Cascade

T300

300 mm On-Wafer Power Semiconductor Probing System

Overview

Designed specifically for accurate power device measurements at the wafer level, the T300 on-wafer power semiconductor probe station from FormFactor 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 FormFactor's patented MicroChamber®, the T300 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 T300 employs an infrared laser light curtain and safety interlock system.

The powerful, Windows 10 compatible **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 T300 system powered by Velox software achieves highest 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
T.I.P.S. “LuPo” High Voltage / High Power Probe Cards	• On-wafer power device characterization up to 10,000 V DC • Safe and convenient integration kits to support T.I.P.S. “LuPo” High Voltage / High Power Probe Cards
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 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

Note: For physical dimensions and facility requirements, refer to the T300 Facility Planning Guide.

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^2 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

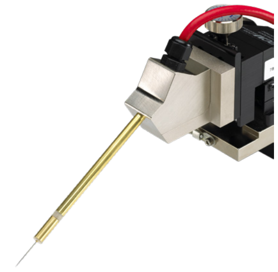
* *Overall leakage current is comprised of two separate components: 1) offset, and 2) noise. Offset is the DC value of current due to instrument voltage offset driving through isolation resistance and instrument offset current itself. Noise is low-frequency ripple superimposed on top of offset and is due to disturbances in the probe station environment. Noise and leakage are measured with a B1505A- B1510A (HPSMU) and or B1513A/B/C (HVSMU) with FormFactor 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 FormFactor setup or equivalent; 2 ms sampling interval, Fixed range: 1 nA, 1 µA compliance, 1 NPLC integration*

System Residual Capacitance

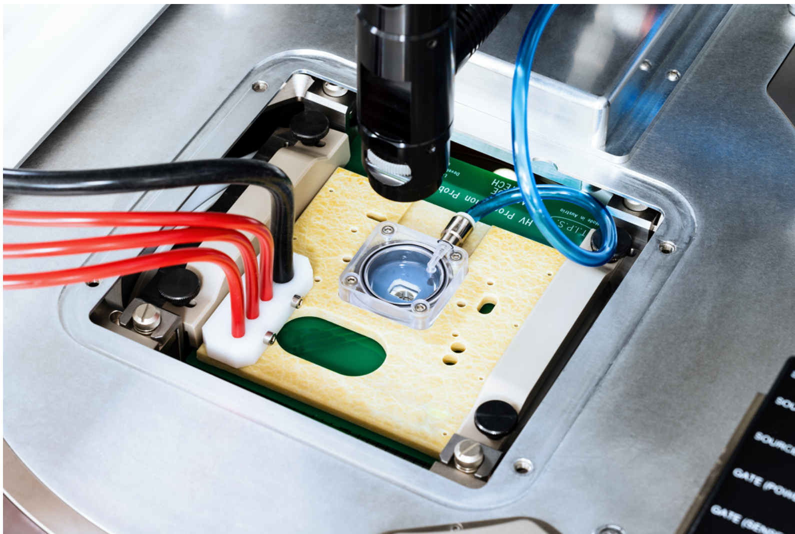
	PN T300-STA-AP	PN T300-STA-M
Capacitance	5 pF	≤ 50 pF

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.*

T.I.P.S. “LuPo” High Voltage / High Power Probe Cards



- Chip scale pressure chamber surrounds DUT to increase breakdown voltage
- On-wafer power device characterization up to 10,000 V DC
- Non-thermal and thermal probe cards with temperatures up to 200°C
- Engineering and production probe cards

Mechanical Performance

X-Y Stage	
Travel	301 mm x 301 mm (11.9 in. x 11.9 in.)
Resolution	0.1 µm (0.004 mils)
Repeatability	≤ 1 µm (0.04 mils)
Accuracy	Precision mode: ≤ 0.3 µm (0.012 mils), Standard mode: ≤ 2 µm (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 µm (0.004 mils)
Repeatability	≤ 1 µm (0.04 mils)
Accuracy	≤ 2 µm (0.08 mils)
Speed	20 mm/sec (0.8 in./sec)

Theta Stage	
Travel	± 7.5°
Resolution	0.65 µm (0.03 mils)*
Repeatability	≤ 1 µm (0.04 mils)*
Accuracy of standard moves	≤ 2 µm (0.08 mils)*
Accuracy of large moves	≤ 5 µm (0.20 mils)*

* *Measured at edge of 300 mm chuck*

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

Light Shielding	
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

Environmental Control	
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

Platen	
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

Platen Ring	
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 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	≥ 100 µm
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 mm
Flatness	≤ 10 µm (0.39 mils)
Positional repeatability	≤ 2 µm (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 T300 station platform. See the wafer/aux chucks ordering information.*

Note: For physical dimensions and facility requirements, refer to the T300 Facility Planning Guide.

General System Specifications

Velox™ Probe Station Control Software

The T300 is equipped with FormFactor's powerful Velox probe station control software:

- User-centered design minimizes training costs and enhances efficiency
- Windows 10 compatibility enables highest performance and safe operation with state-of-the-art hardware
- Comprehensive alignment functions – from simple wafer alignment and mapping to advanced probe-to-pad alignment over multiple temperatures for autonomous semiconductor test
- Simplified operation for inexperienced users: Reduced training costs with Workflow Guide and condensed graphical user interface
- VeloxPro option: SEMI E95-compliant test executive software that enables simplified and safe automation of the entire wafer test cycle

Communication Ports

Type	Qty	Location	Note
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)
GPIB IEEE 488.2	1	Rear connection panel	For test instrument control

Accessory Interface Ports

Type	Qty	Location	Note
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

Type	Qty	Location	Note
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 FormFactor 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[1,2]	±2.5°C at 100°C

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.

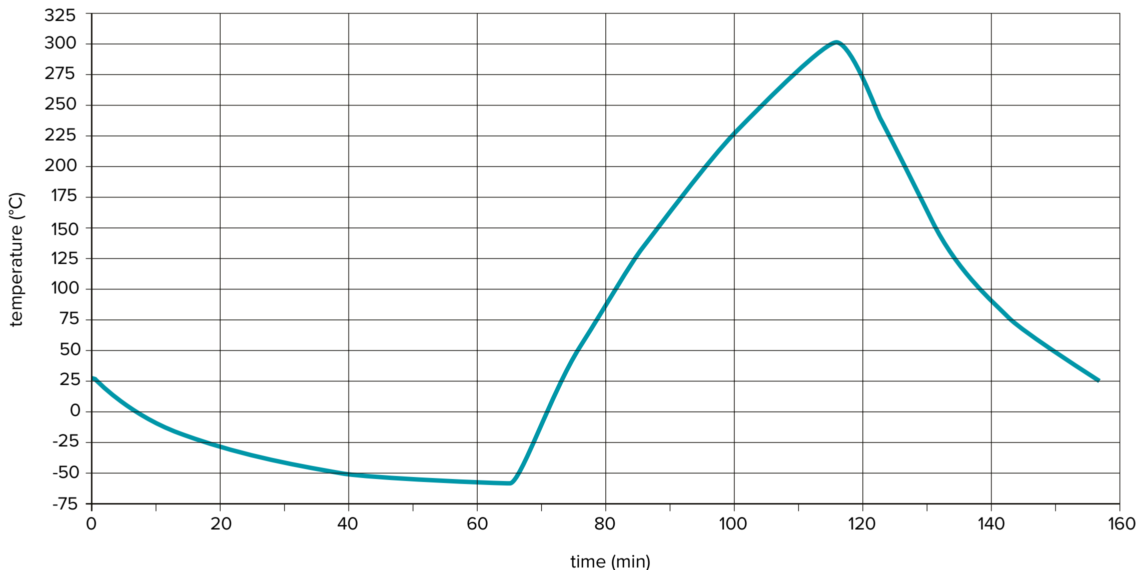
Note: For details on facility requirements, refer to the Facility Planning Guide for your thermal system.

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



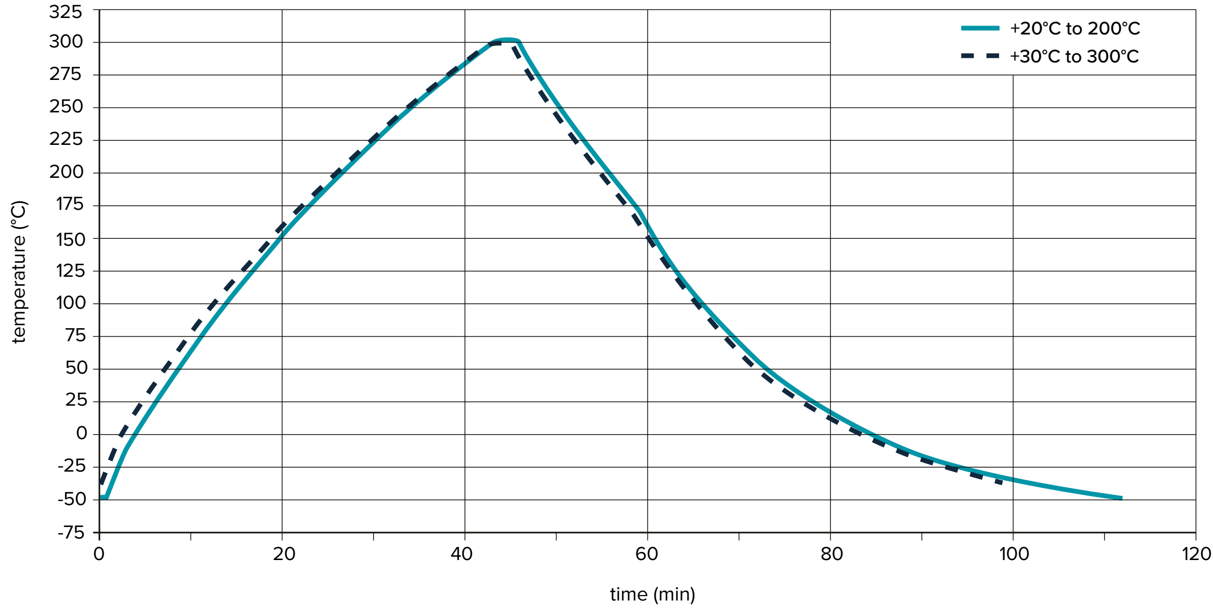
Thermal System Performance (continued)

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

System controller with Velox / Windows 10

Available Station Models

T300 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.

T300 Semi-automated 300 mm Probe Station	Part number	Description
Thermal chuck (standard)	TC-231-402	FemtoGuard triaxial Tesla chuck, -55°C to 300°C (ERS AC3), 300 mm (12 inch)
T300 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

T300 Station Platform

	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 51 mm (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
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

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 FormFactor's Terms and Conditions of Sale for more details.*

© Copyright 2020 FormFactor, Inc. All rights reserved.
FormFactor and the FormFactor logo are trademarks of FormFactor, Inc. All other trademarks are the property of their respective owners.

All information is subject to change without notice.

Corporate Headquarters
7005 Southfront Road
Livermore, CA 94551
Phone: 925-290-4000
www.formfactor.com

T300-DS-1220