

Precision Source Meter

S3022F

 [Data Sheet V2.6](#)

- Dual-channel, compact and cost-effective
- Simultaneous voltage/current sourcing and measurement
- Multi-unit synchronization support
- Output ± 200 V, ± 3 A (DC), ± 10 A (pulsed), 30 W maximum
- Sampling rate up to 1 Msps; measurement resolution down to 100 fA/100 nV



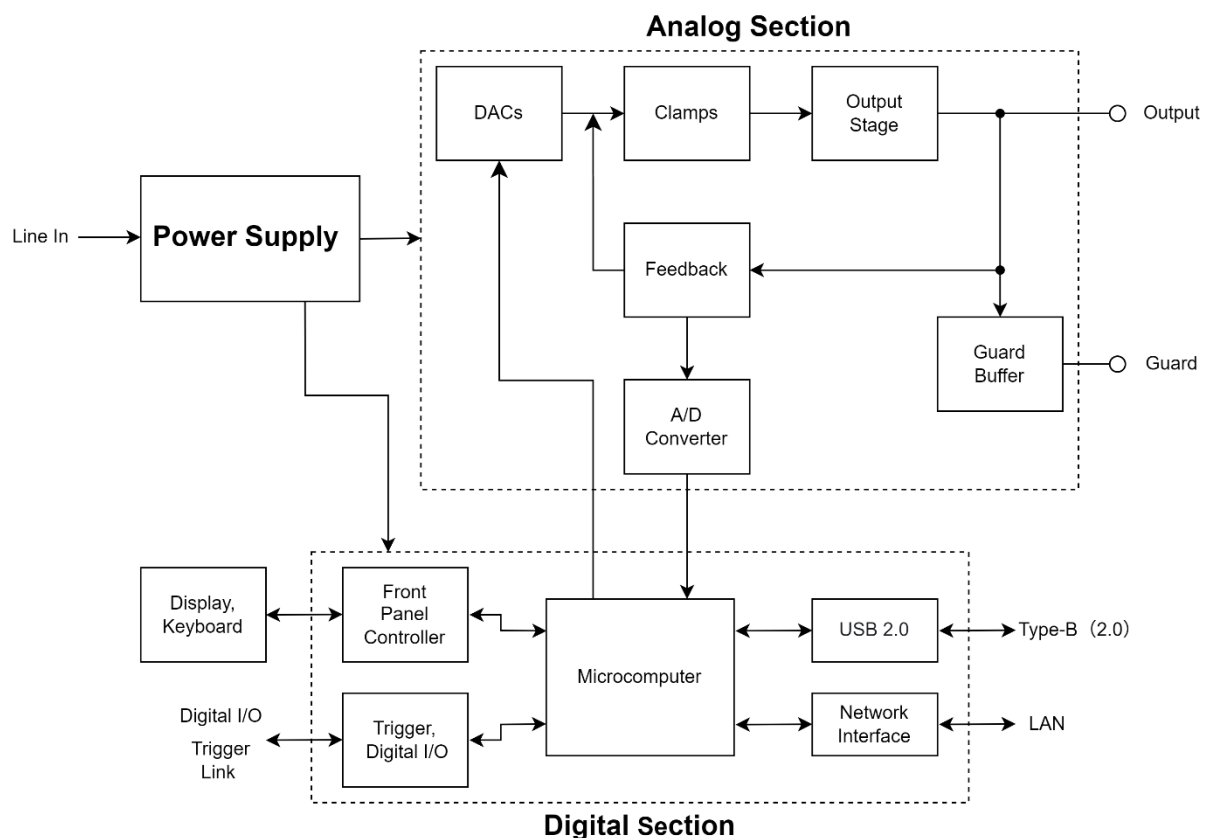
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Product Description

The Semight S3022F Precision Source/Measure Unit is a compact and cost-effective dual-channel benchtop Source/Measure Unit (SMU) with the capability to source and measure both voltage and current. These features make the S3022F an ideal choice for a wide range of IV (current versus voltage) measurement tasks that require both high resolution and accuracy.

The Semight S3022F provides best-in-class performance for a modest price. It has broad voltage (± 200 V) and current (± 3 A DC and ± 10 A pulsed) sourcing capability, excellent precision, 6.5-digit display (minimum 100 fA/100 nV resolution) and possesses a superior color LCD graphical user interface (GUI).



S3022F Block Diagram

Features and Benefits

Integrated Dual-Channel, 4-Quadrant Sourcing and Measuring Capabilities

Easily and accurately measure current and voltage using a single instrument without the need to manually change any connections.

Measurement Range

Wide voltage and current ranges: ± 200 V, ± 3 A (DC), ± 10 A (pulsed).

A single SMU product covers both high voltage and high current measurement needs, allowing for more standardization and simplifying inventory and support concerns.

Minimum Measurement Resolution

Measurement resolution down to 100 fA/100 nV.

Can make low-level measurements using a low-cost benchtop SMU that were previously only possible using a more expensive semiconductor device analyzer.

High-Speed Measurement

Supports an ADC sampling rate up to 1 Msps, with selectable NPLC and sampling rate.

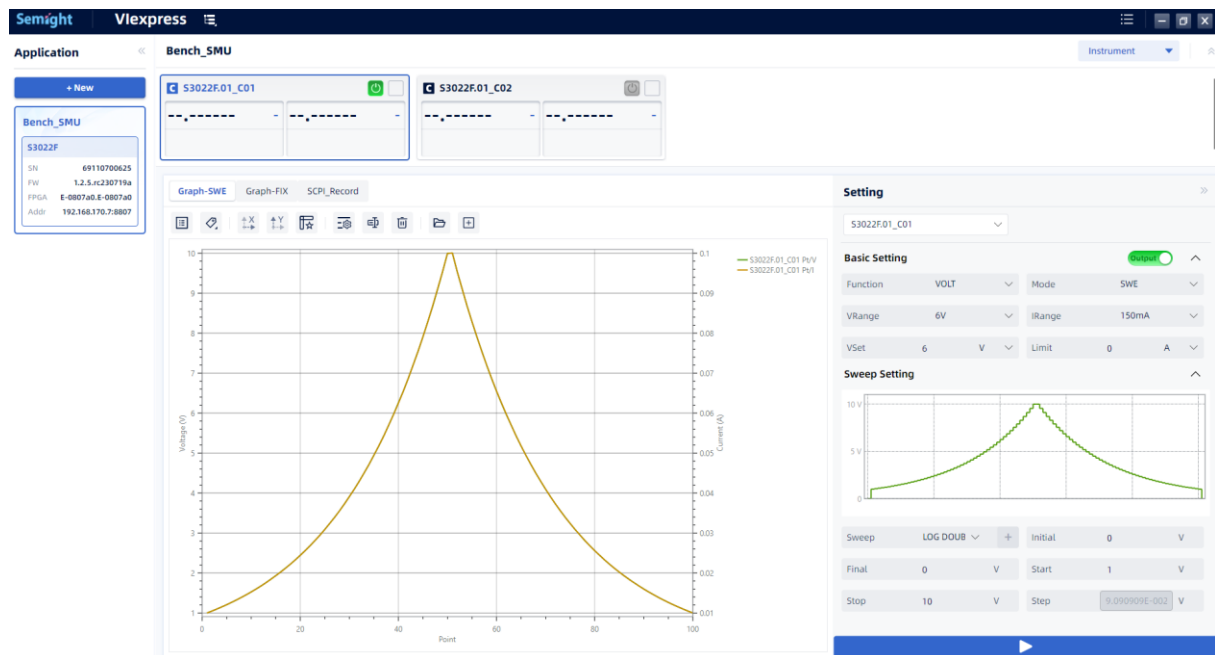
Sensing Mode

Supports 2-wire or 4-wire (remote sense) connections; maximum sense lead resistance: 1 k Ω (at rated accuracy); maximum voltage between the output and sense terminals in remote sense mode: 2 V.

Sweep Mode

Supports linear, logarithmic, and list sweeps in both single and double directions.

The sweep interval is configurable from 1 μ s to 16 s, with a maximum of 64K points per sweep.



Double Logarithmic Sweep

Auto Ranging

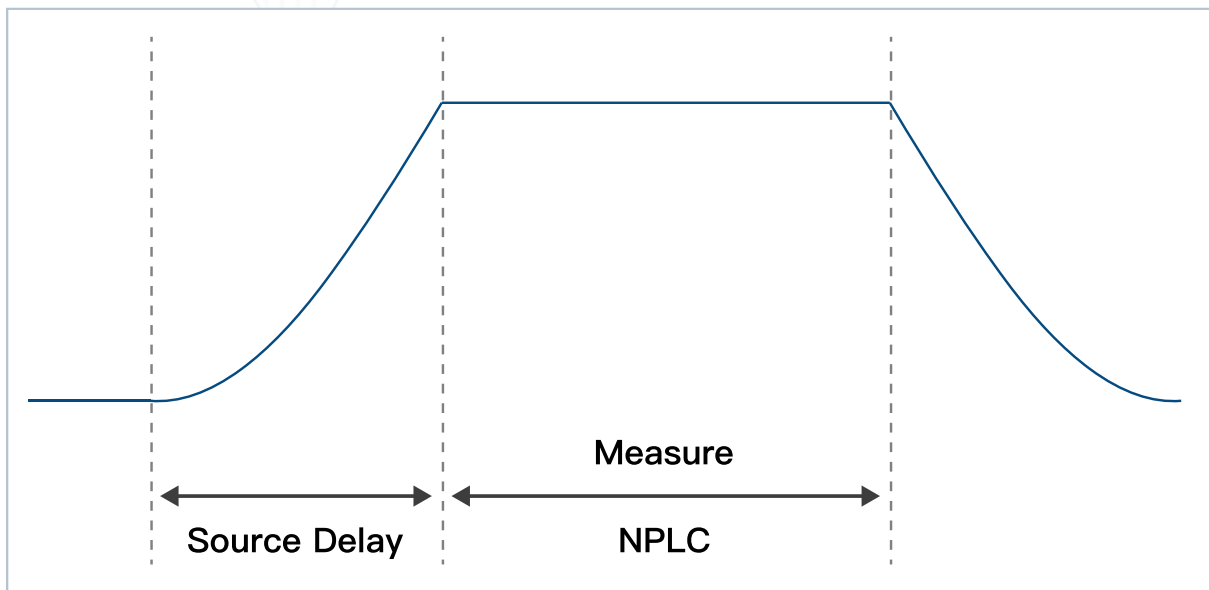
Supports auto-ranging for both spot and sweep measurements.

For overshoot-sensitive devices, it is recommended to turn off the output before switching ranges.

Source Delay

Supports Source Delay measurement.

Users should set an appropriate Source Delay for more accurate measurements.



Source Delay and NPLC Setting Diagram

Note: Source Delay must exceed the source settling time. When the sampling values are inaccurate, it is necessary to consider whether the Source Delay is appropriately set, especially for low-current ranges.

Protection

Supports over-temperature protection. Output turns off at over temperature sensed internally, and operation resumes once the temperature falls below 65°C.

Output turns off when the output voltage exceeds the OVP setting. Further operation is available after device reset. Accuracy: $\pm$ (1% of setting + 500 mV).

Supports Conventional and Default SCPI Commands

Supports conventional SCPI commands.

Conventional SCPI commands provide some compatibility with older SMU code (such as Keithley 2400 series) to minimize code conversion work.

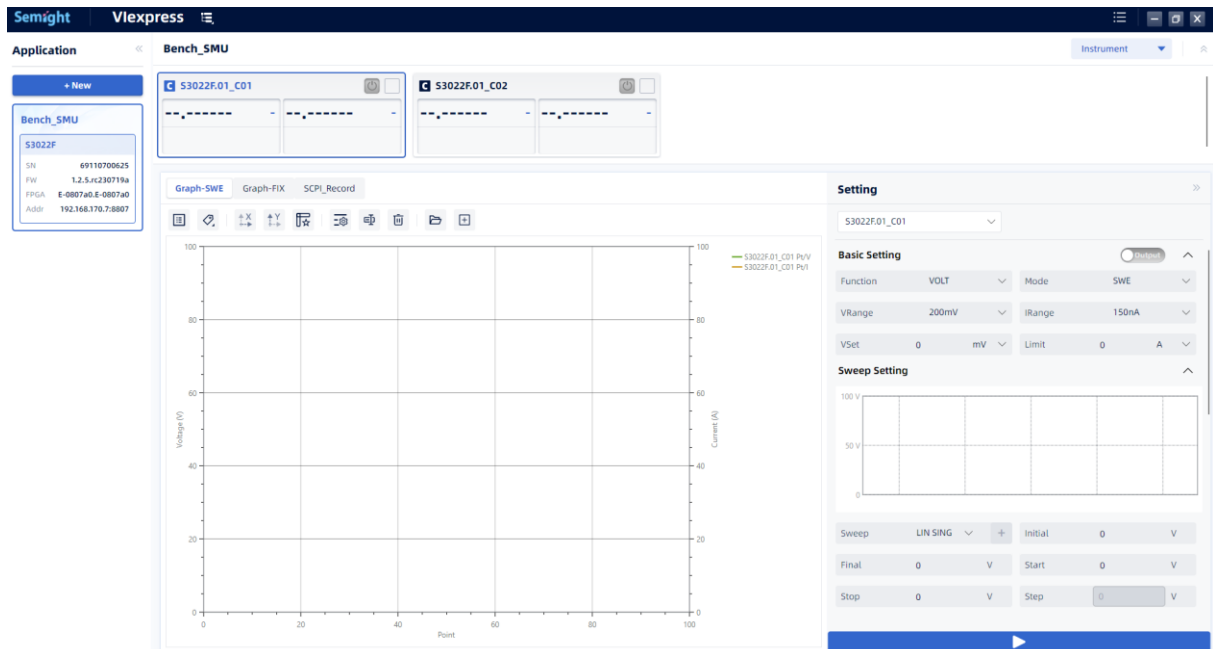
5.0-inch Color LCD Capacitive Touchscreen

User-friendly front panel GUI with a 5.0-inch color LCD capacitive touchscreen.

Can quickly and easily perform measurements and display data on the front panel, thereby greatly speeding up interactive test, characterization and debug operations.

Software Function

The GUI is highly intuitive and concise. Users can perform remote measurement and control from a PC without programming.



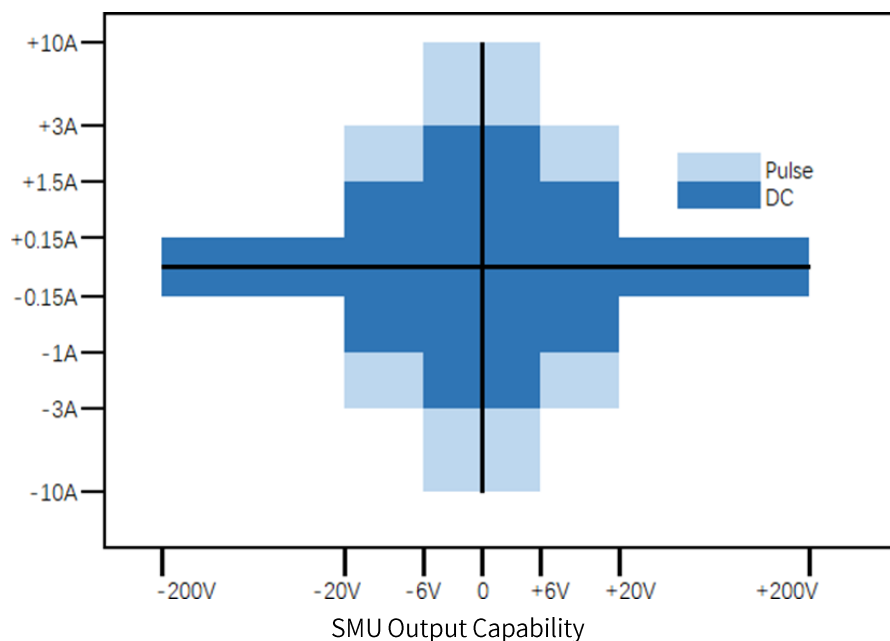
Software GUI

Specifications

Operating Conditions:

- Temperature: 23°C $\pm$ 5°C;
- Humidity: 30% to 70% (RH);
- Measure after 60 minutes warm-up; ambient temperature change must be less than $\pm$ 3°C during measurement;
- Calibration Period: 1 year;
- Measurement Speed: 1 PLC (power line cycle).

SMU Output Capability



Voltage Source Specifications

Item	Specification			
Voltage Setting Accuracy	Range	Resolution	Accuracy (1 Year) ^[1] ± (% reading + offset)	Typical Noise (RMS) 0.1 Hz to 10 Hz
	±200 V ^[2]	1 mV	0.02% + 30 mV	1.5 mV
	±20 V	100 µV	0.02% + 2 mV	160 µV
	±6 V	50 µV	0.02% + 500 µV	36 µV
	±200 mV	1 µV	0.02% + 120 µV	4 µV
Temperature Coefficient	± (0.15 x Accuracy) /°C (0°C to 18°C, 28°C to 50°C)			
Maximum Output Power per Channel	30 W: ±20 V @ 1.5 A; 30 W: ±200 V @ 0.15 A; 18 W: ±6 V @ 3 A			
Setting Time	< 800 µs			
Overshoot	< ±0.1% (6 V voltage range, Normal mode, step is 10% to 90% range, full-scale, resistive load)			
Noise 10 Hz to 20 MHz	< 3 mVrms (6 V voltage source, 3 A resistive load)			

- [1] Example of calculating accuracy: To test the accuracy of a 120 mV output in the 200 mV range, the tolerance is:

$$\pm \left(\underset{\text{reading}}{120} \times 0.02\% + \underset{\text{offset}}{0.12} \right) \text{ mV} = \pm 0.144 \text{ mV}$$

- [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 Source Specifications

Item	Specification			
Current Setting Accuracy	Range	Resolution	Accuracy (1 Year) $\pm$ (% reading + offset)	Typical Noise (RMS) 0.1 Hz to 10 Hz
	± 10 A ^[1]	50 μ A	0.4% + 40 mA	N/A
	± 3 A	15 μ A	0.05% + 2 mA	40 μ A
	± 1.5 A	10 μ A	0.02% + 500 μ A	20 μ A
	± 150 mA	1 μ A	0.02% + 25 μ A	5 μ A
	± 15 mA	100 nA	0.02% + 6 μ A	700 nA
	± 1.5 mA	10 nA	0.02% + 250 nA	16 nA
	± 150 μ A	1 nA	0.02% + 25 nA	1 nA
	± 15 μ A	100 pA	0.02% + 3 nA	140 pA
	± 1.5 μ A	10 pA	0.03% + 450 pA	25 pA
	± 150 nA	1 pA	0.05% + 250 pA	5 pA
Temperature Coefficient	$\pm$ (0.15 x Accuracy) /°C (0°C to 18°C, 28°C to 50°C)			
Maximum Output Power per Channel	30 W: ± 20 V @ 1.5 A; 30 W: ± 200 V @ 0.15 A; 18 W: ± 6 V @ 3 A			
Setting Time	< 500 μ s			
Overshoot	< $\pm 0.1\%$ (6 V voltage range, Normal mode, step is 10% to 90% range, full-scale, resistive load)			

- [1] 10 A range is available only for pulse mode, with typical accuracy.

Voltage Measurement Specifications

Item	Specification		
Voltage Measurement Accuracy	Range	Resolution	Accuracy (1 Year) $\pm$ (% reading + offset)
	± 200 V	100 μ V	0.02% + 30 mV
	± 20 V	10 μ V	0.02% + 2 mV
	± 6 V	1 μ V	0.02% + 500 μ V
	± 200 mV	100 nV	0.02% + 120 μ V
Temperature Coefficient	$\pm (0.15 \times \text{Accuracy}) / ^\circ\text{C}$ (0°C to 18°C, 28°C to 50°C)		

Current Measurement Specifications

Item	Specification		
Current Measurement Accuracy	Range	Resolution	Accuracy (1 Year) $\pm$ (% reading + offset)
	± 10 A ^[1]	10 μ A	0.4% + 25 mA
	± 3 A	10 μ A	0.05% + 2 mA
	± 1.5 A	1 μ A	0.02% + 500 μ A
	± 150 mA	100 nA	0.02% + 25 μ A
	± 15 mA	10 nA	0.02% + 6 μ A
	± 1.5 mA	1 nA	0.02% + 250 nA
	± 150 μ A	100 pA	0.02% + 25 nA
	± 15 μ A	10 pA	0.02% + 3 nA
	± 1.5 μ A ^[2]	1 pA	0.03% + 450 pA
	± 150 nA ^[2]	100 fA	0.05% + 250 pA
Temperature Coefficient	$\pm (0.15 \times \text{Accuracy}) / ^\circ\text{C}$ (0°C to 18°C, 28°C to 50°C)		

[1] 10 A range is available only for pulse mode, with typical accuracy.

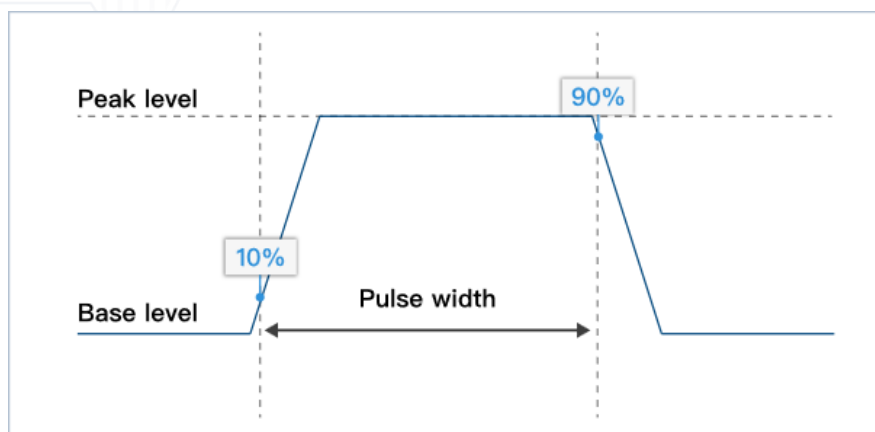
[2] For low-current measurement, it is recommended to use a triaxial cable for connection. Connect ForceHi to the inner conductor, Guard to the inner shield, and the outer shield to protective ground. Connect ForceLo to the inner conductor, leave the inner shield unconnected, and connect the outer shield to protective ground. The triaxial cable must have a rated insulation voltage of at least 250 V.

Resistance Measurement Resolution/Accuracy (4-Wire)

Item	Specification			
Resistance Measurement Accuracy	Range	Resolution	Default Test Current	Typical Accuracy (1 Year) ± (% reading + offset)
	1 Ω	1 μΩ	1.5 A	0.073% + 0.3334 mΩ
	10 Ω	10 μΩ	150 mA	0.057% + 3.334 mΩ
	100 Ω	100 μΩ	15 mA	0.08% + 33.34 mΩ
	1 kΩ	1 mΩ	1.5 mA	0.057% + 333.4 mΩ
	10 kΩ	10 mΩ	150 μA	0.057% + 3.334 Ω
	100 kΩ	100 mΩ	15 μA	0.06% + 33.34 Ω
	1 MΩ	1 Ω	1.5 μA	0.06% + 333.4 Ω
	10 MΩ	10 Ω	0.15 μA	0.35% + 3.334 kΩ
	100 MΩ	100 Ω	0.05 μA	0.95% + 10 kΩ
Temperature Coefficient	± (0.15 x Accuracy) /°C (0°C to 18°C, 28°C to 50°C)			
Manual Current Source Resistance Measurement (4-wire)	<p>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)</p> <p>Example: Current Source Set Current = 1.5 A, Voltage Measurement Range = 6 V</p> <p>Total Error = (0.02% + 0.02% + 500 μA / 1.5 A) + (500 μV / 1.5 A) ≈ 0.073% + 0.3334 mΩ</p>			

Pulse Source Specifications (4-Wire)

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



Pulse Width Definition

Pulse Specifications	Maximum Current Limit	Maximum Pulse Width	Maximum Duty Cycle
1	0.15 A/200 V	DC, no limit	100%
2	1.5 A/20 V	DC, no limit	100%
3	3 A/6 V	DC, no limit	100%
4	3 A/20 V	1 ms	10%
5	10 A/6 V	1 ms	10%

Pulse Source Rise Time (4-Wire)

Output	Range	Typical Rise Time ^{[1][3]}	Typical Settling Time ^{[2][3]}	Test Load
Voltage Source	200 V	600 μ s	1.5 ms	No load
	20 V	200 μ s	360 μ s	
	6 V	160 μ s	300 μ s	
Current Source	10 A	140 μ s	320 μ s	6 V voltage range, full load
	3 A	120 μ s	280 μ s	
	1.5 A	120 μ s	280 μ s	
	150 mA	120 μ s	280 μ s	
	15 mA	120 μ s	280 μ s	
	1.5 mA	120 μ s	280 μ s	

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

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

[3] The current source test is based on the 6 V voltage range, with a 105% full-scale clamp setting.

Output Settling Time

Output	Range	Typical Output Settling Time			Condition
		Fast ^{[1][2]}	Normal ^[1]	Slow ^[1]	
Voltage Source	200 V	< 1.3 ms	< 1.5 ms	< 2.5 ms	Time required to reach within 0.1% of final value at open load condition. Step is 10% to 90% range
	20 V	< 300 μ s	< 360 μ s	< 1 ms	
	6 V	< 150 μ s	< 250 μ s	< 1 ms	
	200 mV	< 200 μ s	< 250 μ s	< 1 ms	
Current Source	3 A	< 200 μ s	< 280 μ s	< 1.2 ms	Time required to reach within 0.1% of final value (0.3% for the 3 A range) under full-load conditions. Step is 10% to 90% range. 6 V voltage range, 105% full-scale clamp setting
	1.5 A	< 200 μ s	< 280 μ s	< 1.2 ms	
	150 mA	< 200 μ s	< 280 μ s	< 1.2 ms	
	15 mA	< 200 μ s	< 280 μ s	< 1.2 ms	
	1.5 mA	< 200 μ s	< 280 μ s	< 1.2 ms	
	150 μ A	< 250 μ s	< 300 μ s	< 1.2 ms	
	15 μ A	< 250 μ s	< 1.2 ms	< 2 ms	
	1.5 μ A	< 600 μ s	< 1.2 ms	< 5 ms	
	150 nA	< 600 μ s	< 5 ms	< 12 ms	

[1] Output slew rate: Fast, Normal, Slow modes.

[2] Fast mode may exhibit significant output overshoot under different ranges or load conditions. For devices sensitive to overshoot, 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 (PLC < 1)

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

PLC	Range							
	200 mV	6 V	20 V to 200 V	150 nA to 1.5 μ A	15 μ A	150 μ A	1.5 mA to 150 mA	1.5 A to 3 A
0.1	0.02%	0.01%	0.01%	0.02%	0.01%	0.01%	0.01%	0.01%
0.01	0.3%	0.02%	0.02%	0.2%	0.04%	0.02%	0.02%	0.02%
0.001	2.9%	0.35%	0.36%	1%	0.4%	2.9%	1.7%	2.7%

Warning: This instrument has a potentially dangerous high voltage (± 210 V) output to the High Force / High Sense / 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.

Communication Port

Function		Description
Ethernet		100BASE-T/10BASE-T
USB		USB2.0 HOST (Front)
		USB2.0 DEVICE (Rear)
Digital I/O DB9 Absolute Max Input Voltage: 5.25 V Absolute Min Input Voltage: -0.25 V Min Logic High Level: 2.1 V Max Logic Low Level: 0.7 V Max Logic Output Current: 2 mA Max Sink Current: -50 mA	Pin5	Ground
	Pin6	IO1, CH1 digital I/O, Sync signal input (single/dual-channel sync mode)
	Pin7	IO2, CH1 digital I/O, Sync signal output (single-channel sync mode)
	Pin8	IO3, CH2 digital I/O, Sync signal output (dual-channel sync mode), Sync signal input (single-channel sync mode)
	Pin9	IO4, CH2 Digital I/O, Syn signal output (single-channel sync mode)

Certification

Item	Description
CE	LVD Directive 2014/35/EU, Standards: EN 61010-1:2010+A1:2019 EMC Directive 2014/30/EU, Standards: EN IEC 61326-1:2021
RoHS	RoHS Directive (EU) 2015/863 amending 2011/65/EU, Standards: IEC 62321-1:2013, IEC 62321-2:2021
FCC	Standards: 47 CFR Part 15, Subpart B
IC	Standards: ICES-003: Issue 7 October 2020

Front Panel

Area	Description
Display	5.0-inch TFT LCD, capacitive touch, resolution 800 x 480
Hardkeys	Trigger, Home, Enter, Cancel, Power, Channel Switch, Rotary Knob
Softkeys	LCD-Mapped Function Keys
Interfaces	USB Host Interface, Output Interface, Chassis Ground Interface

Rear Panel

Area	Description
Interfaces	Ethernet Interface, DB9 Interface, USB Device Interface, AC Power Inlet, Fan, Chassis Ground Screw

Environmental Specifications

Item	Specification
Environment	For use in indoor facilities
Operating	0°C to +50°C, 30% to 70% RH, non-condensing
Storage	−30°C to +70°C, 10% to 90% RH, non-condensing
Altitude	Operating: 0 m to 2000 m Storage: 0 m to 4600 m
Pollution Degree	2
Degree of Ingress Protection	IP20
Power Supply	Voltage range: 100 to 240 VAC Frequency range: 50/60 Hz Maximum power: 250 W Fuse rating: T3.15AH 250 VAC
Mains Supply Voltage Fluctuations	±10% of nominal voltage (90% to 110% of nominal)
Warm-up	1 hour
Dimensions	429 mm x 441 mm x 112 mm (including foot pads, handle and knobs)
Weight	Net weight: 8.6 kg

Ordering Information

Standard Factory Accessories: Power cable, USB cable, Ethernet cable, USB flash drive (including PDF manuals, Quick Measurement Software, and drivers).

Model Number	
S3022F	Precision Source Meter
Options	
TA-01000	S3022F Output Extension Connector, 250 V, 1 A, 4 W, Triaxial
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	
R3C	Factory Extended Warranty Service Plan — 36 Months
R5C	Factory Extended Warranty Service Plan — 60 Months

Warranty

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

GLOBAL SUPPORT CENTERS



China

Suzhou (Headquarter) / Wuhan / Shanghai / Hangzhou



Overseas

Singapore (Subsidiary) / United States (Subsidiary) / Japan (Subsidiary)
South Korea (Subsidiary) / Thailand (Subsidiary) / Malaysia (Factory)

Mission

Innovation & Efficiency to meet test requirement of new emerging Hi-Tech industry

Vision

The Global test solution Leader in the New AI era

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*This information is subject to change without notice.



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