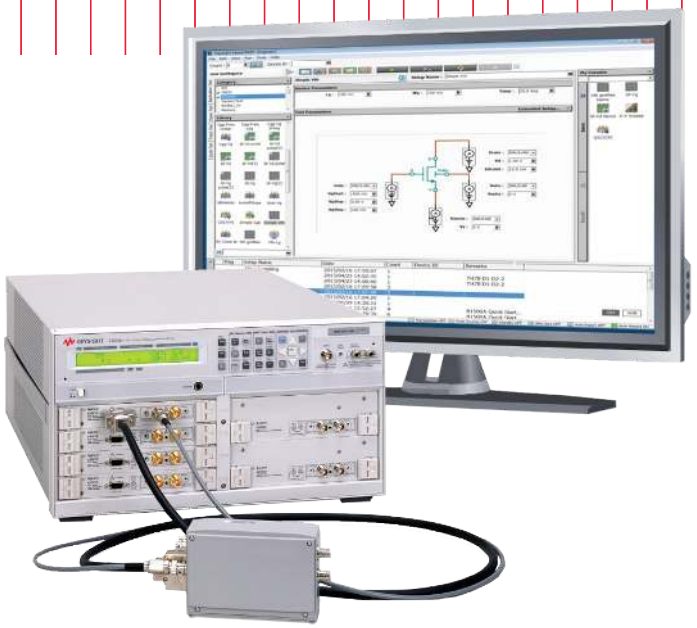
Keysight E5270B

Precision IV Analyzer/8 Slot Precision Measurement Mainframe

Technical Overview



KEYSIGHT TECHNOLOGIES

Unlocking Measurement Insights

Introduction

Keysight E5270B Precision IV Analyzer is the complete solution for current-voltage characterization of a wide range of materials and devices. The E5270B supports multiple SMUs (Source/Monitor Units) for voltage/current sourcing and voltage/current measurement with the best in the class current measurement performance as low as 0.1 fA. Its modular architecture allows you to configure or upgrade SMU modules for available eight slots. The EasyEXPERT group+ GUI based characterization software is furnished and available on your PC to support all the tasks required in the characterization from the measurement setup to the data analysis. Powerful integration of SMU's versatile measurement capabilities and GUI based characterization software makes the E5270B the best solution for characterization and evaluation of devices, materials, semiconductors, active/passive components, or virtually any other type of electronic device with uncompromised measurement reliability and efficiency.

Keysight EasyEXPERT group+ supports efficient and repeatable device characterization in the entire characterization process from measurement setup and execution to analysis and data management either by interactive manual operation or automation across a wafer in conjunction with a semiautomatic wafer prober. EasyEXPERT group+ makes it easy to perform current-voltage characterization immediately with the ready-to-use measurements (application tests) furnished, and allows you the option of storing test condition and measurement data automatically after each measurement in a unique built-in database (workspace), ensuring that valuable information is not lost and that measurements can be repeated at a later date. Keysight E5270B provides the complete solution for current-voltage characterization with these versatile capabilities.

In addition to using as an analyzer, the E5270B is available as a system component SMU for a rack and stuck test system. It provides the scalability and the highest measurement accuracy in the class for current-voltage measurement. It can be controlled remotely by the FLEX command set supporting the powerful measurement capabilities.

Basic features

Current-voltage measurement capabilities

- Accurate and precision measurement ranges of 0.1 fA – 1A and 0.5 µV – 200 V
- Spot and sweep measurement capabilities
- Pulse spot and sweep measurement with minimum 500 µs pulse width
- The ASU (atto-sense and switch unit) can be used with the HRSMU to provide 0.1 fA measurement resolution and SMU/AUX path switching

EasyEXPERT group+ software

- Characterization environment is available on user's PC
- Intuitive GUI based operation with keyboard and mouse operation
- Application Test mode provides the furnished ready-to-use application tests for quick measurement execution (Available application tests can be adapted to configured resources.)
- Classic test mode provides easy access to the instrument features
- Graphical display and analysis capabilities facilitate front-end data analysis without additional utilities and support report generation as image data or Excel data.
- Individualized built-in database (workspace) records test data automatically and simplifies the data management without annoying numerous data files.
- Quick test mode supports test sequencing without programming
- GUI-based control of the Keysight B2200A, B2201A and E5250A switching matrices
- EasyEXPERT remote control function supports the remote execution of application tests via the LAN interface
- Data back capability and various data protection feature for shared usage by multiple users
- EasyEXPERT group+ can be installed on as many PCs as you need without additional charge to take advantage of offline personal analyzer environment among users in your department.

E5270B hardware

- Configurable and upgradable measurement modules up to 8 slots
- High Resolution SMU (HRSMU), Medium Power SMU (MPSMU) and High Power SMU (HPSMU) are available for configurable SMU selection. Optional ASU is supported for HRSMU.
- High-resolution and high-speed analog-to-digital converters (ADCs) are available to all installed modules
- Active ground unit (GNDU) in mainframe to force 0 V and sink the current up to 4 A
- Multiple interfaces (GPIB, trigger in/out and digital I/O)
- FLEX command set and program memory for remote control programming
- Self-test, self-calibration and diagnostics functions

Hardware

Specification conditions

The measurement and output accuracy are specified at the module connector terminals when referenced to the Zero Check terminal under the following conditions:

- Temperature: 23°C ± 5°C (double for 5°C to 18°C, and 28°C to 40°C if not noted otherwise)
- Humidity: 15 % to 60 % (double for 60 % to 70 %)
- After 40 minutes warm-up
- Ambient temperature change less than ± 1°C after auto calibration execution
- Measurement made within one hour after auto calibration execution
- Averaging (high-speed per-SMU ADC): 128 samples in 1 PLC; Integration time (high-resolution central ADC):
  1 PLC (1 nA to 1A range)
  20 PLC (100 pA range)
  50 PLC (1 pA to 10 pA range)
- Filter: ON (for SMUs)
- Kelvin connection
- Calibration period: 1 year

Note: This document lists specifications and supplemental information for the E5270B and its associated modules. The specifications are the standards against which the E5270B and its associated modules are tested. When the E5270B or any of its associated modules are shipped from the factory, they meet the specifications. The "supplemental" information and "typical" entries in the following specifications are not warranted, but provide useful information about the functions and performance of the instrument.

E5270B Mainframe Specification

Supported plug-In modules

The E5270B supports eight slots for plug-in modules.

Part number	Description	Slots occupied	Range of operation	Measure resolution
E5280B	HPSMU	2	-200 V to 200 V, -1 A to 1 A	2 µV, 10 fA
E5281B	MPSMU	1	-100 V to 100 V, -100 mA to 100 mA	0.5 µV, 10 fA
E5287A	Atto Level HRSMU	1	-100 V to 100 V, -100 mA to 100 mA	0.5 µV, 1 fA
E5288A[1]	Atto Sense and Switch Unit (ASU)	–	-100 V to 100 V, -100 mA to 100 mA	0.5 µV, 0.1 fA

1. This is connected with the E5287A Atto Level HRSMU

Maximum output power

The total module power consumption cannot exceed 80 W.

Note: Using the HPSMU, MPSMU, and Atto Level HRSMU units, it is impossible to create a combination that exceeds the 80 watt limit.

Maximum voltage between common and ground

≤ ± 42 V

Pulse measurement

Pulse width: 500 µsec to 2 s
Pulse period: 5 ms to 5 s
Period ≥ width + 2 ms
(when width ≤ 100 ms)
Period ≥ width + 10 ms
(when width > 100 ms)
Pulse resolution: 100 µs

Ground unit (GNDU) specification

The GNDU is furnished with the E5270B mainframe.

Output voltage: 0 V ± 100 µV
Maximum sink current: 4 A
Output terminal/connection:
Triaxial connector, Kelvin (remote sensing)

GNDU supplemental information

Load capacitance: 1 µF
Cable resistance:
For $I_S \leq 1.6$ A:
Force line R < 1 Ω
For 1.6 A < $I_S \leq 2.0$ A:
Force line R < 0.7 Ω
For 2.0 A < $I_S \leq 4.0$ 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.

MPSMU (Medium Power SMU) Module Specifications

Voltage range, resolution, and accuracy (MPSMU)

Measure resolution				Measure accuracy[1]			
Voltage range	Force resolution	High speed ADC	High resolution ADC	Force accuracy[1]	High speed ADC	High resolution ADC	Maximum current
±0.5 V	25 µV	25 µV	0.5 µV	±(0.03 % + 350 µV)	±(0.03 % + 250 µV)	±(0.02 % + 250 µV)	100 mA
±2 V	100 µV	100 µV	2 µV	±(0.03 % + 900 µV)	±(0.03 % + 700 µV)	±(0.02 % + 700 µV)	100 mA
±5 V	250 µV	250 µV	5 µV	±(0.03 % + 2 mV)	±(0.03 % + 2 mV)	±(0.02 % + 1 mV)	100 mA
±20 V	1 mV	1 mV	20 µV	±(0.03 % + 4 mV)	±(0.03 % + 4 mV)	±(0.02 % + 2 mV)	100 mA
±40 V	2 mV	2 mV	40 µV	±(0.03 % + 7 mV)	±(0.03 % + 8 mV)	±(0.02 % + 3 mV)	[2]
±100 V	5 mV	5 mV	100 µV	±(0.04 % + 15 mV)	±(0.03 % + 20 mV)	±(0.03 % + 5 mV)	[3]

1. *± (% of output/measured value + offset voltage V)*
2. *100 mA (Vo ≤ 20 V), 50 mA (20 V < Vo ≤ 40 V), Vo is the output voltage in volts.*
3. *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 (MPSMU)

Measure resolution[4]						
Current range	Force resolution	High speed ADC	High resolution ADC	Force accuracy[1]	Measure accuracy[1,2]	Maximum voltage
±1 nA	50 fA	50 fA	10 fA	±(0.5 %+3 pA+2 fA x Vo)	±(0.5 %+3 pA+2 fA x Vo)	100 V
±10 nA	500 fA	500 fA	10 fA	±(0.5 %+7 pA+20 fA x Vo)	±(0.5 %+5 pA+20 fA x Vo)	100 V
±100 nA	5 pA	5 pA	100 fA	±(0.12 %+50 pA+200 fA x Vo)	±(0.1 %+30 pA+200 fA x Vo)	100 V
±1 µA	50 pA	50 pA	1 pA	±(0.12 %+400 pA+2 pA x Vo)	±(0.1 %+200 pA+2 pA x Vo)	100 V
±10 µA	500 pA	500 pA	10 pA	±(0.12 %+5 nA+20 pA x Vo)	±(0.1 %+3 nA+20 pA x Vo)	100 V
±100 µA	5 nA	5 nA	100 pA	±(0.12 %+40 nA+200 pA x Vo)	±(0.1 %+20 nA+200 pA x Vo)	100 V
±1 mA	50 nA	50 nA	1 nA	±(0.12 %+500 nA+2 nA x Vo)	±(0.1 %+300 nA+2 nA x Vo)	100 V
±10 mA	500 nA	500 nA	10 nA	±(0.12 %+4 µA+20 nA x Vo)	±(0.1 %+2 µA+20 nA x Vo)	100 V
±100 mA	5 µA	5 µA	100 nA	±(0.12 %+50 µA+200 nA x Vo)	±(0.1 %+30 µA+200 nA x Vo)	[3]

1. *± (% of output/measured value + offset current A (fixed part determined by the output/measurement range + proportional part that is multiplied by Vo)*
2. *Measurement accuracy when using either the high-speed ADC or the high-resolution ADC*
3. *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.*
4. *Specified measurement resolution is limited by fundamental noise limits.*

Power consumption (MPSMU)

Voltage source mode:

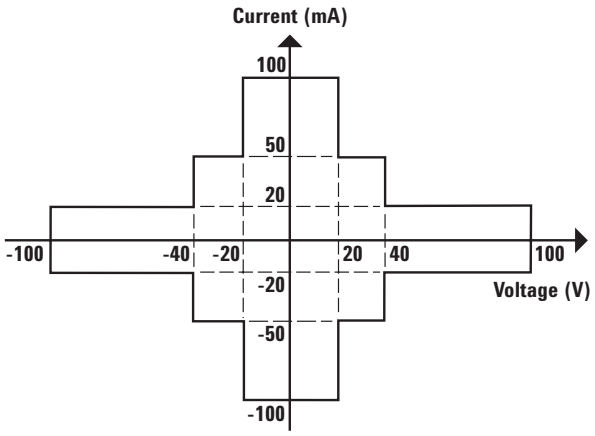
Voltage range	Power
0.5	V 20 x Ic (W)
2 V	20 x Ic (W)
5 V	20 x Ic (W)
20 V	20 x Ic (W)
40 V	40 x Ic (W)
100 V	100 x Ic (W)

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

Output terminal/connection:
Triaxial connector, Kelvin (remote sensing)

Voltage/current compliance (limiting)
The SMU can limit output voltage or current to prevent damaging the device under test.
Voltage: 0 V to ±100 V
Current: ±1 pA to ±100 mA
Compliance accuracy: Same as the current (or voltage) set accuracy.

MPSMU supplemental information
Maximum allowable cable resistance (Kelvin connection):
Force line: 10 Ω
Sense line: 10 Ω
Voltage source output resistance:
0.3 Ω typical (Force line, non-Kelvin connection)
Voltage measurement input resistance:
≥ 10^{13} Ω
Current source output resistance:
≥ 10^{13} Ω (1 nA range)
Current compliance setting accuracy (for opposite polarity):
For 1 nA to 10 nA ranges:
I setting accuracy ± 12 % of range
For 100 nA to 100 mA ranges:
I setting accuracy ± 2.5 % of range
Maximum capacitive load:
For 1 nA to 10 nA ranges: 1000 pF
For 100 nA to 10 mA ranges: 10 nF
For 100 mA ranges: 100 µF
Maximum guard capacitance: 900 pF
Maximum shield capacitance: 5000 pF
Maximum guard offset voltage: ± 3 mV
Noise characteristics (typical, filter ON):
Voltage source: 0.01 % of V range (rms)
Current source: 0.1 % of I range (rms)
Overshoot (typical, filter ON):
Voltage source: 0.03 % of V range
Current source: 1 % of I range
Range switching transient noise (typical, filter ON):
Voltage ranging: 250 mV
Current ranging: 10 mV
Slew rate: 0.2 V/µs
SMU pulse setting accuracy (fixed measurement range):
Width: 0.5 % + 50 µs
Period: 0.5 % + 100 µs
Trigger out delay (pulsed measurements):

HPSMU (High Power SMU) Module Specifications

Voltage range, resolution, and accuracy (HPSMU)

	Measure resolution			Measure accuracy[1]			
Voltage range	Force resolution	High speed ADC	High resolution ADC	Force accuracy[1]	High speed ADC	High resolution ADC	Maximum current
±2 V	100 µV	100 µV	2 µV	±(0.03 % + 900 µV)	±(0.03 % + 700 µV)	±(0.02 % + 700 µV)	1 A
±20 V	1 mV	1 mV	20 µV	±(0.03 % + 4 mV)	±(0.03 % + 4 mV)	±(0.02 % + 2 mV)	1 A
±40 V	2 mV	2 mV	40 µV	±(0.03 % + 7 mV)	±(0.03 % + 8 mV)	±(0.02 % + 3 mV)	[2]
±100 V	5 mV	5 mV	100 µV	±(0.04 % + 15 mV)	±(0.03 % + 20 mV)	±(0.03 % + 5 mV)	[3]
±200 V	10 mV	10 mV	200 µV	±(0.045 % + 30 mV)	±(0.035 % + 40 mV)	±(0.035 % + 10 mV)	[4]

1. *± (% of output/measured value + offset voltage V)*
2. *1 A (Vo ≤20 V), 500 mA (20 V < Vo ≤40 V), Vo is the output voltage in volts.*
3. *1 A (Vo ≤20 V), 500 mA (20 V < Vo ≤40 V), 125 mA (40 V < Vo ≤100 V), Vo is the output voltage in volts.*
4. *1 A (Vo ≤20 V), 500 mA (20 V < Vo ≤40 V), 125 mA (40 V < Vo ≤100 V), 50 mA (100 V < Vo ≤200 V), Vo is the output voltage in volts.*

Current range, resolution, and accuracy (HPSMU)

	Measure resolution[5]					
Current range	Force resolution	High speed ADC	High resolution ADC	Force accuracy[1]	Measure accuracy[1,2]	Maximum voltage
±1 nA	50 fA	50 fA	10 fA	±(0.5 %+3 pA+2 fA x Vo)	±(0.5 %+3 pA+2 fA x Vo)	200 V
±10 nA	500 fA	500 fA	10 fA	±(0.5 %+7 pA+20 fA x Vo)	±(0.5 %+5 pA+20 fA x Vo)	200 V
±100 nA	5 pA	5 pA	100 fA	±(0.12 %+50 pA+200 fA x Vo)	±(0.1 %+30 pA+200 fA x Vo)	200 V
±1 µA	50 pA	50 pA	1 pA	±(0.12 %+400 pA+2 pA x Vo)	±(0.1 %+200 pA+2 pA x Vo)	200 V
±10 µA	500 pA	500 pA	10 pA	±(0.12 %+5 nA+20 pA x Vo)	±(0.1 %+3 nA+20 pA x Vo)	200 V
±100 µA	5 nA	5 nA	100 pA	±(0.12 %+40 nA+200 pA x Vo)	±(0.1 %+20 nA+200 pA x Vo)	200 V
±1 mA	50 nA	50 nA	1 nA	±(0.12 %+500 nA+2 nA x Vo)	±(0.1 %+300 nA+2 nA x Vo)	200 V
±10 mA	500 nA	500 nA	10 nA	±(0.12 %+4 µA+20 nA x Vo)	±(0.1 %+2 µA+20 nA x Vo)	200 V
±100 mA	5 µA	5 µA	100 nA	±(0.12 %+50 µA+200 nA x Vo)	±(0.1 %+30 µA+200 nA x Vo)	[3]
±1 A	50 µA	50 µA	1 µA	±(0.5 %+500 µA+2 µA x Vo)	±(0.5 %+300 µA+2 µA x Vo)	[4]

1. *± (% of output/measured value + offset current A (fixed part determined by the output/measurement range + proportional part that is multiplied by Vo) resolution (< pulse width)*
2. *Measurement accuracy when using either the high-speed ADC or the high-resolution ADC*
3. *200 V (Io ≤ 50 mA), 100 V (50 mA < Io ≤ 100 mA)*
4. *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.*
5. *Specified measurement resolution is limited by fundamental noise limits*

Power consumption (HPSMU)

Voltage source mode:

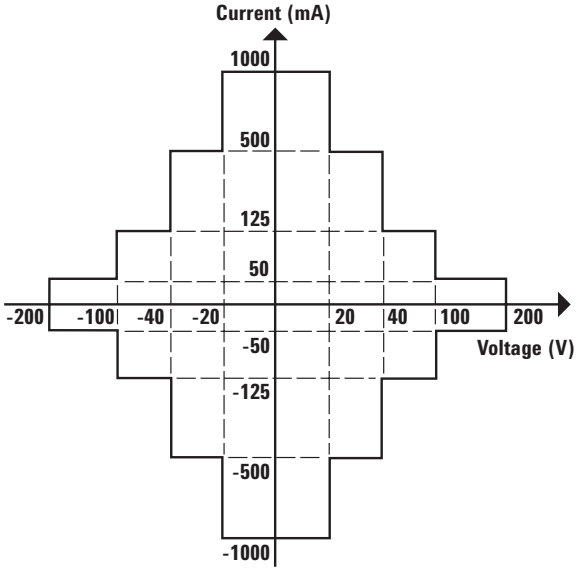
Voltage range	Power
2 V	20 x Ic (W)
20 V	20 x Ic (W)
40 V	40 x Ic (W)
100 V	100 x Ic (W)
200 V	200 x Ic (W)

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

Output terminal/connection:
Triaxial connector, Kelvin (remote sensing)

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
- Current: ± 1 pA to ± 1 A

Compliance accuracy: Same as the current (or voltage) set accuracy.

HPSMU supplemental information
Maximum allowable cable resistance (Kelvin connection):
- Force line: 10 Ω (I ≤ 100 mA)
- Force line: 1.5 Ω (100 mA < I ≤ 1 A)
- Sense line: 10 Ω (All cases)

Voltage source output resistance:
- 0.2 Ω typical (Force line, non-Kelvin connection)

Voltage measurement input resistance:
- ≥ 10^{13} Ω

Current source output resistance:
- ≥ 10^{13} Ω (1 nA range)

Current compliance setting accuracy (for opposite polarity):
For 1 nA to 10 nA ranges:
- I setting accuracy ± 12 % of range

For 100 nA to 1 A ranges:
- I setting accuracy ± 2.5 % of range

Maximum capacitive load:
For 1 nA to 10 nA ranges: 1000 pF
For 100 nA to 10 mA ranges: 10 nF
For 100 mA to 1 A ranges: 100 µF
Maximum guard capacitance: 900 pF
Maximum shield capacitance: 5000 pF
Maximum guard offset voltage: ± 1 mV
Noise characteristics (typical, filter ON):
- Voltage source: 0.01 % of V range (rms)
- Current source: 0.1 % of I range (rms)

Overshoot (typical, filter ON):
- Voltage source: 0.03 % of V range
- Current source: 1 % of I range

Range switching transient noise (typical, filter ON):
- Voltage ranging: 250 mV
- Current ranging: 10 mV

Slew rate: 0.2 V/µs
SMU pulse setting accuracy (fixed measurement range):
- Width: 0.5 % + 50 µs
- Period: 0.5 % + 100 µs

Trigger out delay (pulsed measurements):
- 0 to 32.7 ms with 100 µs resolution (< pulse width)

Atto Level HRSMU Module Specifications (without ASU)

Voltage range, resolution, and accuracy (Atto level HRSMU without ASU)

	Measure resolution			Measure accuracy[1]			
Voltage range	Force resolution	High speed ADC	High resolution ADC	Force accuracy[1]	High speed ADC	High resolution ADC	Maximum current
±0.5 V	25 µV	25 µV	0.5 µV	±(0.02 % + 150 µV)	±(0.01 % + 250 µV)	±(0.01 % + 150 µV)	100 mA
±2 V	100 µV	100 µV	2 µV	±(0.02 % + 400 µV)	±(0.01 % + 700 µV)	±(0.01 % + 200 µV)	100 mA
±5 V	250 µV	250 µV	5 µV	±(0.02 % + 750 µV)	±(0.01 % + 2 mV)	±(0.01 % + 250 µV)	100 mA
±20 V	1 mV	1 mV	20 µV	±(0.02 % + 3 mV)	±(0.01 % + 4 mV)	±(0.01 % + 1 mV)	100 mA
±40 V	2 mV	2 mV	40 µV	±(0.025 % + 6 mV)	±(0.015 % + 8 mV)	±(0.015 % + 2 mV)	[2]
±100 V	5 mV	5 mV	100 µV	±(0.03 % + 15 mV)	±(0.02% + 20 mV)	±(0.02 % + 5 mV)	[3]

1. *± (% of output/measured value + offset voltage)*
2. *100 mA (Vo ≤ 20 V), 50 mA (20 V < Vo ≤ 40 V), Vo is the output voltage in volts.*
3. *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 (Atto level HRSMU without ASU)

	Measure resolution[4,5]					
Current range	Force resolution	High speed ADC	High resolution ADC	Force accuracy[1]	Measure accuracy[1,2]	Maximum voltage
±10 pA	5 fA	1 fA	1 fA	±(0.5 %+40 fA+10 aA x Vo)	±(0.5 %+15 fA+10 aA x Vo)	100 V
±100 pA	5 fA	5 fA	2 fA	±(0.5 %+120 fA+100 aA x Vo)	±(0.5 %+40 fA+100 aA x Vo)	100 V
±1 nA	50 fA	50 fA	10 fA	±(0.25 %+400 fA+1 fA x Vo)	±(0.25 %+300 fA+1 fA x Vo)	100 V
±10 nA	500 fA	500 fA	10 fA	±(0.25 %+4 pA+10 fA x Vo)	±(0.25 %+2 pA+10 fA x Vo)	100 V
±100 nA	5 pA	5 pA	100 fA	±(0.12 %+40 pA+100 fA x Vo)	±(0.1 %+20 pA+100 fA x Vo)	100 V
±1 µA	50 pA	50 pA	1 pA	±(0.12 %+400 pA+1 pA x Vo)	±(0.1 %+200 pA+1 pA x Vo)	100 V
±10 µA	500 pA	500 pA	10 pA	±(0.07 %+4 nA+10 pA x Vo)	±(0.05 %+2 nA+10 pA x Vo)	100 V
±100 µA	5 nA	5 nA	100 pA	±(0.07 %+40 nA+100 pA x Vo)	±(0.05 %+20 nA+100 pA x Vo)	100 V
±1 mA	50 nA	50 nA	1 nA	±(0.06 %+400 nA+1 nA x Vo)	±(0.04 %+200 nA+1 nA x Vo)	100 V
±10 mA	500 nA	500 nA	10 nA	±(0.06 %+4 µA+10 nA x Vo)	±(0.04 %+2 µA+10 nA x Vo)	100 V
±100 mA	5 µA	5 µA	100 nA	±(0.12 %+40 µA+100 nA x Vo)	±(0.1 %+20 µA+100 nA x Vo)	[3]

1. *± (% of output/measured value + offset current A (fixed part determined by the output/measurement range + proportional part that is multiplied by Vo)*
2. *Measurement accuracy when using either the high-speed ADC or the high-resolution ADC.*
3. *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.*
4. *Minimum 10 aA display resolution at 10 pA range by 6 digits.*
5. *Specified measurement resolution is limited by fundamental noise limits.*

Power consumption (Atto level HRSMU without ASU)

Voltage source mode:

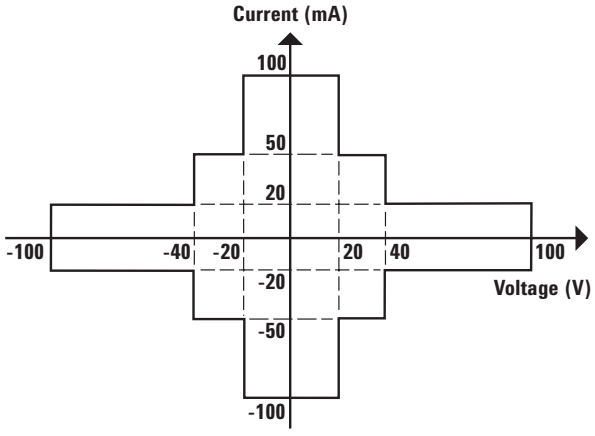
Voltage range	Power
0.5 V	20 x Ic (W)
2 V	20 x Ic (W)
5 V	20 x Ic (W)
20 V	20 x Ic (W)
40 V	40 x Ic (W)
100 V	100 x Ic (W)

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.



Atto level HRSMU without ASU measurement and output range

Output terminal/connection:
Triaxial connector, Kelvin (remote sensing)

Voltage/current compliance(limiting)
The SMU can limit output voltage or current to prevent damaging the device under test.
Voltage: 0 V to ± 100 V
Current: ± 100 fA to ± 100 mA
Compliance accuracy: Same as the current (or voltage) set accuracy.

Atto level HRSMU without ASU supplemental information
Maximum allowable cable resistance (Kelvin connection):
Force line: 10 Ω
Sense line: 10 Ω
Voltage source output resistance:
0.3 Ω typical (Force line, non-Kelvin connection)

Voltage measurement input resistance:
≥ 10^{13} Ω
Current source output resistance:
≥ 10^{13} Ω (1 nA range)
Current compliance setting accuracy (for opposite polarity):
For 10 pA to 10 nA ranges:
I setting accuracy ± 12 % of range
For 100 nA to 100 mA ranges:
I setting accuracy ± 2.5 % of range
Maximum capacitive load:
For 10 pA to 10 nA ranges: 1000 pF
For 100 nA to 10 mA ranges: 10 nF
For 100 mA ranges: 100 µF
Maximum guard capacitance: 900 pF
Maximum shield capacitance: 5000 pF
Maximum guard offset voltage: ± 3 mV
Noise characteristics (typical, filter ON):
Voltage source: 0.01 % of V range (rms)
Current source: 0.1 % of I range (rms)

Overshoot (typical, filter ON):
Voltage source: 0.03 % of V range
Current source: 1 % of I range
Range switching transient noise (typical, filter ON):
Voltage ranging: 250 mV
Current ranging: 10 mV
Slew rate: 0.2 V/µs
SMU pulse setting accuracy (fixed measurement range):
Width: 0.5 % + 50 µs
Period: 0.5 % + 100 µs
Trigger out delay (pulsed measurements):
0 to 32.7 ms with 100 µs resolution (< pulse width)

Atto Level HRSMU Module Specifications (with ASU)

Voltage range, resolution, and accuracy (Atto level HRSMU with ASU)

	Measure resolution			Measure accuracy[1]			
Voltage range	Force resolution	High speed ADC	High resolution ADC	Force accuracy[1]	High speed ADC	High resolution ADC	Maximum current
±0.5 V	25 µV	25 µV	0.5 µV	±(0.02 % + 150 µV)	±(0.01 % + 250 µV)	±(0.01 % + 150 µV)	100 mA
±2 V	100 µV	100 µV	2 µV	±(0.02 % + 400 µV)	±(0.01 % + 700 µV)	±(0.01 % + 200 µV)	100 mA
±5 V	250 µV	250 µV	5 µV	±(0.02 % + 750 µV)	±(0.01 % + 2 mV)	±(0.01 % + 250 µV)	100 mA
±20 V	1 mV	1 mV	20 µV	±(0.02 % + 3 mV)	±(0.01 % + 4 mV)	±(0.01 % + 1 mV)	100 mA
±40 V	2 mV	2 mV	40 µV	±(0.025 % + 6 mV)	±(0.015 % + 8 mV)	±(0.015 % + 2 mV)	[2]
±100 V	5 mV	5 mV	100 µV	±(0.03 % + 15 mV)	±(0.02% + 20 mV)	±(0.02 % + 5 mV)	[3]

1. *± (% of output/measured value + offset voltage)*
2. *100 mA (Vo ≤ 20 V), 50 mA (20 V < Vo ≤ 40 V), Vo is the output voltage in volts.*
3. *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 (Atto level HRSMU with ASU)

	Measure resolution[4,5]					
Current range	Force resolution	High speed ADC	High resolution ADC		Measure accuracy[1,2]	Maximum voltage
±1 pA	1 fA	100 aA	100 aA	±(1.8 %+15 fA)	±(1.8 %+12 fA)	100 V
±10 pA	5 fA	1 fA	400 aA	±(0.5 %+40 fA+10 aA x Vo)	±(0.5 %+15 fA+10 aA x Vo)	100 V
±100 pA	5 fA	5 fA	500 aA	±(0.5 %+120 fA+100 aA x Vo)	±(0.5 %+40 fA+100 aA x Vo)	100 V
±1 nA	50 fA	50 fA	10 fA	±(0.25 %+400 fA+1 fA x Vo)	±(0.25 %+300 fA+1 fA x Vo)	100 V
±10 nA	500 fA	500 fA	10 fA	±(0.25 %+4 pA+10 fA x Vo)	±(0.25 %+2 pA+10 fA x Vo)	100 V
±100 nA	5 pA	5 pA	100 fA	±(0.12 %+40 pA+100 fA x Vo)	±(0.1 %+20 pA+100 fA x Vo)	100 V
±1 µA	50 pA	50 pA	1 pA	±(0.12 %+400 pA+1 pA x Vo)	±(0.1 %+200 pA+1 pA x Vo)	100 V
±10 µA	500 pA	500 pA	10 pA	±(0.07 %+4 nA+10 pA x Vo)	±(0.05 %+2 nA+10 pA x Vo)	100 V
±100 µA	5 nA	5 nA	100 pA	±(0.07 %+40 nA+100 pA x Vo)	±(0.05 %+20 nA+100 pA x Vo)	100 V
±1 mA	50 nA	50 nA	1 nA	±(0.06 %+400 nA+1 nA x Vo)	±(0.04 %+200 nA+1 nA x Vo)	100 V
±10 mA	500 nA	500 nA	10 nA	±(0.06 %+4 µA+10 nA x Vo)	±(0.04 %+2 µA+10 nA x Vo)	100 V
±100 mA	5 µA	5 µA	100 nA	±(0.12 %+40 µA+100 nA x Vo)	±(0.1 %+20 µA+100 nA x Vo)	[3]

1. *± (% of output/measured value + offset current A (fixed part determined by the output/measurement range + proportional part that is multiplied by Vo)*
2. *Measurement accuracy when using either the high-speed ADC or the high-resolution ADC.*
3. *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*
4. *Minimum 1 aA display resolution at 1 pA range by 6 digits.*
5. *Specified measurement resolution is limited by fundamental noise limits.*
6. *Measurements at lower range are affected strongly by vibrations and shocks. Do not place the environment of vibrations and shocks during measurements.*

Power consumption (Atto level HRSMU with ASU)

Voltage source mode:

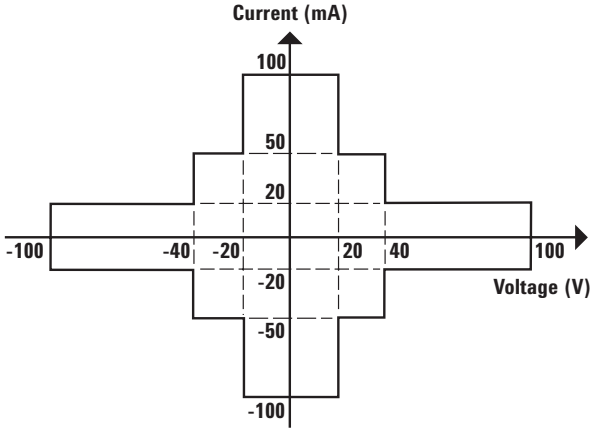
Voltage range	Power
0.5 V	20 x Ic (W)
2 V	20 x Ic (W)
5 V	20 x Ic (W)
20 V	20 x Ic (W)
40 V	40 x Ic (W)
100 V	100 x Ic (W)

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.



Atto level HRSMU with ASU measurement and output range

Output terminal/connection:
Triaxial connector, Kelvin (remote sensing)

Voltage/current compliance(limiting)
The SMU can limit output voltage or current to prevent damaging the device under test.
Voltage: 0 V to ± 100 V
Current: ± 10 fA to ± 100 mA
Compliance accuracy: Same as the current (or voltage) set accuracy.

Atto level HRSMU with ASU supplemental information
Maximum allowable cable resistance (Kelvin connection):
Force line: 10 Ω
Sense line: 10 Ω
Voltage source output resistance:
0.3 Ω typical (Force line, non-Kelvin connection)
Voltage measurement input resistance:
≥ 1013 Ω
Current source output resistance:
≥ 1013 Ω (1 nA range)
Current compliance setting accuracy (for opposite polarity):
For 1 pA to 10 nA ranges:
I setting accuracy ± 12 % of range
For 100 nA to 100 mA ranges:
I setting accuracy ± 2.5 % of range
Maximum capacitive load:
For 1 pA to 10 nA ranges: 1000 pF
For 100 nA to 10 mA ranges: 10 nF
For 100 mA ranges: 100 µF
Maximum guard capacitance: 660 pF
Maximum shield capacitance: 3500 pF
Maximum guard offset voltage:
± 4.2 mV (Iout ≤ 100 µA)
Noise characteristics (typical, filter ON):
Voltage source: 0.01 % of V range (rms)
Current source: 0.1 % of I range (rms)
Overshoot (typical, filter ON):
Voltage source: 0.03 % of V range
Current source: 1 % of I range
Range switching transient noise (typical, filter ON):
Voltage ranging: 250 mV
Current ranging: 10 mV
Slew rate: 0.2 V/µs
Maximum capacitive load:
SMU pulse setting accuracy (fixed measurement range):
Width: 0.5 % + 50 µs
Period: 0.5 % + 100 µs
Trigger out delay (pulsed measurements):
0 to 32.7 ms with 100 µs resolution (< pulse width)

Atto Sense and Switch Unit (ASU)

AUX path specification
Maximum voltage
100 V: between AUX input and AUX common
100 V: between AUX input and circuit common
42 V: between AUX common and circuit common
Maximum current
0.5 A: between AUX input and force output

ASU supplemental information
Band width (at –3 dB): < 30 MHz (AUX port)

Functions

Front panel operations

Display
- Display error messages
- Display spot measurement set value
- Display spot measurement result

Keypad operations
- Set GPIB address
- Set local/remote mode
- Select measurement channel
- Set spot measurement set value
- Start calibration/diagnostics

MPSMU, HPSMU, and Atto Level HRSMU Measurement Mode Details

Spot measurement mode
Outputs and measures voltage and current.

Staircase sweep measurement mode
Outputs swept voltage or current, and measures dc voltage or current. One channel can sweep current or voltage while up to eight channels can measure current or voltage. A second channel can be synchronized with the primary sweep channel as an additional voltage or current sweep source. Linear or log sweeps can be performed.
Number of steps: 1 – 1,001
Hold time: 0 – 655.35 s, 1 ms resolution
Delay time: 0 – 65.5350 s, 100 µs resolution

Multi-channel sweep measurement mode
Outputs swept voltage or current, and measures dc voltage or current. Up to eight channels can sweep current or voltage and up to eight channels can measure current or voltage. Linear or log sweeps can be performed.
Number of steps: 1– 1,001
Hold time: 0 – 655.35 s, 1 ms resolution
Delay time: 0 – 65.5350 s, 100 µs resolution

Pulsed spot measurement mode
Outputs a voltage or current pulse and measures dc voltage or current.
Pulse width: 500 µs to 100 ms, 100 µs resolution
Pulse period: 5 ms to 1 s (≥ pulse width + 4 ms), 100 µs resolution
Maximum pulse duty: 50 %

Pulsed sweep measurement mode
Outputs pulsed swept voltage or current, and measures dc voltage or current. A second channel can be programmed to output a staircase sweep voltage or current synchronized with the pulsed sweep output.

Staircase sweep with pulsed bias measurement mode
Outputs swept voltage or current, and measures dc voltage or current. A second channel can be programmed to output a pulsed bias voltage or current. A third channel can be synchronized with the primary sweep channel as an additional voltage or current sweep source.

Quasi-pulsed spot measurement mode
Outputs quasi-pulsed voltage and measures dc voltage or current.

Linear search measurement mode
Outputs and measure voltage or current by using linear search method.

Binary search measurement mode
Outputs and measure voltage or current by using binary search method.

Time Stamp

The E5270B supports a time stamp function utilizing an internal quartz clock.
Resolution: 100 µs

Program Memory

The E5270B mainframe contains (volatile) memory that can be used to increase test measurement throughput. Program memory allows the storage of program code in the E5270B, eliminating the need to communicate over the GPIB interface. In addition, input data can be passed to code sequences stored in program memory.
Maximum lines of storable code: 40,000
Maximum number of program sequences: 2,000

Output Data Buffer

The number of data points that can be stored in the data buffer varies with the choice of the output data format.
Minimum number of storable data Points: 34,034

Trigger I/O

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

Input
An external trigger input signal can be used to do any of the following:
- Start a measurement
- Start a measurement at each sweep step for a staircase sweep or multi channel sweep measurement
- Start the source output at each sweep step for a staircase sweep, pulsed sweep, staircase sweep with pulsed bias, or multi-channel sweep measurement.
- Start the pulsed output for a pulsed spot measurement.
- Recover from a wait state.
- Input level: TTL level, negative or positive edge trigger, or TTL level, negative or positive gate trigger.

Output
An output trigger signal can be sent when one of the following events occurs:
- The end of a measurement is reached.
- The end of a measurement at each sweep step for a staircase sweep or multi channel sweep measurement is reached.
- Completion of the source output setup at each sweep step for a staircase sweep, pulsed sweep, staircase sweep with pulsed bias, or multi-channel sweep measurement.
- Completion of the pulsed output setup for a pulsed spot measurement.
- A trigger command is issued.

Output level:
TTL level, negative or positive edge trigger, or TTL level, negative or positive gate trigger.

General Purpose Digital I/O

16 general-purpose digital I/O signals are available via a 25-pin DIN connector. These pins can be used as an alternative to the BNC trigger-in and trigger-out lines to synchronize the E5270B with other instruments. They can also be used as output and input ports for digital signals. The user can selectively assign pins to trigger mode or digital I/O mode.

General Specifications

Temperature range
Operating: +5°C to +40°C
Storage: –20°C to +60°C

Humidity range
Operating: 15 % to 70 % RH, non-condensing
Storage: 5 % to 80 % RH, non-condensing

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

Power requirement
ac voltage: 90 V to 264 V
Line frequency: 47 Hz to 63 Hz

Maximum volt-amps (VA)
E5270B: 600 VA

Regulatory compliance
EMC: IEC61326-1:+A1/ EN61326- 1:+A1
AS/NZS 2064.1
Safety: CSA C22.2 No.1010.1-1992
IEC61010-1:+A2/ EN61010-1:+A2
UL3111-1:1994

Certification
CE, CSA, NRTL/C, C-Tick

Dimensions
E5270B: 426 mm W x 235 mm H x 575 mm D

Weight
E5270B (empty): 17 kg
E5280A: 2.5 kg
E5281A: 1.4 kg
E5287A: 1.5 kg
E5288A: 0.5 kg

Furnished Accessories

- USB-GPIB interface (Keysight 82357B)
- GNDU to Kelvin adaptor (Keysight N1254A-100)
- Triaxial cables for SMU
- Triaxial cable for GNDU
- Interlock cable
- CD-ROMs (EasyEXPERT install media, VXI *plug&play* driver and TIS library)

Furnished Software

- EasyEXPERT group+
  See the following section for features and prerequisites.
- VXI *plug&play* driver
- TIS library
  Supported OS: Windows 7 Professional (SP1, 32 bit or 64 bit)

Keysight EasyEXPERT group+ Software

Keysight EasyEXPERT group+ GUI based characterization software is available on your PC to accelerate the characterization tasks. It supports efficient and repeatable device characterization in the entire characterization process from measurement setup and execution to analysis and data management either by interactive manual operation or automation across a wafer in conjunction with a semiautomatic wafer prober. EasyEXPERT group+ makes it easy to perform complex device characterization immediately with the ready-to-use measurements (application tests) furnished, and allows you the option of storing test condition and measurement data automatically after each measurement in a unique built-in database (workspace), ensuring 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

- Multiple measurement modes for quick setup and measurement execution (application test, classic test, and quick test)
- Graphical display, automated analysis capabilities and data generation to Excel and image for analysis and reporting
- Built-in database (workspace) records test data automatically and simplifies the data management without numerous data files
- GUI-based control of the Keysight B2200A, B2201A and E5250A switching matrices
- EasyEXPERT remote control function supports the remote measurement execution of application tests that are created on GUI interactively, via the LAN interface
- Data back capability and various data protection feature for shared usage by multiple users
- Characterization environment is available on user's PC as a personal and portable analyzer environment. EasyEXPERT group+ can be installed on any PC as many as needed without additional charge.

Application library

EasyEXPERT group+ comes with the 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
CMOS Transistor	Id-Vg, Id-Vd, Vth, breakdown, etc.
Bipolar Transistor	Ic-Vc, diode, Gummel plot, breakdown, hfe, etc.
Discrete device	Id-Vg, Id-Vd, Ic-Vc, diode, etc.
Power device	Pulsed Id-Vg, pulsed Id-Vd, breakdown, etc.
Nano Device	Resistance, Id-Vg, Id-Vd, Ic-Vc, etc.
Reliability test	NBTI/PBTI, electro migration, hot carrier injection, J-Ramp, TDDB, etc.

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. Available application tests can be adapted to configured resources.

Classic test mode

The classic test mode provides easy access to the instrument setup and measurement execution capabilities.

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.

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.

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.
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, and the result can be displayed.

Read out functions

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

Data export

X-Y graph plot can be printed or stored as image data to clipboard or mass storage device. (File type: bmp, gif, png, emf).
Graph and list data can be exported to Excel.

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: Boltzman'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 (103), M (106), G (109), T (1012) , P (1015)

Data management

Workspace (Built-in database)

EasyEXPERT group+ supports the built-in database called "workspace". Workspaces are created on a HDD, and they enable to manage and access all the measurement related data without handling numerous files. Every workspace supports the following features:

- Access to measurement capabilities and data stored in the workspace.
- Save/Import/Export measurement settings and data (application library, measurement settings, my favorite setup, and measurement data)
- Recall the setup for measurement reproduction and data for analysis

Data auto record/auto export

EasyEXPERT group+ 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 such as Excel (xls).

Import/export files

File type:
Keysight EasyEXPERT format, XML-SS format, CSV format

Data Protection

EasyEXPERT group+ has various options to protect important data as follows.

- Password protection (workspace, test definition and my favorite)
- User level access control (engineer mode/operator mode)

Workspace back-up and portability

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

EasyEXPERT group+ supported instruments and prerequisites

Supported instruments and features

		Precision Current - Voltage Analyzer Series			Discontinued Parameter Analyzer
		Advanced Device Analyzer	Precision IV Analyzer		
		B1500A	E5270B	E5262/63A E5260A	4155B/C 4156B/C
Supported Operation Mode	Classic Test	Yes	Yes	Yes	Yes
	Application Test	Yes	Yes	Yes	Yes
	Tracer Test	Yes	Yes[1]	Yes[1]	–
	Quick Test	Yes	Yes	Yes	Yes
Measurement Features	I/V Sweep	Yes	Yes	Yes	Yes[2]
	Multi-ch I/V Sweep	Yes	Yes	Yes	–
	I/V List Sweep	Yes	Yes	Yes	–
	I/V-t Sampling	Yes	–	–	Yes
	C-V Sweep	Yes	–	–	–
	SPGU Control	Yes	–	–	–
GUI based switching matrix control		B2200/01A and E5250A/E5252A	B2200/01A and E5250A/E5252A	B2200/01A and E5250A/E5252A	B2200/01A and E5250A/E5252A
External instrument driver support	LCR meter	4284A/E4980A	4284A/E4980A	4284A/E4980A	4284A/E4980A
	Pulse Generator	81110A	81110A	81110A	81110A
	DVM	3458A	3458A	3458A	3458A
Prober control in Quick Test mode		Cascade Microtech Sumit 12000/S300 (Nucleus)	Cascade Microtech Sumit 12000/S300 (Nucleus)	Cascade Microtech Sumit 12000/S300 (Nucleus)	Cascade Microtech Sumit 12000/S300 (Nucleus)
		Cascade Microtech (Suss MicroTec) PA200/PA300	Cascade Microtech (Suss MicroTec) PA200/PA300	Cascade Microtech (Suss MicroTec) PA200/PA300	Cascade Microtech (Suss MicroTec) PA200/PA300
		Vector Semiconductor VX-2000/VX-3000	Vector Semiconductor VX-2000/VX-3000	Vector Semiconductor VX-2000/VX-3000	Vector Semiconductor VX-2000/VX-3000
Firmware requirement		A.04.00 or later[3]	B.01.10 or later	B.01.10 or later	HOSTC: 03.08 or later SMUC: 04.08 or later

1. *It will be supported in future release.*
2. *PGU and VSU/VMU are supported. Differential voltage measurement of VMU is not supported.*
3. *The latest FW revision is strongly recommended to take full advantage of measurement capabilities.*

Prerequisites

Prerequisites to use the EasyEXPERT group+ on an external PC are as follows.

Operating system and service pack	Microsoft Windows Vista Business SP2 or later (32bit)	Microsoft Windows 7 Professional SP1 or later (32bit/64bit)	Microsoft Windows 8.1 Professional or later (32bit/64bit)
Processor	Vista certified PC	Windows 7 certified PC	Windows 8.1 certified PC
Supported language	English (US)	English (US)	English (US)
.NET Framework	Microsoft .NET Framework 3.5 SP1	Microsoft .NET Framework 3.5 SP1	Microsoft .NET Framework 3.5 SP1
Memory	2 GB memory	2 GB memory	2 GB memory
Display	XGA 1024 x 768 (SXGA 1280 x 1024 recommended)	XGA 1024 x 768 (SXGA 1280 x 1024 recommended)	XGA 1024 x 768 (SXGA 1280 x 1024 recommended)
HDD	Installation: 1GB free disk space on the C drive	Installation: 1GB free disk space on the C drive	Installation: 1GB free disk space on the C drive
	Test setup/result data storage: Free disk space more than 30GB is recommended	Test setup/result data storage: Free disk space more than 30GB is recommended	Test setup/result data storage: Free disk space more than 30GB is recommended

Recommended GPIB I/F

		Interface	E5270B E5260A E5262/63A	4155B/C 4156B/C
Keysight	82350B	PCI	✓[1]	✓
	82357A	USB	✓[2]	✓
	82357B	USB	✓[2]	✓
National Instruments	GPIB-USB-HS	USB	✓[2]	

1. *A 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. It is reported that using an even GPIB address sometimes significantly decreases the chance of the error. The NI GPIB-USB-HS is recommended for stability, and the Keysight 82357B is recommended for speed.*

Measurements Modes

Following table shows the measurement modes supported by the EasyEXPERT group+ and FLEX remote command set.

IV Measurement features	EasyEXPERT group+	Command based programming (FLEX command set)
Spot measurement	Yes	Yes
Pulsed spot measurement	Yes	Yes
Staircase sweep	Yes	Yes
Pulsed sweep	Yes	Yes
Staircase sweep with pulsed bias	Yes	Yes
Multi-channel sweep	Yes	Yes
List Sweep	Yes	–
Quasi-pulsed spot	–	Yes
Linear search	–	Yes
Binary search	–	Yes

Ordering Information

Model	
E5270B	Precision IV Analyzer / 8 Slot Precision Measurement Mainframe
	E5270B contains triax cables for GNDU and SMU, the GNDU to Kelvin adapter, USB-GPIB interface and the EasyEXPERT group+ software install media.
Cable length options	
E5270B-015	1.5m cable length
E5270B-030	3.0m cable length
Quick configuration options	
E5270B-A01	Four MPSMU package
E5270B-A02	Two MPSMU and two HRSMU package
E5270B-A03	Four HRSMU package
Add-on module options	
E5270B-A10	Add one HPSMU
E5270B-A11	Add one MPSMU
E5270B-A17	Add one HRSMU
E5270B-A28	Add atto sense and switch unit (ASU)

Upgrade Product

Model	
E5270BU	Upgrade kit for E5270B
Module upgrade options	
E5270BU-080	Precision High Power Source/Monitor Unit Module (E5280B)/ No cable included
E5270BU-081	Precision Medium Power Source/Monitor Unit Module (E5281B)/ No cable included
E5270BU-087	High Resolution Source/Monitor Unit Module (E5287A)/ No cable included
E5270BU-88A	Atto Sense And Switch Unit (E5288A ASU) with 1.5 m Triax and Dsub Cable
E5270BU-88B	Atto Sense And Switch Unit (E5288A ASU) with 3 m Triax and Dsub Cable
EasyEXPERT upgrade option	
E5270BU-SWS	EasyEXPERT Extension support

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A personalized view into the information most relevant to you.

Three-Year Warranty
www.keysight.com/find/ThreeYearWarranty
Keysight's commitment to superior product quality and lower total cost of ownership. The only test and measurement company with three-year warranty standard on all instruments, worldwide.

Keysight Assurance Plans
www.keysight.com/find/AssurancePlans
Up to five years of protection and no budgetary surprises to ensure your instruments are operating to specification so you can rely on accurate measurements.

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