Semight

S3022F

Dual-Channel Precision Source Meter

Version 2.2

Product Description

The S3022F precision source meter is compact and cost-effective bench-top Source/Measure Units (SMUs) with the capability to source and measure both voltage and current. These capabilities make the S3022F ideal for a wide variety of IV (current versus voltage) measurement tasks that require both high resolution and accuracy.

The S3022F provides best-in-class performance for a modest price. They have broad voltage (±200 V) and current (± 3 A DC and ±10 A pulsed) sourcing capability, excellent precision (minimum 100 fA/100 nV measuring resolution) and possess a superior color LCD graphical user interface (GUI). In addition, several task-based viewing modes dramatically improve productivity for test, debug and characterization.

The S3022F offers unmatched measurement throughput and supports 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.

Key Features

Feature	Benefit
Integrated 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: ±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
Source and measurement resolution down to 100 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
Fast measurement	Up to 1M ADC sampling rate, NPLC and sampling rate optional setting
User-friendly front panel GUI with 4.3 inch resistive touchscreen supports both graphical and numerical view modes	Can quickly and easily perform measurements and display data on the front panel, thereby greatly speeding up interactive test, characterization and debug operations
Free quick V/I control software	Can make measurements remotely from a PC without the need to program
Supports both conventional and default SCPI commands	Conventional SCPI commands provide some compatibility with older SMU code (such as Keithley 2400 series) to minimize code conversion work
Synchronization	Highspeed/ low - delay multi-channel synchronization with hardware technology
Digital I/O	Flexibly configured High-speed Digital I/O, support threshold value triggering, so as to realize efficient interaction between output measured values and user system
Small form factor with USB2.0,	Easy integration into rack and stack systems

LAN	

Applications

The S3022F has a broad application range that spans uses from R&D and education to industrial development, production test and automated manufacturing. Moreover, they work equally well as either standalone or system components.

Testing semiconductors, discrete and passive components

- Diodes, laser diodes, LEDs
- Photodetectors, sensors
- Field effect transistors (FETs), bipolar junction transistors (BJTs)
- ICs (analog ICs, RFICs, MMICs, etc.)
- Resistor, varistor, thermistors, switches

Testing precision electronics and green energy devices

- Photovoltaic cells
- Power transistors, power devices
- Battery
- Automotive
- Medical instruments
- Power and DC bias source for circuit test

Research and education

- New material investigations
- Nano devices characterization (e.g. CNT)
- Giant magnetic resistance (GMR)
- Organic devices
- Any precise voltage/current source and measurement Specification

Technical Specification

Temperature :23 ℃ ± 5 ℃

Humidity :30% to 70% RH

Calibration period:1 Year

Measurement speed: 1PLC (power line cycle)

After 60 minutes warm-up, ambient temperature changes less than ± 3 ℃

Voltage source specifications

Voltage programming accuracy	Range	Programming resolution	Accuracy (1 Year) ± (% reading+ offset)	Typical Noise (RMS) 0.1 Hz-10 Hz
	±200 V	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 × accuracy)/°C (0°C-18°C,28°C-50°C)			
Maximum output power	30W: ±20V@1.5A, ±200V@0.1A; 18W: ±6 V@3A			
Settling time	<800 µs (typical)			
Overshoot	<±0.1% (Typical. Normal mode. Step is 10 % to 90 % range, full range, resistive load)			
Noise 10Hz-20MHz	6 V voltage source, 3 A resistive load, <3 mVrms			

Current source specifications

Current programming accuracy	Range	Programming resolution	Accuracy (1 Year) ± (% reading+ offset)	Typical Noise (RMS) 0.1 Hz-10 Hz
	±10 A[1]	50 µA	0.4% + 40 mA	NA
	±3 A	15 µA	0.05%+2 mA	40 µA
	±1.5 A	10 µA	0.02%+500 µA	20 µA

	±150 mA	1 μA	0.02%+25 μA	5 μA
	±15 mA	100 nA	0.02%+6 μA	700 nA
	±1.5 mA	10 nA	0.02%+250 nA	16 nA
	±150 μA	1 nA	0.02%+25 nA	1 nA
	±15 μA	100 pA	0.02%+3 nA	140 pA
	±1.5 μA	10 pA	0.03%+450 pA	25 pA
	±150 nA	1 pA	0.05%+250 pA	5 pA
Temperature coefficient	±(0.15 × accuracy)/°C (0°C-18°C,28°C-50°C)			
Maximum output power	30W: ±20V@1.5A, ±200V@0.1A; 18W: ±6 V@3A			
Settling time	<500 μs (typical)			
Overshoot	<±0.1% (Typical. Normal mode. Step is 10 % to 90 % range, full range, resistive load)			

1,10 A range is available only for pulse mode, accuracy specifications for 10 A range are typical.

Voltage measurement specifications

	Range	Measurement resolution	Accuracy (1 Year) ± (% reading+ offset)
Voltage measurement accuracy	±200 V	100 µV	0.02% + 30 mV
	±20 V	10 µV	0.02% + 2 mV
	±6 V	1 µV	0.02% + 500 µV
	±200 mV	100 nV	0.02% + 120 µV
Temperature coefficient	±(0.15 × accuracy)/°C (0°C-18°C,28°C-50°C)		

Current measurement specifications

	Range	Measurement resolution	Accuracy (1 Year) ± (% reading+ offset)
Current measurement accuracy	±10 A[1]	10 µA	0.4% + 25 mA
	±3 A	10 µA	0.05%+2 mA
	±1.5A	1 µA	0.02%+500 µA
	±150 mA	100 nA	0.02%+25 µA
	±15 mA	10 nA	0.02%+6 µA
	±1.5 mA	1 nA	0.02%+250 nA
	±150 µA	100 pA	0.02%+25 nA
	±15 µA	10 pA	0.02%+3 nA
	±1.5 µA[2]	1 pA	0.03%+450 pA

	±150 nA[2]	100fA	0.05%+250 pA
Temperature coefficient	±(0.15 × accuracy)/°C (0°C-18°C,28°C-50°C)		

1, 10 A range is available only for pulse mode, accuracy specifications for 10 A range are typical.

2, Low Current Measurements, Triaxial Cable is recommended to connect: Force Hi connect to core cable, Guard connects to inner shield, outer shield connects to protective ground, Force Lo connect to core cable, inner shield not connect, and outer shield connect to protective ground. Triaxial Cable rated insulation voltage is not less than 250V

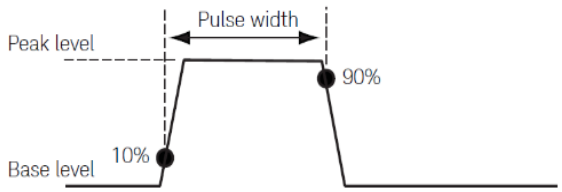
Resistance measurement specifications (4W)

	Range	Measurement resolution	Test current	Typical accuracy (1 Year) ± (% reading+ offset)
Resistance measurement accuracy	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 × accuracy)/°C (0°C-18°C,28°C-50°C)			
Source I mode,	Total error = Vmeas/Isrc = R reading x (gain error % of V range + gain			

manual Ohm measurement (4-wire)	error % of I range + offset error of I source range/Isrc value %) + (offset error of V measure range/Isrc value) Example：I source value=1.5A at 1.5A range V measure range=6V range Total error(% reading + offset) =(0.02%+0.02%+500μA/1.5A)+(500μV/1.5A) ≈0.073%+0.3334mΩ

Pulse source specifications (4W)

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



Item	Maximums	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	1ms	10%
5	10 A/6 V	1ms	10%

Typical Pulse Performance(4W)

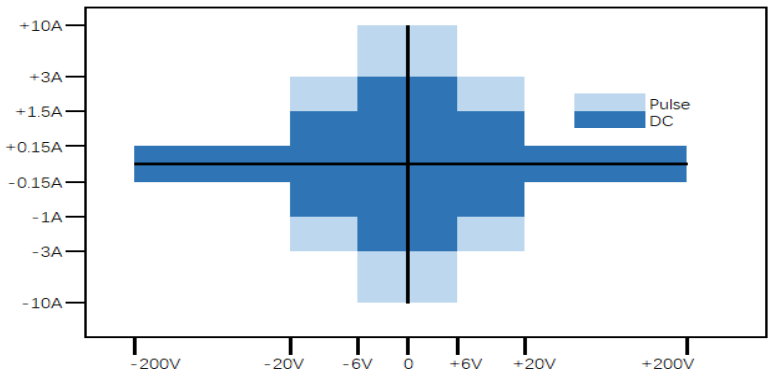
Source	range	Typical rise time [1,3]	Typical Settling Time[2,3]	Test load
Voltage	200 V	600 µs	1.5 ms	No load
	20 V	200 µs	360 µs	No load
	6 V	160 µs	300 µs	No load
Current	10 A	140 µs	320 µs	Full load
	3 A	120 µs	280 µs	Full load
	1.5 A	120 µs	280 µs	Full load
	150 mA	120 µs	280 µs	Full load
	15 mA	120 µs	280 µs	Full load
	1.5 mA	120 µs	280 µs	Full load

1, Leading edge, the time from 10 % leading to 90 % leading

2, The time required from Pulse out 0 to reach within 1 % of final value

3, Pulse current source base 6V voltage range and 105% range limit

I-V Out capability



Typical output settling time

Source	Range	Output settling time			Condition
		Fast [1,2]	Normal [1]	Slow [1]	
Voltage	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 µs	<360 µs	<1 ms	
	6 V	<150 µs	<250 µs	<1 ms	
	200 mV	<200 µs	<250 µs	<1 ms	
Current	3 A	<200 µs	<280 µs	<1.2 ms	Time required to reach within 0.1 % (0.3 % for 3 A range) of final value at short condition. Step is 10 % to 90 % range, Pulse current source base 6V voltage range and 105% range limit
	1.5 A	<200 µs	<280 µs	<1.2 ms	
	150 mA	<200 µs	<280 µs	<1.2 ms	
	15 mA	<200 µs	<280 µs	<1.2 ms	
	1.5 mA	<200 µs	<280 µs	<1.2 ms	
	150 µA	<250 µs	<300 µs	<1.2 ms	
	15 µA	<250 µs	<1.2 ms	<2 ms	
	1.5 µA	<600 µs	<1.2 ms	<5 ms	
	150 nA	<600 µs	<5 ms	<12 ms	

1,Output transition speed: Fast, Normal, Slow。

2, Slow mode is recommended for overshoot sensitive equipment, Fast mode may have overshoot on output in some condition

Sampling rate and NPLC setting

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

Derating accuracy with PLC setting< 1 PLC

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 µA	15 µA	150 µA	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%

Supplemental characteristics

Sensing Modes	2-wire or 4-wire (Remote-sensing) connections
Maximum sense lead resistance:	1 kΩ for rated accuracy
2W internal voltage drop	<60 mV/A
Max voltage between Force and Sense	2 V
Maximum output voltage in	>range 105%(200V range>202V)

output connector	
DC floating voltage	Max ±250 V DC between low force and chassis ground
Sweep	Sweep step time: from 20 μs to 16 s, Max: 64K point
Auto range	Support, turn off output is recommended for overshoot sensitive equipment before range change
Source delay	Support. It is recommended that users set appropriate source delay to obtain higher accuracy
Over temperature protection	The output will be turned off (also disable operation) when the SMU internal temperature is detected higher than 85 degrees. When the temperature returns to less than 65 degrees, operation recover
Over voltage protection	Turn off output when output voltage great than OVP setting value, recover operation after power reset, Accuracy：± (1%Setting+500 mV)
Other abnormal protection	Power reset, recover operation or hardware damage

WARNING: here are potentially hazardous voltages (±210 V) present at the High Force, High Sense, and Guard terminals of this instrument. To prevent electrical shock, the safety precaution must be done before turn on the instrument. Never connect the Guard terminal to any output, including chassis ground, or output LO, doing so will damage the instrument.

Communication port

LAN	100BASE-T / 10BASE-T

USB		USB 2.0 HOST (front)
		USB 2.0 DEVICE (back)
Digital I/O DB9 MAX input voltage: 5.25 V Min input voltage：-0.25 V Min logic H input voltage：2.1 V Max logic L input voltage：0.7 V Max source current：2 mA Max sink current：-50 mA	Pin5	GND
	Pin6	IO1 CH1 digital I/O, Synchronous signal input(single/dual channel Synchronous mode)
	Pin7	IO2, CH1 digital I/O, Synchronous signal output(single channel Synchronous mode)
	Pin8	IO3,CH2 digital I/O, Synchronous signal output(dual channel Synchronous mode),Synchronous signal input(single channel Synchronous mode)
	Pin9	IO4, CH2 digital I/O, single channel Synchronous mode, CH2 Synchronous signal output

Environmental specifications

Environment	For use in indoor facilities
Operating	0 ℃ to +50 ℃, 30 % to 70 % non-condensing
Storage	-30 ℃ to 70 ℃, 10 % to 90 % non-condensing
Altitude	Operating: 0 m to 2000 m, Storage: 0 m to 4600 m
Power	LINE：100-240VAC,50/60Hz,250W FUSE：T3.15AL 250 VAC
Warm-up	1 hour
Dimensions	429 × 441 × 112mm (with foot pad/handle/ rotary Knob)

Weight	Net weight 8 kg

Compliance

CE	LVD Directive 2014/35/EU, Standards: EN 61010-1:2010+A1:2019 EMC Directive 2014/30/EU, Standards: EN IEC 61326-1:2021

Front Panel

Display	4.3” TFT color display (480x272), Resistive touchscreen
Hardkeys	Trigger, Home, Enter, Cancel, power on, output on/off, rotary Knob
Softkeys	LCD Mapping function keys
Connectivity	USB Host, output, ground

Rear panel

Connectivity	LAN, DB9, USB device, AC socket, Ground

Ordering information

Power cable, USB cable, quick reference, U disk (including PDF manuals, quick I/V Measurement Software and drivers)

Model number	
S3022F	Dual Channel Precision Source Meter, pulser

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*This information is subject to change without notice.