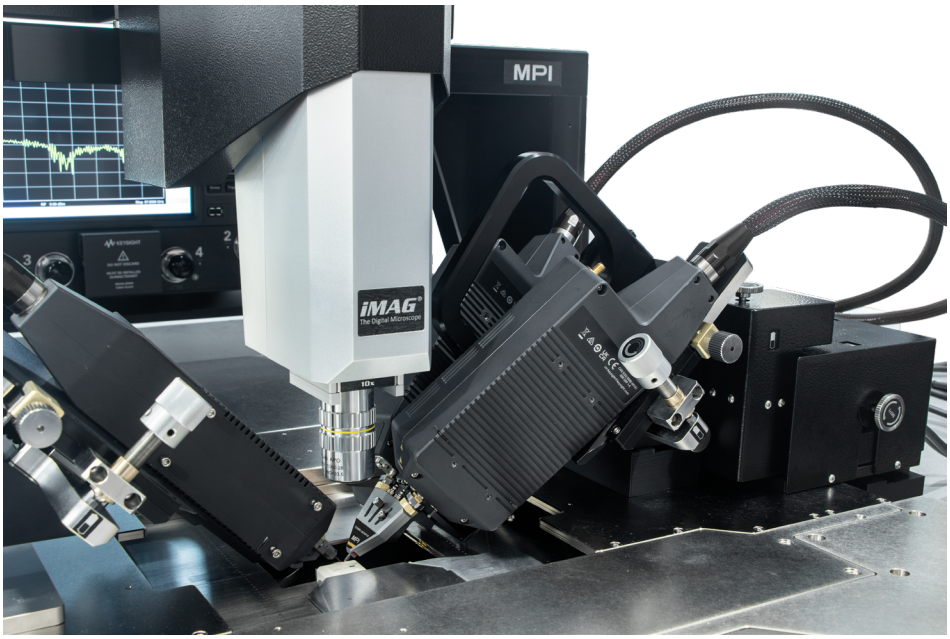
Preliminary Datasheet

TITAN™ Probes for Extra-Broadband DC...250 GHz Characterization with Keysight PNA-X NA5305A/7A Extenders



In partnership with Keysight Technologies, MPI Corporation introduces an advanced solution for wafer-level, single-sweep broadband characterization of devices and mmWave ICs. This co-development combines MPI's renowned TITAN™ Probe technology and system expertise with the new Keysight PNA-X frequency extenders to deliver a seamlessly integrated solution for single-sweep measurements from DC up to 250 GHz.

The new mmWave TITAN™ Probe models, engineered for maximum stability, accuracy, and superior tip visibility, feature a ruggedized 0.5 mm coaxial interface and an integrated tip protector. These innovations safeguard against accidental damage and ensure consistent performance with every touchdown. The dedicated TITAN™ Probe models with enhanced 0.8 mm coaxial connectors support measurements up to 167 GHz, offering a cost-effective solution when full broadband sweep capability is not required.

The carefully designed integration of Keysight's NA5305A/7A PNA-X extenders further enables fast setup, straightforward reconfiguration, and robust protection of sensitive components, securing the user's investment while ensuring full utilization of system capabilities. With this joint solution, MPI probe systems together with mmWave TITAN™ Probes support both single-ended and differential measurements using the Keysight NA5305A (170 GHz) and NA5307A (250 GHz) PNA-X frequency extenders.

BENEFITS

The unique MEMS tips of the mmWave TITAN™ Probe family, combined with the innovative probe body design and carefully engineered user experience, deliver a wide range of benefits, not only for measurement accuracy but also for seamless installation, effortless system reconfiguration, and reliable protection of the most sensitive parts of the probes and the system, safeguarding the customer investment.

- **Ultra-broadband coverage**
  DC to 250 GHz frequency range for seamless direct-mount integration with the NA5307A PNA-X frequency extenders in two-port and four-port configurations with T250MAK-GSGXXXX and T250MSK-GSGSGXXXX TITAN™ probes, respectively. DC to 167 GHz is possible with the single-ended T167MAK-GSGXXXX and the dual T167MSK-GSGSGXXXX TITAN™ probes and NA5305A PNA-X frequency extenders.

- **Highest possible measurement dynamic range**
  The 250 GHz TITAN™ probes incorporate a ruggedized 250 GHz 0.5 mm female connector for direct probe mounting on the extender port. A direct mount without the need for extra cabling means the shortest possible RF path to the DUT, resulting in minimal insertion loss, and maximum directivity and power delivery, while ensuring best-in-class mmWave performance.

- **Superior repeatability and reproducibility of calibration and measurements**
  Excellent probe tip visibility enhances data reproducibility at the highest frequencies. MPI's unique protrusion MEMS tip design and manufacturing processes make it easy for operators to have highly accurate positioning of the RF probe on calibration standards or DUT pads—even for inexperienced operators. Benchmark positioning repeatability on automated systems with SENTIO® ContactSense™ feature.

- **Safeguard probe tips and maximized investment**
  Retractable (on dual GSGSG probes) and removable (on single-ended GSG probes) Tip Protector to guard probe tips during setup, handling, system idle time and storage. Ruggedized 250 GHz 0.5 mm female connector: durable, robust interface.

- **Ergonomic and risk-free system setup and configuration**
  Thoughtful integration of probes and frequency extenders on a vast variety of MPI probe system platforms. Ergonomic extender "lounge" and integrated probe-to-extender alignment guides for fast, reliable and confident equipment assembly.

- **Ideal data correlation by proven TITAN mmWave Probe broadband tip performance**
  Built on the legacy of our DC-220 GHz T220MA and T220MS single-ended and dual TITAN™ Probes to deliver reliable, repeatable results for the world's most demanding applications. Ideal and optimized data correlation across the entire TITAN™ mmWave Probe family offering 67 GHz, 120 GHz, 145 GHz, 165 GHz, 167 GHz and 250 GHz probes in both single-ended and dual/differential configurations.

- **Cost-effective testing up to 167 GHz with maximum system performance**
  The single-ended T167MAK-GSGXXXX and dual T167MSK-GSGSGXXXX TITAN™ Probes use a cost-effective 0.8 mm (f) coaxial connector and are designed for direct mounting on the Keysight NA5305A/7A PNA-X frequency extenders in combination with the ruggedized 0.5 mm (f) to 0.8 mm (m) adapter (Keysight PN Y1921H, or Spinner PN BN 535153). The DC-167 GHz probe models significantly reduce the cost of testing while maintaining superior user experience and uncompromised system performance.

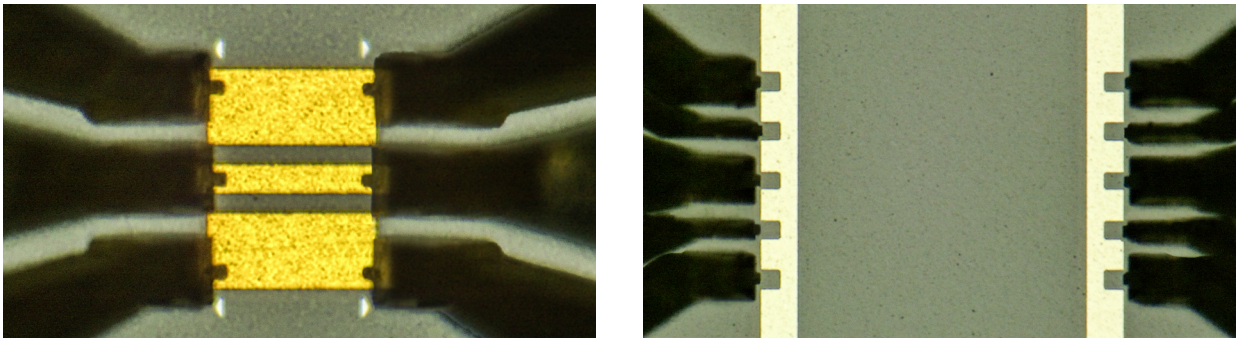
- **Confidence when probing on all types of surfaces and metallization types**
  Robust and flexible nickel-alloy coplanar MEMS tips provide superior individual tip compliance. Applicable on all types of pad metal, e.g. gold, copper, aluminum, and more. One probe for all pad surface types including wafers, ICs, PCBs, BGAs, bumps, and rough or uneven surfaces.

- **Most accurate calibration results on dedicated calibration substrates**
  Optimized with MPI TITAN™ dual TCS-GSGSG-XXXX-XXXX and single-ended TCS-050-100-W calibration substrates for accurate probe tip calibration up 250 GHz including the NIST multiline TRL and TMRR calibration methods. Standards are designed following PlanarCal guidance [1]. Unique traceable calibration on TCS-050-100-W calibration substrate [2] and consistent calibration with minimized crosstalk on dual TCS-GSGSG-XXXX-XXXX calibration substrates with the pair-terminated standards [3]. Simple calibration verification on TCS-050-100-W with symmetrical attenuators.

- **Engineered for Advanced Devices**
  Ideal for broadband PDK model parameters extraction and verification, testing amplifiers, drivers, mixers, frequency multipliers, phase shifters, and high-speed digital ICs in the most demanding research and production environments.

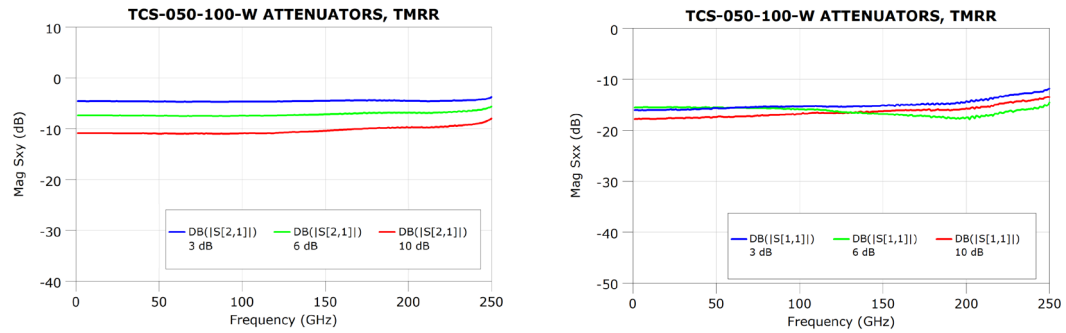
BENCHMARKING TIP VISIBILITY AND DATA REPRODUCIBILITY

For more than 10 years, MPI has consistently led the industry in highlighting the importance of RF probe tip visibility for accurate probe placement on device pads. Accurate positioning on both device pads and calibration standards is the most critical factor for achieving repeatable and reproducible measurements and reliable system calibration. Being able to see the exact point of contact enables highly accurate probe tip positioning even for less experienced operators. The importance of probe placement repeatability becomes even more pronounced at higher frequencies and is most critical for measurements and calibrations at 250 GHz. The innovative protruding 3D MEMS tip design, pioneered by MPI's TITAN™ Probes, set the industry benchmark for real-time visibility of probe contacts more than a decade ago. Today, TITAN™ Probes continue to serve as the industry reference with our new 250 GHz broadband probes. When using TITAN™ Probes in combination with our SENTIO® ContactSense™ feature, the integrated MPI system delivers benchmark positioning repeatability on automated platforms with unmatched accuracy.

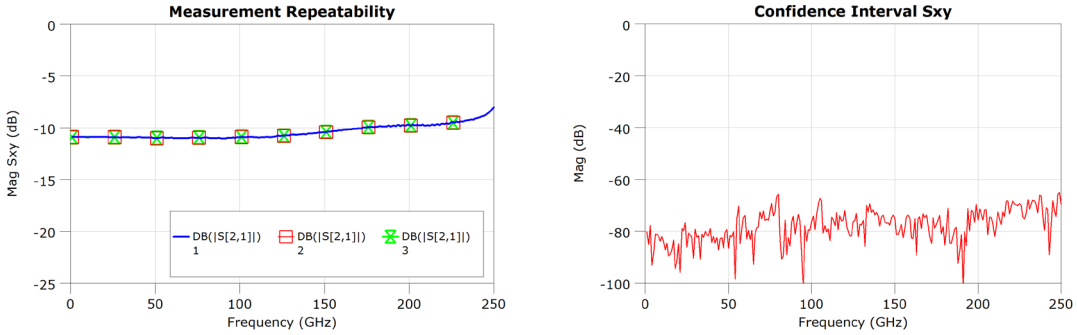


TITAN™ T250MAK-GSG0100 probes contacting the Thru standard of the TCS-050-100-W calibration substrate (left), and T250MSK-GSGSG0050 probes positioned on the alignment mark of the dual TCS-0100-0100 calibration substrate (right)

MEASUREMENT EXAMPLES



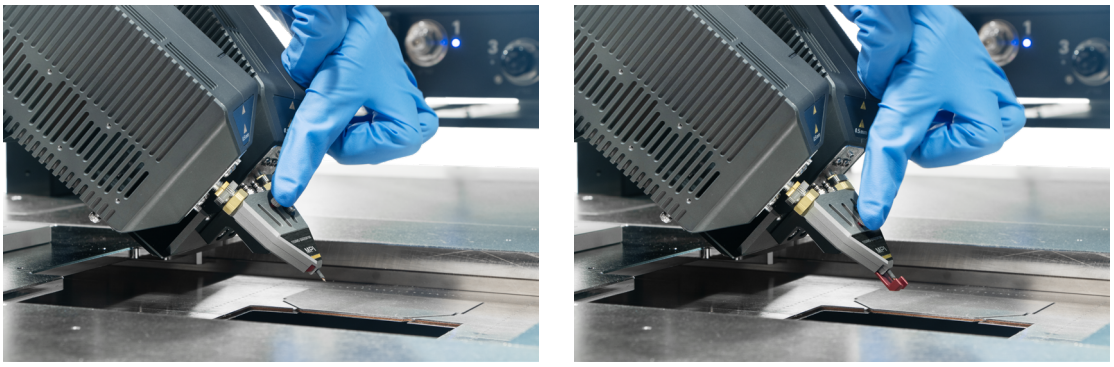
Probe-tip TMRR corrected measurements of three symmetrical attenuators from the TCS-050-100-W calibration substrate.



Example of the measurement repeatability of a symmetrical attenuator from the TCS-050-100-W calibration substrate and the computed 95% confidence interval.

UNIQUE PROBE TIP PROTECTOR

The single-ended TITAN™ probes T250MAK-GSGXXXX and T167MAK-GSGXXXX come with a removable probe tip protector for added convenience and safety. The dual TITAN™ Probes T250MSK-GSGSGXXXX and T167MSK-GS-GSGXXXX feature an integrated, retractable probe tip protector that delivers maximum protection during installation, easy reconfiguration, and secure safety when the system is idle.



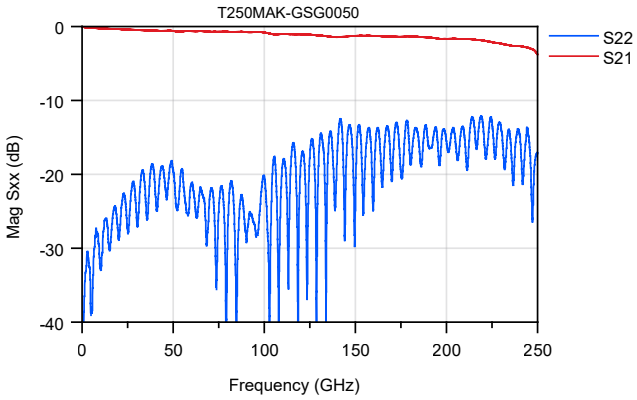
The Dual T250MSK-GSGSG0100 TITAN™ probe with the integrated probe tip protector in action

PROBE MODELS

250 GHz single-ended model: T250MAK

Typical Electrical Characteristics

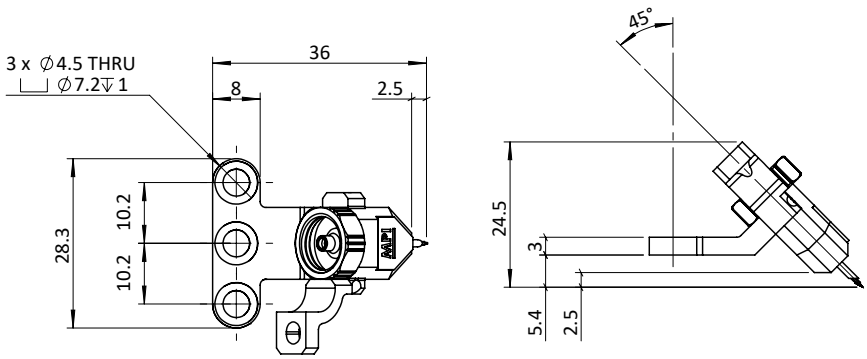
Characteristic Impedance	50 Ω
Frequency range	DC to 250 GHz
Ground & signal alignment error	< +/- 3 µm
Maximal Insertion Loss, typical	1 dB (<110 GHz), 4 dB (<250 GHz)
Minimal Return Loss, typical	15 dB (<110 GHz), 10 dB (<250 GHz)
Maximal voltage	100 V
Maximal current	1 A
Contact resistance on Au	< 6 mΩ
Contact resistance on Al	< 45 mΩ
Temperature range	-40 °C…+175 °C



Mechanical Characteristics

Connector	0.5 mm, female ruggedized
Tip material	Ni Alloy
Tip width	15 µm
Pitch range	50 µm, 75 µm, and 100 µm
Tip configuration	GSG
Mounting type	Direct mount

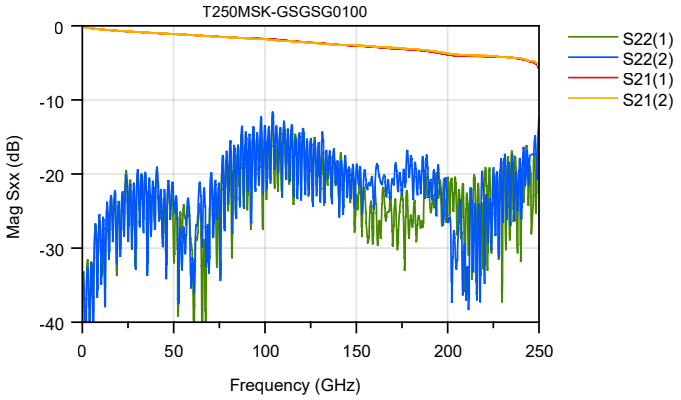
Body Dimensions



250 GHz dual model: T250MSK

Typical Electrical Characteristics

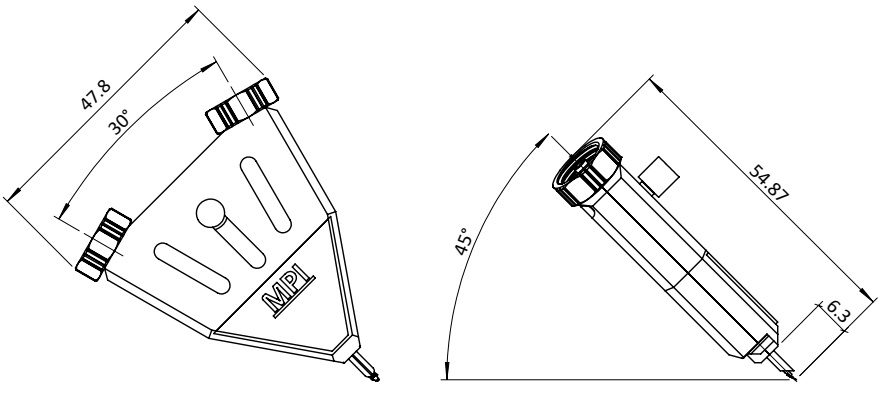
Characteristic Impedance	50 Ω
Frequency range	DC to 250 GHz
Ground & signal alignment error	< +/- 3 µm
Maximal Insertion Loss, typical	2 dB (<110 GHz), 6 dB (<250 GHz)
Minimal Return Loss, typical	12 dB (<110 GHz), 10 dB (<250 GHz)
Maximal voltage	100 V
Maximal current	1 A
Contact resistance on Au	< 6 mΩ
Contact resistance on Al	< 45 mΩ
Temperature range	-40 °C…+175 °C



Mechanical Characteristics

Connector	0.5 mm, female ruggedized (two)
Tip material	Ni Alloy
Tip width	15 µm
Pitch range	50 µm, 75 µm, and 100 µm
Tip configuration	GSGSG
Mounting type	Direct mount

Body Dimensions



167 GHz single-ended model: T167MAK

Typical Electrical Characteristics

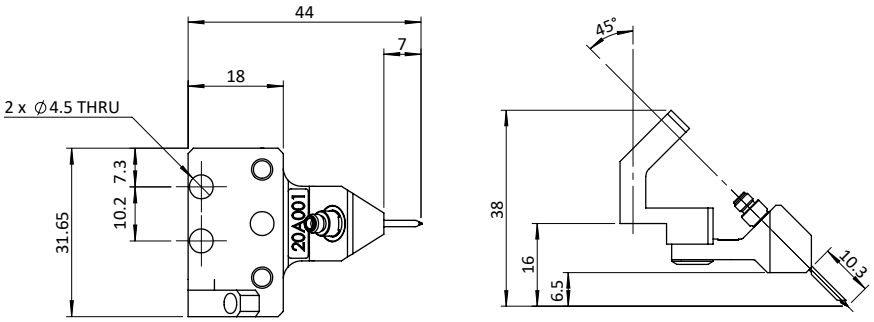
Characteristic Impedance	50 Ω
Frequency range	DC to 167 GHz
Ground & signal alignment error	< +/- 3 µm
Maximal voltage	100 V
Maximal current	1 A
Contact resistance on Au	< 6 mΩ
Contact resistance on Al	< 45 mΩ
Temperature range	-40 °C…+175 °C

Mechanical Characteristics

Connector	0.8 mm, female
Tip material	Ni Alloy
Tip width	15 µm
Pitch range	50 µm, 75 µm, and 100 µm
Tip configuration	GSG
Mounting type	Direct mount (with 0.8 mm to 0.5 mm adapter)*, on the probe arm

**Can be purchased from Spinner (PN BN 535153) or Keysight (PN Y1921H)*

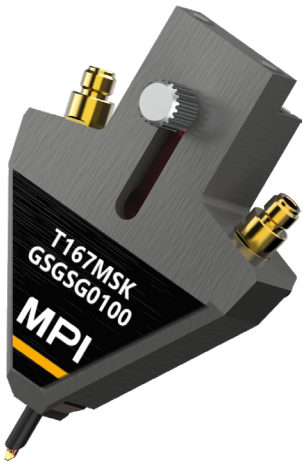
Body Dimensions



167 GHz dual model: T167MSK

Typical Electrical Characteristics

Characteristic Impedance	50 Ω
Frequency range	DC to 167 GHz
Ground & signal alignment error	< +/- 3 µm
Maximal voltage	100 V
Maximal current	1 A
Contact resistance on Au	< 6 mΩ
Contact resistance on Al	< 45 mΩ
Temperature range	-40 °C…+175 °C

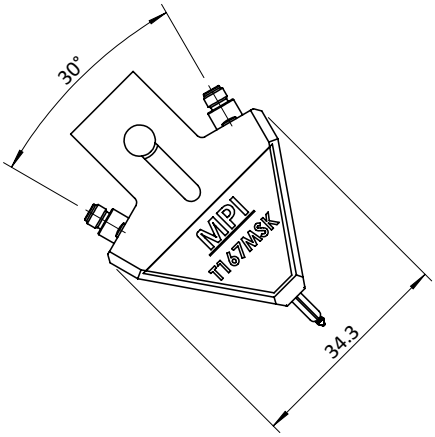


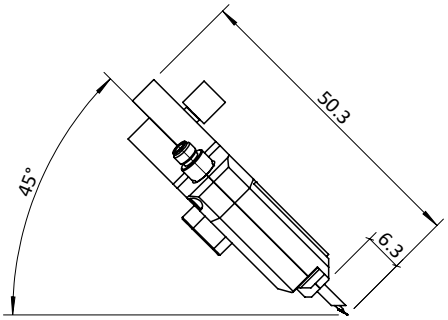
Mechanical Characteristics

Connector	0.8 mm, female (two)
Tip material	Ni Alloy
Tip width	15 µm
Pitch range	50 µm, 75 µm, and 100 µm
Tip configuration	GSGSG
Mounting type	Direct mount (with 0.8 mm to 0.5 mm adapter)*

**Can be purchased from Spinner (PN BN 535153) or Keysight (PN Y1921H)*

Body Dimensions





RECOMMENDED CALIBRATION SUBSTRATES

Single-ended models T250MAK-GSGXXXX and T167MAK-GSGXXXX

Calibration Substrate	Pitch	C-Open fF	L-Short pH	L-Term pH	Delay (offset) ps	Z0 (offset) Ω
TCS-050-100-W	50	4.8	12	5.2	0.011	500
	75	5	12	6	0.012	500
	100	5.50	12.0	8.0	0.016	500

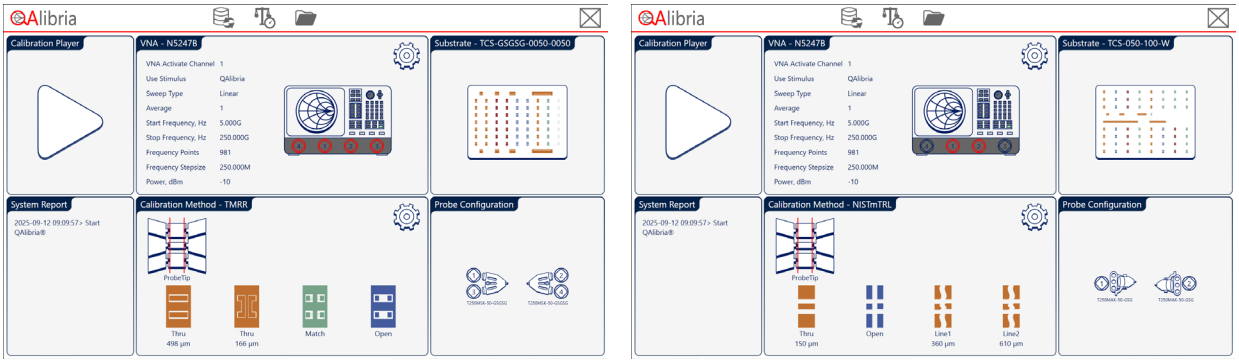
Dual models T250MSK-GSGSGXXXX and T167MSK-GSGSGXXXX

Calibration Substrate	Pitch	C-Open fF	L-Short pH	L-Term pH	Delay (offset) ps	Z0 (offset) Ω
TCS-GSGSG-0050-0050	50	5.8	26	20	0.040	500
TCS-GSGSG-0075-0075	75	5	26.5	17	0.034	500
TCS-GSGSG-0100-0100	100	6.0	36.0	20.0	0.040	500

QAlibria® AND CALIBRATION

The MPI RF Calibration Suite, QAlibria®, is engineered to streamline the inherently complex and time-intensive RF system calibration process. It provides an efficient, repeatable, and accurate approach to achieving optimal calibration results.

QAlibria® features an open architecture with a comprehensive database of calibration substrates and probes, including all necessary definitions for calibration standards and probe correction coefficients. It now fully supports the TITAN™ mmWave Probe Family, including the new T250MAK-GSGXXXX, T250MSK-GSGSGXXXX, T167MAK-GSGXXXX, and T167MSK-GSGSGXXXX models. This capability allows users to automatically configure all required calibration standard definitions and probe-specific electrical parameters, ensuring precise calibration with minimal user intervention.



Example of QAlibria® user interface for calibrating the system with a TITAN™ Probe T250MSK-GSGSG0050 and T250MAK-GSG0050.

SYSTEM COMPATIBILITY

For more information on system compatibility and integration accessories, see the Technical Brief “Extra-Wideband DC–250 GHz Characterization with PNA-X NA5305A/7A Frequency Extenders“.

REFERENCES

[1] M. Spirito, U. Arz, G. N. Phung, F. J. Schmückle, W. Heinrich, and R. Lozar, „Guidelines for the design of calibration substrates, including the suppression of parasitic modes for frequencies up to and including 325 GHz,“ in „EMPIR 14IND02 – PlanarCal,“ Physikalisch-Technische Bundesanstalt (PTB), 2018.

[2] U. Arz, G. N. Phung, and A. Rumiantsev, „Traceable Lumped-Element Calibrations up to 110 GHz on Commercial Calibration Substrates,“ in 2023 100th ARFTG Microwave Measurement Conference (ARFTG), 22-25 Jan. 2023, pp. 1-4.

[3] H. C. Fu and K. Jung, „Improve RF Dual Probe Calibration Accuracy with Peer- Terminated Standards,“ in 2024 IEEE/MTT-S International Microwave Symposium - IMS 2024, 16-21 June 2024.

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

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