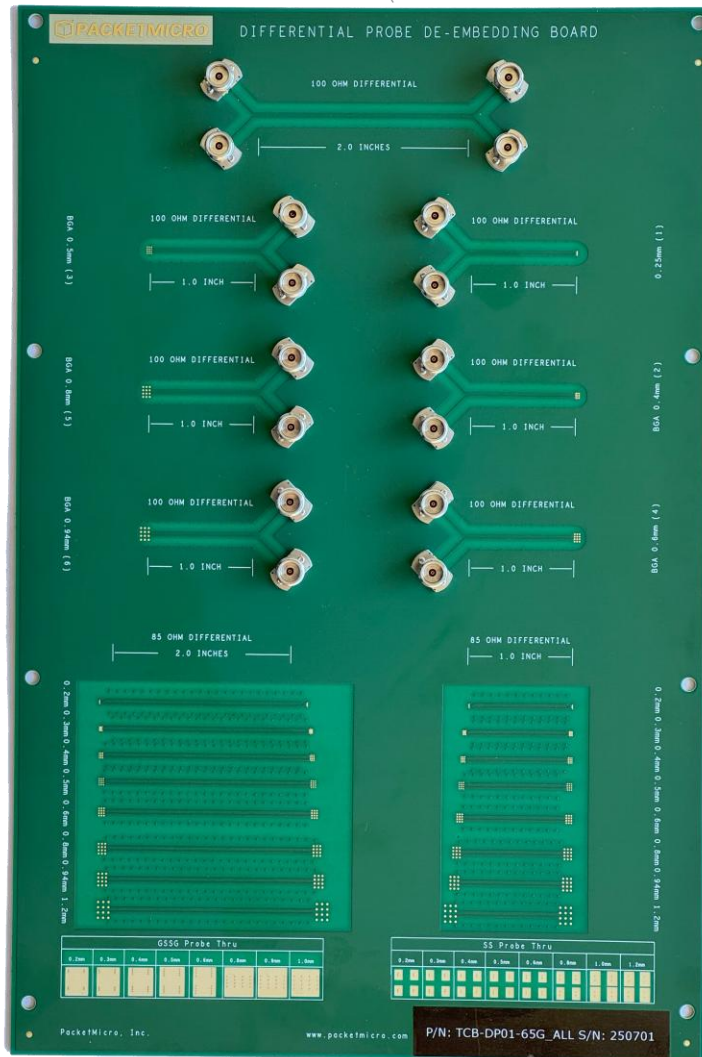


Differential-Probe De-embedding Board



TCB-DP01-65G

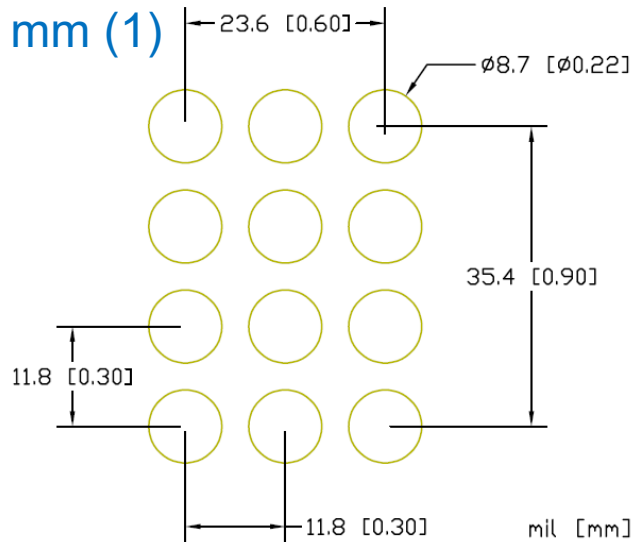
- Frequency: 0 – 65 GHz
- Connectors: 1.85 mm
- Probe Pitches: 0.3mm (1), 0.4mm (2), 0.5mm (3), 0.6mm (4), 0.8mm (5), 0.94mm (6)
- P/N: TCB-DP01-65G_356 (0.5, 0.8, 0.94 mm, 3 pitches mounted)

TCB-DP01-40G

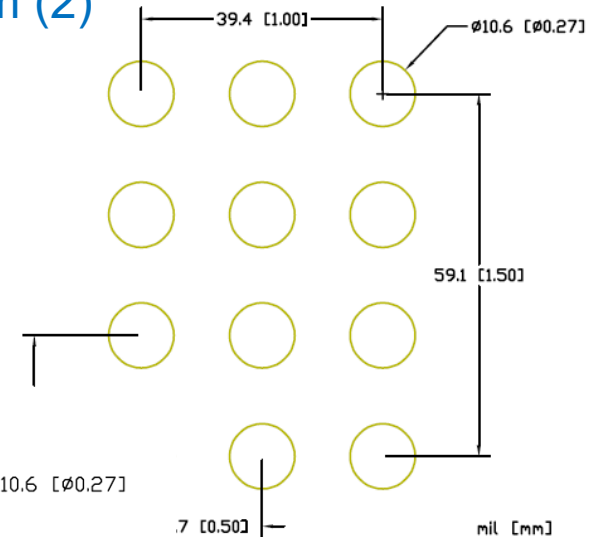
- Frequency: 0 – 40 GHz
- Connectors: 2.92 mm
- Probe Pitches: 0.3mm (1), 0.4mm (2), 0.5mm (3), 0.6mm (4), 0.8 mm (5), 0.94mm (6)
- P/N: TCB-DP01-40G_136 (0.3, 0.5, 0.94 mm, 3 pitches mounted)

Launch Footprints

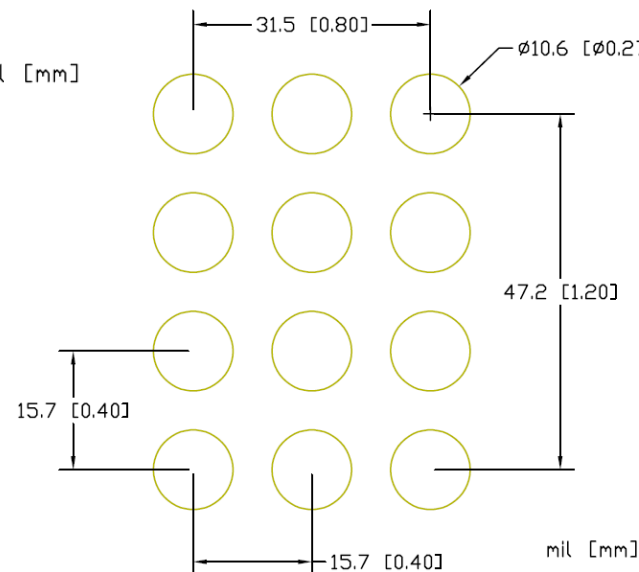
0.3 mm (1)



0.4 mm (2)

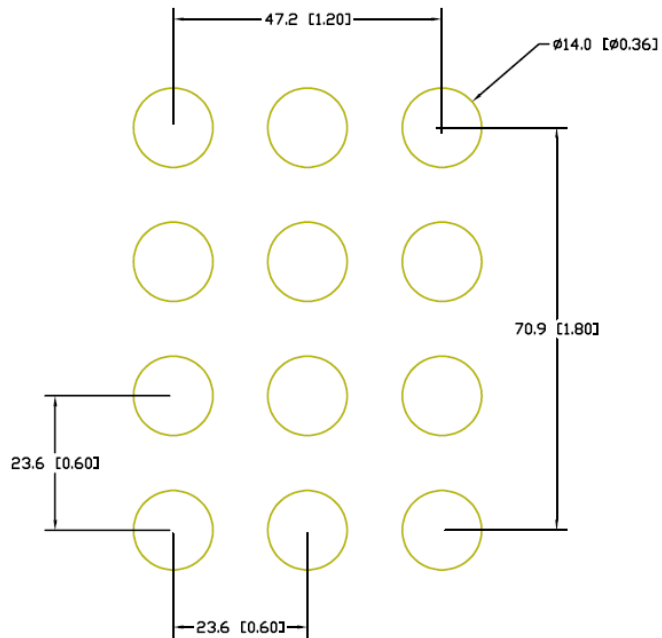


0.5 mm (3)

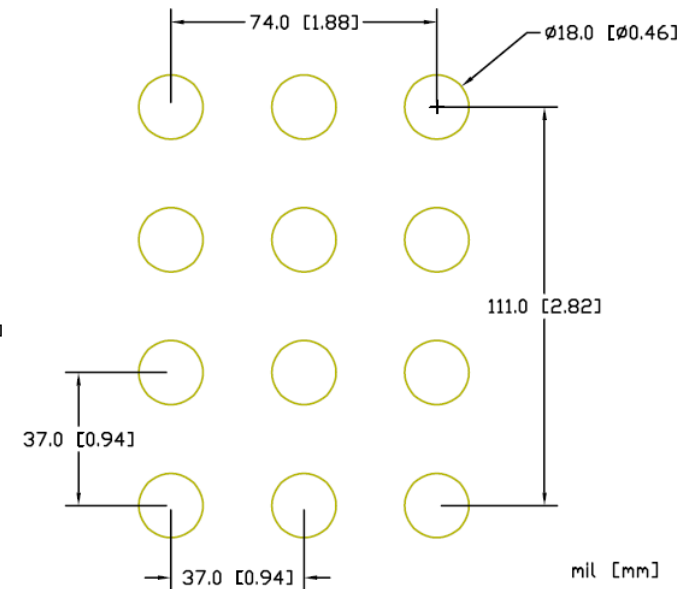


Launch Footprints – cont.

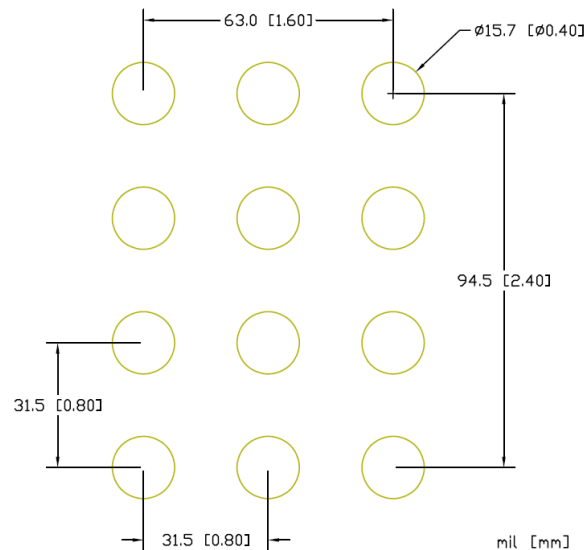
0.6 mm (4)



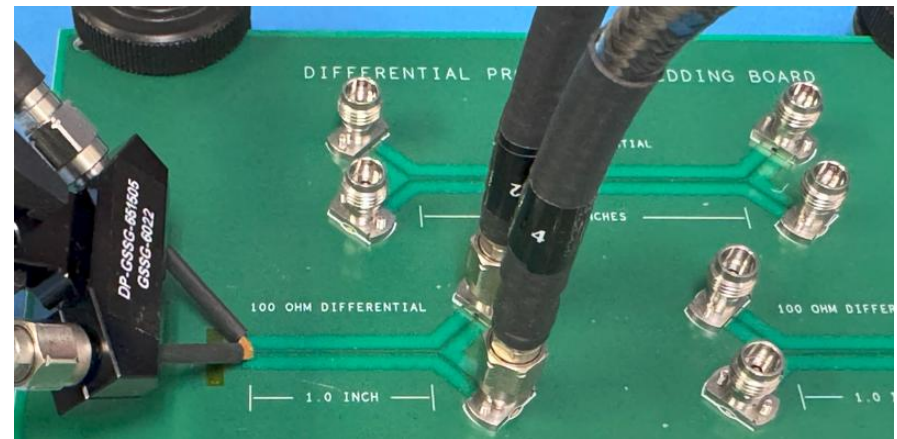
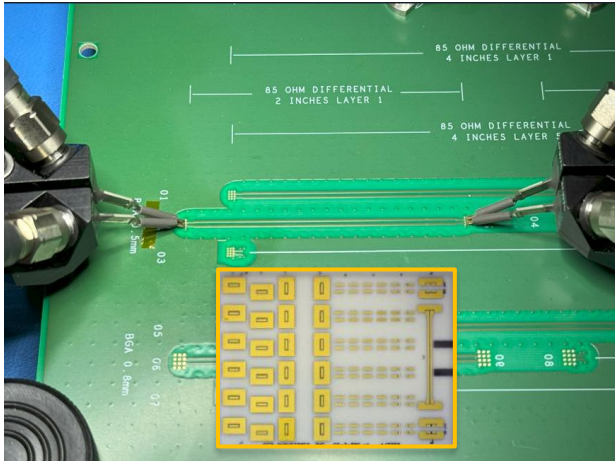
0.94 mm (5)



0.8 mm (6)



Probe SOLT Calibration vs. De-embedding



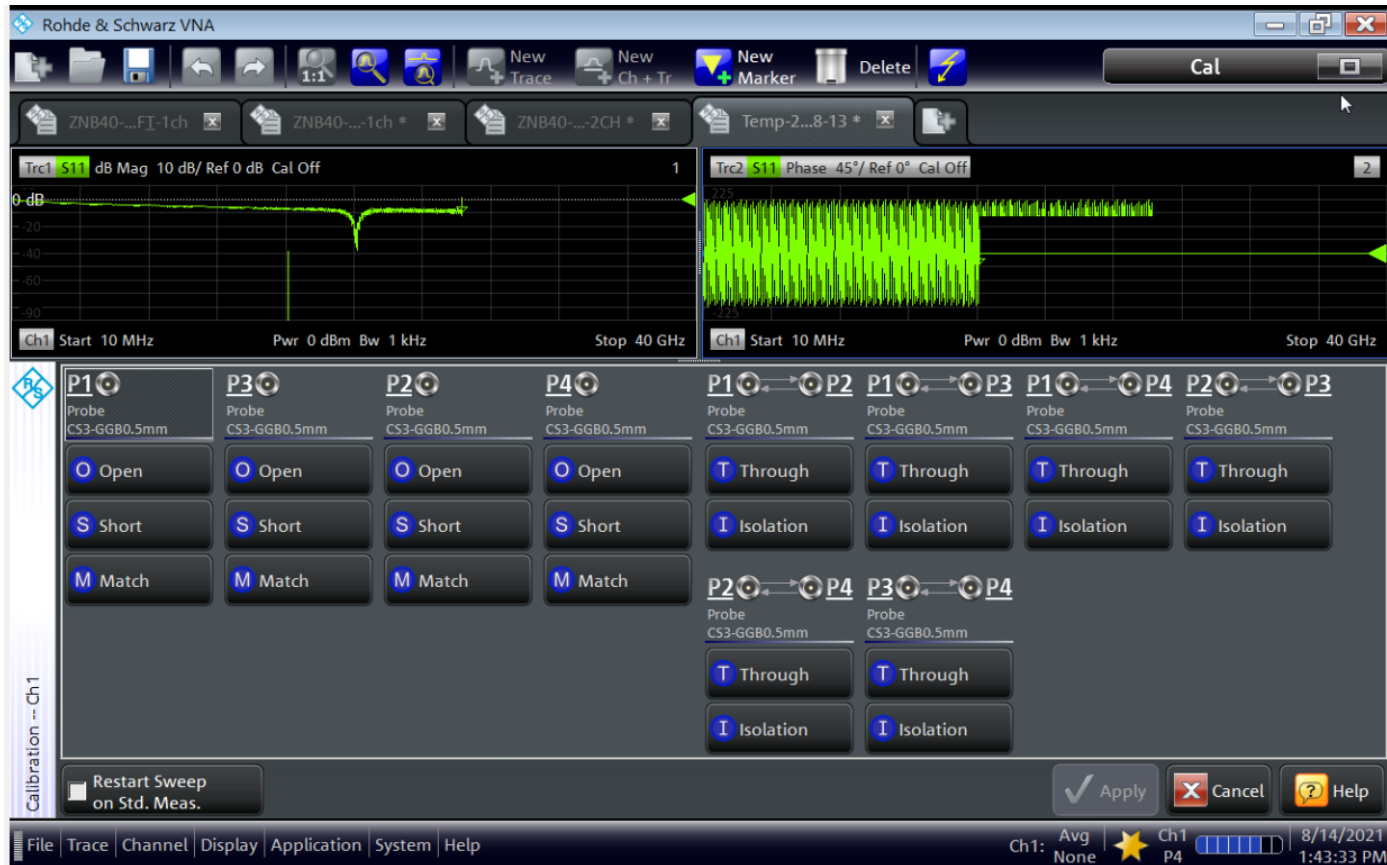
SOLT Calibration

- Accuracy is typically limited to ~50% of probe bandwidth due to mismatch of probe launches between calibration substrate and PCB under test.

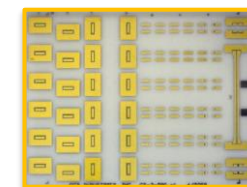
Probe De-embedding Approach

- Good accuracy can be achieved by matching the probe launches of the de-embedding board and PCB under test.

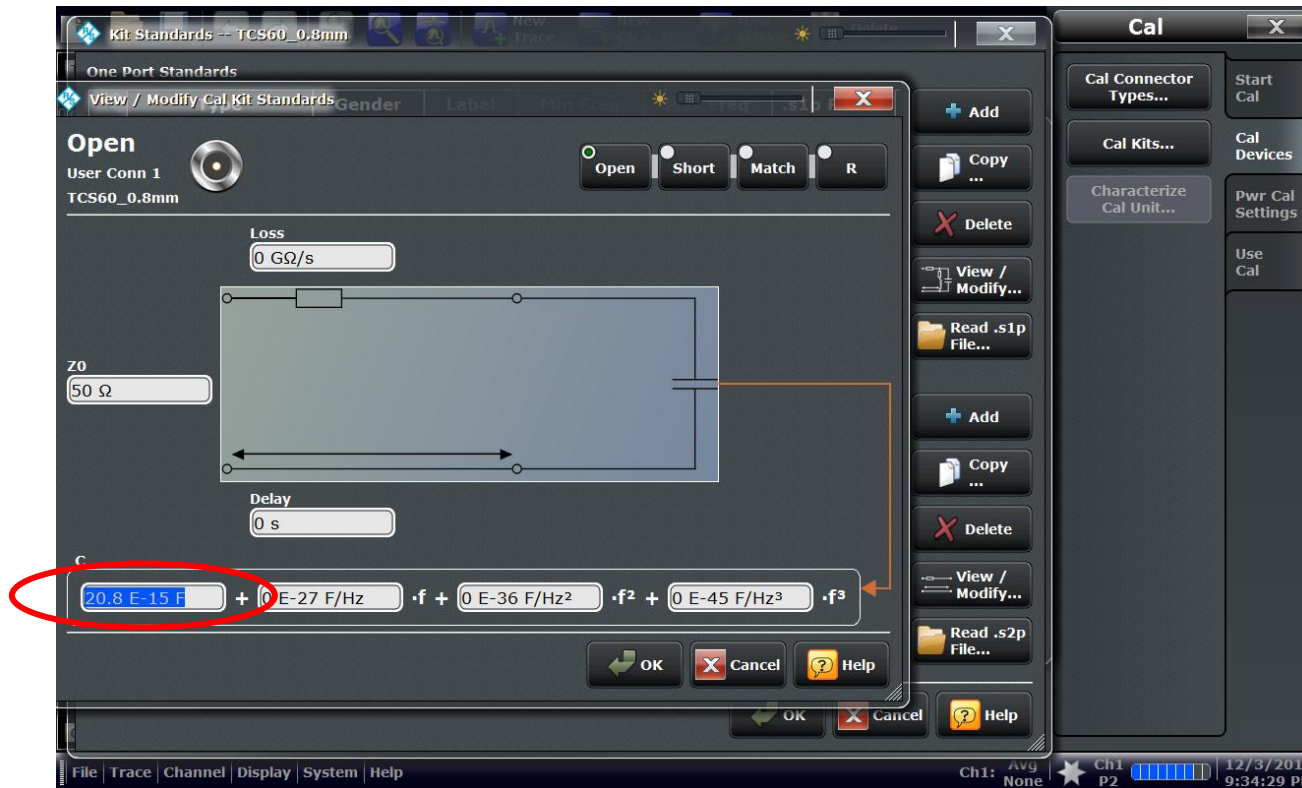
Challenge of SOLT Probe-tip Calibration



- Difficult to perform 18 probing actions (SOL x 4, 2-port Thru x 6) accurately

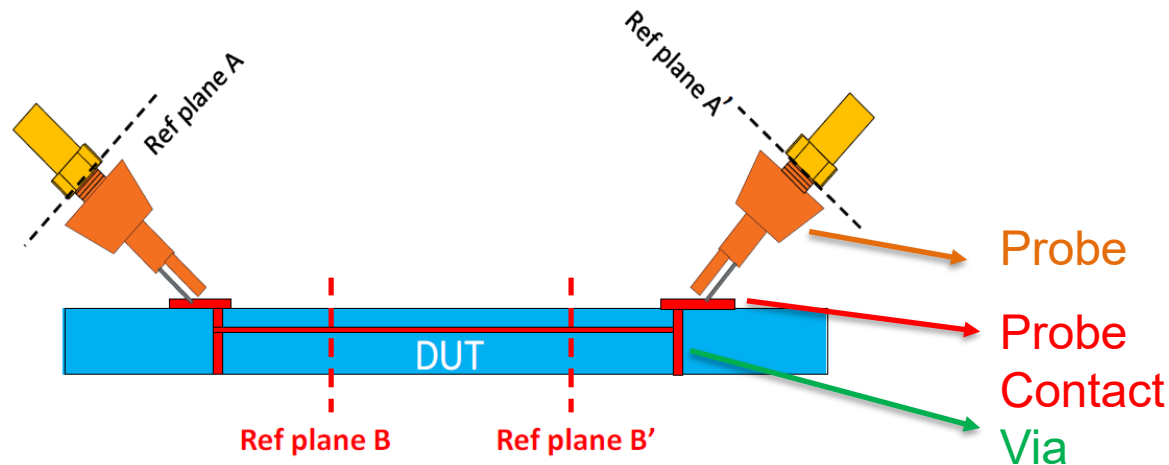


Probe SOL Coefficients



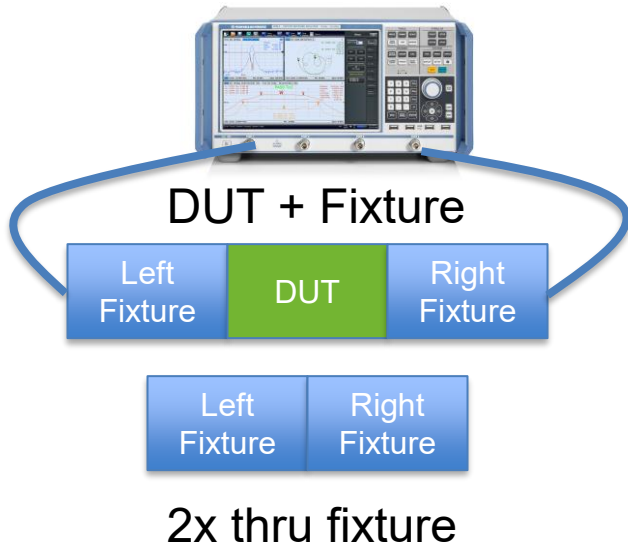
- Only f^0 is provided by probe manufacturers because higher-order terms are probe-launch dependent.
- This constraint causes inaccurate probe measurements with SOLT calibration at high frequencies.

Probe De-embedding Approaches



- **De-embedding with 2X Thru fixture (Best)**
 - Removing the effects caused by probes, probe contacts, and PCB vias.
- **De-embedding by using the de-embedding board**
 - Removing the effect caused by the probes and probe contacts
- **De-embedding with a typical probe S4P from PacketMicro**
 - This is the least accurate one because of the difference in probes and probe launches

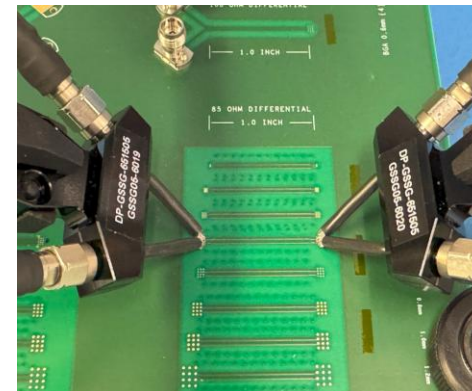
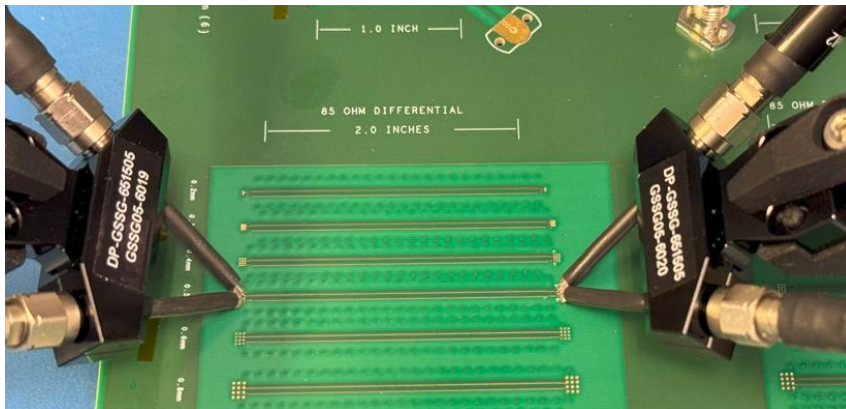
2X Thru De-embedding Approach



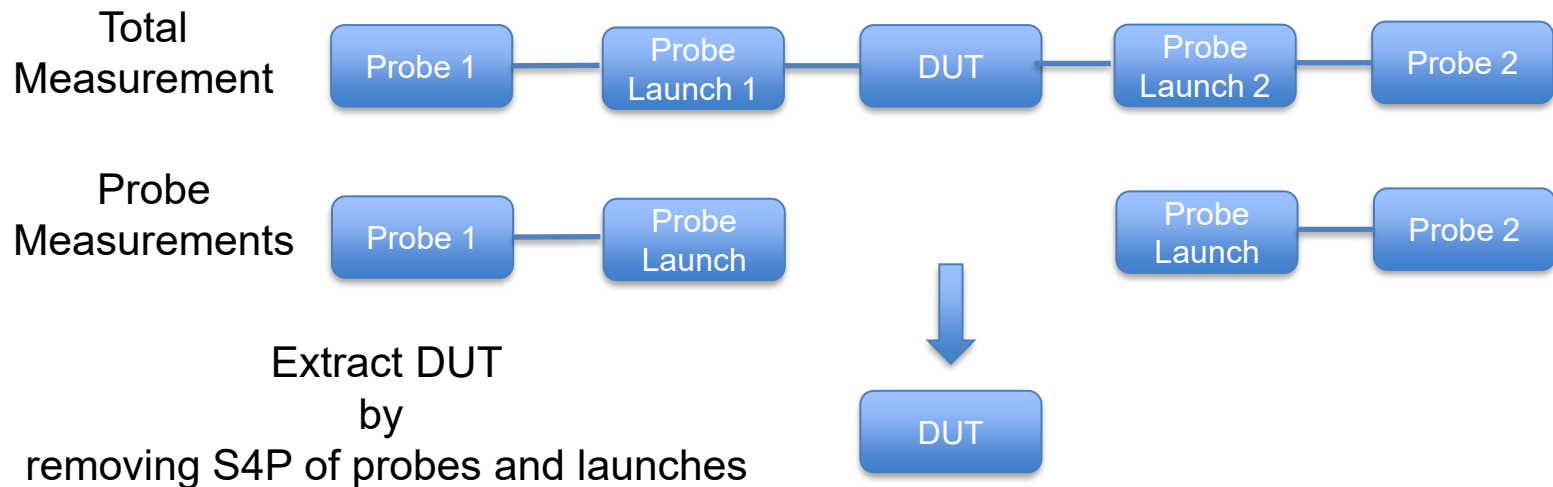
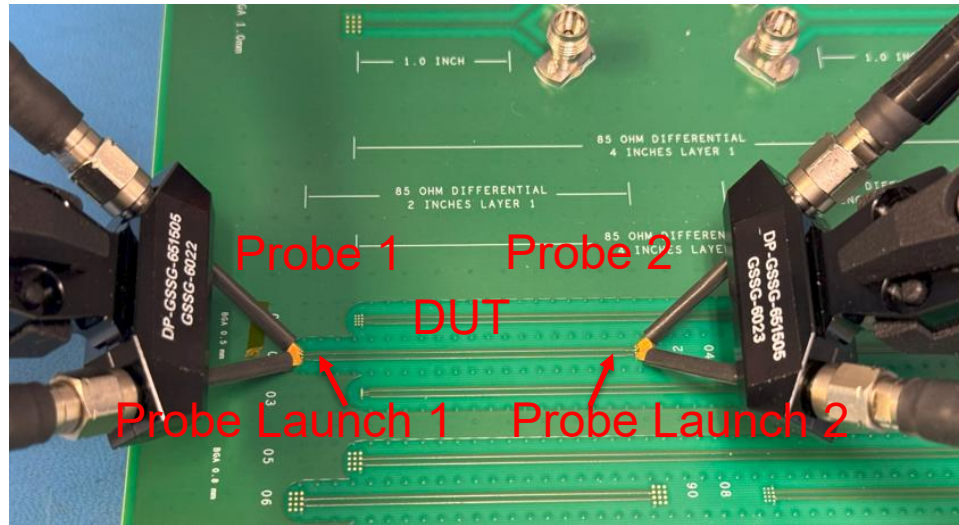
- **2X-Thru De-embedding Method:**
 - Accurate: comparable accuracy to traditional TRL technique
 - Simple: only one 2x thru fixture is needed
 - Tool: Smart Fixture De-embedding **AITT-SFD** Tool

Total = Probe + 2 IN Trace + Probe

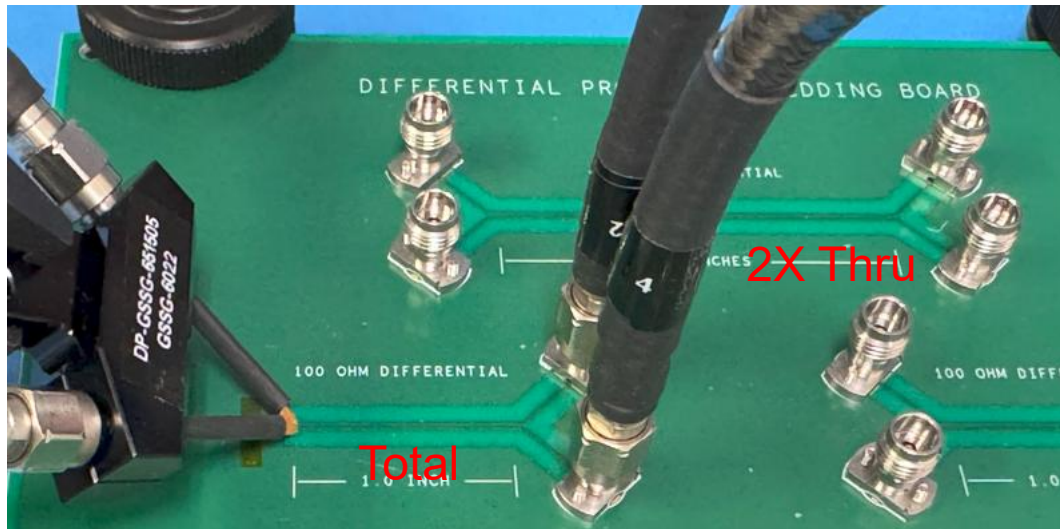
2X = Probe + 1 IN Trace + Probe



De-embedding Board Approach



Extract Probe + Probe Launch



Total Structure



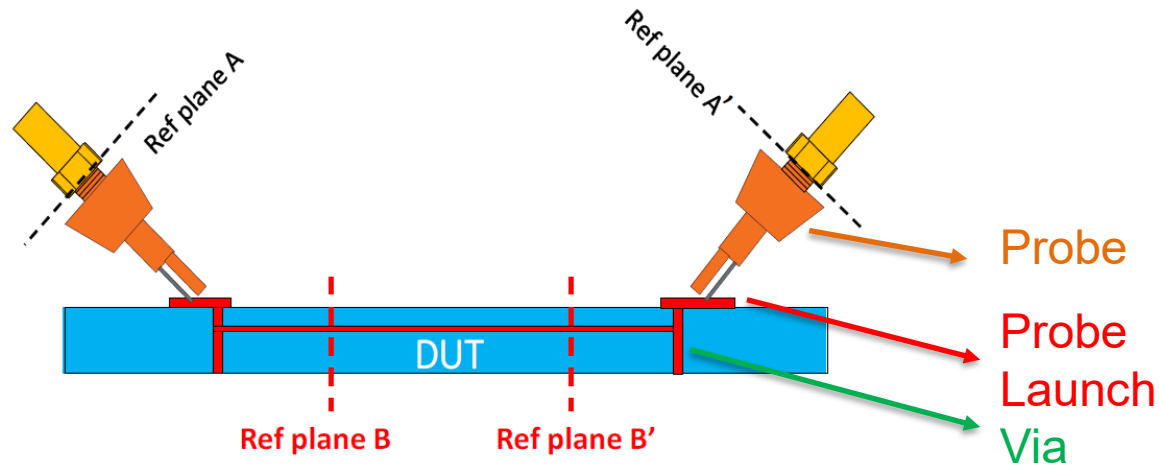
2X Thru Structure



Extract Probe + Launch
by removing S4P of 1X + connector

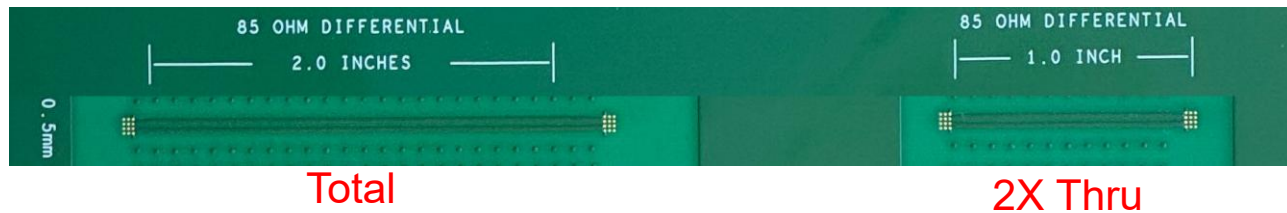


Create Reference DUT for Comparison



- **De-embedding with 2X Thru fixture**
 - Removing the effects caused by probes, probe contacts, and PCB vias.

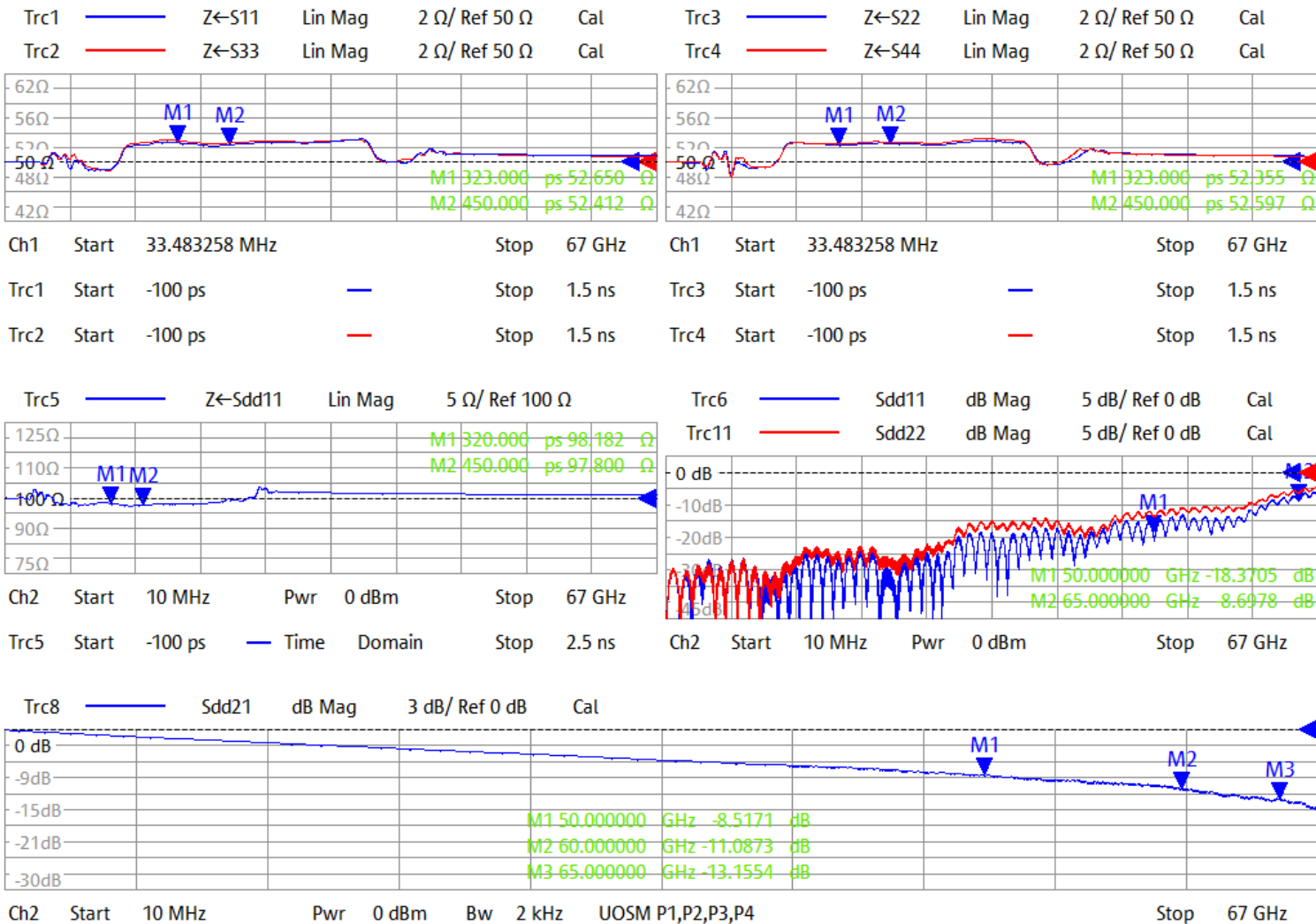
DUT 1 IN
Reference



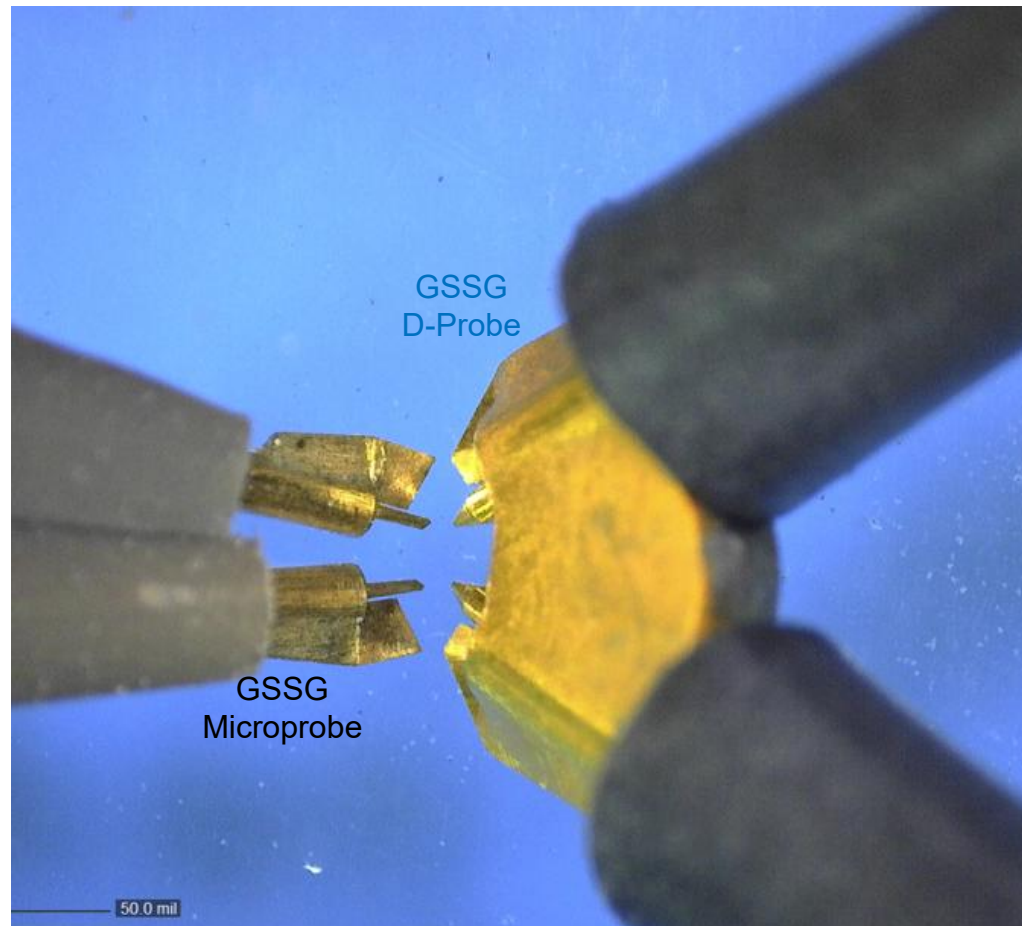
$$\text{Total} = \text{Probe 1} + 2 \text{ IN} + \text{Probe 2}, \text{ 2X Thru} = \text{Probe 1} + 1 \text{ IN} + \text{Probe 2}$$

Connector + 2 IN + Connector

5/19/2025 4:13:06 PM
1332.4500K64-101822-rH

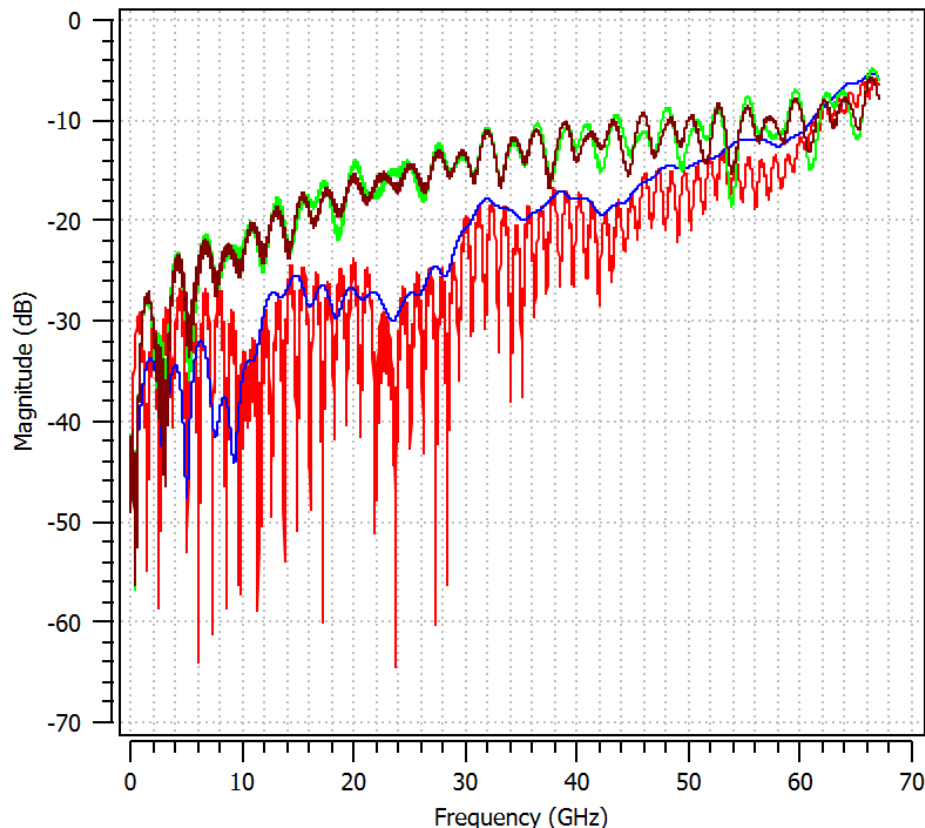


65 GHz DP-GSSG Probes (0.5 mm Pitch)



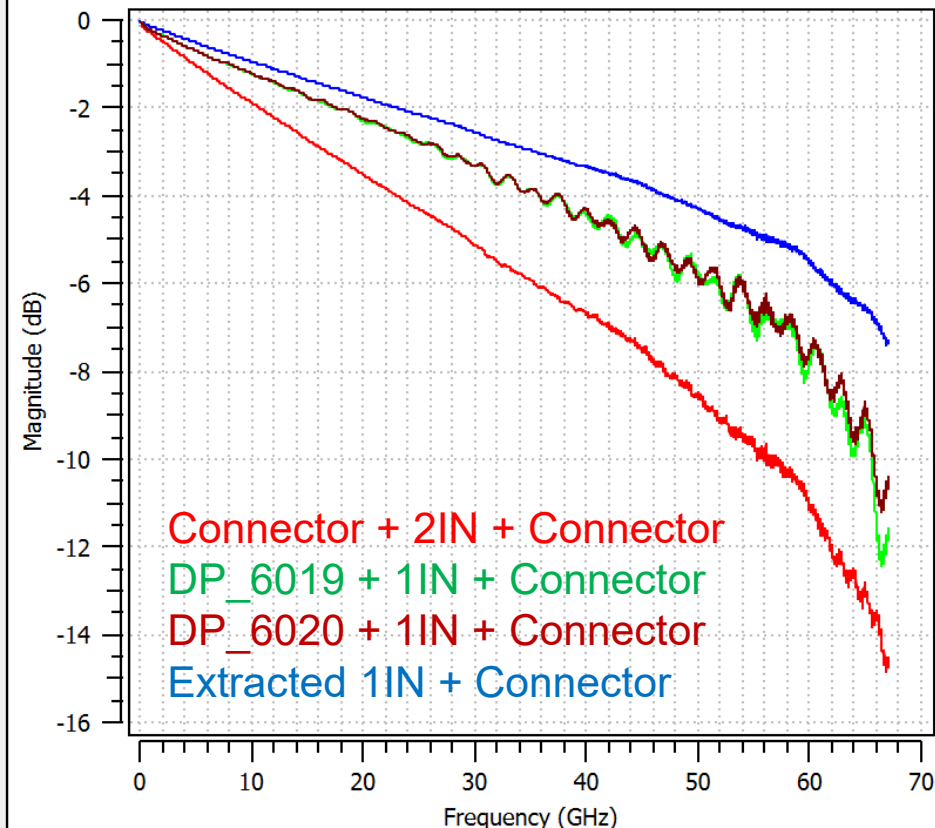
Probe + 1 IN + Connector

SDD11 (Magnitude)



— CONx2-2IN-DP01-250501
 — 0.5BGA-1IN-CON-DP01-250501
 — DPGSSG6505_6019-CON-1IN-DP01-250501
 — DPGSSG6505_6020-CON-1IN-DP01-250501

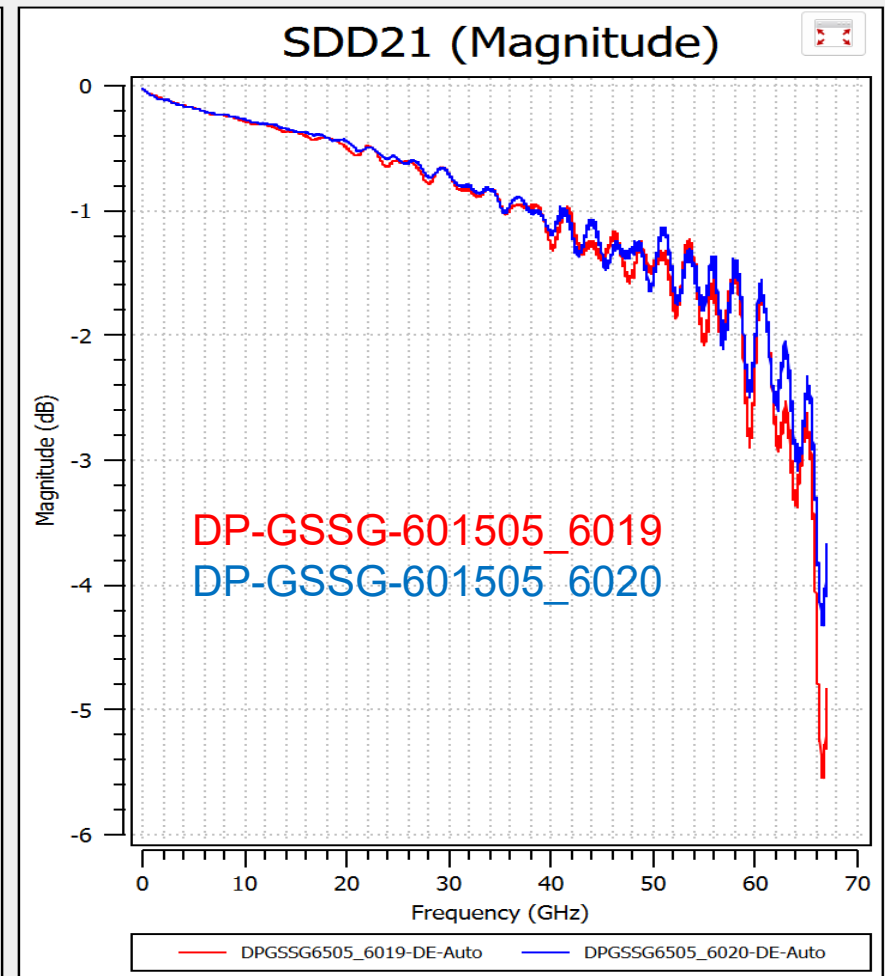
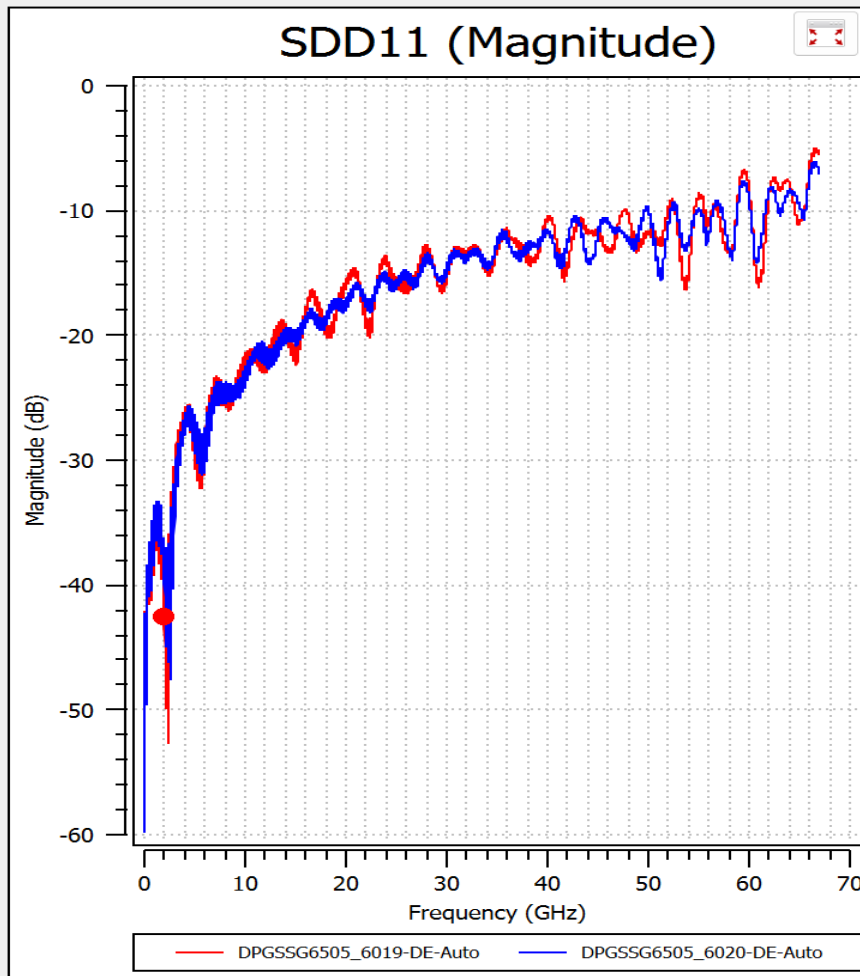
SDD21 (Magnitude)



— Connector + 2IN + Connector
— DP_6019 + 1IN + Connector
— DP_6020 + 1IN + Connector
— Extracted 1IN + Connector

— CONx2-2IN-DP01-250501
 — 0.5BGA-1IN-CON-DP01-250501
 — DPGSSG6505_6019-CON-1IN-DP01-250501
 — DPGSSG6505_6020-CON-1IN-DP01-250501

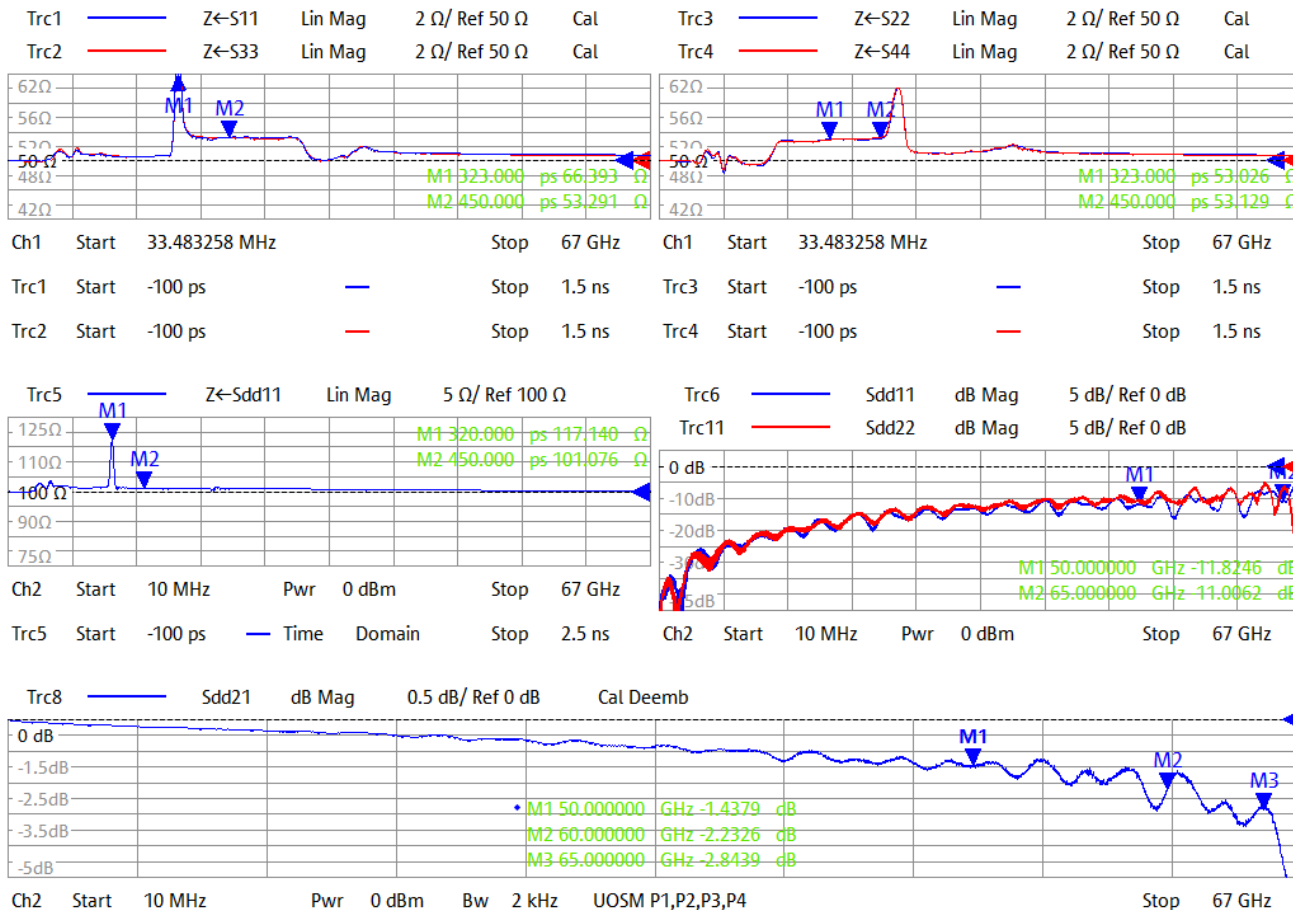
DP-GSSG-651505_6019 & 6020



Extracted S4P of Probe + Probe Launch

DP-GSSG-651505_6019

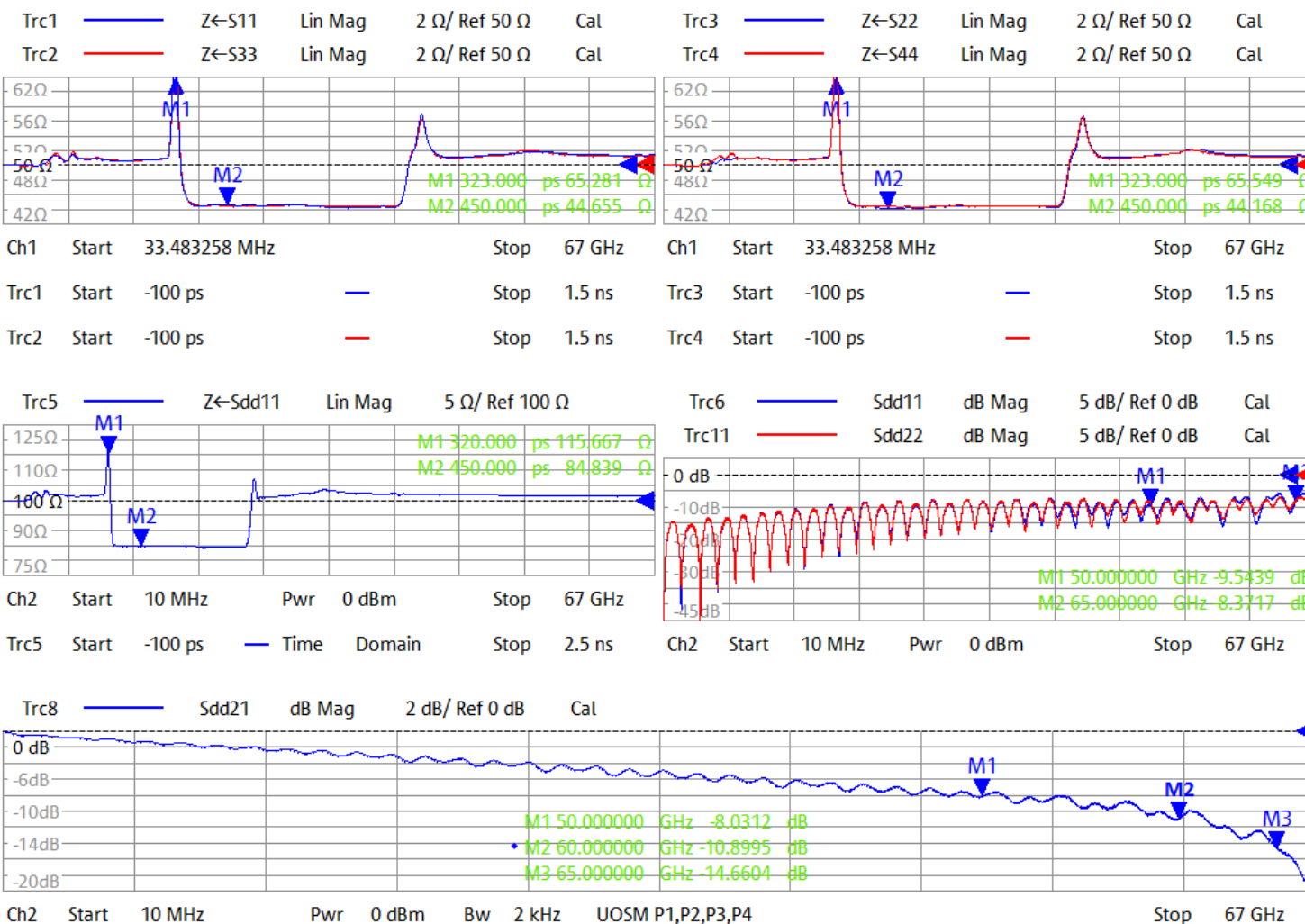
5/19/2025 4:38:49 PM
1332.4500K64-101822+H



Extract “Probe + Probe Launch” S4P by loading “1IN + Connector” S4P into VNA for de-embedding.

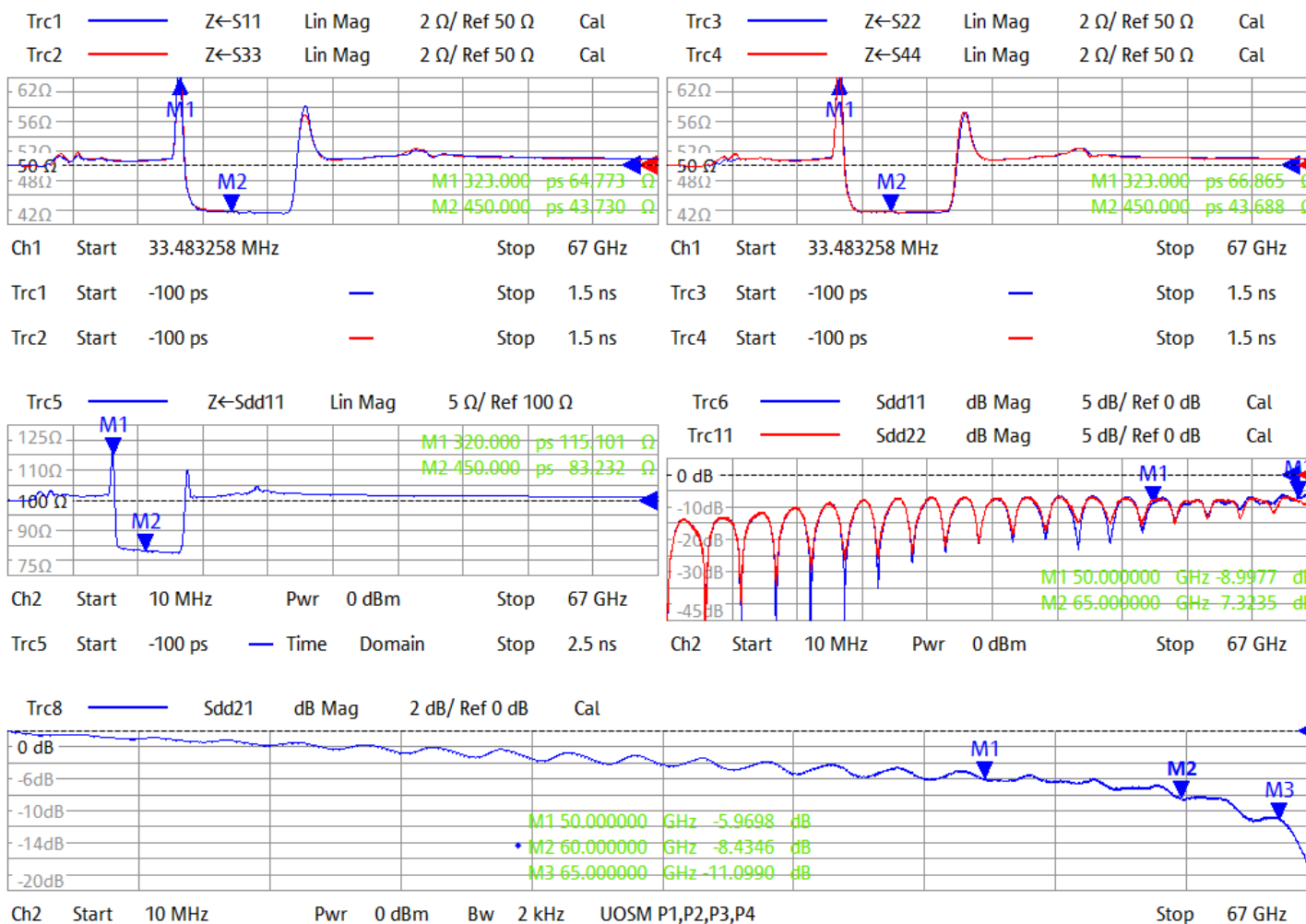
2 IN Microstrip (with 2 DP-GSSG-651505)

5/19/2025 5:55:54 PM
1332.4500K64-101822-rH



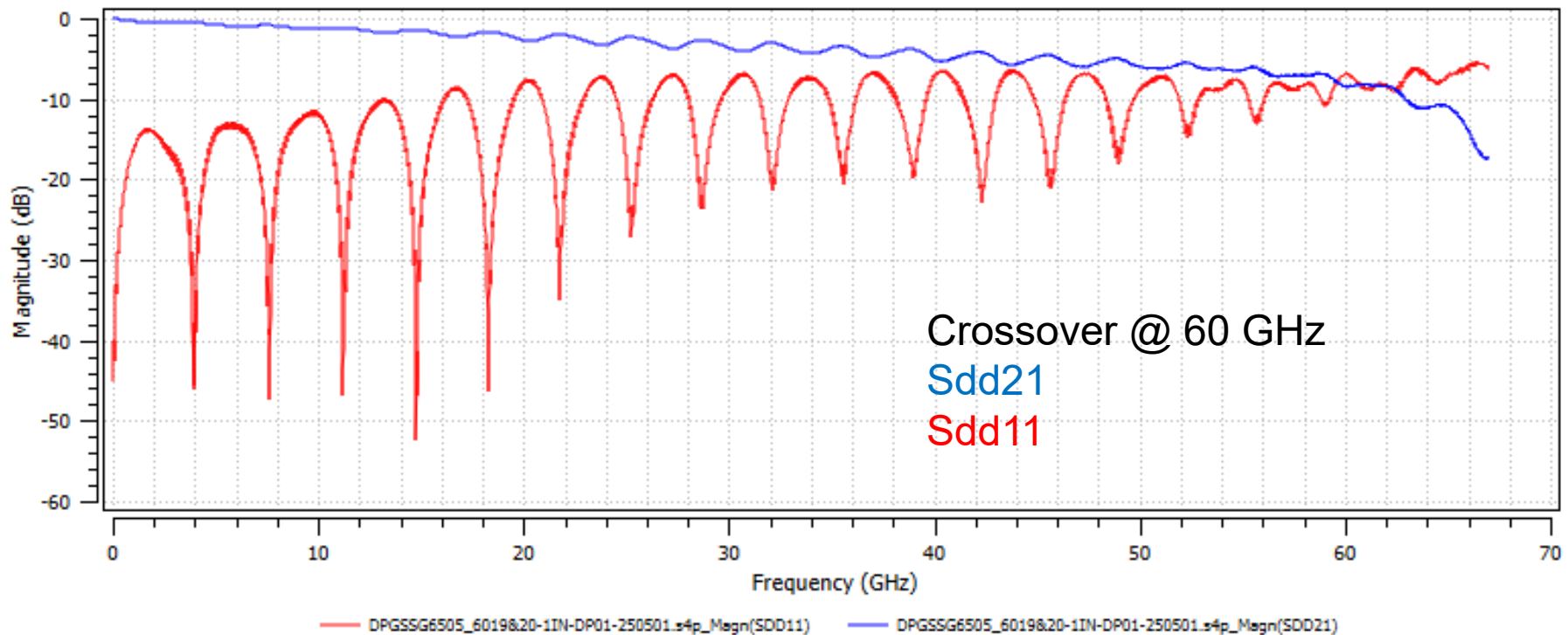
1 IN Microstrip (with 2 DP-GSSG-651505)

5/19/2025 6:01:57 PM
1332.4500K64-101822-rH



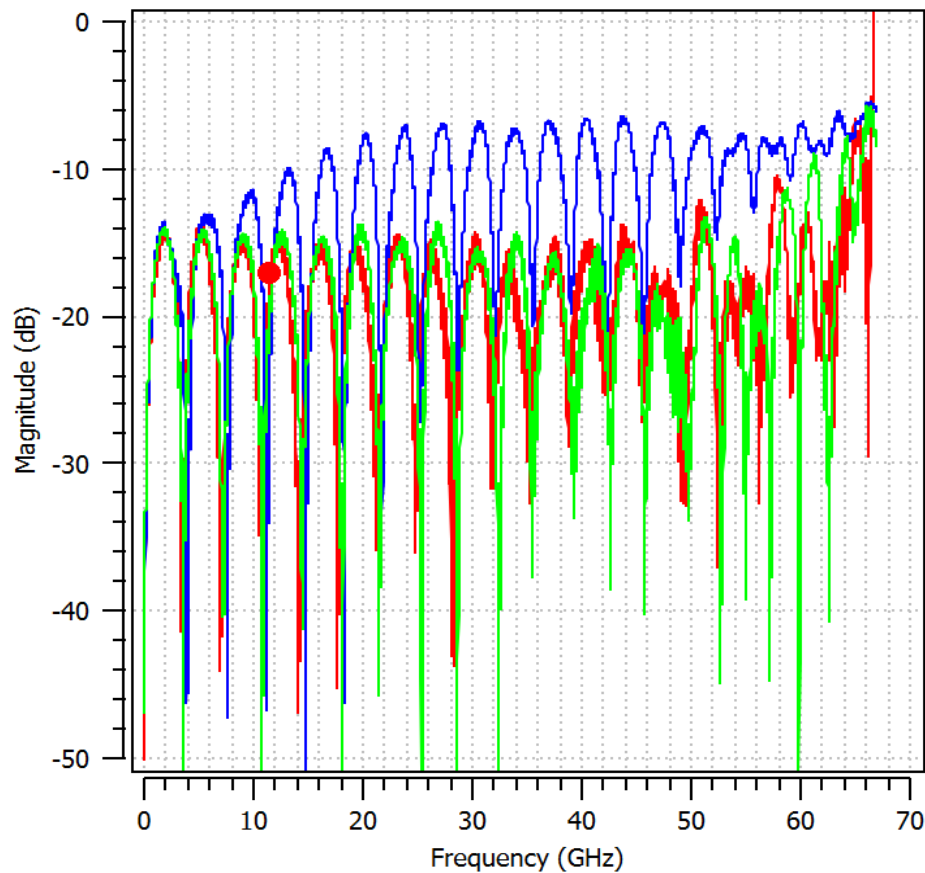
65G GSSG Probe + 1 IN + 65G GSSG Probe

S-Parameter Plot



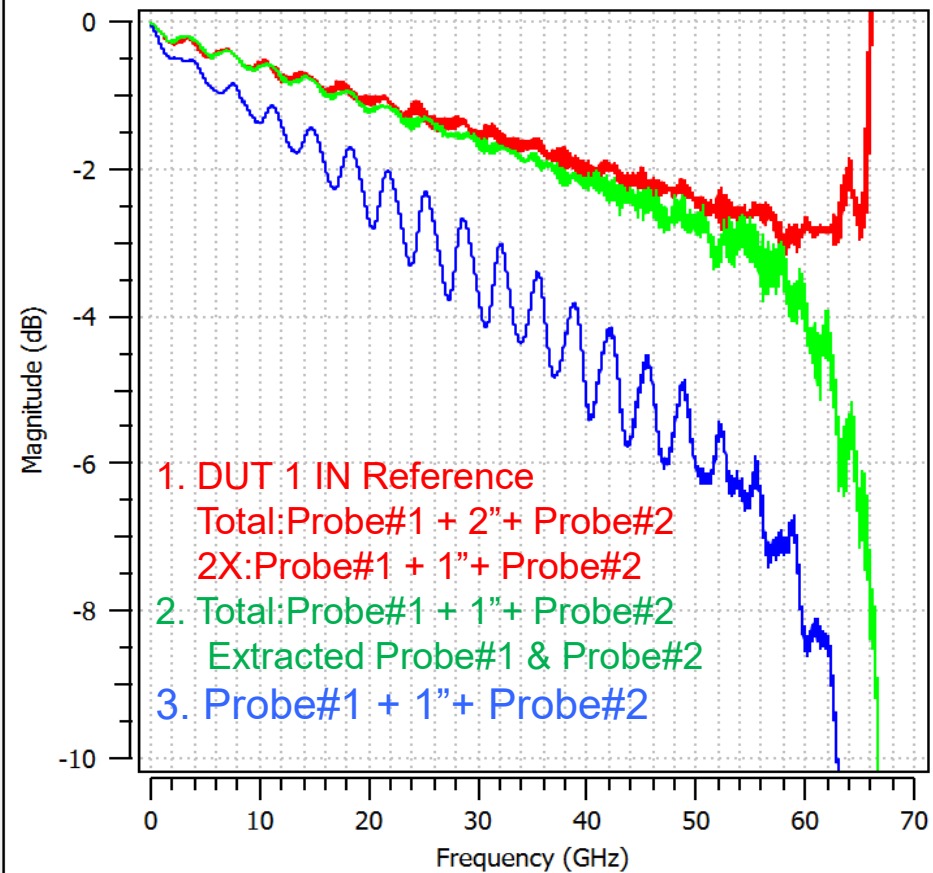
De-embedded 1 IN DUT (65 GHz GSSG Probes)

SDD11 (Magnitude)



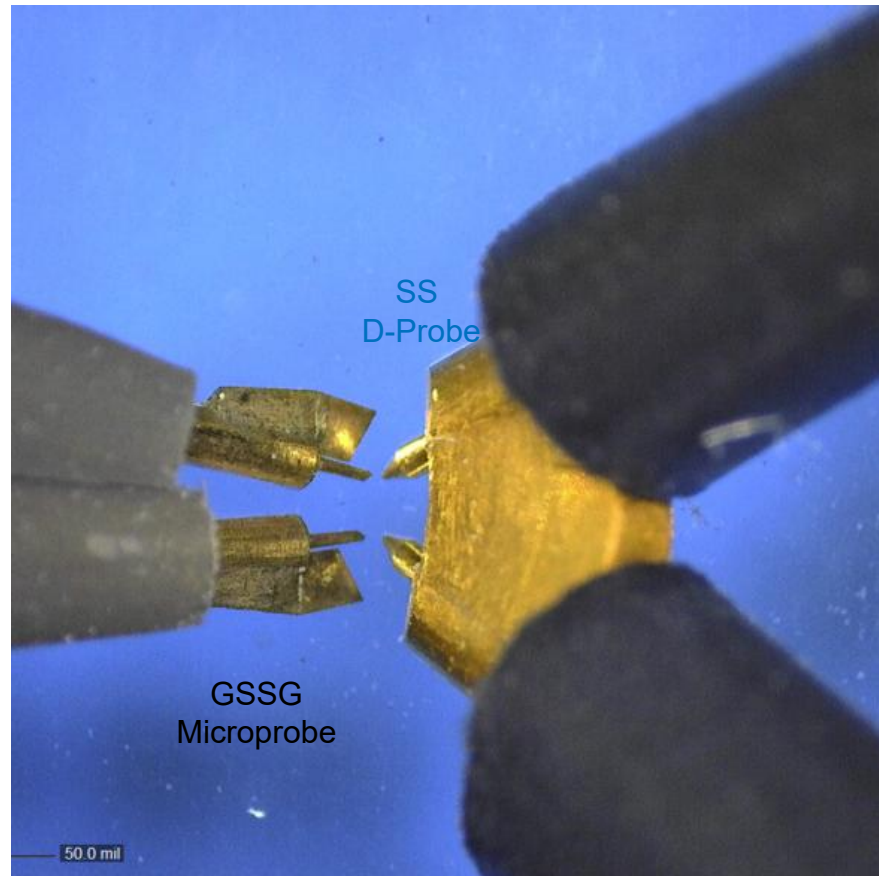
— DUT-1IN-Total_2P2IN-2X_2P1IN — DPGSSG6505_6019&20-1IN-DP01-250501
— DUT-1IN-DEP1P2

SDD21 (Magnitude)



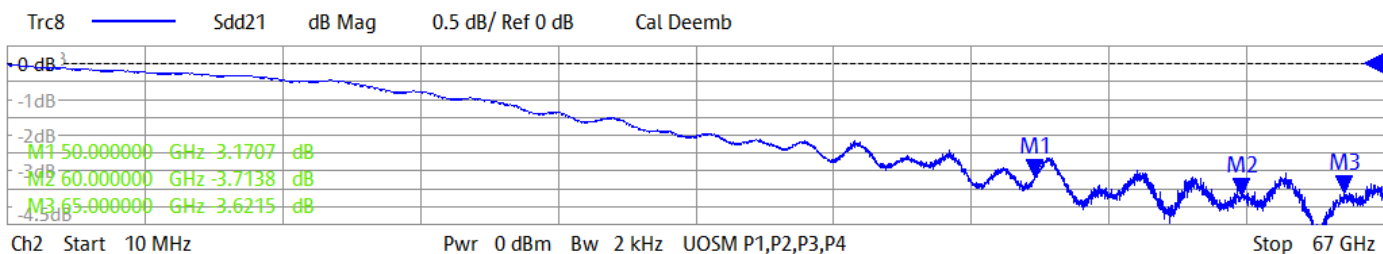
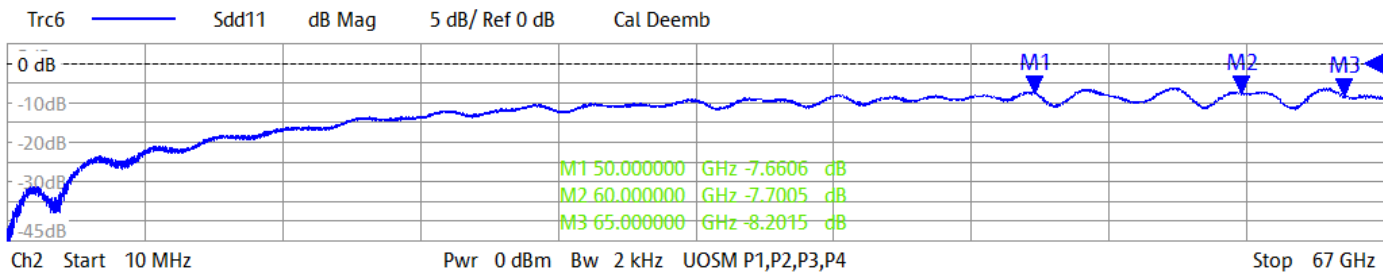
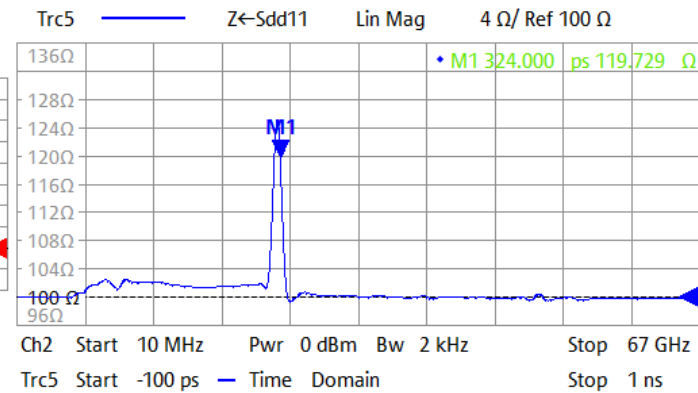
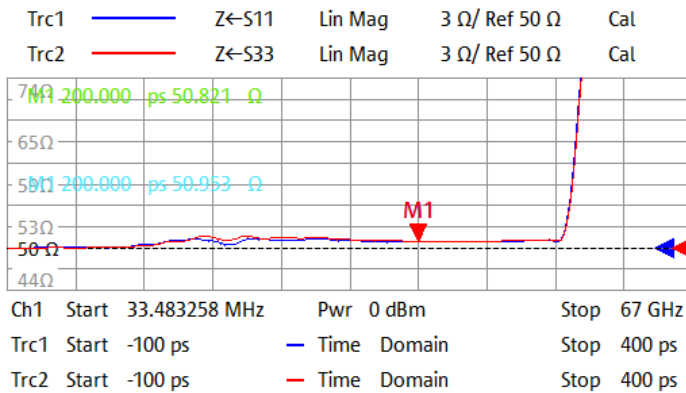
— DUT-1IN-Total_2P2IN-2X_2P1IN — DPGSSG6505_6019&20-1IN-DP01-250501
— DUT-1IN-DEP1P2

50 GHz DP-SS Probes (0.5 mm Pitch)



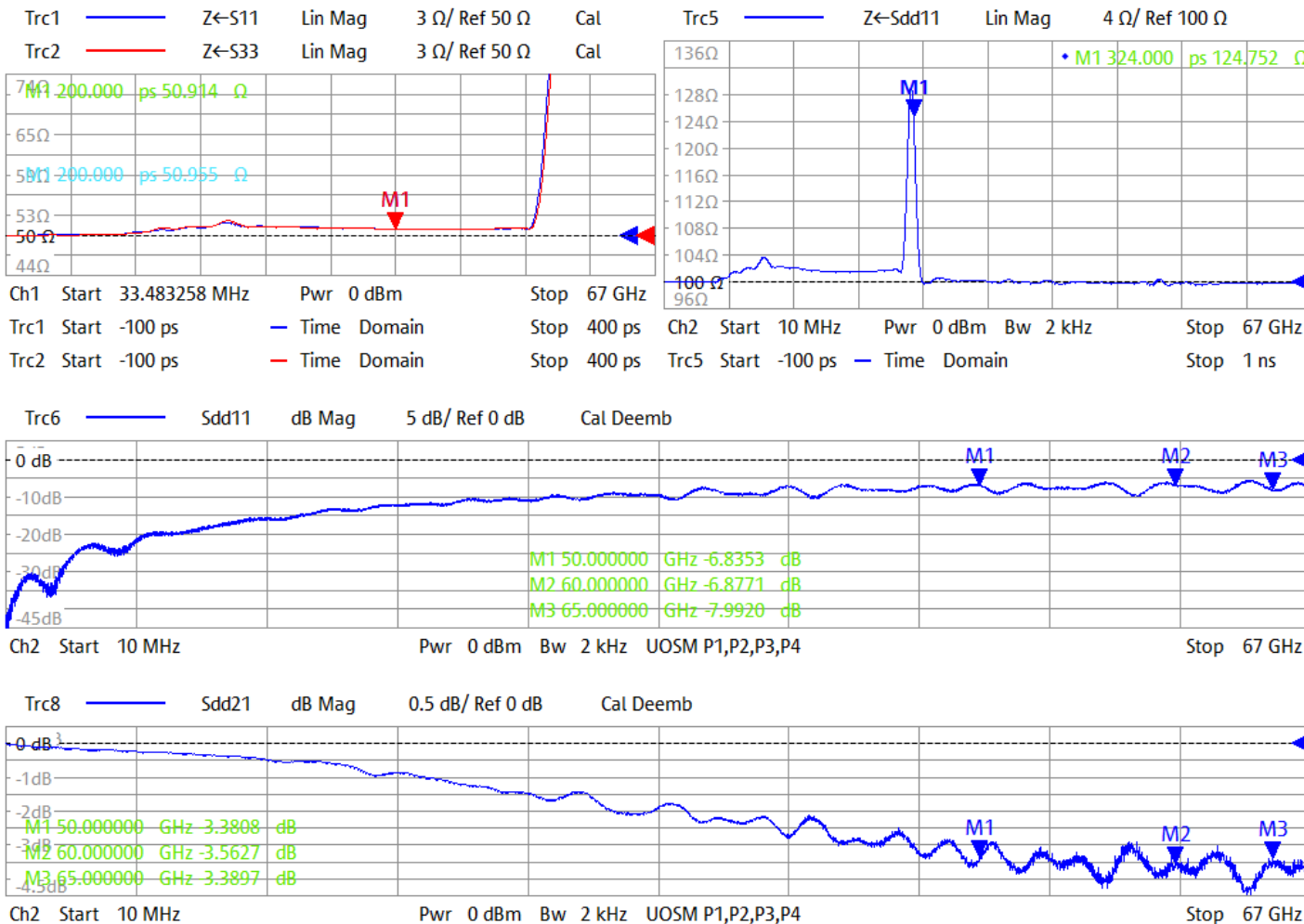
DP-SS-501505_5010

9/26/2025 6:29:29 PM
1332.4500K64-101822-rH



DP-SS-501505_5011

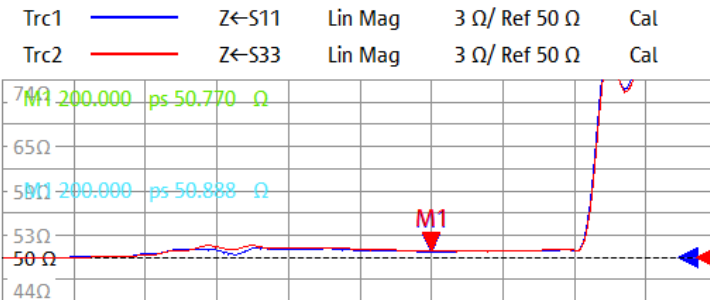
9/26/2025 6:26:26 PM
1332.4500K64-101822-rH



Probe_5010 + 2 IN + Probe_5011



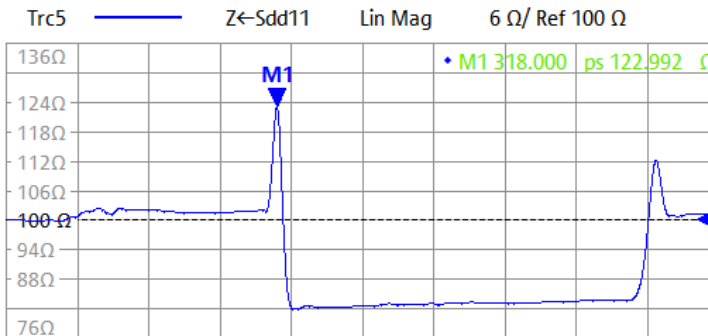
9/26/2025 6:45:54 PM
1332.4500K64-101822-rH



Ch1 Start 33.483258 MHz Pwr 0 dBm Stop 67 GHz

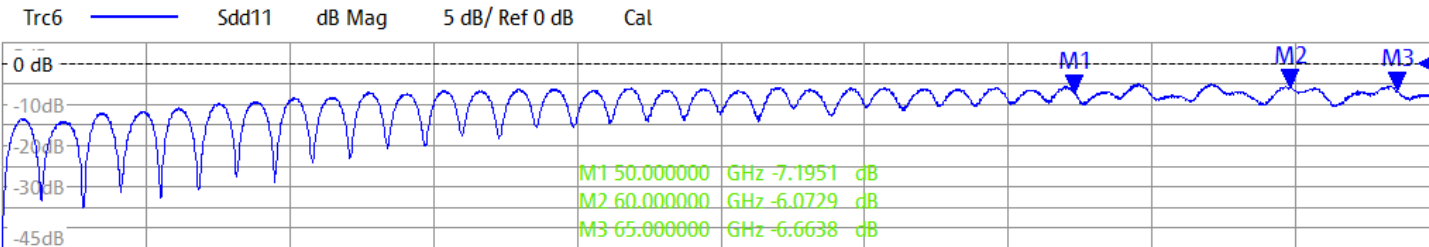
Trc1 Start -100 ps Time Domain Stop 400 ps

Trc2 Start -100 ps Time Domain Stop 400 ps

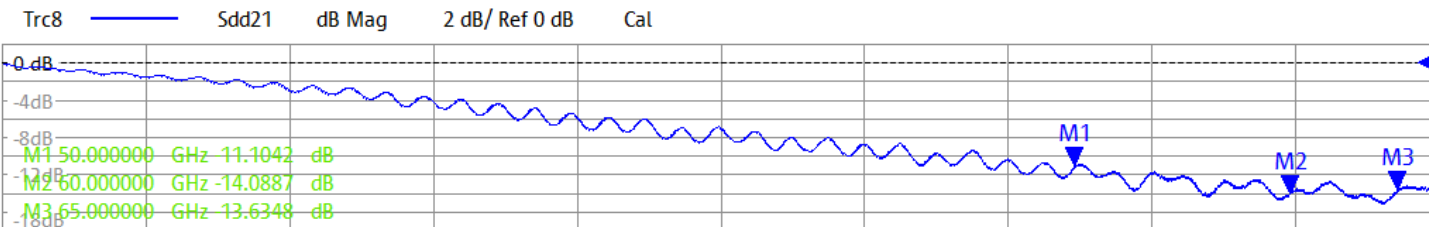


Ch2 Start 10 MHz Pwr 0 dBm Bw 2 kHz Stop 67 GHz

Trc5 Start -100 ps Time Domain Stop 1 ns



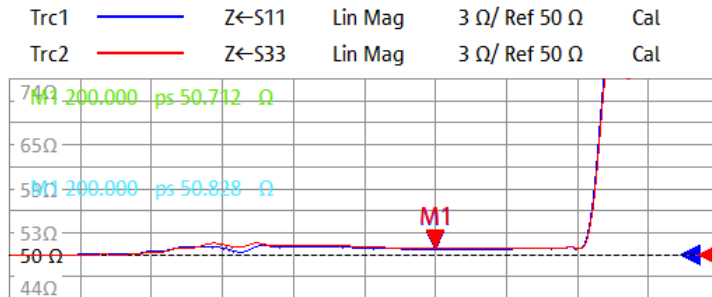
Ch2 Start 10 MHz Pwr 0 dBm Bw 2 kHz UOSM P1,P2,P3,P4 Stop 67 GHz



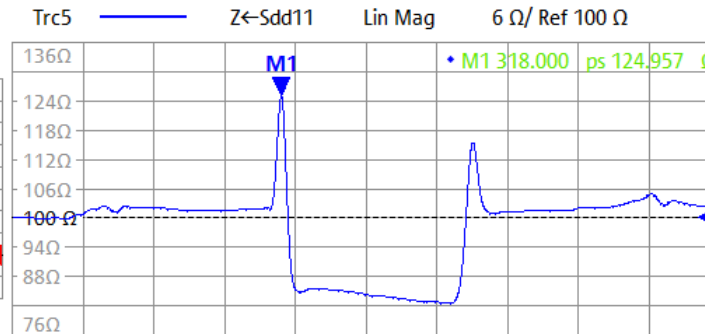
Ch2 Start 10 MHz Pwr 0 dBm Bw 2 kHz UOSM P1,P2,P3,P4 Stop 67 GHz

Probe_5010 + 1 IN + Probe_5011

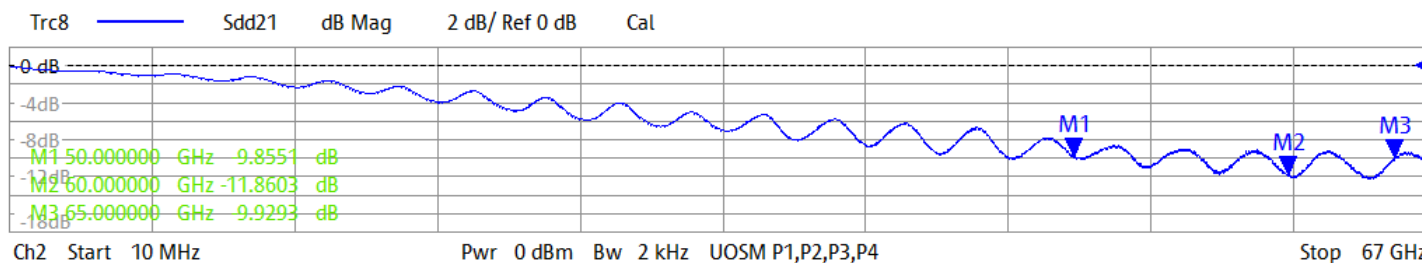
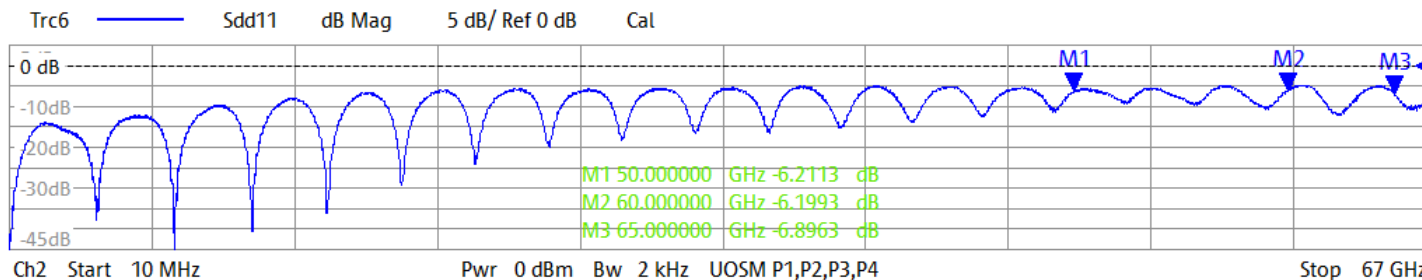
9/26/2025 6:51:57 PM
1332.4500K64-101822-rH



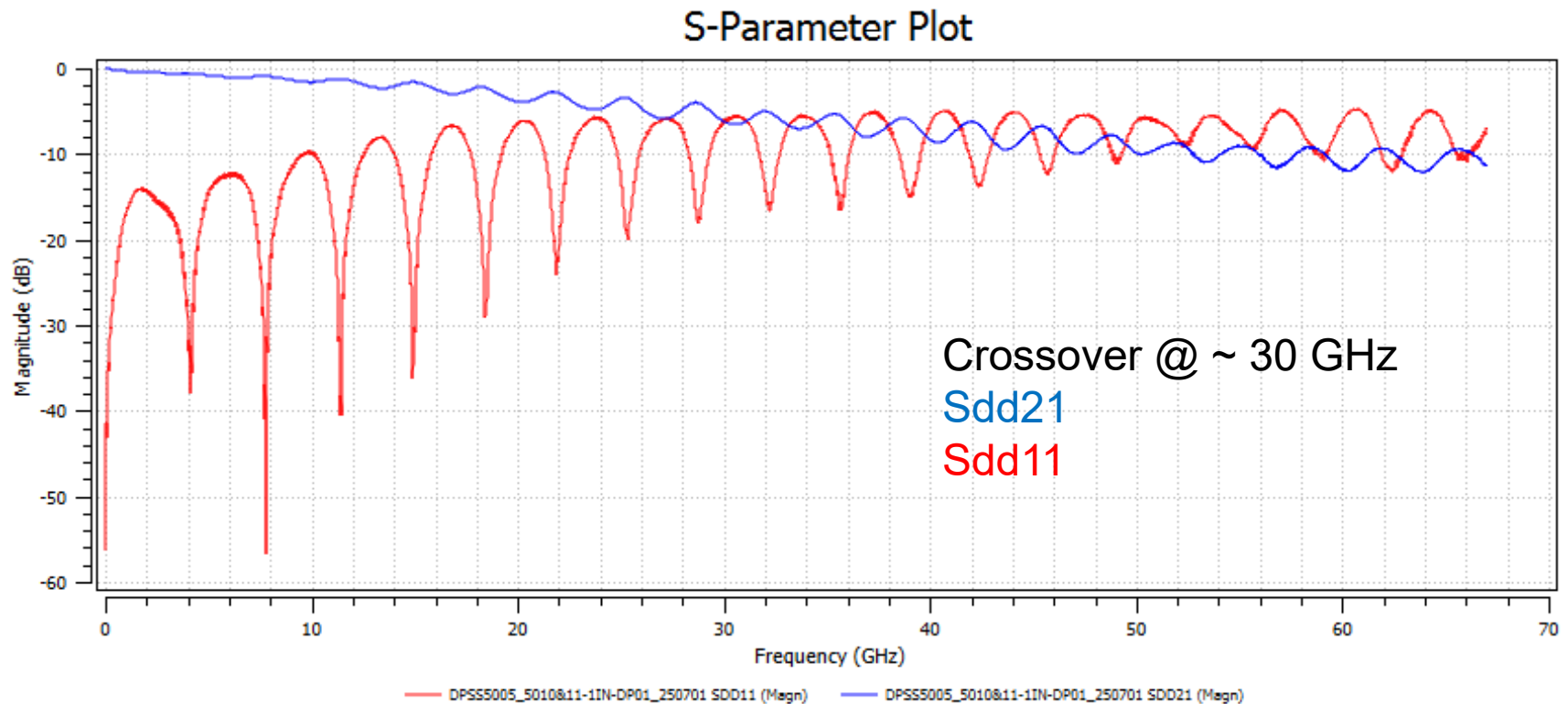
Ch1 Start 33.483258 MHz Pwr 0 dBm Stop 67 GHz
Trc1 Start -100 ps — Time Domain Stop 400 ps
Trc2 Start -100 ps — Time Domain Stop 400 ps



Ch2 Start 10 MHz Pwr 0 dBm Bw 2 kHz Stop 67 GHz
Trc5 Start -100 ps — Time Domain Stop 1 ns

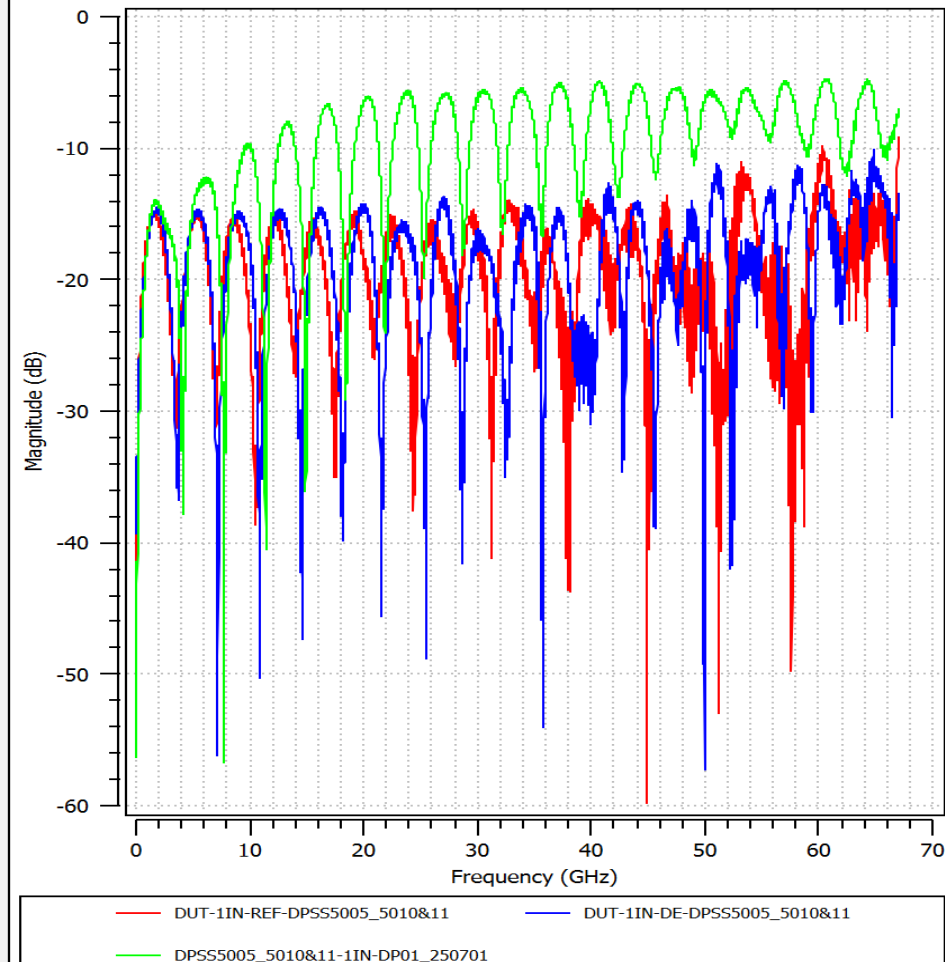


50G SS Probe + 1 IN + 50G SS Probe

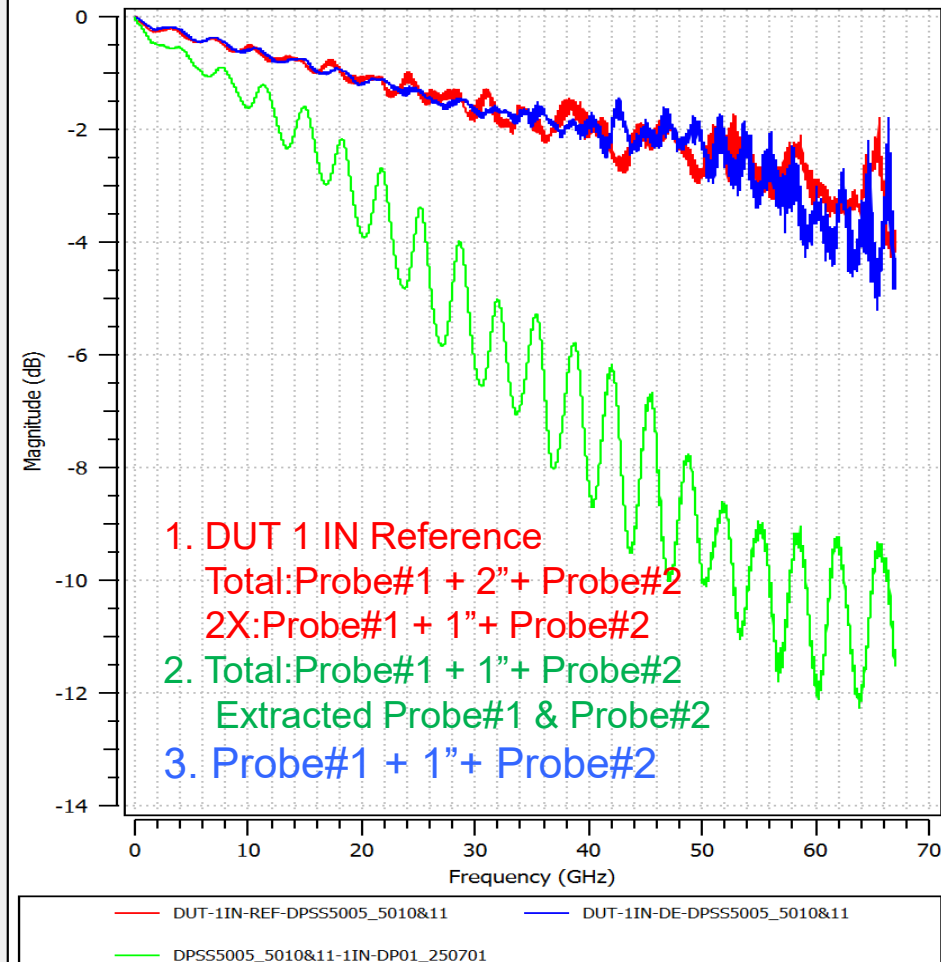


De-embedded 1 IN DUT (50 GHz SS Probe)

SDD11 (Magnitude)



SDD21 (Magnitude)



Thank You

We help make PCB probing easy!

- Benchtop DIY Probe Stations
- Rugged 65 GHz Differential Probes
- Rugged 30 GHz Single-ended Probes
- Engineering Services
- One-stop shopping for SI analysis tools, flexible RF cables, PDN filters, digital microscopes, etc.

Contact:

support@packetmicro.com

Office: 408-675-3900

2312 Walsh Avenue, Suite A, Santa Clara, CA 95051, USA

