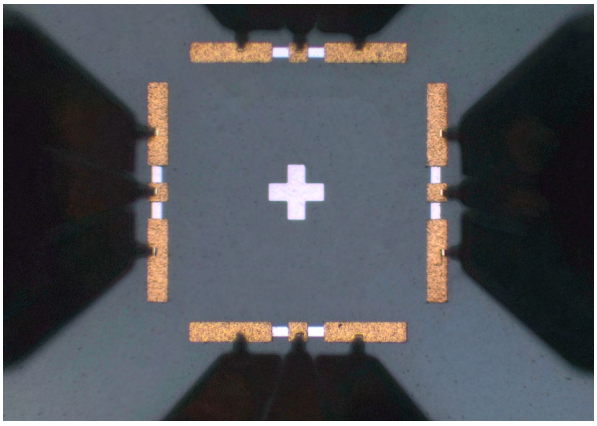
TCS-GSG-0100-0250-SOLR Calibration Substrate

The MPI TITAN™ TCS-GSG-0100-0250-SOLR Calibration Substrate was designed to simplify and support one, two, three, and four-port calibrations of single-ended GSG TITAN™ RF probes in rectangular north-south-east-west configurations. Short, Open, Load, Thru and Right Angle Thru structures are patterned to match the four sides of a typical die or circuit to ease the calibration process. A convenient alignment structure (#0001) and reference marks provide visual cues to the operator to ensure accurate and repeatable measurements. The TCS-GSG-0100-0250-SOLR supports GSG probe tip calibrations up to 120 GHz.



T110A-GSG150-RC probes in separation on the TCS-GSG-0100-0250-SOLR load standard after 10 µm overtravel contact.

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	10
Calibration verification elements	yes
Supported calibration methods	SOL(OSM), TMR, TMRR, LRM, TOSM/SOLT and SOLR(UMSO)
Typical resistance of the load	50 Ω
Typical load trimming accuracy error	± 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	5.16
90DEG-Thru	3.98

PROBE PLANARIZATION

MPI TITAN™ RF probes deliver excellent and real time visibility of the tip contacts, due to the unique protrusion tip design. Accurate positioning of the RF probe on calibration standards or DUT pads is even possible for inexperienced operators.

TITAN™ probes are very robust, however, excessive over travel can damage them. Use care when lowering probe. To planarize the probe, we recommend using the bare gold area of the calibration substrate or the dedicated contact substrate PN TCS-1 (Figure 1).

While monitoring the probe tips under a high resolution microscope, adjust the Z height to bring the probe tips into contact with the surface. The probe is in contact with the pad surface when the probe tips begin to skate forward. After contacting the surface, raise the probe and check the probe marks. If the probe tips are parallel to the pad surface, you should see a uniform probe mark for each tip (Figure 2). If the probe tips are not parallel to surface (Figure 3), rotate planarity knob on positioner and recheck probe marks (Figure 4). This may take several attempts.

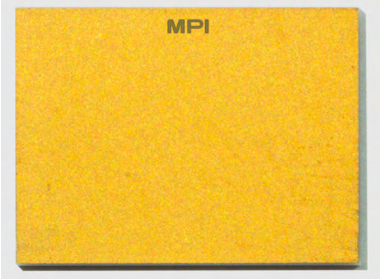


Figure 1. TITAN™ Probe contact substrate TCS-1.

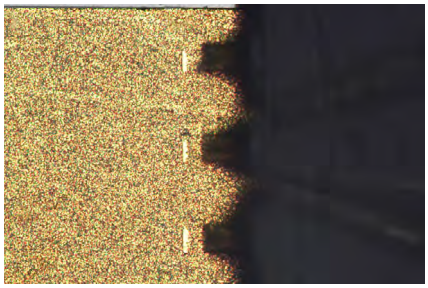


Figure 2. Image of probe marks of Planarized probe.

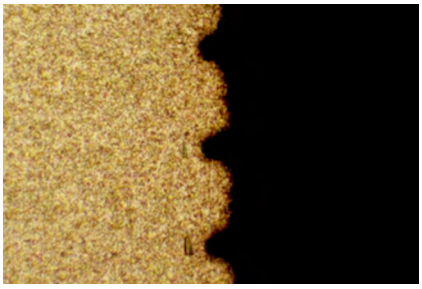


Figure 3. Image of probe that is not parallel to surface.

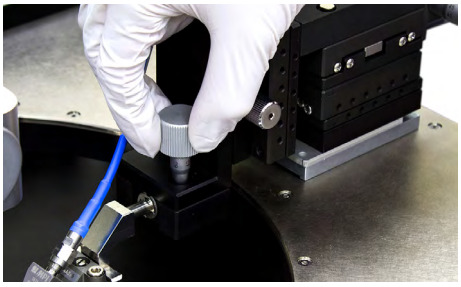
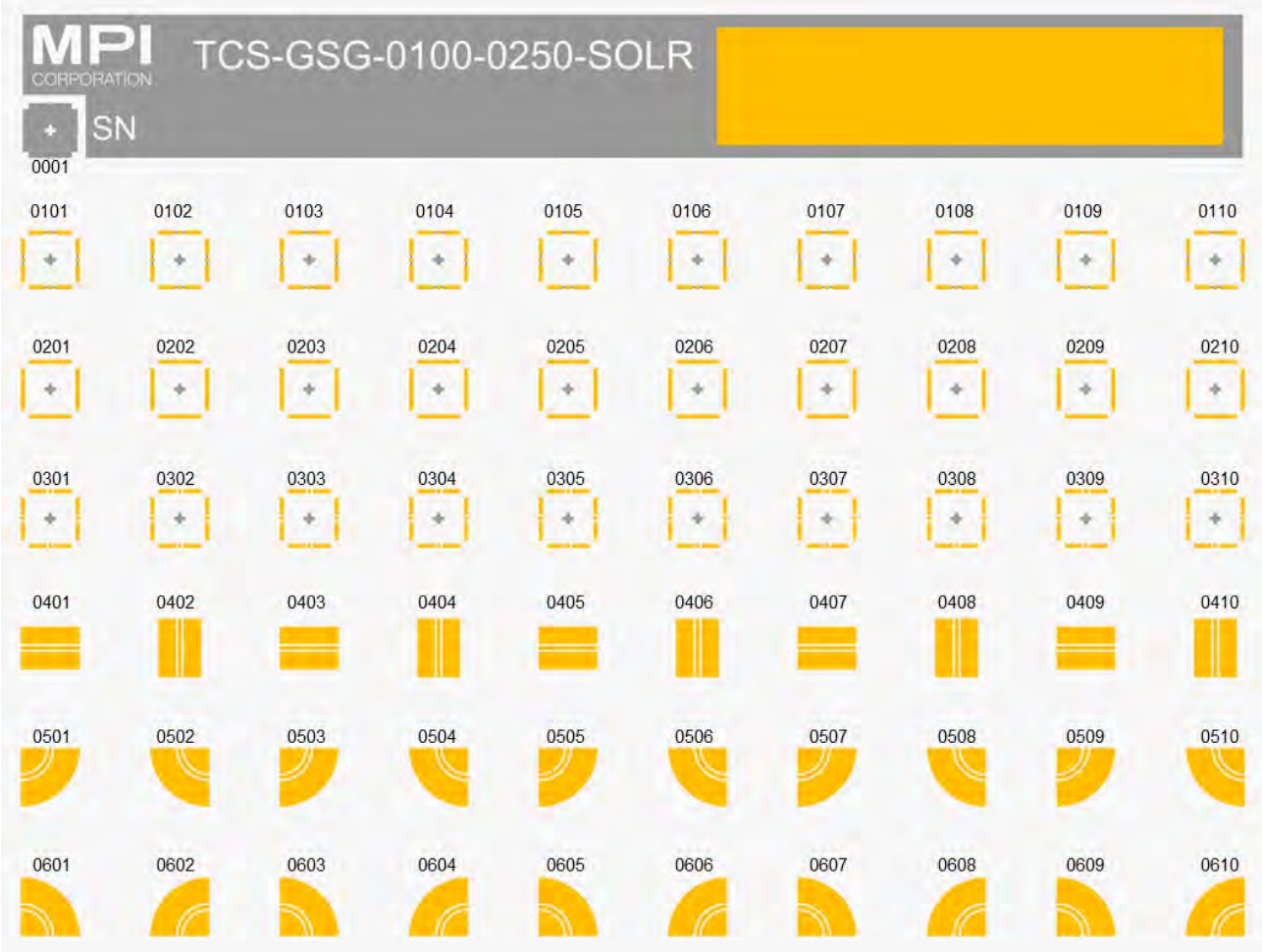


Figure 4. Planarization of TITAN™ Probes.

SUBSTRATE LAYOUT



STANDARD ELEMENTS

One-Port Standards

Load

Open

Short

Thru Standards

Reciprocal Thru Standards

STANDARDS

Probe Alignment Elements

Name	Type	X µm	Y µm	Location Reference	Spacing µm	Length µm
0001	Alignment Mark	1650	0	0101	717	747

Load Standards

Name	Type	X µm	Y µm	Location Reference	Spacing µm	Length µm
0101	Load	0	0	0101	717	747
0102	Load	1650	0	0101	717	747
0103	Load	3300	0	0101	717	747
0104	Load	4950	0	0101	717	747
0105	Load	6600	0	0101	717	747
0106	Load	8250	0	0101	717	747
0107	Load	9900	0	0101	717	747
0108	Load	11550	0	0101	717	747
0109	Load	13200	0	0101	717	747
0110	Load	14850	0	0101	717	747

Short Standards

Name	Type	X µm	Y µm	Location Reference	Spacing µm	Length µm
0201	Short	0	-1650	0101	717	747
0202	Short	1650	-1650	0101	717	747
0203	Short	3300	-1650	0101	717	747
0204	Short	4950	-1650	0101	717	747
0205	Short	6600	-1650	0101	717	747
0206	Short	8250	-1650	0101	717	747
0207	Short	9900	-1650	0101	717	747
0208	Short	11550	-1650	0101	717	747
0209	Short	13200	-1650	0101	717	747
0210	Short	14850	-1650	0101	717	747

Open Standards

Name	Type	X µm	Y µm	Location Reference	Spacing µm	Length µm
0301	Open	0	-3300	0101	717	747
0302	Open	1650	-3300	0101	717	747
0303	Open	3300	-3300	0101	717	747
0304	Open	4950	-3300	0101	717	747
0305	Open	6600	-3300	0101	717	747
0306	Open	8250	-3300	0101	717	747
0307	Open	9900	-3300	0101	717	747
0308	Open	11550	-3300	0101	717	747
0309	Open	13200	-3300	0101	717	747
0310	Open	14850	-3300	0101	717	747

Thru Standards

Name	Type	X µm	Y µm	Location Reference	Spacing µm	Length µm
0401	Thru	0	-4950	0101	717	747
0402	Thru	1650	-4950	0101	717	747
0403	Thru	3300	-4950	0101	717	747
0404	Thru	4950	-4950	0101	717	747
0405	Thru	6600	-4950	0101	717	747
0406	Thru	8250	-4950	0101	717	747
0407	Thru	9900	-4950	0101	717	747
0408	Thru	11550	-4950	0101	717	747
0409	Thru	13200	-4950	0101	717	747
0410	Thru	14850	-4950	0101	717	747

90deg-Thru Standards

Name	Type	X µm	Y µm	Location Reference	Spacing µm	Length µm
0501	90deg-Thru	0	-6600	0101	537	587
0502	90deg-Thru	1650	-6600	0101	537	587
0503	90deg-Thru	3300	-6600	0101	537	587
0504	90deg-Thru	4950	-6600	0101	537	587
0505	90deg-Thru	6600	-6600	0101	537	587
0506	90deg-Thru	8250	-6600	0101	537	587
0507	90deg-Thru	9900	-6600	0101	537	587
0508	90deg-Thru	11550	-6600	0101	537	587
0509	90deg-Thru	13200	-6600	0101	537	587
0510	90deg-Thru	14850	-6600	0101	537	587
0601	90deg-Thru	0	-8250	0101	537	587
0602	90deg-Thru	1650	-8250	0101	537	587
0603	90deg-Thru	3300	-8250	0101	537	587
0604	90deg-Thru	4950	-8250	0101	537	587
0605	90deg-Thru	6600	-8250	0101	537	587
0606	90deg-Thru	8250	-8250	0101	537	587
0607	90deg-Thru	9900	-8250	0101	537	587
0608	90deg-Thru	11550	-8250	0101	537	587
0609	90deg-Thru	13200	-8250	0101	537	587
0610	90deg-Thru	14850	-8250	0101	537	587

ELECTRICAL MODELS OF CALIBRATION STANDARDS

GSG Configuration

Model	C-Open, fF	L-Short, pH	L-Term, pH
100	5.8	-0.1	-5.8
125	6.0	3.3	-3.5
150	6.1	5.8	-1.0
175	6.2	7.4	-0.3
200	6.2	9.0	0.5
225	6.7	13.3	2.5
250	7.1	18.0	4.6

GSG Configuration, for the Keysight VNA

	Open	Short	Load*		
Model	C, fF	L, pH	R, Ohm	Offset Z_0, Ohm	Offset delay, ps
100	5.8	-0.1	50	500	-0.01172
125	6.0	3.3	50	500	-0.00707
150	6.1	5.8	50	500	-0.00202
175	6.2	7.4	50	500	-0.00061
200	6.2	9.0	50	500	0.00101
225	6.7	13.3	50	500	0.00505
250	7.1	18.0	50	500	0.00929

**Use both offset impedance and offset delay parameters.*

Reduced Contact Width (RC) Configuration

Model	C-Open, fF	L-Short, pH	L-Term, pH
100	6.0	3.1	-7.2
125	5.9	4.3	-5.1
150	5.8	5.5	-3.0
175	5.7	6.7	-0.9
200	5.6	7.4	1.2
225	5.5	8.4	3.3
250	5.4	9.5	5.4

Reduced Contact Width (RC) Configuration, for the Keysight VNA

	Open	Short	Load*		
Model	C, fF	L, pH	R, Ohm	Offset Z_0, Ohm	Offset delay, ps
100	6.0	3.1	50	500	-0.01455
125	5.9	4.3	50	500	-0.01030
150	5.8	5.5	50	500	-0.00606
175	5.7	6.7	50	500	-0.00182
200	5.6	7.4	50	500	0.00242
225	5.5	8.4	50	500	0.00667
250	5.4	9.5	50	500	0.01091

**Use both offset impedance and offset delay parameters.*

See MPI Corporation's Terms and Conditions of Sale for more details.

Direct contact:
Asia region: ast-asia@mpi-corporation.com
EMEA region: ast-europe@mpi-corporation.com
America region: ast-americas@mpi-corporation.com

MPI global presence: for your local support, please find the right contact here:
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MPI Global Presence