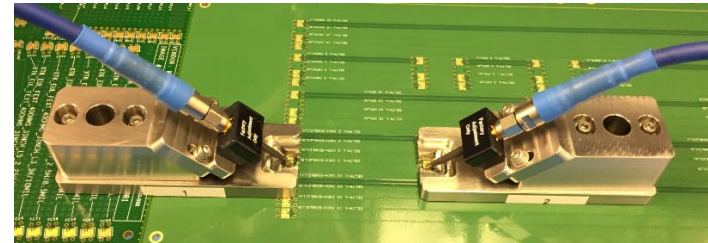


40/20 GHz Solutions for Delta-L 4.0/3.0 PCB Characterization

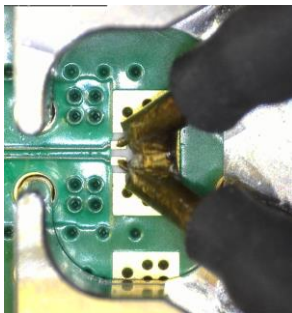
AITT-DLP SW Tool & Rugged Handheld Probes for VNAs



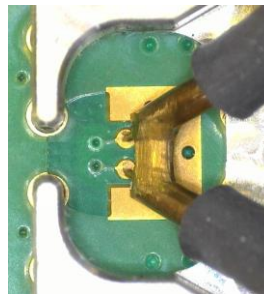
Differential Signal-Signal Probes



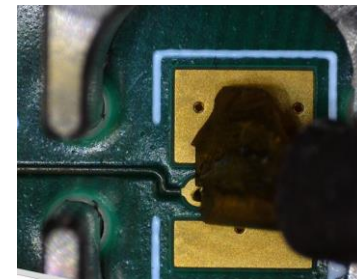
Single-ended Signal-GND Probes



**Delta-L 4.0
(30+ GHz)**



**Delta-L 3.0
(20 GHz)**

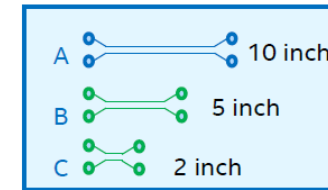


**Delta-L 3.0
(18 GHz)**

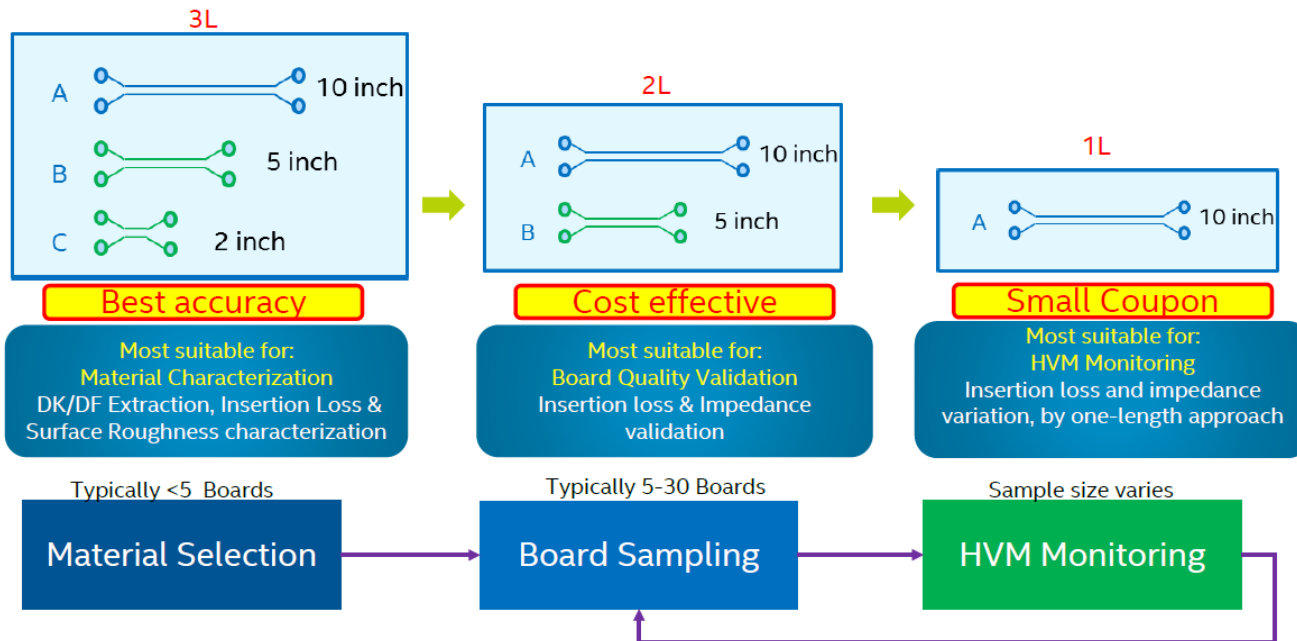
Intel Delta-L+ PCB Characterization

Delta-L+ Metrology

Choose coupons with different length combinations at different stages of PCB Characterization

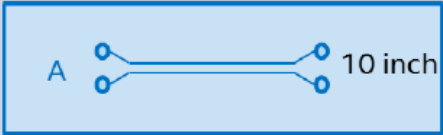
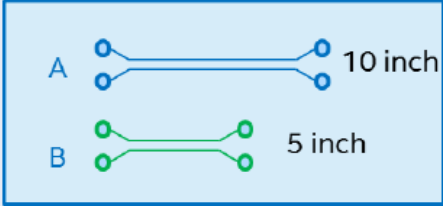
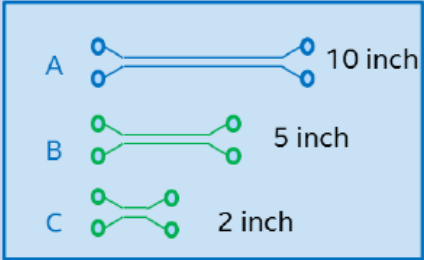


Note: Actual length may vary



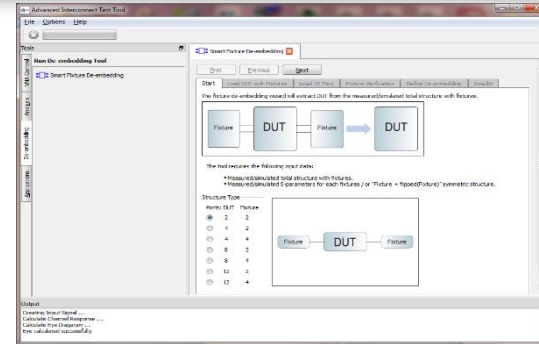
<https://www.intel.com/content/dam/www/public/us/en/documents/guides/delta-l-plus-methodology-for-electrical-characterization-guide.pdf>

Delta-L+ Usage Model

Category	Primary Usage	Note
1L 	PCB house, HVM monitoring	Lowest cost solution, TDR/TDT or VNA is ok
2L 	PCB House (optional) OxM seeking low cost “de-embedding”	This is Delta-L 2.0, TDR/TDR or VNA is ok, VNA is preferred
3L 	Material vendor OxMs Any measurement capability verification	VNA preferred. Prefer rigorous de-embedding (AFR, SFD, TRL, etc.)

40 GHz PCB Test Solution for Delta-L 4.0

Rohde & Schwarz ZNB40
100 kHz - 40 GHz VNA



CSS AITT Tool

De-embedding (2X & 1X), Analysis
(Freq/Time domains), Material Extraction



PacketMicro Probes
40 GHz Rugged Probes



AITT Delta-L+ for PCB manufacturing

AITT-DLP Test Software

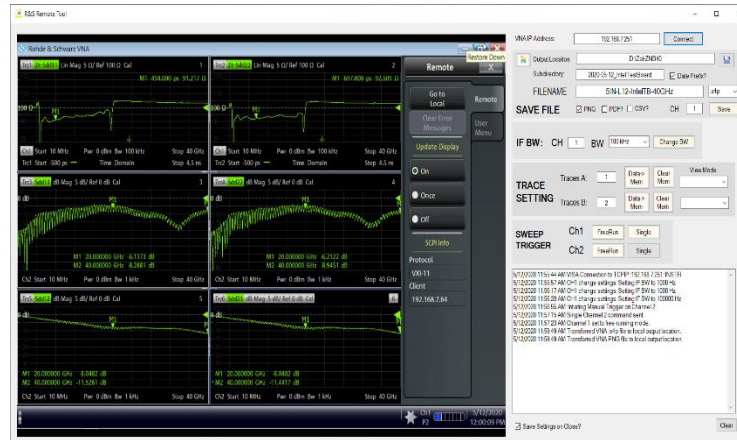
40 GHz Delta-L Test Tool



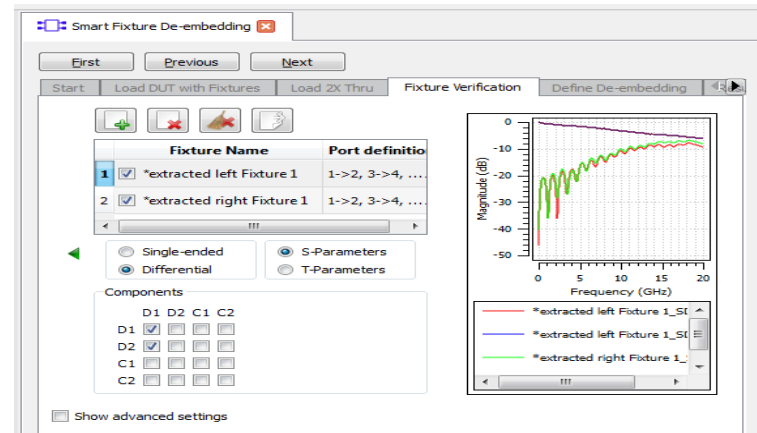
- AITT-DLP guides an operator to make measurements and generates Delta-L test reports.

Advanced Interconnect Test Tool (AITT)

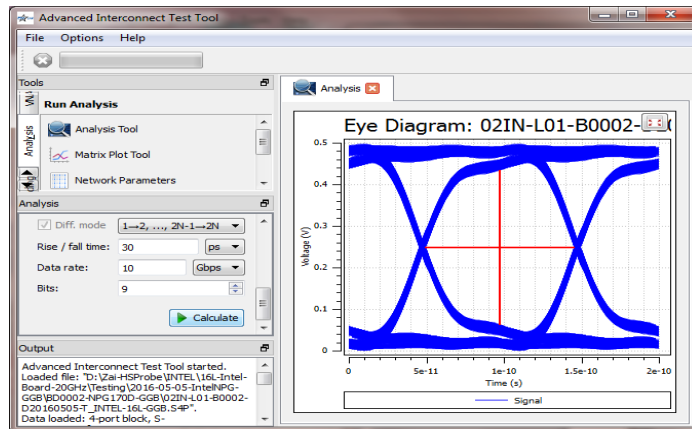
Versatile Tool for Interconnect analysis and Characterization



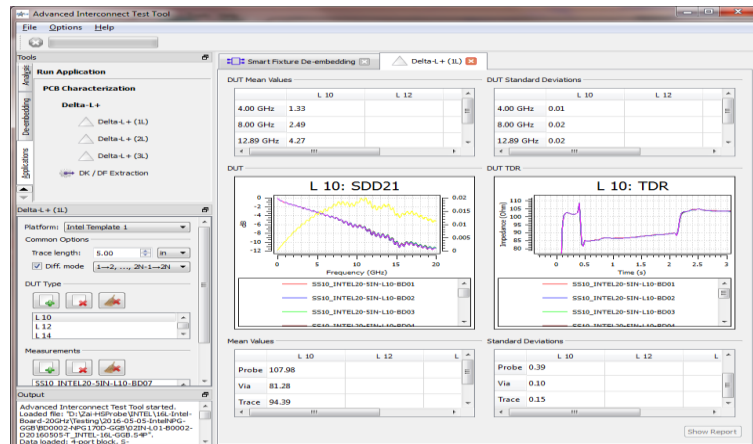
VNA Control



De-embedding Tool

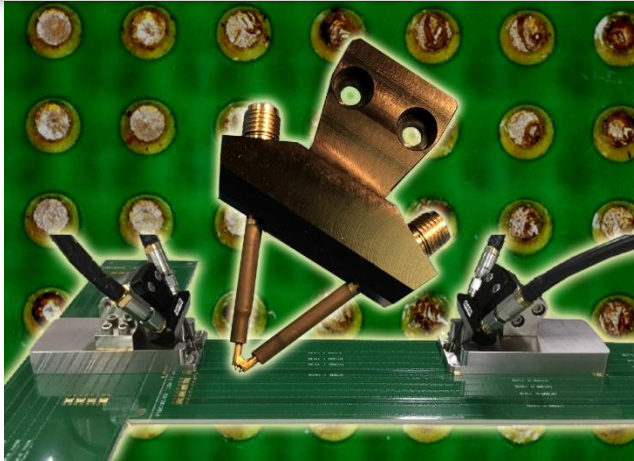


Analysis Tool



Applications (DK/DF Delta-L+)

40/20 GHz D-Probe

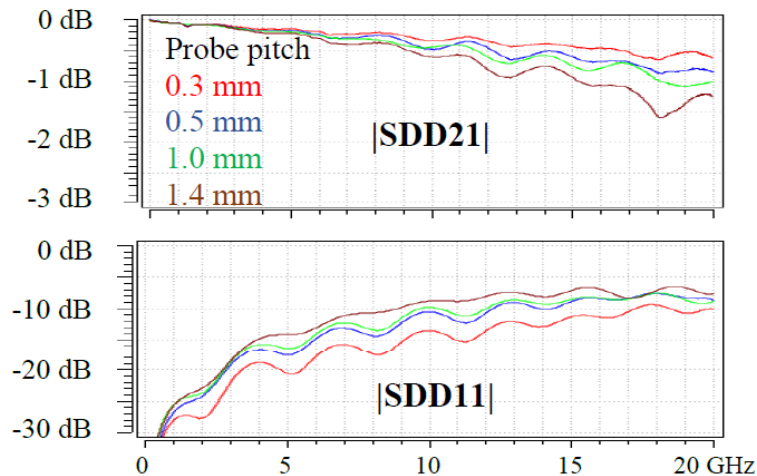


Features

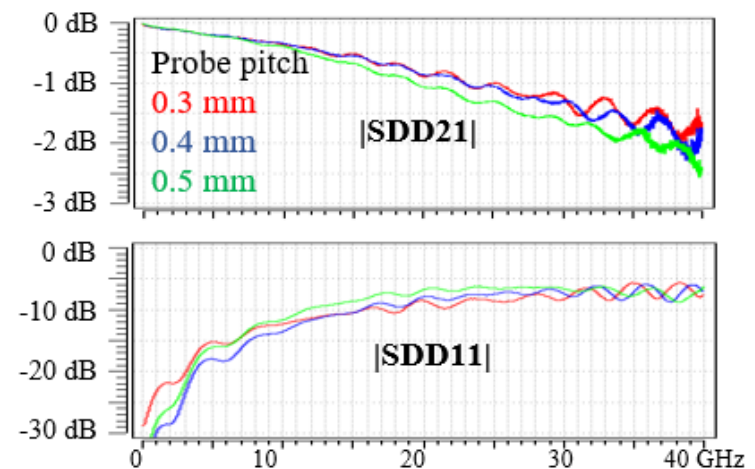
- **High Bandwidth:** DC to 20 or 40 GHz
- **Ruggedness:** Beryllium Copper tips
- **High Repeatability:** No moving part

D-Probe Part No.

- **DP-SS-201504** – 20 GHz, 0.4 mm/16 mil pitch
- **DP-SS-201505** – 20 GHz, 0.5 mm/20 mil pitch
- **DP-SS-201508** – 20 GHz, 0.8 mm/32 mil pitch
- **DP-SS-201510** – 20 GHz, 1.0 mm/40 mil pitch
- **DP-SS-201512** – 20 GHz, 1.2 mm/48 mil pitch
- **DP-SS-401503** – 40 GHz, 0.3 mm/12 mil pitch
- **DP-SS-401504** – 40 GHz, 0.4 mm/16 mil pitch
- **DP-SS-401505** – 40 GHz, 0.5 mm/20 mil pitch

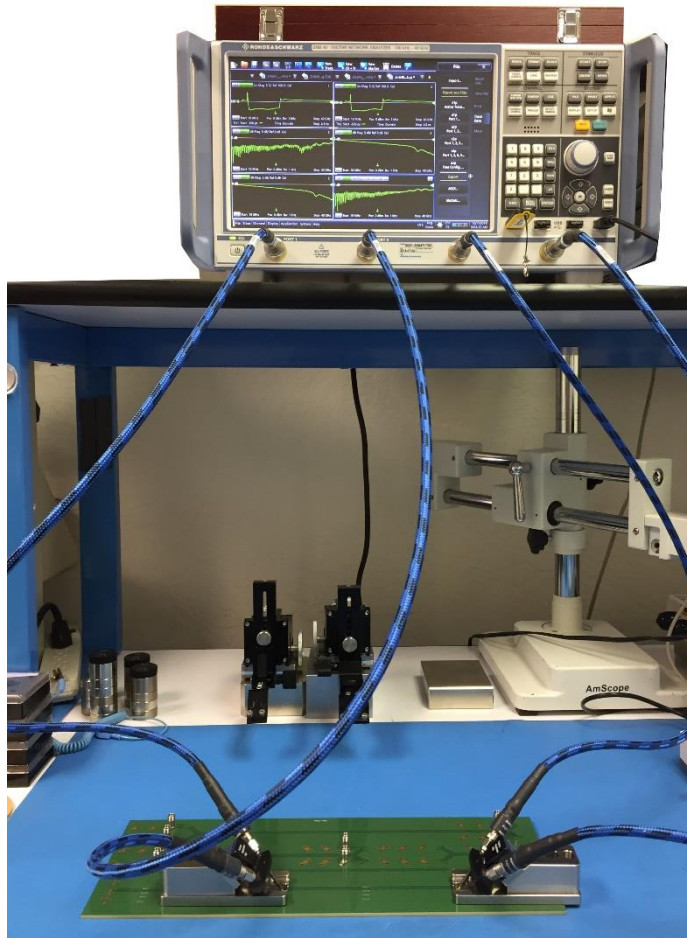


20 GHz D-Probes

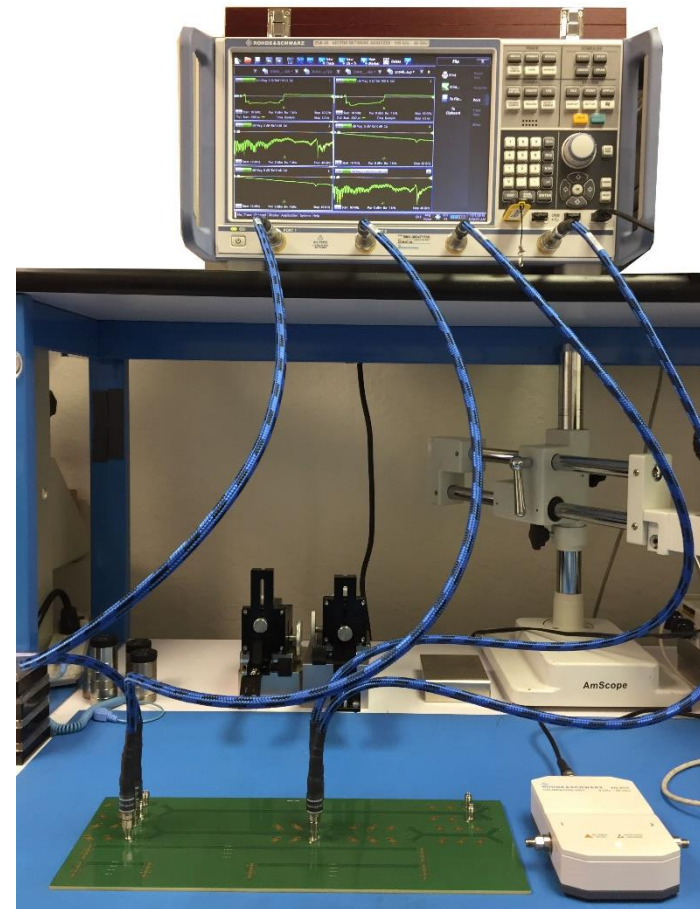


40 GHz D-Probes

40 GHz PCB Testing with R&S ZNB40 VNA

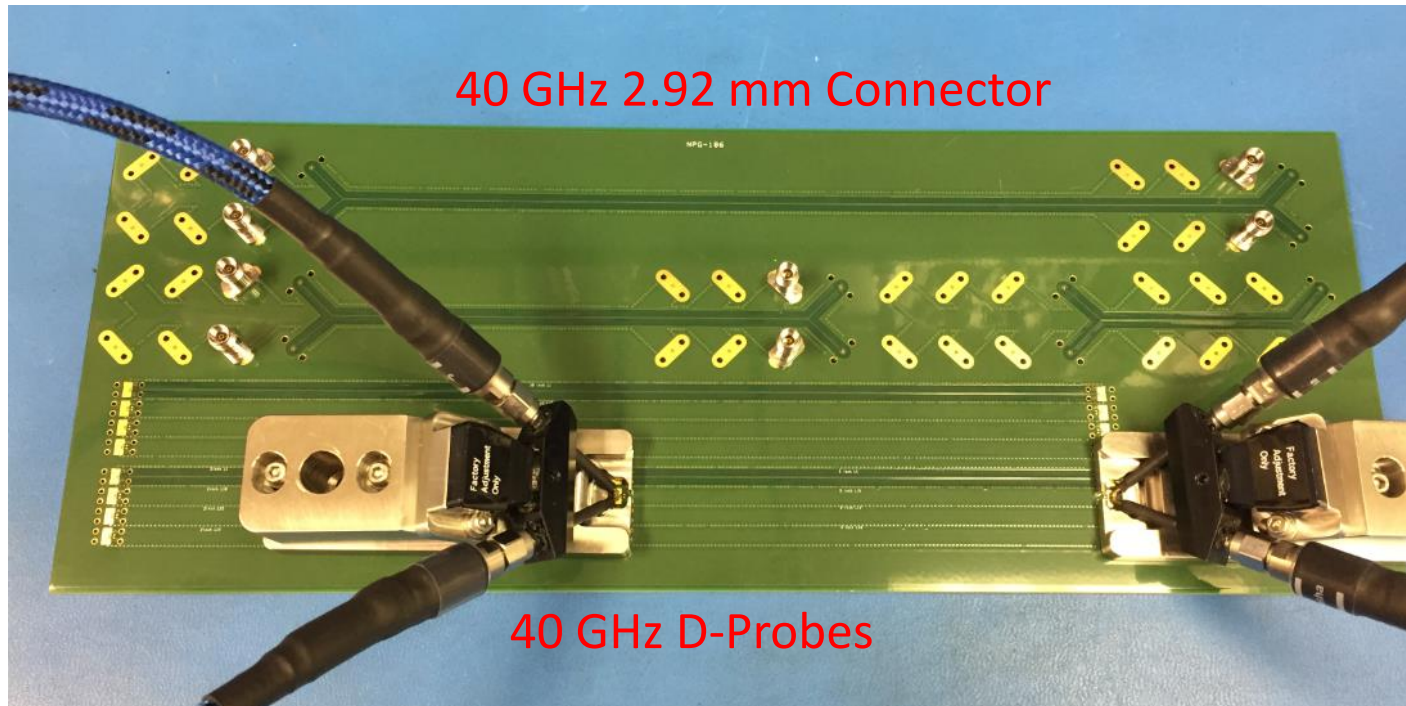


VNA measurement with D-Probe

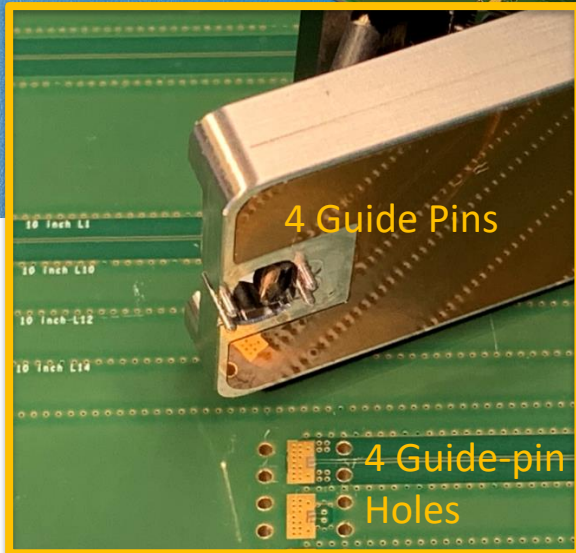
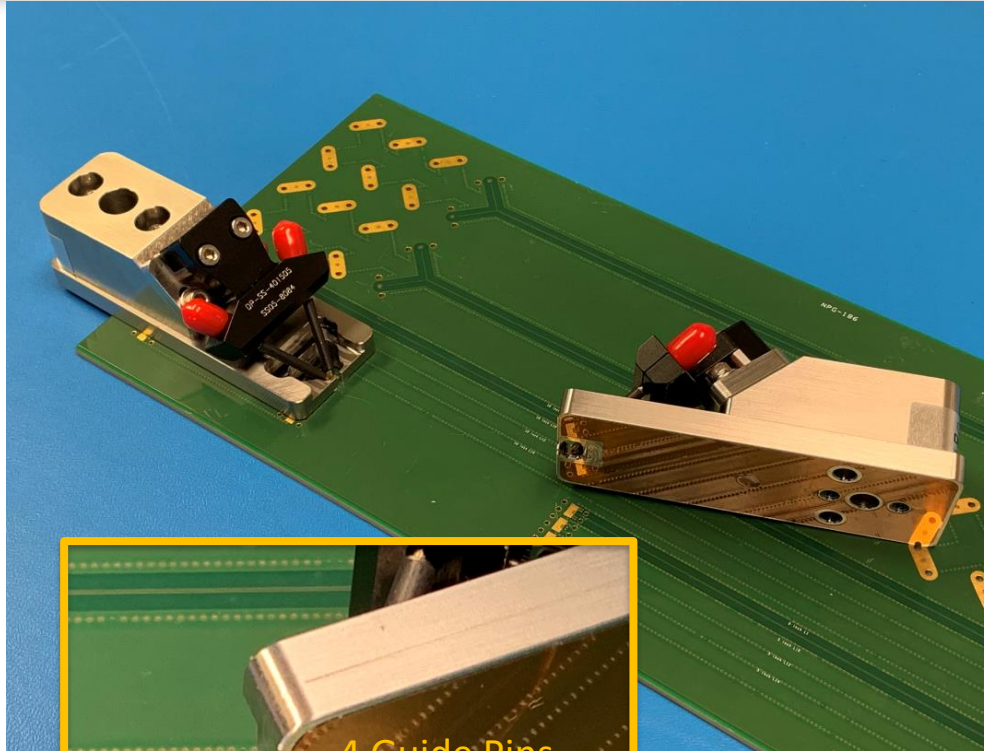


VNA measurement with 2.92 mm

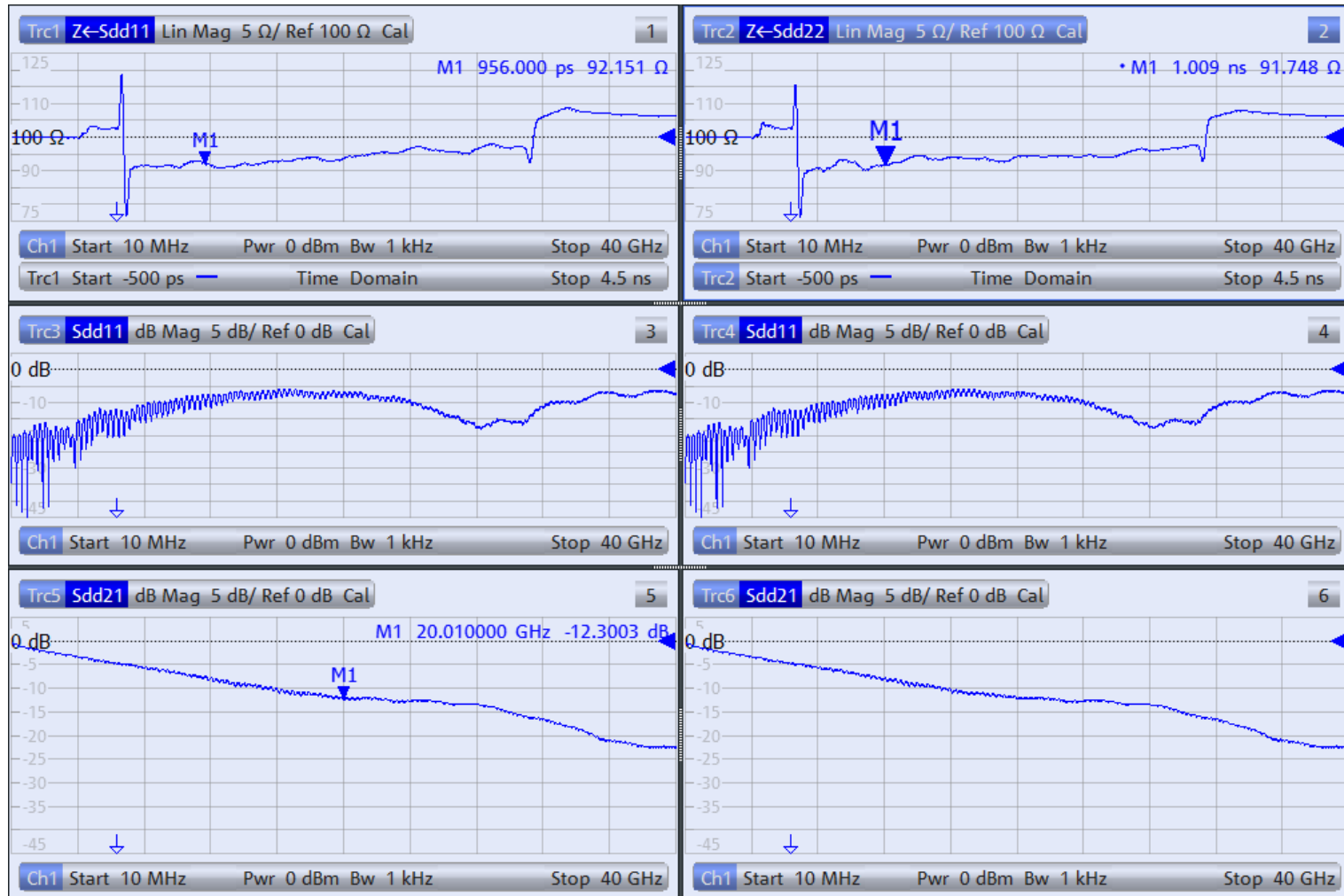
16-Layer NPG-186 Test Board



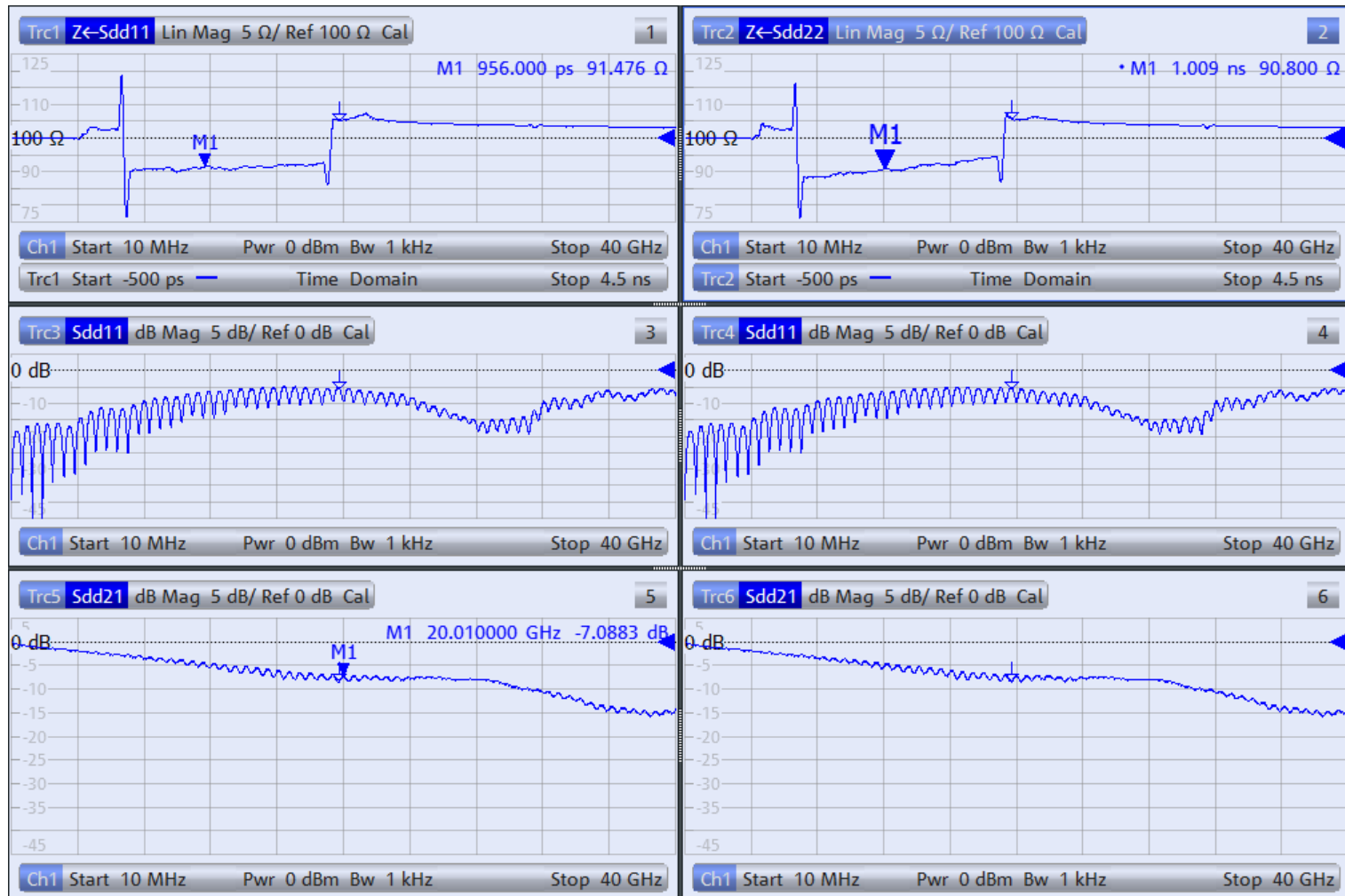
40 GHz DP-SS-401505DL Probe



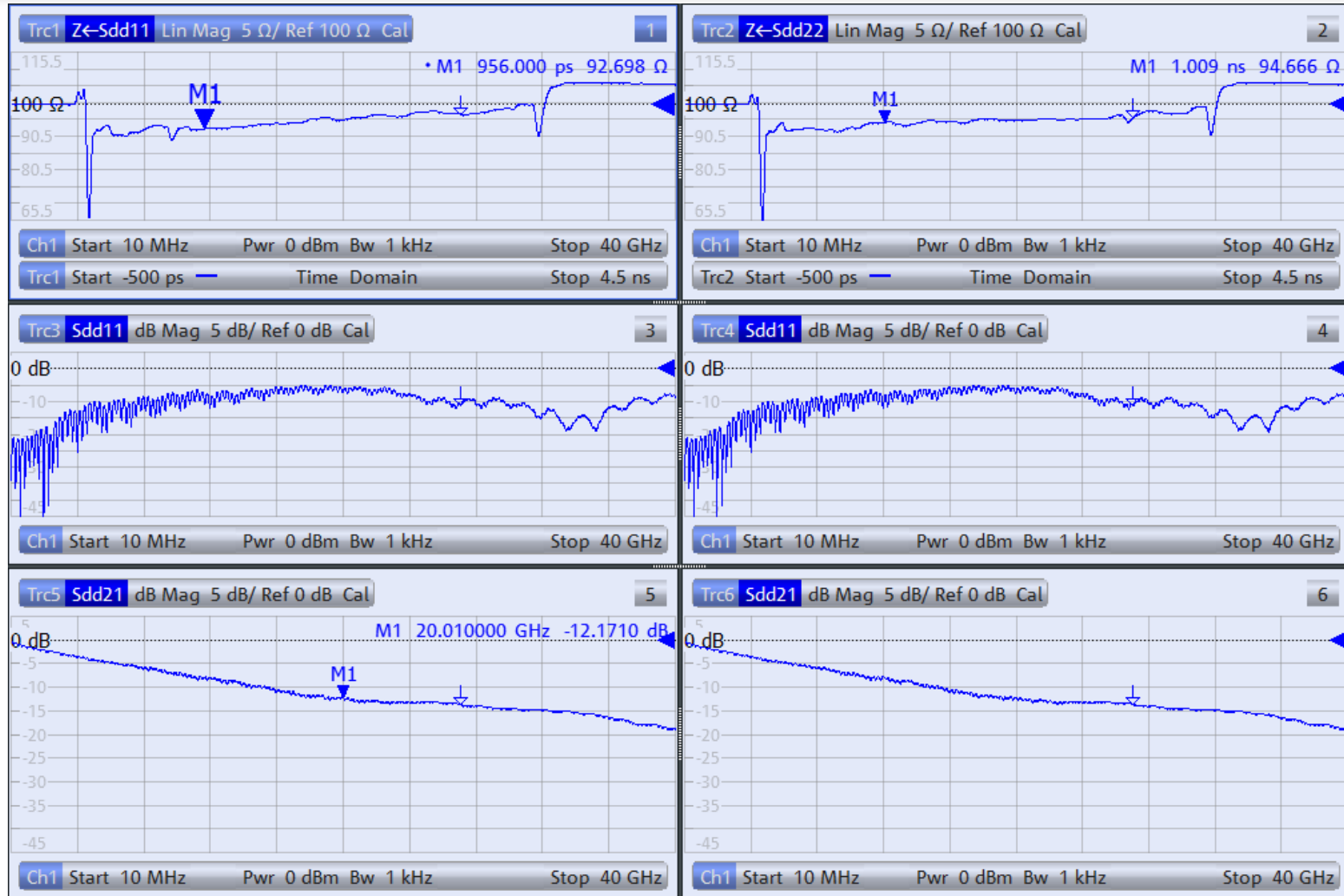
D-Probe Measurement – 10" Stripline



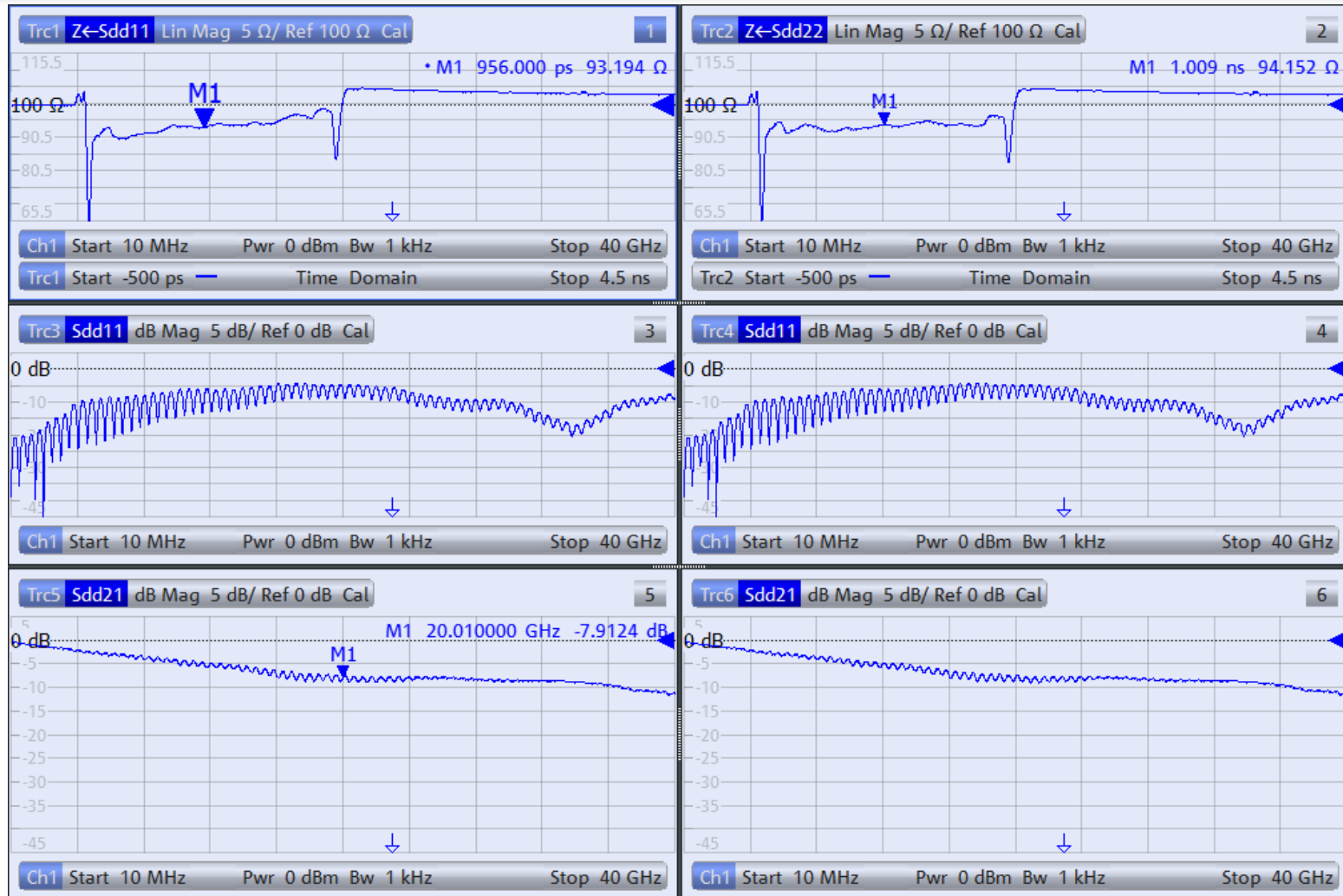
D-Probe Measurement – 5" Stripline



2.92 mm Connector Measurement – 10"

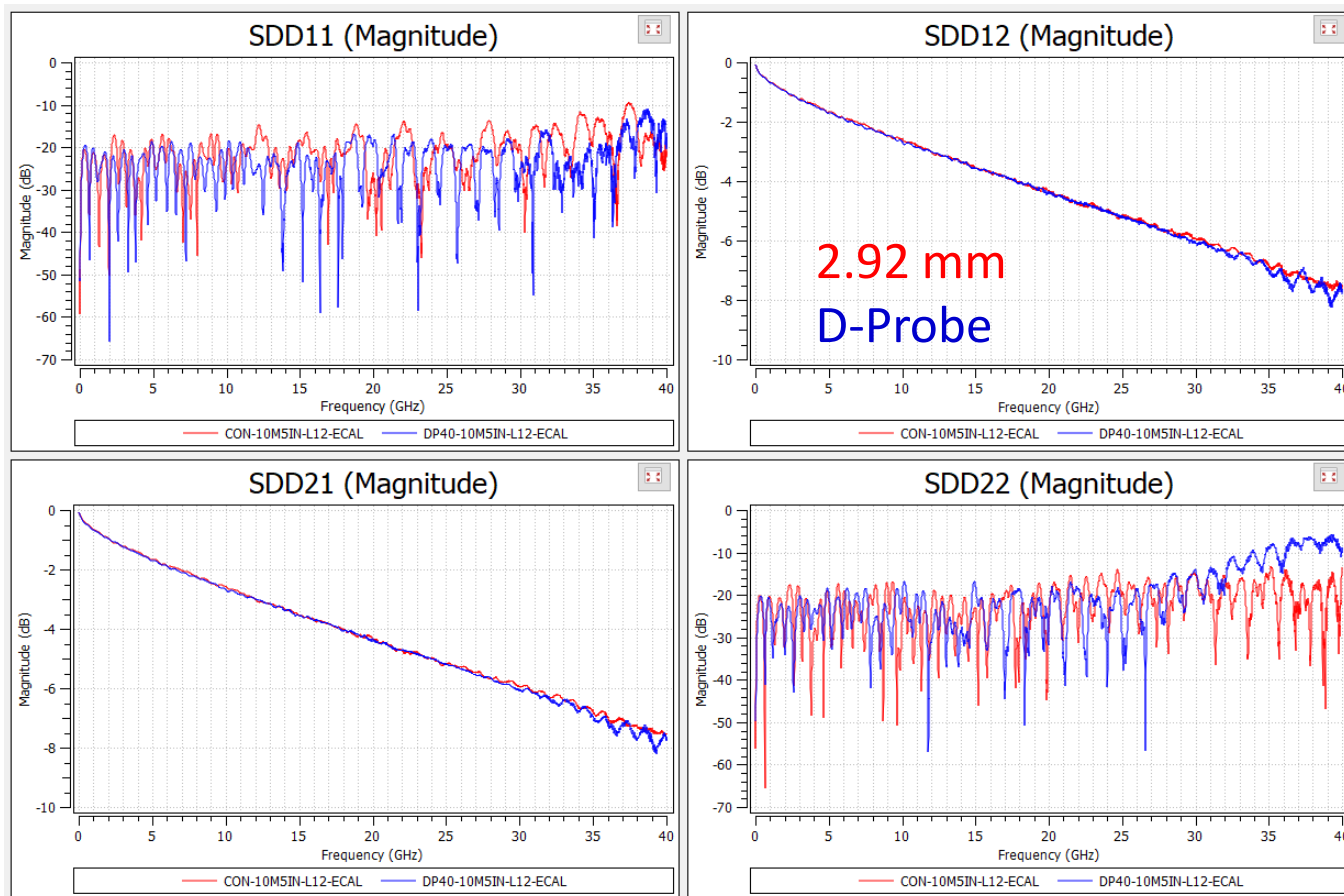


2.92 mm Connector Measurement – 5"



D-Probe vs. 2.92 mm Connector

De-embedded Results

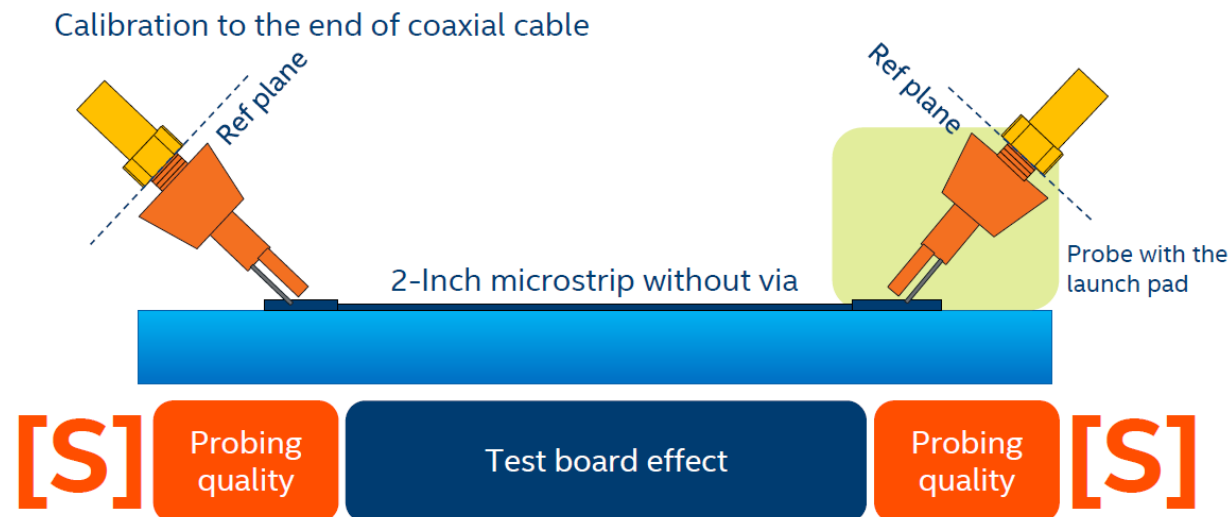


D-Probe and 2.92 mm connector have comparable accuracy up to 35 GHz!

Probing Quality

How to Assure Probing Quality: Electrical Requirement

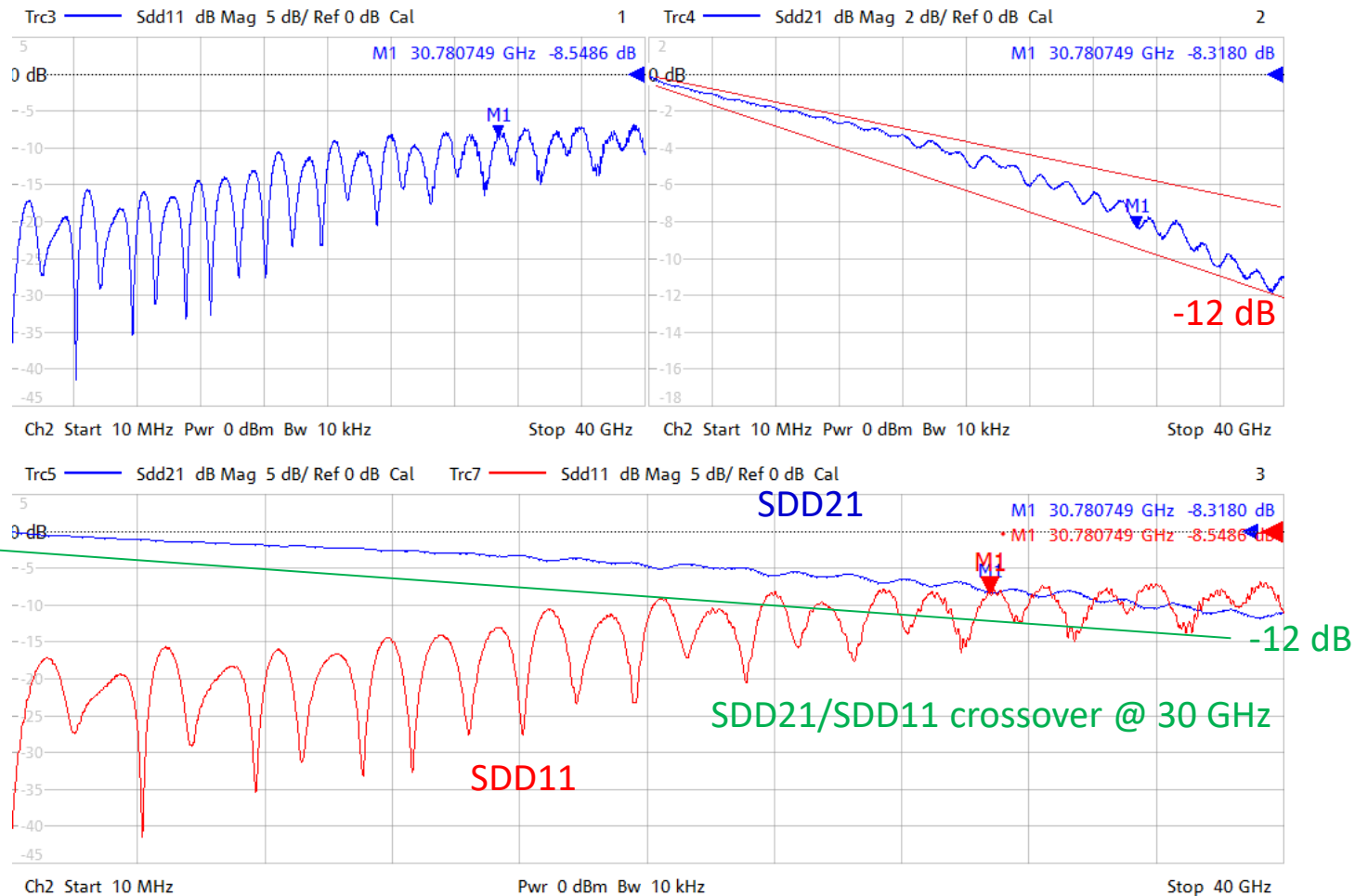
Electrical requirement =
2x probe with the launch (each < 3.5 dB at 40 GHz) + 2-Inch microstrip loss



12 dB Insertion Loss @ 40 GHz = 3.5 dB + 5 dB + 3.5 dB
(2" microstrip trace loss is about 5 dB @40 GHz, Intel reference Board)

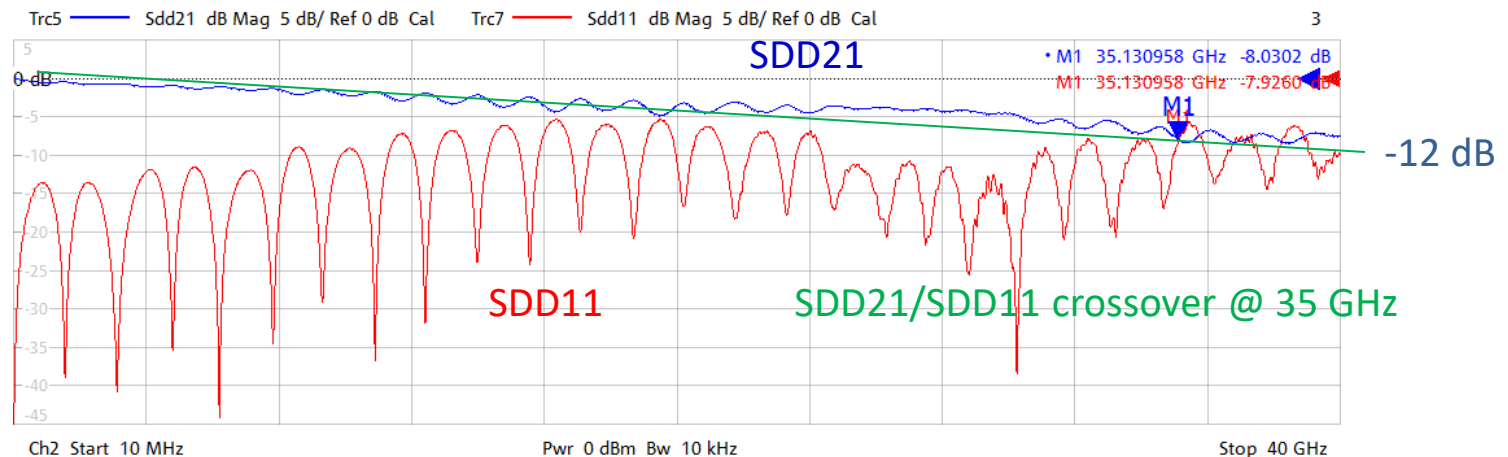
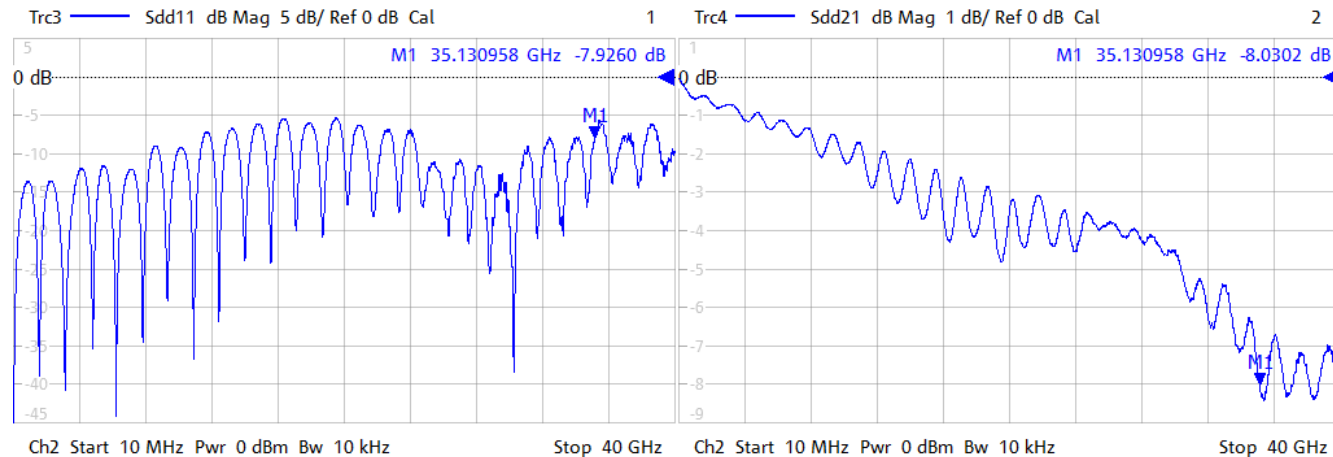
DProbe Quality for 2" Microstrip

6/26/2019 2:41:38 PM
1311.6010K84-101343-KG

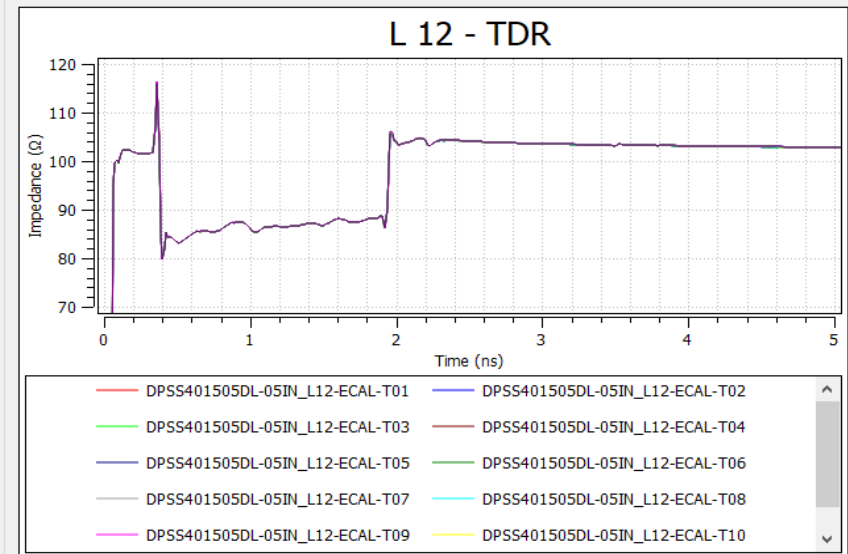
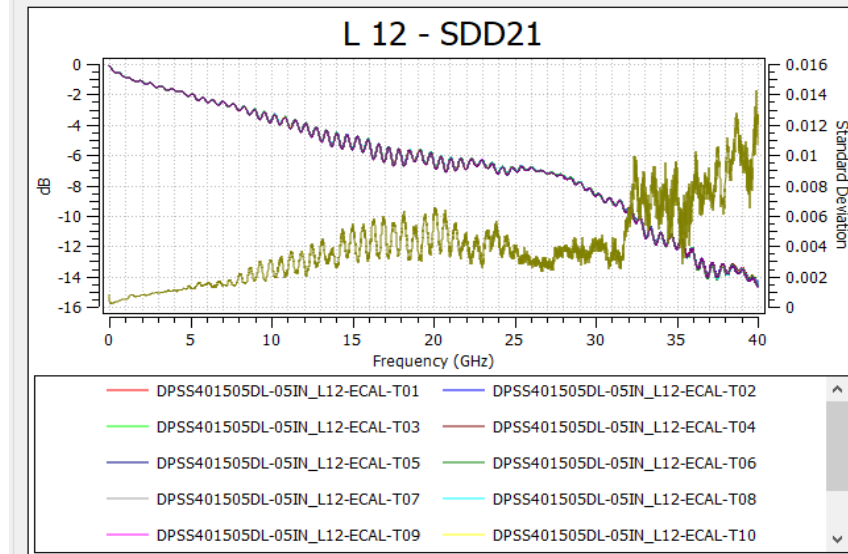


DProbe Quality for 2" Stripline

6/26/2019 2:33:53 PM
1311.6010K84-101343-KG



Differential Delta-L 4.0 (1L) Repeatability



DUT Information					
	Mean	Maximum	Minimum	Range	Standard Deviation
L 12					
4.000 GHz	0.341	0.342	0.339	0.003	0.001
8.000 GHz	0.612	0.616	0.609	0.007	0.002
12.890 GHz	0.884	0.891	0.880	0.011	0.003
16.000 GHz	0.997	1.004	0.990	0.014	0.003
28.000 GHz	1.478	1.485	1.470	0.015	0.004

Summary					
	Mean	Maximum	Minimum	Range	Standard Deviation
L 12					
Probe	115.933	116.531	115.103	1.429	0.409
Via	79.699	79.753	79.640	0.113	0.035
Trace	86.677	86.684	86.668	0.015	0.004

- Good repeatability for 12 separate measurements of the same 5" trace
- The standard deviation is 0.004 dB @ 28 GHz

Differential Delta-L 4.0 (2L) Repeatability

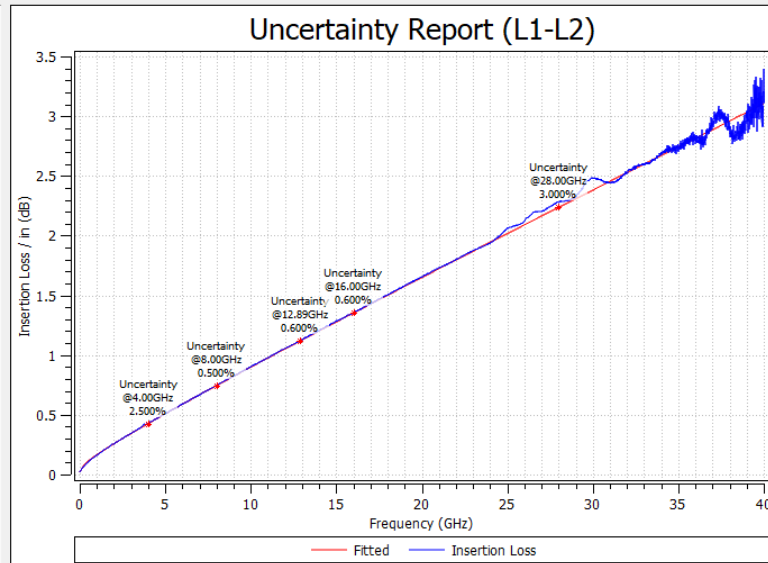
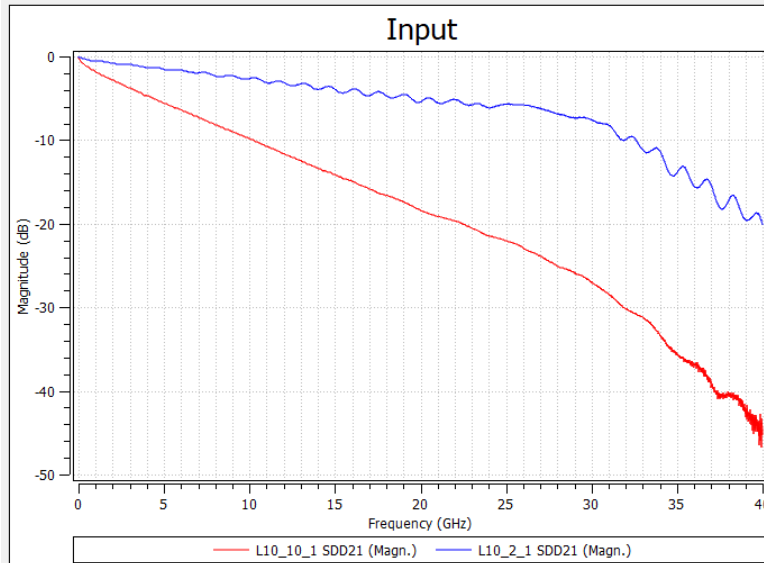
“10 IN – 5 IN” De-embedded Results

L10	4GHz	8GHz	12.89GHz	16GHz
T1	0.468	0.821	1.233	1.488
T2	0.467	0.820	1.231	1.486
T3	0.467	0.820	1.231	1.485
T4	0.468	0.821	1.232	1.488
T5	0.468	0.821	1.232	1.486
T6	0.468	0.821	1.232	1.487
T7	0.468	0.821	1.232	1.487
T8	0.468	0.822	1.234	1.490
T9	0.468	0.822	1.234	1.489
T10	0.468	0.821	1.233	1.489
T11	0.468	0.821	1.233	1.488
T12	0.468	0.821	1.232	1.488
Average	0.468	0.821	1.232	1.488
Max	0.468	0.822	1.234	1.490
Min	0.467	0.820	1.231	1.485
Range	0.001	0.002	0.003	0.005
σ	0.0003	0.0005	0.0010	0.0014
Average + 3 σ	0.469	0.823	1.235	1.492

4GHz Uncertainty	8GHz Uncertainty	12.89GHz Uncertainty	16GHz Uncertainty
1.0	0.6	0.7	1.1
0.8	0.4	0.8	0.6
0.9	0.5	1.3	0.6
0.9	0.5	0.6	0.5
0.8	0.5	0.7	0.7
0.8	0.4	0.5	0.7
0.8	0.4	0.6	0.6
0.8	0.4	0.6	0.6
0.8	0.5	0.5	0.7
0.7	0.4	0.5	0.7
0.7	0.4	0.6	0.7
0.7	0.5	0.4	0.7

Good repeatability for 12 separate measurements of the same 10” and 5” traces

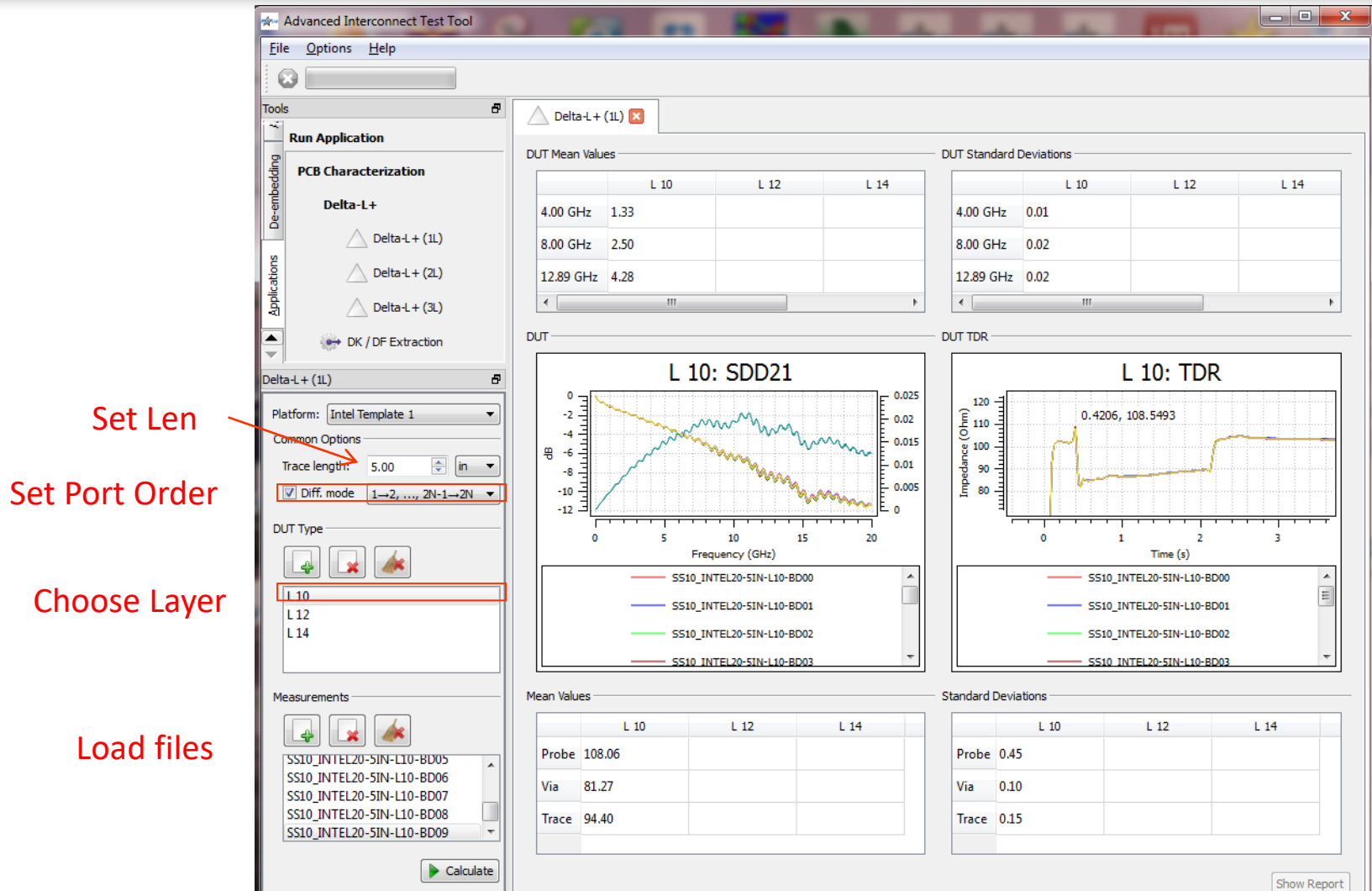
Differential Delta-L 4.0 (2L)



DUT Length (in)	Ref. Length (in)	Effective Length (in)
10.000	2.000	8.000
Z of Trace 1 (Ω)	Z of Trace 2 (Ω)	
92.309	97.084	

Uncertainty (%)	dB/in
0.500	0.746
Frequency: 12.89 GHz	
0.600	1.120
Frequency: 16.00 GHz	
0.600	1.353
Frequency: 28.00 GHz	
3.000	2.236

20 GHz Differential Delta-L 3.0 (1L)



Set Len

Set Port Order

Choose Layer

Load files

Advanced Interconnect Test Tool

Delta-L+ (1L)

Platform: Intel Template 1

Common Options

Trace length: 5.00 in

☒ Diff. mode 1→2, ..., 2N-1→2N

DUT Type

☒ L 10

L 12

L 14

Measurements

SS10_INTEL20-SIN-L10-BD05

SS10_INTEL20-SIN-L10-BD06

SS10_INTEL20-SIN-L10-BD07

SS10_INTEL20-SIN-L10-BD08

SS10_INTEL20-SIN-L10-BD09

Calculate

Delta-L+ (1L)

DUT Mean Values

	L 10	L 12	L 14
4.00 GHz	1.33		
8.00 GHz	2.50		
12.89 GHz	4.28		

DUT Standard Deviations

	L 10	L 12	L 14
4.00 GHz	0.01		
8.00 GHz	0.02		
12.89 GHz	0.02		

L 10: SDD21

Frequency (GHz)

SS10_INTEL20-SIN-L10-BD00

SS10_INTEL20-SIN-L10-BD01

SS10_INTEL20-SIN-L10-BD02

SS10_INTEL20-SIN-L10-BD03

L 10: TDR

Impedance (Ohm)

Time (s)

0.4206, 108.5493

SS10_INTEL20-SIN-L10-BD00

SS10_INTEL20-SIN-L10-BD01

SS10_INTEL20-SIN-L10-BD02

SS10_INTEL20-SIN-L10-BD03

Mean Values

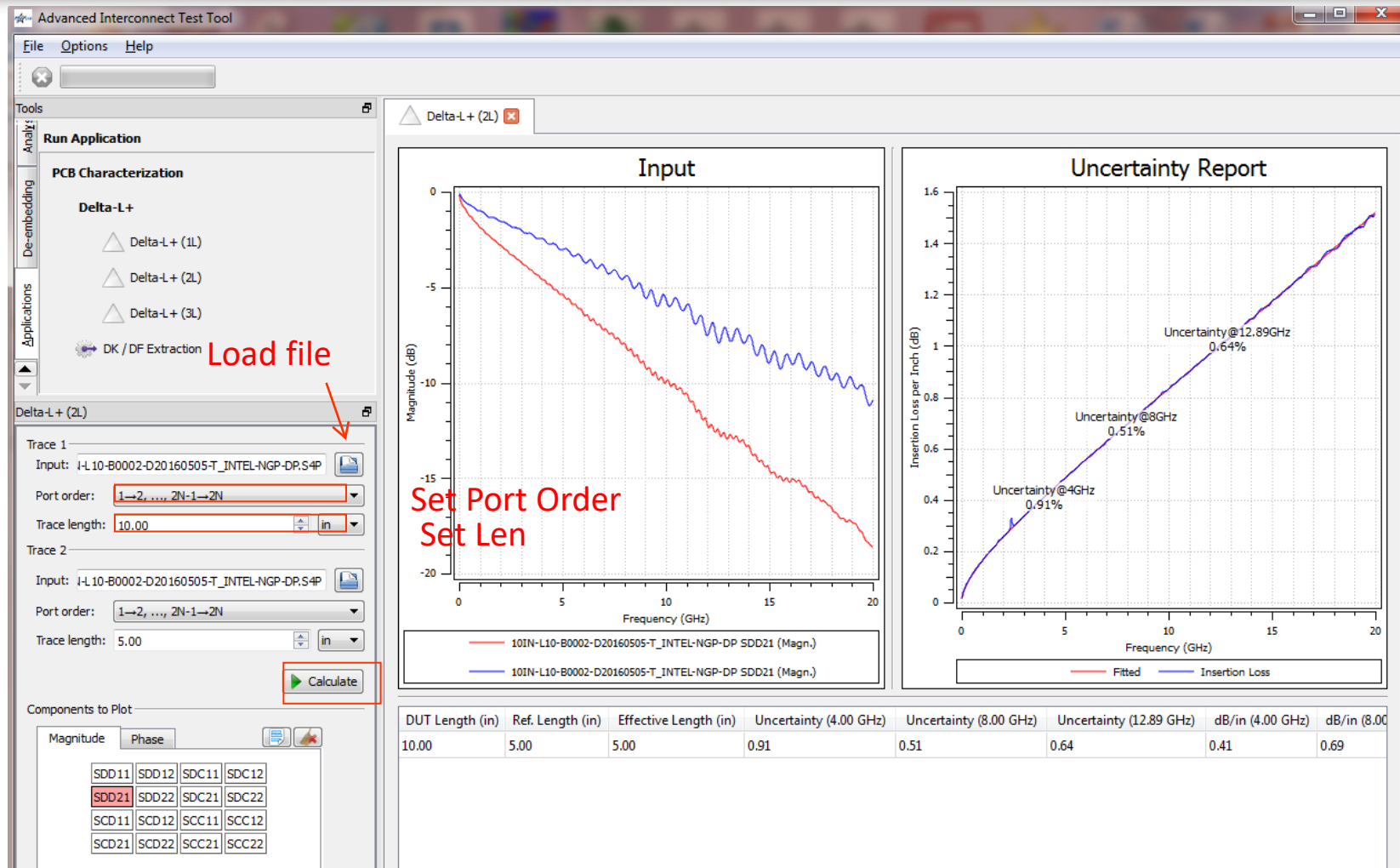
	L 10	L 12	L 14
Probe	108.06		
Via	81.27		
Trace	94.40		

Standard Deviations

	L 10	L 12	L 14
Probe	0.45		
Via	0.10		
Trace	0.15		

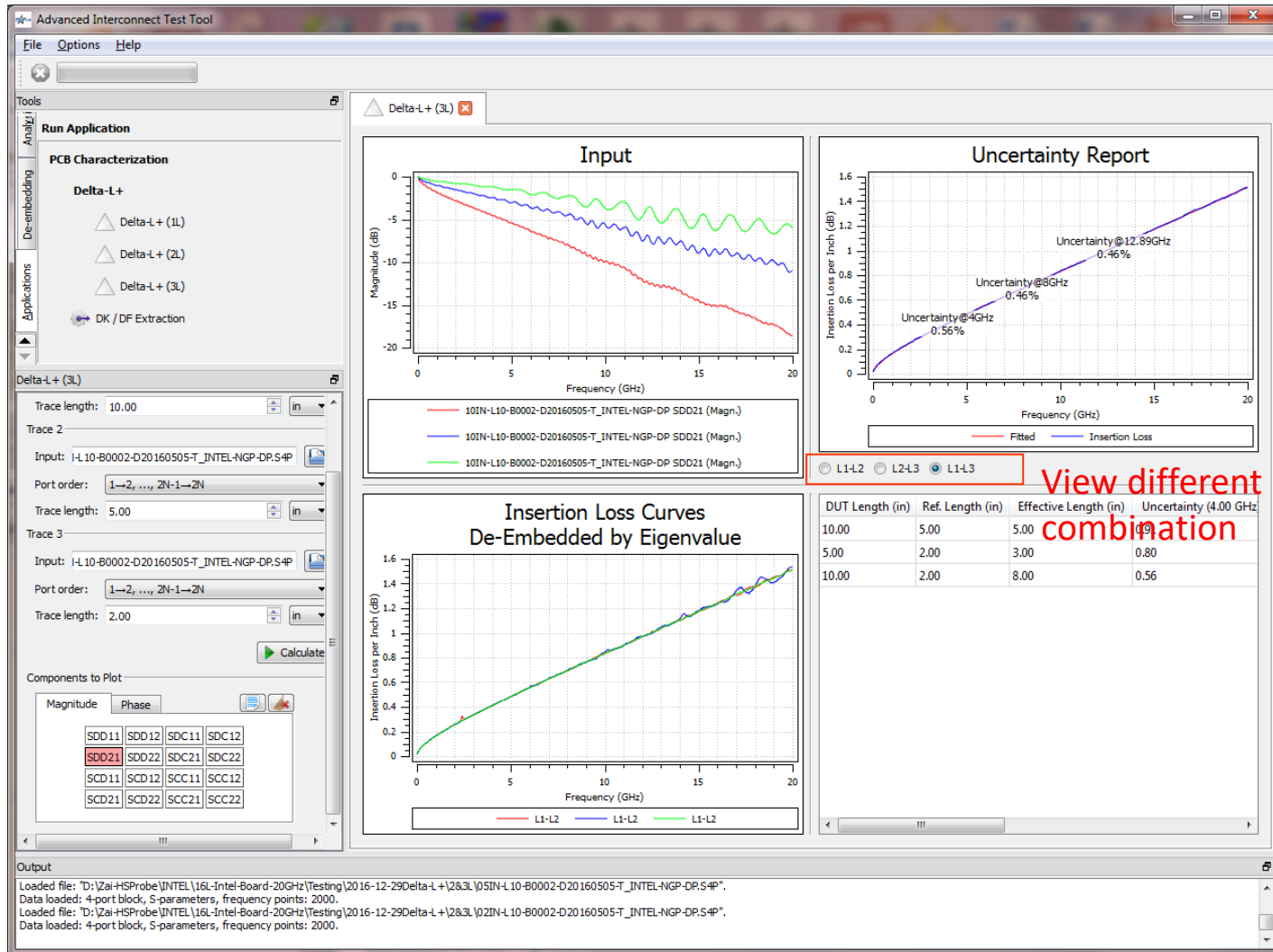
Show Report

20 GHz Differential Delta-L 3.0 (2L)

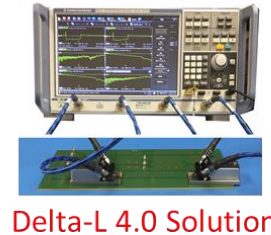
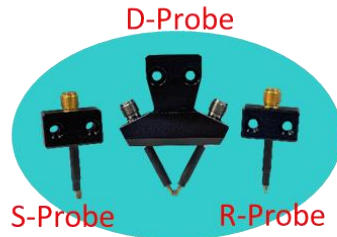


- Make sure to enter trace length

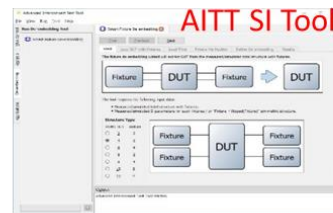
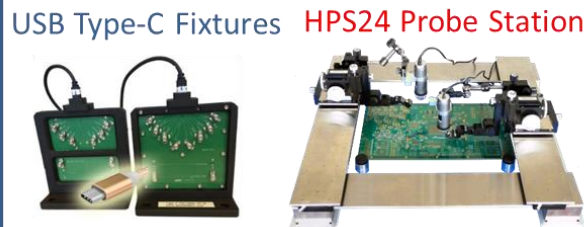
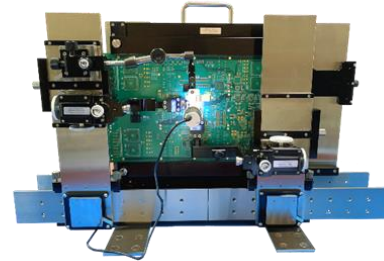
20 GHz Differential Delta-L 3.0 (3L)



PacketMicro Product Offering



VPS10 2-Sided Probe Station



PacketMicro offers one-stop shopping for your needs in PCB probing and SI analysis.

- Rugged 40/30 GHz probes
- Probe Positioners
- DIY Probe Stations
- Junkosha phase-stable cables
- CSS AITT Signal-Integrity Tool
- Dino-Lite Microscopes

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We help make your probing tasks easy!

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- Rugged 30 GHz Single-ended Probes
- Laboratory Rental
- Engineering Services
- Signal Integrity Consulting

Contact:

support@packetmicro.com

Office: 408-675-3900

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