INNO INSTRUMENT

High Precision Power Analyzer

SPA6000

SPA6000 Highest Measurement Accuracy: ± (0.01% of the reading + 0.02% of the range)

Bandwidth: DC, 0.1Hz - 5MHz

4 Power Channels + 2 Motor Channels

Various Plug-and-Play Capability Modules for Multiple Input Ranges and Accuracies

Simultaneous and Independent Analysis of 4-harmonic channels

Harmonic Analysis up to 500th Order

Instantaneous Power Measurement

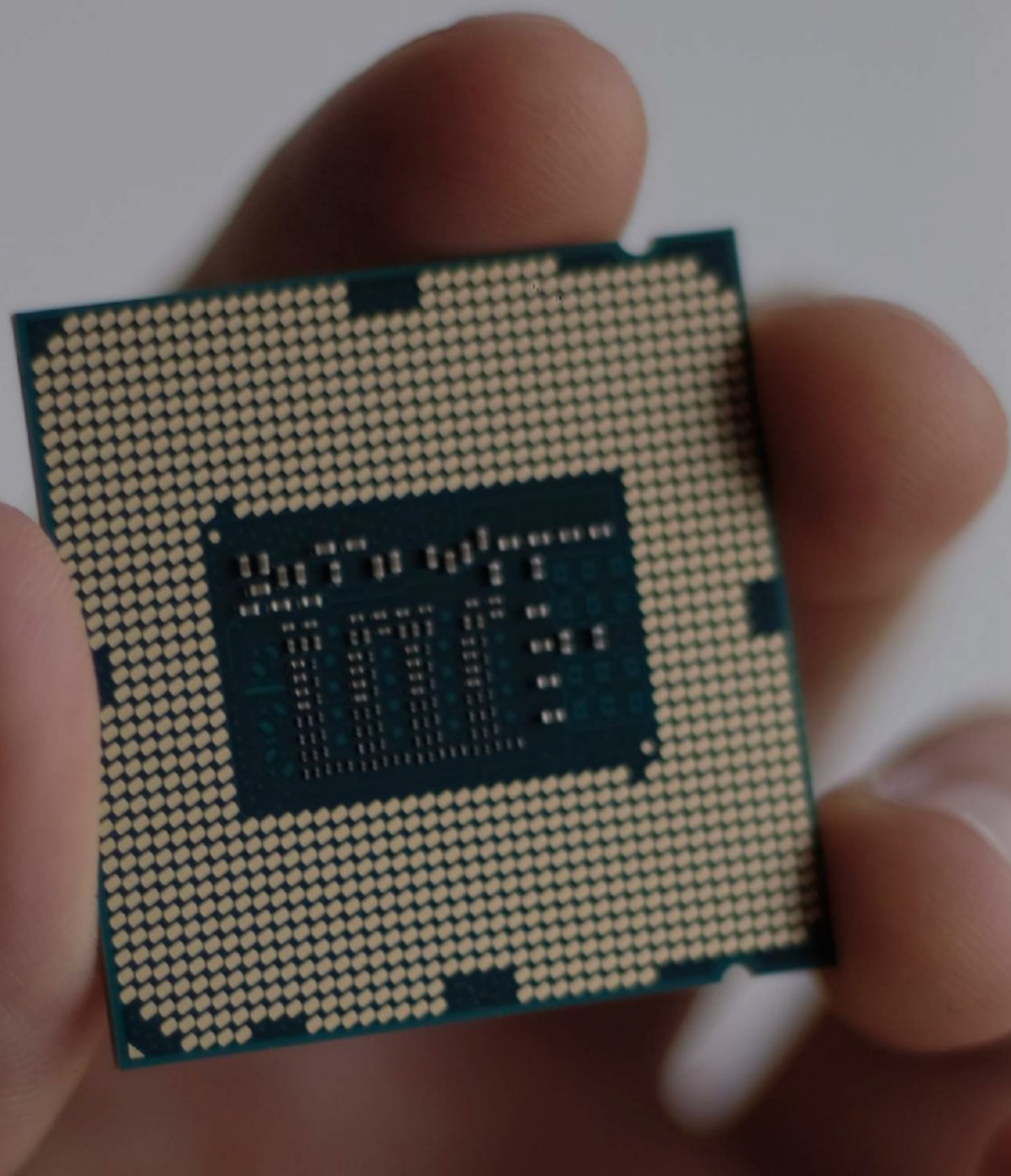
X-Y Graph Display

Data Update Rate up to 10ms

Mass Storage 512GB(1TB Optional)

INNO Instrument is a professional and high-end test solution provider. Based on the technological achievements enabled by years of our R&D investment, INNO provides high-quality and cutting-edge test instruments and advanced, reliable and comprehensive test and measure solutions for developers and manufacturers in power, energy, transportation, automobile, communication and other sectors. We strive to meet the needs of our customers at a deeper level with a systematic approach and support the constant upgrading and sustainable development of the industrial communities across the world.

SPA6000 Power Analyzer can be used to measure various parameters such as voltage, current, power, efficiency, etc., for power conversion devices like inverters, motors, transformers, and more. It offers 4 power channels and 2 motor channels while also supporting a wide range of power module combinations. Its wide measurement range and high accuracy make it suitable for numerous industries, including electric vehicles, renewable energy, inverters, motors, batteries, lighting, household appliances, and the aviation electronics industry, and more. It boasts an array of powerful features, including multi-channel input, high-speed sampling, real-time data display, waveform display, trend graph, bar graph, and vector diagram displays. With capabilities like harmonic analysis, motor evaluation, voltage fluctuation and flicker measurement, and Fast Fourier Transform (FFT), it enables efficient measurement and analysis of various systems.



Functional Advantages and Features

Various Types of Input Modules

SPA6000 supports a variety of voltage and current input ranges modules with distinct levels of precision. A maximum of 4 modules can be installed on a single instrument, each typically offering different specifications. Users can select modules tailored to their specific requirements, thus customizing the instrument to accommodate a wide array of applications using just one power analyzer. We currently offer 4 modules with different specifications, with ongoing development of new modules.

Sensor Power Supply

The power module of SPA6000 has a sensor power supply interface. When the selected sensor requires power, it can be directly powered from this port on the instrument. This eliminates the need for external power supply devices compared to traditional sensors - a significant technical improvement that has made the instrument more convenient and friendly for users.

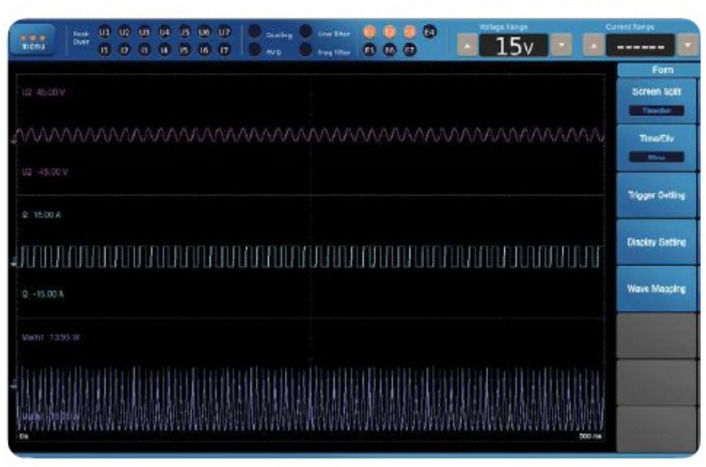
User-friendly GUI

SPA6000 is equipped with a 12.1-inch HD LCD touch screen which supports touch input. A graphical design is adopted for visual and easy operation. Furthermore, key, rotary knob and mouse operation are also supported. It only requires a key to access the channel setup parameter table. Multiple configuration parameters are shown on the same screen for checking and setting, making it easier to input related parameter settings this way.

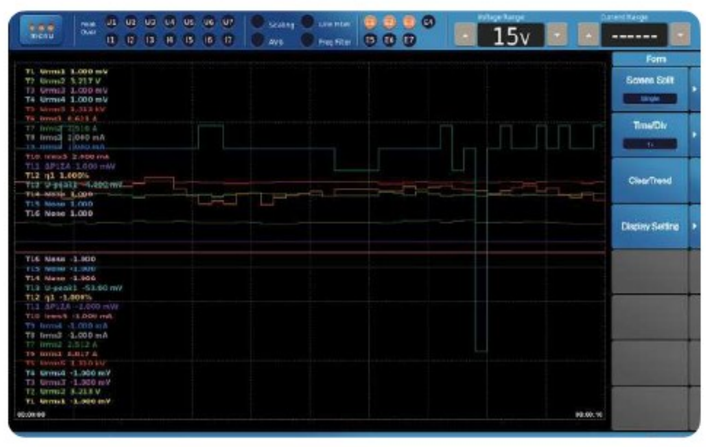
Powerful Display Function

Multiple display types are supported, including numerical value, waveform, bar graph, tendency chart, vector diagram and etc. More information is displayed on the same UI of the big HD screen. Numerical value, waveform, bar graph, tendency chart and other information can be shown on the same UI simultaneously.

Numeric Display



Waveform Display



Trend Display

Combination Display (Multi-screen)

Fast Switching Automatic Range

When auto range is on, this instrument automatically switches its measurement range according to the size of the input signal. However, traditional range switch is done by choosing different measurement levels successively, and it takes time to switch to another measure level. And in case of big variation of input signal, it takes a long time to switch to the appropriate range, disabling measurement of data during this time and thus causing data loss.

For SPA6000 at auto range, if an input signal exceeds the measurement range, it will switch to its max measurement capacity firstly before finding and adjusting to the most appropriate range according to the measured data. This approach can significantly save the time of range switch and reduce data loss.

Current Phase Compensation

SPA6000 offers phase compensation for current with a 0.01° resolution, enhancing power measurement accuracy. Furthermore, the built-in phase compensation features of SPA6000 make measurement of high-frequency or low power factor more accurate.

Update Rate up to 10ms

SPA6000 offers a data update rate from 10ms to 20s at the Auto mode. With the fastest update rate of 10ms, it maintains high precision during high-speed calculations, ensuring measurement stability through independent digital filtering technology. When the automatic rate updating mode is activated, it can track frequency signals as low as 0.1Hz, and the data update rate is automatically adjusted based on the frequency of the input signal. This enables more precise measurement of frequency variations.

Cycle-by-cycle Measurement

Cur power analyzer can measure the voltage, current, power and other parameters of each cycle of AC input signal. It can measure such data up to 3,000 cycles and sort and display the measurements by cycles.

Waveform Function

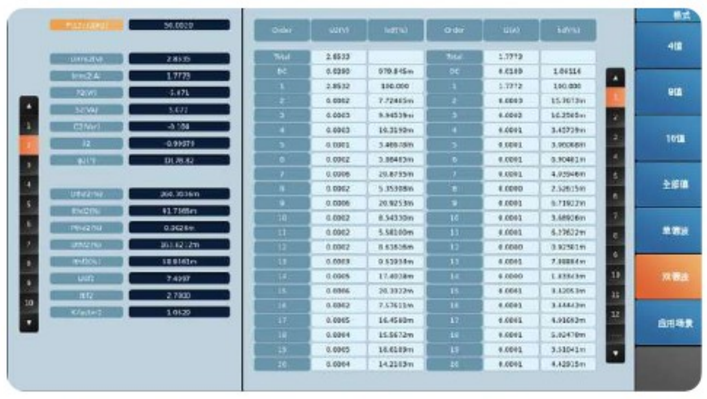
SPA6000 can execute math operations on displayed waveforms and display the waveform after math operation. For example, multiplication can be done on voltage and current waveform to display the instantaneous power waveform of the input signal and measure its value.

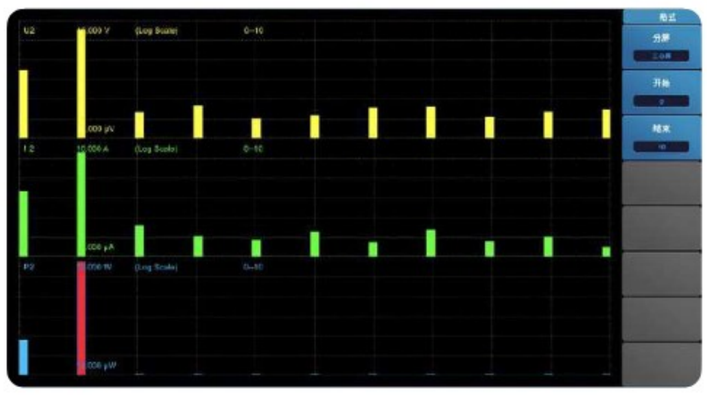
Integration Function

The integration function includes integral of power, current and other parameters. Energy (Wh) or energy charge (Ah) can be calculated. Furthermore, the integral of active power involves two modes: the first one is electricity transaction -- the power purchased and sold by a power grid is calculated with the integral of positive/negative alternating-current power; the second one is charging/discharging -- the charge of battery's charging and discharging is calculated by the integral of positive/negative instantaneous power.
During long-time integration, large variation of input signal can lead to inappropriate range that causes measurement errors. Therefore, it's advised to turn on auto ranging function during integration to effectively reduce such errors.

Harmonic Measurement Function

SPA6000 Power Analyzer can conduct harmonic analysis and measurement on all power channels and select different PLL sources, greatly enhancing harmonic measurement efficiency in fields such as inverter motors, robotics, lighting, and more. The capacity to measure harmonics is up to the 500th order.



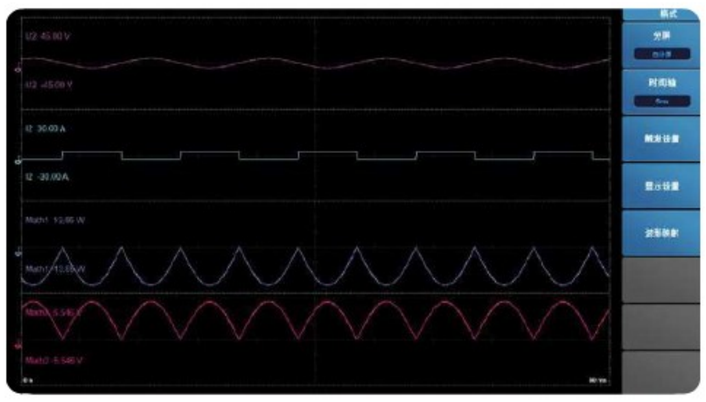


Dual Motor Evaluation

SPA6000 can be linked to a torque and rotation speed sensor to receive analog or pulse output signals. They accurately measure the parameters of motor. The input can be divided into two groups, facilitating the simultaneous testing of two motors' parameters. This is particularly well-suited for multi-motor application scenarios, such as in electric vehicles (EVs).

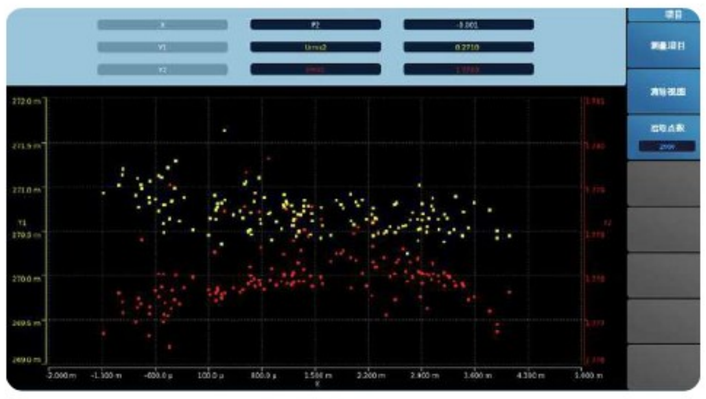
Instantaneous Power Measurement

SPA6000 can execute math operations on displayed waveforms and display the waveform after math operation. For example, multiplication can be done on voltage and current waveform to display the instantaneous power waveform of the input signal and measure its value.



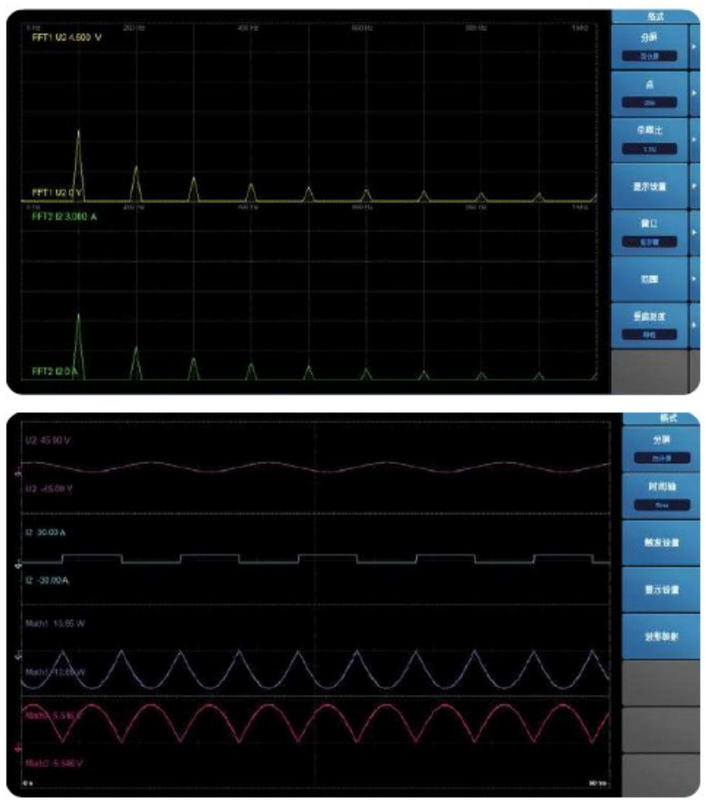
X-Y Graph Display Function

The self-defined two-channel measured data are for x-axis and y-axis respectively. They can display the relative change rule of the two values visually and provide accurate basis to analyze the correlation of them. For example, the ST curve shows the torque rotate speed curve of the motor to analyze the characteristics of the motor.



FFT Function (Fast Fourier Transform)

The FFT function can be used to set sampling number, sampling rate and other parameters and analyze input signal spectrum; the non-displayable partial frequency in harmonics measurement can be observed in this way.



IEC Harmonics and Voltage Flicker

IEC harmonic measurements adhere to the IEC61000-4-7 standard, enabling the measurement and display of current harmonics, including inter-harmonics. It also facilitates the measurement, analysis, and assessment of voltage fluctuations and flicker according to relevant IEC standards.

Mass Storage and Printing

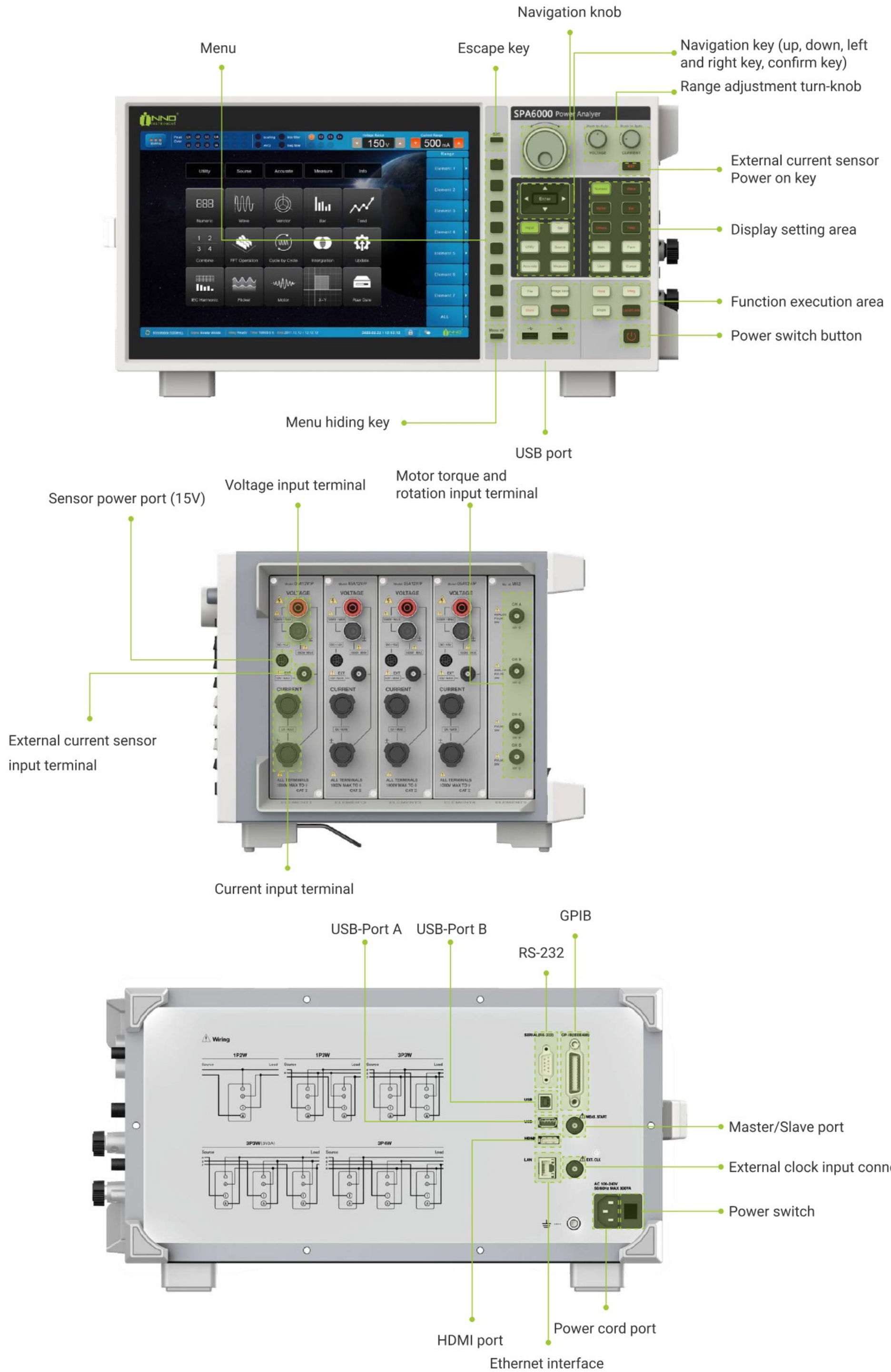
SPA6000 have real-time storage function for voltage, current, power and other measurements, as well as voltage and current display waveform data. The fastest storage rate can reach 100 times of data per second. They can also store the sampled original data for further data processing and analysis. The instrument offers a large memory for large-capacity and efficient data storage.

In the meantime, SPA6000 can connect a printer via the USB or LAN port for on-site printing.

INNO PA Viewer software

INNO PA Viewer is a PC application software by which users can control the meter remotely through the PC; the software also enables display of numerical value, single harmonic and biharmonic, tendency chart, vector, bar graph, data combination, IEC harmonic, FFT, voltage flicker, motor, period analysis, X-Y chart, low voltage ride-through and etc. It can save data on the PC, and save and print IEC harmonic and voltage flicker data report.

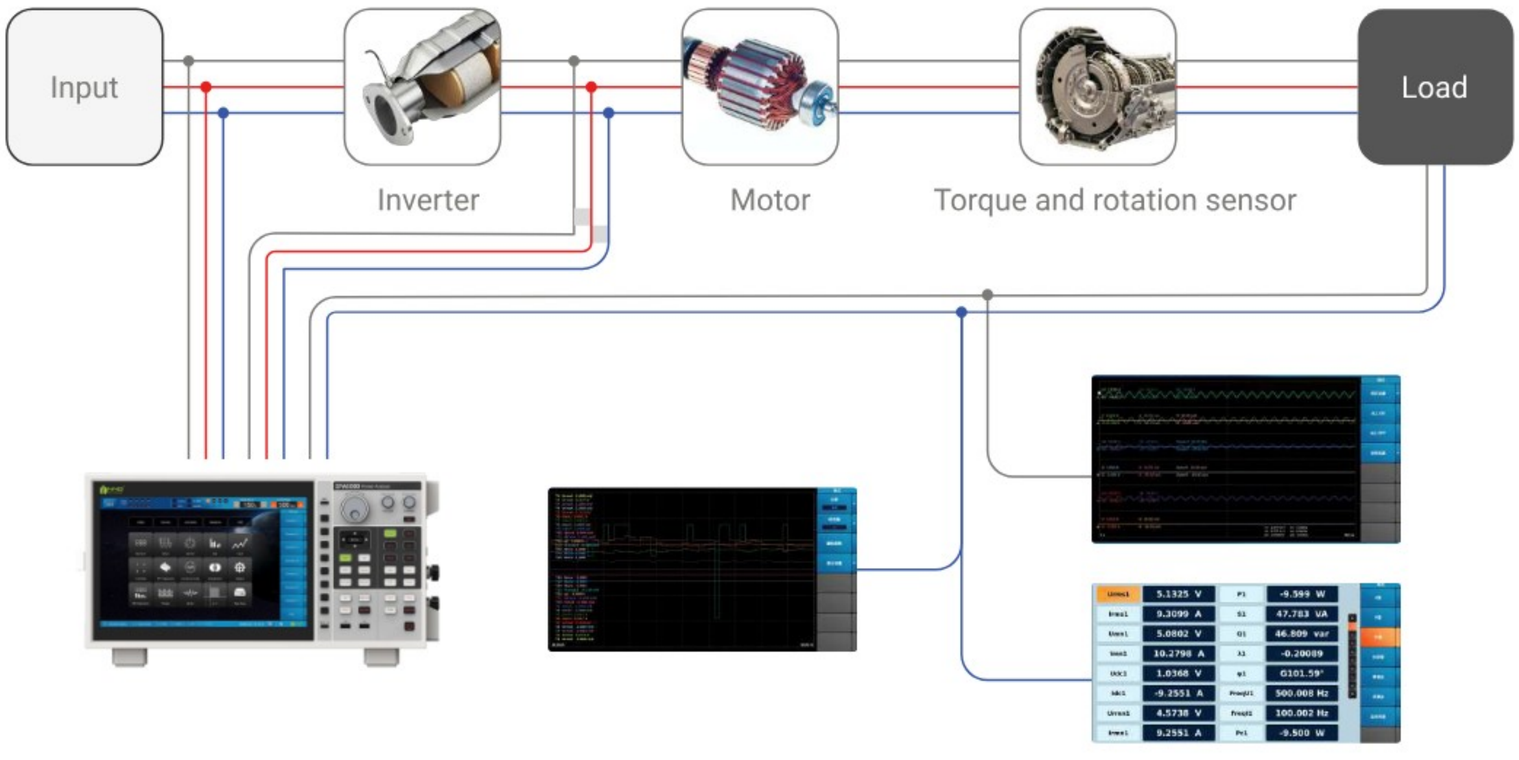
Product Overview



Applications

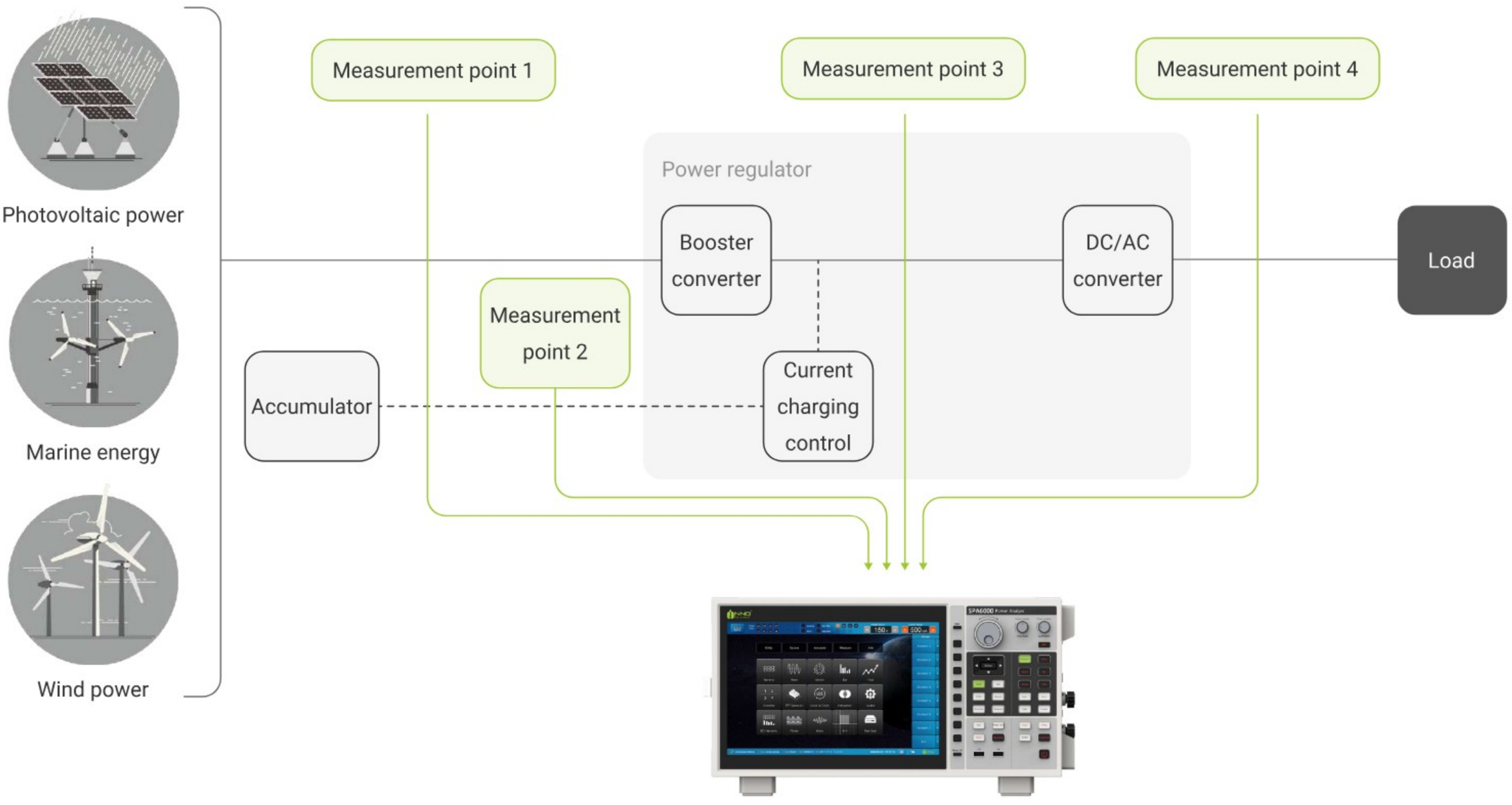
Evaluation of hybrid electric vehicles, frequency converters, and variable frequency motors

SPA6000 provides four power measurement units and two motor measurement channels which can easily measure and assess the voltage, current, power, efficiency and other parameters of controller (inverter), charger, battery, motor and other devices of electric vehicles. The two motor measurement channels can measure the power and efficiency of the drive motor and power generation motor simultaneously. In the meantime, the integration function can assess battery charging/discharging.



Energy efficiency conversion of new energy

As renewable energy power generation is more prevalent, the power quality problems are becoming increasingly prominent. Power analyzer can be used to effectively monitor and assess power quality issues such as harmonics and low voltage in renewable energy generation, and to measure efficiency and losses of all parts. SPA6000 provides 4 power measurement units, allowing the measurement and analysis of voltage, current, efficiency, and harmonics at various nodes. Its integration function can assess and analyze electricity transaction of power grid and charging/discharging of battery.



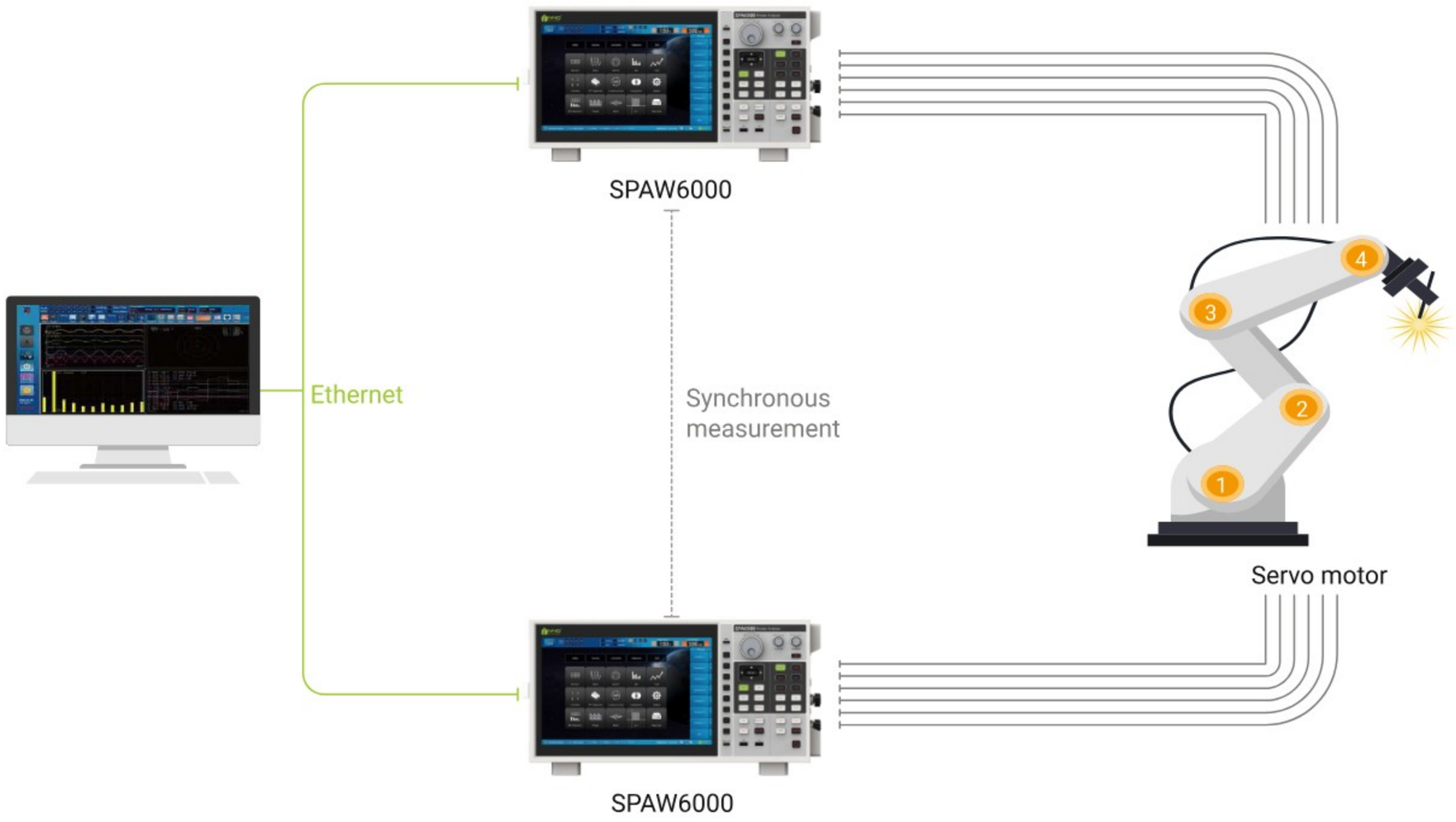
Home appliance performance testing

As most home appliances are single-phase equipment, one SPA6000 Power Analysis Wavecorder can replace up to 4 single-phase power analyzers for measuring voltage, current, power, frequency, power factor, harmonic, etc. IEC standard related measurement and evaluation can also be completed with IEC harmonic and its fluctuation and flicker functions.

Measurement of aircraft power system

As aircraft AC power supply system frequency is usually 400Hz or 800Hz, regular power analyzer can hardly meet its measurement needs, especially harmonics measurement. SPA6000 Power Analyzer has a sampling rate up to 2Ms/s, and can measure 500 times of harmonics when the frequency of fundamental wave is 400Hz, so they can meet the measurement needs quite well.

Performance evaluation and testing of industrial robots



Servo motor, reducer and controller are the essential parts of an industrial robot. When a robot is in motion, its motion capability of multiple degrees of freedom is driven by its servo motor, its steady large-torque output is achieved by the reducer, and its multi-axis drive synchronous control is enabled by the controller. None of the three parts is dispensable. Given that industrial robots typically comprise multiple motors, assessing a motor-driven industrial robot requires measuring the power consumption of both the motors and controllers across various working conditions throughout the entire process. In order to analyze and study the control process and assess the transient characteristics of industrial robots, their transient voltage, current, power and variation trend must be measured and these measurements must be stored for further analysis.

Our SPA6000 Power Analysis Wavecorders have a sampling rate up to 2MHz with waveform math operation features. It can measure transient power and it is equipped with a 512G/1TG large-capacity memory. The instrument can conduct four-channel harmonic analysis with different phase locked loop (PLL) circuits. It can measure two motors simultaneously. By synchronizing two SPA6000 Power Analysis Wavecorders, the mechanical output parameters of four motors can be measured simultaneously. It is especially suitable for robot performance assessment and testing.

Technical Specifications

Signal Input

Item	Specification
Input Terminal Type	**Voltage:** Plug-in terminal (safety terminal) **Current:** Exterior of wiring terminal **Current sensor:** Insulated BNC socket
Input Type	**Voltage:** Floating input, by resistance voltage divider **Current:** Floating input, by shunt input
Measurement Range (Voltage)	**SPA6000 05A12/40A13:** 15V, 30V, 60V, 100V, 150V, 300V, 600V, 1000V (crest factor 3) 7.5V, 15V, 30V, 50V, 75V, 150V, 300V, 500V (crest factor 6)
Measurement Range (Current)	• **Direct input** **SPA6000 05A12:** 2mA, 5mA, 10mA, 20mA, 50mA, 100mA, 200mA, 500mA, 1A, 2A, 5A (crest factor 3) 1mA, 2.5mA, 5mA, 10mA, 25mA, 50mA, 100mA, 250mA, 0.5A, 1A, 2.5A (crest factor 6) **SPA6000 40A13:** 100mA, 200mA, 500mA, 1A, 2A, 5A, 10A, 20A, 40A (crest factor 3) 50mA, 100mA, 250mA, 500mA, 1A, 2.5A, 5A, 10A, 20A (crest factor 6) • **External current sensor** 50mV, 100mV, 200mV, 500mV, 1V, 2V, 5V, 10V (crest factor 3) 25mV, 50mV, 100mV, 250mV, 500mV, 1V , 2.5V, 5V (crest factor 6)
Input Impedance	**Voltage** **SPA6000 05A12/40A13:** Input resistance about 4MΩ, input capacitance about 10pF (parallel connection of resistors) **Current** • **Direct input** **SPA6000 05A12:** When the input current ranges from 2mA to 10mA, the input resistance is about 10Ω (indistinguishable inductive effect) When the input current ranges from 20mA to 200mA, the input resistance is about 1Ω; input inductance: about 0.28μH (series connection of resistors) When the input current ranges from 0.5A to 5A, the input resistance is about 60mΩ; input inductance: about 0.25μH (series connection of resistors) **SPA6000 40A13:** When the input current ranges from 100mA to 1A, the input resistance is about 110mΩ; input inductance: about 0.1μH (series connection of resistors) When the input current ranges from 2A to 10A, the input resistance is about 8.5mΩ; input inductance: about 0.1μH (series connection of resistors) When the input current ranges from 20A to 40A, the input resistance is about 3mΩ; input inductance: about 0.1μH (series connection of resistors) • **External current sensor** Input resistance: approx. 1MΩ
Instantaneous Continuous Maximum Allowable Input Value	**Voltage** **SPA6000 05A12/40A13:** Smaller value from 3kV peak value and 2kV voltage rms value

Instantaneous Continuous Maximum Allowable Input Value	**Current** • **Direct input** **SPA6000 05A12:** When the input current ranges from 2mA to 10mA, take the smaller value from 0.2A peak value and 0.1A current effective value When the input current ranges from 20mA to 200mA, take the smaller value from 4A peak value and 2.5A current effective value When the input current ranges from 0.5A to 5A, take the smaller value from 20A peak value and 12A current effective value **SPA6000 40A13:** 100mA~1A, smaller value from 8A peak value and 4A effective value 2A~10A, smaller value from 80A peak value and 40A current effective value 20A~40/50A, smaller value from 100A peak value and 55A current effective value • **External current sensor** Peak value less than 5 times the range
Rated Voltage to Ground	**Voltage input terminal:** CATII 1000V **Current input terminal** CATII 1000V **External current sensor input terminal:** CATII 1000V
A/D Converter	**Concurrent conversion for voltage and current** **Resolution:** 16 bit **Conversion rate (sampling rate):** about 0.5μs
Automatic Range Function	**Range increase (any of the following conditions is met)** ·The Urms or Irms exceeds 110% of the currently set measurement range ·The Upk or Ipk value of the input signal exceeds 330% of the currently set measurement range (660% when the crest factor set at 6) **Range decrease (all of the following conditions are met)** ·Urms or Irms less than or equal to 30% of the measurement range ·The Upk and Ipk value of the input signal are less than 300% of the next lower range (less than 600% when the crest factor set at 6)
Sensor Power Supply	**Connector type:** Mini DIN 8Pin **Output voltage:** ±15V DC **Maximum output power:** 15W

Technical Specifications of Input Module

Input module	Range	Bandwidth (Voltage/Current)	Sampling Rate	Power Accuracy ± (% of the reading + % of the range)
SPA6000 05A12	Voltage: 15~1000V Current: 2mA~5A	DC, 0.1Hz~5MHz	2MHz	0.01+0.02
SPA6000 40A13	Voltage: 15~1000V Current: 100mA~40A	DC, 0.1Hz~5MHz	2MHz	0.01+0.03

Measurement Conditions

Item	Specification
Crest Factor	3 or 6
Measurement Period	Measurement period and calculation period are determined by the zero-cross point of sync source signal (when sync source is none, measurement period will be data update period); when measuring harmonics, the measurement period starts from the starting point of the update interval and ends when 1024 or 10240 points are sampled.
Sync Source	U1~U4, I1~I4, EXT CLK, None
Wiring System	1P2W, 1P3W, 3P3W, 3V3A, 3P4W The available number of wiring systems is subject to the number of the installed input units
Line Filter	OFF, 0.1kHz-100kHz (increment as 0.1kHz), 300kHz, 1MHz
Frequency Filter	OFF, 100Hz, 1kHz,10kHz
Scaling Factor	When inputting the output of external current, VT or CT, the conversion ratio, VT ratio, CT ratio and power coefficient of the current sensor can be set. Selectable range: 0.0001 to 99999.9999

Accuracy Compensation	Efficiency compensation: compensating the power loss caused by the instrument during efficiency calculation Wiring compensation: compensating the power loss caused by wiring variation Two wattmeter method compensation: compensating the power loss caused by leakage current
Average Function Operation	Exponential average: select the attenuation constant from 2 to 64 Linear average: select the average number from 8 to 64 Harmonics measurement can only be used for exponential average
Data Update Rate	10ms, 20ms, 50ms, 100ms, 200ms, 500ms, 1s, 2s, 5s, 10s, 20s, Auto
Peak Hold	Hold the peak data(The displayed data will not be updated)
Single Measurement	Update the displayed data once under the held status
NULL Function	Purpose: compensate DC offsets Compensation object: Input element's voltage and current (U1 - U4, I1 - I4) Rotate speed and torque
Zero Setting	Purpose: improve the measurement accuracy of the instrument Method: manual or automatic initialization; automatic zero adjustment when the range is changed manually

Measurement Accuracy

Conditions: temperature: 23± 5℃, humidity: 30-75%RH, input waveform: sine wave, power factor(λ): 1, common mode voltage: 0V, crest factor: 3, line filter: OFF, frequency filter: ON, after 30 minutes of preheating, execute zero-level compensation before testing. f means frequency and the unit is kHz; last for half a year after calibration.

SPA6000 05A12 Module

Indicator: ± (% of reading + % of range)

Input signal frequency range	Voltage	Current	Power
DC	0.01+0.02	0.01+0.02	0.01+0.02
0.1Hz≤f<30Hz	0.02+0.05	0.02+0.05	0.06+0.1
30Hz≤f<45Hz	0.02+0.05	0.02+0.05	0.05+0.05
45Hz≤f<66Hz	0.01+0.02	0.01+0.02	0.01+0.02
66Hz≤f<1kHz	0.02+0.05	0.02+0.05	0.04+0.05
1kHz≤f<10kHz	0.08+0.05	0.08+0.05	0.12+0.1
10kHz≤f<50kHz	0.25+0.1	0.25+0.1	0.3+0.15
50kHz≤f<100kHz	0.012*f+0.2	0.012*f+0.2	0.014*f+0.3
100kHz≤f<500kHz	0.009*f+0.5	0.009*f+0.5	0.012*f+0.2
500kHz≤f≤1MHz	(0.022*f-7)+1	(0.022*f-7)+1	(0.048*f-19)+2

SPA6000 40A13 Module

Indicator: ± (% of reading + % of range)

Input signal frequency range	Voltage	Current	Power
DC	0.01+0.03	0.01+0.03	0.01+0.03
0.1Hz≤f<30Hz	0.03+0.05	0.03+0.05	0.08+0.1
30Hz≤f<45Hz	0.03+0.05	0.03+0.05	0.05+0.05
45Hz≤f<66Hz	0.01+0.03	0.01+0.03	0.01+0.03

66Hz≤f<1kHz	0.03+0.05	0.03+0.05	0.05+0.05
1kHz≤f<10kHz	0.1+0.05	0.1+0.05	0.14+0.1
10kHz≤f<50kHz	0.3+0.1	0.3+0.1	0.4+0.15
50kHz≤f<100kHz	0.012*f+0.2	0.012*f+0.2	0.014*f+0.3
100kHz≤f<500kHz	0.009*f+0.5	0.009*f+0.5	0.012*f+0.5
500kHz≤f≤1MH	(0.022*f-7)+1	(0.022*f-7)+1	(0.048*f-19)+2

Display Function

Item	Specification
Display	12.1-Inch TFT color touchscreen
Screen Resolution	1280 (horizontal) * 800 (vertical)
Type of Display	Numerical value, waveform, vector, bar graph, tendency chart, combination, X-Y display
Touch Screen	Touch input is supported

Numerical Value Display

Item	Specification
Resolution of Numeric Display	6 digits, 5 digits
Display Format	4 values, 8 values, 16 values, 32 values, all values, single harmonic, biharmonic, application scenario
Display Item	All measurement functions of this instrument

Vector Display

Item	Specification
Display Format	Single screen, split screen
U/I Scale Range	0.1~100
Display Item	Unit 1 - Unit 4, ΣA, ΣB, ΣC voltage, the relation between effective value of fundamental wave of current and phase difference as a vector

Waveform Display

Item	Specification
Display Format	Single screen, split screen, three split screen, four split screen, five split screen, six split screen
Time Axis	From 0.05ms - 2s/div. But the largest value is 1/10 of data update rate
Interpolation Type	On: line segment interpolation between two points Off: only the data points are displayed
Vertical Scale Factor	0.1~100.0
Vertical Position	0.00~±100.00
Display Item	Input element's voltage and current (U1 - U4, I1 - I4) Motor's rotate speed and torque (Speed1, Torque1) Waveform calculation (Math1, Math2)

Bar Graph Display

Item	Specification
Display Method	Single screen, split screen, three split screen
Display Item	U, I, P, S, Q, λ, Φ, ΦU, ΦI, Z, Rs, Xs, Rp, Xp Value of each harmonic

Trend Display

Item	Specification
Display Format	Single screen, split screen, three split screen, four split screen
Time Axis	1s~1day
Displayed Channels	Up to 16 channels
Display Item	All measurement functions

Frequency Measurement Function

Item	Specification
Measured Object	Measures the frequency of the voltage or current of all input elements concurrently
Measurement Method	Reciprocal method
Frequency Measurement Range	Frequency measurement time / Frequency measurement range 10ms / 0.25kHz≤f≤1MHz 20ms / 0.1kHz≤f≤2MHz 50 ms / 45Hz≤f≤1MHz 100 ms / 25Hz≤f≤1MHz 200 ms / 12.5Hz≤f≤500kHz 500 ms / 5Hz≤f≤200 kHz 1s / 2.5Hz ≤f≤100kHz 2s / 1.25Hz≤f≤50kHz 5s / 0.5Hz≤f≤20kHz 10s / 0.25Hz≤f≤10kHz
Frequency Measurement Range	20s / 0.1Hz≤f≤5kHz AUTO / 0.1Hz≤f≤500kHz * Under auto update rate, the frequency measurement range is impacted by overtime time and sync source
Frequency Accuracy	Condition: when input signal level exceeds or equals to 30% of the measurement range (when the crest factor is 6, the level shall exceed or equal to 60% of the measurement range) and measured voltage or current frequency is less than or equals to 200Hz, the frequency filter accuracy is turned on: ± (0.05% of reading)
Minimum Resolution	0.0001Hz

Integration Function

Item	Specification
Integration Mode	Regular, continuous, real-time regular, real-time continuous
Integration Timer	Selectable range: 00:00:01~10000:59:59
Integration Termination Condition	When integration time reaches the largest value The integrated value reaches its maximum/minimum displayable value
Accuracy	± (power or current accuracy + timer accuracy)
Time Accuracy	± 0.02% of reading

Motor Evaluation Function

Item	Specification
Input Terminal	Single motor mode: torque, rotate speed (phase A, phase B, phase Z) Dual motor mode: torque 1/2, rotate speed 1/2
Input Resistance	Approx.1MΩ
Input Connector Type	Isolated BNC
Analog Input	Fixed range: 1V, 2V, 5V, 10V, 20V Auto range state: On; Off Effective input range: measurement range±110% Cutoff frequency: OFF, 100Hz, 1kHz Sampling rate: about 200kS/s Resolution: 16bit Sync source: U1~U4, I1~I4, EXT CLK, None Accuracy: ± (0.03% of reading + 0.05% of range) Temperature float: ± 0.03% of range/°C
Pulse Input	Input amplitude range: ± 12 Vpeak Frequency measurement range: 2Hz-2MHz Max common mode voltage: ± 42 Vpeak Accuracy: ± (0.05+f/500)% ± 1mHz of reading ww Detection level: H level: about 2V or above L level: about 0.8V or less Impulse width: 250ns or above

Image Storage Function

Item	Specification
Image Name	Number, date, self-defined fields
Image Save Format	PNG, BMP, JPG

Harmonic Measurement Function

Item	Specification			
Measured Object	All installed elements			
Method	PLL synchronization method			
PLL Source	U1~U4, I1~I4, EXT CLK			
Frequency Measurement Range	Fundamental frequency range between 0.5Hz and 99.9kHz			
Sampling Rate, Window Width and Measured Time Limit	1024 points, when data update rate is 50ms, 100ms or 200ms		Measured time limit	
	Fundamental frequency	Window width	U, I,P, φ， φU,φI	Other measured values
	15Hz - 40Hz	1	500	500
	40Hz - 440Hz	2	500	500
	440Hz - 1.1kHz	10	500	500
	1.1kHz - 2.6kHz	25	500	500
	2.6kHz - 4.8kHz	50	250	250
	4.8kHz - 10.5kHz	50	100	100
	10.5kHz - 20.5kHz	50	50	50
	20.5kHz - 34kHz	50	25	25
	34kHz - 99.9kHz	50	10	10
Sampling Rate, Window Width and Measured Time Limit	10240 points, when data update rate is 500ms, 1s, 2s, 5s, 10s or 20s		Measured time limit	
	Fundamental frequency	Window width	U, I,P, φ， φU,φI	Other measured values
	0.5Hz - 40Hz	1	500	500
	40Hz - 440Hz	2	500	500
	440Hz - 1.1kHz	10	500	500
	1.1kHz - 2.6kHz	25	300	300
	2.6kHz - 4.8kHz	50	200	200
	4.8kHz - 9kHz	50	100	100
	9kHz -20kHz	50	50	50
	20kHz - 50kHz	50	20	20
	50kHz - 99.9kHz	50	10	10
Harmonic Measurement Accuracy (Indicator: ± % of reading + % of range)	The following accuracy values are added besides the regular measurement accuracies When the line filter is turned off SPA6000 40A13/05A12			
	Frequency		Voltage/current	Power
	0.5Hz ≤ f < 30Hz		0.01 + 0.015	0.02 + 0.04
	30Hz ≤ f < 45Hz		0.01 + 0.015	0.02 + 0.04
	45Hz ≤ f < 66Hz		0.01 + 0.015	0.02 + 0.03
	66Hz ≤ f < 1kHz		0.01 + 0.015	0.02 + 0.04
	1kHz ≤ f < 10kHz		0.01 + 0.015	0.02 + 0.04
	10kHz ≤ f < 50kHz		0.05 + 0.05	0.1 + 0.15
	50kHz ≤ f < 100kHz		0.1 + 0.1	0.2 ＋0.2
	100kHz ≤ f < 500kHz		0.1 + 0.25	0.1 + 0.8
	500kHz ≤ f ≤ 1MHz		0.35 + 1.5	0.5 + 3

Waveform Calculation

Item	Specification
Display Item	Math1, Math2
Waveform for Calculation	U1-U4 waveform, I1-I4 waveform, torque waveform, rotate speed waveform
Operators	Four operations: addition (+), subtraction (-), multiplication (*), and division (/) Absolute value (ABS) Square (SQR) Square root (SQRT) Natural logarithm (LN) Common logarithm (LOG10) Exponent arithmetic (EXP) Negation operation (NEG) Averaging operation (AVG2, AVG4, AVG8, AVG16, AVG32, AVG64)
Constant	K1-K8

Cycle-by-Cycle Measurement Function

Item	Specification
Measured Item	Power unit: Urms, Irms (effective value), Urmn, Irmn (rectified mean value), Umn, Imn (rectified mean current calibrated to the rms value), Udc, Idc (DC value and simple averages), Uac, Iac (AC value), U+Peak, U-Peak, I+Peak, I-Peak (peak value), CfU, CfI (crest factor), P (active power), Q (reactive power), S (apparent power), Phi (power factor), λ (power factor angle), Pc (corrected power) Motor unit: Speed1 (rotate speed 1), Torque1 (torque 1), Pm1 (mechanical power 1) Sync source frequency Freq (frequency)
Sync Source	U1~U4, I1~I4, EXT CLK
Sync Source Frequency Range	0.1Hz~1kHz(EXT CLK) 1Hz~1kHz(U1~U4、I1~I4)
Cycle counts	10~3000
Time-out Time	0-3,600s (time-out period is 24 hours when “0” is selected)

Cursor Measurement Function

Item	Specification
Cursor Type	C1+, C2x
Cursor Applications	Waveform, tendency, bar graph or FFT calculation
Cursor Measurement Display Items	Waveform: Y+, Yx, ΔY, X+, Xx, ΔX Tendency: Y+, Yx, ΔY, X+, Xx, ΔX, D+, Dx Bar graph: Y+, Yx, ΔY, X+Order, XxOrder FFT calculation: Y+, Yx, ΔY, X+, Xx, ΔX

Storage Function

Item	Specification
File Naming	Date, number, self-defined
Save Format	ssf, csv
Storage Location	Internal SSD drive or external USB storage device
Properties of Internal Hard Drive	SSD, 512GB/1TB
Save Mode	Manual and automatic (save as csv format)
Stored Item Type	Numerical value, waveform, numerical value + waveform
Storage Time	1-9999999
Storage Interval	0 second-10,000 hours 59 minutes and 59 seconds; when set as “0:0:0”, it means the storage interval is same as the data update interval
Maximum Storage Period	It depends on the storage amount and storage medium

Print Function

Item	Specification
Printing Type	Manual, automatic
Automatic Printing Mode	Printing regularly, synchronization with integration, event driven
Printer Connection	LAN, USB

External Hardware Interfaces

Item	Specification
External Clock Input	BNC port, TTL level: 50% duty ratio square wave
Master/Slave Sync Port	BNC port, TTL level
Front Type A USB Port	Complying with USB Rev.2.0, power supply: 5V, 500mA
Rear Type A USB Port	Complying with USB Rev.3.0, power supply: 5V, 500mA
Video Output Port	HDMI 2.0/VGA

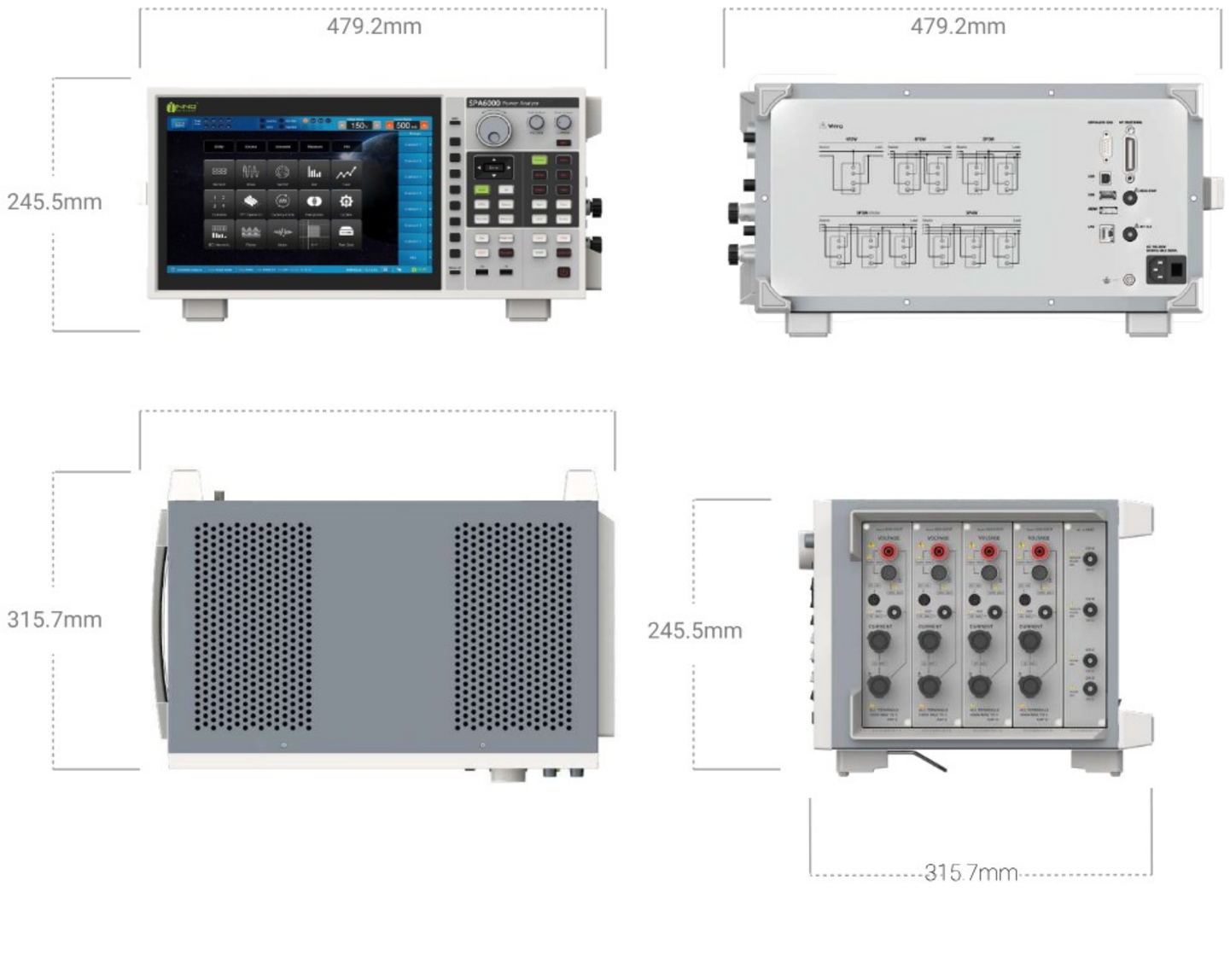
Communication Interfaces

Item	Specification
USB-Port B	USB 2.0, USBTMC-USB488 Ver 1.0
Ethernet Interface	RJ-45 port, complying with IEEE802.3, 1000BASE-T, 100BASE-TX, 10BASE-T
RS-232 Port	DB-9 (pin), complying with EIA-574 (EIA-232 (RS-232) 9-pin standard)
GP-IB Port	Complying with IEEE standard 488-1978 (JIS C 1901-1987) and IEEE standard 488.2-1992

General Specifications

Item	Specification
Dimensions	479.2mm*315.7mm*245.5mm
Rated Supply Voltage	AC100 ~240V
Allowable Supply Voltage Range	AC85 ~264V
Rated Supply Frequency	50/60Hz
Allowable Supply Frequency Range	48~63Hz
Maximum Power Consumption	300VA (supplying power for four 15W current sensors)
Preheating Time	About 30 minutes
Operating Environment	Temperature: 5°C to 40°C Humidity: 20% to 80% RH (No condensation)
Operating Altitude	No more than 2,000 meters
Applicable Environment	Indoor
Storage Environment	Temperature: -25°C to 60°C Humidity: 20% to 80% RH (No condensation)
Weight	About 15kg

Dimension of the Instrument



Accessories

Current Sensor of SCTH Series

	Rated Current	Accuracy	Measuring Bandwidth	Ratio KN	Resistance Rm	Aperture	Connector	Supply
SCTH60	AC/DC 60A	±(0.05% of rdg + 15μA)	DC-800kHz	1: 600	0-72Ω	Ø28mm	DB9	±12V~±15V
SCTH200	AC/DC 200A	±(0.05% of rdg + 15μA)	DC-500kHz	1: 1000	0-32Ω	Ø28mm	DB9	±12V~±15V
SCTH600	AC/DC 600A	±(0.05% of rdg + 15μA)	DC-300kHz	1: 1500	0-8.2Ω	Ø30.9mm	DB9	±15V~±24V
SCTH1000	AC/DC 1000A	±(0.05% of rdg + 15μA)	DC-300kHz	1: 2000	0-2Ω	Ø30.9mm	DB9	±15V~±24V

Current Sensor of SCTX Series

	DC	Accuracy	Measuring Bandwidth	Ratio KN	Resistance Rm	Aperture	Connector	Supply
SCTX60	AC/DC 60A	±(0.01% of rdg + 10μA)	DC-800kHz	1: 600	0-72Ω	Ø28mm	DB9	±12V~±15V
SCTX200	AC/DC 200A	±(0.008% of rdg +10μA)	DC-500kHz	1: 1000	0-32Ω	Ø28mm	DB9	±12V~±15V
SCTX600	AC/DC 600A	±(0.008% of rdg +10μA)	DC-300kHz	1: 1500	0-8.2Ω	Ø30.9mm	DB9	±15V~±24V
SCTX1000	AC/DC 1000A	±(0.008% of rdg +10μA)	DC-300kHz	1: 2000	0-2Ω	Ø30.9mm	DB9	±15V~±24V

Boxes

Model	Name	Schematic diagram	Purpose
PTB01	Test converter box of single phase connection		Used for switching for single phase circuit so that users can measure the power coefficient of the equipment quickly
PTB03	Test converter box of three-phase connection		Used for switching for single phase circuit so that users can measure the power coefficient of the equipment quickly
PTB02	External sensor connection fittings		Used for switching for single phase circuit so that users can measure the power coefficient of the equipment quickly

Connectors and Cables

Model	Name	Sample	Usage
PAC-1001	Fork terminal adapter		Used when attaching banana plug to binding post. Specification: 1000V, CAT II, 20A Color: red, black
PAC-1002	BNC Conversion adapter		Connector: Conversion between safety BNC and banana jack Specification: 600V, CAT III
PAC-1007	Small alligator adapter		Connector: safety connector Specification: 300V, CAT II, 15A Color: red, black
PAL-1001	Measurement lead		Connector: safety connector Specification: 1000V, CAT II, 32A , 600V, CAT III Color: red, black
PAL-1002	Safety BNC cable		Connector: BNC connector Specification: 1000V, CAT II, 600V, CATIII Color: black
PAL-1003	External sensor Cable		Connector: one BNC safety connector Specification: 300V, CAT II, 2A Color: black
PAC-1003	Safety adapter		Connector: Safety connector; Solder can be used for tightening the test cables. Specification: 600V, CAT II, 20A Color: red, black
PAC-1004	Safety adapter		Connector: safety connector, spring-hold type Specification: 600V, CAT II, 10A Color: red, black
PAC-1005	Safety clamp		Connector: hook shape connector Specification: 1000V, CAT III, 4A Color: red, black
PAC-1006	Large alligator adapter		Connector: safety connector Specification: 600V, CAT , 19A Color: red, black

Model and Code

Name	Model	Description
Main Frame	SPA6000	Power analyzer main frame (including a power cord)
Main Frame Options	/HF /WA /MS	IEC harmonic and flicker Waveform calculation; X-Y display 1TB SSD drive
Input Module Options	05A12 40A13 MA2	5A, 1000V, 0.01%+0.02% 40A, 1000V, 0.01%+0.03% Motor evaluation function
Additional Input Module Option	/P	Power supply for current sensor

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