

High Precision Source Meter

S2035H/S2036H

[Datasheet V1.3](#)

Based on the digital control loop technology, the S2035H/S2036H achieve higher voltage and current accuracy and support multi-unit synchronous testing. They provide ± 200 V, ± 1 A (DC), and ± 3 A (pulsed) output with a constant power of 20 W, a maximum sampling rate of 1 Msp/s and a minimum measurement resolution of 1 fA/100 nV.



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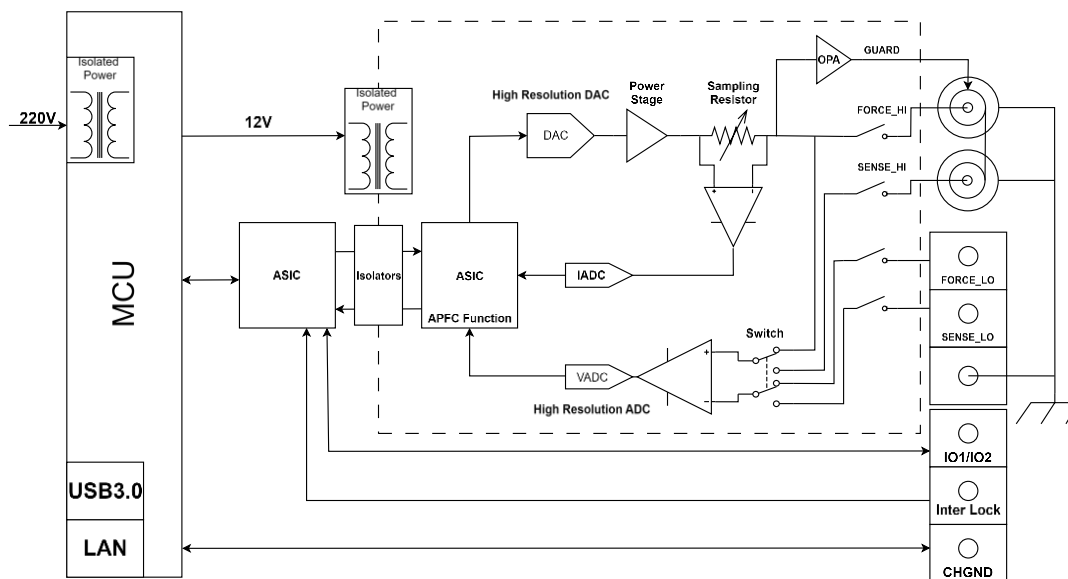


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1 Product Description

The Semight S2035H/S2036H Precision Source/Measure Units are compact and cost-effective single/dual-channel bench-top Source/Measure Units (SMUs) with the capability to source and measure both voltage and current. These capabilities make the S2035H/S2036H ideal for a wide variety of IV (current versus voltage) measurement tasks that require both high resolution and accuracy.

The S2035H/S2036H provide best-in-class performance for a modest price. They have broad voltage (± 200 V) and current (± 1 A DC and ± 3 A pulsed) sourcing capability, excellent precision, a 6.5-digit display (minimum 1 fA/100 nV display resolution) and a superior color LCD graphical user interface (GUI), and support conventional SMU SCPI commands for easy test code migration. These features improve efficiency and lower the cost of ownership when integrating the SMUs into systems for production test.



[illegible]

2 Features and Benefits

APFC System

Supports user modification of APFC (Adaptive Precision-fast Control) parameters.

Users can adjust the parameters based on load characteristics to achieve precise and rapid output characteristics.



Waveforms Comparison Before and After APFC Adjustment

Maximum Range

Output range: ± 200 V, ± 1 A (DC), ± 3 A (pulsed). A single SMU product covers both high voltage and high current measurement needs.

Minimum Measurement Resolution

Current and voltage measurement resolution down to 1 fA and 100 nV. Can make low-level measurements using a low-cost bench-top SMU that were previously only possible using a more expensive semiconductor device analyzer.

High-speed Measurement

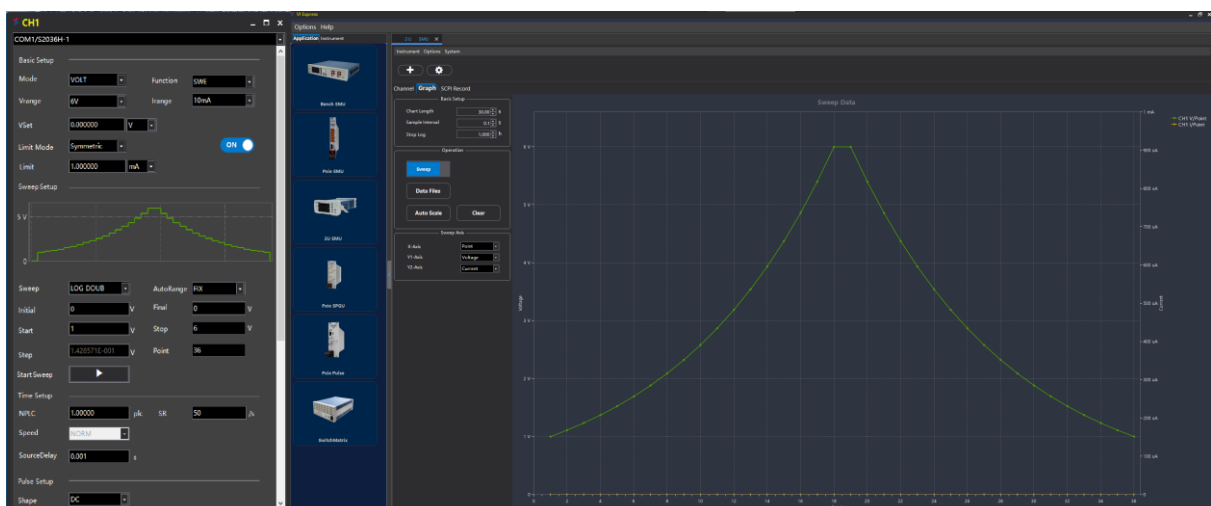
ADC sampling rates up to 1 Msps, with selectable NPLC (Number of Power Line Cycles) and sampling rate.

Sensing Mode

Supports 2-wire or 4-wire (remote-sensing) connections. Maximum sense lead resistance is 1 K Ω (for rated accuracy). Maximum voltage between remote sense output and sense terminals is 2 V.

Sweep Mode

Supports linear, logarithmic, and list sweeps in both single and double directions. The step interval is configurable from 1 μ s to 16 s, with a maximum of 10^6 points per sweep.



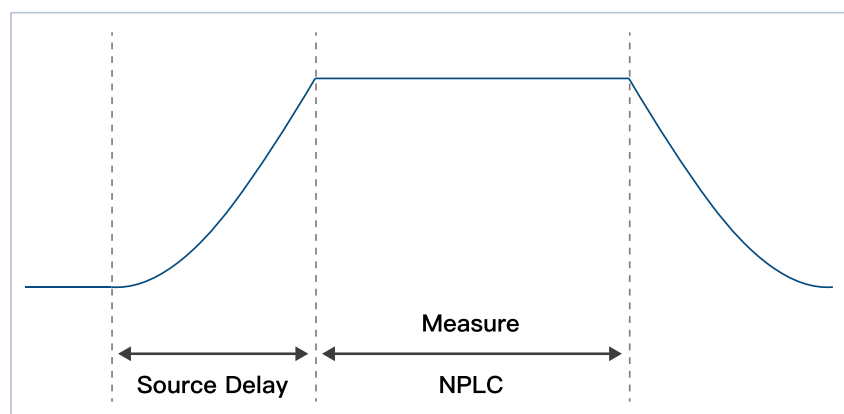
Double Logarithmic Sweep

Auto Ranging

Supports auto-ranging for both spot and sweep measurement. For overshoot-sensitive devices, it is recommended to turn off the output before switching ranges.

Source Delay

Supports Source Delay measurement. Users are recommended to set an appropriate Source Delay for more accurate measurements. Source Delay must exceed the source settling time, especially for low current ranges. When the sampling values are inaccurate, it is necessary to consider whether the Source Delay is appropriately set.



Source Delay and NPLC Setting Diagram

Protection

- Over-temperature protection: The system power shuts down at over temperature sensed internally.
- Over-current and over-voltage protection: Operation resumes after a hardware reset command or power cycling.
- DC floating voltage: ± 250 VDC.

Synchronous Triggering

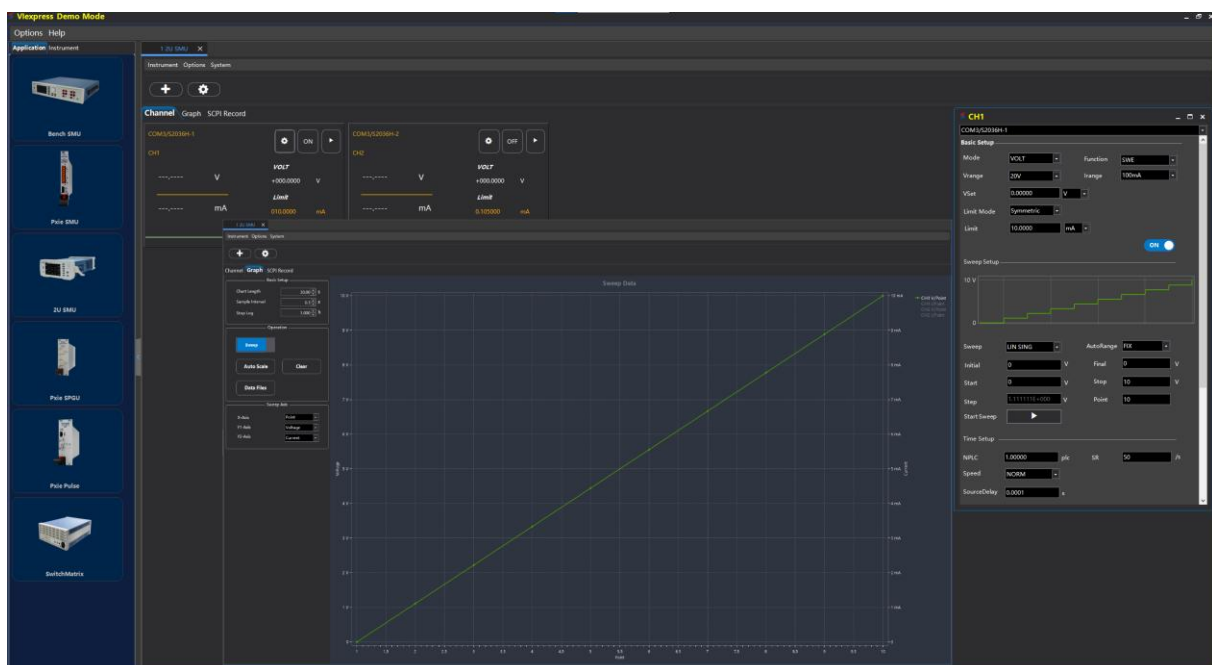
- The external trigger function provides 2/4 DIO trigger signals and must follow the principles: A channel can be configured with multiple I/O ports for trigger output, but only a single I/O port can be configured for trigger input at any given time; An I/O port can be configured as a trigger input for multiple channels, but it can only be configured as a trigger output for one channel at any given time.
- Pulse width: 100 ns to 1 ms (configurable); Active high.
- External DIO trigger level:

DIO Parameters	Maximum Rating Value
Absolute Maximum Input Voltage	5.25 V
Absolute Minimum Input Voltage	-0.25 V
Minimum Logic High Level	2.1 V

Maximum Logic Low Level	0.7 V
Maximum Logic Output Current	2 mA
Maximum Sink Current	-50 mA

Free PC-based GUI Control Software

Can make measurements and control remotely from a PC without the need to program.



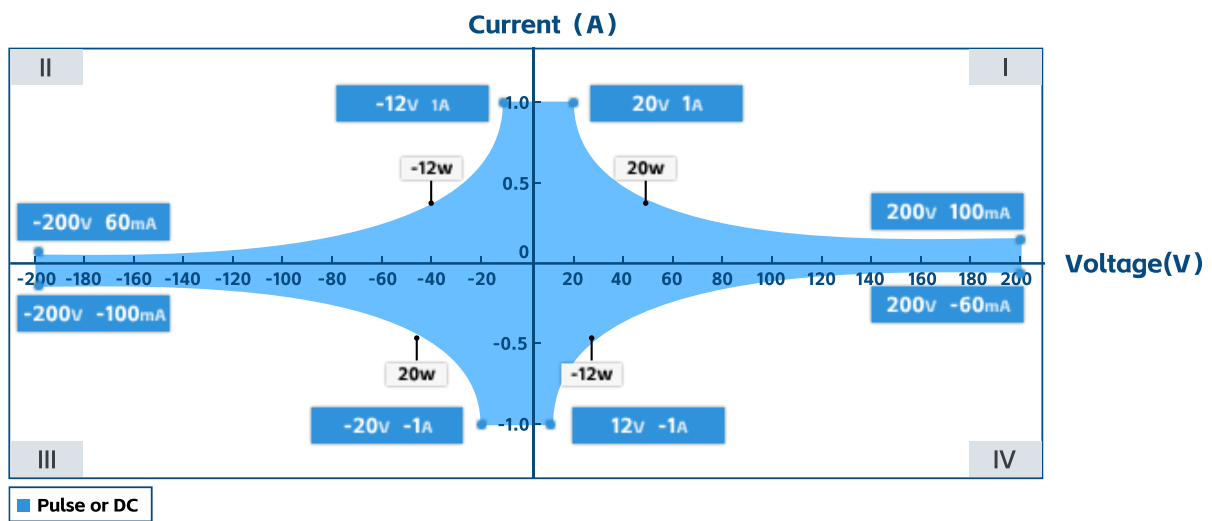
Software GUI

3 Specifications

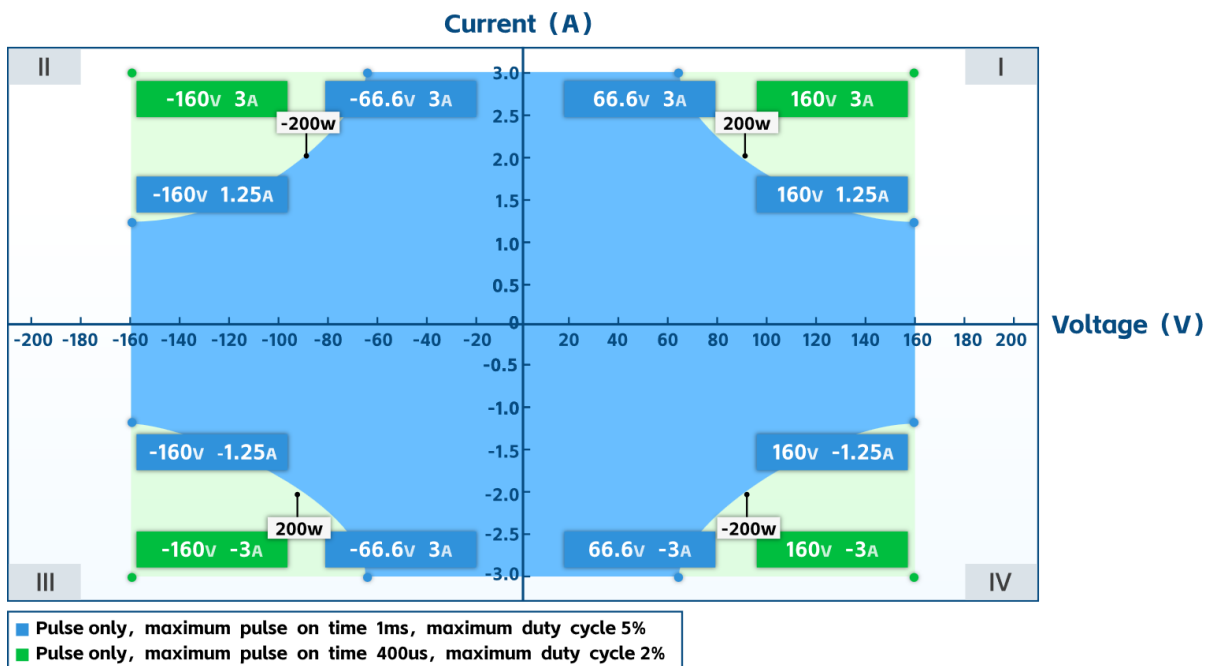
Operating Conditions:

- Temperature: $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$
- Humidity: 30% to 60% (RH)
- Measure after a 60-minute warm-up; Ambient temperature change less than $\pm 3^{\circ}\text{C}$ during measurement
- Calibration period: 1 year
- Measurement speed: 1 PLC (power line cycle)

SMU Output Capability



DC I-V Output Capability



Pulse I-V Output Capability

Voltage Programming and Measurement Resolution/Accuracy

	Range	Resolution	Accuracy (1 Year) $\pm$ (% reading + offset) ^[1]	Typical Noise (RMS) 0.1 Hz to 10 Hz
Voltage Accuracy	± 200 V ^[2]	100 μ V	0.03% + 10 mV	400 μ V
	± 40 V	10 μ V	0.03% + 2 mV	100 μ V
	± 20 V	10 μ V	0.03% + 1 mV	50 μ V
	± 2 V	1 μ V	0.03% + 100 μ V	10 μ V
	± 0.6 V	100 nV	0.03% + 50 μ V	2 μ V
Temperature Coefficient	$\pm$ (0.15 x Accuracy)/°C (0°C to 18°C, 28°C to 50°C)			
Overshoot	< $\pm 0.1\%$ (Normal; Step is 10% to 90% range, full-scale, resistive load)			
Noise 10 Hz to 20 MHz	< 5 mVrms (20 V voltage source, 1 A resistive load)			

[1] Example of calculating accuracy: To test the accuracy of a 120 mV output in the 600 mV range, the tolerance is:

$$\pm \left(\underset{\text{reading}}{120} \times 0.03\% + \underset{\text{offset}}{0.05} \right) \text{ mV} = \pm 0.086 \text{ mV}$$

[2] This instrument has a potentially dangerous high voltage (± 210 V) output to the HI / Sense HI / Guard terminals. To prevent electric shock, relevant safety precautions must be taken before powering on. Do not connect the Guard terminal to any output, including shorting it to the chassis ground or output LO, as this will damage the instrument.

Current Programming and Measurement Resolution/Accuracy

	Range	Resolution	Accuracy (1 Year) $\pm$ (% reading + offset)	Typical Noise (RMS) 0.1 Hz to 10 Hz
Current Accuracy	± 3 A ^[3]	1 μ A	0.03% + 2 mA	20 μ A
	± 1 A	100 nA	0.03% + 90 μ A	4 μ A
	± 100 mA	10 nA	0.03% + 9 μ A	600 nA
	± 10 mA	1 nA	0.03% + 900 nA	60 nA
	± 1 mA	100 pA	0.03% + 90 nA	6 nA
	± 100 μ A	10 pA	0.03% + 9 nA	700 pA
	± 1 μ A ^[4]	100 fA	0.03% + 200 pA	20 pA
	± 10 nA ^{[4][5]}	10 fA	0.06% + 9 pA	600 fA
	± 1 nA ^{[4][5]}	1 fA	0.1% + 3 pA	60 fA
	± 100 pA ^{[4][5]}	1 fA	0.3% + 1 pA	30 fA
Temperature Coefficient	$\pm$ (0.15 x Accuracy)/°C (0°C to 18°C, 28°C to 50°C)			
Overshoot	< $\pm 0.1\%$ (20 V voltage range, Normal; Step is 10% to 90% range, full-scale, resistive load)			

[3] 3 A range is available only for pulse mode, with typical accuracy.

[4] For accurate low current measurements, triaxial cable connection is recommended. Converting the triaxial output to standard wiring will affect current measurement accuracy.

[5] Condition: NPLC = 10 PLC.

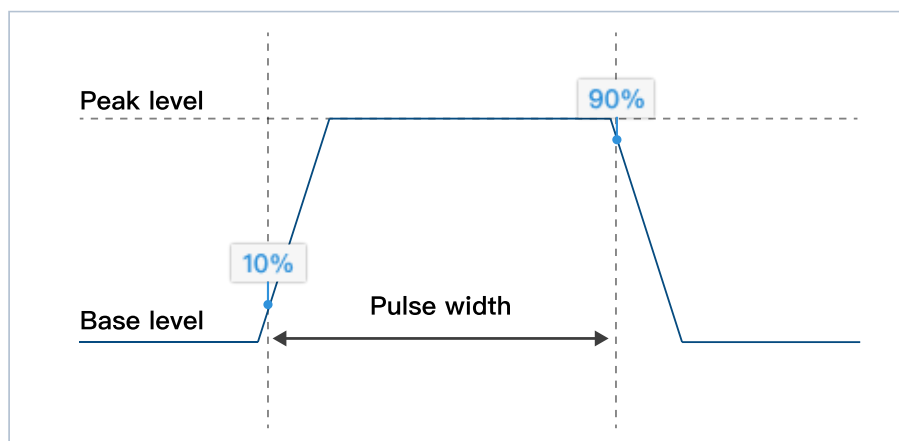
Resistance Measurement Resolution/Accuracy (4-Wire)

	Range	Resolution	Default Test Current	Accuracy (1 Year) $\pm$ (% reading + offset)
Resistance Measurement Accuracy	600 m Ω	100 n Ω	1 A	0.07% + 50 $\mu\Omega$
	6 Ω	1 $\mu\Omega$	100 mA	0.07% + 500 $\mu\Omega$
	60 Ω	10 $\mu\Omega$	10 mA	0.07% + 5 m Ω
	600 Ω	100 $\mu\Omega$	1 mA	0.07% + 50 m Ω
	6 K Ω	1 m Ω	100 μ A	0.07% + 500 m Ω
	60 K Ω	10 m Ω	10 μ A	0.15% + 5 Ω
	600 K Ω ^[6]	100 m Ω	1 μ A	0.08% + 50 Ω
	6 M Ω ^[6]	1 Ω	100 nA	0.26% + 500 Ω
	60 M Ω ^[6]	10 Ω	10 nA	0.18% + 5 K Ω
	600 M Ω ^[6]	100 Ω	1 nA	0.43% + 50 K Ω
	6 G Ω ^[6]	1 K Ω	100 pA	1.35% + 500 K Ω
Temperature Coefficient	$\pm$ (0.15 x Accuracy)/ $^{\circ}$ C (0 $^{\circ}$ C to 18 $^{\circ}$ C, 28 $^{\circ}$ C to 50 $^{\circ}$ C)			
Manual Current Source Resistance Measurement (4-Wire)	Total Error = Measured Voltage / Current Source Set Current = Resistance Reading x (Voltage Source Range Gain Error Percentage + Ammeter Range Gain Error Percentage + Current Source Range Offset Error / Set Current) + (Voltage Source Range Offset Error / Set Current Value) Example: Current Source Set Current = 1 A, Voltage Measurement Range = 600 mV Total Error = (0.03% + 0.03% + 90 μA / 1 A) + (50 μV / 1 A) $\approx$ 0.07% + 50 $\mu\Omega$			

[6] Condition: NPLC = 10 PLC.

Pulse Source Specifications

Item	Specification
Minimum Programmable Pulse Width	100 μ s
Pulse Width Programming Resolution	1 μ s
Pulse Width Programming Accuracy	± 10 μ s
Pulse Width Jitter	2 μ s
Pulse Width Definition	The time from 10% leading to 90% trailing edge as follows



Pulse Width Definition

Maximum Current Limit	Maximum Pulse Width	Maximum Duty Cycle
0.1 A/200 V	DC, no limit	100%
1 A/20 V	DC, no limit	100%
3 A/66.6 V	1 ms	5%
3 A/160 V	400 μ s	2%

Pulse Source Rise Time

Output	Maximum Output	Rise Time ^[7]	Settling Time ^[8]	Test Load
Voltage Source	160 V	800 μs	1.2 ms	No load
	40 V	400 μs	800 μs	
	20 V	100 μs	400 μs	
Current Source	3 A to 1 mA	90 μs	250 μs	Full load ^[9]
	100 μA	120 μs	400 μs	
	1 μA	800 μs	1.2 ms	
	10 nA	5 ms	20 ms	
	1 nA	10 ms	50 ms	
	100 pA	100 ms	500 ms	

[7] Time required for the pulse leading edge to rise from 10% to 90%.

[8] Time required for the pulse to reach within 1% of final value.

[9] Test conditions: Normal mode, resistive full load, voltage rises to 6 V.

Output Settling Time

Output	Range	Output Settling Time ^[10]			Test Condition
		Fast ^[11]	Normal	Slow	
Voltage Source	200 V	< 600 μ s	< 1.2 ms	< 2 ms	Time required to reach within 0.1% of final value at open load condition. Step is 10% to 90% range.
	40 V	< 200 μ s	< 400 μ s	< 900 μ s	
	20 V	< 100 μ s	< 200 μ s	< 600 μ s	
	2 V	< 300 μ s	< 300 μ s	< 300 μ s	
	0.6 V	< 300 μ s	< 300 μ s	< 300 μ s	
Current Source	3 A to 1 mA	< 150 μ s	< 200 μ s	< 0.8 ms	Time required to reach within 0.1% (0.3% for 3 A range) of final value under Normal mode at full load with the voltage output rising to 6 V. Step is 10% to 90% range.
	100 μ A	< 150 μ s	< 250 μ s	< 0.8 ms	
	1 μ A	< 1 ms	< 1 ms	< 1 ms	
	10 nA	< 10 ms	< 10 ms	< 10 ms	
	1 nA	< 50 ms	< 50 ms	< 50 ms	
	100 pA	< 500 ms	< 500 ms	< 500 ms	

[10] Output slew rate: Fast, Normal, Slow modes. Users can adjust APFC parameters according to load characteristics to achieve appropriate settling time or stability.

[11] Fast mode may exhibit significant output overshoot under different ranges or load conditions. For devices sensitive to overshoot, Normal or Slow mode is recommended.

Sampling Rate and NPLC Setting

Setting	Range
NPLC	0.00005 PLC to 10 PLC
Sampling Rate	5 sps to 1 Msps

Measurement Accuracy Derating

Add % of range using the following table for measurement with PLC < 1.

PLC	Range							
	0.6 V	2 V	20 V	40 V	200 V	100 pA to 1 μ A	100 μ A to 100 mA	1 A to 3 A
0.1	0.02%	0.02%	0.01%	0.01%	0.01%	0.02%	0.01%	0.01%
0.01	0.30%	0.30%	0.30%	0.03%	0.02%	0.20%	0.02%	0.02%
0.001	3.20%	3.20%	3.20%	0.40%	0.10%	2.50%	0.03%	0.03%

Communication Port

Function	Specification
Ethernet	1000BASE-T / 100BASE-T
USB	USB 3.0 HOST (Front)
	USB 3.0 DEVICE (Rear)
Digital I/O	S2035H: IO1, IO2 Sync Port
	S2036H ^[12] : IO1, IO2, IO3, IO4 Sync Port

[12] S2036H: CH1 corresponds to IO1 and IO2; CH2 corresponds to IO3 and IO4.

Front Panel

Display	5.0" TFT LCD display (800 x 480, with capacitive touchscreen)
Hardkeys	Home, Menu, Exit, Enter, Trigger, Up, Down, Power, Rotary Knob, On/Off
Softkeys	LCD Mapping Function Keys
Interfaces	USB Host Interface

Rear Panel

Interfaces	Output Connector, Ethernet Port, USB Device Interface, AC Mains Input Receptacle with Switch, Chassis Ground Screw
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Environmental Specifications

Item	Specification
Environment	For use in indoor facilities
Operating	0°C to +50°C, 30% to 60% RH, non-condensing
Storage	-30°C to 70°C, 10% to 90% RH, non-condensing
Altitude	Operation: 0 m to 2000 m, Storage: 0 m to 4600 m
Power Supply	Voltage Range: 100 VAC to 240 VAC, Frequency Range: 50/60 Hz, Maximum Power: 250 W, Fuse Specification: T3.15AH 250 VAC
Warm-up	1 hour
Pollution Degree	2
Dimensions	404.5 mm x 217.5 mm x 105.5 mm (with feet, handles, and knob) 446 mm x 233 mm x 112 mm (with protective cover)

Net Weight

S2035H: 5.2 kg; S2036H: 5.7 kg

4 Ordering Information

Power cable, USB cable, Ethernet cable, LO terminal connector, Digital I/O connector (cable not included), Quick Reference, USB Drive (including PDF manuals, Quick I/V Measurement Software, and drivers).

Model Number	
S2035H	High Precision Source Meter, 1ch
S2036H	High Precision Source Meter, 2ch
Options	
TA-01003	Output Expansion Adapter, Triaxial to Screw Terminals, 250 V, 1 A
TA-01007	Triaxial to Banana Plug Extension Adapter, Male-to-Female, 0.75 m, 250 V, 1 A
Consumables/Accessories	
TA-03001	Triaxial Output Cable, Male-to-Male, 0.6 m, 250 V, 1 A
TA-03002	Triaxial Output Cable, Male-to-Male, 1.5 m, 250 V, 1 A
TA-03003	Triaxial Output Cable, Male-to-Male, 4 m, 250 V, 1 A
Service (Select One)	
R3C	Factory Extended Warranty Service Plan – 36 Months
R5C	Factory Extended Warranty Service Plan – 60 Months

5 Warranty

No.	Item	Content	Warranty Period
1	Main Unit	Free repair within warranty	12 months
2	Options	Consumables and accessories are not covered under warranty	3 months
3	Calibration Interval	Factory calibrated or calibrated at the nearest Semight service center	12 months



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