

# Tesla

## 300 mm 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 200 A. It supports a measurement temperature range of -55°C to 300°C. 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 and 200 A Reduced probe and device destruction at high currents up to 10 A DC and 200 A pulse 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 Advanced MicroVac™ chuck surface for minimum contact resistance between wafer and chuck Accurate $R_{ds(on)}$ 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

## POWER HANDLING

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 <sup>2</sup> area at -40°C

## MEASUREMENT PERFORMANCE

### Typical Chuck Noise (Triaxial)\*

		PN T300-STA-AP	PN T300-STA-M	Settling Time**
10 V	-55°C/-50°C	20 fA	40 fA	< 200 fA @ 1.0 sec
	25°C	20 fA	40 fA	< 200 fA @ 0.5 sec
	200°C	20 fA	40 fA	< 200 fA @ 1.0 sec
	300°C	30 fA	60 fA	< 200 fA @ 2.0 sec
3 kV	-55°C	2 pA	4 pA	< 15 pA @ 1.5 sec
	25°C	2 pA	4 pA	< 15 pA @ 1.5 sec
	200°C	3 pA	6 pA	< 15 pA @ 1.5 sec
	300°C	6 pA	10 pA	< 15 pA @ 4.5 sec

### Typical Chuck Leakage (Coaxial)

		PN T300-STA-AP	PN T300-STA-M
3 kV	-55°C	2 nA	2 nA
	25°C	2 nA	2 nA
	200°C	5 nA	5 nA
	300°C	10 nA	10 nA
6 kV	-55°C	4 nA	4 nA
	25°C	4 nA	4 nA
	200°C	10 nA	10 nA
	300°C	20 nA	20 nA
10 kV	-55°C	7 nA	7 nA
	25°C	7 nA	7 nA
	200°C	17 nA	17 nA
	300°C	34 nA	34 nA

\* 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/B/C (HVSU) with Cascade Microtech setups or equivalent; 1s sample interval, auto or 1 nA range, 1  $\mu$ A 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  $\mu$ A compliance, 1 NPLC integration

MEASUREMENT PERFORMANCE (CONTINUED)

System Residual Capacitance

	PN T300-STA-AP	PN T300-STA-M	
Capacitance	≤ 5 pF	≤ 50 pF	

HIGH POWER PROBES FOR T300

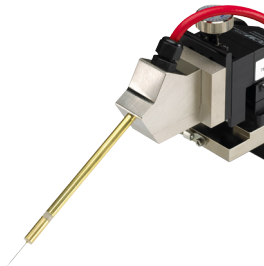
Ultra High Power Probe



High-Current Probe



High-Voltage Probe



Probe	UHP	HCP-XX	HVP-XX
Current	Up to 300 A	Up to 100 A	Up to 5 A
Voltage	Up to 10,000 V	Up to 500 V	Up to 3,000 V

\*See High-Power Probe data sheet for more information.

## MECHANICAL PERFORMANCE

### X-Y Stage

Travel	301 mm x 301 mm (11.9 in. x 11.9 in.)
Resolution	0.1 $\mu\text{m}$ (0.004 mils)
Repeatability	$\leq 1 \mu\text{m}$ (0.04 mils)
Accuracy	Precision mode: $\leq 0.3 \mu\text{m}$ (0.012 mils), Standard mode: $\leq 2 \mu\text{m}$ (0.08 mils)
Speed	100 mm/sec (4 in./sec)
Bearings	Air
Motor-drive system	Brushless linear servo motor
Feedback system	Ceramic ultra-low thermal expansion linear encoder

### Z Stage

Travel	10.0 mm (.39 in.)
Resolution	0.1 $\mu\text{m}$ (0.004 mils)
Repeatability	$\leq 1 \mu\text{m}$ (0.04 mils)
Accuracy	$\leq 2 \mu\text{m}$ (0.08 mils)
Speed	20 mm/sec (0.8 in./sec)

### Theta Stage

Travel	$\pm 7.5^\circ$
Resolution	0.65 $\mu\text{m}$ (0.03 mils)*
Repeatability	$\leq 1 \mu\text{m}$ (0.04 mils)*
Accuracy of standard moves	$\leq 2 \mu\text{m}$ (0.08 mils)*
Accuracy of large moves	$\leq 5 \mu\text{m}$ (0.20 mils)*

\* Measured at edge of 300 mm chuck

### System

Attenuation of the vibration dampening system	$\geq 0 \text{ dB @ } 6 \text{ Hz}$ , 5 dB per octave @ 6 Hz to 48 Hz, $\geq 15 \text{ dB}$ above 48 Hz*
Stage move time	$\leq 0.75 \text{ sec}$ (200 $\mu\text{m}$ Z down – 1000 $\mu\text{m}$ X-Y – 200 $\mu\text{m}$ Z up)
Stage dampening	$\geq 15 \text{ dB}$ in less than 1500 msec
Probe-force capability	$\geq 20 \text{ kg}$ (44 lb.)
Probe-force deflection	$\leq 0.001 \mu\text{m}/\mu\text{m}$ slope per 10 kg load (0.001 in./in. / 22 lb), measured at the chuck stage
System planarity	$\leq 25 \mu\text{m}$ (1.0 mils) @ 25°C
	$\leq 30 \mu\text{m}$ (1.2 mils) @ -60°C
	$\leq 30 \mu\text{m}$ (1.2 mils) @ 200°C
	$\leq 40 \mu\text{m}$ (1.6 mils) @ 300°C
Attenuation of the vibration dampening system	$\geq 0 \text{ dB @ } 6 \text{ Hz}$ , 5 dB per octave @ 6 Hz to 48 Hz, $\geq 15 \text{ dB}$ above 48 Hz*
Stage move time	$\leq 0.75 \text{ sec}$ (200 $\mu\text{m}$ Z down – 1000 $\mu\text{m}$ X-Y – 200 $\mu\text{m}$ Z up)
Stage damping	$\geq 15 \text{ dB}$ in less than 1500 msec

## MICROCHAMBER

Electrical	PN T300-STA-AP	PN T300-STA-M
EMI shielding	≥ 20 dB 1 kHz - 100 MHz (typical)	≥ 20 dB 1 kHz - 100 MHz (typical)
<b>Light Shielding</b>		
Type	Complete dark enclosure around chuck	
Wafer access	Front access door with rollout stage for easy wafer loading	
Probe compatibility	Standard MicroChamber TopHat™ allows access for up to eight probes	
Light attenuation	≥ 120 dB	
<b>Environmental Control</b>		
Purge gas	Clean dry air or oil-free nitrogen (see facilities planning guide for detailed purge gas requirements.)	
Test environment	Low volume for fast purge, external positioning and cable access to maintain sealed environment	
Dew point capability	> -70°C for frost-free measurements and high-voltage measurements*	
Purge time	15 min for measurements @ -55°C (typical)	
External condensation control	Integrated laminar-flow air distribution on external MicroChamber surfaces to eliminate condensation Controls for ON/OFF and flow rate for both top and bottom surfaces	
Purge control	Manual or automatic (software controlled)	
Purge flow rate	Standard - Manual variable 0 to 110 l/min (4 CFM) at SATP** Quick purge - Standard purge rate or maximum > 110 l/min (4 CFM) at SATP**	

\* Please see the facilities guide for air requirements to enable optimum dew point for low-temperature measurements using a thermal chuck inside the MicroChamber.

\*\* Standard Ambient Temperature And Pressure (SATP).

## PLATEN SYSTEM

<b>Platen</b>	
Dimensions	101.6 cm (W) x 86.4 cm (D) x 25 mm (T) (40.0 in. x 34.0 in. x 1.0 in.)
Mounting system	Kinematic, high thermal stability enhanced
Platen-to-chuck height	40.0 ± 0.5 mm (1.575 ± 0.02 in.)
Lift range	3.0 mm (0.12 in.)
Lift repeatability	≤ 3 µm (0.12 mils)
Accessory mounting	Universal Rail System: 53 cm (21 in.) Left / Right Rail, 71 cm (28 in.) Top Rail

<b>Platen Ring</b>	
Diameter	717.6 mm (28.25 in.)
Weight	43 kg (95 lb.)
Material	Steel for magnetic positioners
Surface finish	Fine ground for vacuum positioner high stability
Usability features	Removable and clockable in 90° increments

## PLATEN SYSTEM (CONTINUED)

### Platen Ring Insert

Diameter	342.9 mm (13.5 in.)
Standard interface	Probe card holders and custom adapters

## WAFER AND AUX CHUCK DESIGN

### Wafer

Diameter	301.5 mm (11.87 in)
Material	Gold-plated aluminum
Vacuum system	Patented MicroVac technology using 971 micro-hole pattern for uniform vacuum hold down of thin, warped and partial wafers, and uniform temperature conductivity
Vacuum zone	Hole patterns arranged in approximately 8, 70, 140, 200 and 275 mm diameter (0.4, 2.8, 5.5, 7.9, and 10.8 in)
Supported wafer thickness	$\geq 100 \mu\text{m}$
Supported wafer diameter	Shards or wafers from 50 mm (2 in.) through 301 mm (12 in.)

### Auxiliary Chuck\*

Quantity	Two positions, mounted independent of the thermal chuck
Max substrate size	15.2 mm x 22.1 mm (0.6 in. x 0.87 in.) ISS substrate 19 mm x 19 mm (0.75 in. x 0.75 in.) Square substrate
Material	Magnetically loaded, RF absorbing Eccosorb
Thermal isolation	Air gap $> 10 \text{ mm}$
Flatness	$\leq 10 \mu\text{m}$ (0.39 mils)
Positional repeatability	$\leq 2 \mu\text{m}$ (0.08 mils) after rollout event
Vacuum actuation	Independent software control

\* These specifications are for the modular wafer/aux chucks that are configured with a Tesla station platform. See the wafer/aux chucks ordering information.

## GENERAL SYSTEM SPECIFICATIONS

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

### Velox Probe Station Control Software

The Tesla 300 mm power device characterization system is equipped with Velox probe station control software. The Velox software provides all features and benefits required for semi-automated operation of the probe system, such as:

- WaferMap with Z-profiling, sub-die stepping, binning and other useful features
- Integrated thermal controls
- CellView using stitched image of the full device to enable on-screen navigation within the die layout when using eVue
- Configurable user interface and programmable buttons

### Communication Ports

Type	Qty	Locacation	Notes
USB 2.0	2	Side of station	For quick access to USB devices
USB 2.0	4	Rear connection panel	For security keys and USB instrument control
RS232	4	Rear connection panel	For instrument control (thermal, LASER, microscope, etc)
GPIO IEEE 488.2	1	Rear connection panel	For test instrument control

### Accessory Interface Ports

EDGE	1	Rear connection panel	Probe card contact sense
VNA-CAL	1	Rear connection panel	Control for switched GPIB (remote/local software control)
INKER	1	Rear connection panel	Control for die inker
ULC	1	Rear connection panel	Control for upward looking camera

## PLATFORM

### Switched AC Power

IEC (f) Microscope	1	Rear connection panel	Software ON/OFF control for Microscope light
IEC (f) Aux	1	Rear connection panel	Software ON/OFF control for Auxiliary power

\* Due to the sensitivity of measurements to vibrations, the Elite™ is equipped with a high-performance active vibration dampening system. However, unacceptable equipment vibrations can occur when the floor vibrations are high. For this reason the Elite must be used in an environment having background vibrations at or below the Operating Theatre level. This corresponds to a maximum level of 4000 micro-inches / sec [72 dB], measured using the 1/3-octave-band velocity spectra method (expressed in RMS velocity as specified by The International Standards Organization [ISO]). For further information, and technical solutions with environments using raised floors, please see the Cascade Microtech Stations Facilities guide.

## THERMAL SYSTEM PERFORMANCE

### Thermal System Overview

Temperature ranges	-55°C to 300°C, ERS AC3 (200/230 VAC 50/60 Hz)
	+20°C to 300°C, ERS AC3 (100-230 VAC 50/60 Hz)
	+30°C to 300°C, ERS AC3 (100-230 VAC 50/60 Hz)

Wafer temperature accuracy <sup>1,2</sup>	± 2.5°C at 100°C
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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.

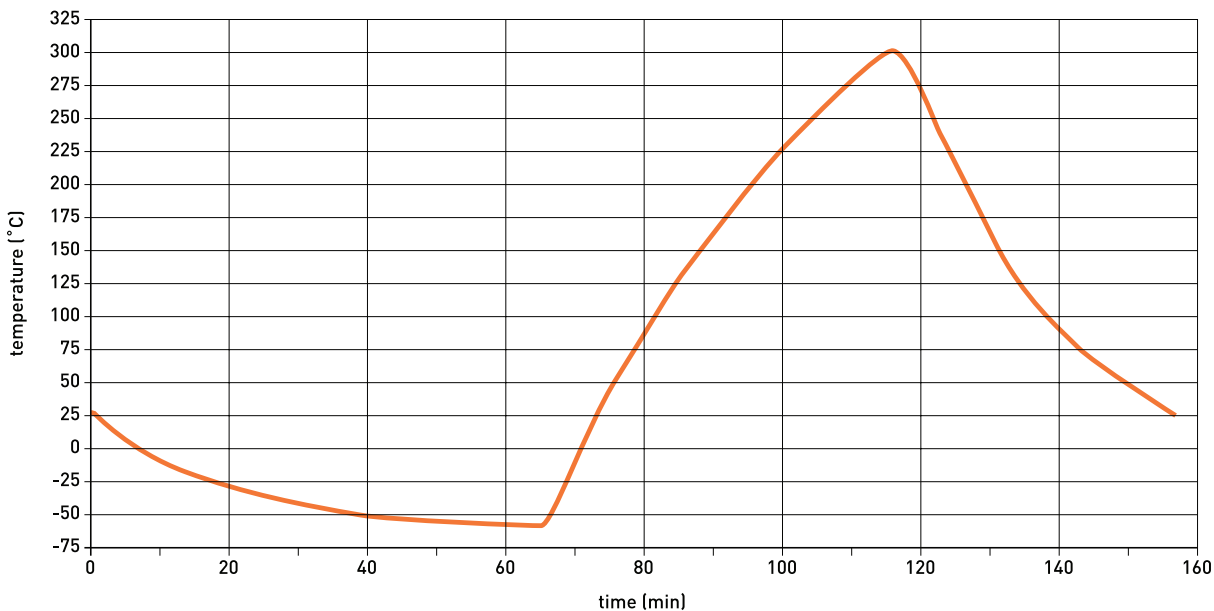
Note: For details on facility requirements, refer to the Facility Planning Guide for your thermal system.

### ERS AC3 Thermal System Specifications

Temperature range	-55°C to 300°C
Resolution	0.1°C
Thermal uniformity	≤ 0.5°C @ 25°C, ≤ 2.0°C @ -60°C, ≤ 3.0°C @ 300°C
Transition time – Heating	-55°C to 25°C = 7 min, 25°C to 300°C = 42 min (typical)
Transition time – Cooling	300°C to 25°C = 39 min, 25°C to -60°C = 58 min (typical)

### ERS Thermal Transition Time (-55°C to 300°C)

Typical times using Elite300/AP with FemtoGuard® Chuck



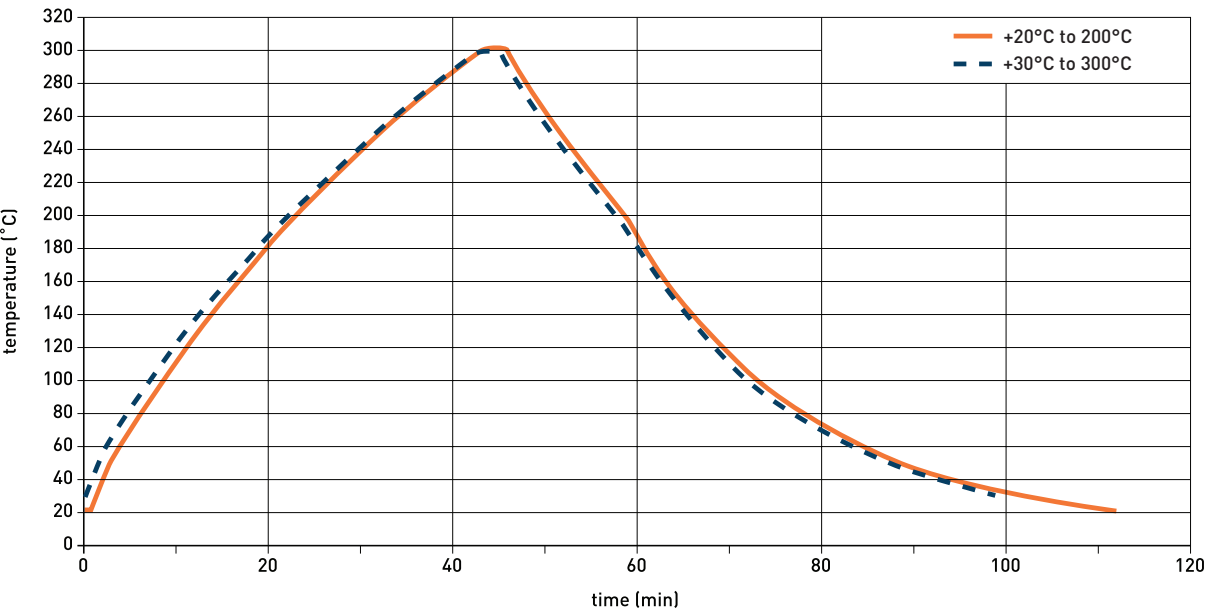


ERS AC3 Thermal System Specifications

	Forced Ambient	Ambient
Temperature range	+20°C to 300°C	+30°C to 300°C
Resolution	0.1°C	0.1°C
Thermal uniformity	≤ 0.5°C @ 30°C, ≤ 3.0°C @ 300°C	≤ 0.5°C @ 30°C, ≤ 3.0°C @ 300°C
Transition time – Heating	20°C to 300°C = 43 min (typical)	30°C to 300°C = 44 min (typical)
Transition time – Cooling	300°C to 20°C = 59 min (typical)	300°C to 30°C = 55 min (typical)

ERS Thermal Transition Time

Typical times using Elite300/M with FemtoGuard Chuck.



## STATION CONTROLLER

P/N E3-CTL1	System controller with Nucleus™ / Windows XP
P/N E3-CTL3	System controller with Velox / Windows 7

## AVAILABLE STATION MODELS

Tesla Semi-automated 300 mm Probe Station	P/N T300-STA-AP	P/N T300-STA-M
MicroChamber for dark, dry and enhanced EMI-shielding enclosure	●	●
PureLine™ technology for premium signal path fidelity	●	Option
AttoGuard® for enhanced I-V and C-V testing	●	Option
Roll-out wafer stage for safe and easy wafer loading	●	●
Microscope bridge/transport – programmable, 75 mm (3 in. x 3 in.) – E3-ST75P	●	Option
Microscope bridge/transport – motorized, 75 mm (3 in. x 3 in.) – E3-ST75	N/A	●
Premium control kit (LCD, manual XY controls) – E3-PCK	●	Option
AUX chuck kit – E3-AUX	●	Option
Computer accessory mount kit, LCD monitor and ergonomic arm	●	●
Intel controller – E3-CTL1	●	●
Standard height kit – E3-SHK	●	●
Velox probe station control software	●	●
Complete automation tools - AutoAlign, AutoDie, AutoXYZT correction	●	●
Thermal control, video window, wafer map, remote access	●	●

## 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 300 mm Chuck	Part number	Description
Thermal chuck (standard)	TC-231-402	FemtoGuard triaxial Tesla chuck, -55°C to 300°C (ERS AC3), 300 mm (12 inch)
Tesla Thermal System (300 mm)	Part number	Description
	TS-231-14P	Thermal system, -55°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)
	TS-231-02T	Thermal system, 30°C to 300°C, ERS AC3 (100-230 VAC, 50/60Hz)

## MICROSCOPE MOUNT OPTIONS

### Tesla 300 mm 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 $\mu$ m (0.02 mils)	0.4 $\mu$ m (0.02 mils)	N/A
Resolution Z	0.08 $\mu$ m (0.003 mils)	0.08 $\mu$ m (0.003 mils)	N/A
Repeatability X-Y	$\leq 2$ $\mu$ m (0.08 mils)	N/A	N/A
Repeatability Z	$\leq 1$ $\mu$ m (0.04 mils)	$\leq 1$ $\mu$ m (0.04 mils)	N/A
Accuracy X-Y	$\leq 5$ $\mu$ m (0.2 mils)	N/A	N/A
Accuracy Z	$\leq 4$ $\mu$ m (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

Integrated infrared light curtain and safety interlock system

Dual LCD monitor and stand kit

Additional keyboard and mouse tray

Side/rear accessory shelves

Microscope objective lens

High-voltage probes / positioners

High-current probes / positioners

Chuck connectors

Interconnect accessories kit (package) for various power device analyzers

High-voltage /high-current cables and adapters

## 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.

### 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 certified for US and Canada, CE
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## WARRANTY

Warranty*	Fifteen months from date of delivery or twelve months from date of installation
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Service contracts	Single and multi-year programs available to suit your needs
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\*See Cascade Microtech's Terms and Conditions of Sale for more details.

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