Tesla

On-Wafer Power Device Characterization System

DATA SHEET

Designed specifically for accurate power device measurements at the wafer level, the Tesla on-wafer power device characterization system is engineered to provide probing levels of up to 3,000 V (triaxial), 10,000 V (coaxial) and 100 W/cm^2. It supports a measurement temperature range of -55ºC to 300ºC. In combination with Cascade Microtech's patented MicroChamber®, the Tesla features a high-power, gold-plated chuck to ensure low-contact resistance, thin-wafer handling and power dissipation; all while providing a low-noise, fully guarded and shielded test environment. To ensure the utmost safety during a high-voltage measurement, the Tesla employs an infrared laser light curtain and safety interlock system.

The powerful Velox™ probe station control software features easy on-screen navigation, wafer mapping, seamless integration with analyzers and measurement software, and enables simple operation of motorized positioners and thermal systems. For a wide range of high-power applications, the Tesla system powered by Velox software achieves high accuracy and high test efficiency.

FEATURES / BENEFITS

High-voltage/ current probes	On-wafer power device characterization up to 10,000 V, 600 A and 100 W Reduced probe and device destruction at high currents up to 20 A DC and 300 A pulse (600 A when two probes are used in parallel) Increased isolation resistance and dielectric strength to provide full triaxial capability at high voltage (3,000 V) for low-leakage measurement
Gold-plated high-power chuck technology	Prevent thin wafers from curling and breaking Highly polished chuck surface for minimum contact resistance between wafer and chuck Accurate Rds(on) measurement at high current
Safety for operator and device	Light curtain and safety interlock system for operator safety during measurements Roll-out stage for full wafer access and easy wafer loading/unloading
Seamless integration	Convenient connection kits for easy and safe system integration with Keysight and Keithley parametric analyzers Seamless integration between Velox and analyzers/measurement software

CascadeMicrotech®

Note: For physical dimensions and facility requirements, refer to the Tesla Facility Planning Guide.

POWER HANDLING (HIGH CURRENT CHUCK)

Max voltage	3,000 V (triaxial), 10,000 V (coaxial)*
Max current	600 A (pulsed), 20 A (DC)
Power dissipation	Maximum 100 W generated in 1 cm^2 area at -40°C

*Maximum 6,000 V (coaxial) with T200-STA-AP stations

POWER HANDLING (STANDARD CHUCK)

Max voltage	3,000 V (triaxial), 10,000 V (coaxial)*
Max current	200 A (pulsed), 10 A (DC)
Power dissipation	Maximum 100 W generated in 1 cm^2 area at -40°C

*Maximum 6,000 V (coaxial) with T200-STA-AP model

MEASUREMENT PERFORMANCE (STANDARD CHUCK)

Typical Chuck Noise (Triaxial)*

		200 mm, AP	**200 mm, M**	**300 mm, AP**	**300 mm, M**	**Settling Time****
10 V	-55°C	20 fA	40 fA	20 fA	40 fA	< 200 fA @ 1.0 sec
	25°C	20 fA	40 fA	20 fA	40 fA	< 200 fA @ 0.5 sec
	200°C	20 fA	40 fA	20 fA	40 fA	< 200 fA @ 1.0 sec
	300°C	30 fA	60 fA	30 fA	60 fA	< 200 fA @ 2.0 sec
3 kV	-55°C	2 pA	4 pA	2 pA	4 pA	< 15 pA @ 1.5 sec
	25°C	2 pA	4 pA	2 pA	4 pA	< 15 pA @ 1.5 sec
	200°C	3 pA	6 pA	3 pA	6 pA	< 15 pA @ 1.5 sec
	300°C	6 pA	10 pA	10 pA	20 pA	< 15 pA @ 4.5 sec

Typical Chuck Leakage (Coaxial)

		200 mm, AP	**200 mm, M**	**300 mm, AP**	**300 mm, M**
3 kV	-55°C	≤ 6 nA	≤ 6 nA	≤ 6 nA	≤ 6 nA
	25°C	≤ 6 nA	≤ 6 nA	≤ 6 nA	≤ 6 nA
	200°C	≤ 6 nA	≤ 6 nA	≤ 6 nA	≤ 6 nA
	300°C	≤ 6 nA	≤ 6 nA	≤ 6 nA	≤ 6 nA
6 kV	-55°C	≤ 6 nA	≤ 6 nA	≤ 6 nA	≤ 6 nA
	25°C	≤ 6 nA	≤ 6 nA	≤ 6 nA	≤ 6 nA
	200°C	≤ 6 nA	≤ 6 nA	≤ 6 nA	≤ 6 nA
	300°C	≤ 6 nA	≤ 6 nA	≤ 6 nA	≤ 6 nA
10 kV	-55°C	NA	≤ 6 nA	≤ 6 nA	≤ 6 nA
	25°C	NA	≤ 6 nA	≤ 6 nA	≤ 6 nA
	200°C	NA	≤ 6 nA	≤ 6 nA	≤ 6 nA
	300°C	NA	≤ 6 nA	≤ 6 nA	≤ 6 nA

MEASUREMENT PERFORMANCE (CONTINUED)

* Overall leakage current is comprised of two separate components: 1) offset, and 2) noise. Offset is the DC value of current due to instrument voltage offset driving through isolation resistance and instrument offset current itself. Noise is low-frequency ripple superimposed on top of offset and is due to disturbances in the probe station environment. Noise and leakage are measured with a B1505A- B1510A (HPSMU) and or B1513A (HVSMU) with Cascade Microtech setups or equivalent; 1s sample interval, auto or 1 nA range, 1 µA compliance, 40 PLC integration. Typical noise values are defined using the standard deviation. The maximum peak noise value may be 2-3 times higher than typical noise values depending on environmental factors such as humidity, vibration, temperature fluctuation, condition of the cable and connectors etc.

** Settling time is measured with a B1505A/HPSMU Cascade Microtech setup or equivalent; 2 ms sampling interval, Fixed range: 1 nA, 1 µA compliance, 1 NPLC integration.

System Residual Capacitance

	200 mm, AP	**200 mm, M**	**300 mm, AP**	**300 mm, M**	
Capacitance	4.0 pF	40 pF	≤ 5 pF	≤ 50 pF	

MECHANICAL PERFORMANCE

	200 mm	**300 mm**
Travel	203 mm x 203 mm (8 inch x 8 inch)	301 mm x 301 mm (11.9 inch x 11.9 inch)
Resolution	1 µm (0.04 mils)	0.1 µm (0.004 mils)
Repeatability	< ± 1 µm (0.04 mils)	< ± 1 µm (0.04 mils)
Speed	51 mm/second (2 inch/second)	100 mm/second (4 inch/second)
Accuracy	< ± 2 µm (0.08 mils)	Precision mode: < ± 0.3 µm (0.012 mils) Standard mode: < ± 2 µm (0.08 mils)
Bearings	Cross roller	Air
Z stage travel	5 mm (200 mils)	10 mm (400 mils)
Z stage resolution	1 µm (0.04 mils)	0.1 µm (0.004 mils)
Z stage repeatability	≤ ± 1 µm (0.04 mils)	≤ ± 1 µm (0.04 mils)

THERMAL CHUCK SYSTEM

	200 mm	**300 mm**
Size	8 inch (203 mm) diameter	12 inch (301 mm) diameter
Material	Gold-plated	Gold-plated
Supported wafer thickness	≥ 100 µm	≥ 100 µm
Supported wafer diameter	Shards or wafers from 3 inch (76.2 mm) through 8 inch (203 mm)	Shards or wafers from 2 inch (50 mm) through 12 inch (301 mm)
Temperature range	-55ºC to 300ºC, 20ºC to 300ºC	-55ºC to 300ºC, 20ºC to 300ºC
Wafer temperature accuracy[1, 2]	± 2.5°C at 100°C	± 2.5°C at 100°C
Transition rate (from -55 ºC to 300 ºC)	36 minutes	49 minutes

1. As measured with an Anritsu WE-11K-TSI-ANP or WE-12K-GW1-ANP type K thermocouple surface temperature measurement probe with offset calibration procedure. Conditions: closed chamber with minimum recommended purge air, probe centered on a blank silicon wafer, chuck at center of travel and standard probe height. Typical type K thermocouple probe tolerances are ±2.2°C or ±0.75% of the measured temperature in °C (whichever is greater).
2. The test setup can change the wafer temperature accuracy from the calibration by ±5°C (typical). Test setup attributes include open or closed chamber, probe or probe card construction and number of contacts, purge air flow rate, and lab environmental conditions.

STATION CONTROLLER

	200 mm	300 mm
System controller with Nucleus™ / Windows XP	P/N 125-014	P/N E3-CTL1
System controller with Velox / Windows 7	P/N 158-270	P/N E3-CTL3

AVAILABLE STATION MODELS

Tesla Semi-automated 200 mm Probe Station	**P/N T200-STA-AP**	**P/N T200-STA-M**
MicroChamber for dark, dry and enhanced EMI-shielding enclosure	●	●
PureLine™ technology for premium signal path fidelity	●	N/A
AttoGuard® for enhanced I-V and C-V testing	●	N/A
Roll-out wafer stage for safe and easy wafer loading	●	●
High-stability platen with linear lift	●	●
Four-axis precision motorized stage	●	●
User guides, tools and accessories	●	●
Universal power cord kit	●	●
Velox probe station control software	●	●
Complete automation tools – AutoAlign, AutoDie, AutoXYZT correction	●	●
Thermal control, video window, wafer map, remote access	●	●

Tesla Manual 200 mm Probe Station	**P/N T200M-STA-AP**	**P/N T200M-STA-M**
MicroChamber for dark, dry and enhanced EMI-shielding enclosure	●	●
PureLine technology for premium signal path fidelity	●	N/A
AttoGuard for enhanced I-V and C-V testing	●	N/A
Roll-out wafer stage for safe and easy wafer loading	●	N/A
High-stability platen with linear lift	●	●
Precision manual X-Y stage	●	●
User guides, tools and accessories	●	●

Tesla Semi-automated 300 mm Probe Station	**P/N T300-STA-AP**	**P/N T300-STA-M**
Microscope bridge/transport – programmable, 75 mm (3 in. x 3 in.) – E3-ST75P	●	●
Microscope bridge/transport – motorized, 75 mm (3 in. x 3 in.) – E3-ST75	N/A	●
Premium control kit (LCD, manual XY controls) – E3-PCK	●	N/A
AUX chuck kit – E3-AUX	●	N/A
Computer accessory mount kit, LCD monitor and ergonomic arm	●	●
Intel controller – E3-CTL1	●	●
Standard height kit – E3-SHK	●	●

AVAILABLE CHUCK MODELS

To complete the station configuration:

1. Select a modular chuck from the following non-thermal or thermal list.
2. Select a matching thermal system if a thermal chuck is desired.

High-Power 200 mm Chuck	**Part number**	**Description**
Thermal chuck (high current)	TC-412-402	FemtoGuard triaxial chuck, -55°C to 300°C (ATT), 200 mm (8 inch)
Thermal chuck (standard)	TC-232-402	FemtoGuard triaxial chuck, -55°C to 300°C (ERS AC3), 200 mm (8 inch)
Thermal chuck (high current)	TC-232-502	FemtoGuard triaxial chuck, -55°C to 300°C (ERS AC3), 200 mm (8 inch), 600 A

High-Power 300 mm Chuck	**Part number**	**Description**
Thermal chuck (standard)	TC-231-402	FemtoGuard triaxial chuck, -55°C to 300°C (ERS AC3), 300 mm (12 inch)
Thermal chuck (high current)	TC-231-502	FemtoGuard triaxial chuck, -55°C to 300°C (ERS AC3), 300 mm (12 inch), 600 A

Tesla Thermal System (200 mm)	**Part number**	**Description**
	TS-412-05T	Thermal system for Summit, +20°C to 300°C, ATT, air cool(100-230 VAC 50/60 Hz)
	TS-412-14P	Thermal system for Summit, -60°C to 300°C, ATT, air cool(200-240 VAC 50/60 Hz)
	TS-232-14P	Thermal system, -55°C to 300°C, ERS AC3 (200/230 VAC, 50/60 Hz)
	TS-232-05T	Thermal system, 20°C to 300°C, ERS AC3 (100/230 VAC, 50/60 Hz)

Tesla Thermal System (300 mm)	**Part number**	**Description**
	TS-231-14P	Thermal system, -60°C to 300°C, ERS AC3 (200/230 VAC, 50/60 Hz)
	TS-231-05T	Thermal system, 20°C to 300°C, ERS AC3 (100/230 VAC, 50/60 Hz)

MICROSCOPE MOUNT OPTIONS

Tesla T200 Station Platform (200 mm)

	P/N 162-165	**P/N 162-160**
High-stability bridge/transport	Programmable	Manual
Travel X-Y	50 mm x 50 mm (2 inch x 2 inch)	50 mm x 50 mm (2 inch x 2 inch)
Travel X-Y in TopHat™	13 mm x 13 mm (0.5 inch x 0.5 inch)	13 mm x 13 mm (0.5 inch x 0.5 inch)
Type	Stepper motor with closed-loop encoder system	N/A
Resolution X-Y	0.4 µm (0.016 mils)	5 mm (0.2 inch)/turn, coaxial XY control
Repeatability X-Y	≤ 2 µm (0.08 mils)	N/A
Accuracy X-Y	≤ 5 µm (0.2 mils)	N/A
Speed X-Y	5 mm (0.2 inch)/second	N/A
Planarity	10 µm (0.4 mils) over full travel with 5 kg (11 lb.) load	10 µm (0.4 mils) over full travel with 5 kg (11 lb.) load
Z gross lift	4" vertical lift, pneumatic with up/down, for easy probe access	4" vertical lift, pneumatic with up/down, for easy probe access
Z gross repeatability	1 µm (0.04 mils)	1 µm (0.04 mils)
Z focus	Coarse/fine focus uses microscope system, programmable focus available	Coarse/fine focus uses microscope system
LASER compatible	Yes	Yes

Tesla T300 Station Platform (300 mm)

	P/N E3-ST75P	**P/N E3-ST75**	**P/N E3-ST50**
High-stability bridge/transport	Programmable	Motorized	Manual
Travel XYZ	76 mm x 76 mm x 152 mm (3 inch x 3 inch x 6 inch)	76 mm x 76 mm x 152 mm (3 inch x 3 inch x 6 inch)	51 mm x 51 mm x 51mm (2 inch x 2 inch x 2 inch)
Travel in TopHat	13 mm x 13 mm (0.5 inch x 0.5 inch)	13 mm x 13 mm (0.5 inch x 0.5 inch)	13 mm x 13 mm (0.5 inch x 0.5 inch)
Z lift	152 mm (6 inch)	152 mm (6 inch)	152 mm (6 inch)
Resolution X-Y	0.4 µm (0.02 mils)	0.4 µm (0.02 mils)	N/A
Resolution Z	0.08 µm(0.003 mils)	0.08 µm(0.003 mils)	N/A
Repeatability X-Y	≤ 2 µm (0.08 mils)	N/A	N/A
Repeatability Z	≤ 1 µm (0.04 mils)	≤ 1 µm (0.04 mils)	N/A
Accuracy X-Y	≤ 5 µm (0.2 mils)	N/A	N/A
Accuracy Z	≤ 4 µm (0.16 mils)	N/A	N/A
Speed	5 mm (0.2 inch)/second	5 mm (0.2 inch)/second	N/A

STATION ACCESSORIES

Microscope/video system

Vibration isolation table

Integrated infrared light curtain and safety interlock system

LCD monitor and stand kit

Key board and mouse tray

Side shelf

Scope mount

Objective lens

Probe card holders

RF and DC probes, needles and probe cards

RF and DC cables and adapters

RF and DC probe positioners

Calibration software and standards

Vacuum pump and air compressor

PROBING KIT

Probing kit includes necessary accessories, such as high-current/voltage probes, probe holders, positioners and interconnect cables for typical vertical and lateral device measurement setup.
High-voltage and high-current probing kits are available for both 200 mm and 300 mm Tesla systems.

Probing Kit for Keysight B1505A

Item	Description
High-current probe package	HCP high-current parametric probe holder with BNC connector (quantity of two)
	Replaceable probe tips (box of five)
	Probe micropositioner (quantity of two)
High-voltage probe package with Kelvin sense capability	HVP high-voltage parametric probe holders with SHV connectors (quantity of three), or with Keysight triaxial connectors (quantity of two)
	Replaceable probe tips (box of 25)
	Probe micropositioner (quantity of five)
System interface panels	Keysight B1505A accessory mounting kit
Cables	Basic cable kit for Keysight B1505A accessory connection, including probe-to-panel, panel-to-chuck and chuck-to-instruments cables

Probing Kit for Keithley Equipment 236/237

Item	Description
High-current probe package	HCP high-current parametric probe holder with banana jack (quantity of two)
	Replaceable probe tips (box of five)
	Probe micropositioner (quantity of two)
High-voltage probe package with Kelvin sense capability	HVP high-voltage parametric probe holders with Amphenol triaxial connectors (quantity of three)
	Replaceable probe tips (box of 25)
	Probe micropositioner (quantity of three)
System interface panels	High-voltage interface panel (triaxial)
	High-current interface panel
Cables	High-voltage triaxial cable package, including probe-to-panel, panel-to-instrument and chuck-to-instruments cables

REGULATORY COMPLIANCE

Certification	TÜV compliance tested for CE and CB, certified for US and Canada, SEMI S2 and S8

WARRANTY

Warranty*	Fifteen months from date of delivery or twelve months from date of installation
Service contracts	Single and multi-year programs available to suit your needs

*See Cascade Microtech's Terms and Conditions of Sale for more details.

TESLA-DS-0715

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