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NEA for AI Package model contribution for GZ41 and GL102 build-up films on substrate, S-Parameters: May 14, 2025

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Abstract: Advanced PCB Microstrip and Stripline designs with via's present significant resonant properties around 90GHz compromising their utility in serving 448Gbps applications for PAM4 modulated signals. The Nyquist frequency of 106GHz requires packaging design concepts for CPC or NPO based signal transmission off a high performance substrate. This contribution re-uses some older instrument grade test vehicles designed for mm wave applications, as an informative view on what is possible.

Substrate Material and package transmission line properties

Microstrip Line		
Material	Frequency (GHz)	Loss (dB/mm)
GZ41	50	0.117
	75	0.171
	100	0.232
GL102	50	0.109
	75	0.158
	100	0.210

Strip Line (with Microstrip Contribution Removed)		
Material	Frequency (GHz)	Loss (dB/mm)
GZ41	50	0.146
	75	0.213
	100	0.245
GL102	50	0.136
	75	0.191
	100	0.260

Microstrip Line
- Signal Layer Top (Layer 1)
- GND Reference (Layer 4)
- Line Width = 260 um
- Dielectric Height ~120 um
- Line Length = 35 mm

Strip Line
- Signal Layer Top (Layer 4)
- GND Reference (Layer 2, Layer 6
- Line Width = 80 um
- Dielectric Height ~120 um
- Line Length = 21.4 mm

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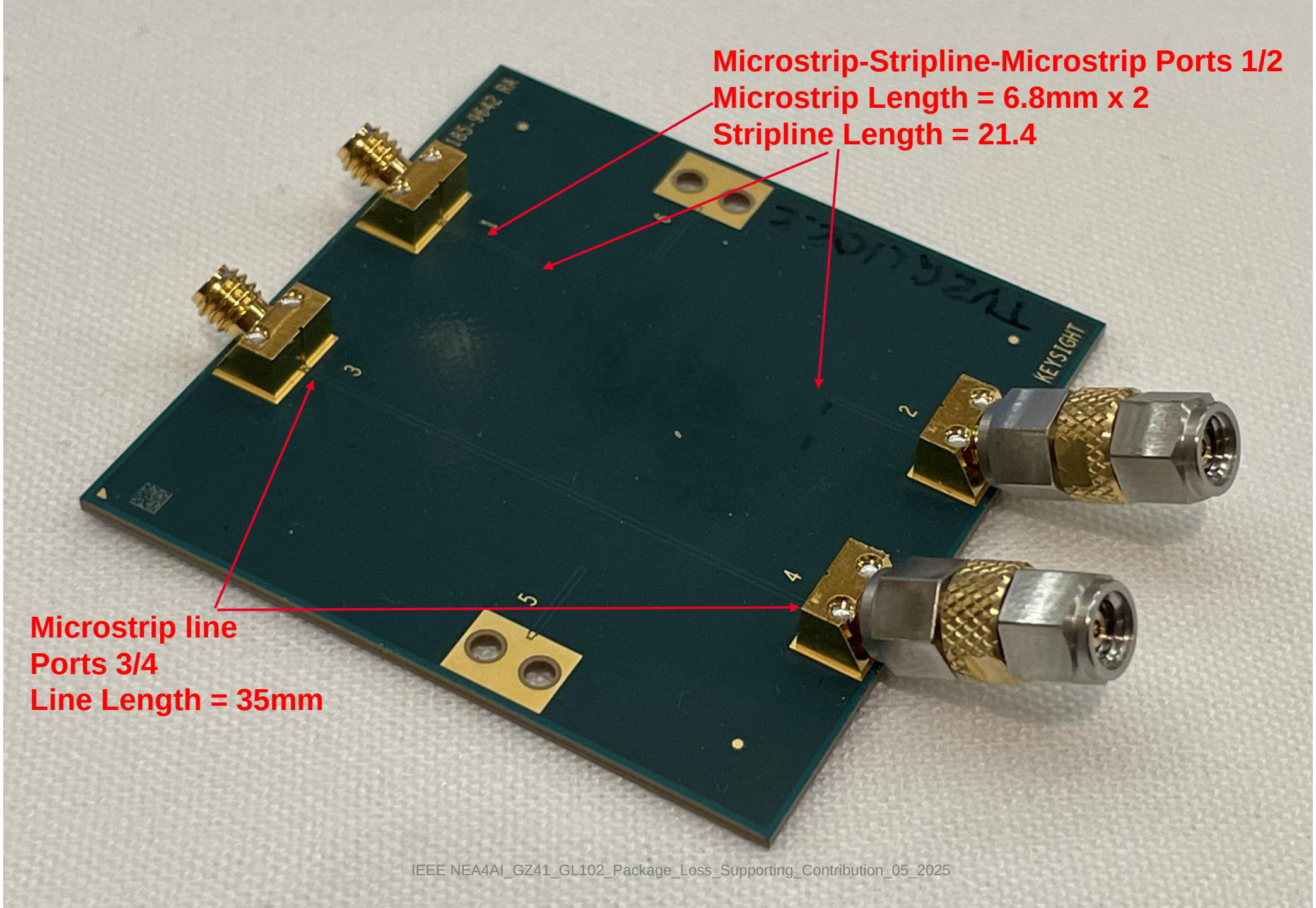
These are thin dielectrics on GZ41 and GL102 substrates, with metal layers stacked every 48u. The via drops down two layers for a total of 96u vertical. It is a controlled impedance structure with flanking ground vias and tuned feeds. The package via is 50u in diameter, with 100u capture pads on each layer. These via's are actually two vias side by side in parallel to reduce the via transition impedance. These structures support 130GHz.


Microstrip-Stripline-Microstrip Ports 1/2
Microstrip Length = 6.8mm x 2
Stripline Length = 21.4
Microstrip line
Ports 3/4
Line Length = 35mm
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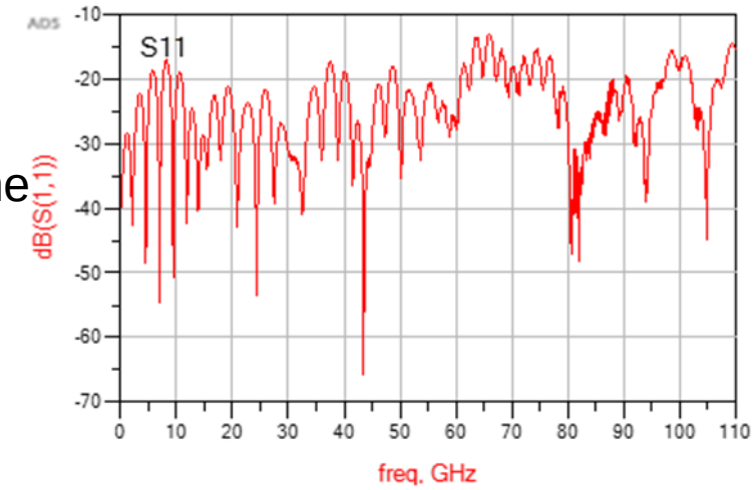
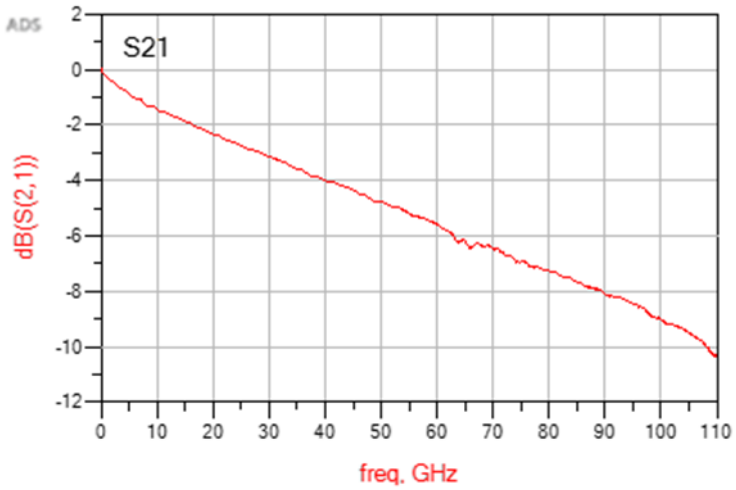
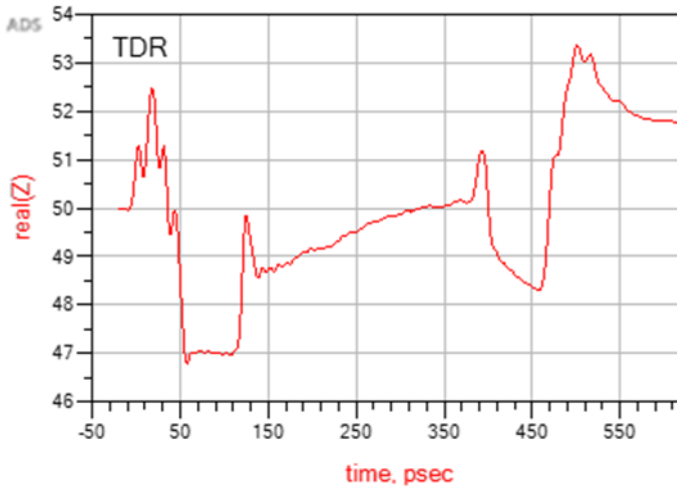
GZ41 Substrate Single-Ended S-Params

tv2gz41_port12.s2p:

Stripline

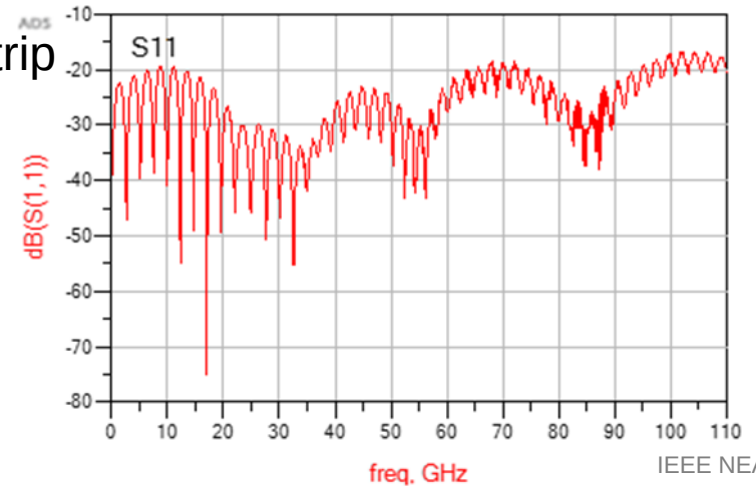


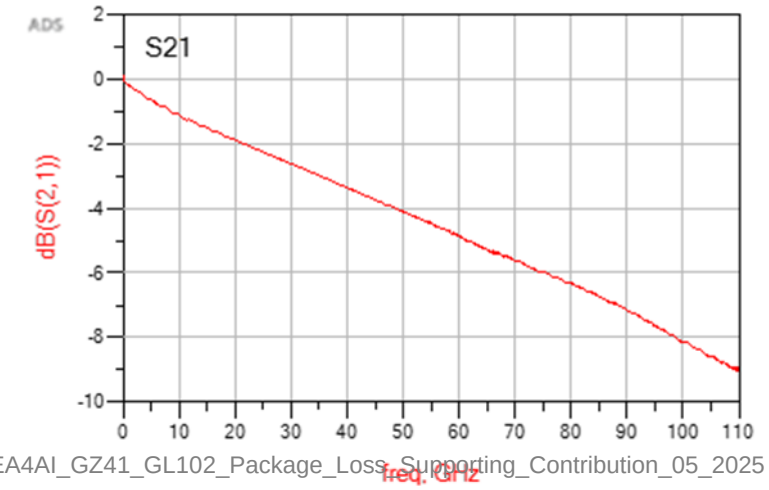


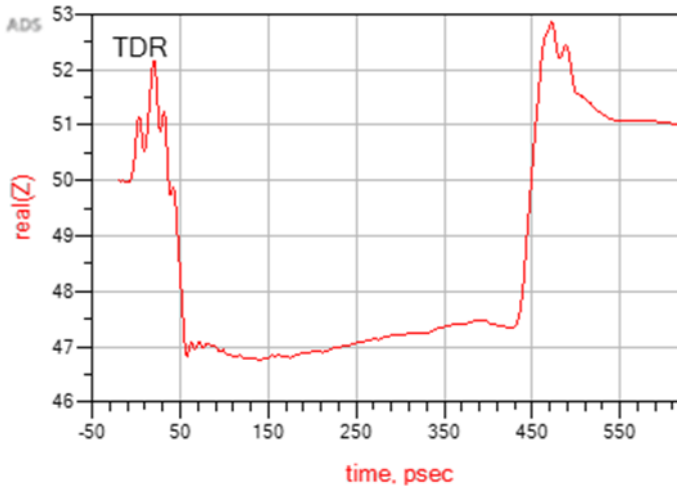


tv2gz41_port34.s2p:

Microstrip



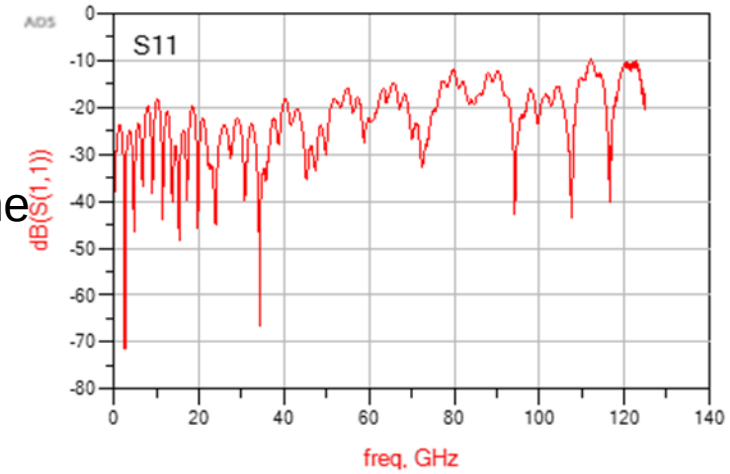


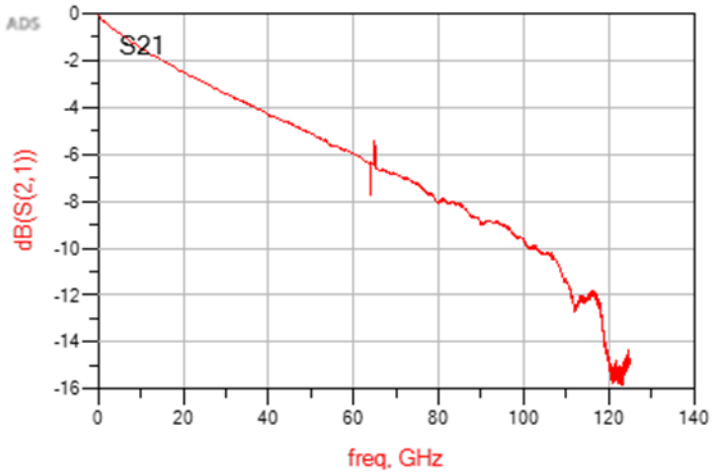


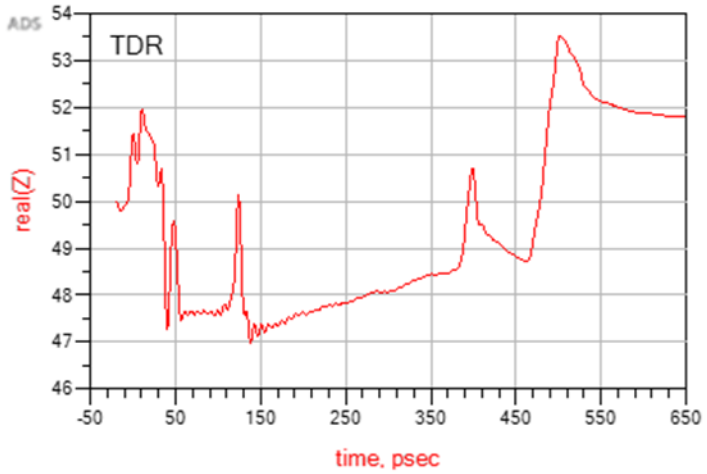
GL102 Substrate Single-Ended S-Params

tv2gl102_port12.s2p:

Stripline

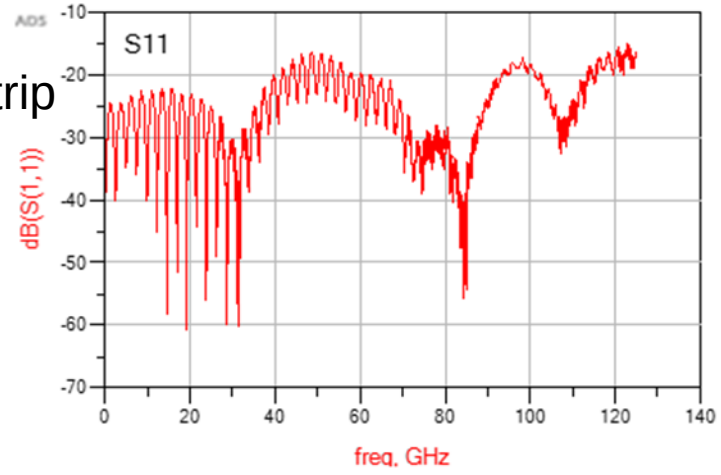


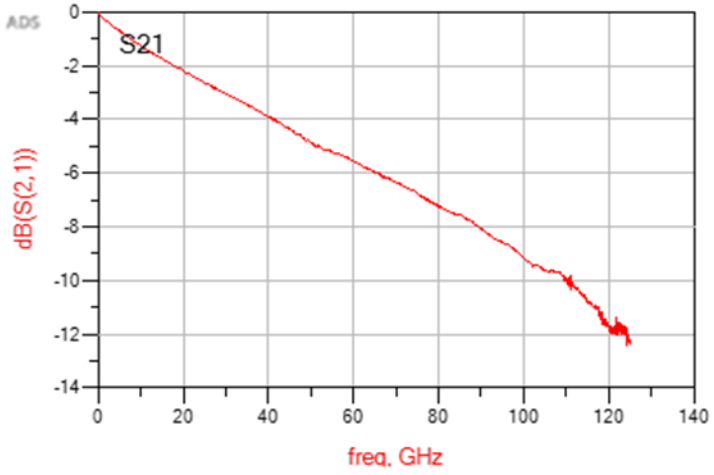


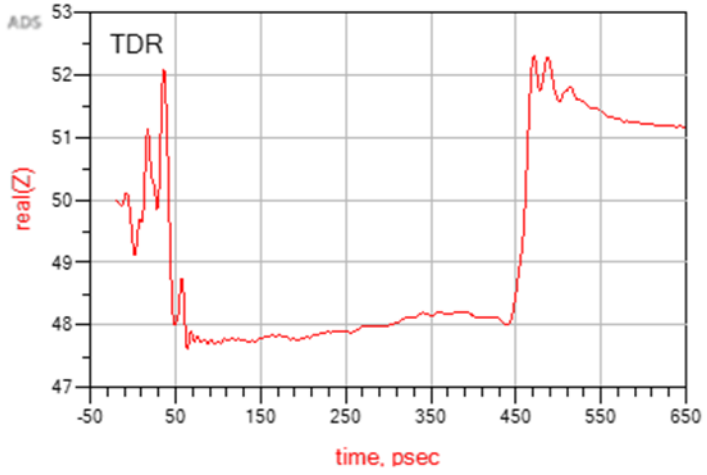


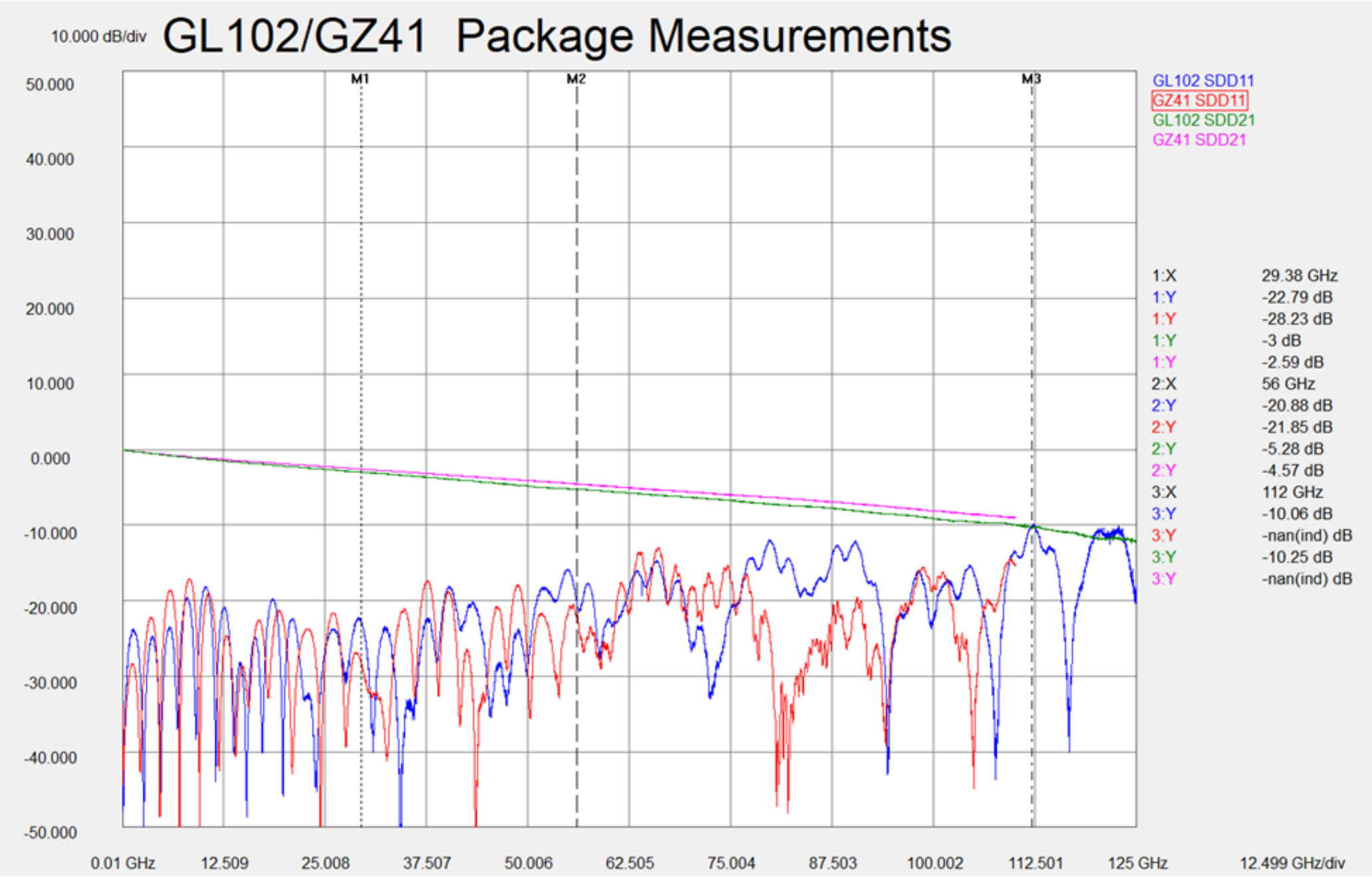
tv2gl102_port3.s2p

Microstrip








10.000 dB/div
GL102/GZ41 Package Measurements
M1
M2
M3
GL102 SDD11
GZ41 SDD11
GL102 SDD21
GZ41 SDD21
1:X 29.38 GHz
1:Y -22.79 dB
1:Y -28.23 dB
1:Y -3 dB
1:Y -2.59 dB
2:X 56 GHz
2:Y -20.88 dB
2:Y -21.85 dB
2:Y -5.28 dB
2:Y -4.57 dB
3:X 112 GHz
3:Y -10.06 dB
3:Y -nan(ind) dB
3:Y -10.25 dB
3:Y -nan(ind) dB
50.000
40.000
30.000
20.000
10.000
0.000
-10.000
-20.000
-30.000
-40.000
-50.000
0.01 GHz
12.509
25.008
37.507
50.006
62.505
75.004
87.503
100.002
112.501
125 GHz
12.499 GHz/div

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Thank you