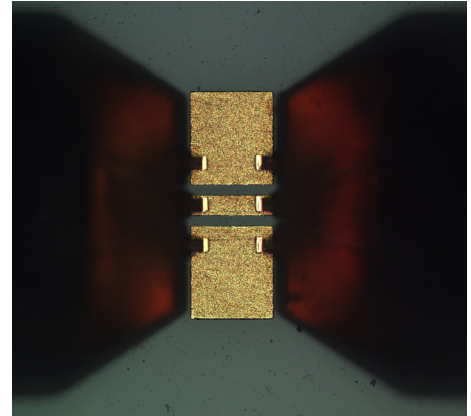


AC-2 Calibration Substrate

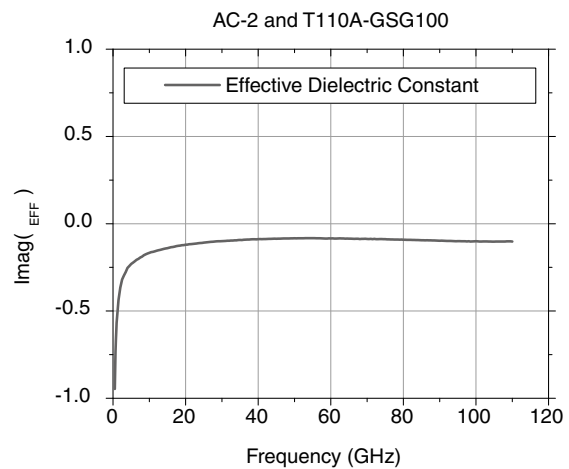
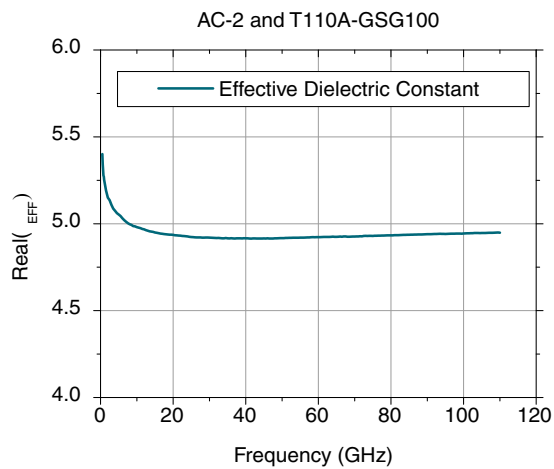
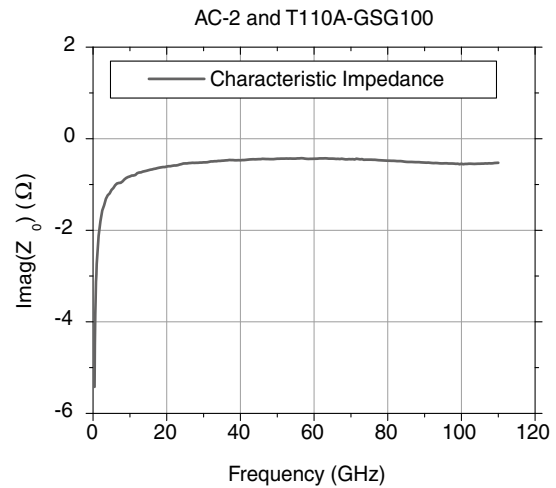
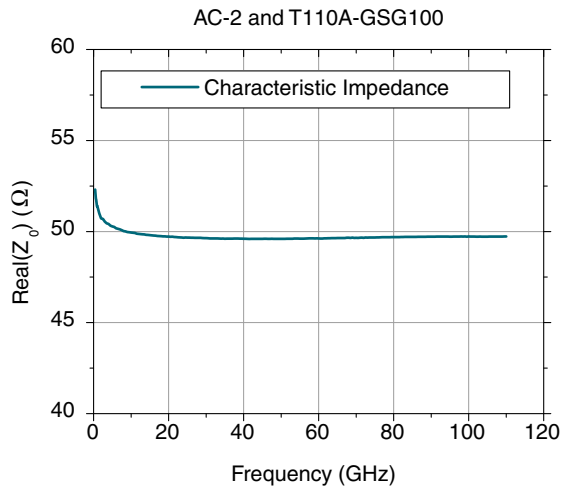
AC-2 calibration substrate is designed to provide accurate probe tip calibration of MPI TITAN™ RF probe family with ground-signal-ground (GSG) probe tips configuration and accommodates 100 to 250 μm probe pitch variation.

It supports industry standard short-open-load-thru (SOLT) calibration method, as well as advanced line-reflect-match (LRM), and thru-reflect-line (TRL). AC-2 contains 26 groups of the lumped standard elements, as well as the full set of coplanar transmission lines for multiline TRL calibration from 5 to 110 GHz.



T110A-GSG100 probes in separation on the AC-2 thru standard after 10 μm overtravel contact.

Typical Electrical Figures



Typical characteristic impedance and the effective dielectric constant of the AC-2 line standard measured using the method of National Institute of Standard and Technologies (NIST, Boulder, CO, USA) [1, 2].

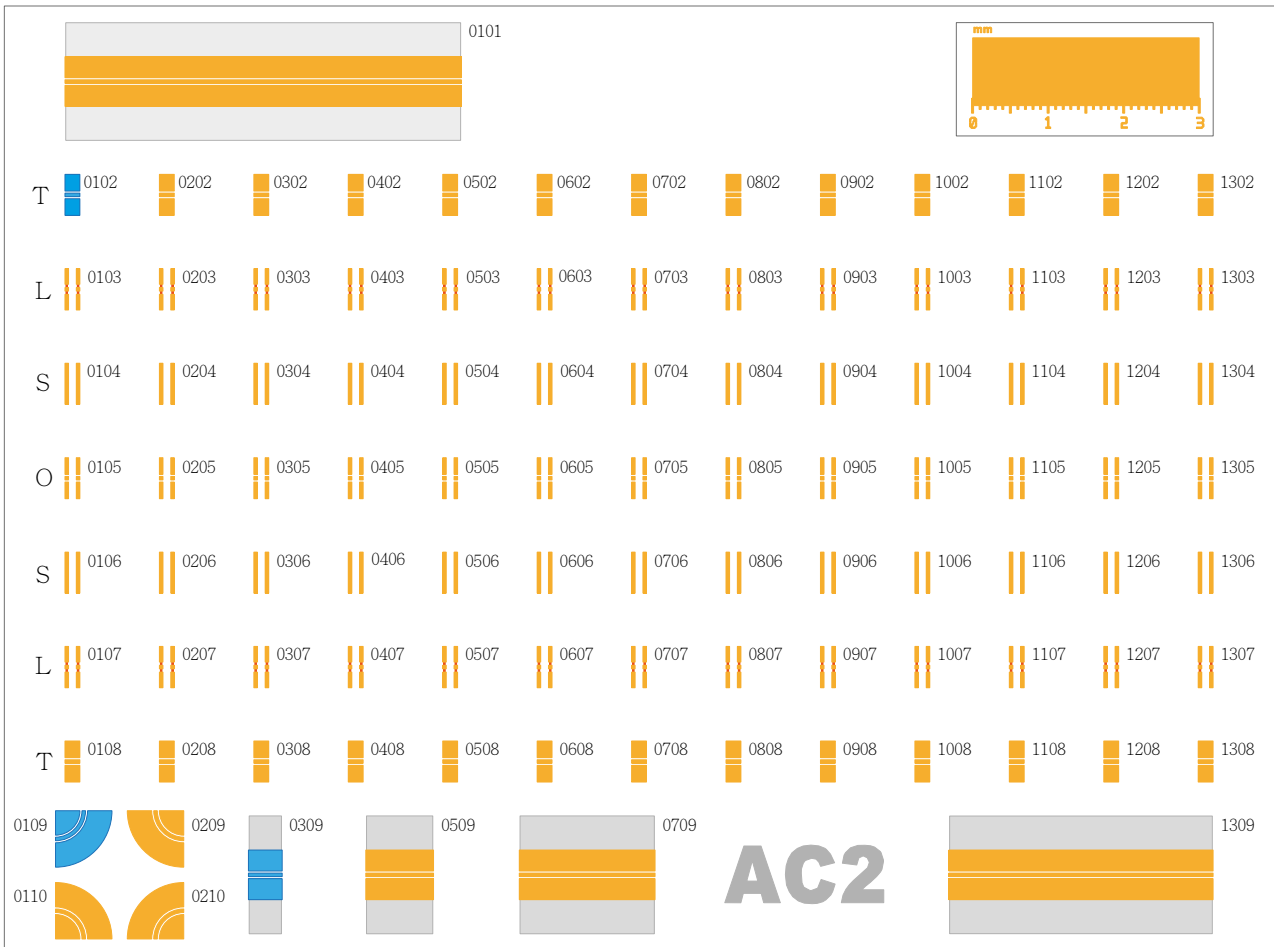
Substrate Characteristics

Material	Alumina
Size	16.5 x 12.5 mm
Thickness	635 μm
Design or standards	Coplanar
Probe configuration	GSG
Supported probe pitch	100 to 250 μm
Number of lumped standard groups	26
Number of calibration and verification lines	5
Calibration verification elements	yes
Supported calibration methods	SOLT, LRM, SOLR, TRL and multiline TRL
Typical resistance of the load	50 Ω
Typical load trimming accuracy error	$\pm 0.3 \%$
Open standard	Au pads on substrate
Ruler scale	0 to 3 mm
Ruler step size	100 μm
Recommended overtravel for TITAN™ probes	10 μm

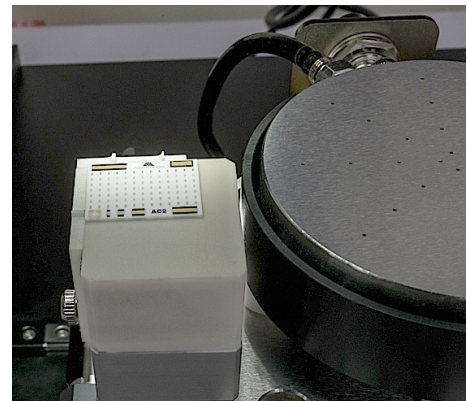
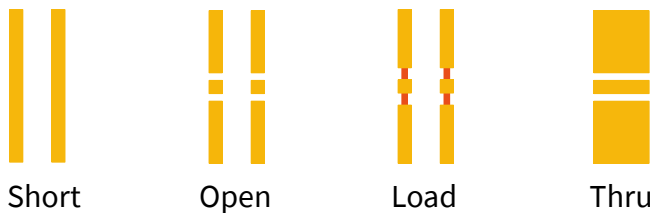
Electrical Characteristics of CPW Line Standards

Nominal capacitance per unit length, pF/cm	1.492
Nominal characteristic impedance @20 GHz	50 Ω
Effective dielectric constant @20 GHz, real part	4.94
Effective velocity factor @20 GHz	0.45
Parameters of the simplified model of line losses	
Reference loss, dB	0.34
Reference delay, ps	25.5
Reference frequency, GHz	20
Electrical length of line, ps	
Thru	1.10
Line 1 (0309)	3.00
Line 2 (0509)	6.50
Line 3 (0709)	13.00
Line 4 (1309)	25.50
Line 5 (0101)	38.50

Substrate Layout



*Location reference elements are marked blue.



AC-2 calibration substrate on ceramic AUX chuck of TS50 manual probe system.

Reference Elements

Name	X μm	Y μm	Location Reference	Spacing μm	Note
0102	0	0	0102	150	Reference for SOLT/LRM elements
0309	2425	8945	0102	400	Reference for TRL line elements
0109	-125	8425	0102	--	Reference for reciprocal elements

Thru Standards

Name	Type	X μm	Y μm	Location Reference	Spacing μm	Length μm
0102	THRU	0	0	0102	150	200
0202	THRU	1250	0	0102	150	200
0302	THRU	2500	0	0102	150	200
0402	THRU	3750	0	0102	150	200
0502	THRU	5000	0	0102	150	200
0602	THRU	6250	0	0102	150	200
0702	THRU	7500	0	0102	150	200
0802	THRU	8750	0	0102	150	200
0902	THRU	10000	0	0102	150	200
1002	THRU	11250	0	0102	150	200
1102	THRU	12500	0	0102	150	200
1202	THRU	13750	0	0102	150	200
1302	THRU	15000	0	0102	150	200
0108	THRU	0	7500	0102	150	200
0208	THRU	1250	7500	0102	150	200
0308	THRU	2500	7500	0102	150	200
0408	THRU	3750	7500	0102	150	200
0508	THRU	5000	7500	0102	150	200
0608	THRU	6250	7500	0102	150	200
0708	THRU	7500	7500	0102	150	200
0808	THRU	8750	7500	0102	150	200
0908	THRU	10000	7500	0102	150	200
1008	THRU	11250	7500	0102	150	200
1108	THRU	12500	7500	0102	150	200
1208	THRU	13750	7500	0102	150	200
1308	THRU	15000	7500	0102	150	200

Line Standards

Name	Type	X μm	Y μm	Location Reference	Spacing μm	Length μm	Δl	Note
0309	LINE	2425	8945	0102	400	450	250	For Multi-TRL
0509	LINE	1555	0	0309	850	900	700	For Multi-TRL
0709	LINE	3585	0	0309	1750	1800	1600	For Multi-TRL
1309	LINE	9270	0	0309	3450	3500	3300	For Multi-TRL
0101	LINE	0	-1555	0102	5200	5250	5050	For Multi-TRL

Load Standards

Name	Type	X μm	Y μm	Location Reference	Spacing μm
0103	LOAD	0	1250	0102	150
0203	LOAD	1250	1250	0102	150
0303	LOAD	2500	1250	0102	150
0403	LOAD	3750	1250	0102	150
0503	LOAD	5000	1250	0102	150
0603	LOAD	6250	1250	0102	150
0703	LOAD	7500	1250	0102	150
0803	LOAD	8750	1250	0102	150
0903	LOAD	10000	1250	0102	150
1003	LOAD	11250	1250	0102	150
1103	LOAD	12500	1250	0102	150
1203	LOAD	13750	1250	0102	150
1303	LOAD	15000	1250	0102	150
0107	LOAD	0	6250	0102	150
0207	LOAD	1250	6250	0102	150
0307	LOAD	2500	6250	0102	150
0407	LOAD	3750	6250	0102	150
0507	LOAD	5000	6250	0102	150
0607	LOAD	6250	6250	0102	150
0707	LOAD	7500	6250	0102	150
0807	LOAD	8750	6250	0102	150
0907	LOAD	10000	6250	0102	150
1007	LOAD	11250	6250	0102	150
1107	LOAD	12500	6250	0102	150
1207	LOAD	13750	6250	0102	150
1307	LOAD	15000	6250	0102	150

Short Standards

Name	Type	X μm	Y μm	Location Reference	Spacing μm
0104	SHORT	0	2500	0102	150
0204	SHORT	1250	2500	0102	150
0304	SHORT	2500	2500	0102	150
0404	SHORT	3750	2500	0102	150
0504	SHORT	5000	2500	0102	150
0604	SHORT	6250	2500	0102	150
0704	SHORT	7500	2500	0102	150
0804	SHORT	8750	2500	0102	150
0904	SHORT	10000	2500	0102	150
1004	SHORT	11250	2500	0102	150
1104	SHORT	12500	2500	0102	150
1204	SHORT	13750	2500	0102	150
1304	SHORT	15000	2500	0102	150
0106	SHORT	0	5000	0102	150
0206	SHORT	1250	5000	0102	150
0306	SHORT	2500	5000	0102	150
0406	SHORT	3750	5000	0102	150
0506	SHORT	5000	5000	0102	150
0606	SHORT	6250	5000	0102	150
0706	SHORT	7500	5000	0102	150
0806	SHORT	8750	5000	0102	150
0906	SHORT	10000	5000	0102	150
1006	SHORT	11250	5000	0102	150
1106	SHORT	12500	5000	0102	150
1206	SHORT	13750	5000	0102	150
1306	SHORT	15000	5000	0102	150

Open Standards

Name	Type	X μm	Y μm	Location Reference	Spacing μm
0105	OPEN	0	3750	0102	150
0205	OPEN	1250	3750	0102	150
0305	OPEN	2500	3750	0102	150
0405	OPEN	3750	3750	0102	150
0505	OPEN	5000	3750	0102	150
0605	OPEN	6250	3750	0102	150
0705	OPEN	7500	3750	0102	150
0805	OPEN	8750	3750	0102	150
0905	OPEN	10000	3750	0102	150
1005	OPEN	11250	3750	0102	150
1105	OPEN	12500	3750	0102	150
1205	OPEN	13750	3750	0102	150
1305	OPEN	15000	3750	0102	150

References

- [1] R. B. Marks and D. F. Williams, "Characteristic impedance determination using propagation constant measurement," IEEE Microwave and Guided Wave Letters, vol. 1, pp. 141-143, June 1991.
- [2] D. F. Williams and R. B. Marks, "Transmission line capacitance measurement," Microwave and Guided Wave Letters, IEEE, vol. 1, pp. 243-245, 1991.

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