

# EPS150RF/EPS200RF

A complete 150 mm/200 mm manual probing package for RF applications up to 67 GHz

## TECHNICAL REVIEW

### Introduction

The EPS150RF and EPS200RF probe systems are application-focused packages that offer complete solution for best-in-class RF measurement results up to 67 GHz. Based on leading technology in RF probing and probe system design, and over 30 years of experience and application expertise, these solutions are the key to achieving accurate measurement results in the shortest time—with maximum confidence.

The EPS150RF package is based on MPS150 150 mm probe station platform and the EPS200RF package is based on the PM8 200 mm probe station platform (Image 1). Both EPS150RF and EPS200RF include RF probe platen, scope mount (for EPS150RF) or scope transport (for EPS200RF), camera-ready microscope, positioners, probe arms, dedicated RF chuck, and RF cables and adapters optimized for two-port S-parameter measurement RF probing requirements up to 67 GHz. Additionally, the package includes light source, integrated vibration-isolation solution and probe accessories such as Probe Polish and contact substrate. Included in the EPS150RF and EPS200RF packages is a full license for WinCal XE™ calibration software as well as your choice of a pair of 40, 50, or 67 GHz single-ended standard RF probes from our Infinity Probe®, |Z| Probe® or ACP probe families that correspond to the frequency range, contact pad configuration and contact pad metallization material of your device, as well as one calibration substrate that supports your probes.\*



Image 1. The EPS150RF probe system (left) and the EPS200RF probe system (right).

The EPS150RF and EPS200RF pre-configured packages address multiple needs common for universities, start-ups and shared R&D labs:

- **Application-ready – right out of the box**
- **Consistently deliver credible, accurate measurement results**
- **Effortlessly probe RF devices with pads as small as 25  $\mu\text{m}$  x 35  $\mu\text{m}$**
- **Minimize training efforts by operating with ease and confidence**
- **Gain free time with simplified system re-configuration and minimized errors**

\* [Terms and conditions apply. See sales representative for details]

**Consistently deliver credible, accurate measurement results**

**Contact Performance**

Consistency of RF data strongly depends on the contact repeatability, reliability and stability for both calibration and measurements. Unreliable and inconsistent contact leads to re-contacting and re-measurement of the device under test (DUT), repeated calibration and significant increases in test time. Moreover, unnecessary touchdowns on the calibration standards and DUT pads decrease the lifetime of the calibration substrate, destroy DUT pads and make further probing and/or bounding difficult or impossible. The contact-separation drive of EPS150RF and EPS200RF (Fig. 1) features +/-1 µm repeatability (Fig. 2). Together with solid and stiff probe arms of the positioners (Fig. 3), both EPS150RF and EPS200RF ensure repeatable, reliable and consistent contact force. A dedicated RF chuck with excellent surface planarity enables consistent overtravel across the entire wafer and calibration substrate (Fig. 4)

Current technologies for semiconductor development utilize different contact pad metallization materials. RF probes must provide reliable and consistent contact on all types of contact pad material—from soft and very low-resistant gold, to aluminum, which builds a highly-resistive, hard-to-break-through oxide layer under atmospheric conditions (Fig. 5). With EPS150RF/EPS200RF, you receive your choice of a pair of 40, 50, or 67 GHz single-ended standard RF probes from our ACP<sup>[1]</sup>, Infinity Probe<sup>[2]</sup> or |Z| Probe<sup>[3]</sup> families and will gain uncompromised contact performance independent from your DUT pad metallization material.

Particles from the contact pads can be accumulated on the RF probe tips, significantly reducing the accuracy and consistency of data. Depending on the contact pad material, probe design and operator experience, cleaning of the RF probe can be required after a few contact cycles<sup>[4]</sup>. The EPS150RF and EPS200RF include a non-destructive Probe Polish cleaning accessory that is optimized for all RF probe types (Fig. 6).

RF characterization of an active device in a hot mode requires S-parameter measurement at different DC bias points. Applying DC sweep adds a new dimension to the device data, exponentially increasing the measurement time. Depending on the number of bias points and the frequency list, RF probes may need to stay in contact for half an hour or longer when characterizing just one transistor. Therefore, contact quality and contact stability over time are essential for accuracy and consistency of such measurements. Parasitic vibrations that may be generated by laboratory equipment or outside sources and transmitted to the measurement platform over the laboratory floor and table can turn long-term measurements into a very challenging exercise. The solid system mainframe with the granite base and integrated vibration isolation solution decouple the DUT from possible vibrations.



Figure 1. Contact-separation drive on the EPS200RF

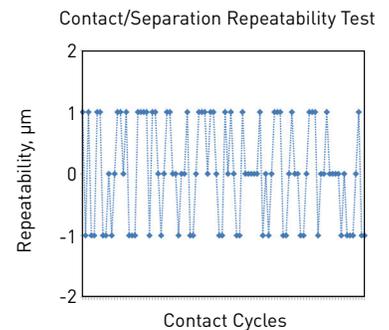


Figure 2. Measured repeatability of the contact/separation drive over 100 cycles, using EPS200RF with RPP305 positioners

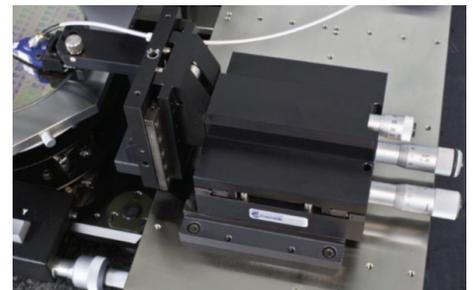


Figure 3. RPP305 positioner on EPS200RF with a solid and stiff probe arm provides accurate probe placement, consistent contact force and overtravel



Figure 4. Dedicated RF chuck with excellent surface planarity and small vacuum holes

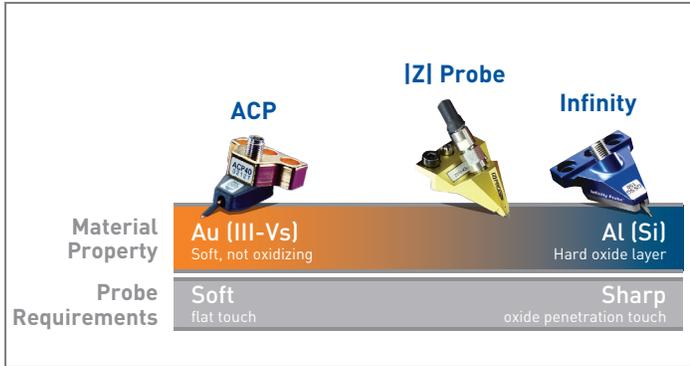


Figure 5. Cascade Microtech's ACP Probes, IZI Probes and Infinity Probes address needs of the entire spectrum of pad metallization

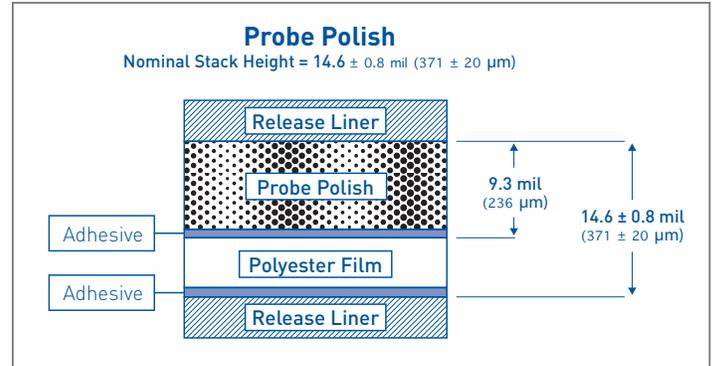


Figure 6. Cross section of probe cleaning material

Solution	Advantage	Benefit
Platen contact-separation drive with +/- 1 $\mu\text{m}$ repeatability	Repeatable and reliable contact force	Repeatable and reliable data
Integrated gauge for visual feedback on the platen position	Reduces risk of damaged probes, DUT pads and calibration standards by precisely controlling overtravel	Saves money and time
Solid and stiff probe arms	Consistent contact force and overtravel Increases lifetime of probe, DUT pads and standards due to minimal overtravel	Consistent calibration and measurement data Saves money and time
Trinocular 6.7x stereo zoom microscope with 30x eyepieces	Excellent optical resolution and field-of-view for accurate probe placement pads as small as 25 $\mu\text{m}$ x 35 $\mu\text{m}$	Consistent calibration and measurement data Ready for future requirements Save money
Dedicated RF chuck with excellent surface planarity and small vacuum holes	Consistent overtravel over entire wafer and calibration substrate Constant contact resistance over the entire wafer Probe height re-adjustment is not required Protect probes, DUT pads and calibration standards from unnecessary damage	Consistent calibration and measurement data Ease of use Saves time Saves money
Your choice of a pair of ACP Probes, Infinity Probes, or IZI Probes	Optimal probe contact performance to your DUT pad metallization material	Consistent data Save money
Probe Polish cleaning accessory	Constant contact resistance Optimized non-destructively clean material	Consistent data Long probe lifetime Saves money
Integrated vibration-isolation solution	Decouple probe system from possible vibration transmitted over the laboratory table Minimized pad damage Constant contact resistance of long-term measurements	Consistent calibration and measurement data Save time and money

**Consistent calibration and measurement boundary conditions**

Modern microwave integrated circuits implement various design types of transmission media: microstrip (MS), coplanar waveguide (CPW), grounded-CPW (or GCPW) and some others. The unique feature of the CPW design is that all conductors are on the same side (on the top) of the substrate. This attribute simplifies manufacturing, scaling, characterization and integration of CPW circuits.

CPW design is common for semi-insulating, high-resistive III-V substrates (e.g. GaAs). The resistivity of the wafer material sufficiently isolates the DUT from possible impact of the metal chuck (such as parasitic coupling and cross-talk). However, special care of the chuck surface must be taken to provide consistent electro-magnetic boundary conditions across the entire wafer for repeatable and location-independent measurement results.

With an increase of measurement frequency of about 20 GHz, parasitic coupling of the electro-magnetic energy through the surface of the metal chuck can also affect the accuracy of the probe-tip calibration<sup>[5]</sup>. To suppress it, calibration substrates can be placed on a special RF absorbing holder<sup>[6]</sup>. However, it elevates the calibration substrate much higher above the wafer surface increasing the risk of unexpected probe damage.

Further increase of the measurement frequency may lead to unwanted signal coupling and higher propagation modes<sup>[7]</sup>. The DUT measurement results may exhibit unexpected and difficult-to-interpret behavior<sup>[8]</sup>. The specially-designed dedicated RF chuck of the EPS150RF/EPS200RF has small vacuum holes (Fig. 4) and an integrated ceramic inlay on the AUX chuck (Fig. 7) to optimize measurement and calibration boundary conditions at higher frequencies (Fig. 8).



Figure 7. Embedded ceramic AUX chuck for optimized calibration boundary conditions

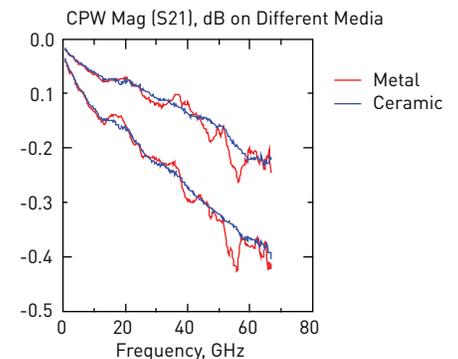


Figure 8. Optimized boundary conditions provided by ceramic AUX chuck improve characteristics of calibration standards

Solution	Advantage	Benefit
Dedicated RF chuck with small vacuum holes and excellent planarity of the surface	<ul style="list-style-type: none"> <li>Homogeneous measurement conditions across entire wafer</li> <li>Consistent and accurate measurement data</li> <li>No data post-processing and system debug</li> </ul>	Reduce time and cost of test
Dedicated ceramic AUX site	<ul style="list-style-type: none"> <li>Homogeneous calibration conditions across the ISS</li> <li>Reduce parasitic coupling with the metal chuck</li> <li>Increase calibration accuracy and confidence in calibration verification</li> <li>Calibration substrate is at DUT height for simplified contact height readjustment for test/calibration/verification</li> </ul>	<ul style="list-style-type: none"> <li>Reduce time and cost of test</li> <li>Ease of use</li> </ul>

**Accurate probe placement on calibration standards**

Accurate S-parameter measurements can only be obtained after determining the vector network analyzer (VNA) error coefficients. This step is also called “VNA calibration.” Various calibration methods are known and used in engineering practice depending on application requirements. In the commonly available SOLT method all standards must be fully known and specified<sup>[9]</sup>.

In contrast to the coaxial or waveguide applications, actual frequency response of a planar standard critically depends on the probe placement (Fig. 9, Fig. 10)<sup>[10-12]</sup>. Implementation of special alignment marks can improve consistency of probe placement, but their use remains subject to operator interpretation. Subtle differences in probe placement seem inevitable, and limit calibration accuracy and reproducibility.

As a result, calibration residual errors caused by disagreement between the actual standard response and its definition may lead to misinterpretation of the DUT performance: inaccurate model parameters, over/under estimation of the figure of merits (e.g.  $f_{MAX}$ , Fig. 11)<sup>[13]</sup>.

Dedicated probe-tip calibration available from WinCal XE, such as LRRM method with automated compensation of the Load inductance variation,<sup>[12]</sup> significantly minimizes impact of the probe misplacement on calibration and measurement results.

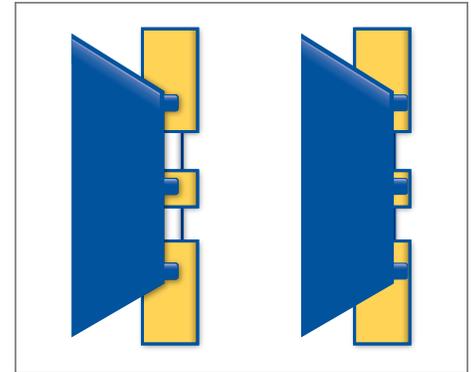


Figure 9. Example of different probe placement on the Load standard

Solution	Advantage	Benefit
Solid and stiff probe arms	Consistent contact force and probe forward skating	Consistent calibration and measurement data
Trinocular 6.7x stereo zoom microscope with 30x eyepiece	Excellent optical resolution and field-of-view for accurate probe alignment and placement	Consistent calibration and measurement data
WinCal XE LRRM calibration with patented load inductance determination procedure	Automated compensation for possible variation in the Load standard frequency response	Accurate and consistent calibration and measurement data

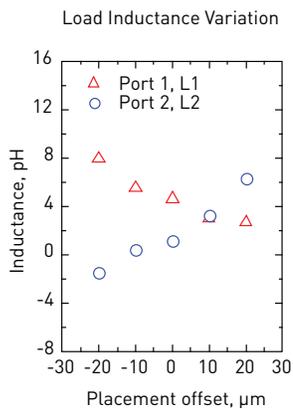


Figure 10. Variation of the equivalent inductance of the Load standard due to different probe placement

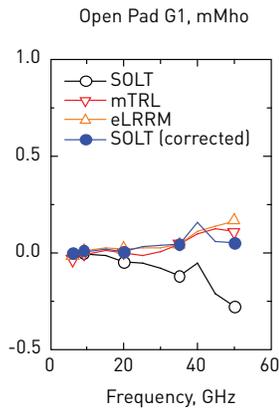
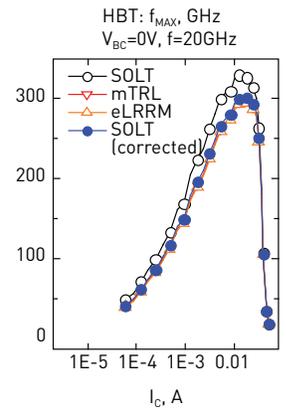
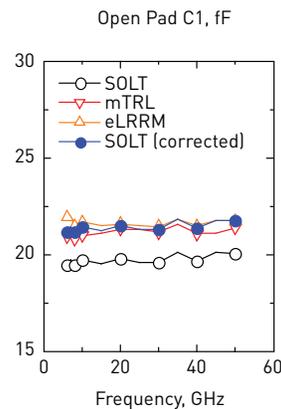


Figure 11. Extracted conductance  $G1$  and capacitance  $C1$  of test OPEN dummy element and maximum oscillation frequency  $f_{MAX}$  of a high-performance HBT with respect to SOLT, multi-line TRL, LRRM and SOLT-corrected for the probe placement error



**Verified calibration standards**

Establishment of a solid traceability chain for wafer-level RF measurement results is still underway. However, substantial achievements have already been made toward developing reliable methods for verification and comparison of planar calibration standards and wafer-level calibration methods<sup>[14-17]</sup>. This work enabled the comparison of Cascade Microtech’s ISS and CSR substrate families (Fig. 12) and calibration methods (Fig. 13) to national references<sup>[18-21]</sup>.

Furthermore, implementing the calibration comparison technique developed in conjunction with NIST<sup>[18]</sup>, the WinCal XE verification tool provides metrological-level analysis of calibration and measurement accuracy (Fig. 14)<sup>[22]</sup>.

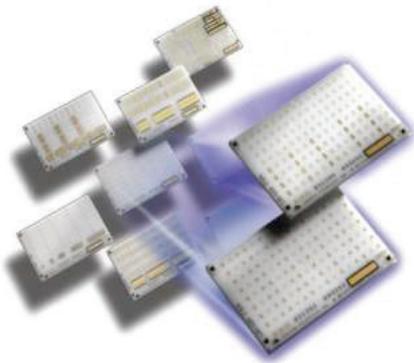


Figure 12. Impedance Standard Substrates (ISS)

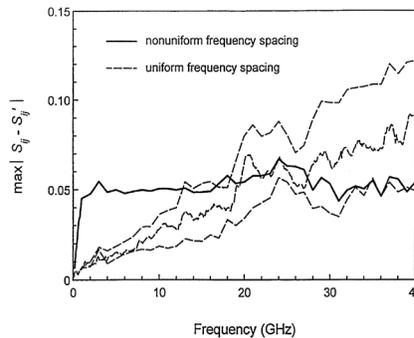


Figure 13. Verification results of probe tip LRRM calibration

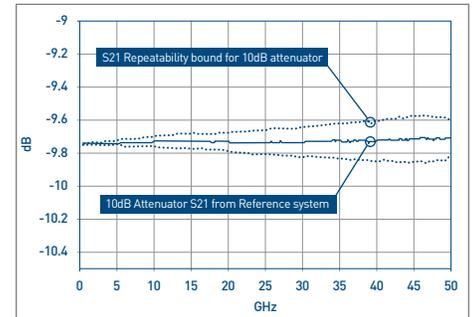


Figure 14. Measurement accuracy verification for a sample DUT calculated by WinCal XE tool

Solution	Advantage	Benefit
ISS and CSR calibration substrate families	Accurately trimmed resistance of the Load standard  Optimized and verified characteristic impedance of the thru/ line standards	Confidence in calibration and measurement results
WinCal XE calibration comparison and validation tool	Quick and insightful procedure to gain confidence in an on-wafer measurement system of unknown accuracy	Confidence in calibration and measurement results  Ease of use

**Dedicated wafer-level calibration methods**

Vector network analyzers do not provide the front-panel calibration methods optimized to wafer-level measurement needs, e.g. insensitivity to the probe placement and dispersion of characteristic impedance of CPW lines<sup>[9]</sup>. Such methods are only available from the wafer-level calibration software WinCal XE (Fig. 15, Fig. 16, Table 1)<sup>[12,23-30]</sup>.

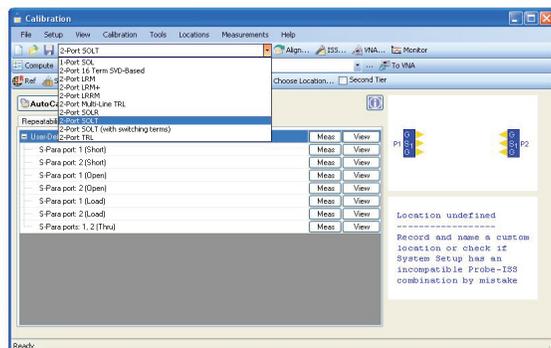


Figure 15. The extensive package of wafer-level calibration methods available from WinCal XE addresses needs of a wide variety of applications: from the probe-tip and up to in-situ calibration on semi-conductive wafer materials.

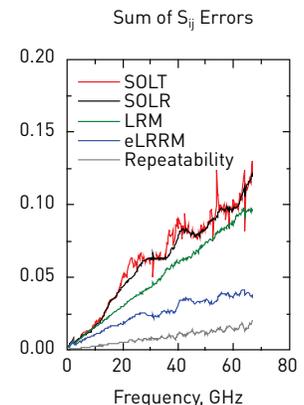


Figure 16. Comparison of different probe-tip calibration methods

Method	Application
SOLR	Off-wafer (ISS) calibration of rectangular configurations
NIST-Style TRL	On-wafer (in-situ) calibration on III-Vs (e.g. GaAs)
LRM+	On-wafer (in-situ) calibration on Si
LRRM	Off-wafer (ISS) calibration

Table 1. Recommended application of wafer-level calibration methods

Solution	Advantage	Benefit
Unique, wafer-level optimized calibration methods such as LRRM, LRM+, NIST-style multiline TRL and hybrid calibration available from WinCal XE	Out-of-box accurate and repeatable calibration and measurement of any DUT type Confidence in DUT extracted parameters Eliminates the need for calibration trouble-shooting	Save time and money
WinCal embedded extensive database of probe and calibration substrates	Quick and easy calibration setup Definition of calibration standard models is not required	Ease of use Save time

## High quality cables

Often entry-level manual systems are equipped with cheap, low-quality cables. The impact of the phase and magnitude instability of such cables on calibration and measurement results increases drastically with the frequency. As a result, the system must be re-calibrated more often, which costs time and reduces the lifespan of high-value calibration standards.

In order to reduce calibration and measurement accuracy degradation, the EPS150RF/EPS200RF package includes high-quality Gore cables (Fig. 17) that guarantee maximum amplitude and phase stability with flexure and minimal performance degradation with the time and assemble/dis-assemble cycles (Fig. 18)<sup>[31]</sup>.

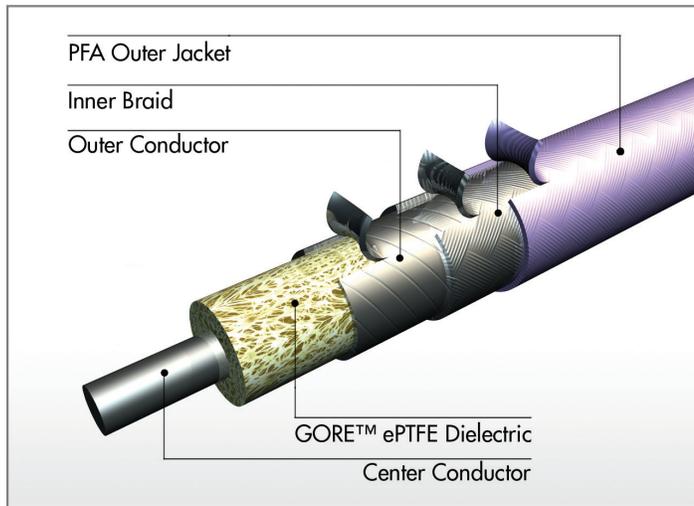


Figure 17. Construction of Gore cable assembly

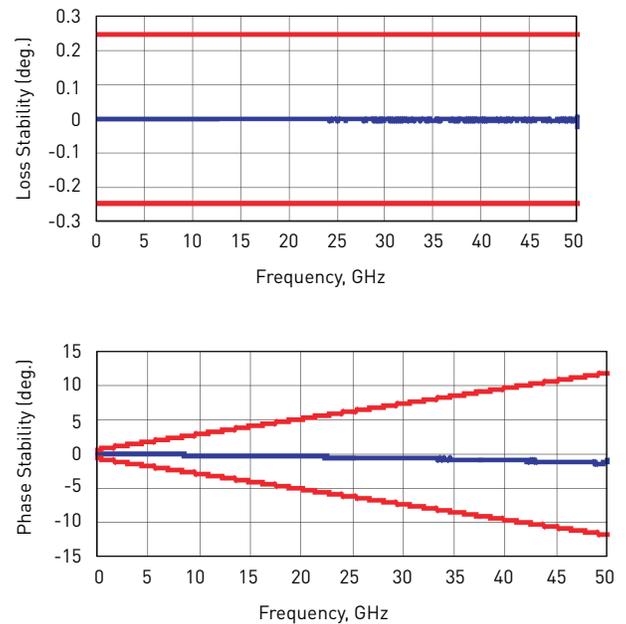


Figure 18. Amplitude and phase stability of Gore cables with flexure

Solution	Advantage	Benefit
Phase-stable, high-quality industry benchmark Gore cables	Repeatable, consistent calibration Minimal performance degradation over time	Ease of use Save time Protect your investment

### Probing on small pads

RF probes are built on the cantilever force delivery mechanism that requires additional pad space supporting the probe forward skate. The probe skate might be up to some tens of microns long when probing on silicon wafers and aluminum pad metallization.

On the other hand, the impact of parasitic capacitance of the DUT contact pads increases with the frequency. It is common that measurements from approximately 3 GHz and above require significant minimization of the pad size. Nowadays, the unitization of contact pads as small as 50 μm x 50 μm is a common engineering practice for RF and mm-wave devices and circuits.

Probe-to-pad misalignment, which is in most cases caused by inaccurate location of positioners, unstable probe arms and inaccurate theta adjustment of the wafer, makes probing on small pads very challenging if not impossible—misaligned probes skate off of the pad or damage pads.

Aligning a 150 mm or 200 mm wafer, port-to-port adjustment of the unguided magnetic or vacuum-based positioners can easily become a lengthy procedure.

The RF probe platen of the EPS150RF and EPS200RF systems, together with the RF positioner, its short and stiff probe arm, the intuitive operation concept, the fine-theta adjustment of the chuck (Fig. 19) and high-quality microscope configuration (Fig. 20) provide easy, accurate and consistent RF probe adjustment and placement.

In addition, Infinity Probe technology (Fig. 21)<sup>[2]</sup> enables probing on pads as small as 25 x 35 μm, even with Al metallization.



Figure 19. The chuck stage available on the EPS200RF is designed with integrated coarse X/Y movement, fine X/Y positioning and fine-theta adjustment



Figure 20. Trinocular 6.7x stereo zoom microscope with 30x eyepieces included in EPS150RF and EPS200RF packages

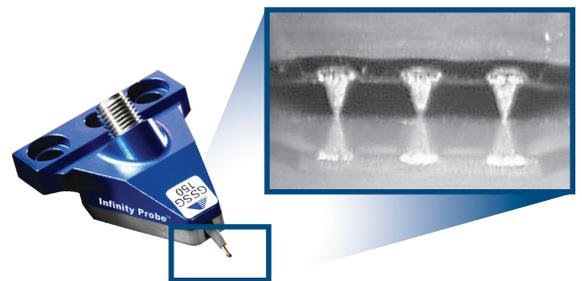


Figure 21. Infinity Probe technology

Solution	Advantage	Benefit
Fine-Theta adjustment of the wafer	Precise wafer-to-probes alignment	Ease of use
Guided magnetic RPP210 positioners with EPS150RF	Eliminate the need for port-to-port positioner adjustment	Ease of use
Bolt-down RPP305 positioners with EPS200RF	Backlash-free, precise probe adjustment to the DUT pad	
Solid and stiff probe arms with integrated planarization micrometer	Backlash-free, precise probe adjustment to the DUT pad Minimize pad damage	Ease of use
Contact substrate	Simple and effective probe planarization and planarization verification	Ease of use
Trinocular 6.7x stereo zoom microscope with 30x eyepiece	Optimal combination of the field-of-view / optical resolution for probing on pads as small as 25 $\mu\text{m}$ x 35 $\mu\text{m}$ Quick probe adjustment/ planarization	Ease of use Save money
Marked and one-side located micrometers of the RF positioner	X, Y, Z final probe adjustment under continuous optical DUT inspection (intuitive operation)	Ease of use

## Operation by inexperienced users

### Inconsistent calibration and measurement results

It is common that universities and research institutes do not have dedicated, experienced RF operators of the measurement system, and the measurement setup is shared between different groups, with multiple users that access the test system infrequently. The lack of operator hands-on experience often leads to inaccurate probe alignment, inconsistent probe placement and contact force on both calibration standards and the DUT. As a result, measurement data obtained for the same device can vary significantly from operator to operator, and between different measurement and calibration sessions for the same operator.



Figure 22. Integrated gauge for precise adjustment of overtravel and live feedback of the probe platen position

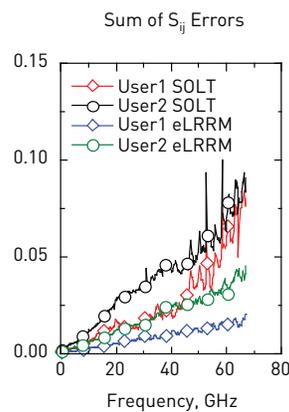


Figure 23. LRRM calibration provides consistent results that are less operator dependent

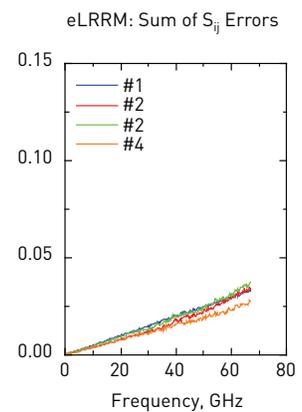


Figure 24. Highly repeatable LRRM calibration available from WinCal XE (included in package)

The probe platen of the EPS150RF/EPS200RF integrates a gauge that provides live feedback on the platen position and supports even the inexperienced operator in setting accurate and consistent contact and overtravel heights across the entire wafer, ISS and measurement sessions (Fig. 22).

The enhanced LRRM calibration available from WinCal XE additionally improves the consistency of measured data as it is less sensitive to the probe placement on calibration standards and as a result, less sensitive to operator experience (Fig. 23, 24).

An extensive library of wizards, tutorials and examples available from WinCal XE supports inexperienced users for quick and correct system configuration and operation (Fig. 25).



Figure 25. WinCal XE embedded wizards and tutorials supporting inexperienced operators

Solution	Advantage	Benefit
WinCal XE LRRM calibration with patented load inductance determination procedure	Automated compensation for possible variation in the Load standard frequency response  Minimized impact of inexperienced operator on calibration accuracy	Accurate and consistent calibration and measurement data
WinCal XE calibration wizards, extensive tutorials and library of examples	Quick and correct configuration and execution of calibration procedures	Minimized risk, simplified complexity of system RF calibration task  Save time
Trinocular 6.7x stereo zoom microscope with 30x eyepiece	Optimal combination of the field-of-view / optical resolution for quick and accurate probe placement	Ease of use
Platen contact-separation drive with +/- 1 µm repeatability (Contact separation: 200 µm with EPS150RF, 400 µm with EPS200RF)	Consistent contact force over all calibration standards and wafer  Gentle, smooth and simultaneous device contacting by all probes at the same time  Constant probe-to-probe distance between calibration standards	Ease of use
Gauge for measurement of probe platen position	Live feedback of the applied overtravel  Contact force consistency comparable to semi-automated system	Repeatable and consistent calibration and measurement
Phase and magnitude stable Gore cables	Reduces need for system recalibration after accidental touch/move of cables	Save time

**Avoid high risk of damaging RF probes, calibration standards and DUT pads**

A lack of experience also increases risk for damage RF probes, calibration standards and DUT pads when operating a manual system. The design of the RF probe platen and the platen drive mechanism prevents the probes from crashing unexpectedly. The adjustable marker on the platen gauge (Fig. 22) and the fixed and marked position of the contact/separation handle (Fig. 1) help to minimize risk of moving the chuck while it is in contact.

The robustness of the |Z| Probe technology with 200 µm tip compliance supports the first steps of inexperienced operators in building their confidence in wafer probing (Fig. 26).

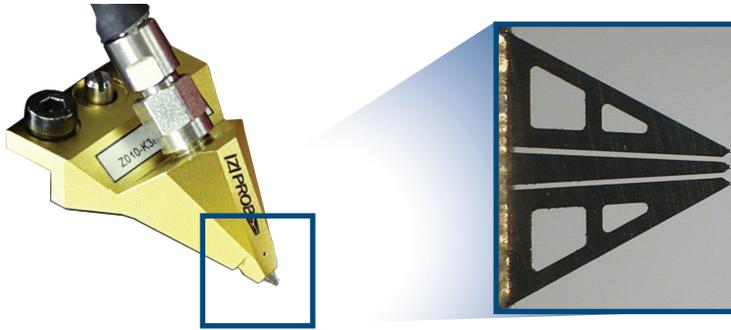


Figure 26. Long MEMS-fabricated coplanar contacts of |Z| Probe provide 200 μm tip compliance and are less sensitive to critical actions

Solution	Advantage	Benefit
Platen drive designed to keep the platen fixed at any arbitrary position between contact and separation	No risk for probe damage due to accidental platen drop from separation to contact position	Ease of use Save time Protect your investment
Available  Z  Probes	Guaranteed 200 μm tip compliance	Save money

### The need for frequent system re-configuration

Shared laboratories or limited-budget projects frequently require a system that must support multiple applications on a single platform. Changeover from IV/CV to RF and microwave measurements, from measurement of passive devices to ICs, and from two to 3- or 4-port configurations, can turn into a complicated and time-consuming task that is associated with a high risk of possible mistakes. The new configuration of the DUT, such as different contact pitch, pad layout, frequency range, contact pad material and port count, requires the change and re-adjustment of RF probes. Moreover, the new probe connection coefficients have to be entered manually from the VNA front panel as a new calibration kit and the system must be re-calibrated. In some cases, modification of the probe platen may be required.

System reconfiguration is always associated with re-connecting, re-locating and re-banding RF cables. RF cables have a limited lifetime, as every mechanical stress degrades cable performance of low-quality cables.

Often, engineers are asked to probe small parts of the wafer or even diced single chips. The small geometry of the test element does not allow it to be properly fixed on the chuck. Insufficient fixation of the device under test on the chuck due to lack of vacuum holes makes probing very difficult, reduces contact quality and, as a result, leads to inconsistent measurement data.

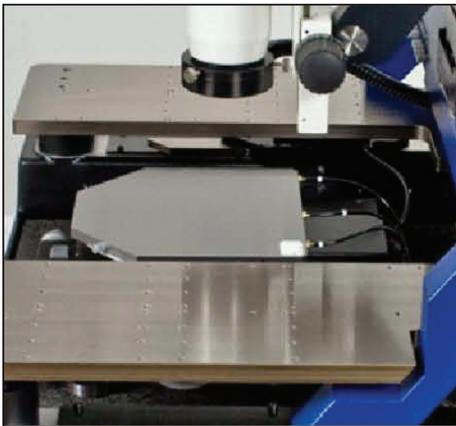


Figure 27. Multi-purpose RF platen supporting various positioner configurations

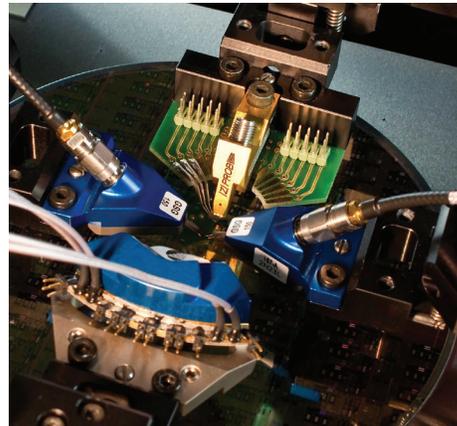


Figure 28. Four-port configuration option for IC verification and debug

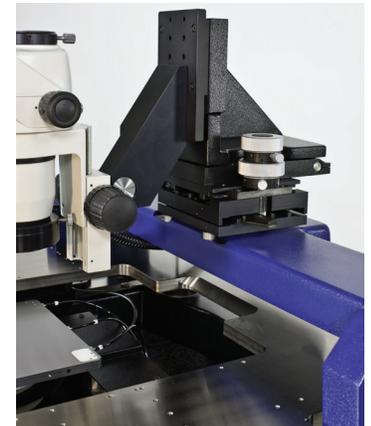


Figure 29. Solid design of the microscope RF bridge and transport with tilt lift

The multi-purpose RF platen of the EPS150RF/EPS200RF with guided magnetic RPP210 positioners (EPS150RF) or bolt-down RPP305 positioners (EPS200RF) (Fig. 27), pre-configured options for 4-port probing (Fig. 28), makes frequent system re-configuration quick and seamless.

The chuck of the EPS150RF/EPS200RF has additional four vacuum holes at its center (Fig. 30) to support probing on diced chips (Fig. 31).

A complete database of probe calibration coefficients and calibration standards embedded in WinCal XE makes switching the probe configuration as simple as a mouse click (Fig. 32).

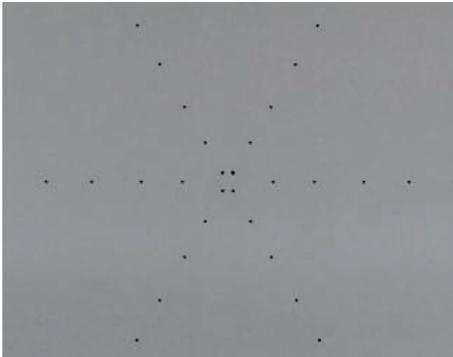


Figure 30. Vacuum holes of the RF chuck supporting single chip probing

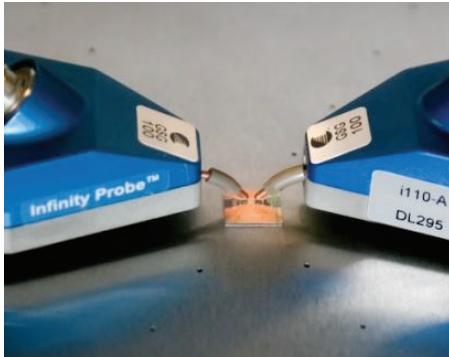


Figure 31. Probing of a single chip on RF chuck

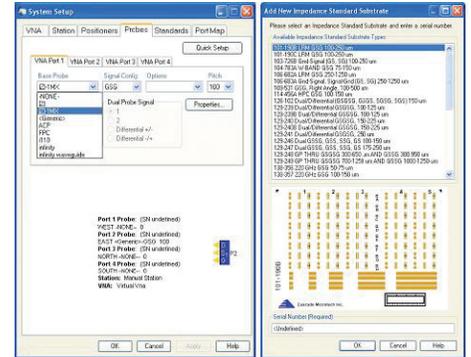


Figure 32. Complete database of Cascade Microtech's RF probes and calibration substrates embedded in WinCal XE

Solution	Advantage	Benefit
RPP210/RPP305 E/W probe arms in NW/SE, full 4-port compatible	Ready for the full four RF ports E/S/W/N configuration Ready for additional bias ports	Save money, protect your investment
Multi-purpose RF probe platen	Holes supporting different RPP305 locations as well as full 4-port configuration	Quick and easy system reconfiguration and upgrade
Option for 4-port RF configuration	Two additional positioners with S/N probe arms included in one part number	Quick ordering Eliminates mistake of misconfiguration
Stiff probe arms of RPP210/RPP305 positioners	Stable and precise handling of multi-contact and mixed-signal probes	Ease of use
High-quality cable with durable construction that resists crushing, twisting, and kinking	Long cable service life	Save money
WinCal XE embedded extensive database of probe and calibration substrates	Quick and easy calibration setup Definition of calibration standard models is not required	Ease of use Save time and money
Additional holes at the chuck center	Probing diced chips on the chuck without additional chip holders	Saves time and money

**Convenience and ease of use**

**Quick and precise navigation**

The test chip typically consists of different device geometries and associated contact pad de-embedding dummy elements. Often there are several test chips that are distributed over the wafer. Testing a targeted DUT requires long-distance navigation over the entire wafer (chip-to-chip or site-to-site) as well as precise movement within a test chip (sub-site).

Calibration standards, calibration verification elements and probe cleaning pads are located off-wafer on AUX chucks. Switching between measurement mode and system calibration/verification and probe clean up requires long-distance chuck travel.

The unique design of the chuck stage of EPS200RF (Fig. 19) enables quick and simultaneous coarse movement in both X and Y axes and precise fine adjustment around the targeted position provides switching from measurement (on-wafer) to calibration or probe cleaning (on AUX chuck) in a second. The capability for independent coarse movement for Y or X axes significantly simplifies and speeds up the chip-to-chip stepping.

An extensive collection of measurement examples and data report styles available from the WinCal XE measurement tool helps to take data of various DUT types right away (Fig. 33). No additional measurement software is needed.

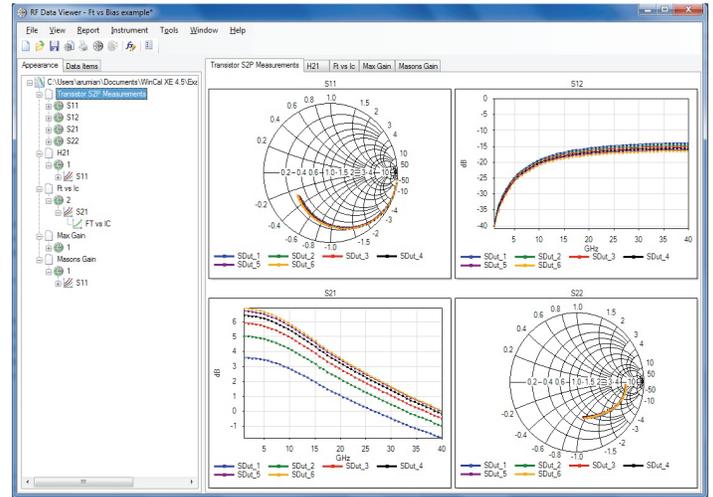


Figure 33. Example of measurement data taken with WinCal XE

Solution	Advantage	Benefit
Unique design of the chuck X/Y stage (EPS200RF)	Quick coarse movement and sub- $\mu\text{m}$ positioning Quick switch between DUT measurement (on-wafer) and calibration/verification/probe clean (on AUX chuck) Integrated navigation marker Independent X/Y stepping	Ease of use
Accurate contact/separation platen drive (200 $\mu\text{m}$ with EPS150RF, 400 $\mu\text{m}$ with EPS200RF)	Quick measurement /navigation switch Navigation always in focus on DUT/wafer	Ease of use
WinCal XE DUT measurement tool with extensive set of examples	Quick start-up Additional measurement software is not required in most cases	Ease of use Save money

**Changeover for calibration, measurements and probe cleaning**

Depending on the technology, material and application, the thickness of the wafer varies in a wide range and may be very different from that of calibration and contact substrates as well as the probe cleaning pads. As a result, cleaning probes and/or re-calibrating the system may require a lengthy and time-consuming re-adjustment of the contact height.

The platen drive with quick move (200 µm contact/separation with EPS150RF, 400 µm contact/separation with EPS200RF) and the capability to fix the platen at an arbitrary position (Fig. 1) significantly simplifies switchover between measurement, calibration, calibration verification and probe clean.

Integrated ceramic AUX chuck of the RF chuck holds the calibration substrate at comparable with the wafer height (Fig. 7). It eliminates the need to re-adjust contact height between calibration and measurement.

Solution	Advantage	Benefit
40 mm platen drive with 200/400 µm contact/separation mechanism that can be used at arbitrary positions	Positioner re-adjustment in Z is not required when changing between measurements, calibrations or when cleaning probes	Ease of use
RF chuck with two integrated AUX sites	Eliminates the need for change over between measurement, calibration and probe cleaning as wafer, ISS and cleaning pads are held on the chuck simultaneously.	Ease of use

**Summary**

Characterization of modern RF devices and integrated circuits is associated with serious challenges. Engineers are called upon to deliver high-precision measurement results, dealing with structures and multi-functional ICs that continuously decrease physical dimensions, increase operation frequencies and increase the level of integration complexity.

The EPS150RF and EPS200RF probe systems are uncompromised solutions that quickly support every engineer in achieving the highest level of accuracy and confidence in measurement results. It delivers flexibility and enables probing on cutting-edge technologies as a complete solution – ready for your application – right out of the box!

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