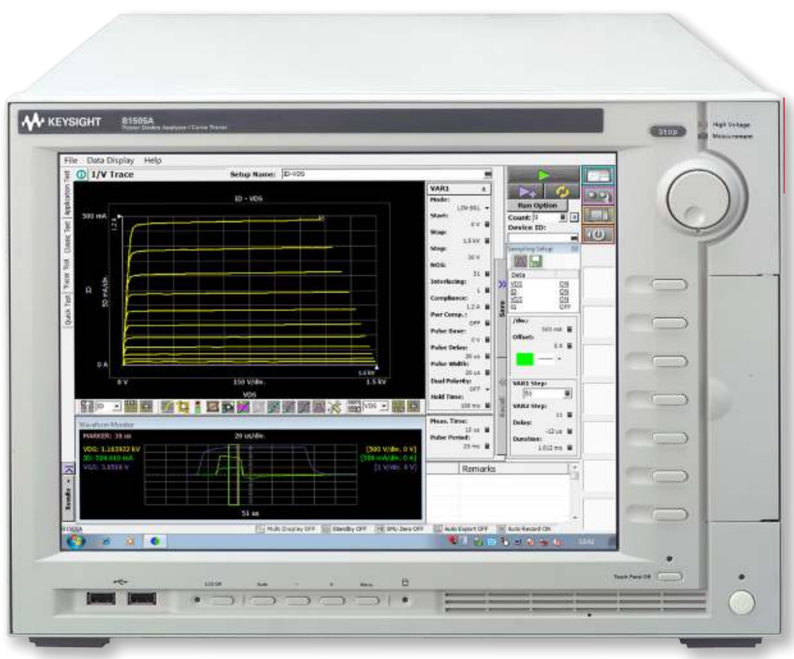
Keysight Technologies
B1505A Power Device Analyzer/Curve Tracer

Data Sheet



Introduction

The Keysight Technologies, Inc. B1505A Power Device Analyzer/Curve Tracer is a single-box solution with next-generation curve tracer functionality that can accurately evaluate and characterize power devices at up to 10 kV and 1500 amps. The B1505A is capable of handling all types of power device evaluation, with features that include a wide voltage and current range, fast pulsing capability (10 µs), µΩ level on-resistance measurement resolution and sub-pA level current measurement capability. In addition, an oscilloscope view permits visual verification of both current and voltage pulsed waveforms.

Two independent analog-to-digital (A/D) converters on each channel support a 2 µs sampling rate for accurate monitoring of the critical timings that can affect device behavior.

It can also perform capacitance measurements at high voltage biases (up to 3000 V). The B1505A with EasyEXPERT software includes a curve tracer mode that combines familiar curve tracer functionality with the convenience of a PC-based instrument; this makes it easy for traditional curve-tracer users to become productive quickly. Module selector and Quick Test feature enable fully automated measurement on multiple parameters without the need to recable. The net result is improved ease of use, better data analysis and simplified data management for the measurement of power devices and power circuitry.

Basic features

- Performs wide range of IV measurements
- Up to 10 kV / 1500 A
- Large peak power : 22.5 kW
- Medium current measurement with high voltage bias (e.g. 500 mA at 1200 V, Peak power : 900 W)
- μΩ resistance measurement
- sub-pA leakage measurement
- Performs high bias voltage CV measurements
- Pulsed measurement (≥10 μs)
- Two independent A/D converters (22 bit equivalent) on each channel enable the simultaneous high-speed (2 μs) sampling of current and voltage
- Temperature measurement
- Easy to use EasyEXPERT test environment
- Curve tracer test mode with knob sweep capability
- Oscilloscope view
- Modular configuration with ten module slots for supported modules
- Multiple SMU types available: HPSMU, MPSMU, HCSMU, MCSMU and HVSMU
- Support for high power devices with up to 6 pins
- Fast high voltage/high current switch for GaN current collapse effect characterization
- Multi-frequency capacitance measurement unit (MFCMU) (1 kHz to 5 MHz) available
- Standard accessories for package test and wafer test: test fixture, module selector and high voltage bias-tee
- 4.2-amp ground unit included standard with the mainframe
- GPIB, USB, LAN interfaces and VGA video output port
- Self-test, self-calibration, diagnostics

Specification conditions

The measurement and output accuracy are specified under the conditions listed below. Note: The SMU measurement and output accuracies are specified at the SMU connector terminals, using the Zero Check terminal as a reference.

1. Temperature: 23 °C ± 5 °C
2. Humidity: 20% to 70%
3. Self-calibration after a 40 minute warm-up is required.
4. Ambient temperature change less than ±1 °C after self-calibration execution. (Note: This does not apply to the MFCMU).
5. Measurement made within one hour after self-calibration execution. (Note: This does not apply to the MFCMU).
6. Calibration period: 1 year
7. SMU integration time setting:
1 PLC (1 nA to 1 A range, voltage range), 200 μs (20 A range)
Averaging of high-speed ADC:
128 samples per 1 PLC
8. SMU filter: ON (for HPSMU and MPSMU)
9. SMU measurement terminal connection: Kelvin connection (for HPSMU, MPSMU, HCSMU and MCSMU), non-Kelvin (for HVSMU)

Note: This document lists specifications and supplemental characteristics for the B1505A and its associated modules. The specifications are the standards against which the B1505A and its associated modules are tested. When the B1505A or any of its associated modules are shipped from the factory, they meet the specifications. The "supplemental" characteristics described in the following specifications are not guaranteed, but provide useful information about the functions and performance of the instrument.

Note: Module upgrades to existing B1505A systems must be carried out at a Keysight Technologies, Inc. service centre. In order to ensure system specifications the new modules need to be installed and the complete unit calibrated. Contact your nearest Keysight Technologies office to arrange the installation and calibration of new B1505A modules.

B1505A Specifications

Supported plug-In modules				
The B1505A supports ten slots for plug-in modules.				
Part number	Description	Slots occupied	Range of operation	Measure resolution
B1510A	High Power Source Monitor Unit (HPSMU)	2	-200 V to 200 V, -1 A to 1 A	2 µV, 10 fA
B1511A	Medium Power Source Monitor Unit (MPSMU)	1	-100 V to 100 V, -100 mA to 100 mA	0.5 µV, 10 fA
B1512A	High Current Source Monitor Unit (HCSMU)	2	-40 V to 40 V, -1 A to 1 A -20 V to 20 V, -20 A to 20 A (Pulse only)	200 nV, 10 pA
B1513B	High Voltage Source Monitor Unit (HVSMU)	2	-3000 V to 3000 V, -4 mA to 4 mA -1500 V to 1500 V, -8 mA to 8 mA	200 µV, 10 fA
B1514A	Medium Current Source Monitor Unit (MCSMU)	1	-30 V to 30 V, -100 mA to 100 mA -30 V to 30 V, -1 A to 1 A (Pulse only)	200 nV, 10pA
B1520A[1]	Multi Frequency Capacitance Measurement Unit (MFCMU)	1	1 kHz to 5 MHz	0.035 fFrms[2]

1. N1300A-100 SMU CMU Unify Unit (SCUU) is not supported for the B1505A.
2. Valid when connecting a 10 pF capacitor to the measurement terminals under the following measurement conditions: a frequency of 1 MHz, a signal level of 250 mV AC, and a measurement time of 1 PLC. The display resolution is 0.000001 fF at 1 fF order by 6 digits display.

Maximum module configuration

The total power consumption of all modules cannot exceed 84 W. Under this rule, the B1505A can contain any combination of the following SMUs:

- Up to 4 dual-slot HPSMUs[1]
- Up to 10 single-slot MPSMUs
- Up to 2 dual-slot HCSMUs[1]
- Up to 6 single-slot MCSMUs
- 1 dual-slot HVSMU

1. The total number of installed HPSMU and HCSMU modules cannot exceed 4.

In addition, up to 1 single-slot MFCMU can be installed per B1505A mainframe for any of the above listed SMU configurations.

The installation order of the modules is: HPSMU, MPSMU, MFCMU, MCSMU, HCSMU and HVSMU starting from the bottom of the B1505A mainframe.

Maximum voltage between Common and Ground

≤ ± 42 V

Ground unit (GNDU) specifications

The GNDU is furnished with the B1505A mainframe.

Output voltage: 0 V ± 100 µV
Maximum sink current: ± 4.2 A
Output terminal/connection:
Triaxial connector, Kelvin (remote sensing)

GNDU supplemental characteristics

Load capacitance: 1 µF
Cable resistance:
For I_S ≤ 1.6 A: Force line R < 1 Ω
For 1.6 A < I_S ≤ 2.0 A: Force line R < 0.7 Ω
For 2.0 A < I_S ≤ 4.2 A: Force line R < 0.35 Ω
For all cases: Sense line R ≤ 10 Ω

Where I_S is the current being sunk by the GNDU.

HPSMU Module Specifications

Voltage range, resolution, and accuracy (high resolution ADC)					
Voltage range	Force resolution	Measure resolution	Force accuracy [1] ±(% + mV)	Measure accuracy [1] ±(% + mV)	Maximum current
±2 V	100 μV	2 μV	±(0.018 + 0.4)	±(0.01 + 0.14)	1 A
±20 V	1 mV	20 μV	±(0.018 + 3)	±(0.009 + 0.9)	1 A
±40 V	2 mV	40 μV	±(0.018 + 6)	±(0.01 + 1)	500 mA
±100 V	5 mV	100 μV	±(0.018 + 15)	±(0.012 + 2.5)	125 mA
±200 V	10 mV	200 μV	±(0.018 + 30)	±(0.014 + 2.8)	50 mA

1. *± (% of reading value + offset value in mV)*

Current range, resolution, and accuracy (high resolution ADC)					
Current range	Force resolution	Measure resolution	Force accuracy [1] ±(% + A + A)	Measure accuracy [1] ±(% + A + A)	Maximum voltage
±1 nA	50 fA	10 fA	±(0.1 + 3E-13 + Vo x 1E-15)	±(0.1 + 2E-13 + Vo x 1E-15)	200 V
±10 nA	500 fA	10 fA	±(0.1 + 3E-12 + Vo x 1E-14)	±(0.1 + 1E-12 + Vo x 1E-14)	200 V
±100 nA	5 pA	100 fA	±(0.05 + 3E-11 + Vo x 1E-13)	±(0.05 + 2E-11 + Vo x 1E-13)	200 V
±1 μA	50 pA	1 pA	±(0.05 + 3E-10 + Vo x 1E-12)	±(0.05 + 1E-10 + Vo x 1E-12)	200 V
±10 μA	500 pA	10 pA	±(0.05 + 3E-9 + Vo x 1E-11)	±(0.04 + 2E-9 + Vo x 1E-11)	200 V
±100 μA	5 nA	100 pA	±(0.035 + 15E-9 + Vo x 1E-10)	±(0.03 + 3E-9 + Vo x 1E-10)	200 V
±1 mA	50 nA	1 nA	±(0.04 + 15E-8 + Vo x 1E-9)	±(0.03 + 6E-8 + Vo x 1E-9)	200 V
±10 mA	500 nA	10 nA	±(0.04 + 15E-7 + Vo x 1E-8)	±(0.03 + 2E-7 + Vo x 1E-8)	200 V
±100 mA	5 μA	100 nA	±(0.045 + 15E-6 + Vo x 1E-7)	±(0.04 + 6E-6 + Vo x 1E-7)	200 V [2]
±1 A	50 μA	1 μA	±(0.4 + 3E-4 + Vo x 1E-6)	±(0.4 + 15E-5 + Vo x 1E-6)	200 V [2]

1. *± (% of reading value + fixed offset in A + proportional offset in A), Vo is the output voltage in V.)*
2. *200 V (Io ≤ 50 mA), 100 V (50 mA < Io ≤ 125 mA), 40 V (125 mA < Io ≤ 500 mA), 20 V (500 mA < Io ≤ 1 A), Io is the output current in Amps.*

Voltage range, resolution, and accuracy (high speed ADC)					
Voltage range	Force resolution	Measure resolution	Force accuracy [1] ±(% + mV)	Measure accuracy [1] ±(% + mV)	Maximum current
±2 V	100 μV	100 μV	±(0.018 + 0.4)	±(0.01 + 0.7)	1 A
±20 V	1 mV	1 mV	±(0.018 + 3)	±(0.01 + 4)	1 A
±40 V	2 mV	2 mV	±(0.018 + 6)	±(0.015 + 8)	500 mA
±100 V	5 mV	5 mV	±(0.018 + 15)	±(0.02 + 20)	125 mA
±200 V	10 mV	10 mV	±(0.018 + 30)	±(0.035 + 40)	50 mA

1. *±(% of reading value + offset value in mV). Averaging is 128 samples in 1 PLC.*

Current range, resolution, and accuracy (high speed ADC)					
Current range	Force resolution	Measure resolution	Force accuracy [1] ±(% + A + A)	Measure accuracy [1] ±(% + A + A)	Maximum voltage
±1 nA	50 fA	50 fA	±(0.1 + 3E-13 + Vo x 1E-15)	±(0.25 + 3E-13 + Vo x 1E-15)	200 V
±10 nA	500 fA	500 fA	±(0.1 + 3E-12 + Vo x 1E-14)	±(0.25 + 2E-12 + Vo x 1E-14)	200 V
±100 nA	5 pA	5 pA	±(0.05 + 3E-11 + Vo x 1E-13)	±(0.1 + 2E-11 + Vo x 1E-13)	200 V
±1 μA	50 pA	50 pA	±(0.05 + 3E-10 + Vo x 1E-12)	±(0.1 + 2E-10 + Vo x 1E-12)	200 V
±10 μA	500 pA	500 pA	±(0.05 + 3E-9 + Vo x 1E-11)	±(0.05 + 2E-9 + Vo x 1E-11)	200 V
±100 μA	5 nA	5 nA	±(0.035 + 15E-9 + Vo x 1E-10)	±(0.05 + 2E-8 + Vo x 1E-10)	200 V
±1 mA	50 nA	50 nA	±(0.04 + 15E-8 + Vo x 1E-9)	±(0.04 + 2E-7 + Vo x 1E-9)	200 V
±10 mA	500 nA	500 nA	±(0.04 + 15E-7 + Vo x 1E-8)	±(0.04 + 2E-6 + Vo x 1E-8)	200 V
±100 mA	5 μA	5 μA	±(0.045 + 15E-6 + Vo x 1E-7)	±(0.1 + 2E-5 + Vo x 1E-7)	200 V [2]
±1 A	50 μA	50 μA	±(0.4 + 3E-4 + Vo x 1E-6)	±(0.5 + 3E-4 + Vo x 1E-6)	200 V [2]

1. *±(%of reading value + fixed offset in A + proportional offset in A), Vo is the output voltage in V.)*
2. *200 V (Io ≤ 50 mA), 100 V (50 mA < Io ≤ 125 mA), 40 V (125 mA < Io ≤ 500 mA), 20 V (500 mA < Io ≤ 1 A), Io is the output current in Amps.*

Power consumption

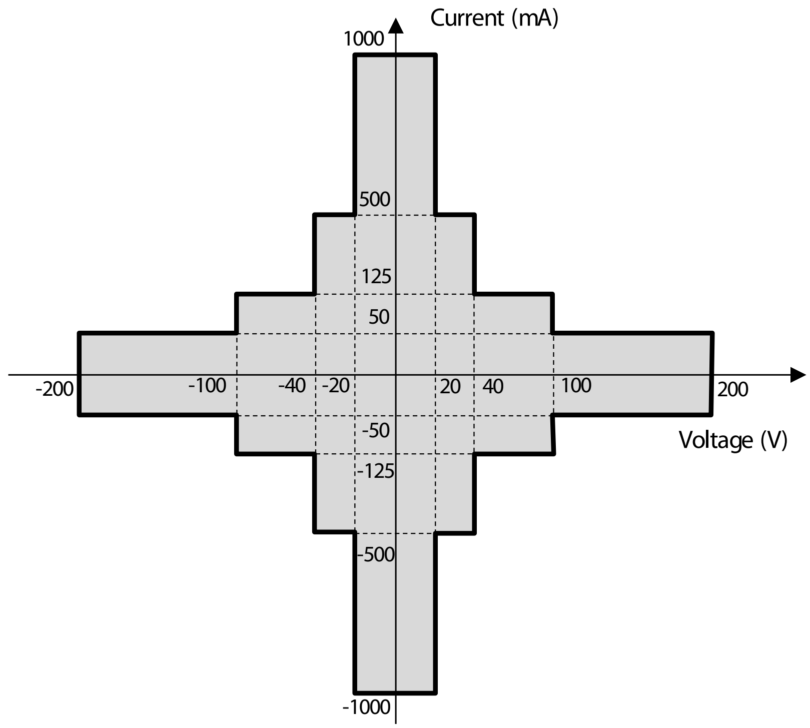
Voltage source mode:	
Voltage range	**Power**
2 V	20 x Ic (W)
20 V	20 x Ic (W)
40 V	40 x Ic (W)
100 V	100 x Ic (W)
200 V	200 x Ic (W)

Where Ic is the current compliance setting.

Current source mode:	
Voltage compliance	**Power**
Vc ≤ 20	20 x Io (W)
20 < Vc ≤ 40	40 x Io (W)
40 < Vc ≤ 100	100 x Io (W)
100 < Vc ≤ 200	200 x Io (W)

Where Vc is the voltage compliance setting and Io is output current.

HPSMU measurement and output range



MPSMU Module Specifications

Voltage range, resolution, and accuracy (high resolution ADC)					
Voltage range	Force resolution	Measure resolution	Force accuracy [1] ±(% + mV)	Measure accuracy [1] ±(% + mV)	Maximum current
±0.5 V	25 µV	0.5 µV	±(0.018 + 0.15)	±(0.01 + 0.12)	100 mA
±2 V	100 µV	2 µV	±(0.018 + 0.4)	±(0.01 + 0.14)	100 mA
±5 V	250 µV	5 µV	±(0.018 + 0.75)	±(0.009 + 0.25)	100 mA
±20 V	1 mV	20 µV	±(0.018 + 3)	±(0.009 + 0.9)	100 mA
±40 V	2 mV	40 µV	±(0.018 + 6)	±(0.01 + 1)	[2]
±100 V	5 mV	100 µV	±(0.018 + 15)	±(0.012 + 2.5)	[2]

1. ± *(% of reading value + offset value in mV)*
2. *100 mA (Vo ≤ 20 V), 50 mA (20 V < Vo ≤ 40 V), 20 mA (40 V < Vo ≤ 100 V), Vo is the output voltage in Volts.*

Current range, resolution, and accuracy (high resolution ADC)					
Current range	Force resolution	Measure resolution	Force accuracy [1] ±(% + A + A)	Measure accuracy [1] ±(% + A + A)	Maximum voltage
±1 nA	50 fA	10 fA	±(0.1 + 3E-13 + Vo x 1E-15)	±(0.1 + 2E-13 + Vo x 1E-15)	100 V
±10 nA	500 fA	10 fA	±(0.1 + 3E-12 + Vo x 1E-14)	±(0.1 + 1E-12 + Vo x 1E-14)	100 V
±100 nA	5 pA	100 fA	±(0.05 + 3E-11 + Vo x 1E-13)	±(0.05 + 2E-11 + Vo x 1E-13)	100 V
±1 µA	50 pA	1 pA	±(0.05 + 3E-10 + Vo x 1E-12)	±(0.05 + 1E-10 + Vo x 1E-12)	100 V
±10 µA	500 pA	10 pA	±(0.05 + 3E-9 + Vo x 1E-11)	±(0.04 + 2E-9 + Vo x 1E-11)	100 V
±100 µA	5 nA	100 pA	±(0.035 + 15E-9 + Vo x 1E-10)	±(0.03 + 3E-9 + Vo x 1E-10)	100 V
±1 mA	50 nA	1 nA	±(0.04 + 15E-8 + Vo x 1E-9)	±(0.03 + 6E-8 + Vo x 1E-9)	100 V
±10 mA	500 nA	10 nA	±(0.04 + 15E-7 + Vo x 1E-8)	±(0.03 + 2E-7 + Vo x 1E-8)	100 V
±100 mA	5 µA	100 nA	±(0.045 + 15E-6 + Vo x 1E-7)	±(0.04 + 6E-6 + Vo x 1E-7)	[2]

1. ± *(% of reading value + fixed offset in A + proportional offset in A), Vo is the output voltage in V.)*
2. *100 V (Io ≤ 20 mA), 40 V (20 mA < Io ≤ 50 mA), 20 V (50 mA < Io ≤ 100 mA), Io is the output current in Amps.*

Voltage range, resolution, and accuracy (high speed ADC)					
Voltage range	Force resolution	Measure resolution	Force accuracy [1] ±(% + mV)	Measure accuracy [1] ±(% + mV)	Maximum current
±0.5 V	25 µV	25 µV	±(0.018 + 0.15)	±(0.01 + 0.25)	100 mA
±2 V	100 µV	100 µV	±(0.018 + 0.4)	±(0.01 + 0.7)	100 mA
±5 V	250 µV	250 µV	±(0.018 + 0.75)	±(0.01 + 2)	100 mA
±20 V	1 mV	1 mV	±(0.018 + 3)	±(0.01 + 4)	100 mA
±40 V	2 mV	2 mV	±(0.018 + 6)	±(0.015 + 8)	[2]
±100 V	5 mV	5 mV	±(0.018 + 15)	±(0.02 + 20)	[2]

1. *±(% of reading value + offset value in mV). Averaging is 128 samples in 1 PLC.*
2. *100 mA (Vo ≤ 20 V), 50 mA (20 V < Vo ≤ 40 V), 20 mA (40 V < Vo ≤ 100 V), Vo is the output voltage in Volts.*

Current range, resolution, and accuracy (high speed ADC)					
Current range	Force resolution	Measure resolution	Force accuracy [1] ±(% + A + A)	Measure accuracy [1] ±(% + A + A)	Maximum voltage
±1 nA	50 fA	50 fA	±(0.1 + 3E-13 + Vo x 1E-15)	±(0.25 + 3E-13 + Vo x 1E-15)	100 V
±10 nA	500 fA	500 fA	±(0.1 + 3E-12 + Vo x 1E-14)	±(0.25 + 2E-12 + Vo x 1E-14)	100 V
±100 nA	5 pA	5 pA	±(0.05 + 3E-11 + Vo x 1E-13)	±(0.1 + 2E-11 + Vo x 1E-13)	100 V
±1 µA	50 pA	50 pA	±(0.05 + 3E-10 + Vo x 1E-12)	±(0.1 + 2E-10 + Vo x 1E-12)	100 V
±10 µA	500 pA	500 pA	±(0.05 + 3E-9 + Vo x 1E-11)	±(0.05 + 2E-9 + Vo x 1E-11)	100 V
±100 µA	5 nA	5 nA	±(0.035 + 15E-9 + Vo x 1E-10)	±(0.05 + 2E-8 + Vo x 1E-10)	100 V
±1 mA	50 nA	50 nA	±(0.04 + 15E-8 + Vo x 1E-9)	±(0.04 + 2E-7 + Vo x 1E-9)	100 V
±10 mA	500 nA	500 nA	±(0.04 + 15E-7 + Vo x 1E-8)	±(0.04 + 2E-6 + Vo x 1E-8)	100 V
±100 mA	5 µA	5 µA	±(0.045 + 15E-6 + Vo x 1E-7)	±(0.1 + 2E-5 + Vo x 1E-7)	[2]

1. *±(%of reading value + fixed offset in A + proportional offset in A), Vo is the output voltage in V.)*
2. *100 V (Io ≤ 20 mA), 40 V (20 mA < Io ≤ 50 mA), 20 V (50 mA < Io ≤ 100 mA), Io is the output current in Amps.*

Power consumption

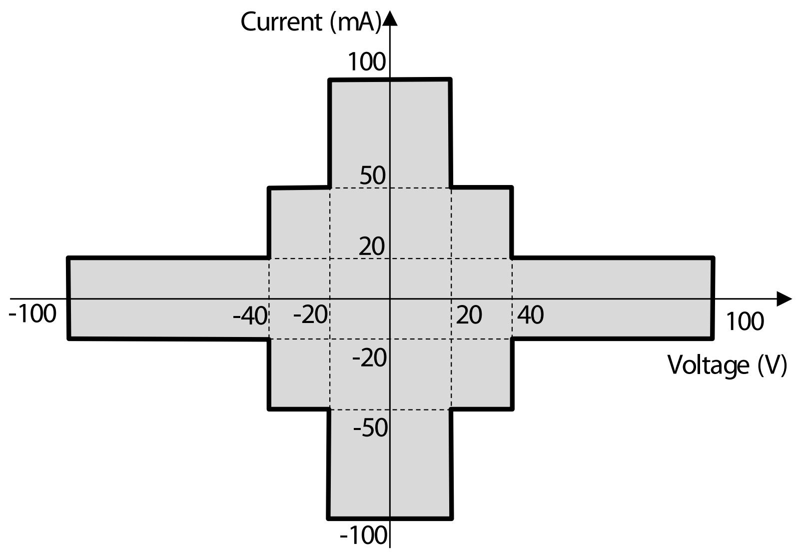
Voltage source mode:	
Voltage range	**Power**
0.5 V	20 x Ic (W)
2 V	20 x Ic (W)
5 V	20 x Ic (W)
20 V	20 x Ic (W)
40 V	40 x Ic (W)
100 V	100 x Ic (W)

Where Ic is the current compliance setting.

Current source mode:	
Voltage compliance	**Power**
Vc ≤ 20	20 x Io (W)
20 < Vc ≤ 40	40 x Io (W)
40 < Vc ≤ 100	100 x Io (W)

Where Vc is the voltage compliance setting and Io is output current.

MPSMU measurement and output range



HCSMU Module Specifications

Voltage range, resolution, and accuracy					
Voltage range	Force resolution	Measure resolution	Force accuracy[1] ±(% + mV + mV)	Measure accuracy[1] (% + mV + mV)	Maximum current
±0.2 V	200 nV	200 nV	±(0.06 + 0.14 + Io x 0.05)	±(0.06 + 0.14 + Io x 0.05)	20 A
±2 V	2 μV	2 μV	±(0.06 + 0.6 + Io x 0.5)	±(0.06 + 0.6 + Io x 0.5)	20 A
±20 V	20 μV	20 μV	±(0.06 + 3 + Io x 5)	±(0.06 + 3 + Io x 5)	20 A
±40 V	40 μV	40 μV	±(0.06 + 3 + Io x 10)	±(0.06 + 3 + Io x 10)	1 A

1. *±(% of reading value + fixed offset in mV + proportional offset in mV). Note: Io is the output current in A.*

Current range, resolution, and accuracy					
Current range	Force resolution	Measure resolution	Force accuracy[1] (% + A + A)	Measure accuracy[1] (% + A + A)	Maximum voltage
±10 μA	10 pA	10 pA	±(0.06 + 2E-9 + Vo x 1E-10)	±(0.06 + 2E-9 + Vo x 1E-10)	40 V
±100 μA	100 pA	100 pA	±(0.06 + 2E-8 + Vo x 1E-9)	±(0.06 + 2E-8 + Vo x 1E-9)	40 V
±1 mA	1 nA	1 nA	±(0.06 + 2E-7 + Vo x 1E-8)	±(0.06 + 2E-7 + Vo x 1E-8)	40 V
±10 mA	10 nA	10 nA	±(0.06 + 2E-6 + Vo x 1E-7)	±(0.06 + 2E-6 + Vo x 1E-7)	40 V
±100 mA	100 nA	100 nA	±(0.06 + 2E-5 + Vo x 1E-6)	±(0.06 + 2E-5 + Vo x 1E-6)	40 V
±1 A	1 μA	1 μA	±(0.4 + 2E-4 + Vo x 1E-5)	±(0.4 + 2E-4 + Vo x 1E-5)	40 V
±20 A[2]	20 μA	20 μA	±(0.4 + 2E-3 + Vo x 1E-4)	±(0.4 + 2E-3 + Vo x 1E-4)	20 V

1. *±(% of reading value + fixed offset in A + proportional offset in A), Vo is the output voltage in V.*
2. *Pulse mode only. The maximum value of the base current during pulsing is ±100 mA.*

Power consumption

Voltage source mode:	
Voltage range	Power
0.2 V	40 x Ic (W)
2 V	40 x Ic (W)
40 V	40 x Ic (W)

Where Ic is the current compliance setting.
For pulse current, Ic = (duty) x Ipulse

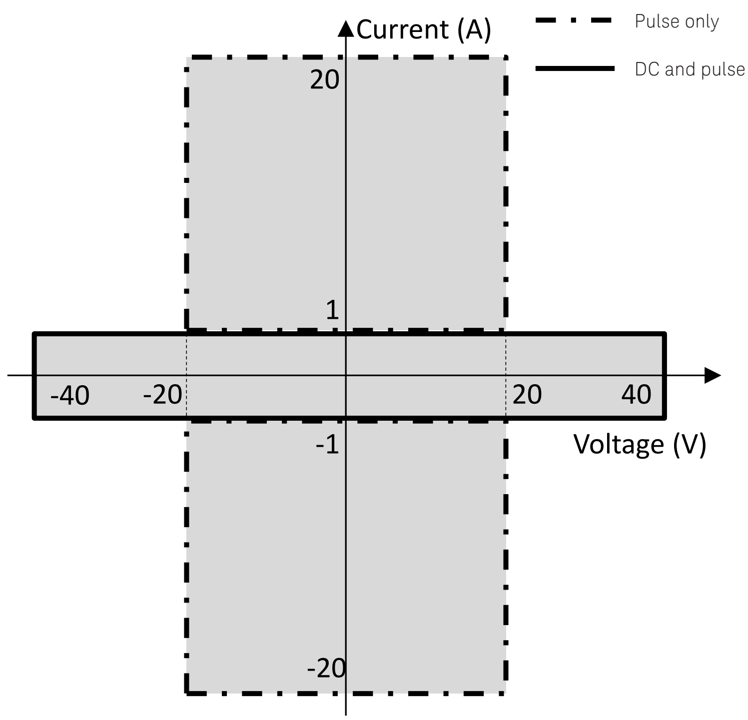
Current source mode:	
Voltage compliance	Power
Vc ≤ 0.2	40 x Io (W)
0.2 < Vc ≤ 2	40 x Io (W)
2 < Vc ≤ 40	40 x Io (W)

Where Vc is the voltage compliance setting and Io is output current.
For pulse current, Io = (duty) x Ipulse

Current range expansion

If two HCSMUs are combined using the Dual HCSMU combination adapter or the Dual HCSMU Kelvin combination adapter, then the maximum current ranges are 40A (Pulsed) and 2A (DC).

HCSMU measurement and output range



HVSMU Module Specifications

Voltage range, resolution, and accuracy					
Voltage range	Force resolution	Measure resolution	Force accuracy [1] ±(% + mV)	Measure accuracy [1] ±(% + mV)	Maximum current
±200 V	200 µV	200 µV	±(0.03 + 40)	±(0.03 + 40)	8 mA
±500 V	500 µV	500 µV	±(0.03 + 100)	±(0.03 + 100)	8 mA
±1500 V	1.5 mV	1.5 mV	±(0.03 + 300)	±(0.03 + 300)	8 mA
±3000 V	3 mV	3 mV	±(0.03 + 600)	±(0.03 + 600)	4 mA

1. *±(% of reading value + offset voltage V)*

Current range, resolution, and accuracy						
Current range	Force resolution	Measure resolution	Force accuracy [1] ±(% + A + A)	Measure accuracy [1] ±(% + A + A)	Maximum voltage	Minimum set current [2]
±1 nA	10 fA	10 fA	±(0.1 + 6E-13 + Vo x 1E-15)	±(0.1 + 6E-13 + Vo x 1E-15)	3000 V	1pA
±10 nA	100 fA	100 fA	±(0.1 + 25E-13 + Vo x 1E-15)	±(0.1 + 25E-13 + Vo x 1E-15)	3000 V	1pA
±100 nA	100 fA	100 fA	±(0.05 + 25E-12 + Vo x 1E-13)	±(0.05 + 25E-12 + Vo x 1E-13)	3000 V	100 pA
±1 µA	1 pA	1 pA	±(0.05 + 1E-10 + Vo x 1E-13)	±(0.05 + 1E-10 + Vo x 1E-13)	3000 V	100 pA
±10 µA	10 pA	10 pA	±(0.04 + 2E-9 + Vo x 1E-11)	±(0.04 + 2E-9 + Vo x 1E-11)	3000 V	10 nA
±100 µA	100 pA	100 pA	±(0.03 + 3E-9 + Vo x 1E-11)	±(0.03 + 3E-9 + Vo x 1E-11)	3000 V	10 nA
±1 mA	1 nA	1 nA	±(0.03 + 6E-8 + Vo x 1E-10)	±(0.03 + 6E-8 + Vo x 1E-10)	3000 V	100 nA
±10 mA	10 nA	10 nA	±(0.03 + 2E-7 + Vo x 1E-9)	±(0.03 + 2E-7 + Vo x 1E-9)	1500 V	1 µA

1. *±(%of reading value + fixed offset in A + proportional offset in A), Vo is the output voltage in V.)*

2. *Output current needs to be set more than current shown in the table.*

Power consumption

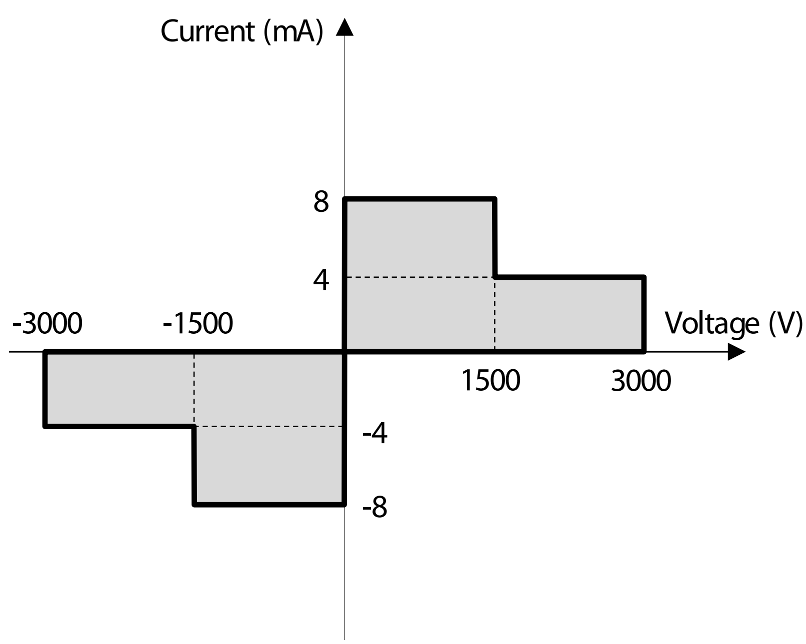
Voltage source mode:	
Current compliance	Power
Ic ≤ 4m	3000 x Ic (W)
4m < Ic ≤ 8m	1500 x Ic (W)

Where Ic is the current compliance setting.

Current source mode:	
Voltage compliance	Power
Vc ≤ 1500	1500 x Io (W)
1500 < Vc ≤ 3000	3000 x Io (W)

Where Vc is the voltage compliance setting and Io is output current.

HVSMU measurement and output range



MCSMU Module Specifications

Voltage range, resolution, and accuracy					
Voltage range	Force resolution	Measure resolution	Force accuracy [1] ±(% + mV)	Measure accuracy [1] (% + mV + mV)	Maximum current
±0.2 V	200 nV	200 nV	±(0.06 + 0.14)	±(0.06 + 0.14 + Io x 0.05)	1 A
±2 V	2 µV	2 µV	±(0.06 + 0.6)	±(0.06 + 0.6 + Io x 0.5)	1 A
±20 V	20 µV	20 µV	±(0.06 + 3)	±(0.06 + 3 + Io x 5)	1 A
±40 V[2]	40 µV	40 µV	±(0.06 + 3)	±(0.06 + 3 + Io x 10)	1 A

1. ±(% of reading value + fixed offset in mV + proportional offset in mV). Note:Io is the output current in A.

2. Maximum output voltage is 30 V.

Current range, resolution, and accuracy					
Current range	Force resolution	Measure resolution	Force accuracy [1] (% + A + A)	Measure accuracy [1] (% + A + A)	Maximum voltage
±10 µA	10 pA	10 pA	±(0.06 + 2E-9 + Vo x 1E-10)	±(0.06 + 2E-9 + Vo x 1E-10)	30 V
±100 µA	100 pA	100 pA	±(0.06 + 2E-8 + Vo x 1E-9)	±(0.06 + 2E-8 + Vo x 1E-9)	30 V
±1 mA	1 nA	1 nA	±(0.06 + 2E-7 + Vo x 1E-8)	±(0.06 + 2E-7 + Vo x 1E-8)	30 V
±10 mA	10 nA	10 nA	±(0.06 + 2E-6 + Vo x 1E-7)	±(0.06 + 2E-6 + Vo x 1E-7)	30 V
±100 mA	100 nA	100 nA	±(0.06 + 2E-5 + Vo x 1E-6)	±(0.06 + 2E-5 + Vo x 1E-6)	30 V
±1 A[2]	1 µA	1 µA	±(0.4 + 2E-4 + Vo x 1E-5)	±(0.4 + 2E-4 + Vo x 1E-5)	30 V

1. ±(% of reading value + fixed offset in A + proportional offset in A), Vo is the output voltage in V.

2. Pulse mode only. The maximum value of the base current during pulsing is ±50 mA.

Power consumption

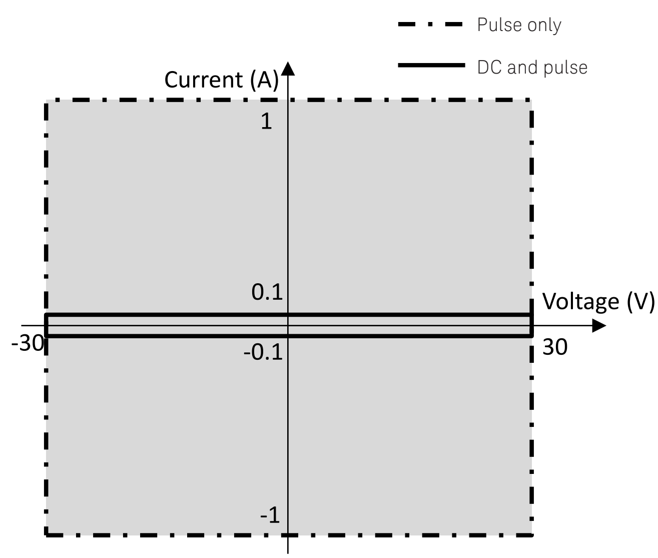
Voltage source mode:	
Voltage range	Power
0.2 V	40 x Ic (W)
2 V	40 x Ic (W)
40 V	40 x Ic (W)

Where Ic is the current compliance setting.

Current source mode:	
Voltage compliance	Power
Vc ≤ 0.2	40 x Io (W)
0.2 < Vc ≤ 2	40 x Io (W)
2 < Vc ≤ 40	40 x Io (W)

Where Vc is the voltage compliance setting and Io is output current.

MCSMU measurement and output range



SMU source measurement mode

For HPSMU and MPSMU:
VFIM, IFVM
For HCSMU, MCSMU and HVSMU:
VFIM, VFVM, IFVM, IFIM

Output terminal/connection:

For HPSMU and MPSMU:
- Dual triaxial connector,
- Kelvin (remote sensing)

For HCSMU:
- Triaxial connector (for sense) and coaxial connector (for force)
- Kelvin (remote sensing)

For MCSMU:
- Dual triaxial connector, Kelvin (remote sensing)

For HVSMU:
- High voltage triaxial connector, non-Kelvin

Voltage/current compliance (limiting)

The SMU can limit output voltage or current to prevent damaging the device under test.

Voltage:
- 0 V to ±200 V (HPSMU)
- 0 V to ±100 V (MPSMU)
- 0 V to ±40 V (HCSMU)
- 0 V to ±30 V (MCSMU)
- 0 V to ±3000 V (HVSMU)

Current:
- ±1 pA to ±1 A (HPSMU)
- ±1pA to ±100 mA (MPSMU)
- ±10 nA to ±20 A (HCSMU)
- ±10 nA to ±1 A (MCSMU)
- ±1 pA to ±8 mA (HVSMU)

Compliance accuracy:
- Same as the current or voltage set accuracy.

Power compliance

For HPSMU:
- Power: 0.001 W to 20 W
- Resolution: 0.001 W

For MPSMU:
- Power: 0.001 W to 2 W
- Resolution: 0.001 W

For HCSMU:
- Power: 0.001 W to 40 W (DC)
- 0.001 W to 400 W (Pulse)
- Resolution: 0.001 W

For MCSMU:
- Power: 0.001 W to 3 W (DC)
- 0.001 W to 30 W (Pulse)
- Resolution: 0.001 W"

For HVSMU:
- No power compliance

SMU pulse measurement

Pulse width, period, and delay:

For HPSMU and MPSMU:
- Pulse width: 500 µs to 2 s
- Pulse width resolution: 100 µs
- Pulse period: 5 ms to 5 s
  - Period ≥ delay + width + 2 ms (when delay + width ≤ 100 ms)
  - Period ≥ delay + width + 10 ms (when delay + width > 100 ms)
  - Pulse period resolution: 100 µs
  - Pulse delay: 0 s

For HCSMU:
- Pulse width:
  - 50 µs to 1 ms (20 A range)
  - 50 µs to 2 s (10 µA to 1 A range)
- Pulse width resolution: 2 µs
- Pulse period: 5 ms to 5 s
- Pulse period resolution: 100 µs
- Pulse duty:
  - For 20 A range: ≤ 1%
  - For 10 µA to 1 A range
    - Period ≥ delay + width + 2 ms (when delay + width ≤ 100 ms)
    - Period ≥ delay + width + 10 ms (when delay + width > 100 ms)
    - Pulse delay: 0 to (Period–width)

For MCSMU:
- Pulse width:
  - 10 µs to 100 ms (1 A range)
  - 10 µs to 2 s (10 µA to 100 mA range)
- Pulse width resolution: 2 µs
- Pulse period: 5 ms to 5 s
- Pulse period resolution: 100 µs
- Pulse duty:
  - For 1 A range: ≤ 5%
  - For 10 µA to 100m A range
    - Period ≥ delay + width + 2 ms (when delay + width ≤ 100 ms)
    - Period ≥ delay + width + 10 ms (when delay + width > 100 ms)
    - Pulse delay: 0 to (Period–width)

For HVSMU:
- Pulse width: 500 µs to 2 s
- Pulse width resolution: 2 µs
- Pulse period: 5 ms to 5 s
  - Period ≥ delay + width + 2 ms (when delay + width ≤ 100 ms)
  - Period ≥ delay + width + 10 ms (when delay + width > 100 ms)
- Pulse period resolution: 100 µs
- Pulse delay: 0 to (Period – width)
- Pulse output limitation:
  - When the pulse voltage is more than 1500 volts, the peak and base of pulse should be same polarities.
- Pulse measurement delay:
  - 2 µs to (Period – pulse measurement time – 2 m) s, 2 µs resolution

Supplemental Characteristics

Current compliance setting accuracy (for opposite polarity):

For HPSMU and MPSMU:
- For 1 pA to 10 nA ranges:
  - V/I setting accuracy ±12% of range
- For 100 nA to 1 A ranges:
  - V/I setting accuracy ±2.5% of range

For HCSMU and MCSMU:
- For 10 µA to 1 A ranges:
  - V/I setting accuracy ±2.5% of range
- For 20 A range (HCSMU):
  - V/I setting accuracy ±0.6% of range

For HVSMU:
- For 1 nA to 10 nA ranges:
  - V/I setting accuracy ±12% of range
- For 100 nA to 10 mA ranges:
  - V/I setting accuracy ±2.5% of range

SMU pulse setting accuracy (fixed measurement range):

For HPSMU and MPSMU:
- Width: ±0.5% ± 50 μs
- Period: ±0.5% ± 100 μs

For HCSMU and MCSMU:
- Width: ±0.1% ± 2 μs
- Period: ±0.1% ± 100 μs

For HVSMU:
- Width: ±0.1% ± 2 μs
- Period: ±0.5% ± 100 μs

Minimum pulse measurement time:

16 μs (HPSMU and MPSMU)
2 μs (HCSMU and MCSMU)
6 μs (HVSMU)

Voltage source output resistance:

(Force line, non-Kelvin connection)
0.2 Ω (HPSMU)
0.3Ω (MPSMU)
3 Ω (HVSMU, at 10 mA range)

Voltage measurement input resistance:

≥ 10^{13} Ω (HPSMU, MPSMU)
≥ 10^{9} Ω (HCSMU, MCSMU, ≤ 1 A),
80 kΩ (HCSMU, 20 A)
≥ 10^{12} Ω (HVSMU)

Current source output resistance:

≥ 10^{13} Ω (HPSMU, MPSMU)
≥ 10^{9} Ω (HCSMU, MCSMU, ≤ 1 A),
80 kΩ (HCSMU, 20 A)
≥ 10^{12} Ω (HVSMU, at 10 nA range)

Maximum allowable cable resistance:

(Kelvin connection)

For HPSMU and MPSMU:
- Sense: 10 Ω
- Force: 10 Ω (≤ 100 mA), 1.5 Ω (>100 mA)

For HCSMU:
- Sense: 10 Ω
- Force: 0.6 Ω (with Low Force)

For MCSMU:
- Sense: 10 Ω
- Force : 1 Ω (with Low Force)

Maximum allowable inductance:

For HCSMU and MCSMU:
- Force 3 μH (with Low Force (shield))

Maximum load capacitance:

For HPSMU and MPSMU:
- 1 pA to 10 nA ranges: 1000 pF
- 100 nA to 10 mA ranges: 10 nF
- 100 mA and 1 A ranges: 100 μF

For HCSMU:
- 10 μA to 10 mA ranges: 12 nF
- 100 mA to 20 A ranges: 100 μF

For MCSMU:
- 10μA to 10 mA range : 12 nF
- 100 mA to 1 A range : 100 μF

For HVSMU:
- 1 nA to 1 μA ranges: 1000 pF
- 10 μA to 10 mA ranges: 10 nF

Maximum guard capacitance:

900 pF (HPSMU and MPSMU)
1500 pF (HVSMU)

Maximum shield capacitance:

5000 pF (HPSMU, MPSMU and HVSMU)

Noise characteristics:

For HPSMU, MPSMU and HVSMU (Filter ON for HPSMU and MPSMU.)
- Voltage source: 0.01% of V range (rms.)
- Current source: 0.1% of I range (rms.)

For HCSMU
- Voltage/Current source: 100 mV (0 to peak) max

For MCSMU
- Voltage / Current source: 200 mV (0 to peak) max

Overshoot:

(Filter ON for all SMUs)

For HPSMU and MPSMU
- Voltage source: 0.03% of V range
- Current source: 1% of I range

For HCSMU and MCSMU (filter ON)
- Voltage/Current source: 10% of range

For HVSMU
- Voltage source: 1V (resistive load)
- Current source: 1% of I range

Range switching transient noise:

For HPSMU and MPSMU (filter ON):
- Voltage ranging: 250 mV
- Current ranging: 70 mV

For HCSMU and MCSMU:
- 10 μA to 1 A ranges:
  - Voltage ranging: 250 mV
  - Current ranging: 70 mV
- 20 A ranges:
  - Voltage ranging: 5 V max

For HVSMU:
- Voltage ranging: 300 mV
- Current ranging: 300 mV

Maximum guard offset voltage:

±1 mV (HPSMU)
±3 mV (MPSMU)
±5 mV (HVSMU)

Maximum slew rate:

0.2 V/μs (HPSMU and MPSMU)
1 V/μs (HCSMU and MCSMU)
0.4 V/μs (HVSMU)

Output settling time

For HVSMU:
- Output settling time: 500 μs
- To reach 0.01% of settling value.
- Conditions:
  - 100 V step, 8 mA compliance, 1000 pF load capacitance

MFCMU (multi frequency capacitance measurement unit) module specifications

Measurement functions

Measurement parameters:

Cp-G, Cp-D, Cp-Q, Cp-Rp, Cs-Rs, Cs-D, Cs-Q, Lp-G, Lp-D, Lp-Q, Lp-Rp, Ls-Rs, Ls-D, Ls-Q, R-X, G-B, Z-θ, Y-θ

Ranging:

Auto and fixed

Measurement terminal:

Four-terminal pair configuration, four BNC (female) connectors

Cable length:

1.5 m or 3 m, automatic identification of accessories

Test signal

Frequency:

Range: 1 kHz to 5 MHz
Resolution: 1 mHz (minimum)
Accuracy: ±0.008%

Output signal level:

Range: 10 mV_{rms} to 250 mV_{rms}
Resolution: 1 mV_{rms}
Accuracy:
±(10.0% + 1 mV_{rms}) at the measurement port of the MFCMU
±(15.0% + 1 mV_{rms}) at the measurement port of MFCMU cable (1.5 m or 3.0 m)

Output impedance: 50 Ω, typical
Signal level monitor:
Range: 10 mVrms to 250 mV_{rms}
Accuracy:
±(10.0% of reading + 1 mV_{rms}) at the measurement port of the MFCMU
±(15.0% + 1 mV_{rms}) at the measurement port of MFCMU cable (1.5 m or 3.0 m)

DC bias function

DC bias:

Range: 0 to ±25 V
Resolution: 1 mV
Accuracy: ±(0.5% + 5.0 mV) at the measurement port or the MFCMU or the MFCMU cable (1.5 m/3 m)

Maximum DC bias current (Supplemental characteristics):

Impedance measurement range	Maximum DC bias current
50 Ω	10 mA
100 Ω	10 mA
300 Ω	10 mA
1 kΩ	1 mA
3 kΩ	1 mA
10 kΩ	100 µA
30 kΩ	100 µA
100 kΩ	10 µA
300 kΩ	10 µA

Output impedance: 50 Ω, typical
DC bias monitor:
Range: 0 to ±25 V
Accuracy (open load):
±(0.2% of reading + 10.0 mV) at the measurement port or the MFCMU cable (1.5 m/3 m)

Sweep characteristics

Available sweep parameters:
Oscillator level, DC bias voltage, frequency
Sweep type: linear, log
Sweep mode: single, double
Sweep direction: up, down
Number of measurement points:
Maximum 1001 points

Measurement accuracy

The following parameters are used to express the impedance measurement accuracy at the measurement port of the MFCMU or the MFCMU cable (1.5 m or 3 m).

Z_X: Impedance measurement value (Ω)

D_X: Measurement value of D

$E = E_P' + (Z_S'/|Z_X| + Y_O'|Z_X|) \times 100$ (%)

$E_P' = E_{PL} + E_{POSC} + E_P$ (%)

$Y_O' = Y_{OL} + Y_{OSC} + Y_O$ (S)

$Z_S' = Z_{SL} + Z_{OSC} + Z_S$ (Ω)

|Z| accuracy
±E (%)

θ accuracy
±E/100 (rad)

C accuracy
at $D_X \le 0.1$
±E (%)

at $D_X > 0.1$
$\pm E \times \sqrt{(1+D_X^2)}$ (%)

D accuracy
at $D_X \le 0.1$
±E/100

at $D_X > 0.1$
$\pm E \times (1 + D_X)/100$

G accuracy
at $D_X \le 0.1$
$\pm E/D_X$ (%)

at $D_X > 0.1$
$\pm E \times \sqrt{(1+D_X^2)}/D_X$ (%)

Note: measurement accuracy is specified under the following conditions:
Temperature: 23 °C ±5 °C
Integration time: 1 PLC

Parameters E_{POSC} Z_{OSC}		
Oscillator level	EP_{OSC} (%)	Z_{OSC} (mΩ)
125 mV < V_{OSC} ≤ 250 mV	0.03 x (250/ V_{OSC} – 1)	5 x (250/V_{OSC} – 1)
64 mV < V_{OSC} ≤ 125 mV	0.03 x (125/ V_{OSC} – 1)	5 x (125/V_{OSC} – 1)
32 mV < V_{OSC} ≤ 64 mV	0.03 x (64/ V_{OSC} – 1)	5 x (64/V_{OSC} – 1)
V_{OSC} ≤ 32 mV	0.03 x (32/ V_{OSC} – 1)	5 x (64/V_{OSC} – 1)

V_{osc} is oscillator level in mV.

Parameters E_{PL} Y_{OL} Z_{SL}			
Cable length	E_{PL} (%)	Y_{OL} (nS)	Z_{SL} (mΩ)
1.5 m	0.02 + 3 x f/100	750 x f/100	5.0
3 m	0.02 + 5 x f/100	1500 x f/100	5.0

f is frequency in MHz. If measurement cable is extended, open compensation, short compensation, and load compensation must be performed.

Parameters Y_{OSC} Y_O E_P Z_S				
Frequency	Y_{OSC} (nS)	Y_O (nS)	E_P (%)	Z_S (mΩ)
1 kHz ≤ f ≤ 200 kHz	1 x (125/ V_{OSC} – 0.5)	1.5	0.095	5.0
200 kHz < f ≤ 1 MHz	2 x (125/ V_{OSC} – 0.5)	3.0	0.095	5.0
1 MHz < f ≤ 2 MHz	2 x (125/ V_{OSC} – 0.5)	3.0	0.28	5.0
2 MHz < f	20 x (125/ V_{OSC} – 0.5)	30.0	0.28	5.0

f is frequency in Hz.
V_{osc} is oscillator level in mV.

Example of calculated C/G measurement accuracy				
Frequency	Measured capacitance	C accuracy [1]	Measured conductance	G accuracy [1]
5 MHz	1 pF	± 0.61%	≤ 3 μS	± 192 nS
	10 pF	± 0.32%	≤ 31 μS	± 990 nS
	100 pF	± 0.29%	≤ 314 μS	± 9 μS
	1 nF	± 0.32%	≤ 3 mS	± 99 μS
1 MHz	1 pF	± 0.26%	≤ 628 nS	± 16 nS
	10 pF	± 0.11%	≤ 6 μS	± 71 nS
	100 pF	± 0.10%	≤ 63 μS	± 624 nS
	1 nF	± 0.10%	≤ 628 μS	± 7 μS
100 kHz	10 pF	± 0.18%	≤ 628 nS	± 11 nS
	100 pF	± 0.11%	≤ 6 μS	± 66 nS
	1 nF	± 0.10%	≤ 63 μS	± 619 nS
	10 nF	± 0.10%	≤ 628 μS	± 7 μS
10 kHz	100 pF	± 0.18%	≤ 628 nS	± 11 nS
	1 nF	± 0.11%	≤ 6 μS	± 66 nS
	10 nF	± 0.10%	≤ 63 μS	± 619 nS
	100 nF	± 0.10%	≤ 628 μS	± 7 μS
1 kHz	100 pF	± 0.92%	≤ 63 nS	± 6 nS
	1 nF	± 0.18%	≤ 628 nS	± 11 nS
	10 nF	± 0.11%	≤ 6 μS	± 66 nS
	100 nF	± 0.10%	≤ 63 μS	± 619 nS

1. *The capacitance and conductance measurement accuracy is specified under the following conditions:*
   D_X ≤ 0.1
   Integration time: 1 PLC
   Test signal level: 30 mV_{rms}
   At four-terminal pair port of MFCMU

UHC (Ultra High Current) Expander / Fixture (N1265A) Specifications

Specifications

Functions:

Fixture capability

Current expander capability

Expands the B1505A's current capability up to 1500 A. Current expansion is made using the Ultra High Current Unit (UHCU), which is comprised of an external module and either two MCSMUs, two HCSMUs or one MCSMU and one HCSMU.

Selector capability

This allows the user to switch the output between the UHCU and other modules connected to the selector input ports. The modules supported on the high-voltage input port are the HVSMU and HVMCU; the modules supported on the SMU input port are the HPSMU and MPSMU.

Channels:

Channel	Number	Input	Output
SMU	6 (When using non-Kelvin connections) 3 (When using Kelvin connections)	Triaxial[1]	Banana
UHV	1	UHV coaxial (High), SHV (Low)	UHV coaxial (High), SHV (Low)
Bias Tee	1	SHV x 2(High, Low)	SHV x 2 (High, Low)
Gate control	1	Triaxial x 2 (Force, Sense)	Banana x 2 (High, Low)
Selector	1[2]	HV Triaxial x 1 Triaxial x 2 (Force, Sense)	Banana x 6 (High Force/Sense, Low Force/Sense, Guard, Chassis)

1. Either the HCSMU or the Dual HCSMU can be connected to the SMU 3 port.

2. The UHCU or any module connected to one of the other two selector input terminals can be connected to the output terminal.

Maximum output for selector channel:

HVSMU Output : ±3000 V/4 mA, ±1500 V/8 mA

HVMCU Output : ±2200 V/1.1 A, ±1500 V/2.5 A

HPSMU Output: ±200 V/1 A

MPSMU Output: ±100 V/100 mA

UHCU Output: ±60 V/1500 A or 500 A

Refer to each module specification.

Gate control channel:

Non-Kelvin connection

Maximum Voltage : ±40 V

Maximum Current : ±1 A Pulse, 100m A DC.

Output Resistance: 0 Ω/10 Ω/100 Ω/1000 Ω (nominal value)

UHCU:

Output peak power	
Current range	**Peak power**
± 500 A	7.5 kW
± 1500 A	22.5 kW

Voltage range, resolution, and accuracy				
Voltage range	Setting resolution	Measure resolution	Setting accuracy[1,2,3] ±(% + mV)	Measure accuracy[1,3] ±(% + mV)
± 60 V	200 µV	100 µV	±(0.2 + 10)	±(0.2 + 10)

1. ±(% of reading value + fixed offset in mV)
2. Setting accuracy is defined at open load.
3. Accuracy is defined 1ms pulse width at 500A range and 500 µs pulse width at 1500A range.

Current range, resolution, and accuracy[1]				
Current range	Setting resolution	Measure resolution	Setting accuracy[2,3] ±(% + A + A)	Measure accuracy[2,3] ±(% + A + A)
± 500 A	1 mA	500 µA	±(0.6 + 0.3 + 0.01*Vo)	±(0.6 + 0.3 + 0.01*Vo)
± 1500 A	4 mA	2 mA	±(0.8 + 0.9 + 0.02*Vo)	±(0.8 + 0.9 + 0.02*Vo)

1. Maximum voltage compliance in current pulse mode is 63 V. Over 400 A at 500 A range and over 1200 A at 1500 A range are supplemental characteristics.
2. Accuracy is defined with 1ms pulse width at 500 A range and with 500 µs pulse width at 1500 A range.
3. ±(% of reading value + fixed offset in A + proportional offset in A), Vo is the Output Voltage.

UHCU Pulse width and resolution				
Current range	Voltage pulse width	Current pulse width	Resolution	Pulse period[1]
500 A	10 µsec – 1 msec	10 µsec – 1 msec	2 µsec	Duty ≤ 0.4%
1500 A	10 µsec – 500 µsec	10 µsec – 500 µsec	2 µsec	Duty ≤ 0.1%

1. At continuous maximum current output, the output current may be reduced due to insufficient charging time.

Other functionality

Fiilter

Filter can be used for UHC output in current mode at 500 A range.

Thermocouple input: 2ea

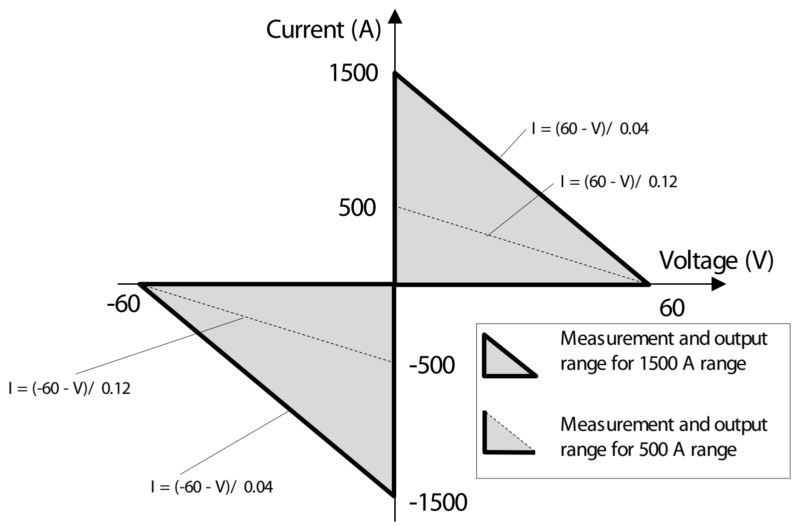
Two K-type thermocouple inputs

Temperature range: -50 °C to 300 °C.

Other Terminals/Indicators

Digital I/O input: 1ea.
Digital I/O output: 1 ea.
Power indicator: 1ea.
High voltage indicator: 1ea.
Selector indicator: 1ea.
Interlock terminal: 1ea.
Earth terminal: 1ea.
Wrist strap terminal: 1ea.

UHC measurement and output range



The UHCU output is only available in pulsed mode.

In the equations in the above diagram, 'I' stands for current, 'V' for Voltage and 'Rdut' stands for the impedance of the device under test.

Supplemental characteristics

UHCU Output resistance	
Output range	Nominal value
500 A	120 mΩ
1500 A	40 mΩ

Leakage

Selector channel

HVSMU is applied at High Sense terminal: less than 1n A

HPSMU/MPSMU is applied at High Force terminal: less than 10 nA

UHVU channel

Less than 1nA

SMU channel

Less than 1nA

Thermocouple reading accuracy	
Temperature range	Accuracy
0°C <= T < 100° C	+/-2°C
T>= 100° C	+/-5°C
T< 0° C	+/-5°C

HVSMU Current Expander (N1266A) Specifications

Specifications

Functions:

Current expander capability

Expands HVSMU current up to 2.5 A. Current expansion is made using the High Voltage Medium Current Unit (HVMCU), which is comprised of a module in the N1266A, HVSMU and two MCSMUs.

Selector capability

This allows the connections between the output terminal to be switched between the HVMCU and the HVSMU. The HVSMU output can be routed either directly or through a 100 kΩ resistor.

Output Terminals:

High (HV Triaxial)
Low (BNC)

Maximum output:

HVSMU : ±3000 V/4 mA, ±1500 V/8 mA
HVMCU : Refer to HVMCU specification

HVMCU

Output Peak Power	
Voltage range	Peak power
± 2200 V	600 W
± 1500 V	900 W

Voltage range, resolution, and accuracy				
Voltage range	Setting resolution	Measure resolution	Setting accuracy[1, 2, 3] ±(% + V)	Measure accuracy[1, 2] ±(% + V)
± 2200 V	3 mV	3 mV	±(5 + 20)	±(0.8 + 1.8)
± 1500 V	1.5 mV	3 mV	±(5 + 20)	±(0.8 + 1.8)

1. ±(% of reading value + fixed offset in V)
2. Accuracy is defined with 100 μs pulse at 1.1 A range and 2.5 A range, 1 ms pulse at 100 mA range.
3. Setting accuracy is defined at open load.

Current range, resolution, and accuracy[1, 2]		
Current range	Measure resolution	Measure accuracy[1] ±(% + A + A)
± 2.5 A	4 μA	±(0.9 + 4E-3 + Vo x 3E-7)
± 1.1 A	4 μA	±(0.9 + 4E-3 + Vo x 3E-7)
± 110 mA	200 nA	±(0.9 + 2E-4 + Vo x 3E-7)

1. Supplemental characteristics over 1.1 A.
2. Applicable condition: 20 averaging samples

HVMCU Pulse width and resolution		
Output range	Pulse width	Resolution
1500 V / 2.5 A	10 µsec – 100 µsec	2 µsec
2200 V / 1.1 A	10 µsec – 100 µsec	2 µsec
2200 V / 110 mA	10 µsec – 1 msec	2 µsec

Other Terminals / Indicators

Digital I/O Input: 1ea.
Digital I/O output: 1ea.
Power indicator: 1ea
Selector indicator: 1ea

Supplemental characteristics

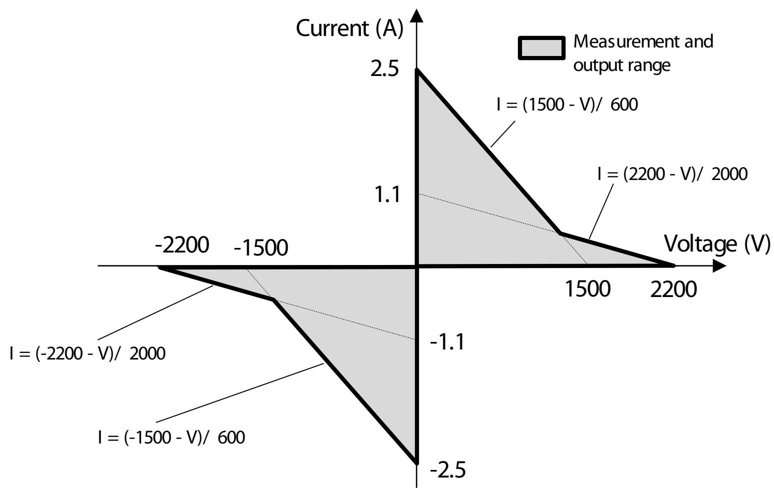
HVMCU Charged Capacitance: 0.22 µF

Output resistance	
Output range	Nominal value
1500 V / 2.5 A	600 Ω
2200 V / 1.1 A	2000 Ω
2200 V / 110 mA	20000 Ω

Leakage

Selector output
HVSMU: less than 80 pA

HVMCU Measurement and output range



The HVMCU's output is only available in pulsed mode.

In the equations in the above diagram, 'I' stands for current, 'V' for Voltage and 'Rdut' stands for the impedance of the device under test.

UHV (Ultra High Voltage) Expander (N1268A) Specifications

Specifications

Voltage range, resolution, and accuracy[1]				
Voltage range	Force resolution	Measure resolution	Setting accuracy[2, 3] ±(% + V)	Measure accuracy[2] ±(% + V)
± 10 kV	10 mV	10 mV	±(1.2 + 42)	±(1.2 + 42)

1. N1268A is controlled and makes measurement with two MCSMUs or a combination of a HCSMU and a MCSMU.
2. ±(% of reading value + fixed offset in V)
3. Setting accuracy is defined at open load.

Current range, resolution, and accuracy[1]		
Current range	Measure resolution	Measure accuracy[2] ±(% + A + A)
± 10 μA	10 pA	±(0.06 + 2E-9 + 1E-9)
± 100 μA	100 pA	±(0.06 + 2E-8 + 1E-9)
± 1 mA	1 nA	±(0.06 + 2E-7 + 1E-9)
± 10 mA	10 nA	±(0.06 + 2E-6 + 1E-9)
± 100 mA[3]	100 nA	±(0.06 + 20E-6 + 1E-9)

1. N1268A is controlled and makes measurement with two MCSMUs or a combination of a HCSMU and a MCSMU.
2. ±(% of reading value + fixed offset in A + fixed offset in A)
3. Pulsed mode only (Maximum pulse width is 1 ms). The maximum current is 20 mA.

UHV Pulse width and resolution		
Output range	Pulse width	Resolution
100 mA	100 μs to 1 ms	2 μs
≤ 10 mA	100 μs to 2 s	2 μs

Pulse Period

Min: 10 ms
Max: 5 s

Output Terminals

High : UHV coaxial
Low : SHV

Other Terminals / Indicators

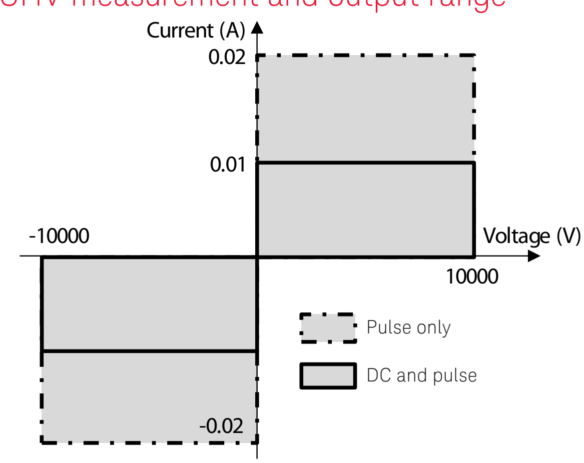
Digital I/O Input: 1ea.
Power indicator: 1ea
High Voltage indicator: 1ea
Interlock terminal Input: 1ea
Interlock terminal Output: 1ea
Earth terminal: 1ea

Supplemental characteristics

UHVU Output resistance	
Output range	Nominal value
High	10000 Ω
Low	1000 Ω

Other AC characteristics	
Slew rate	100 V/μs (with 1m cable)
Overshoot	±1% of setting voltage
Ripple	3 Vp-p
Maximum load capacitance	5 nF
Maximum load inductance	5 μH

UHV measurement and output range



N1267A High Voltage Source Monitor Unit / High Current Source Monitor Unit Fast Switch

Features

The N1267A supports fast switching between the HVSMU and HCSMU to enable the measurement of the Gallium Nitride current collapse effect.

The N1267A switch requires one MCSMU in the B1505A mainframe for control. The gate of the DUT (Device Under Test) can be driven by either an MCSMU or an HCSMU.

Note #1: The N1267A can only be used with the B1513B HVSMU; it cannot be used with the B1513A HVSMU.
Note #2: The N1267A does not support the two HCSMU 40 A configuration.
Note #3: The N1267A does not support the N1265A test fixture/current expander.

Specifications

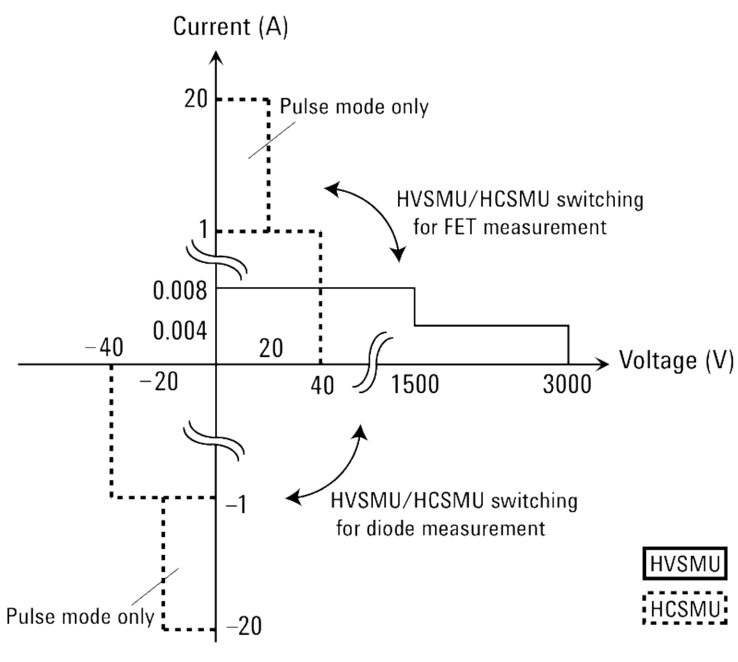
Input terminals:
HVSMU port, 1ea (HV triaxial)
HCSMU port, 1ea (Force: BNC, Sense: Triaxial)
MCSMU port, 1ea (Force/Sense: Triaxial)
GND port, 1ea (Triaxial)
Output terminals: High (HV triaxial), Low (BNC)
Maximum current: 20 A
Maximum voltage: 3000 V

Measurement mode

GaN Current collapse (Dynamic I-V) measure mode
1. I-V time domain measurement
2. I-V trace measurement

Static characteristics mode
1. Id-Vds, Vf-If measurement
2. Id(off)-Vds, Vr-Ir measurement

Source and Measure Range



GaN current collapse measure mode

To make the GaN current collapse measurement, the HVSMU first applies high voltage stress to the DUT when the DUT is in the OFF-state. Next the HVSMU performs voltage measurement and the HCSMU performs I-V measurement to monitor the ON-state characteristics of the DUT. When making the ON-state measurement, the HVSMU is measuring voltage and both the HVSMU and HCSMU are used to measure the total current.

HVSMU Source setting range for OFF-state	
Voltage	Current
+1 V - +3000 V [1]	4 mA (V > 1500 V), 8 mA (V ≤ 1500 V)

[1] *Setting value must be the ON state voltage plus 1 V or more.*

HCSMU source setting range for ON-state		
Voltage	Current	
0 V - ±40 V [2]	Maximum	Minimum
	20A pulse (V ≤ 20V) / 1A DC	20 mA [3]

[2] *Voltage actually applied to the device under test (DUT) is the setting value minus the voltage drop of the switch.*
[3] *Sum of HCSMU output current and HVSMU output current flow into DUT.*

Minimum voltage measurement resolution for OFF-state: 200 μV
Minimum current measurement resolution for ON-state: 100 nA
Minimum transition time (OFF to ON): 20 μs
Duration setting for OFF-state: 10 ms - 655.35
Sampling rate: 2 μs to 12 μs for current, 6 μs for voltage
Minimum ON state duration: 50 μs

Static characteristics mode

The following information applies to measurement of the DUT ON-state static characteristics. The N1267A ensures that the DUT is in the ON-state during these measurements. The HVSMU applies 0 V with 1 μA compliance and measures Vds or Vf. At the same time, the HCSMU is also performing an I-V measurement. The Id or If is determined by adding together the total current measured by both the HCSMU and the HVSMU.

HCSMU source setting for Id-Vds, Vf-If measurement		
Voltage	Current	
0 V - ±40 V	Maximum	Minimum
	20A pulse (V ≤ 20V) / 1A DC	20 mA [4]

Minimum voltage measurement resolution: 200 μV
Minimum current measurement resolution: 10 pA [4])
[4] *Offset error for the Id-Vds, If-Vf measurement is typical 1 μA*

The following information applies to measurement of the DUT OFF-state static characteristics. The N1267A ensures that the DUT is in the OFF-state during these measurements. The HCSMU applies 0 V. At the same time, the HVSMU performs I-V measurement and measures Vds or Vr. The Id(Off) or Ir is determined by adding together the total current measured by both the HCSMU and the HVSMU.

HVSMU source setting for Id(off)-Vds, Vr-Ir measurement		
Voltage	Current	
0 V - +3000V	Maximum	Minimum
	4 mA (V > 1500 V), 8 mA (V ≤ 1500 V)	10 μA [5]

Minimum voltage measurement resolution: 200 μV
Minimum current measurement resolution: 10 pA [5])
[5] *Leak error for the Idss, Ir-Vr measurement is typical 2 nA.*

Accessories

N1258A module selector

Specifications

Input terminals:
- HPSMU force port[1], 1 ea., (Triaxial)
- HPSMU sense port[1], 1 ea., (Triaxial)
- HCSMU force port, 1 ea. (BNC)
- HCSMU sense port, 1 ea. (Triaxial)
- HVSMU port[2], 1 ea. (HV triaxial)
- GNDU port, 1 ea. (Triaxial)
- Digital I/O port, 1 ea. (D-sub 25 pin)
- AC power line connector, 1 ea.

1. Either HPSMU or MPSMU can be connected to HPSMU port.
2. Either HVSMU or HVMCU can be connected to HVSMU port.

Output terminal:
- High force (HV triaxial)
- High sense (HV triaxial)
- Low force (BNC)
- Low sense (BNC)
- External relay control output (D-sub 25 pin)

Protection:
- HPSMU, GNDU, HCSMU Low Force

Power indicator:
- LED turns yellow when AC power is applied and turns green the module selector is ready to use.

Status indicator:
- Green LED lights to indicate the present connection path of module selector; Open, HCSMU, HPSMU, or HVSMU.

Maximum voltage/current:
- For HPSMU port:
  - ±200 V/1 A
- For HCSMU port:
  - ±40 V/2 A, ±20 V/30 A (Pulse width 1 ms, duty 1%)
- For HVSMU port:
  - ±3000 V/4 mA, ±1500 V/2.5 A, ±2200 V/1.1 A

Supplemental characteristics

Leakage current:
- For HPSMU:
  - 10 pA at 200 V
- For HCSMU:
  - 100 pA at 10 V (High Force to Low Force, High Sense to Low Sense)
- For HVSMU:
  - 10 pA at 1500 V (humidity range: 20% to 70% RH)
  - 20 pA at 3000 V (humidity range: 20% to 50% RH)

N1259A test fixture

Specifications

Input terminals:
- HPSMU port[1], 2 ea.
  - Force, sense (Triaxial)
- HCSMU port, 2 ea.
  - Force (BNC), sense (Triaxial)
- HVSMU port[2], 1 ea. (HV triaxial)
- GNDU port, 1 ea. (Triaxial)
- AUX port, 2 ea. (BNC)
- Interlock port, 1 ea.

1. Either HPSMU or MPSMU can be connected to HPSMU port.
2. Either HVSMU or HVMCU can be connected to HVSMU port.

Protection:
- HPSMU, GNDU, HCSMU Low Force terminal

High voltage indicator:
- LED turns red when a SMU output voltage is over 42 V.

Maximum voltage/current:
- For HPSMU port:
  - Force: ±200 V/1 A
  - Sense: ±200 V
- For HCSMU port:
  - High Force: ±40 V/2 A, ±20 V/40 A (Pulse width 1 ms, duty 1%)
  - Low Force: ±40 V/2 A, ±20 V/40 A (Pulse width 1 ms, duty 1%)
  - High Sense: ±40 V
  - Low Sense: ±40 V
- For HVSMU port:
  - Force: ±3000 V/4 mA, ±1500 V/2.5 A, ±2200 V/1.1 A

Note: The total power consumption of all modules cannot exceed 50 W when using test fixture under the condition that operating temperature is more than 35 °C.

Supplemental characteristics

Leakage current:
- For HPSMU (Force, Sense) port:
  - 10 pA at 200 V (Force, Sense)
- For HCSMU (High Force, High sense) port: 100 pA at 10 V
- For HVSMU (Force) port:
  - 10 pA at 1500 V (humidity range: 20% to 70% RH)
  - 20 pA at 3000 V (humidity range: 20% to 50% RH)

N1259A-010 inline package socket module (3 pin)

Specifications

Number of terminal:
- Sockets, 6 ea. (Ø4 mm jack (banana))

DUT interface:
- Inline package socket (3-pin)

Maximum voltage for terminals:
- 3000 Vdc

N1259A-011 universal socket module

Specifications

Number of terminal:
- Sockets, 8 ea. (Ø4 mm jack (banana))

Maximum voltage for terminals:
- 3000 Vdc

N1259A-013 Curve Tracer test adapter socket module

Specifications

Number of terminals:
 Sockets, 6 ea.
 (Ø4 mm jack (banana))
Test adapter interface:*
 Sockets, 6 ea.
 (Ø4 mm jack (banana))
Maximum voltage at terminals:
 3000V Vdc
Maximum current for terminals:
 For Collector/Drain Force and Emitter/Source Force
 39 A (DC), 500 A (Pulse)
 For others
 1A (DC), 20 A (Pulse)

*A test adapter for Tektronix curve tracers (370B/371B) can be connected to this interface.

N1259A-020 high voltage bias-tee

Specifications

Input terminals:
 DC bias input, 1 ea.
 (Ø4 mm jack (banana))
 MFCMU port, 1 ea.
 Hcur, Hpot, Lcur, Lpot, (BNC)
 Guard input, 1ea (Ø4 mm banana jack)
Output terminal:
 MFCMU port
 High (SHV)
 Low (SHV)
External DC bias voltage: ±3000 V
Frequency:
 10 kHz to 1 MHz (150 Ω at 10 kHz)
Series capacitance: 110 nF ±5%
Input resistance: 100 kΩ ±1%

N1259A-021 1 MΩ resistor box

Specifications

Input/output terminals:
 Ø4 mm jack (banana), 1 ea.
Resistance: 1 MΩ ±5%
Maximum voltage: ±3000 V
Power rating: 9 W

Supplemental characteristics

Leakage current: 10 pA at 100 V

N1259A-022 100 kΩ resistor box

Specifications

Input/output terminals:
 Ø4 mm jack (banana), 1 ea.
Resistance: 100 kΩ ±5%
Maximum voltage: ±3000 V
Power rating: 6.4 W

Supplemental characteristics

Leakage current: 10 pA at 100 V

N1259A-030 1 kΩ resistor box for gate

Specifications

Input/output terminals:
 Ø4 mm jack (banana), 1 ea.
Resistance: 1 kΩ ±10%
Maximum voltage: ±200 V
Maximum power: 1 W

Supplemental characteristics

Leakage current: 10 pA at 100 V

N1259A-035 Universal resistor box

Specifications

Input/output terminals:
 Ø4 mm banana jack, 1 ea.
Resistance: Installed by a user
Maximum voltage for terminals:
 ±3000 V

N1259A-300 module selector for test fixture

Specifications

Input terminals:
 HPSMU port[1], 1 ea.
 Force, sense (Triaxial)
 HCSMU port, 1 ea.
 Force (BNC), sense (Triaxial)
 HVSMU port[2], 1 ea. (HV triaxial)
 GNDU port, 1 ea. (Triaxial)
 Digital I/O port, 1 ea. (D-sub 25 pin)
 AC power line connector, 1 ea.

1. Either HPSMU or MPSMU can be connected to HPSMU port.
2. Either HVSMU or HVMCU can be connected to HVSMU port.

Output terminal:
 High force and guard
 High sense and guard
 Low force
 Low sense
 (Ø4 mm jack (banana))
Protection:
 HPSMU, GNDU, HCSMU Low Force
Power indicator:
 LED turns yellow when AC power is applied and turns green the module selector is ready to use.
Status indicator:
 Green LED lights to indicate the present connection path of module selector; Open, HCSMU, HPSMU, or HVSMU.
Maximum voltage/current:
 For HPSMU port:
 ±200 V/1 A
 For HCSMU port:
 ±40 V/2 A, ±20 V/30 A
 (Pulse width 1 ms, duty 1%)
 For HVSMU:
 ±3000 V/4 mA,
 ±1500 V/2.5 A, ±2200 V/1.1 A

Supplemental characteristics

Leakage current:
 For HPSMU:
 10 pA at 200 V
 For HCSMU:
 100 pA at 10 V (High Force to Low Force, High Sense to Low Sense)
 For HVSMU:
 10 pA at 1500 V (humidity range: 20% to 70% RH)
 30 pA at 3000 V (humidity range: 20% to 50% RH)

N1260A high voltage bias-tee

Specifications

Input terminals:
HVSMU port, 1 ea. (HV triaxial)
MFCMU port, 1 ea.
(4 BNC, Hp, Hc, Lp, Hc)
Output terminal:
H-AC Guard (SHV connector)
L-AC Guard (SHV connector)
External DC bias voltage: ±3000 V
Frequency:
10 kHz to 1 MHz (150 Ω at 10 kHz)
Series capacitance: 110 nF ±5%
Input resistance: 100 kΩ ±1%

N1261A protection adapter

N1261A-001 protection adapter for HPSMU (triaxial output)

Specifications

Input terminals:
Force (Triaxial)
Sense (Triaxial)
Output terminals:
Force (Triaxial)
Sense (Triaxial)

1. Either the HPSMU or the MPSMU can be connected to HPSMU port.

Supplemental characteristics

Leakage current: 10 pA at 200 V

N1261A-002 protection adapter for GNDU (BNC output)

Specifications

Input terminals:
Force/Sense (Triaxial)
Output terminals:
Force (BNC)
Sense (BNC)

N1261A-003 protection adapter for HPSMU (HV triaxial output)

Specifications

Input terminals[1]:
Force (Triaxial)
Sense (Triaxial)
Output terminals:
Force (HV triaxial)
Sense (HV triaxial)

1. Either the HPSMU or the MPSMU can be connected to HPSMU port.

Supplemental characteristics

Leakage current: 10 pA at 200 V

N1261A-004 protection adapter for GNDU (SHV output)

Specifications

Input terminals:
Force/Sense (Triaxial)
Output terminals:
Force (SHV)
Sense (SHV)

N1262A Resistor Box

N1262A-001 1 MΩ resistor box

Specifications

Input terminals:
HVSMU port, 1 ea. (HV triaxial)
Output terminals:
SHV connector, 1 ea.
Resistance: 1 MΩ ±5%
Maximum voltage: ±3000 V
Maximum power: 9 W

Supplemental characteristics

Leakage current:
10 pA at 100 V

N1262A-002 100 kΩ resistor box

Specifications

Input terminals:
HVSMU port, 1 ea. (HV triaxial)
Output terminals:
SHV connector, 1 ea.
Resistance: 100 kΩ ±5%
Maximum voltage: ±3000 V
Maximum power: 6.4 W

Supplemental characteristics

Leakage current: 10 pA at 100 V

N1262A-010 1 kΩ resistor box for gate (triaxial output)

Specifications

Input terminals:
Triaxial connector, 1 ea.
Output terminals:
Triaxial connector, 1 ea.
Resistance: 1 kΩ ±10%
Maximum voltage: ±200 V
Maximum power: 1 W

Supplemental characteristics

Leakage current: 10 pA at 100 V

N1262A-011 1 kΩ resistor box for gate (SHV output)

Specifications

Input terminals:
HV triaxial connector, 1 ea.
Output terminals:
SHV connector, 1 ea.
Resistance: 1 kΩ ±10%
Maximum voltage: ±3000 V
Maximum power: 1 W

Supplemental characteristics

Leakage current: 10 pA at 100 V

N1262A-020 Universal resistor box, Triaxial

Specifications

Input terminals:
Triaxial connector, 1 ea.
Output terminals:
Triaxial connector, 1 ea.
Resistance: Installed by user
Maximum voltage for terminals: ±200 V

N1262A-021 Universal resistor box, HV Triaxial to SHV

Specifications

Input terminals:
  HVSMU port, 1 ea. (HV triaxial)
Output terminals:
  SHV connector, 1 ea.
Resistance: Installed by user
Maximum voltage for terminals:
±3000 V

N1262A-023 Universal resistor box for Ultra High Voltage

Specifications

Input terminals:
  UHV coaxial connector, 1 ea.
Output terminals:
  UHV coaxial connector, 1 ea.
Resistance: Installed by user
Maximum voltage for terminals:
±10 kV

N1262A-036 50 Ohm Termination Adapter

Specifications

Input terminal (BNC)
Output terminal (BNC)
Maximum power: 1 W

Accessories for N1265A

N1254A-524 500 A Ultra High Current Prober System Cable

Specifications

Input terminals: 8 ea. (Ø4 mm jack (banana))
  Selector Output
    High Force
    High Sense
    Low Force
    Low Sense
    Guard
  Gate output
    High Force
    Low Force
  Chassis
Output terminals
    High Force (Ø4 mm jack (banana))
    Low Force (Ø4 mm jack (banana))
    High Sense (HV triaxial)
    Low Sense (BNC)
    Gate (BNC)
Maximum voltage / current
  For High Force
    ±3000 V/39 A (DC), 500 A (Pulse)
  For Low Force
    ±200 V/39 A (DC), 500 A (Pulse)
  For High Sense
    ±3000 V/1 A
  For Low Sense, Gate
    ±200 V/1 A

N1265A-010 500 A Ultra High Current 3-pin Inline Package Socket Module

Specifications

Number of terminal:
  Sockets, 6 ea. (Ø4 mm jack (banana))
  DUT interface:
  Inline package socket (3-pin)
  Maximum voltage for terminals:
    3000 Vdc
Maximum current for terminals:
  For Force
    39 A (DC), 500 A (Pulse)
  For sense
    1A (DC), 20 A (Pulse)

N1265A-011 Universal Socket Module

Specifications

Number of terminal:
  Sockets, 6 ea. (Ø4 mm jack (banana))
Maximum voltage for terminals:
  3000 Vdc
Universal blank area :
  90 mm (W) x 81 mm (D)

N1265A-013 Curve Tracer Test Adapter Socket Module

Specifications

Number of terminals: Sockets, 6 ea.
  (Ø4 mm jack (banana))
Test adapter interface:*
  Sockets, 6 ea. (Ø4 mm jack (banana))
Maximum voltage at terminals:
  3000V Vdc
Maximum current for terminals:
  For Collector/Drain Force and Emitter/Source Force
    39 A (DC), 500 A (Pulse)
  For others
    1A (DC), 20 A (Pulse)
*A test adapter for Tektronix curve tracers (370B/371B) can be connected to this interface.

N1265A-035 Universal R-Box for N1265A

Specifications

Input: 4 ea. (Ø4 mm plug (banana))
  High (Force, Sense)
  Low (Force, Sense)
Output terminals: 2 ea. (Ø4 mm jack (banana))
  High, Low
Resistance: Installed by a user
Maximum voltage for terminals: ±200 V

N1265A-040 10 kV Ultra High Voltage Gate Protection Adapter

Specifications

Input: 4 ea. (Ø4 mm plug (banana))
  High (Force, Sense)
  Low (Force, Sense)
Output terminals: 2 ea. (Ø4 mm jack (banana))
  High, Low
Maximum voltage: ±200 V
Maximum surge voltage: ±10 kV

N1265A-041 Thermocouple, Type K, 2 ea

Feature

N1265A-041 can be connected to Thermocouple terminal inside the N1265A and enables B1505A to read out temperature at the top of the thermocouple.

Specifications

Connector: Type K plug
Length: 3000 mm
Temperature range: -50 °C to +180 °C

N1265A-045 Container for Protection Adapter and Bias Tee

Feature

N1265A-045 can accommodate protection adapters and bias tee which are used with N1265A to make the measurement environment clean and safe

Specifications

Dimension: 420 mm W x 193 mm H x 565 mm D
Weight: 15 kg
Maximum superimposed load: 50 kg

N1269A Ultra High Voltage Connection Adapter

Feature

To make the connection simple and to protect measurement resources from unexpected surge when connecting UHVU to wafer prober.

Specifications

Input terminals:
- Gate MCSMU Force, 1ea (Triaxial)
- Gate MCSMU Sense, 1ea (Triaxial)
- Chuck MCSMU Force, 1ea (Triaxial)
- Chuck MCSMU Sense, 1ea (Triaxial)
- UHV Low, 1ea (HV triaxial)

Output terminals: 3ea (SHV)
- Gate, Chuck, Source

Maximum voltage: ±200 V
Maximum surge voltage: ±10 kV

Keysight EasyEXPERT Software

Keysight EasyEXPERT, resident GUI-based software running on the B1505A's embedded Windows 7 platform, supports efficient and repeatable device characterization ranging from interactive manual measurements all the way up to test automation across a wafer in conjunction with an automatic wafer prober. With hundreds of ready-to-use measurements (application tests) furnished at no charge, EasyEXPERT makes it easy to perform complex device characterization immediately. The EasyEXPERT GUI can be accessed using the B1505A's 15-inch touch screen, as well as through an optional USB keyboard and mouse. EasyEXPERT also allows you the option of storing the test conditions and measurement data automatically after each measurement into unique workspaces. This ensures that valuable information is not lost and that measurements can be repeated at a later date. Finally, EasyEXPERT has built-in analysis capabilities and a graphical programming environment that facilitate the development of complex testing algorithms.

Key features:
- Ready-to-use application test library
- Multiple measurement modes (application test, classic test, tracer test, oscilloscope view and quick test)
- Multiple measurement functions (spot, sweep, time sampling, C-V, C-f, C-t, etc.)
- Data display, analysis and arithmetic functions
- Workspace and data management
- External instrument control
- Multiple programming methods (EasyEXPERT remote control and FLEX GPIB control)
- Multiple interface (USB, LAN, GPIB and digital I/O)

Application library

EasyEXPERT comes with over 40 application tests conveniently organized by device type, application, and technology. You can easily edit and customize the furnished application tests to fit your specific needs. Application tests are provided for the following categories; they are subject to change without notice.

Device Type	Application Tests
Power MOSFET (Si, GaN)	Id-Vds, Rds-Id, Id-Vgs, Vth, Cgs, Cds, Cgd, Current collapse, Breakdown, QSCV, etc.
IGBT	Ic-Vce, Ic-Vge, Vth, Cge, Cce, Cgc, Breakdown, etc.
SiC	Id-Vds, Rds-Id, Id-Vgs, Vth, Cgs, Cds, Cgd, Breakdown, QSCV, etc.
Power BJT	Ic-Vce, Vce(sat), Ic-Vcbo, Ic-Vceo, Ie-Vbeo, etc.
Power Diode	If-Vf, Ir-Vr, Cj-Vr, etc.
Capacitor	C-V, C-f, C-t, leak-V, Breakdown, TDDB, etc.
And more	And more

Measurement modes and functions

Operation mode:

Application test mode

The application test mode provides application oriented point-and-click test setup and execution. An application test can be selected from the library by device type and desired measurement, and then executed after modifying the default input parameters as needed.

Classic test mode

The classic test mode provides function oriented test setup and execution with the same look, feel, and terminology of the 4155/4156 user interface. In addition, it improves the 4155/4156 user interface by taking full advantage of EasyEXPERT's GUI features.

Tracer test mode

The tracer test mode offers intuitive and interactive sweep control using a rotary knob similar to a curve tracer. Just like an analog curve tracer, you can sweep in only one direction (useful for R&D device analysis) or in both directions (useful in failure analysis applications). Test set ups created in tracer test mode can be seamlessly and instantaneously transferred to classic test mode for further detailed measurement and analysis.
Each SMU can sweep using VAR1 (primary sweep), VAR2 (secondary sweep), or VAR1' (synchronous sweep).

Oscilloscope view

The oscilloscope view (available in tracer test mode) displays measured current or voltage data versus time. The pulsed measurement waveforms appear in a separate window for easy verification of the measurement timings. This function is useful for verifying waveform timings and debugging pulsed measurements. The following modules are supported in this view: HCSMU, MCSMU, HVSMU, UHCU, HVMCU, and UHVU. The oscilloscope view can display the pulsed waveform timings at any (user specified) sweep step of the sweep output.

Sampling interval:
- 2 µs (HCSMU/MCSMU/UHCU/HVMCU/UHVU)
- 6 µs (HVSMU)

Sampling points:
- 2000 Sa (HCSMU/MCSMU/UHCU/HVMCU/UHVU)
- 4000 Sa (HVSMU)

Marker function:
- Read-out for each data channel
- Resolution: 2µs

Data saving:
- Numeric: Text/CSV/XMLSS
- Image: EMF/BMP/JPG/PNG

Quick test mode

A GUI-based Quick Test mode enables you to perform test sequencing without programming. You can select, copy, rearrange and cut-and-paste any application tests with a few simple mouse clicks. Once you have selected and arranged your tests, simply click on the measurement button to begin running an automated test sequence.

Measurement modes:

The Keysight B1505A supports the following measurement modes:

–IV measurement
- Spot
- Staircase sweep
- Pulsed spot
- Pulsed sweep
- Staircase sweep with pulsed bias
- Sampling
- Multi-channel sweep
- Multi-channel pulsed sweep
- List sweep
- Linear search[1]
- Binary search[1]

–C measurement
- Spot C
- CV (DC bias) sweep
- Pulsed spot C
- Pulsed sweep CV
- C-t sampling
- C-f sweep
- CV (AC level) sweep
- Quasi-Static CV (QSCV)

1. Supported only by FLEX commands.

Sweep measurement

Number of steps: 1 to 10001 (SMU), 1 to 1001 (CMU)
Sweep mode: Linear or logarithmic (log)
Sweep direction: Single or double sweep
Hold time:
- 0 to 655.35 s, 10 ms resolution

Delay time:
- 0 to 65.535 s, 100 µs resolution
- 0 to 655.35 s, 100 µs resolution (CV (AC level) sweep, C-f sweep)

Step delay time:
- 0 to 1 s, 100 µs resolution

Step output trigger delay time:
- 0 to (delay time) s, 100 µs resolution

Step measurement trigger delay time:
- 0 to 65.535 s, 100 µs resolution

Sampling (time domain) measurement

Displays the time sampled voltage/current data (by SMU) versus time.

Sampling channels: Up to 10

Sampling mode: Linear, logarithmic (log)

Sampling points:

For linear sampling:

1 to 100,001/(number of channels)

For log sampling:

1 to 1+ (number of data for 11 decades)

Sampling interval range:

100 μs to 2ms, 10μs resolution

2 ms to 65.535 s, 1 ms resolution

For < 2ms, the interval is ≥ 100 μs +20 μs x (num. of channels – 1)

Hold time, initial wait time:

-90 ms to -100 μs, 100 μs resolution

0 to 655.35 s, 10 ms resolution

Measurement time resolution: 100 μs

Other measurement characteristics

Measurement control

Single, repeat, append, and stop

SMU setting capabilities

Limited auto ranging, voltage/current compliance, power compliance, automatic sweep abort functions, self-test, and self-calibration

Standby mode

SMUs in "Standby" remain programmed to their specified output value even as other units are reset for the next measurement.

Bias hold function

This function allows you to keep a source active between measurements. The source module will apply the specified bias between measurements when running classic tests inside an application test, in quick test mode, or during a repeated measurement. The function ceases as soon as these conditions end or when a measurement that does not use this function is started.

Current offset cancel

This function subtracts the offset current from the current measurement raw data, and returns the result as the measurement data. This function is used to compensate the error factor (offset current) caused by the measurement path such as the measurement cables, manipulators, or probe card.

Time stamp

The B1505A supports a time stamp function utilizing an internal quartz clock.

Resolution: 100 μs

Data display, analysis and arithmetic functions

Data Display

X-Y graph plot

X-axis and up to eight Y-axes, linear and log scale, real time graph plotting. X-Y graph plot can be printed or stored as image data to clip board or mass storage device. (File type: bmp, gif, png, emf)

Scale:

Auto scale and zoom

Marker:

Marker to min/max, interpolation, direct marker, and marker skip

Cursor:

Direct cursor

Line:

Two lines, normal mode, grad mode, tangent mode, and regression mode.

Overlay graph comparison:

Graphical plots can be overlaid.

List display

Measurement data and calculated user function data are listed in conjunction with sweep step number or time domain sampling step number. Up to 20 data sets can be displayed.

Data variable display

Up to 20 user-defined parameters can be displayed on the graphics screen.

Automatic analysis function

On a graphics plot, the markers and lines can be automatically located using the auto analysis setup. Parameters can be automatically determined using automatic analysis, user function, and read out functions.

Analysis functions

Up to 20 user-defined analysis functions can be defined using arithmetic expressions. Measured data, pre-defined variables, and read out functions can be used in the computation. The results can be displayed on the LCD.

Read out functions

The read out functions are built-in functions for reading various values related to the marker, cursor, or line.

Arithmetic functions

User functions

Up to 20 user-defined functions can be defined using arithmetic expressions.

Measured data and pre-defined variables can be used in the computation. The results can be displayed on the LCD.

Arithmetic operators

+, -, *, /, ^, abs (absolute value), at (arc tangent), avg (averaging), cond (conditional evaluation), delta, diff (differential), exp (exponent), integ (integration), lgt (logarithm, base 10), log (logarithm, base e), mavg (moving average), max, min, sqrt, trigonometric function, inverse trigonometric function, and so on.

Physical constants

Keyboard constants are stored in memory as follows:

q: Electron charge, 1.602177E-19 C

k: Boltzmann's constant, 1.380658E-23

ε (e): Dielectric constant of vacuum, 8.854188E-12

Engineering units

The following unit symbols are also available on the keyboard:

a (10^{-18}), f (10^{-15}), p (10^{-12}), n (10^{-9}), u or μ (10^{-6}), m (10^{-3}), k (10^{3}), M (10^{6}), G (10^{9}), T (10^{12}) , P (10^{15})

Workspace and data management

Workspace

Workspaces are separate work environments residing on the B1505A's internal hard disk drive. Every workspace supports the following features:

– Setup and execute the measurement

– Save/Recall"My Favorite Setups"

– Save/Recall measurement data and settings

– Import/Export device definition, measurement settings, my favorite setup, measurement data, and application library

– Test result data management

– Private/public accessibility setting

Data auto record / auto export

EasyEXPERT has the ability to automatically store the measurement setup and data within a workspace. It can also export measurement data in real time, in a variety of formats. You can save data to any storage drive connected to the instrument's PC.

Import/export files

File type:

Keysight EasyEXPERT format, XML-SS format, CSV format

Workspace management

The EasyEXPERT has the ability to import/export a workspace for back-up and portability.

External instrument control

External instruments supported by application tests:

Keysight 4284A/E4980A, 81110A, 3458A

Prober control

Popular semi- or full-automatic wafer probers are supported by EasyEXPERT. You can define wafer, die, and module information for probing across an entire wafer. You can also combine wafer prober control with either Quick Test mode or an application test based test sequence to perform multiple testing on various devices across the wafer.

Program and interface capabilities

Data storage

Hard disk drive, DVD-R drive

Interfaces

GPIB, interlock, USB (USB 2.0, front 2, rear 2), LAN (1000BASE-T/100BASE-TX/10BASE-T), trigger in/out, digital I/O, VGA video output

Remote control capabilities

– FLEX commands (GPIB)

– EasyEXPERT remote control function (LAN)

Trigger I/O

This feature is only available using GPIB FLEX commands.

Trigger in/out synchronization pulses before and after setting and measuring DC voltage and current. Arbitrary trigger events can be masked or activated independently.

Furnished software

– Prober control execution files

– Desktop EasyEXPERT software

– 4155/56 setup file converter tool

This tool can convert 4155 and 4156 measurement setup files (file extensions MES or DAT) into equivalent EasyEXPERT/Desktop EasyEXPERT classic test mode setup files.

– MDM file converter

This tool can convert data in the EasyEXPERT file formats (XTR/ZTR) to Keysight IC-CAP MDM file format.

Only the following Classic Mode measurements made using EasyEXPERT are supported:

- IV Sweep
- Multi-channel IV Sweep
- CV Sweep

Supported operating systems:

Microsoft Windows XP Professional (Service Pack 3 or later), Windows Vista Business (Service Pack 2 or later (32bit only)), and Windows 7 Professional (Service Pack 1 or later (32bit and 64bit))

Supported language: English (US))

Supported .NET Framework: Microsoft .NET Framework 3.5 SP1

Recommended GPIB I/F

		Interface	B1505A
Keysight	82350B	PCI	✓[1]
	82357A	USB	✓[2]
	82357B	USB	✓[2]
National Instrument	GPIB-USB-HS	USB	✓[2]

1. An 82350B card is highly recommended because of stability and speed.

2. USB GPIB interfaces might cause serial poll error intermittently due to the intrinsic communication scheme differences.

General specification

Temperature range

Operating: +5 °C to +40 °C
Storage: -20 °C to +60 °C

Humidity range[1]

Operating: 20% to 70% RH, non-condensing
Storage: 10% to 90% RH, non-condensing
Storage: 20% to 80% RH, non-condensing (N1268A)

Altitude

Operating: 0 m to 2,000 m (6,561 ft)
Storage: 0 m to 4,600 m (15,092 ft)
0 m to 2,000 m (6,561 ft) (N1268A)

Power requirement

ac Voltage: 90 V to 264 V
Line Frequency: 47 Hz to 63 Hz

Maximum volt-amps (VA)

B1505A: 900 VA
N1258A: 65VA
N1259A-300: 35VA
N1265A: 400 VA
N1266A: 60 VA
N1268A: 350 VA

Acoustic Noise Emission

Lpa < 70 dB

About measurement accuracy

RF electromagnetic field and SMU measurement accuracy: SMU voltage and current measurement accuracy can be affected by RF electromagnetic field strengths greater than 3 V/m in the frequency range of 80 MHz to 1 GHz. The extent of this effect depends upon how the instrument is positioned and shielded.

Induced RF field noise and SMU measurement accuracy:
SMU voltage and current measurement accuracy can be affected by induced RF field noise strengths greater than 3 Vrms in the frequency range of 150 kHz to 80 MHz. The extent of this effect depends upon how the instrument is positioned and shielded.

Regulatory compliance

EMC:
  IEC 61326-1 / EN 61326-1
  Canada: ICES/NMB-001
  AS/NZS CISPR 11
Safety:
  IEC61010-1 / EN 61010-1
  CAN/CSA-C22.2 No. 61010-1

Certification

CE, cCSAus, C-Tick

Dimensions

B1505A:
  420 mm W x 330 mm H x 575 mm D
N1258A module selector:
  330 mm W x 120 mm H x 410 mm D
N1259A test fixture:
  420 mm W x 272 mm H x 410 mm D
N1260A High voltage bias-tee:
  164 mm W x 53 mm H x 125 mm D
N1261A-001 HPSMU protection adapter (Triaxial output):
  80 mm W x 40 mm H x 110 mm D
N1261A-002 GNDU protection adapter (BNC output):
  80 mm W x 40 mm H x 110 mm D
N1261A-003 HPSMU protection adapter (HV triaxial output):
  90 mm W x 40 mm H x 140 mm D
N1261A-004 GNDU protection adapter (SHV output):
  80 mm W x 40 mm H x 125 mm D
N1262A resister box:
  50 mm W x 40 mm H x 125 mm D
N1265A UHC expander / fixture:
  420 mm W x 285mm H x 575 mm D
N1266A HVSMU current expander:
  420 mm W x 75 mm H x 575 mm D
N1267A HVSMU / HCSMU fast switch:
  202 mm W x 56 mm H x 175 mm D
N1268A UHV expander:
  420 mm W x 222 mm H x 482 mm D
N1269A Ultra High Voltage Connection Adapter:
  134 mm W x 56 mm H x 150 mm D

Weight

B1505A (empty): 20 kg
B1511A: 1.1 kg
B1510A: 2.0 kg
B1512A: 2.1 kg
B1513B: 2.0 kg
B1514A: 1.3 kg
B1520A: 1.3 kg
N1258A: 5.0 kg
N1259A: 12.0 kg
N1260A: 0.6 kg
N1261A: 0.3 kg
N1262A: 0.3 kg
N1265A: 30 kg
N1266A: 10 kg
N1267A: 0.8 kg
N1268A: 18 kg
N1269A: 0.4 kg

Furnished accessories

Measurement cables and adapter
  Triaxial cable for HPSMU, MPSMU and MCSMU, 2 ea.
  HCSMU cable, 1 ea.
  HCSMU Kelvin adapter, 1 ea.
  HVSMU cable, 1 ea.
Interlock cable, 1 ea.
Ground unit cable, 1 ea.
Keyboard, 1 ea.
Mouse, 1 ea.
Stylus pen, 1 ea.
Power cable, 1 ea.
Manual CD-ROM, 1 ea.
Desktop EasyEXPERT CD-ROM, 1 ea.
License-to-use for EasyEXPERT and
  Desktop EasyEXPERT,
Software CD-ROM
  (including utility tools)
Disk set for Keysight
  4155B/4155C/4156B/4156C
  firmware update, 1 set
SMU number label for the B1505A
  installed with SMU, 1 sheet
N1258A : Digital I/O cable, 1 ea.
N1259A-300 : Digital I/O cable, 1 ea.
N1265A : Digital I/O cable, 1 ea.
N1266A : Digital I/O cable, 1 ea.
N1268A : Digital I/O cable, 1 ea., Interlock cable, 1 ea.

1. In case of some supplemental characteristics, humidity range is defined as 20% to 50% RH

Order Information

Mainframe and modules	
B1505A	Power Device Analyzer/Curve Tracer mainframe
	Configure the following modules: High power SMU (HPSMU) Medium power SMU (MPSMU) High current SMU (HCSMU) Medium current SMU (MCSMU) High voltage SMU (HVSMU) Multi frequency CMU (MFCMU)
B1505A-015	1.5 m cable
B1505A-030	3.0 m cable
B1505A-050	50 Hz line frequency
B1505A-060	60 Hz line frequency
B1505A-A6J	ANSI Z540 compliant calibration
B1505A-UK6	Commercial calibration certificate with test data
B1505A-ABA	English documentation
B1505A-ABJ	Japanese documentation
B1500A-1CM	Rackmount kit
B1505A expanders/fixtures	
N1259A	Test fixture
N1259A-010	Inline package socket module (3 pin)
N1259A-011	Universal socket module
N1259A-012	Blank PTFE board
N1259A-013	Curve Tracer test adaptor socket module
N1259A-020	High voltage bias-tee
N1259A-021	1 MΩ Resistor box
N1259A-022	100 kΩ Resistor box
N1259A-030	1 kΩ Resistor box for gate
N1259A-035	Universal R-Box
N1259A-300	Module selector
N1265A	UHC expander / fixture
N1265A-010	500 A Ultra High Current 3-pin Inline Package Socket Module
N1265A-011	Universal Socket Module
N1265A-013	Curve Tracer Test Adapter Socket Module
N1265A-015	1500 A Current Option
N1265A-035	Universal R-Box for N1265A
N1265A-040	10 kV Ultra High Voltage Gate Protection Adapter
N1265A-041	Thermocouple, Type K, 2 ea
N1265A-045	Container for Protection Adapter and Bias Tee
N1266A	High Voltage Source Monitor Unit Current Expander
N1267A	High Voltage Source Monitor Unit / High Current Source Monitor Unit Fast Switch
N1268A	Ultra High Voltage Expander

B1505A accessories	
16444A-001	Keyboard
16444A-002	Mouse
16444A-003	Stylus pen
N1253A-100	Digital I/O cable
N1253A-200	Digital I/O BNC box
N1254A-100	Ground unit Kelvin adapter
N1254A-101	Triaxial(m)-BNC(f)
N1254A-102	Triaxial(m)-BNC(m)
N1254A-103	Triaxial(m)-BNC(f)
N1254A-104	Triaxial(f)-BNC(m)
N1254A-105	Triaxial(f)-BNC(m)
N1254A-106	Triaxial(m)-BNC(f)
N1254A-107	Triaxial(m)-BNC(f)
N1254A-500	HV Jack Connector (Solder Type)
N1254A-501	HV Jack /Jack Adapter
N1254A-502	HV plug Connector(Solder Type)
N1254A-503	BNC Coax Cable Assy 1.5m(Open End)
N1254A-504	HVTriax Jack Coax Cable Assy 1.5m(Open End)
N1254A-505	HVTriax Plug Triax Cable Assy 1.5m (Open End)
N1254A-506	HVTriax Plug Coax Cable Assy 1.5m(Open End)
N1254A-507	HVTriax Plug Coax Cable Assy 1.5m
N1254A-508	Test Lead cable Black
N1254A-509	Test Lead cable Red
N1254A-510	Dolphin clip 2 ea. (red and black)
N1254A-511	Cable lag adapter 2 ea. (red and black)
N1254A-512	SHV Cable Assy 250mm
N1254A-513	SHV to Banana
N1254A-514	BNC-Plug Plug
N1254A-515	BNC-Jack-Plug-Jack
N1254A-516	BNC-Jack-Jack-Jack
N1254A-517	Adapter, Trixial Jack to Triaxial Plug
N1254A-518	SHV Cable 1.5 m
N1254A-520	10 kV Ultra High Voltage Open End Cable, 1 m.
N1254A-521	10 kV Ultra High Voltage Jack to Jack Adapter
N1254A-522	1500 A Ultra High Current Banana to Banana Cable, 2 ea.
N1254A-523	1500 A Ultra High Current Banana to Open End Cable, 1 m, 2 ea
N1254A-524	500 A Ultra High Current Prober System Cable
N1258A	Module selector
N1260A	High voltage bias-tee
N1261A	Protection adapter
N1262A	Resistor box
N1262A-020	Universal R-Box, Triaxial
N1262A-021	Universal R-Box, HV Triaxial to SHV
N1262A-023	Universal R-Box for Ultra High Voltage
N1262A-036	50 Ohm Termination Adapter

Order Information

SMU cables/accessories	
16493S-001	HCSMU cable (1.5 m)
16493S-002	HCSMU cable (3 m)
16493S-010	HCSMU Kelvin adapter
16493S-011	HCSMU non-Kelvin adapter
16493S-020	Dual HCSMU Kelvin combination adapter
16493S-021	Dual HCSMU combination adapter
16493T-001	High voltage triaxial cable (1.5 m)
16493T-002	High voltage triaxial cable (3 m)
16493U-001	High current BNC cable (1.5 m)
16493U-002	High current BNC cable (3 m)
16494A-001	Triaxial cable (1.5 m)
16494A-002	Triaxial cable (3 m)
16493K-001	Kelvin triaxial cable (1.5 m)
16493K-002	Kelvin triaxial cable (3 m)
16493V-001	10 kV Ultra High Voltage Cable, 1.5 m
16493V-002	10 kV Ultra High Voltage Cable, 3 m
N1269A	Ultra High Voltage Connection Adapter
CMU accessories	
N1300A-001	CMU cable (1.5 m)
N1300A-002	CMU cable (3 m)
Other accessories	
16493G-001	Digital I/O cable (1.5 m)
16493G-002	Digital I/O cable (3 m)
16493J-001	Interlock cable (1.5 m)
16493J-002	Interlock cable (3 m)
16493L-001	GNDU cable (1.5 m)
16493L-002	GNDU cable (3 m)

Retrofit and upgrade kits	
B1505AU	Upgrade kit for B1505A
B1505AU-001	Conversion kit from B1500A to B1505A
B1505AU-010	High power source monitor unit (B1510A)
B1505AU-011	Medium power source monitor unit (B1511A)
B1505AU-012	High current source monitor unit (B1512A)
B1505AU-013	High voltage source monitor unit (B1513B)
B1505AU-014	Medium current source monitor unit (B1514A)
B1505AU-020	Multi frequency capacitance measurement unit (B1520A)
B1505AU-SWS	EasyEXPERT Extension support and subscription
N1259AU	Upgrade kit for N1259A
N1265AU	Upgrade kit for N1265A
Package solution	
B1505AP	Pre-configured Power Device Analyzer/Curve Tracer (B1505A w/ modules/fixture)
B1505AP-H20	3 kV / 20 A / Fixture Pack
B1505AP-H21	3 kV / 20 A / C-V / Fixture Pack
B1505AP-H50	3 kV / 500 A / Fixture Pack
B1505AP-H51	3 kV / 500 A / C-V / Fixture Pack
B1505AP-H70	3 kV / 1500 A / Fixture Pack
B1505AP-H71	3 kV / 1500 A / C-V / Fixture Pack
B1505AP-U50	10 kV / 500 A / Fixture Pack
B1505AP-U70	10 kV / 1500 A / Fixture Pack

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