Tesla

On-Wafer Power Device Characterization System

The power to accelerate development, increase productivity and lower measurement costs.

CascadeMicrotech®

Answering the call for wafer-level power device characterization

Throughout the world, emerging energy standards are driving a clear and present demand for efficient power utilization. In turn, the impact on power semiconductor device manufacturers is growing. Utilized in industries including transportation, consumer electronics, mobile products, space and medical, efficient power devices are in record demand. In fact, market growth for power devices now exceeds the rest of the semiconductor market. Simply put, the broad use of power devices, plus the premium of efficient power utilization, has created enormous pressure for manufacturers to rapidly design, develop and characterize new power devices. Time-to-market is everything. And that's okay, because help is here.

Tesla is the industry's first complete system for on-wafer power device characterization. By eliminating the need for time-consuming, in-package characterization or risky in-house test solutions, Tesla delivers unprecedented productivity gains, faster development cycles and a lower cost of test. Now power device manufacturers can take advantage of a complete on-wafer solution for over temperature, low-contact resistance measurements of power devices up to 100 A (pulsed) / 10 A (DC) and 3,000 V (triax) / 10,000 V (coax) on either 200 mm or 300 mm high-power probe station. Unlike any other commercially available probing system, the Tesla system is dedicated exclusively to helping engineers overcome the unique on-wafer measurement challenges of power devices. More importantly, Tesla is here to help power device manufacturers meet and beat the extraordinary pace of the global marketplace.

The ideal development path — measure, characterize, model and production

Design > **On-Wafer Characterization** > **Models Extracted** > **Production**

Cascade Microtech's advanced electrical metrology systems and production probes have been cornerstones of the semiconductor development process for more than twenty years. As a result, the broader semiconductor market has arrived at a streamlined development process that truly helps speed time-to-revenue. It's a process where the device is designed, characterized on-wafer, models are extracted and the device moves quickly to processing for mass production

Eliminate cumbersome, costly and time-consuming in-package characterization

Sent out for packaging

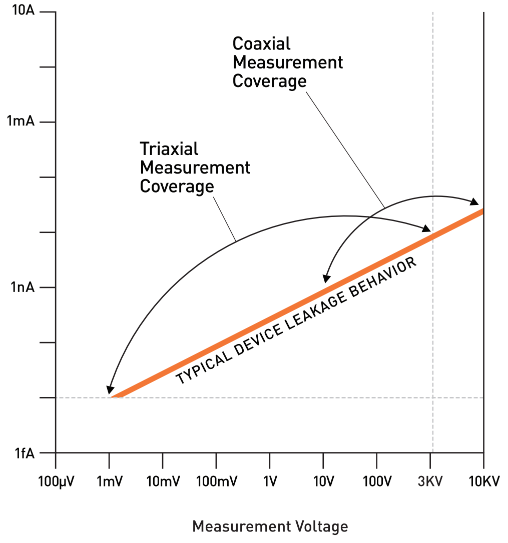
Design **In-Package Characterization** > **Models Extracted** > **Production**

Until Tesla, power device manufacturers have been straddled with the task of sending power devices out for packaging prior to characterization and model extraction. This extra step adds cost, plus development schedules can often face delays of several weeks or months. By providing accurate, reliable and repeatable on-wafer power device characterization, Tesla erases this unfortunate detour by putting power device characterization on an ideal development path so power device manufacturers can swiftly and cost effectively achieve critical time-to-market goals.

Now you have the power to:

- Reduce overall chip development cost
- Increase measurement productivity
- Eliminate the cost, delays and uncertainty of in-package characterization
- Accelerate device development for a faster time to market

Optimized Measurement Coverage with Cascade Microtech Tesla System

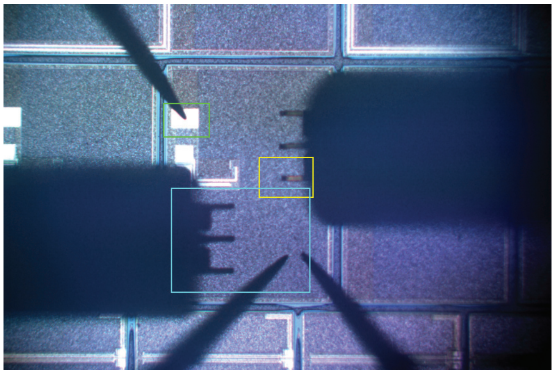


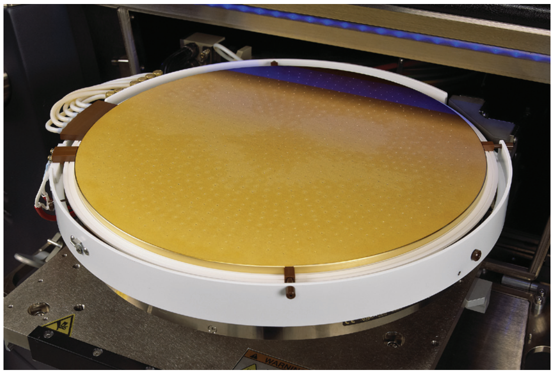
The Tesla system unlocks triaxial measurements at high voltages so engineers can now uncover unprecedented levels of device leakage behavior.

PROBLEMS SOLVED

The Tesla system has been developed from the ground up to satisfy the unique demands and overcome the specific challenges associated with achieving accurate, wafer-level power device characterization.

	Problem	Solution	High-Current Probe	High-Voltage Probe	Gold-Plated Chuck	Tesla Probe Station
Mounting thin wafers	**PROBLEM:** With an average thickness of 100 µm, today's wafers introduce added complexity to device characterization. These thin wafers are difficult to hold down on a standard wafer chuck and are often prone to curling at the ends, much like a potato chip. This creates problems for wafer probing and, in particular, for securing low-contact resistance between the wafer and the chuck.	**SOLUTION:** Tesla features a state-of-the-art chuck for mounting thin wafers. With the uniform and dense distribution of fine vacuum holes (400 µm diameter), the innovative gold-plated chuck technology delicately provides the appropriate amount of vacuum to protect against wafer breakage or probe damage. For the most accurate backside connections, a highly polished gold-top surface ensures low-contact resistance between wafer and chuck.			●	
Rds(on) measurements	**PROBLEM:** The pursuit for the ideal power device is leading engineers to drive the ON state resistance to increasingly lower and lower levels. With today's power semiconductor devices requiring high-current pulses and VDMOS power devices having the drain on the backside, accurate Rds(on) measurements have proven to be more and more difficult and problematic to perform on-wafer.	**SOLUTION:** Tesla enables engineers to make Rds(on) measurements at values lower than ever before on a probe station. This extraordinary performance comes through the highly polished gold chuck surface and a superior vacuum pattern that provides contact resistance in the milliohm range. Measuring drain resistance at a very high current has never been easier with the HCP probes supporting up to 100 A pulses.	●	●		●
High-current probe burnout	**PROBLEM:** Accurate probing of power devices requires high-current measurement capabilities. Reliable wafer-level characterization of power devices has always been a challenge due to inconvenient device heating at the probe tip. Furthermore, smaller and smaller pad dimensions only increase the likelihood of problematic device heating at the probe tip.	**SOLUTION:** Tesla's high-current probe reduces probe and/or device destruction at high currents. It supports 10 A DC and up to 100 A of pulsed current. By design, the probe tip minimizes contact resistance at the wafer-to-probe interface to prevent device heating at the tip. The probe distributes current over multiple contact points at the tip and is joined by a single heatsink that pulls pull heat from the probe tip.	●			
Low-leakage measurement at high voltage	**PROBLEM:** Precision measurements of high-voltage devices present some formidable challenges for probe design. Higher voltage between the guard and shield elements of the probe drives higher leakage currents through the resistance of various isolating materials separating those elements. In order to prevent dielectric breakdown (arcing) and maintain a safe operation, the distance must increase between internal elements of the probe. Additionally, upgraded cables and connectors are required.	**SOLUTION:** To ensure precision measurements of today's high-voltage devices, Tesla's HVP probes provide increased isolation resistance and dielectric strength by incorporating advanced internal isolation materials, as well as custom cabling and connectors. The unique internal design of HVP probe layers and elements assures the distance achieved by isolating materials, as well as inter-layer creepage paths, will prevent any breakdowns at high voltage and still enable full triaxial capability.		●	●	●
Safety for device, operator and probing equipment	**PROBLEM:** With power devices requiring upwards of 200 V, the integrity of this high-performance electrical test environment starts with ensuring both hardware and humans are protected from damage and/or severe injury. The advent of home-spun device characterization systems can present several safety issues, as these in-house test systems often include several disparate components and may lack the know-how to include all required safety protocols.	**SOLUTION:** The entire Tesla system is deliberately designed to ensure operator safety while providing a high-performance electrical measurement path. Features like an integrated safety interlock light curtain ensure operator safety during measurements. Additionally, the probe, chuck, chuck environment, cables, connectors and interface panels all contribute to this ultra-safe test environment and high-performance electrical path.	●	●	●	●





far left: The Tesla HCP probe reduces contact resistance at the tip through an innovative multi-finger design that provides a distribution of current for minimal device heating at the tip, while providing minimal probe marks.

left: Tesla features a gold-plated high-power chuck for mounting thin wafers.

The industry's first on-wafer probing system dedicated to power device characterization

Because Tesla is specifically optimized around the key high-voltage/high-current measurement challenges unique to power devices, no stone was left unturned when designing and developing this complete and comprehensive solution. The Tesla system is engineered to withstand probing levels of up to 100 A (pulsed) / 10 A (DC) and 3,000 V (triax) / 10,000 V (coax) on both 200 and 300 mm wafers. It supports a measurement temperature range of -55°C to 300°C. Rest assured, Tesla has been built from the ground up to ensure power device manufacturers will immediately reap the benefits of a high-performance electrical measurement path in an ultra-safe testing environment.

TESLA SYSTEM TYPICAL CONFIGURATION

Probe station package	Tesla 200 mm manual/semi-automatic probe station or Tesla 300 mm semi-automatic probe station with low-noise performance package (MicroChamber®, AttoGuard®)
Thermal wafer chuck package	Gold-plated thermal chuck optimized for minimal chuck-to-wafer contact resistance and thin-wafer mounting
	High-performance thermal controller and chiller system
Safety interlock system	Infrared laser light curtain
	Deluxe anti-vibration table kit
Hands-free digital imaging system	eVue™ digital imaging system 40X remote focus
	2X objective with smart objective mount
	Motorized microscope bridge-mount with 2 x 2 programmable focus
High-current probe package	HCP high-current parametric probe holders
	Box of five replaceable probe tips
	Probe micropositioners
High-voltage probe package with Kelvin sense capability	HVP high-voltage parametric probe holders
	Box of 25 replaceable probe tips
	Probe micropositioners
System interface panels	High-voltage interface panel
	High-current interface panel
Cables	High-voltage/current cable package

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