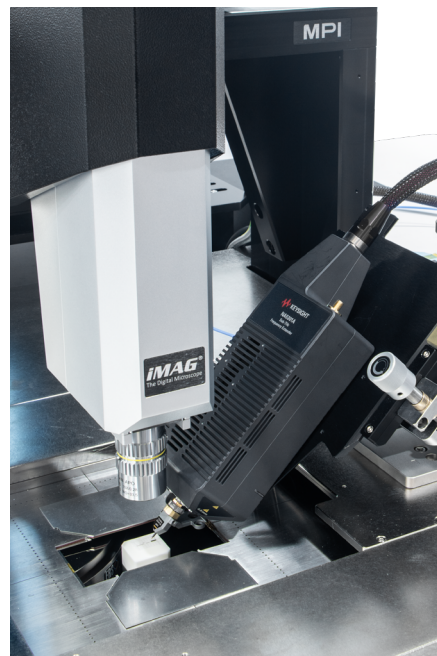
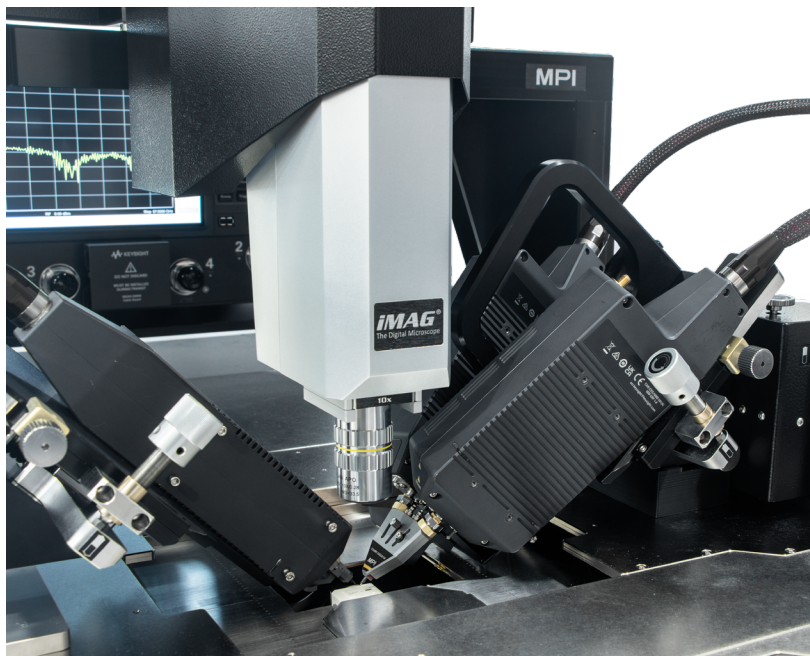


Extra-Wideband Characterization with PNA-X NA5305A/7A Frequency Extenders

Leading the way in broadband, mmWave, and high-speed digital measurements



OVERVIEW

MPI Corporation, in collaboration with Keysight Technologies, delivers a breakthrough solution for wafer-level single-sweep broadband device and mmWave ICs characterization. Our joint development brings MPI's proven TITAN™ Probes technology and probe systems expertise into a seamlessly integrated single-sweep DC-250 GHz solution. With TITAN™ Probes engineered for stability, accuracy, unmatched tip visibility, and an integrated tip protector, engineers can now accelerate their development cycles with absolute confidence with every touch-down. The integration of Keysight's new broadband 170 GHz and 250 GHz frequency extenders guarantees quick setup, easy reconfiguration, and protects sensitive system components from accidental damages safeguarding the customer's investment and ensuring full system utilization. MPI's thoughtful probe systems designs can be configured for single-ended and dual/differential tests with Keysight's 170 GHz NA5305A or the 250 GHz NA5307A PNA-X frequency extenders.

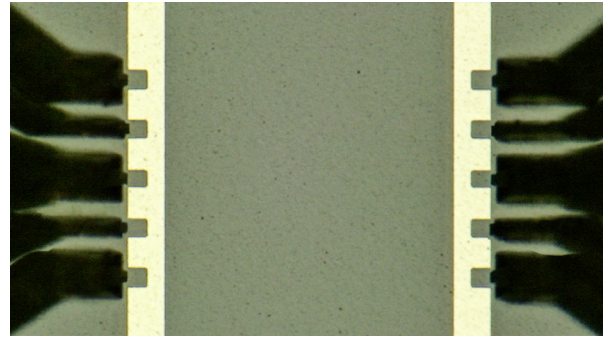
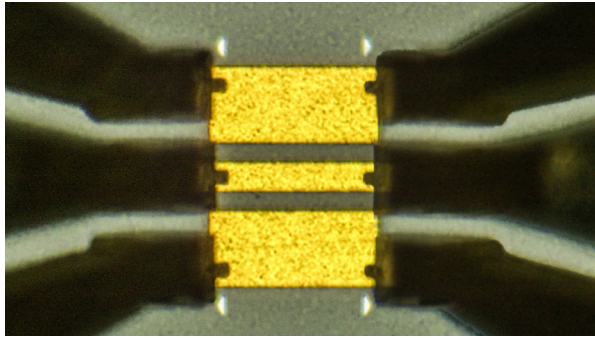
TECHNICAL CHALLENGES ADDRESSED

Testing broadband mmWave devices and ICs remains a demanding task due to a number of practical and fundamental limitations. True broadband characterization, ideally extending from DC to beyond 200 GHz, is difficult to achieve in a single setup. Achieving this capability requires dedicated broadband instrumentation and a matching broadband interface. At higher frequencies, the Signal-to-Noise Ratio (SNR) rapidly decreases, driven by both the reduced output power of the instrumentation and by increasing losses along the signal path from the measurement port to the device's contact pads. This in turn restricts accurate verification of critical power amplifier characteristics such as gain compression, linearity, and third-order intercept (IP3). The situation is further complicated by the need for differential characterization and accessories that are not only costly, but fragile, requiring thoughtful integration and careful handling. Moreover, integration of test instrumentation components with the probe station presents significant challenges, as installation and re-configuration are labor-intensive processes that carry an inherent risk of accidental damaging sensitive hardware. To address these limitations, the new TITAN™ Probes and integration solutions developed by MPI for the new Keysight's NA5305A and NA5307A PNA-X frequency extenders provide broadband characterization with simplified setup, more straightforward re-configuration, and improved protection of the instrumentation.

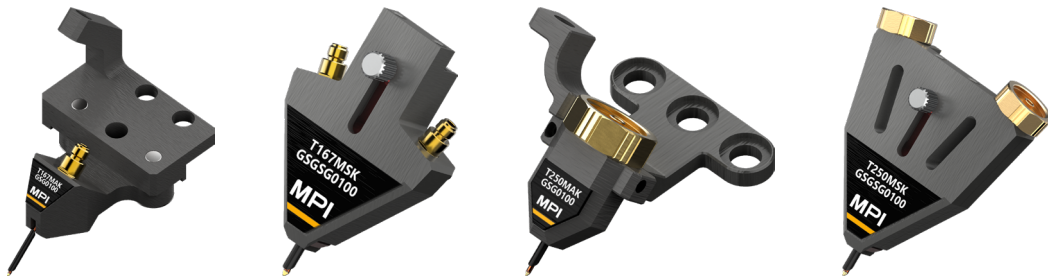
COLLABORATIVE INNOVATION

The new Keysight NA5305A and NA5307A frequency extenders, equipped with 0.5 mm ruggedized coaxial test port connectors, enable broadband millimeter-wave measurements up to 170 GHz and 250 GHz respectively. In combination with the N522xB/4xB PNA/PNA-X microwave network analyzer and the N5292A test set controller, they support accurate S-parameter and power measurements. In combination with our new TITAN™ single-ended T250MAK-GSGXXXX probes and dual T250MSK-GSGSGXXXX probes, the integrated systems provide the following benefits:

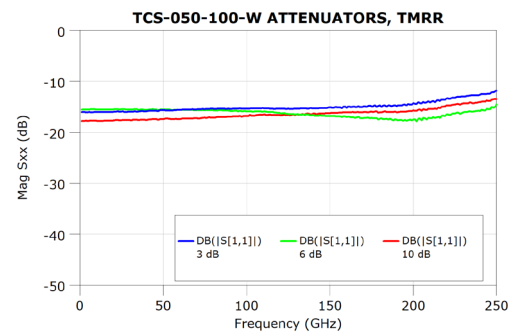
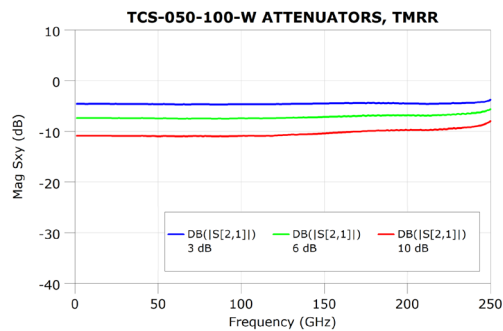
- **Ultra-broadband coverage:**
DC to 250 GHz frequency range for seamless integration with the latest test instrumentation in two-port and four-port configurations.
- **Ruggedized 250 GHz 0.5 mm Female Connector:**
Durable, robust interface for direct mounting to frequency extender (no cables) and designed to protect both your TITAN™ probe and instrumentation.
- **Highest possible measurement dynamic range:**
Direct probe mounting to frequency extenders. Shortest possible RF path to the DUT results in minimal insertion loss, maximum directivity, and maximum power delivery, 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. The last is crucial for accurate system calibration at mmWave frequencies.
- **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.
- **Safeguard probe tips and maximize 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.
- **Ideal data correlation by proven TITAN mmWave Probe broadband tip performance:**
Built on the legacy of our DC-220 GHz TITAN™ T220MA (single ended) and T220MS (dual) probes, delivering reliable, repeatable results for the world's most demanding applications. Ideal data correlation across the entire TITAN™ mmWave Probe family offering probes in 67 GHz, 120 GHz, 145 GHz, 165 GHz, 167 GHz, 220 GHz, and 250 GHz in both single-ended and dual/differential configurations.
- **Probing on all types of surfaces and device pads metallization:**
Flexible, spring-like nickel-alloy MEMS tips can be used 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:**
Compatible with MPI TITAN™ TCS-GSGSG-XXXX-XXXX and TCS-050-100-W calibration substrates for accurate probe tip calibrations up to 250 GHz utilizing the NIST multiline TRL and TMRR calibration methods. Standards are designed following PlanarCal guidance [1]. The TCS-050-100-W calibration substrate [2] is the only commercially available calibration substrate with an established traceability chain for the coplanar elements and probe tip calibration to the National Metrology Institute (NMI). The dual/differential TCS-GSGSG-XXXX-XXXX calibration substrates provide consistent calibration results with minimized crosstalk for dual probes with unique the pair-terminated standards [3].
- **Engineered for Advanced Devices:**
Ideal for testing amplifiers, mixers, frequency multipliers, phase shifters, and high-speed digital ICs in the most demanding research and production environments.



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)



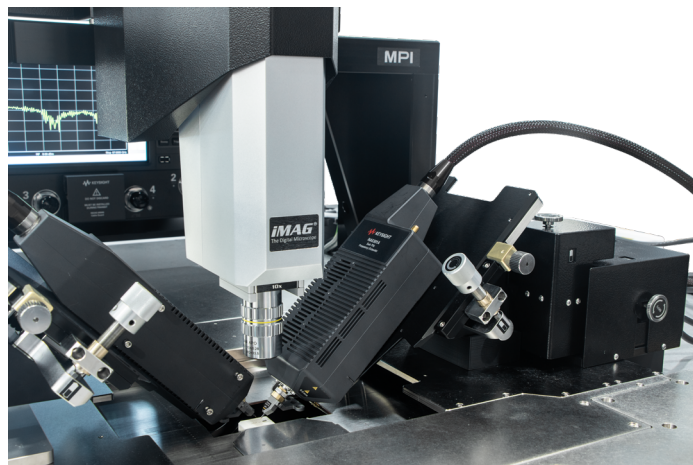
With TITAN™ T170/250MAK and T170/250MSK probes, you're equipped to lead in broadband, mmWave, and high-speed digital measurement—today and tomorrow.



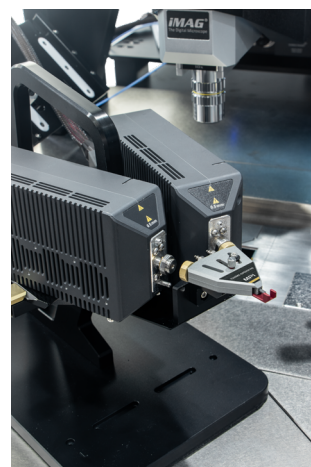
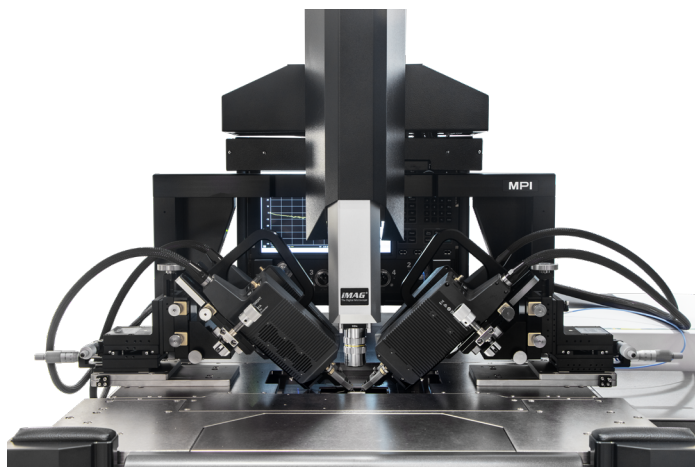
Example of data measured by T250MAK-GSG0050 probes. TMRR corrected data for three symmetrical (untrimmed) attenuators from TCS-050-100-W calibration substrate

INTEGRATION GUIDE

Single-Ended (Two-Port) Measurements



MPI Part Number	Description
MP80INT3-NA5300A-STD-E	KEYSIGHT NA5305A/NA5307A 170 GHz/250 GHz frequency extender integration with MP80/PMP80 Positioner integration, East.
MP80INT3-NA5300A-STD-W	KEYSIGHT NA5305A/NA5307A 170 GHz/250 GHz frequency extender integration with MP80/PMP80 Positioner integration, West.
T250MAK-GSGXXX	DC-250 GHz TITAN™ Broadband RF Probe, GSG tips. Ruggedized 0.5 mm (f) connector with direct mounting on the NA5305A/NA5307A frequency extender.
T167MAK-GSGXXX	DC-167 GHz TITAN™ Broadband RF Probe, GSG tips. 0.8 mm (f) connector with direct mounting on the NA5305A/NA5307A frequency extender. Requires separate purchase of ruggedized 0.5 mm (f) to standard 0.8 mm (m) adapter, DC to 167 GHz from Spinner (PN BN 535153) or Keysight (PN Y1921H).
TCS-050-100-W	Coplanar alumina calibration substrate for calibrating GSG TITAN™ Probes. Pitch ranges from 50 μ m to 100 μ m. Supported calibration methods: mTRL, TMRR, LRM, SOLT. Includes symmetrical 3 dB, 6 dB and 10 dB symmetrical attenuators for calibration verification.
MSP-QALIBRIA	QAlibria® RF Calibration Software toolset.

Differential (Four-Port) Measurements

MPI Part Number	Description
MP80INT3-2NA5300A-STD	KEYSIGHT NA5305A/NA5307A 170 GHz/250 GHz frequency extenders integration with MP80/PMP80 Positioner integration. Differential measurements. Set of two holders.
T250MSK-GSGSGXXXX	DC-250 GHz TITAN™ Broadband Dual/Differential RF Probe, GSGSG tips. Ruggedized 0.5 mm (f) connectors with direct mounting on the NA5305A/NA5307A frequency extenders. Integrated tip protector.
T167MSK-GSGSGXXXX	DC-167 GHz TITAN™ Broadband Dual/Differential RF Probe, GSGSG tips. 0.8 mm (f) connectors with direct mounting on the NA5305A/NA5307A frequency extenders. Integrated tip protector. Requires separate purchase of two ruggedized 0.5 mm (f) to standard 0.8 mm (m) adapters, DC to 167 GHz from Spinner (PN BN 535153) or Keysight (PN Y1921H).
TCS-GSGSG-0050-0050	Differential Calibration Substrate for calibrating GSGSG TITAN™ Dual Probes with 50 µm pitch. Pair-terminated standards. Supported Calibration methods: mTRL, TMRR, LRM, SOLT, SOLR.
TCS-GSGSG-0075-0075	Differential Calibration Substrate for calibrating GSGSG TITAN™ Dual Probes with 75 µm pitch. Pair-terminated standards. Supported Calibration methods: mTRL, TMRR, LRM, SOLT, SOLR.
TCS-GSGSG-0100-0100	Differential Calibration Substrate for calibrating GSGSG TITAN™ Dual Probes with 100 µm pitch. Pair-terminated standards. Supported Calibration methods: mTRL, TMRR, LRM, SOLT, SOLR.
FEAD3-NA5300A-1	KEYSIGHT NA5305A/NA5307A 170 GHz/250 GHz frequency extenders adaptation for single-ended measurements (2-port) on differential (4-port) system. Note: requires PN MP80INT3-2NA5300A-STD.
MSP-QALIBRIA	QAlibria® RF Calibration Software toolset.

COMPATIBLE SYSTEM PLATFORMS

Manual probe systems

MPI Part Number	Description
TS200-THZ	200 mm Advanced manual test system for mmWave characterization. Optional thermal characterization in the range of +20°C to +300°C.
TS200-IFE	200 mm IceFreeEnvironment™ advanced manual test system for mmWave and thermal characterization. Temperature range of -60°C to +300°C.
TS300-IFE	300 mm IceFreeEnvironment™ Advanced manual test system for mmWave and thermal characterization. Temperature range of -60°C to +300°C.

Automated and fully-automated probe systems

MPI Part Number	Description
TS2000-IFE	200 mm IceFreeEnvironment™ advanced automated test system for mmWave and thermal characterization. Temperature range of -60°C to +300°C.
TS3000	300 mm automated test system. Optional thermal characterization in the range of +20°C to +300°C.
TS3500	300 mm automated test system designed to be configured with MPI WaferWallet™ option as a fully-automated probe system. Optional thermal characterization in the range of +20°C to +300°C.
TS3000-IFE	300 mm IceFreeEnvironment™ advanced automated test system for mmWave and thermal characterization. Temperature range of -60°C to +300°C.
TS3500-IFE	300 mm IceFreeEnvironment™ advanced automated test system for mmWave and thermal characterization. Temperature range of -60°C to +300°C. Designed to be configured with MPI WaferWallet® option as a fully-automated probe system.

If you already own an MPI probe system, please contact MPI sales for a system upgrade to incorporate the components needed for 170 GHz or 250 GHz applications.

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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mpi-corporation.com/ast/support/regional-sales-contact

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