Hangyu Power System (Shanghai) Co., Ltd.

AC&DC Power Source

HY-SMUSU 3000
Source Measure Unit

Technology Leads The Future

Source Meter, Breaking The Boundaries Of Imagination

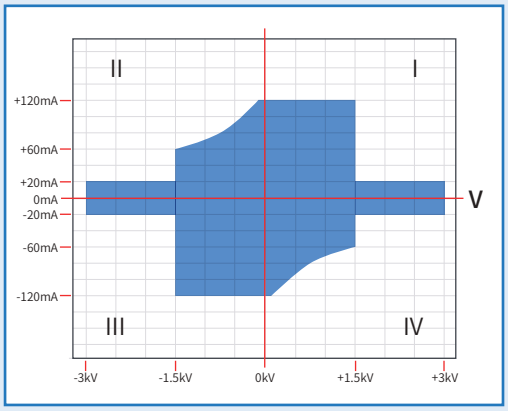
www.hangyupower.com

HY-SMUSU 3000

Product Introduction

The HY-SMUSU 3000 is a high voltage, high power, low currentsource measure unit (SMU) instrument that deliversunprecedented power, precision, speed, flexibility,and ease of use to improve productivity in R&D, production test, and reliability environments.

The HY-SMUSU 3000 offers the highest powerand best low current performance in the industry. It is designed specifically for characterizing and testing high voltage electronics and power semiconductors, such as diodes, FETs, and lGBTs, as well as other components and materials in which high voltage, fast response, and precise measurements of voltage and current are required.



HY-SMUSU 3000 can source or sink up to 3000V/20mA or 1500V/120mA

Product Function

- It offers highly flexible, four-quadrant voltage andcurrent source/load coupled with precision voltage andcurrent meters
- Source or sink up to 180W of DC or pulsed power (±3000V/20mA, ±1500V/120mA)
- 1fA low current resolution
- Dual 22-bit precision ADCs and dual 18-bit 1µs per point digitizers for high accuracy and high speed transient capture
- Easy compatibility with other digital source tables for system integration
- Combines a precision power supply, current source, DMM, arbitrary waveform generator, V or I pulse generator, electronic 18-bit load, and trigger controller-all in one instrument

Can Be Used As

- Semiconductor characterization instrument
- V or I waveform generator
- V or I pulse generator
- Precision power supply with V and I readback
- True current source
- Digital multimeter (DCV, DCI, ohms, and power with 6½-digit resolution)
- Precision electronic load

Application Field

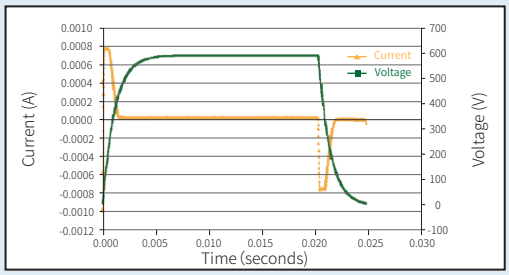
Ideal for current/voltage characterization and functional test of a wide range of today's modern electronics and devices, including:

- Power semiconductor device characterization and testing
- Characterization of GaN, SiC, and other compound materials and devices
- Breakdown and leakage testing to 3kV
- Characterization of sub-millisecond transients

Two Measurement Modes: Digitizing Or Integrating

Precisely characterize transient and steady-state behavior,including rapidly changing thermal effects, with the two measurement modes in the HY-SMUSU 3000. Each mode is defined by its independent analog-to-digital (A/D) converters.

The digitizing measurement mode provides speeds up to 1μs per sample. The dual 18-bit digitizers allow you to capture voltage and current transients simultaneously. In the integrating measurement mode, the dual 22-bit integrating analog to digital converters allow more precise measurement of voltage and current. Two A/D converters are used with each measurement mode, one for current and the other for voltage, that run simultaneously for accurate source readback that does not sacrifice test throughput.



The dual high speed A/D converters sample as fast as 1μs per point,enabling full simultaneous characterization of both voltage and current.

Standard Features And Functions

- Flexibility for use as either a bench-top I-V characterization tool or as a building block component of multiple channel I-V test systems
- Perform common I-V tests quickly and easily without programming or software installation
- 14 digital I/O lines for direct connection to a probe station, component handler, or other automation tools
- USB port for extra data and test program storage via USB memory device. Instrument Control Start-up Software

Upper Computer Software

Upper computer instrument control/start-up software enables users to start making measurements in minutes without programming. In most cases, users merely need to make some quick measurements, graph the data, and store the data to disk for later analysis in software environments such as Excel. Upper computer offers:

- Configure and control up to four SMU instruments for DC or Pulsed I-V test in either the same app, same project, or a combination of the two
- Create tests by mixing any other HY-SMUSU instruments from Hangyu Power (DC only).
- Differentiate HY-SMUSU instrument channels and their measurement data using labels that are relevant to your device or module
- Native X-Y graphing, panning, and zooming; screenshot capturing of graphs
- Spreadsheet/tabular viewing of data; export data for further analysis
- Annotating of tests; save test setups
- GPIB, USB 2.0, Ethernet compliance

Voltage Accuracy Specifications[1]

	Source		Measure		
Range	Programming Resolution	Accuracy ±(% rdg + volts)	Display Resolution	Integrating ADC Accuracy[2] ±(% rdg + volts)	High Speed ADC Accuracy[3] ±(% rdg + volts)
200V	5mV	0.03%+50mV	100μV	0.025%+50mV	0.05%+100mV
500V	10mV	0.03%+125mV	100μV	0.025%+100mV	0.05%+200mV
1500V	40mV	0.03%+375mV	1mV	0.025%+300mV	0.05%+600mV
3000V	80mV	0.03%+750mV	1mV	0.025%+600mV	0.05%+1.2V

Current Accuracy Specifications[4]

	Source		Measure		
Range	Programming Resolution	Accuracy ± (% reading + amperes + proportional offset in amperes)	Display Resolution	Integrating ADC Accuracy[2] ± (% reading + amperes[5] + proportional offset in amperes)	High Speed ADC Accuracy[3] ± (% reading + amperes[5] + proportional offset in amperes)
1nA	30fA	0.1%+2pA+*V_o×E^{-15}	1fA	0.1%+1.2pA+*V_o×E^{-15}	0.2%+1.2pA+*V_o×E^{-15}
10nA	300fA	0.1%+5pA+*V_o×E^{-14}	10fA	0.1%+5pA+*V_o×E^{-15}	0.2%+5pA+*V_o×E^{-15}
100nA	3pA	0.1%+60pA+*V_o×E^{-13}	100fA	0.1%+60pA+*V_o×E^{-13}	0.2%+60pA+*V_o×E^{-13}
1μA	30pA	0.03%+700pA	1pA	0.025%+400pA	0.08%+800nA
10μA	300pA	0.03%+5nA	10pA	0.025%+1.5nA	0.08%+3nA
100μA	3nA	0.03%+60nA	100pA	0.02%+25nA	0.05%+50nA
1mA	30nA	0.03%+300nA	1nA	0.02%+200nA	0.05%+400nA
2mA	60nA	0.03%+1.2μA	1nA	0.02%+500nA	0.05%+1μA
20mA	600nA	0.03%+12μA	10nA	0.02%+5μA	0.05%+10μA
120mA	3μA	0.03%+36μA	100nA	0.02%+24μA	0.05%+50μA

*V_o is the output voltage.

Notes:
1. For temperatures 0° to 18°C and 28° to 50°C, accuracy is degraded by ±(0.15 × accuracy specification) °C;
2. Derate accuracy specification for NPLC setting <1 by increasing error term. Add appropriate typical percent of range term for resistive loads using the table below:

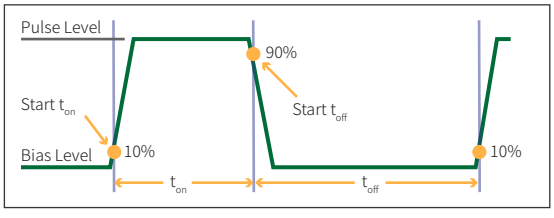
NPLC Setting	200V and 500V Ranges	1500V and 3000V Ranges	100nA Range	1μA to 120mA Ranges
0.1	0.01%	0.01%	0.01%	0.02%
0.01	0.08%	0.07%	0.1%	0.08%
0.001	0.8%	0.6%	1%	0.7%

3. 18-bit ADC. Average of 1000 samples taken at 100μs intervalst;
4. For temperatures 0° to 18 °C and 28 ° to 50 °C, accuracy is degraded by ±(0.15 × accuracy specification)/°C. 1nA to 10μA accuracy is degraded by ± (0.35 × accuracy specification)/°C;
5. Offset (amperes) is typical for 1nA range.

Pulse[6] Characteristics

Pulse Width Programming Resolution	1μs
Pulse Width Programming Accuracy	±10μs
Pulse Width Jitter	7μs

Notes:
6. Times measured from the start of pulse to the start off-time; see figure below.



Supplementary Features

Voltage Source Output Settling Time	Time required to reach within 1% of final value after source level command is processed on a fixed range[7] R_L=10MΩ	Range / Settling time 200V / ＜5ms 500V / ＜5ms 1500V / ＜5ms 3000V / ＜7ms
Current Source Output Settling Time	Time required to reach within 1% of final value after source level command is processed on a fixed rang Values below for V= $I_{OUT} \times R_{LOAD}$	Current Range / R_{LOAD} / Settling Time 120mA / 12.5kΩ / ＜5ms 20mA / 50kΩ / ＜5ms 2mA / 500kΩ / ＜10ms 1mA / 1MΩ / ＜5ms 100μA / 10MΩ / ＜15ms 10μA / 100MΩ / ＜20ms 1μA / 1GΩ / ＜200ms 100nA / 10GΩ / ＜2s 10nA / 10GΩ / ＜2s 1nA / 10GΩ / ＜2s

Notes:
7. With measure and compliance set to the maximum current for the specified voltage range.

Additional Source Characteristics

Noise 10Hz to 20MHz	< 1.2V peak to peak, < 400mVRMS. 3000V range with a 20mA limit
Noise (peak to peak) 0.1Hz to 10Hz	**Voltage:** 0.005% of range **Current:** 0.08% of range
Overshoot	**Voltage:** < ±1% for 1500V and 3000V ranges. Step size = 10% to 90% of range, resistive load, maximum current limit/compliance **Current:** < ±1%. Step size = 10% to 90% of range, resistive load. See Current source output settling time for additional test conditions
Range Change Overshoot	**Voltage:** < 1% of larger range. Overshoot into a 100kΩ load, 20MHz bandwidth **Current:** < 5% of larger range. $I_{OUT} \times R_{LOAD}$ = 100V
Guard Offset Voltage	< 4mV (100kΩ guard impedance). Current < 700μA
Remote Sense Operating Range[8]	Maximum voltage between HI and SENSE HI = 3V Maximum voltage between LO and SENSE LO = 3V
Voltage Output Headroom	**3000V Range:** Maximum output voltage = 3030V – (total voltage drop across source leads) **1500V range:** Maximum output voltage = 1515V – (total voltage drop across source leads)
Overtemperature Protection	Internally sensed temperature overload puts the instrument in standby mode
Limit (compliance)	Bipolar limit (compliance) set with a single value **Voltage[9]:** Minimum value is 20V; accuracy is the same as voltage source **Current[10]:** Minimum value is 100pA; accuracy is the same as current source

Notes:
8. Add 50μV to source accuracy specifications per volt of HI lead drop;
9. For sink operation (quadrants II and IV) without sink mode enabled, add 0.6 percent of limit range to the corresponding voltage source accuracy specifications. Specifications apply with sink mode enabled;
10. For sink operation (quadrants II and IV) without sink mode enabled, add 0.6 percent of limit range to the corresponding current limit accuracy specifications. Specifications apply with sink mode enabled.

Additional Characteristics

Maximum Load Capacitance	Normal mode 100nF, High-capacitance mode 10μF
Common Mode Voltage	250VDC
Common Mode Isolation	>1GΩ, <4500pF
Sense High Input Impedance	>100TΩ
Maximum Sense Lead Resistance	1kΩ for rated accuracy
Overrange	101% of source range, 101% of measure range

High-Capacitance Mode Characteristics[11、12]

<table>
<tr><td>Accuracy Characteristics</td><td>Accuracy characteristics are applicable in both normal and high-capacitance modes</td></tr>
<tr><td>Voltage Source Output Settling Time</td><td>Time required to reach within 1% of final value after source level command is processed on a fixed range for the maximum current limit of the given range[13]
The values in the right column are applicable when V_{OUT} = 100V
<table>
<tr><th>Voltage Source Range</th><th>Settling Time with C_{LOAD} = 4.7μF</th></tr>
<tr><td>200V-500V</td><td>＜ 5ms</td></tr>
<tr><td>1500V</td><td>＜ 7ms</td></tr>
<tr><td>3000V</td><td>＜ 30ms</td></tr>
</table></td></tr>
<tr><td>Current Measure Settling Time</td><td>Time required to reach within 1% of final value after voltage source is stabilized on a fixed range
The values in the right column are applicable when V_{OUT} ＝1kV
<table>
<tr><th>Current Measure Range</th><th>Settling Time</th></tr>
<tr><td>2mA–120mA</td><td>＜100μs</td></tr>
<tr><td>100μA-1mA</td><td>＜3ms</td></tr>
<tr><td>1μA-10μA</td><td>＜230ms</td></tr>
</table></td></tr>
<tr><td>Mode Change Delay</td><td>Current ranges of 100μA and above: 11ms delay for both in and out of high-capacitance mode; 11ms delay out of high-capacitance mode
Current ranges below 100μA: 250ms delay into high-capacitance mode; 11ms delay out of high-capacitance mode</td></tr>
<tr><td>Measure Input Impedance</td><td>> 30GΩ in parallel with 150pF</td></tr>
<tr><td>Voltage Source Range Change Overshoot</td><td>< 400mV + 0.1% of larger range. Overshoot into a 100kΩ load, 20MHz bandwidth</td></tr>
</table>

Notes:
11. High-capacitance mode specifications are for dc measurements only and use locked ranges. Autorange is disabled;
12. 100nA range and below are not available in high-capacitance mode;
13. With measure and compliance set to the maximum current for the specified voltage range.

Measurement Speed Characteristics[14]

Maximum sweep operation rates (operations per second) for 60Hz (50Hz)

A/D Converter Speed	Trigger Origin	Measure to Memory (using user scripts)	Measure to GPIB (using user scripts)	Source Measure to Memory (using user scripts)	Source Measure to GPIB (using user scripts)	Source Measure to Memory (using sweep API)	Source Measure to GPIB (using sweep API)
0.001 NPLC	Internal	20000 (20000)	9800 (9800)	7000 (7000)	6200 (6200)	12000 (12000)	5900 (5900)
0.001 NPLC	Digital I/O	8100 (8100)	7100 (7100)	5500 (5500)	5100 (5100)	11200 (11200)	5700 (5700)
0.01 NPLC	Internal	4900 (4000)	3900 (3400)	3400 (3000)	3200 (2900)	4200 (3700)	4000 (3500)
0.01 NPLC	Digital I/O	3500 (3100)	3400 (3000)	3000 (2700)	2900 (2600)	4150 (3650)	3800 (3400)
0.1 NPLC	Internal	580 (480)	560 (470)	550 (465)	550 (460)	560 (470)	545 (460)
0.1 NPLC	Digital I/O	550 (460)	550 (460)	540 (450)	540 (450)	560 (470)	545 (460)
1.0 NPLC	Internal	59 (49)	59 (49)	59 (49)	59 (49)	59 (49)	59 (49)
1.0 NPLC	Digital I/O	58 (48)	58 (49)	59 (49)	59 (49)	59 (49)	59 (49)
High-speed ADC	Internal	38500 (38500)	18000 (18000)	10000 (10000)	9500 (9500)	14300 (14300)	6300 (6300)
High-speed ADC	Digital I/O	12500 (12500)	11500 (11500)	7500 (7500)	7000 (7000)	13200 (13200)	6000 (6000)

Notes:
14. Exclude current measurement ranges less than 1mA.

Maximum single measurement rates (operations per second) for 60Hz (50Hz)

A/D Converter Speed	Trigger Origin	Measure to GPIB	Source Measure to GPIB	Source Measure Pass/ Fail to GPIB
0.001 NPLC	Interna	1900 (1800)	1400 (1400)	1400 (1400)
0.01 NPLC	Interna	1450 (1400)	1200 (1100)	1100 (1100)
0.1 NPLC	Interna	450 (390)	425 (370)	425 (375)
1.0 NPLC	Interna	58 (48)	57 (48)	57 (48)

Other technical indicators

Maximum Measurement Range Change Rate	> 4000 per second for > 10μA
Maximum Source Range Change Rate	> 250 per second > 10μA
Maximum Source Function Change Rate	> 90 per second

Triggering And Synchronization Characteristics

Triggering	Trigger In to Trigger Out	0.5μs
	Trigger In to Source Change[15]	10μs
	Trigger Timer Accuracy	±2μs
	Source Change[15] after Trigger	280μs
Synchronizatio	Multi-node Synchronized Source Change[15]	＜0.5μs
	Single-node Synchronized Source Change[15]	＜0.5μs

Notes:
15. Fixed source range with no polarity change.

Supplemental Information

Front-panel Interface	Two-line vacuum fluorescent display (VFD) with keypad and navigation wheel
Display	1, Show error messages and user-defined messages 2, Display source and limit settings 3, Show current and voltage measurements 4, View measurements stored in dedicated reading buffers
Keypad Operations	1, Change host interface settings 2, Save and restore instrument setups 3, Load and run factory and user-defined test scripts that prompt for input and send results to the display 4, Store measurements into dedicated reading buffers
Reading Buffers	**Nonvolatile memory uses dedicated storage areas reserved for measurement data. Reading buffers are arrays of measurement elements. Each element can store the following items:** 1, Measurement 2, Source setting (at the time the measurement was taken) 3, Measurement status 4, Range information 5, Timestamp Reading buffers can be filled using the front-panel STORE key and retrieved using the RECALL key or host interface
Buffer Size, with Timestamp and Source Setting	> 60000 samples
Buffer Size, without Timestamp and Source Setting	> 140000 samples

HY-SMUSU Technical Parameters

Digital I/O Interface

Connector	25-pin female D
Input/Output Pins	14 open drain I/O bits
Absolute Maximum Input Voltage	5.25V
Absolute Minimum Input Voltage	-0.25V
Maximum Logic Low Input Voltage	0.7V, +850μA
Minimum Logic High Input Voltage	2.1V, +570μA
Maximum Source Current (flowing out of digital I/O bit)	+960μA
Maximum Sink Current At Maximum Logic Low Voltage (0.7)	-5.0mA
Absolute Maximum Sink Current (flowing into digital I/O pin)	-11mA
5V Power Supply Pin	Limited to 250mA, solid-state fuse protected
Safety Interlock Pin	Active high input > 4.0V at 50mA must be externally applied to this pin to allow the high-voltage output to operate. Connect the 5V output and the interlock input of the 25-pin digital I/O connector on the back of the HY-SMUSU 3000 to the switch in your fixture. The output will be disabled when the interlock signal is < 4.0V Absolute maximum input is −0.4V to +6.0V

General Specifications

(Default mode unless specified)

IEEE-488	IEEE Std 488.1 compliant. Supports IEEE Std 488.2 common commands and status model topology
RS-232	Baud rates from 300 bps to 115200 bps Programmable number of data bits, parity type, and flow control (RTS/CTS hardware or none) When not programmed as the active host interface, the HY-SMUSU 3000 can use the RS-232 interface to control other instruments
Ethernet	RJ-45 connector, 10/100BT，Auto-MDIX
USB File System	**USB 2.0 Host:** Mass storage class device
Power Supply	100VAC to 240VAC, 50Hz or 60Hz, 350VA maximum
Cooling	Forced air; side and top intake and rear exhaust
Size	482mm (W) ×630mm (D) ×88mm (H)
Weight	10.7kg
Operating Ambient (Temperature And Humidity)	0 °C to 50 °C, 20%-90% RH, no dew formation (For indoor use only)
Altitude	Maximum 2000m above sea level
Storage Ambient Temperature	-25°C to 65°C

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HY-SMUSU 3000 Source Measure Unit, Version 02.03, June 2025

All technical data and instructions are based on the actual product

If there is any change, Hangyu Power has the final interpretation right

Authorized distributor：