raw measurement in the VNA.
   - This should remove the DVT40 probe loss, shown as the blue insertion loss trace in Figure 2.
   - The blue measurement should show about ~4 dB less loss than the raw green trace, indicating the probe loss has been removed, leaving only the PCB trace loss.
5. Conclusion
   - The difference in loss represents the probe's frequency loss, leaving only the PCB trace loss.
   - This process helps determine if your differential trace measurement for your prototype PCB meets design.

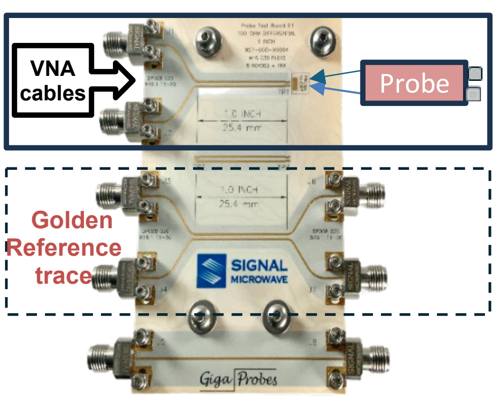

Figure 1. ISBNN VNA Test Verification Board (40 GHz, 50 GHz 70 GHz and 110 GHz)

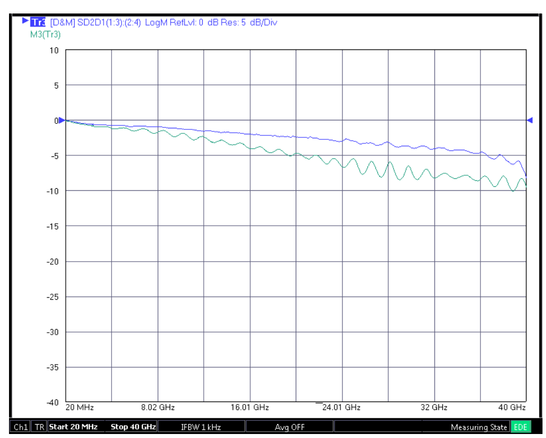

Figure 2. Verifying de-embedding accuracy involves comparing the insertion loss measurements from the probe pads to the connector trace on the ISB40 board.

The green trace shows the raw measurement, including both probe and trace loss.

The blue trace represents the same measurement with probe de-embedding applied, isolating only the trace loss from the green raw data.

The difference between the two traces equals the de-embedded probe loss.

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Using the VNA Test Verification Board "Golden Reference Trace" to verify measurement accuracy

Perform a SOLT (Short-Open-Load-Thru) calibration. If it's a differential calibration, measure the connectorized golden reference differential trace on the ISBNN VNA Test Verification Board and leave the probe in place so you have a real time measurement.

The measurement (as shown in Figure 3) should show a linear frequency roll off to the VNA bandwidth stop frequency bandwidth. If unsure what the measurement should be, refer to the [ISBNN & DBNN User Guide] for gold reference trace measurement examples.

If this measurement signature is correct, then your VNA is fully calibrated, all cables are functional, the port assignments are correct and there are no front panel settings that should affect the VNA measurement accuracy. The VNA is fully calibrated and tested for making critical VNA measurements.

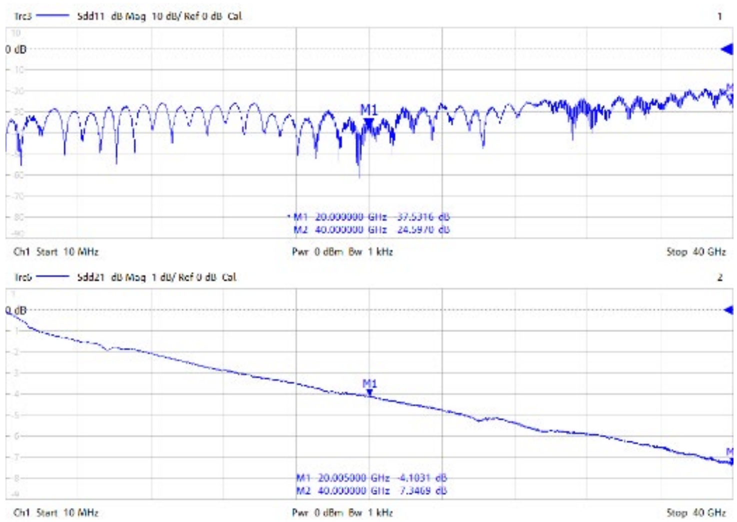

Figure 3 40 GHz insertion loss measurement from an ISB40 40 GHz differential trace.

Troubleshooting

- If there is noise or a narrow frequency suckout in the golden reference measurement, you likely have a bad cable. Use a spare unused cable and swap out one cable at a time until the real-time measurement matches the stored reference measurement.
- If there are no anomalies in the insertion loss measurements, but they do not correlate with the golden reference trace measurement, a front panel setting might be causing the issue.
- If the measurement does not have noise or frequency suckout, but the insertion loss does not match the golden reference measurements:
  - Check the front panel settings.
  - Is there a de-embedding file left in the VNA setup that is not related to your measurements?
  - Check for offset value settings or other settings not relevant for your measurement.
  - Check for proper VNA port assignments.

The goal is to get the Gold Reference insertion loss measurement to have a linear loss signature with no noise or random frequency suckouts, offsets and the insertion loss should start at 0 dB. etc. If all these issues are negative it is possible that the VNA needs to be sent for calibration.