Agilent E5260A

8 Slot High speed Measurement Mainframe

Technical Overview

Introduction

The Agilent E5260A 8 Slot high speed measurement mainframe is completely user-configurable. You can install up to eight single-slot modules (such as the MPSMU), up to four dual-slot modules (such as the HPSMU), or any physically allowable combination thereof.

Basic features

- Performs high-speed, dc parametric measurements
- Eight slots for plug-in modules
- User interface allows spot measurements to be made from the front panel
- High-speed ADC present on each installed SMU
- Ground unit up to 4 A
- BNC trigger-in and trigger-out connectors
- 16 general-purpose digital I/Os
- Program memory
- GPIB port for instrument control
- Self-test, self-calibration, diagnostics

Measurement modes

The Agilent E5260A supports the following measurement modes:

- Spot
- Pulsed spot
- Quasi-pulsed spot
- Staircase sweep
- Multi-channel sweep
- Pulsed sweep
- Staircase sweep with pulsed bias
- Linear search
- Binary search

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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:

1. Temperature: 23°C ± 5°C (double for 5°C to 18°C, and 28°C to 40°C if not noted otherwise)
2. After 40 minutes warm-up
3. Ambient temperature change less than ± 1°C after auto calibration execution
4. Measurement made within one hour after auto calibration execution
5. Averaging (high-speed per-SMU ADC): 128 samples in 1 PLC; Integration time
6. Filter: ON (for SMUs)
7. Kelvin connection
8. Calibration period: 1 year

Note: This document lists specifications and supplemental information for the E5260A and its associated modules. The specifications are the standards against which the E5260A and its associated modules are tested. When the E5260A 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.

E5260A Mainframe Specification

Supported plug-In modules
The E5260A supports eight slots for plug-in modules.

Part number	Description	Slots occupied	Range of operation	Minimum resolution
E5290A	High speed HPSMU	2	–200 V to 200 V, –1 A to 1 A	100 µV, 5 pA
E5291A	High speed MPSMU	1	–100 V to 100 V, –200 mA to 200 mA	100 µV, 5 pA

Maximum output power
The total module power consumption cannot exceed 80 W.

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

Maximum voltage between common and ground
Maximum common to ground voltage must be ± 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 E5260A 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)

Voltage range	Force resolution	Measure resolution	Force accuracy[1]	Measure accuracy[1]	Maximum current
±2 V	100 µV	100 µV	±(0.03 % + 900 µV)	±(0.03 % + 700 µV)	200 mA
±20 V	1 mV	1 mV	±(0.03 % + 4 mV)	±(0.03 % + 4 mV)	200 mA
±40 V	2 mV	2 mV	±(0.03 % + 7 mV)	±(0.03 % + 8 mV)	[2]
±100 V	5 mV	5 mV	±(0.04 % + 15 mV)	±(0.03 % + 20 mV)	[3]

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

Current range	Force resolution	Measure resolution[4]	Force accuracy[1]	Measure accuracy[1,2]	Maximum voltage
±100 nA	5 pA	5 pA	±(0.12 % + 50 pA + 5 pA x (Vo/25))	±(0.1 % + 30 pA + 5 pA x (Vo/25))	100 V
±1 µA	50 pA	50 pA	±(0.12 % + 400 pA + 50 pA x (Vo/25))	±(0.1 % + 200 pA + 50 pA x (Vo/25))	100 V
±10 µA	500 pA	500 pA	±(0.12 % + 5 nA + 500 pA x (Vo/25))	±(0.1 % + 3 nA + 500 pA x (Vo/25))	100 V
±100 µA	5 nA	5 nA	±(0.12 % + 40 nA + 5 nA x (Vo/25))	±(0.1 % + 20 nA + 5 nA x (Vo/25))	100 V
±1 mA	50 nA	50 nA	±(0.12 % + 500 nA + 50 nA x (Vo/25))	±(0.1 % + 300 nA + 50 nA x (Vo/25))	100 V
±10 mA	500 nA	500 nA	±(0.12 % + 4 µA + 500 nA x (Vo/25))	±(0.1 % + 2 µA + 500 nA x (Vo/25))	100 V
±100 mA	5 µA	5 µA	±(0.12 % + 50 µA + 5 µA x (Vo/25))	±(0.1 % + 30 µA + 5 µA x (Vo/25))	[3]
±200 mA	10 µA	10 µA	±(0.12 % + 100 µA + 10 µA x (Vo/50))	±(0.1 % + 60 µA + 10 µA x (Vo/50))	[4]

1. *± (% of output/measured value + offset current A (fixed part determined by the output/measurement range + proportional part that is multiplied by Vo)*
2. *Round up below decimal point for the value of (Vo/25) and (Vo/50)*
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. *100 V (Io ≤ 20 mA), 40 V (20 mA < Io ≤ 50 mA), 20 V (50 mA < Io ≤ 200 mA), Io is the output current in amps.*

Power consumption (MPSMU)

Voltage source mode:

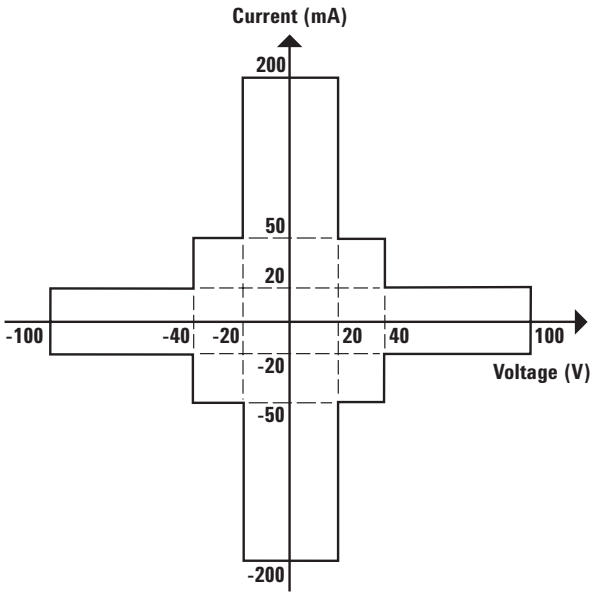
Voltage range	Power
2 V	20 x Ic (W)
20 V	20 x Ic (W)
40 V	40 x Ic (W)
100 V	100 x Ic (W)

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: ± 100 pA to ± 200 mA
Compliance accuracy: Same as the current (or voltage) set accuracy.

MPSMU supplemental information
Maximum allowable cable resistance (Kelvin connection):
Force Line: 10 Ω (I ≤ 100 mA)
Force Line: 1.5 Ω
(100 mA < I ≤ 200 mA)
Sense Line: 10 Ω (All cases)

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 100 nA to 200 mA ranges:
I setting accuracy ± 2.5 % of range
Maximum capacitive load:
For 100 nA to 10 mA ranges: 10 nF
For 100 mA to 200 mA 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)

HPSMU (High Power SMU) Module Specifications

Voltage range, resolution, and accuracy (HPSMU)

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

Current range	Force resolution	Measure resolution	Force accuracy[1,2]	Measure accuracy[1,2]	Maximum voltage
±100 nA	5 pA	5 pA	±(0.12 % + 50 pA + 5 pA x (Vo/25))	±(0.1 % + 30 pA + 5 pA x (Vo/25))	200 V
±1 µA	50 pA	50 pA	±(0.12 % + 400 pA + 50 pA x (Vo/25))	±(0.1 % + 200 pA + 50 pA x (Vo/25))	200 V
±10 µA	500 pA	500 pA	±(0.12 % + 5 nA + 500 pA x (Vo/25))	±(0.1 % + 3 nA + 500 pA x (Vo/25))	200 V
±100 µA	5 nA	5 nA	±(0.12 % + 40 nA + 5 nA x (Vo/25))	±(0.1 % + 20 nA + 5 nA x (Vo/25))	200 V
±1 mA	50 nA	50 nA	±(0.12 % + 500 nA + 50 nA x (Vo/25))	±(0.1 % + 300 nA + 50 nA x (Vo/25))	200 V
±10 mA	500 nA	500 nA	±(0.12 % + 4 µA + 500 nA x (Vo/25))	±(0.1 % + 2 µA + 500 nA x (Vo/25))	200 V
±100 mA	5 µA	5 µA	±(0.12 % + 50 µA + 5 µA x (Vo/25))	±(0.1 % + 30 µA + 5 µA x (Vo/25))	[3]
±1 A	50 µA	50 µA	±(0.5 % + 500 µA + 50 µA x (Vo/25))	±(0.5 % + 300 µA + 50 µA x (Vo/25))	[4]

1. ± (% of output/measured value + offset current A (fixed part determined by the output/measurement range + proportional part that is multiplied by Vo)
2. Round up below decimal point for the value of (Vo/25).
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.

Power consumption (HPSMU)

Voltage source mode:

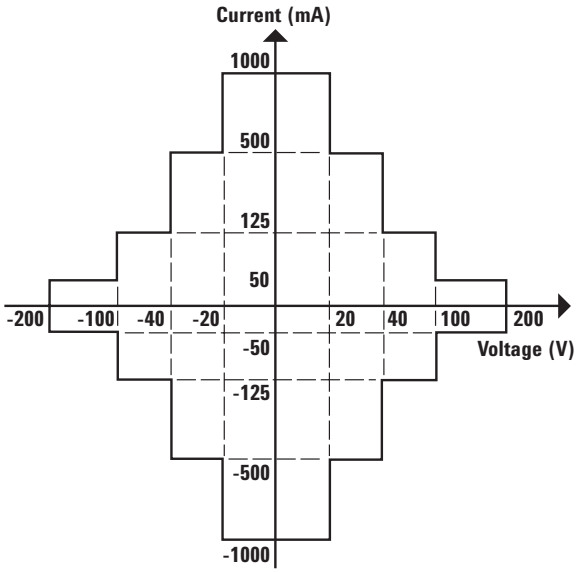
Voltage range	Power
2 V	20 x Ic (W)
20 V	20 x Ic (W)
40 V	40 x Ic (W)
100 V	100 x Ic (W)
200 V	200 x Ic (W)

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: ± 100 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 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)

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 and HPSMU 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 E5260A supports a time stamp function utilizing an internal quartz clock.

Resolution: 100 µs

Program Memory

The E5260A mainframe contains (volatile) memory that can be used to increase test measurement throughput. Program memory allows the storage of program code in the E5260A, 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:

1. Start a measurement
2. Start a measurement at each sweep step for a staircase sweep or multi channel sweep measurement
3. Start the source output at each sweep step for a staircase sweep, pulsed sweep, staircase sweep with pulsed bias, or multi-channel sweep measurement.
4. Start the pulsed output for a pulsed spot measurement.
5. 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:

1. The end of a measurement is reached.
2. The end of a measurement at each sweep step for a staircase sweep or multi channel sweep measurement is reached.
3. 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.
4. Completion of the pulsed output setup for a pulsed spot measurement.
5. 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 E5260A 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.

Attached Software

A VXI *plug&play* driver is supplied.

Supported operating systems:
Microsoft® Windows® XP Professional (SP3), Windows Vista Business (SP2, 32 bit), Windows 7 Professional (SP1, 32 bit or 64 bit)

General Specifications

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

Humidity range
Operating: 15 % to 80 % RH, non-condensing
Storage: 5 % to 90 % 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)
E5260A: 600 VA

Regulatory compliance
EMC: IEC 61326-1:+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
E5260A: 426 mm W x 235 mm H x 575 mm D

Weight
E5260A (empty): 17 kg
E5290A: 2.5 kg
E5291A: 1.4 kg

Furnished accessories
Software CD-ROM (including VXI*plug&play* driver)

Other Agilent Products

Agilent B2900A Series Precision Source/Measure Unit
www.agilent.com/find/B2900A

Agilent B1500A Semiconductor Device Analyzer
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Agilent B1505A Power Device Analyzer/ Curve Tracer (40A/3000V)
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