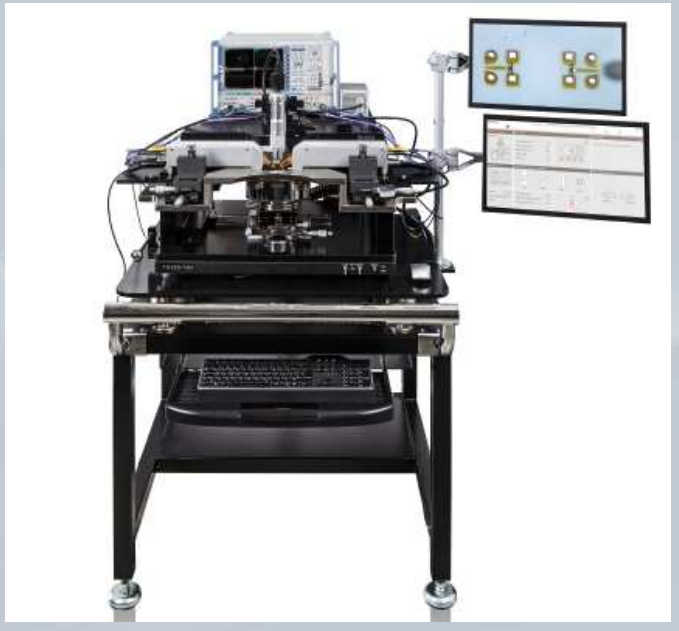
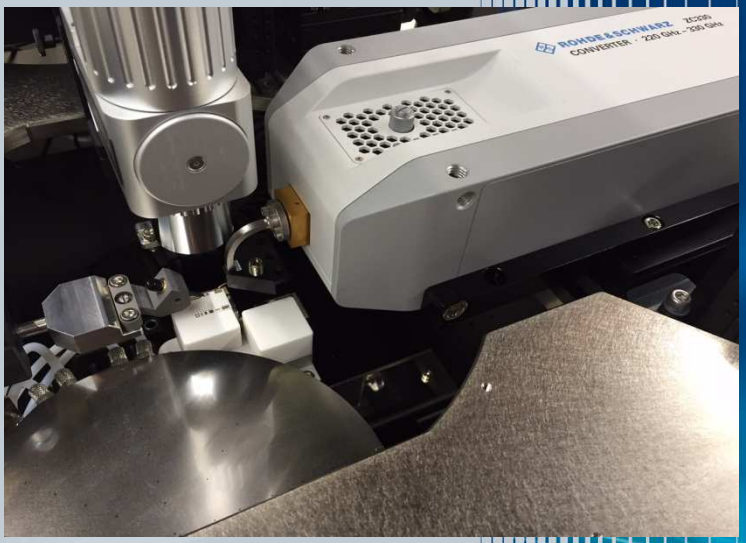
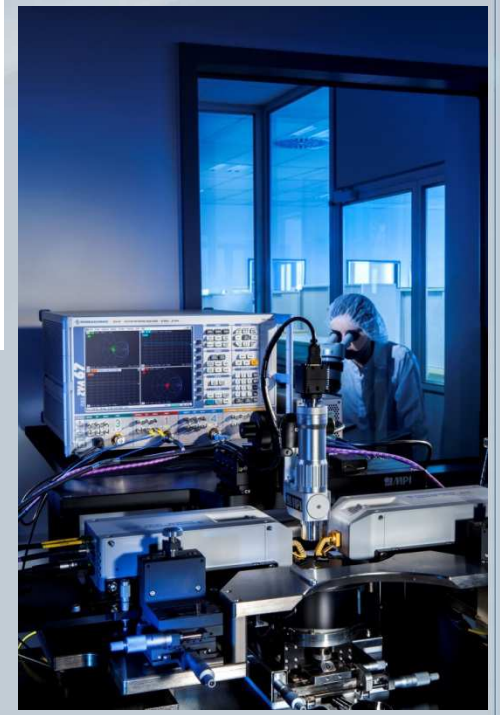
# Millimeter-wave VNA Solutions





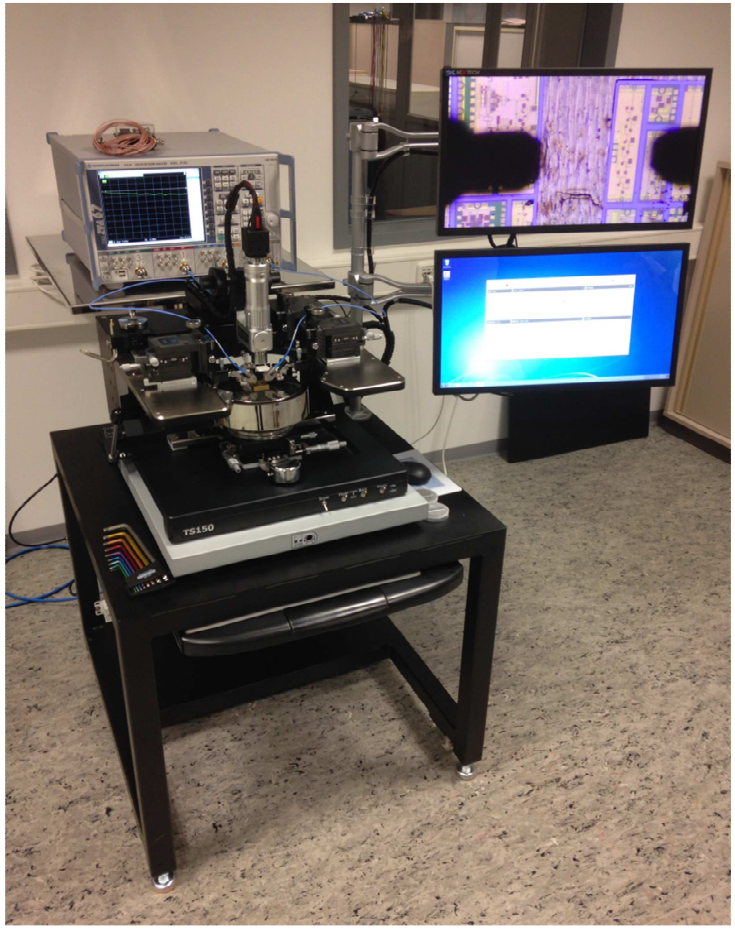



**On-Wafer Testing with MPI probers**

ROHDE&SCHWARZ

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# OnWafer System Providers



**Cascade**

- WinCal support of ZVA, ZVT
- Mechanical adaption of mm-wave converters, ZVA110

**Semiprobe**

- Support of ZVA

**MPI**

- Support of ZVA, ZNB, ZVT in QAlibria software
- Mechanical adaption of mm-wave converters, ZVA110

**Signatone (local cooperation)**

# MPI Corporation, Taiwan

- **High quality mechanics**
- **Unique features for probers**
- **Unique calibration algorithm**
- **Dedicated mm-wave prober**
- **Manual and semi-automatic systems**



# Who is MPI Corporation ?

- **A Taiwanese Company founded in 1995**
- **> 1000 employees**
- **Appr. 1.2B US$ turnover**
- **Four main busines fields**
  - Advance Semiconductor Test
  - LED Test Solutions (No 1 worldwide)
  - Probe Card Technologies (No 5 worldwide)
  - Thermal Test



- **More than 9000 LED and probe card test stations already being delivered and**



# Who is MPI Corporation ?

**Important steps for MPI towards RF Wafer Probing:**

- **Aquisition of Allstron probes**
- **Aquisition of Vector Semiconductor Probe Sta**
- **Hiring of  several people from Cascade/Suess Microtech**
- **Contract with ERS Germany (High Accurate Thermal Chuck Systems)**



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# MPI
# Product Portfolio

# MPI corporation product portfolio

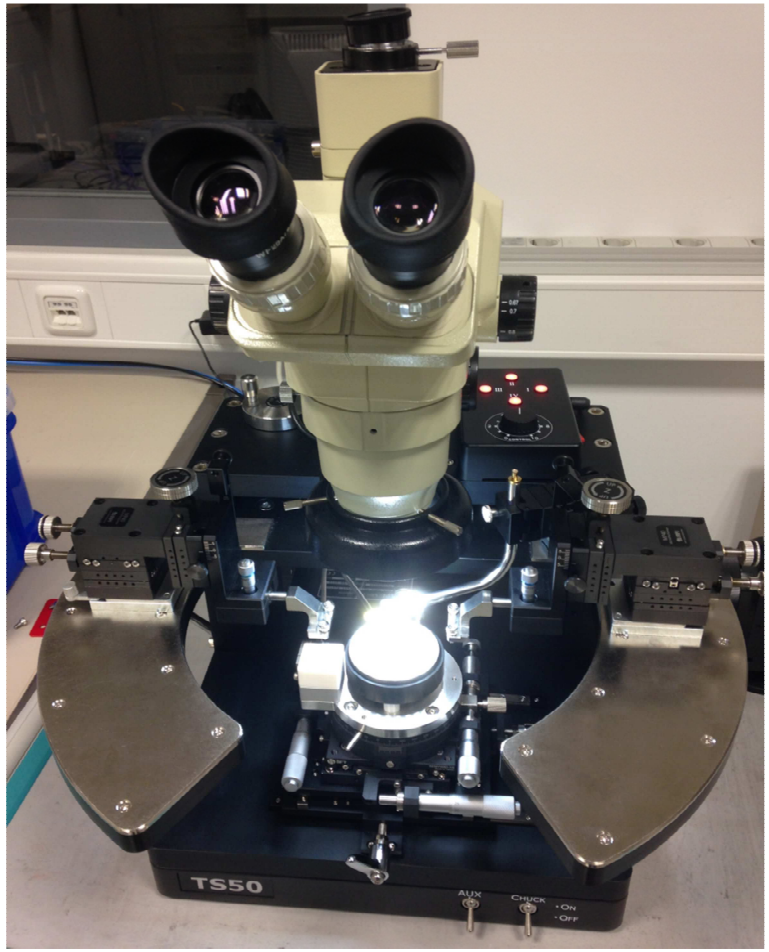
Advanced Semiconductor Test






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# MPI corporation product portfolio




**TS50 : Smallest manual prober**

- **Simple lab use**
- **Universities**
- **No bigger wafers possible**
- **No 4port setup**

# MPI TS50 | 50 mm Manual Probe System

## For accurate and reliable DC/CV and RF measurements

### Microscope and Optics Options
- Various optics options available
- Stereo MPI ST45 or single tube MPI SZ10 with up to 10x zoom and 95 mm working distance
- HDMI cameras with up to 5 MP available

### Microscope Mount and Movement
- Stable bridge for high quality optics
- Microscope pivot XY movement
- 50 mm linear Z with the focus block

### Adjustable Platen Height
- Micrometer control for precise adjustment
- 20 mm range for various applications

### Probe Platen
- Stable and rigid design
- Supports DC/CV and RF measurements
- Rectangular adjustments for RF positioners

### Ultra Small Footprint
- 300 x 300 mm base plate designed for bench top use
- Comes with vibration absorber base
- Low profile design for maximum usability
- Ideal for load pull applications




### RF Calibration
- Auxiliary chuck for calibration substrates
- Built-in ceramic for accurate calibration
- 1 µm flatness for consistent contact quality

### Modular Chucks
- Ambient chucks
- Supports DC/CV and RF applications

### DC and RF Positioners
- Supports 2-port RF and up to 6 DC positioners
- Wide range of positioners available
- Dedicated probe arms for DC/CV and RF measurements

### Chuck XY-Theta Stage Movement
- 100 x 75 mm XY movement
- Including 25 x 25 mm fine micrometer control
- ±5° Theta fine adjustment
- Quick release function
- Independent fast XY navigation

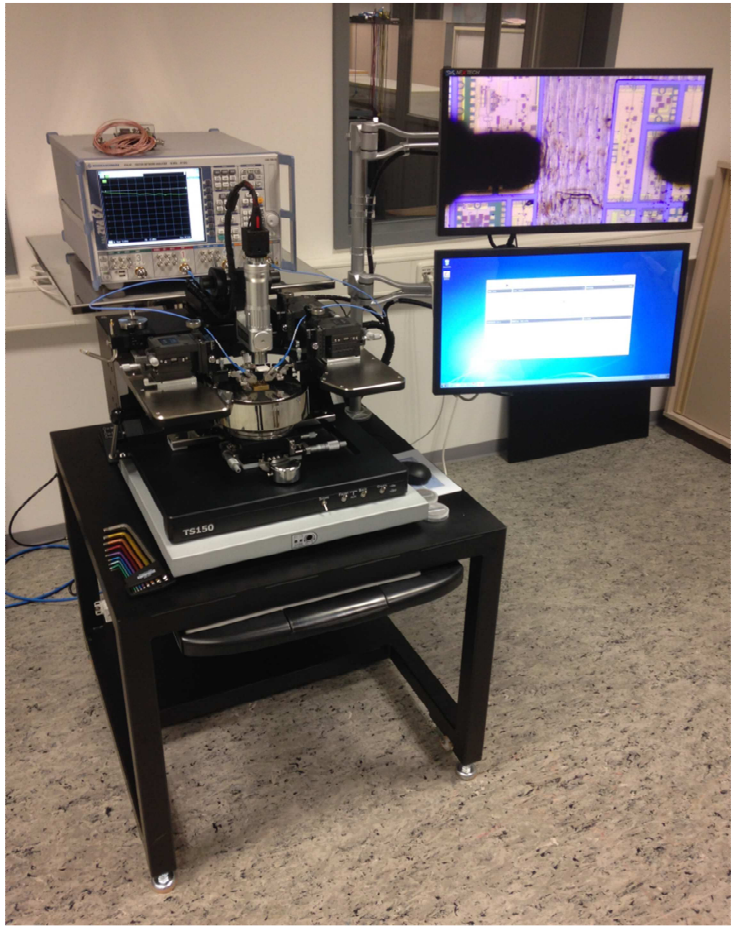
### Front Mounted Vacuum Control
- Easy access
- Clearly marked

### ***Available Options***
- Vibration isolation platform
- EMI-shielded DarkBox
- Vacuum pump
- Table with integrated rack for thermal controller, computer and keyboard push tray
  - Dual monitor stand option
  - Instrument shelf option



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# MPI corporation product portfolio




**TS150 :**

- **Various microscopes available**
- **Thermo and High Power chuck**
- **Up to 67GHz**
- **2 and 4port possible**

- **Permanent test setup at R&S which can be used for customer demos**

# MPI TS150 | 150 mm Manual Probe System

## For accurate and reliable DC/CV and RF measurements

### Microscope Mount and Movement
- Stable bridge for high quality optics
- Linear Z lift for easy reconfiguration
- 25 x 25 mm air bearing or 50 x 50 mm linear XY movement

### Adjustable Platen Height
- Micrometer control for precise adjustment
- 20 mm range for various applications

### Probe Platen
- Stable and rigid design
- Supports DC/CV and RF measurements
- Rectangular adjustments for RF positioners
- Designed for maximum thermal stability

### RF Calibration
- 2 auxiliary chucks for calibration substrates
- Built-in ceramic for accurate calibration
- 1 µm flatness for consistent contact quality

### Unique Platen Lift
- Three discrete positions for contact, separation (300 µm) and safety loading (3 mm)
- Safety lock function at loading position
- ±1 µm repeatability for consistent contact quality

### Ultra Small Footprint
- Designed for bench top use
- Comes with vibration absorber base
- Low profile design for maximum usability
- Ideal for load pull applications




### Microscope and Optics Options
- Various optics options available
- Stereo MPI ST45 or single tube MPI SZ10, MZ12 with up to 12x zoom and 95 mm working distance
- High Power microscopes FS70/PSM-1000
- HDMI cameras with up to 5 MP available

### Thermal Chuck Integration
- Seamless integration of the thermal controller touch screen panel provides most convenient operation

### Modular Chucks
- Various ambient or thermal chucks
- Choice of triaxial or coaxial connection
- Wide range of temperature up to 300 °C
- Field upgradable for reduced cost of ownership
- Easy switch between center and small wafer size control

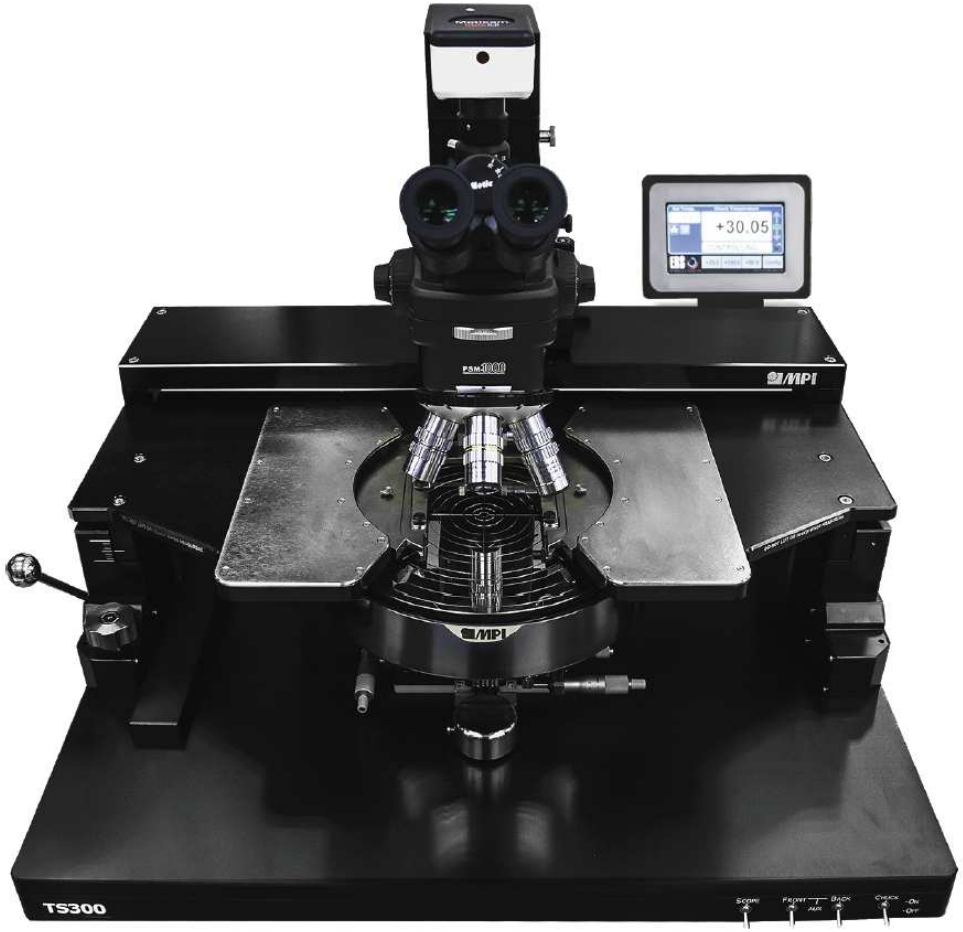
### DC and RF Positioners
- Supports up to 4 RF and 10 DC positioners
- Wide range of positioners available
- Dedicated probe arms for for coaxial, triaxial, Kelvin and RF measurements

### Chuck XY-Theta Stage Movement
- Unique puck controlled air bearing stage for quick single-handed operation
- 175 x 225 mm XY movement
- Including 25 x 25 mm fine micrometer control
- Extra wide Y-range for easy loading
- ±5° Theta fine adjustment

### Front Mounted Vacuum Control
- Easy access
- Clearly marked

### ***Available Options***
- Vibration isolation platform
- EMI-shielded DarkBox
- Vacuum pump and air compressor unit
- Table with integrated rack for thermal controller, computer and keyboard push tray
- Dual monitor stand option & Instrument shelf option

# TS300 Prober – 300mm Manual Probe System



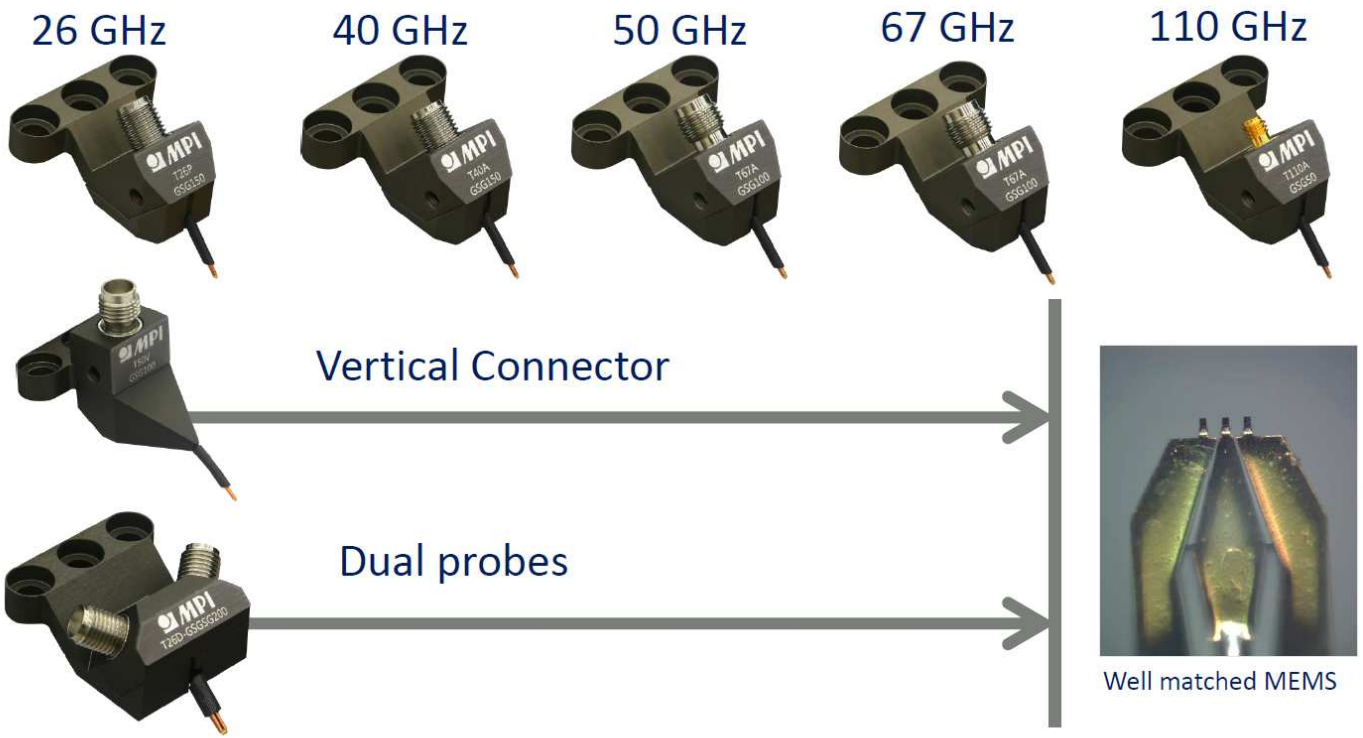
# Automated Probe Systems TS2000 from MPI






# MPI – TITAN Probe Series

## TITAN™ Probe Technology: Variety



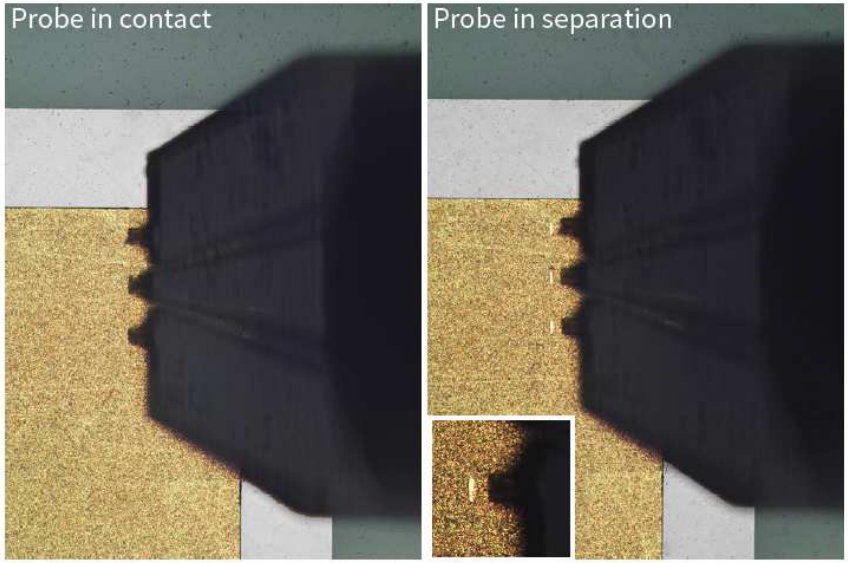


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# MPI – TITAN Probe Series

- **Visibility of probe tips**

- **GSG, GSSG, GSGSG**
- **Calibration substrates**



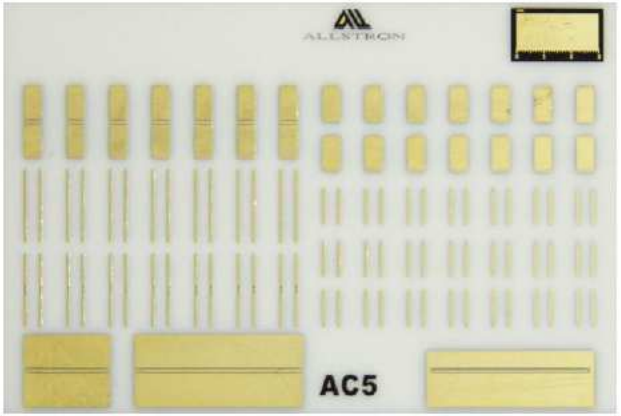
Minimal forward skate due to the unique design of the tip.

**Typical Electrical Characteristics:**

- Characteristic impedance: 50 Ω
- Insertion loss @110 GHz, max (GSG configuration): 1.2 dB
- Return loss @110 GHz, min (GSG configuration): 14 dB

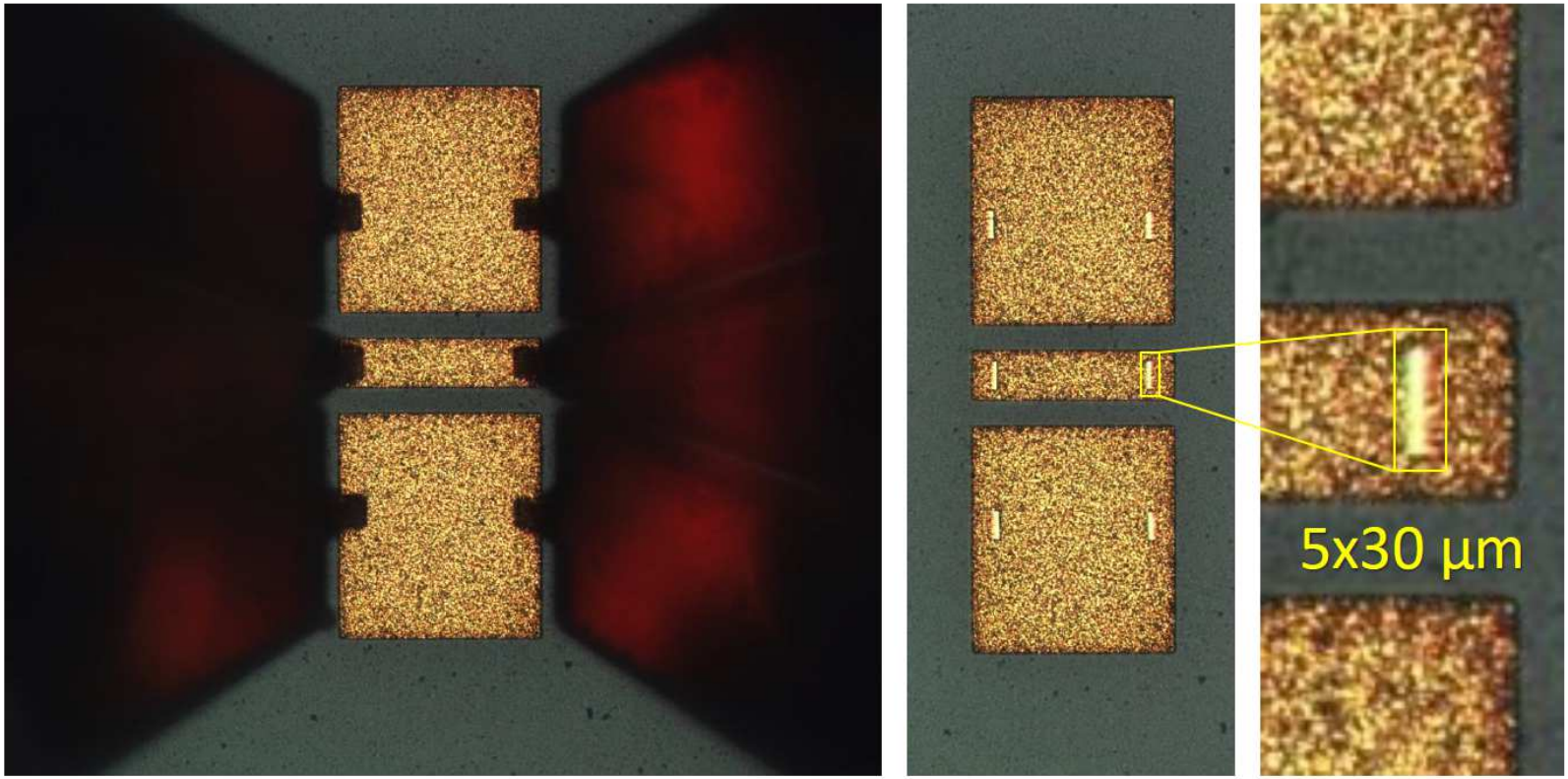
**Available Pitch:**

- 40 GHz to 67 GHz: 50 to 500 µm in 50 µm step, 600 to 1000 µm in 100 µm step, and 1250 µm
- 110 GHz: 50 to 150 µm in 50 µm step, and 125 µm



# MPI – TITAN Probe Series

Visibility and footprint of probe tips





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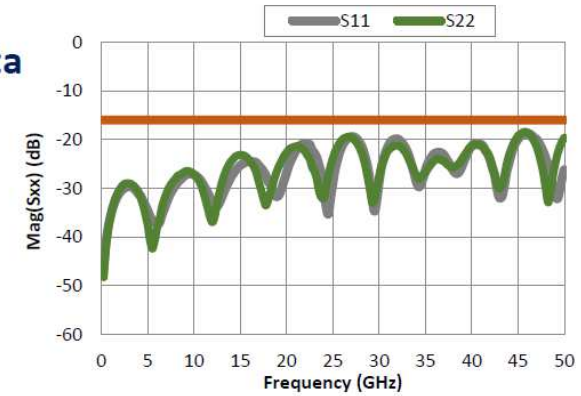
# MPI – TITAN Probe Series vs other probes

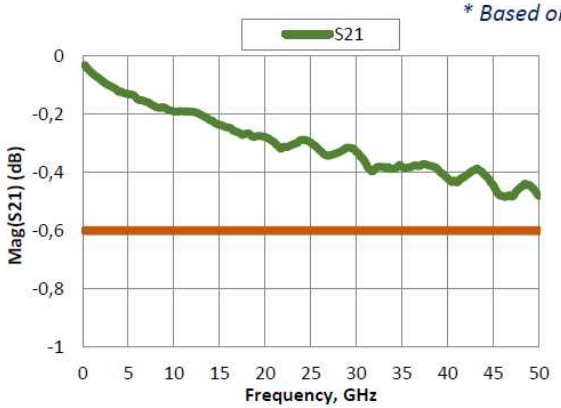
## Comparison of specifications

| Freq. | 26 | | 40 | | 50 | | 67 | | 110 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Spec. | RL | IL | RL | IL | RL | IL | RL | IL | RL | IL |
| TITAN™ | 16 | 0.4 | 18 | 0.6 | 17 | 0.6 | 16 | 0.8 | 14 | 1.2 |
| ACP | N/A | N/A | ? | 1.0 | ? | 1.4 | ? | 2.0 | ? | 1.25 |
| Infinity | N/A | N/A | 20 | 0.7 | 17 | 0.8 | 16 | 1.1 | 14 | 1.4 |
| \|Z\| | N/A | N/A | 18 | 0.8 | 17 | 0.8 | 17 | 1.0 | N/A | N/A |
| GGB | N/A | N/A | 16 | 0.6 | 16 | 0.8 | 14 | 1.0 | 10 | 1.6 |

** Based on published public data*

**Typical Data**



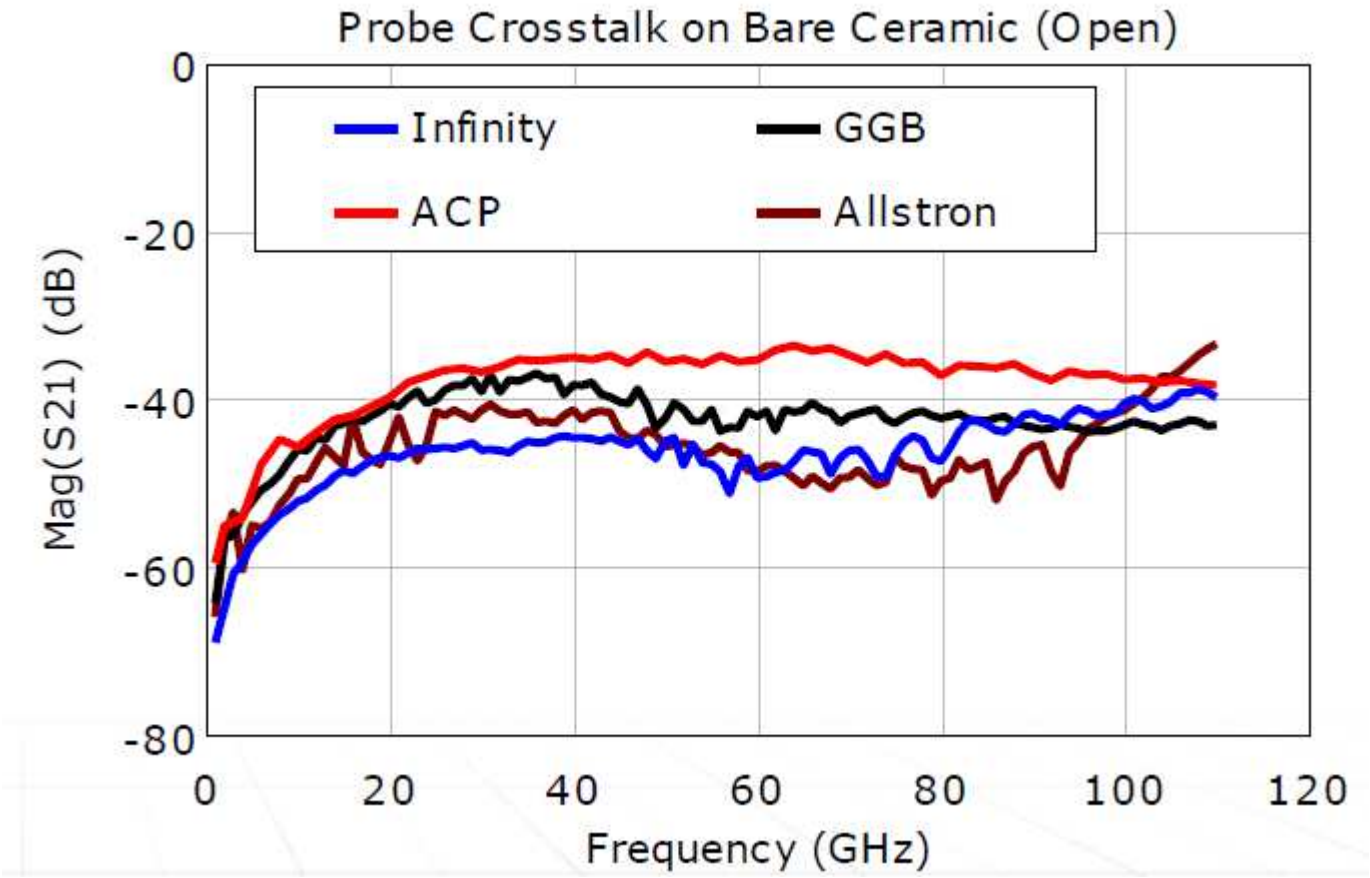




T50A-GSG100-14A033



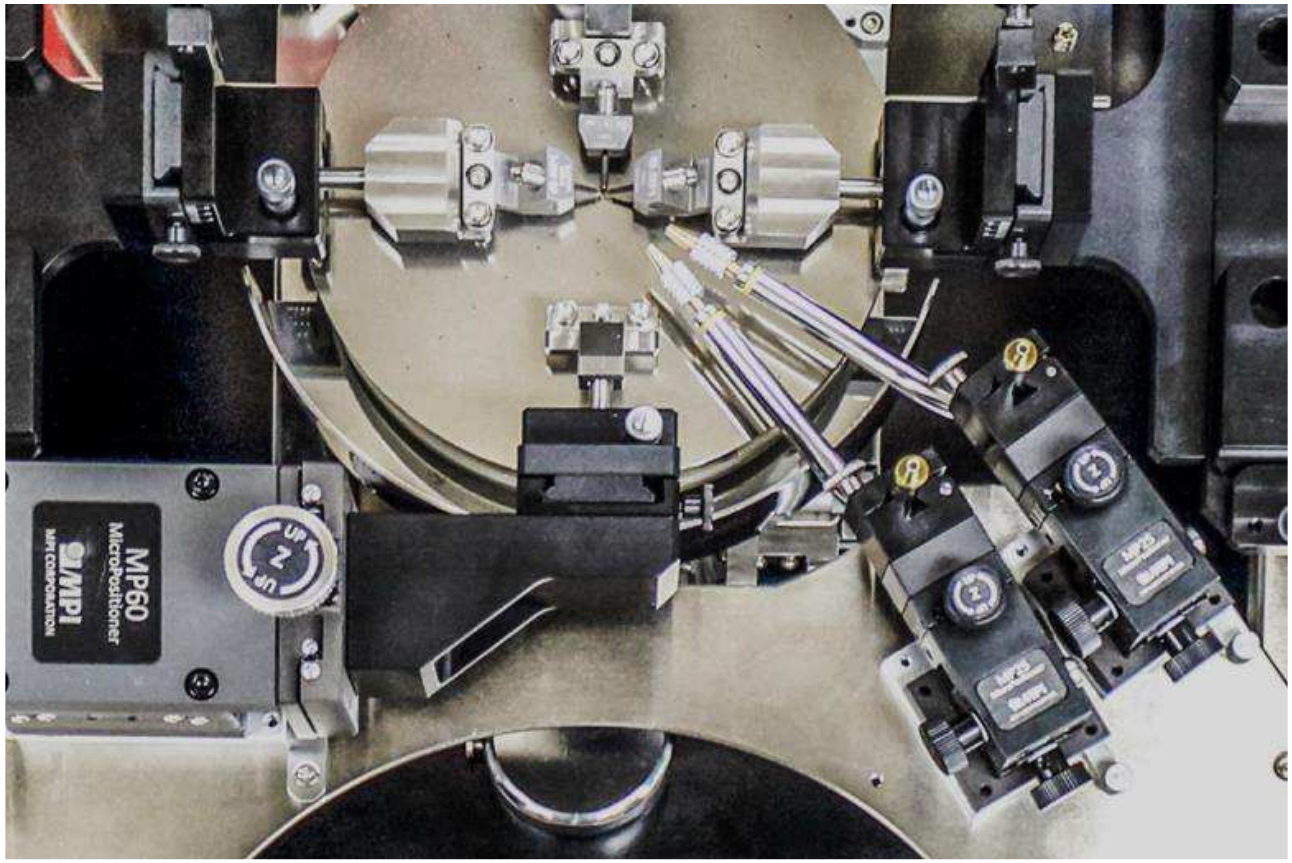
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# MPI – TITAN Probe Series



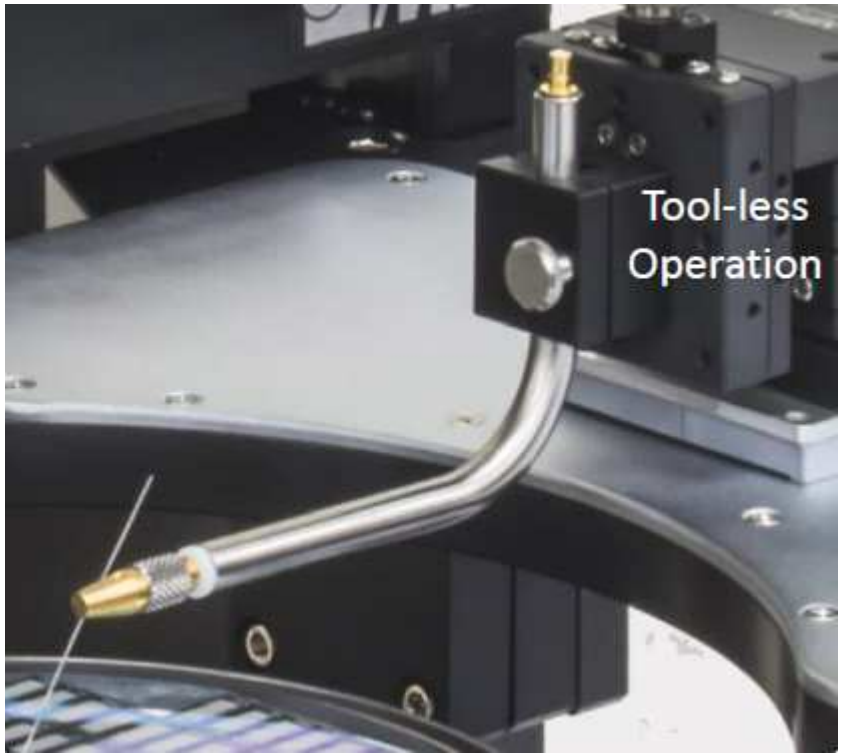

Comparable to Cascade´s Infinity probes – but visible probe tips for easy contacting

# 4-Port Configuration for IC measurements




Flexible setup with up to 4 micro positioners plus DC supply

# Micro Positioner – Magnetic fixing for easy setup












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# MPI MZ12 & SZ10 Microscopes



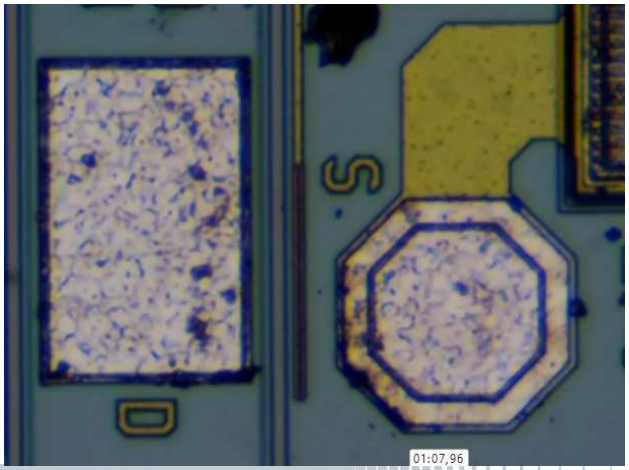

Mega Zoom
12X



Super Zoom
10X

- **Optical zoom**
  - 12x & 10x
- **Optical resolution**
  - 1.6 µm & 2.5µm
- **Working distance:**
  - 46.2 mm & 95 mm

- **Best microscope on the market for probing systems**



# Increase Repeatability: Auto-Contact

Separation → Contact




1µm repeatability




Operator independent

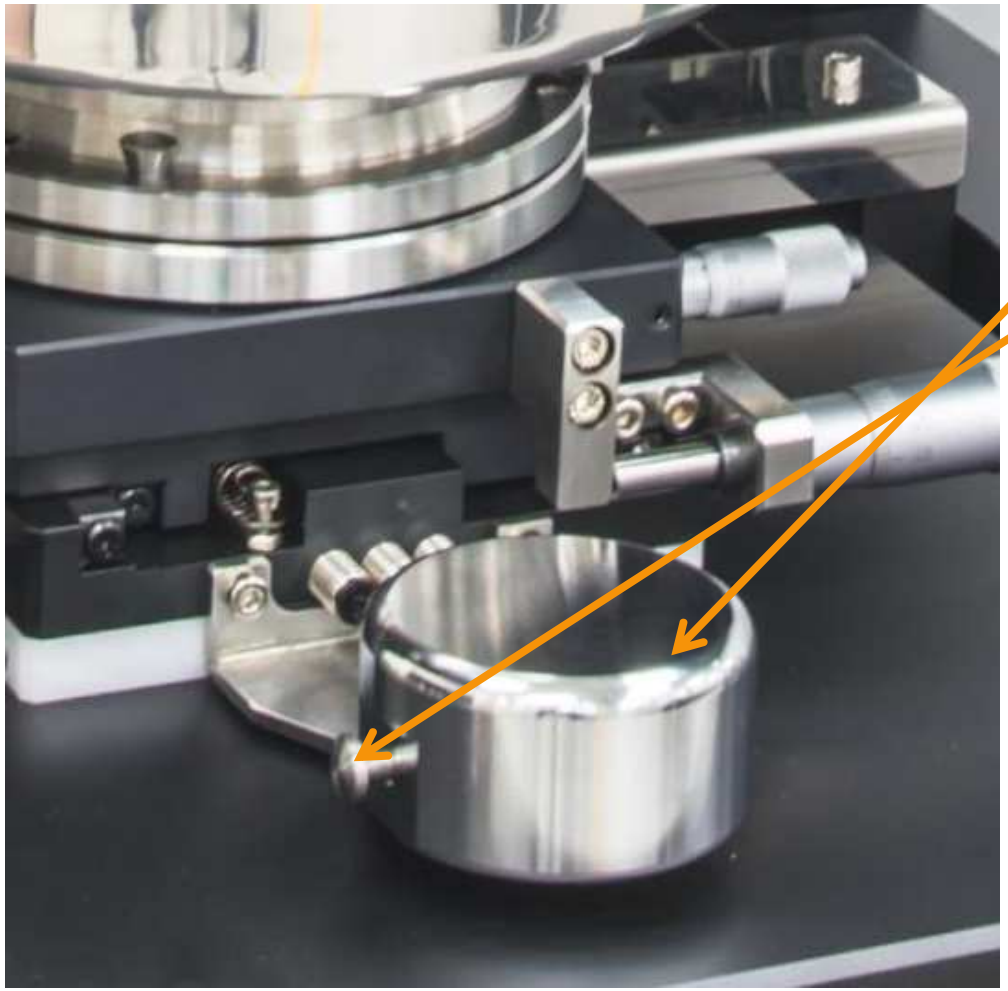
# Minimize Damage: Platen Lock

Locked

Unlocked



# Easy and convenient chuck movement

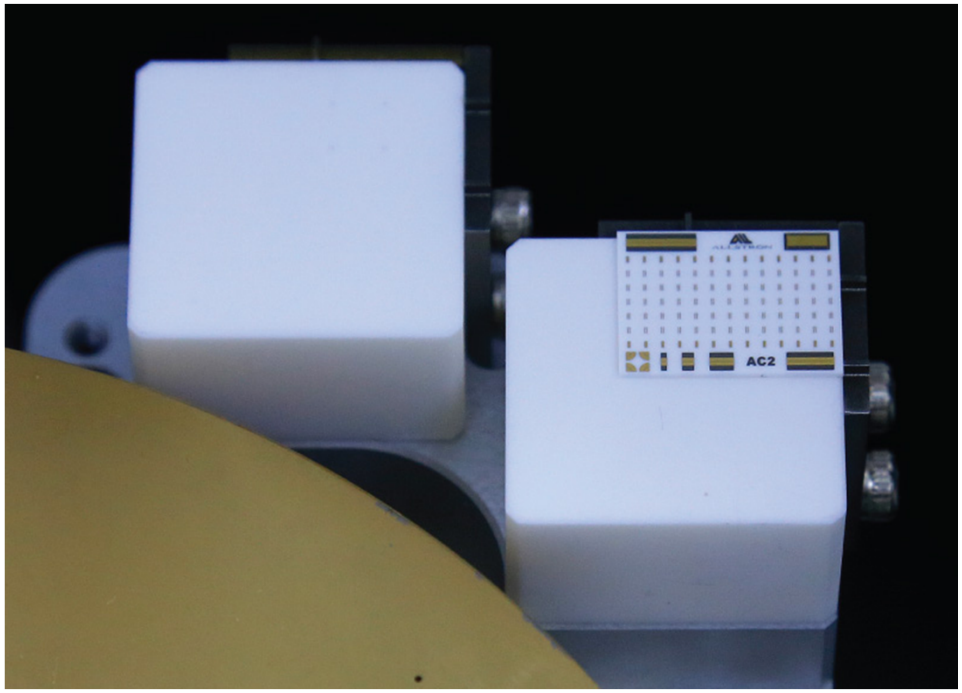


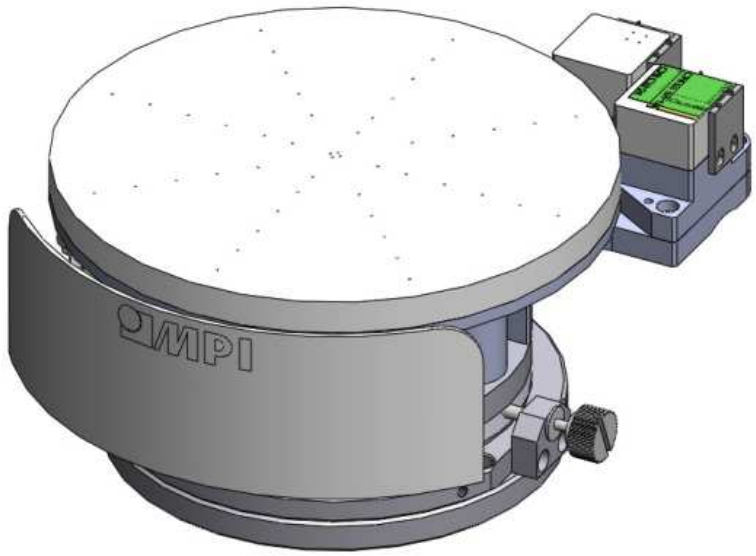
Slide the chuck by unlocking
and movement of this knob



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# Ceramic AUX chucks



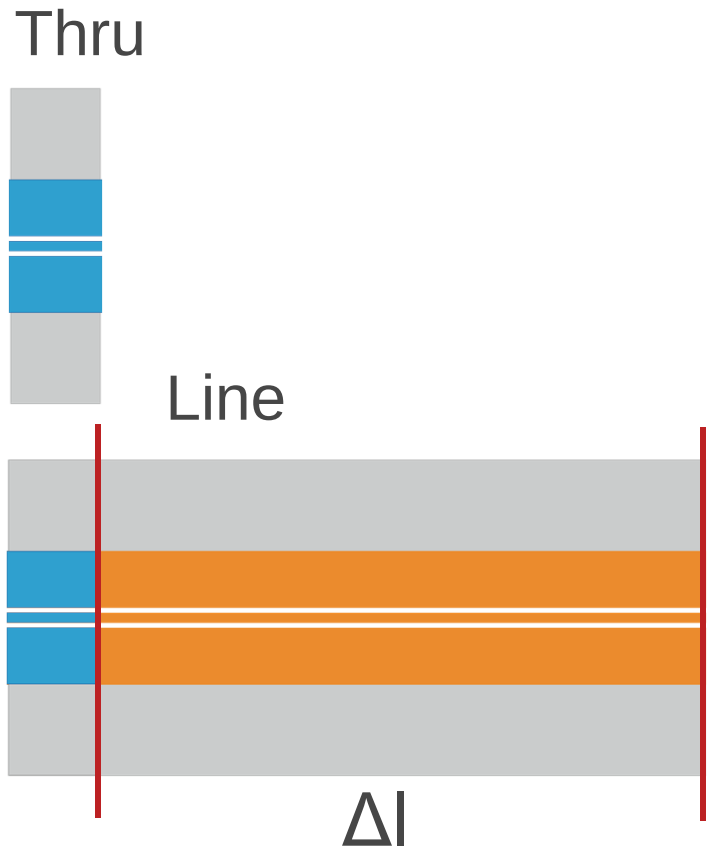




No higher modes disturbing like with metal chucks

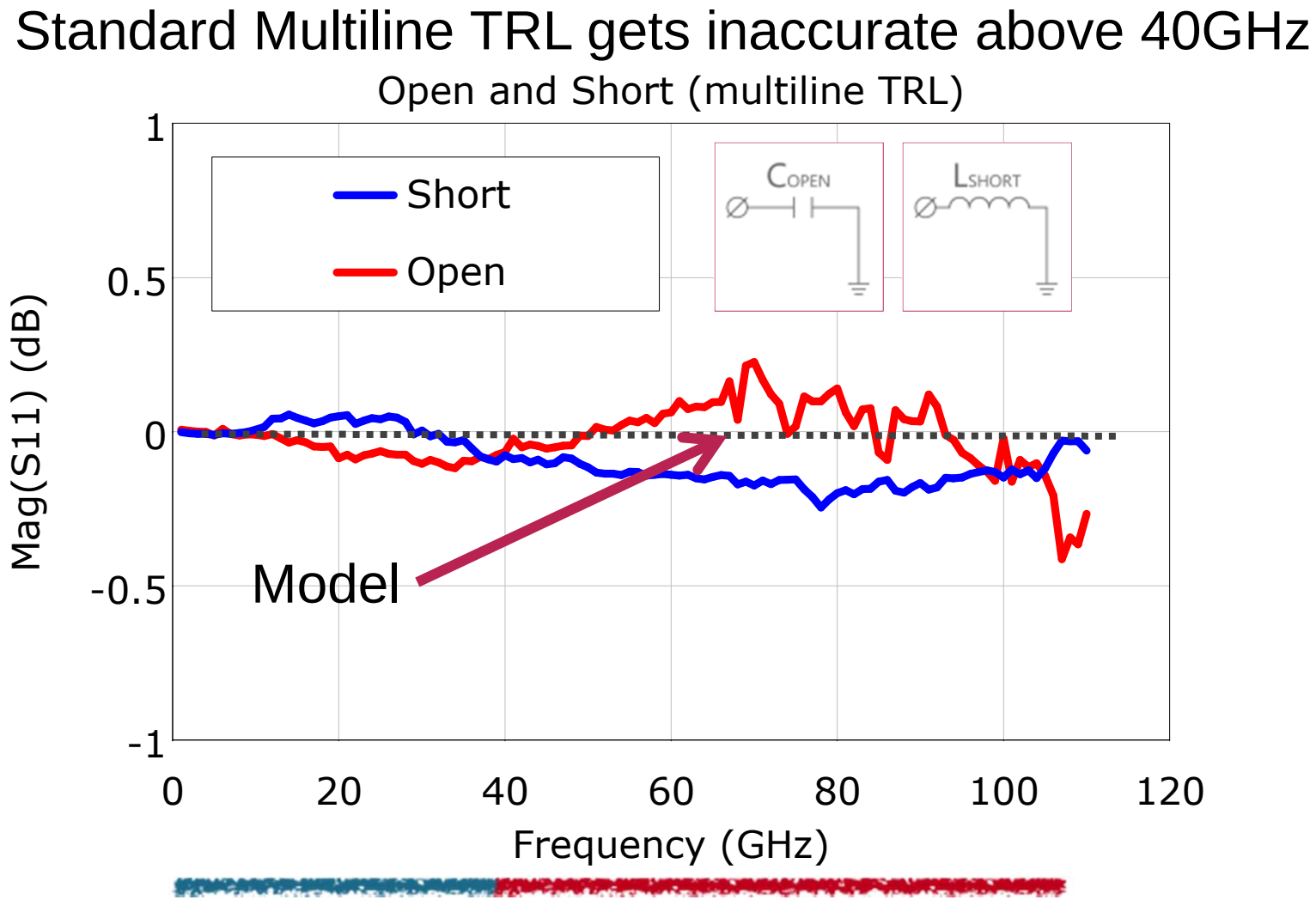
# Micrometer Screw for Multiline TRL calibration




Unique micrometer screw for ea
setting of line length

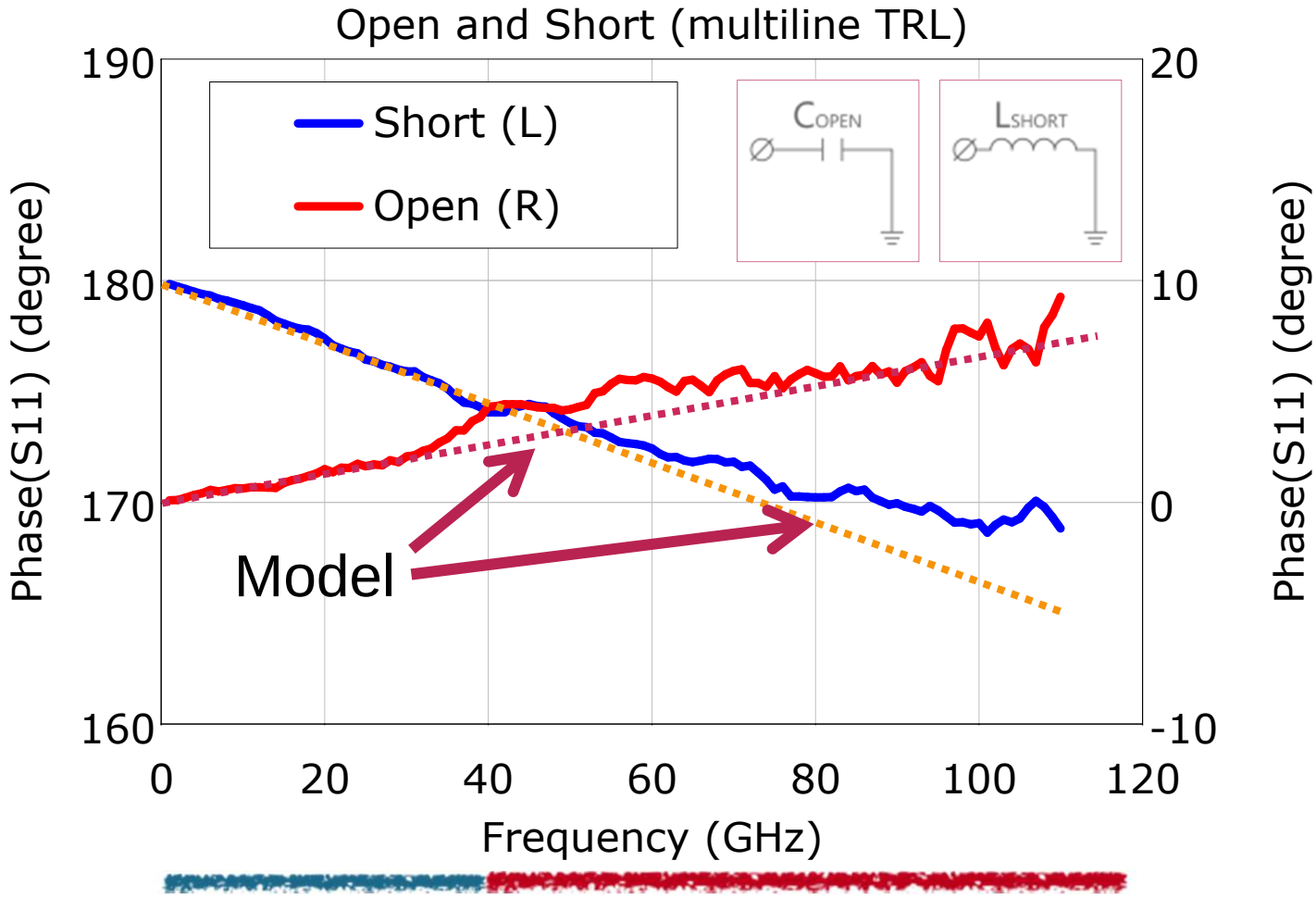


# Advanced Models Needed above 40 GHz

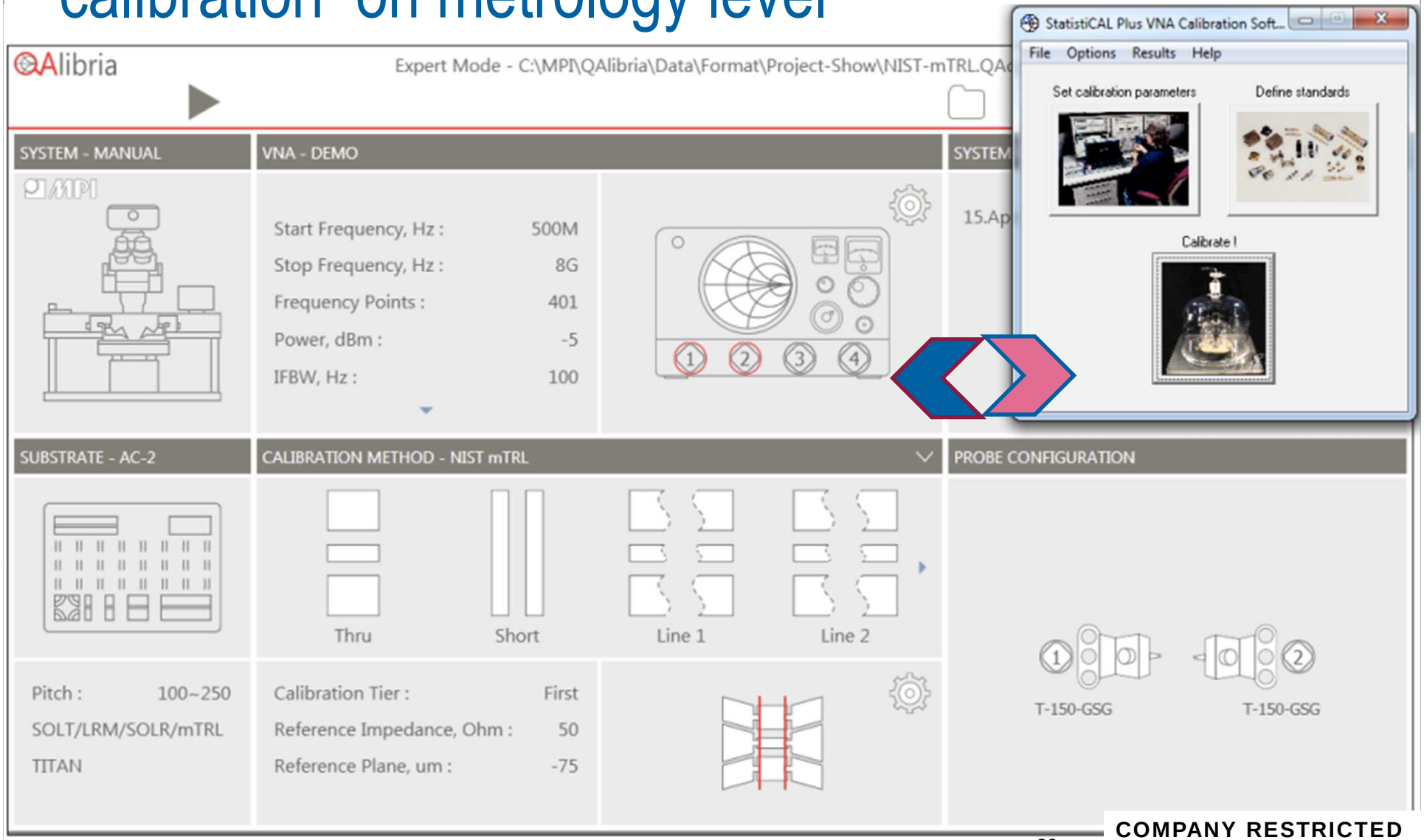


# Advanced Models Needed above 40 GHz

## Standard Multiline TRL gets inaccurate above 40GHz



# QAlibria – offering NIST Multiline TRL calibration on metrology level



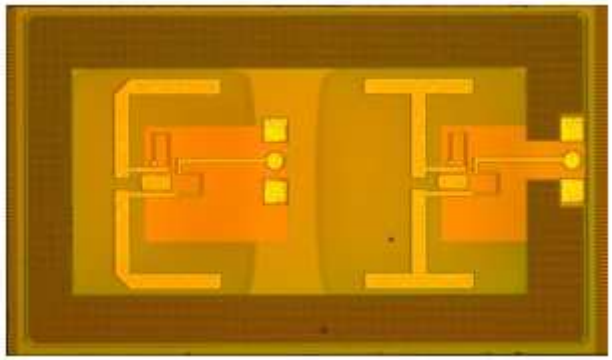


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# Millimeter Wave
# On-Wafer Measurements

# Millimeter wave applications

- **Component test on-wafer (e.g. passive structures)**
- **Transistor or amplifier characterization**
- **On-chip antennas, e.g. 77GHz for automotive radar**
- **Development work on new technologies, like CMOS in the mm-wave range**



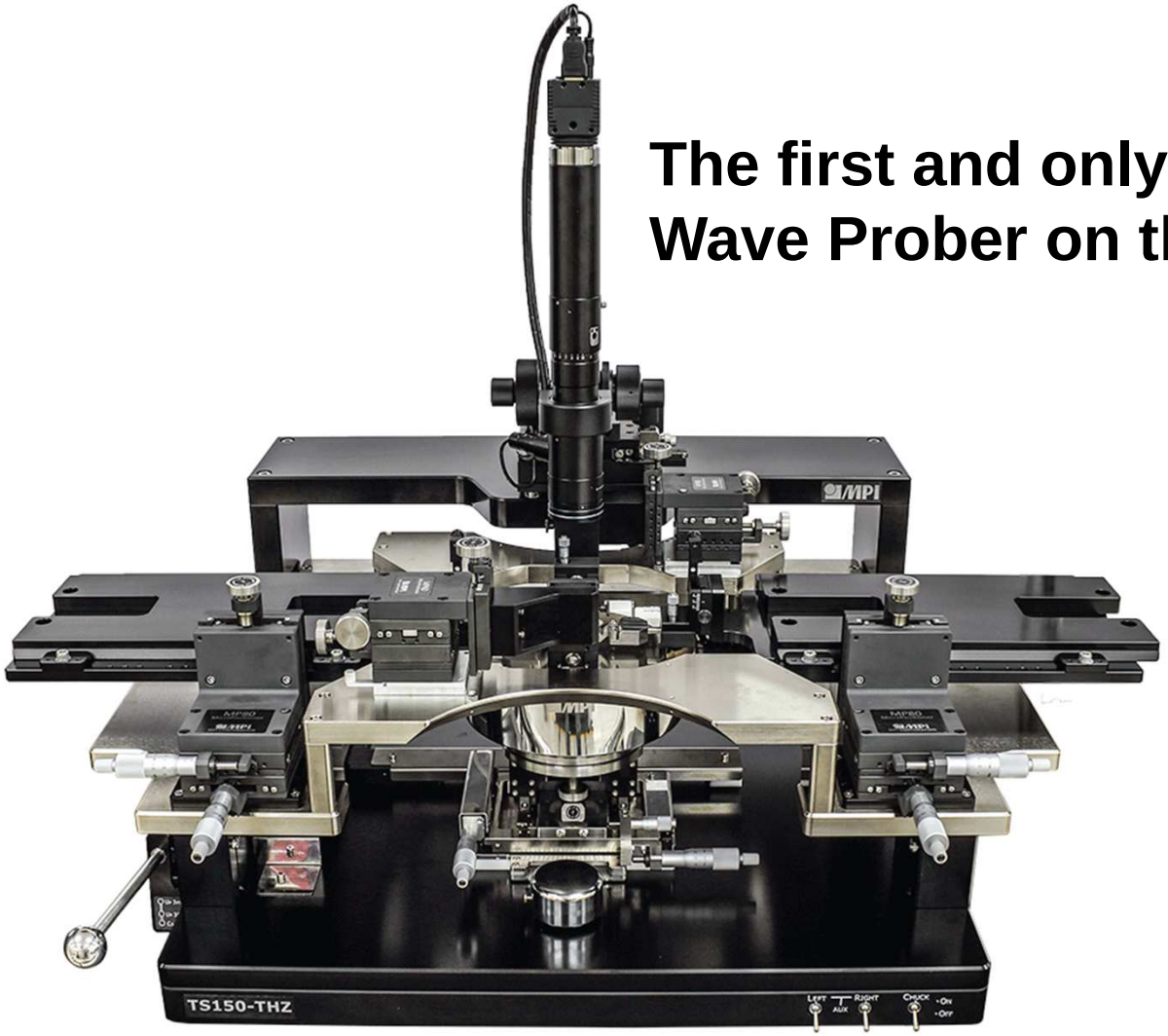
77GHz On-Chip antenna

- **Radar and imaging**
- **Material characterization**
- **5G research**
- **Backhaul (P2P)**
- **Radio Astronomy**
- **….**



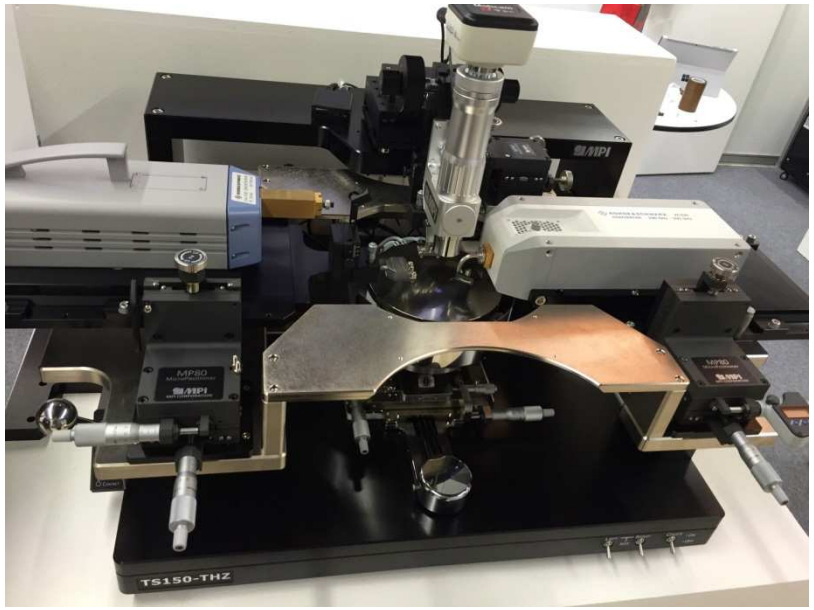
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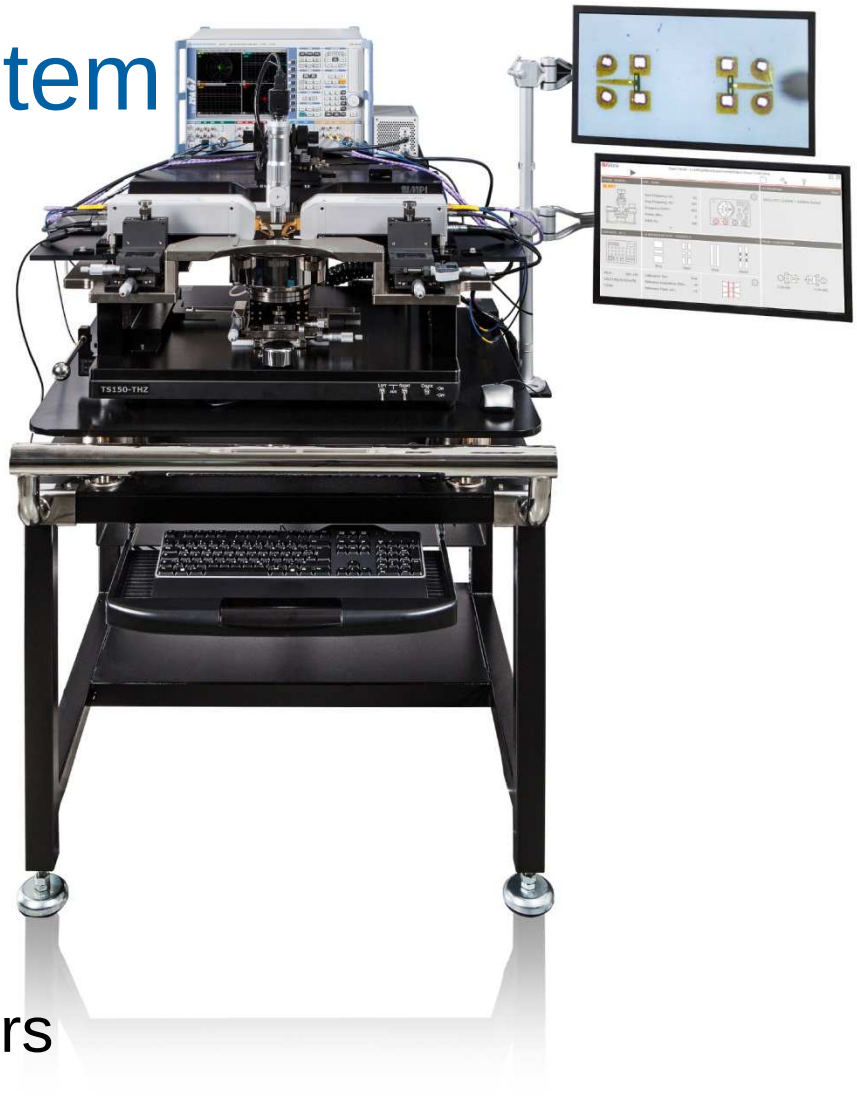
# Dedicated TS150-THZ System




**The first and only dedicated Millimeter Wave Prober on the market**

# TS150-THZ
# Millimeter Wave System




ZCxxx and ZVA-Zxx converters are fully integrated

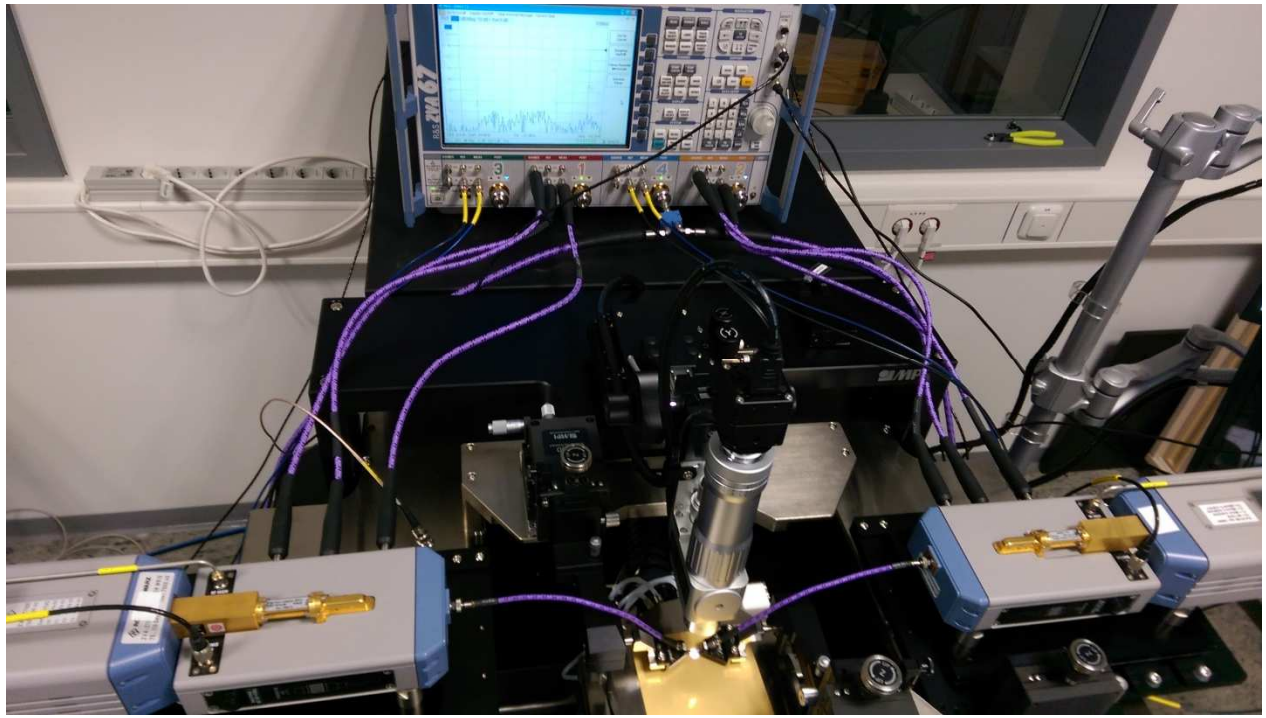
# Stability: No Chuck Elevation required

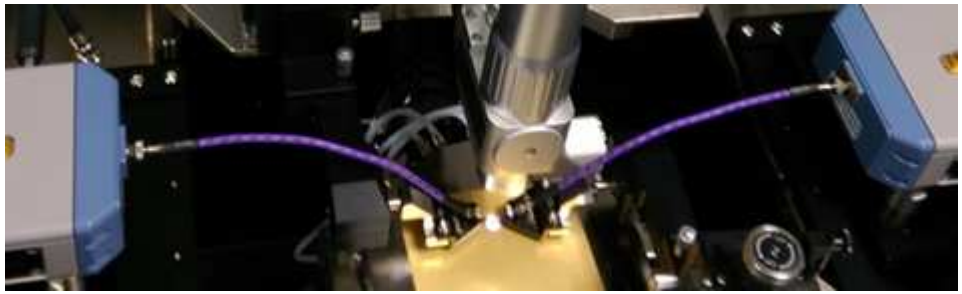



Chuck on same level – no instability due to chuck elevation

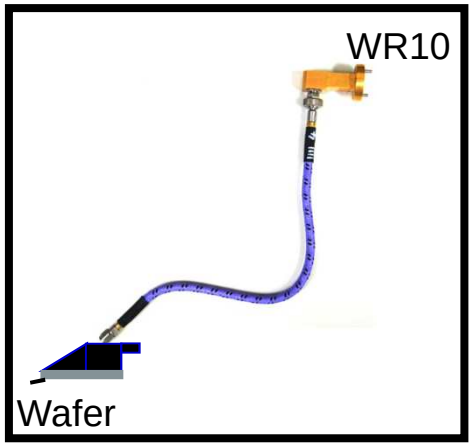
**Direct mounting of mm-wave probe on converter output possible !!**
**Minimizing loss between converter output and probe tip (good directivity)**

# Power Calibration on the Wafer










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# Challenges for accurate Power Levels



**Goal : Power calibration  in the reference plane of the DUT (amplifier)**

**Problem : No access with coaxial power meter possible**




**Solution:**

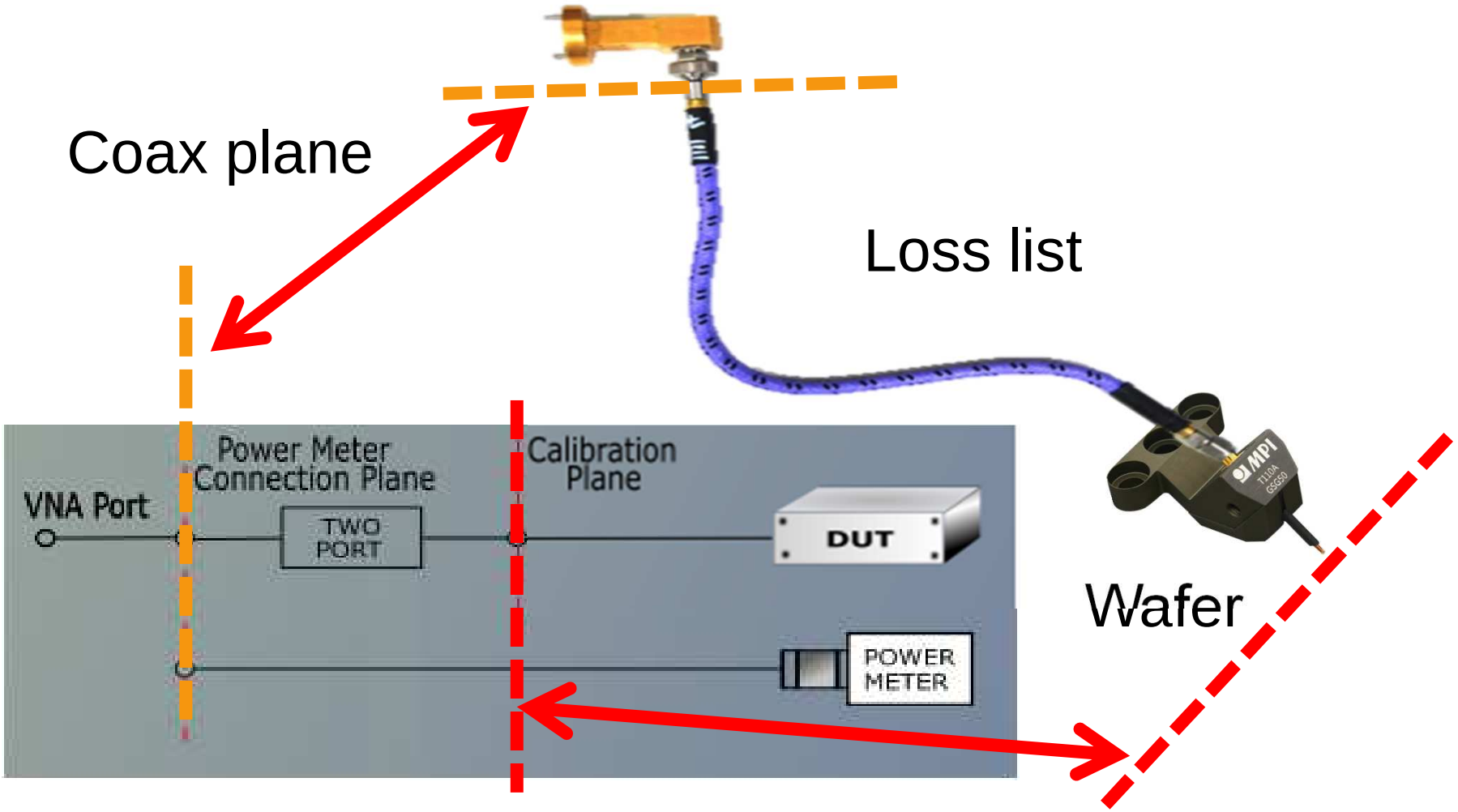
- **Characterization of the S-parameter between coaxial interface and the wafer prober tip**




- **Correction of  the coaxial power calibration with this loss list**


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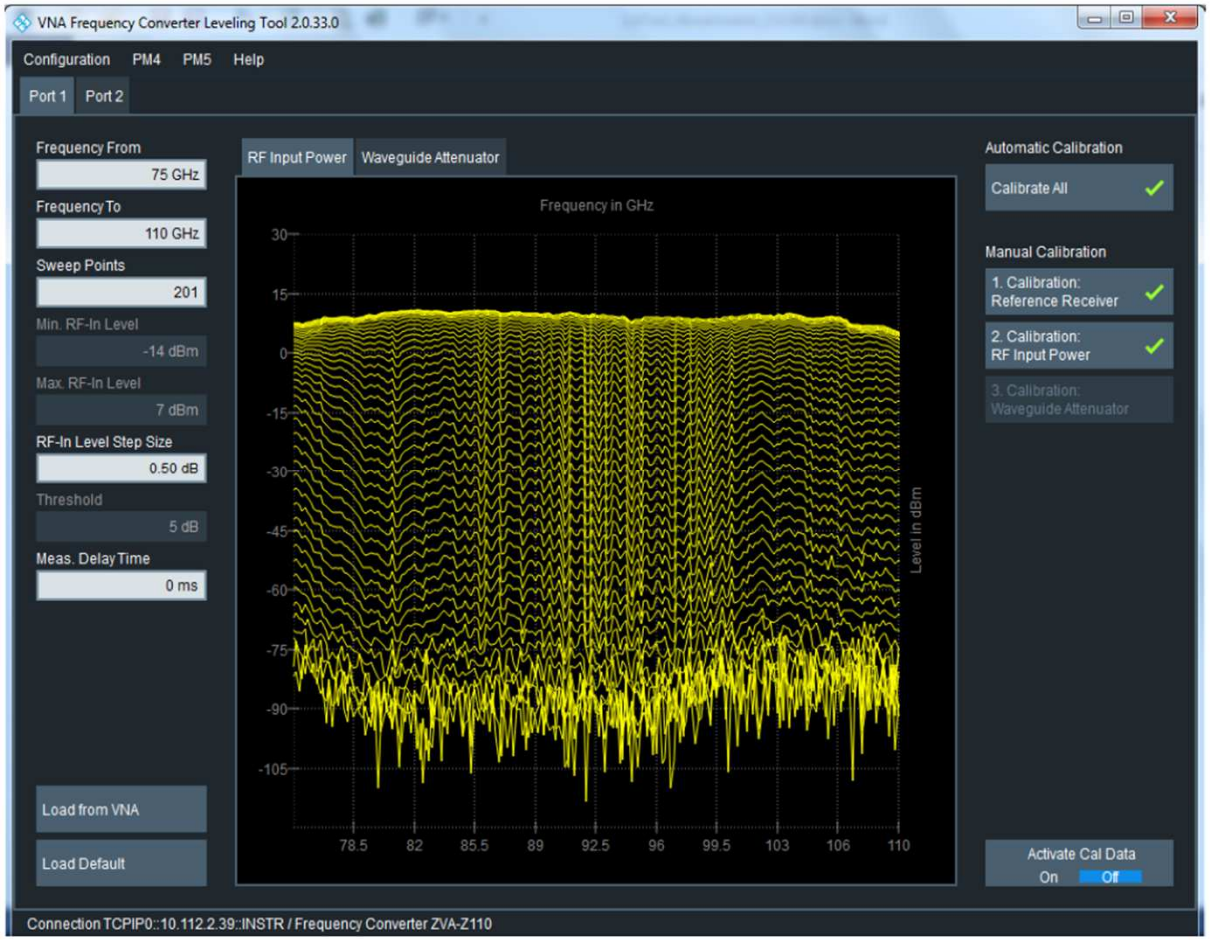
# Power Correction with Loss List





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# Leveling Tool for Power Sweep Capability




Flat output power across band is precondition for power sweep


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# Thank you for your attention

***1950 : World´s first Vector Network Analyzer***
***- made by R&S***




**Direct display of S-Parameters**
**in a complex plane**

***> 60 years of experience in network analysis***


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