

## Digital Power Meter

# SPA3000

# SPA2000

# SPA1000



Highest Measurement Accuracy:  $\pm(0.1\% \text{ of reading} + 0.05\% \text{ of range})$

Bandwidth: DC, 0.1Hz - 100kHz

Measurement Voltage up to 1000V(SPA1000/SPA2000/SPA3000)

Measurement Current up to 20A(SPA1000/SPA3000), 50A(SPA2000)

1 Power Channel + 1 External Current Sensor Connection(SPA1000/SPA2000)

3 Power Channel + 3 External Current Sensor Connection(SPA3000)

Harmonic Analysis up to 100th Order(SPA1000/SPA2000), 50th Order(SPA3000)

Instantaneous Power Measurement

Peak Hold, Save and Re-load Configuration, D/A Output, Comparator and Computation Function

PM Viewer Software



INNO Instrument is a professional high-end test instrument and equipment company. Rooted in the technological achievements gained from the research and development investment by the group company for many years, it provides advanced, reliable and comprehensive test and measurement solutions for developers and producers with high-quality cutting-edge test products in many fields such as electric power, energy, transportation, automobile and communication, so as to systematically meet the deep needs of customers and support the continuous upgrading and development of the global industry.

SPA Digital Power Meter is a powerful instrument for measuring home appliances, OA products (office automation), and equipment with large power and process control automation. It is widely used in the areas such as power industry, office or home appliances testing and evaluation, battery drive test and motor efficiency test. This instrument is also equipped with the functions such as recording real time waveform and the waveform data record and analyzing the harmonic. Small in size, compact in structure, convenient in operation, economical in price but accurate in measurement, it is an ideal instrument working on the bench.





# Functional Advantages and Features

## Simultaneously Measuring All Parameters

This digital power meter can measure all DC and AC parameters. It can also measure harmonics and perform integration simultaneously without changing the measurement mode.

## Fast Display with Data Update Rate up to 100ms

The fast display and 100ms maximum data update rate of the digital power meter can offer users a shorter test time in their testing procedures.

## Peak Hold Function

The maximum values of voltage, current, active power, reactive power and apparent power can be held in 4 different modes RMS, MEAN, DC, and PEAK.

## Save and Re-load Configuration Parameters

This instrument can save the configuration parameters which can be fast loaded when in similar measurement conditions next time, reducing the time spent by users for parameter access next time.

## D/A Output for Measurement Recording

The D/A option can be used to output the Voltage, Current, Power and other measured data and record them in the data loggers or other devices ( $\pm 5\text{VDC}$  outputs).

## Comparator Function

The measured value is compared with the set value. According to the comparison result, output value is +5V, 0V or -5V.

## Current Sensor Input

The instrument with expanded range of current measurement is equipped with current clamps or current sensors of voltage output model.

## Computation Function

Multiple computations are available on this instrument, including performing computations such as crest factor, four arithmetic operations and average active power.

## Data Storage Function

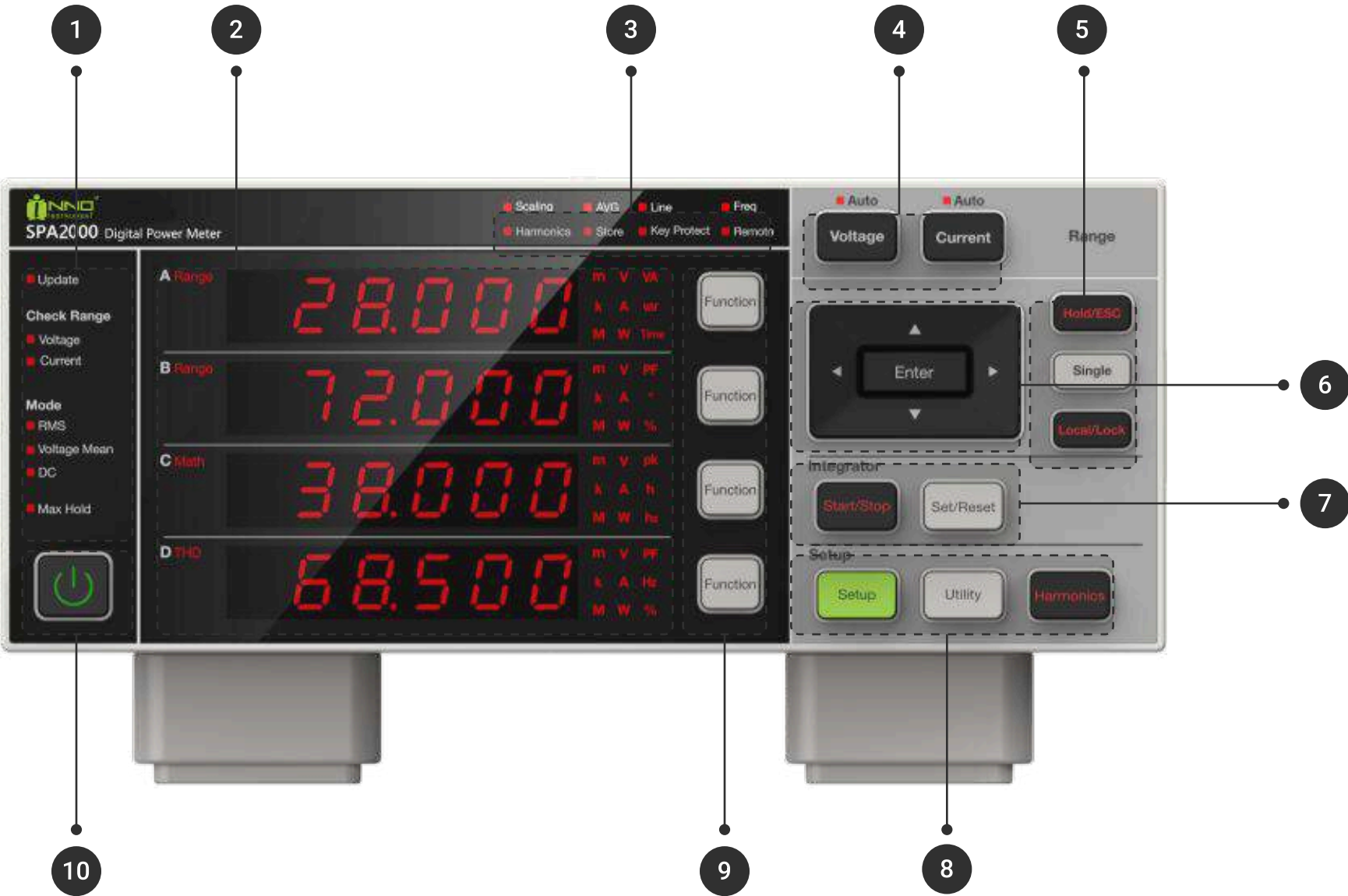
The measured data can be stored , and internal free memory space is available up to 4GB. And the stored data can be accessed to and analyzed via computer or PC connected instead of being displayed and loaded in the screen of this digital digital power meter.

## INNO PM Viewer Software

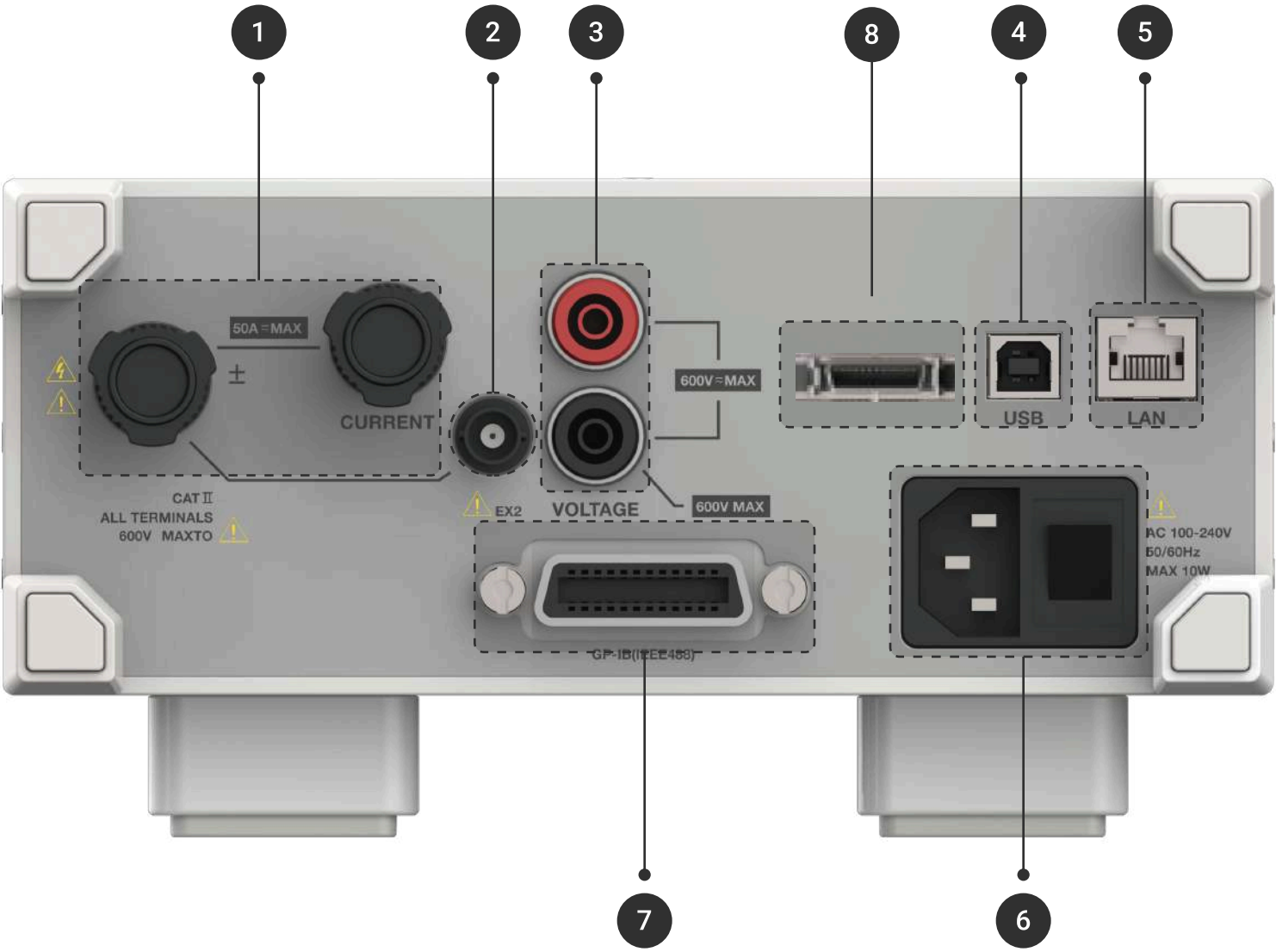
The INNO PM Viewer is an software installed in PC available to remotely control the digital power meter connected via a communication interface (network connector or USB connector), and display the results analyzed by the digital power meter in the form of numeric, waveform, trend, vector, and bar graph.



# Product Overview - SPA1000/SPA2000



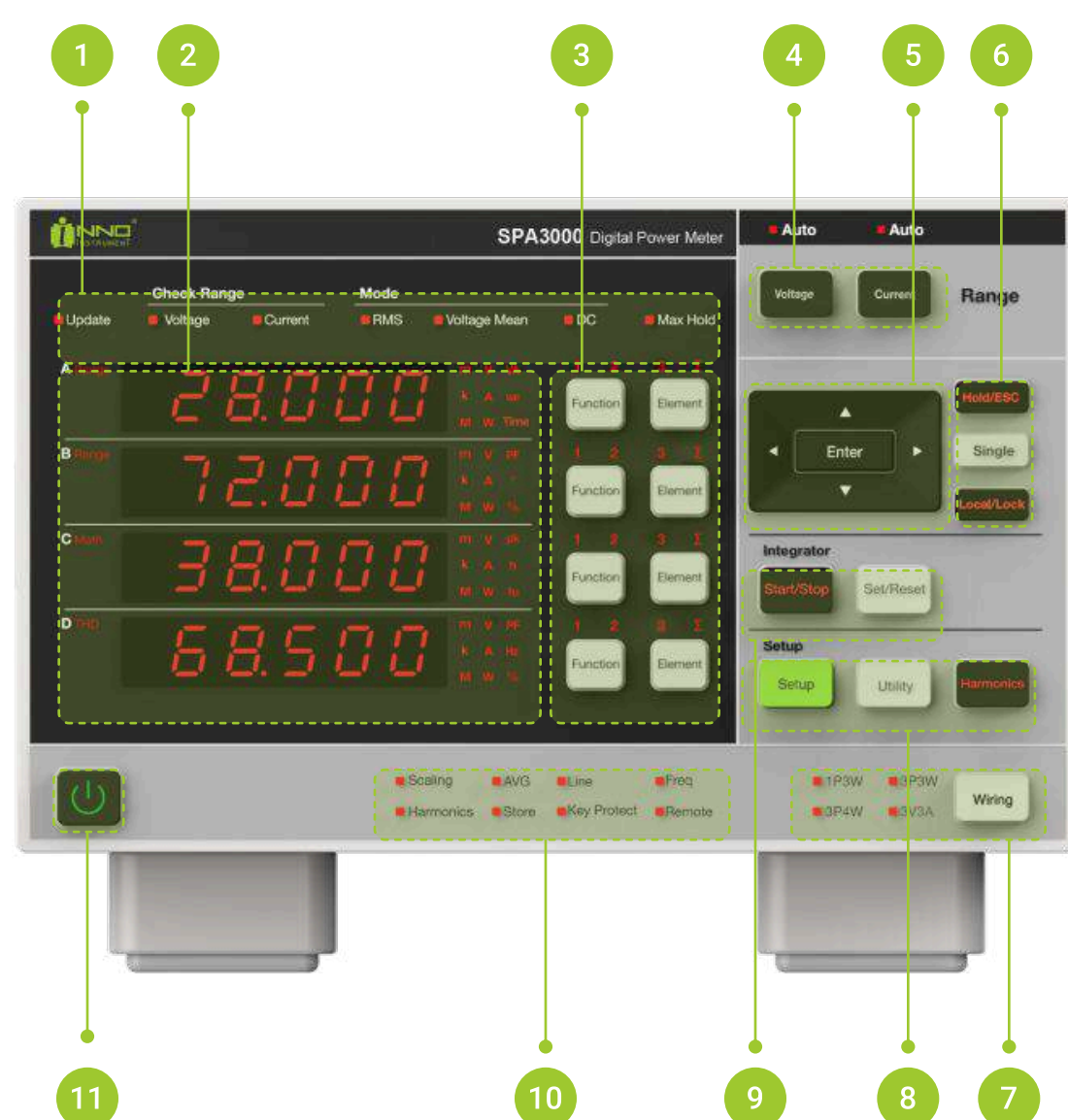
- ① Status display I
- ② Data display
- ③ Indicators II
- ④ Range setting
- ⑤ Other function settings
- ⑥ Navigation keys
- ⑦ Integration setup keys
- ⑧ Setup, utility, Harmonic keys
- ⑨ Functions selection
- ⑩ Power switch



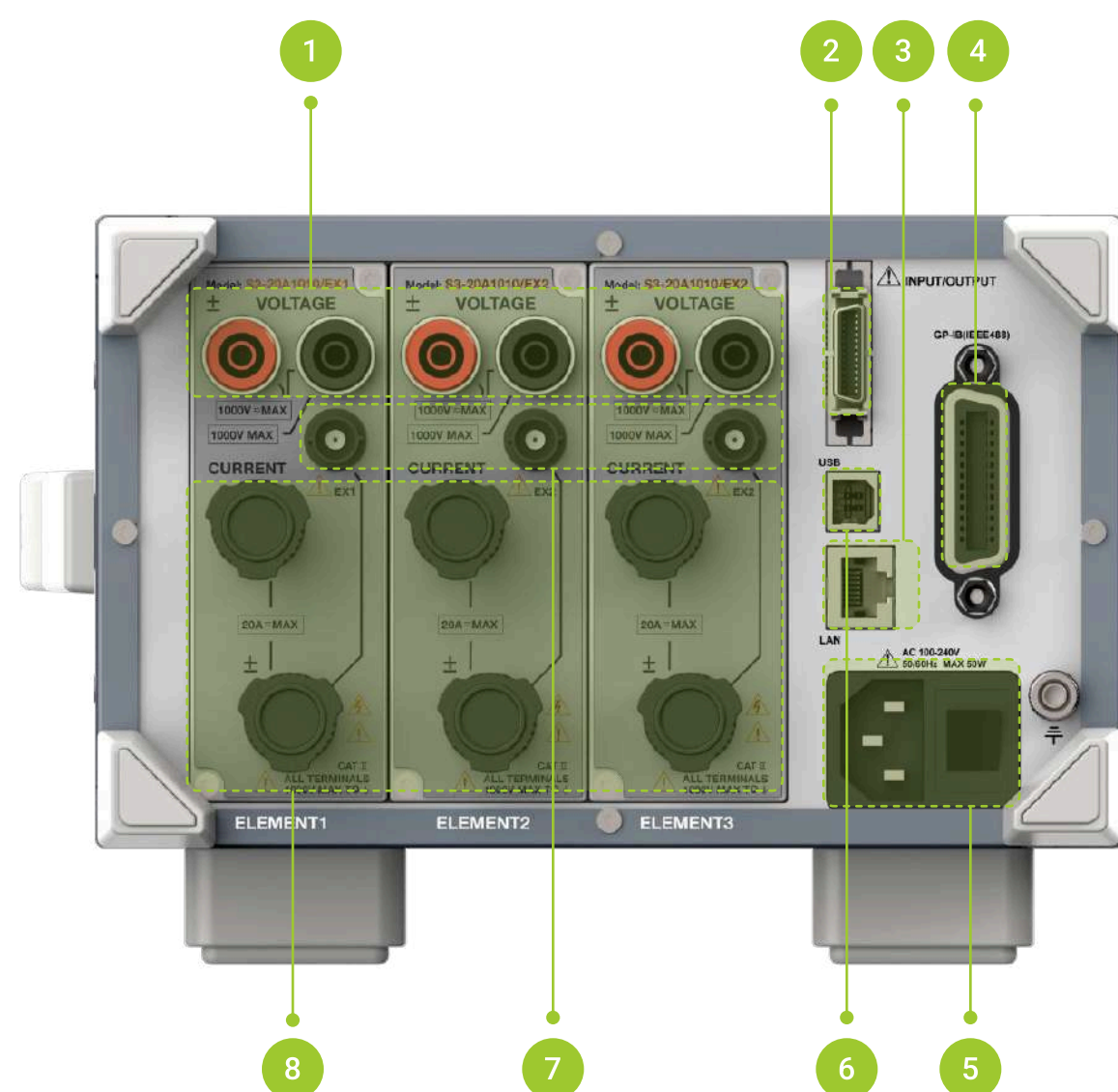
- ① Current input terminal
- ② EXT current sensor input terminal
- ③ Voltage input terminal
- ④ Type B USB connector
- ⑤ Ethernet connector
- ⑥ Power switch and power cord connector
- ⑦ GP-IB / RS-232 connector
- ⑧ D / A Connector



# Product Overview - SPA3000



- ① Status display I
- ② Measurement display
- ③ Displayed function settings
- ④ Range setting
- ⑤ Navigation keys
- ⑥ Function settings I
- ⑦ Wiring settings
- ⑧ Function settings II
- ⑨ Integration setup keys
- ⑩ Status display I
- ⑪ Power switch



- ① Voltage input terminal
- ② D / A connector
- ③ USB connector
- ④ GP-IB / RS-232 connector
- ⑤ Power switch and power cord connector
- ⑥ Ethernet connector
- ⑦ EXT current sensor input terminal
- ⑧ Current input terminal

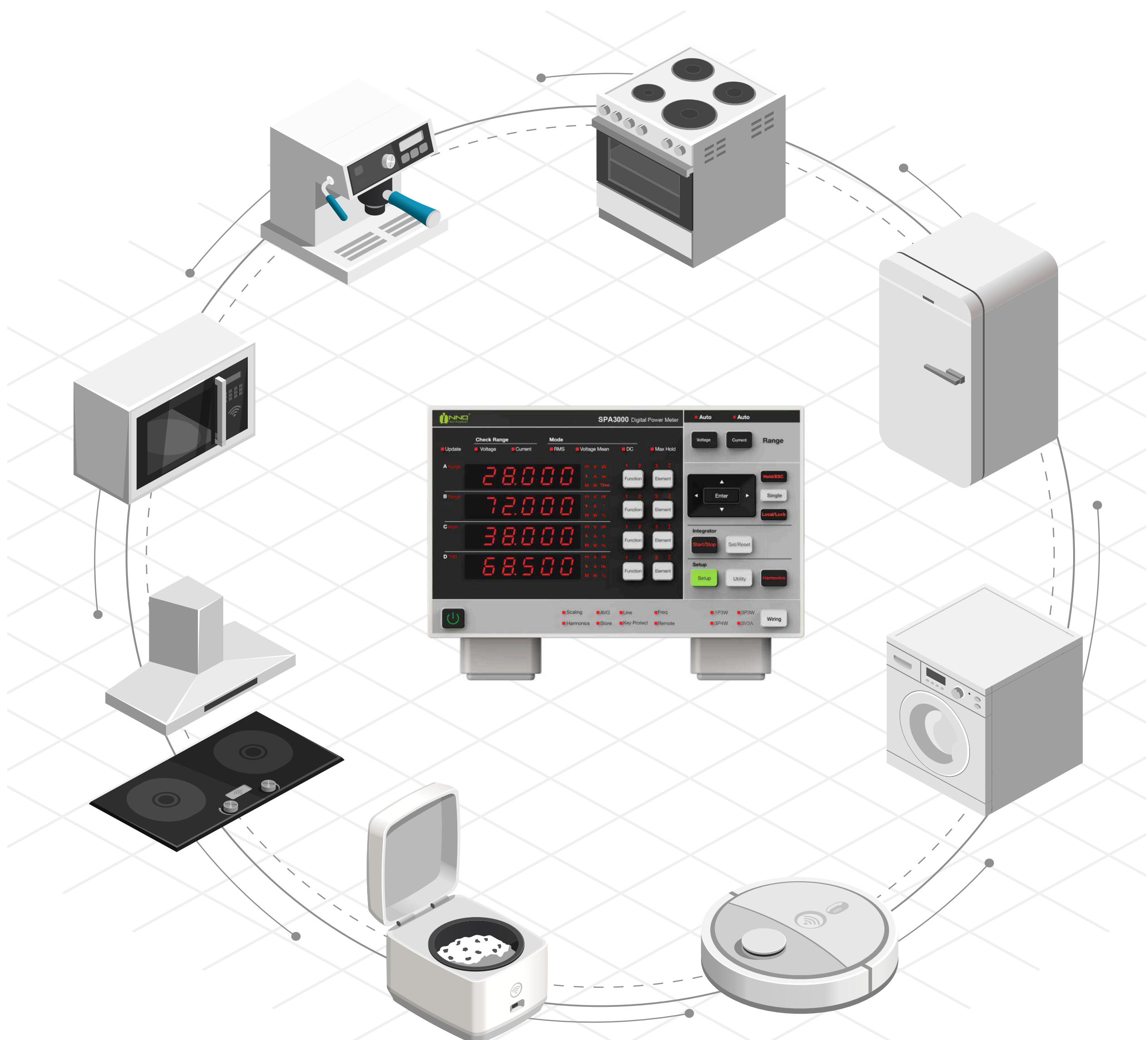


# Applications

This digital power meter is easy to use, economy and accurate in measurement, widely used in production, testing, evaluation and research & development.

## Home appliances and Office equipment

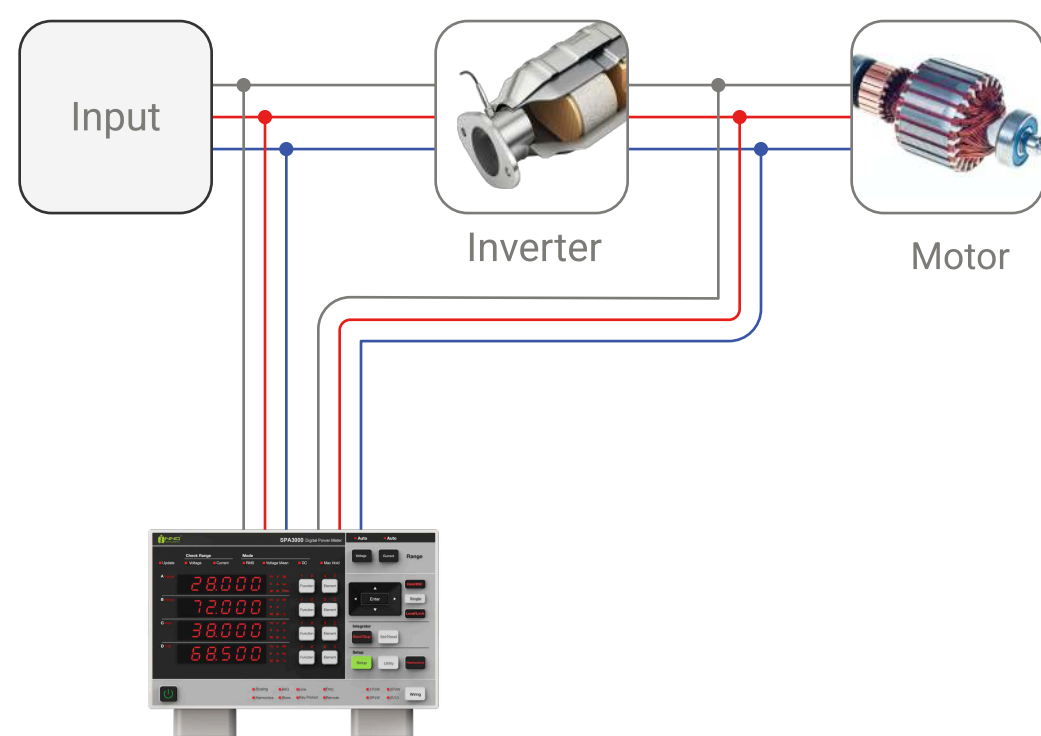
Recently, there are more concerns about energy efficiency, such as reducing the power consumption for the civil electrical appliances (such as air conditioner, washing machine, induction cooker, water heater). The digital power meter can be used to test the power produced by home appliances. One piece of the digital power meter of this series can effectively measure the voltage, current, power, frequency, power factor and THD (Harmonic distortion).





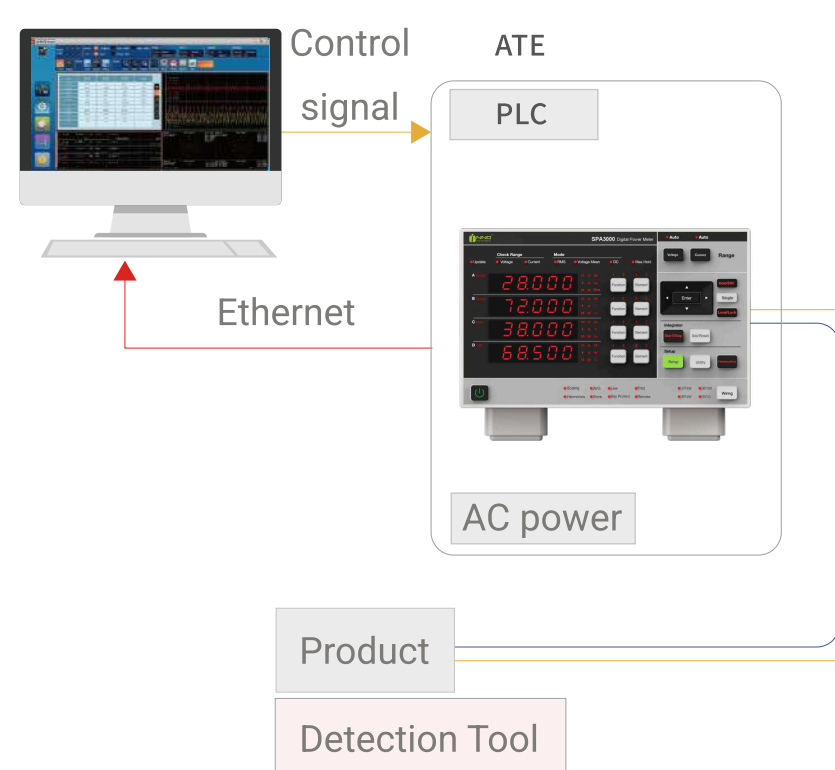
## Industrial equipment and transportation use

Automotive - Battery or Driven Device Evaluation This digital power meter can directly measure the high current up to 50A. This provides an economical and accurate method for testing DC driven devices in vehicles without any extra sensors.



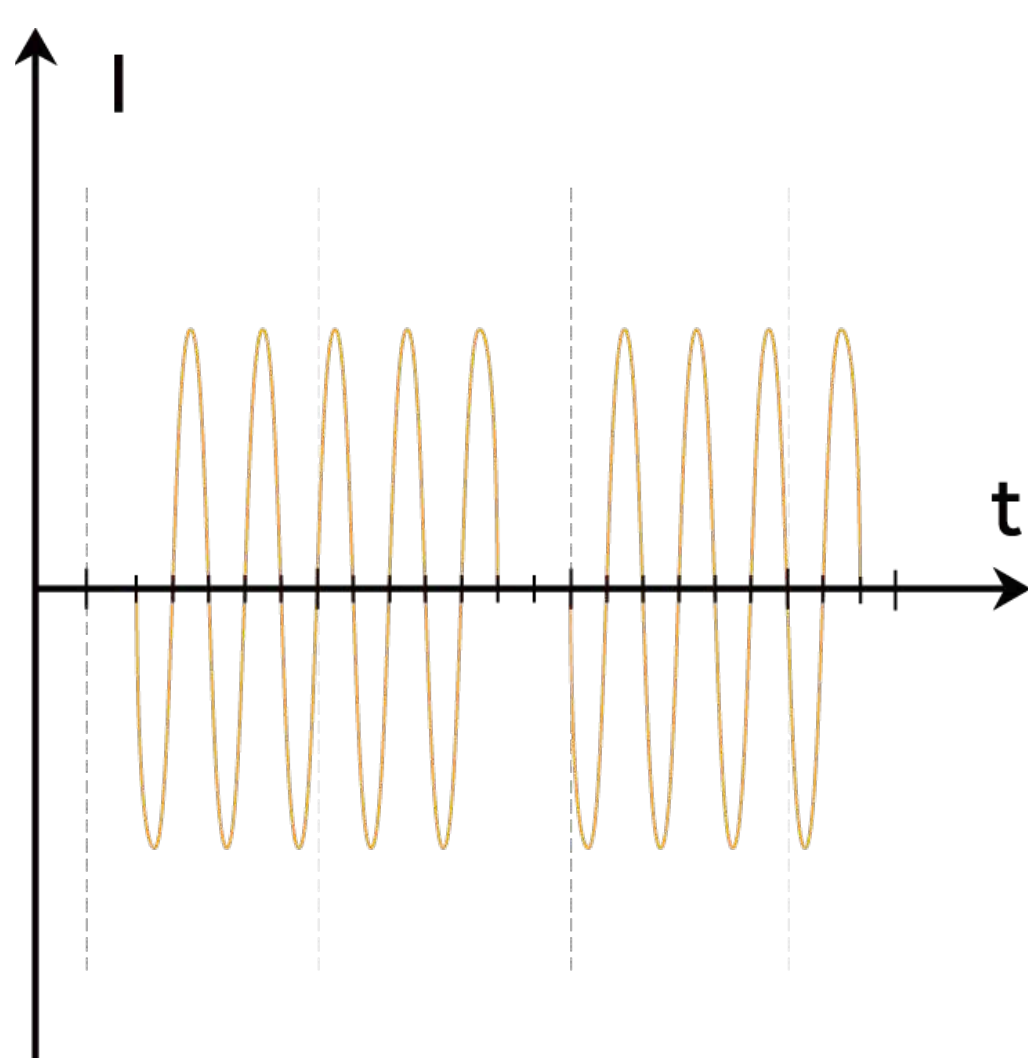
## Production line test

This instrument is so compact in structure to be easily mounted on the shelf for testing during production. Testing platform can be economically set up at a favorable price. The parameters such as voltage, current, frequency, power factor, and harmonics can be measured by this digital power meter, so as to improve testing efficiency.

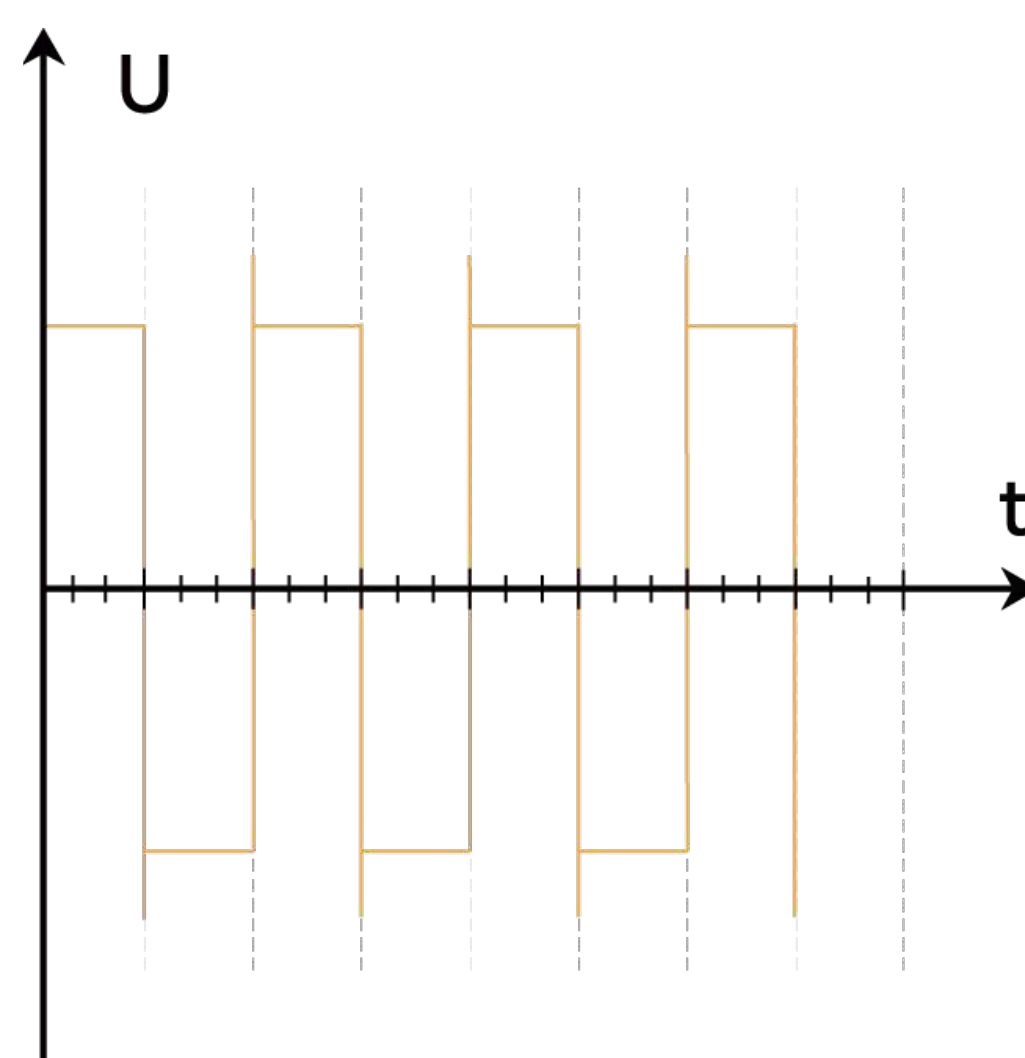


## Evaluation testing of special waveform driving device and distorted waveform containing DC component

The digital power meter of this series has a broad frequency capability of DC (from 0.1Hz to 100 kHz). It can measure the RMS value of distorted waveforms like square waveforms or special waveform driven devices. The average active power measurement function gives accurate power consumption data for fluctuating power devices such as burst waveform operated devices. Therefore the users can perform accurate distorted waveform measurements without any need to setting special modes.



Inter-harmonic shock wave



Square wave



# Technical Specifications - SPA1000/SPA2000

## Signal Input

Item	Specification
Input Terminal Type	<b>Voltage(U):</b> Plug-in terminal (Safety terminal) <b>Current(A):</b> binding post <b>External current sensor input:</b> Insulated BNC connector
Input Format	<b>Voltage:</b> Floating input, resistive potential method <b>Voltage:</b> Floating input, Shunt input method
Measurement Range	<b>Voltage</b> 15V, 30V, 60V, 150V, 300V, 600V(CF3), 1000V(CF2) 7.5V, 15V, 30V, 75V, 150V, 300V(CF6), 500V(CF4)  <b>Current</b> · <b>Direct input</b> <b>SPA1000-20A105:</b> 5mA, 10mA, 20mA, 50mA, 100mA, 200mA, 500mA, 1A, 2A, 5A, 10A, 20A(CF3) 2.5mA, 5mA, 10mA, 25mA, 50mA, 100mA, 250mA, 500mA, 1A, 2.5A, 5A, 10A(CF6) <b>SPA2000-50A105:</b> 1A, 2A, 5A, 10A, 20A, 50A(CF3) 500mA, 1A, 2.5A, 5A, 10A, 25A(CF6) · <b>External current sensor input</b> <b>EX1:</b> 2.5V, 5V, 10V(CF3) 1.25V, 2.5V, 5V(CF6) <b>EX2:</b> 50mV, 100mV, 200mV, 500mA, 1V, 2V(CF3) 25mV, 50mV, 100mV, 250mA, 500mV, 1V(CF6)
Input Impedance	<b>Voltage:</b> Input resistance: Approximately 2MΩ; Input capacitance: Approximately 13pF(paralleled with resistance)  <b>Current</b> · <b>Direct input</b> <b>SPA1000-20A105:</b> When 5mA~200mA,Approximately0.6Ω; Approximately 0.1μH(resistance in series) When 0.5A~20A,Approximately 8mΩ; Approximately 0.1μH(resistance in series) <b>SPA2000-50A105:</b> When 1A~50A, Approximately5mΩ; Approximately 0.1μH(resistance in series) protection; · <b>External current sensor input</b> <b>EX1:</b> Input resistance: Approximately 100KΩ <b>EX2:</b> Input resistance: Approximately 20kΩ
Instantaneous Continuous Maximum Allowable Input Value	<b>Voltage:</b> Peak voltage of 1.5kV or RMS of 1kV, whichever is lower  <b>Current</b> · <b>Direct input</b> <b>SPA1000-20A105:</b> When 5mA~200mA, with 2.5A continuous overload protection; When 0.5A~20A, with 30A continuous overload protection; <b>SPA2000-50A105:</b> Peak current of 100A or RMS of 55A, whichever is lower · <b>External current sensor input</b> Peak value less than or equal to 5 times the range
A/D Converter	Simultaneous voltage and current input conversion <b>Resolution:</b> 16bit <b>Conversion speed (sampling period):</b> Approximately 10μs
Automatic Range Function	<b>Range up(When one of the following conditions is met)</b> <ul style="list-style-type: none"><li>Urms or Irms exceed 110% of the range</li><li>Upk or Ipk of the input signal exceed 330% of the range(660% for CF6)</li></ul> <b>Range down(When all the following conditions met)</b> <ul style="list-style-type: none"><li>Urms or Irms is less or equal to 30% of the measurement range</li><li>Upk or Ipk of the input signal is less than 300% of the lower range(600% or less for CF6)</li></ul>



## Measurement Accuracy

Conditions: Temperature: 23±5°C; Humidity: 30 to 75%RH; Input waveform: Sine wave; Crest factor: 3; Common-mode voltage: 0V; Scaling function: OFF; Number of displayed digits: 5 digits; Frequency filter: Turn ON to measure voltage or current of 200 Hz or less; After 30 minutes of warm-up time has passed; Zero setting before wiring; Frequency f with unit kHz; within half a year after calibrated.

Format: ± (% of reading + % of range)

Frequency range	Voltage	Current	Active Power
DC	0.1+0.05	0.1+0.05	0.1+0.05
0.1Hz<f<45Hz	0.1+0.2	0.1+0.2	0.3+0.2
45Hz≤f≤66Hz	0.1+0.05	0.1+0.05	0.1+0.05
66Hz<f≤1kHz	0.1+0.2	0.1+0.2	0.2+0.2
1kHz<f≤10kHz	0.07*f+0.3	0.07*f+0.3	0.09*f +0.3
10kHz<f≤100kHz	0.05*f +0.5	0.05*f +0.5	0.08*f +0.5

## Measurement Conditions

Item	Specification
Crest Factor	3 or 6
Measurement Period	Interval for determining the measurement function and performing calculations The measurement period is set by the zero crossing of the reference signal (When synchronization source is set to be None, measurement period becomes data update interval)
Measurement Mode	Select RMS(the true RMS value of voltage and current), DC (simple average of voltage and current), MEAN (The rectified mean value calibrated to the RMS value of the voltage)
Sync Source	Select voltage, current or None
Scaling Factor	Set the current sensor transformation ratio, VT ratio, CT ratio, and power factor when applying the external current sensor, VT, or CT output to the instrument Selectable range: 0.001 to 9999
Line Filter	Select OFF or ON(cutoff frequency of 500Hz)
Frequency Filter	Select OFF or ON(cutoff frequency of 500Hz)
Average Function Operation	Exponential average: Select an attenuation constant from the values of 8, 16, 32, and 64 Linear average: Select the number of averages from the values of 8, 16, 32, and 64 Harmonic measurement: Only exponential averaging is available
Data Update Rate	Select 50ms, 100ms, 250ms, 500ms, 1s, 2s, 5s, 10s, 20s or Auto
Peak Measurement	Measure the peak (max/min) value of voltage, current or power from the instantaneous voltage, instantaneous current or instantaneous power that is sampled
Zero Setting	Remove the internal offset



# Technical Specifications - SPA3000

## Signal Input

Item	Specification
Input Terminal Type	<b>Voltage(U):</b> Plug-in terminal (Safety terminal) <b>Current(A):</b> binding post <b>External current sensor input:</b> Insulated BNC connector
Input Format	<b>Voltage:</b> Floating input, resistive potential method <b>Voltage:</b> Floating input, Shunt input method
Measurement Range	<b>Voltage</b> 15V, 30V, 60V, 150V, 300V, 600V(CF3), 1000V(CF2) 7.5V, 15V, 30V, 75V, 150V, 300V(CF6), 500V(CF4)  <b>Current</b> <ul style="list-style-type: none"><li><b>Direct input</b> 0.5A, 1A, 2A, 5A, 10A, 20A(CF3) 0.25A, 0.5A, 1A, 2.5A, 5A, 10A(CF6)</li><li><b>External current sensor input</b></li></ul> <b>EX1:</b> 2.5V, 5V, 10V(CF3) 1.25V, 2.5V, 5V(CF6) <b>EX2:</b> 50mV, 100mV, 200mV, 500mA, 1V, 2V(CF3) 25mV, 50mV, 100mV, 250mA, 500mV, 1V(CF6)
Input Impedance	<b>Voltage:</b> Input resistance: Approximately 2MΩ; Input capacitance: Approximately 13pF(paralleled with resistance)  <b>Current</b> <ul style="list-style-type: none"><li><b>Direct input</b> Input resistance: Approximately 7mΩ; Input capacitance: Approximately 0.1 μF(resistance in series)</li><li><b>External current sensor input</b></li></ul> <b>EX1:</b> Input resistance:Approximately 100KΩ <b>EX2:</b> Input resistance:Approximately 20kΩ
Instantaneous Continuous Maximum Allowable Input Value	<b>Voltage:</b> Peak voltage of 2kV or RMS of 1.1kV, whichever is lower  <b>Current</b> <ul style="list-style-type: none"><li><b>Direct input</b> Peak current of 50A or RMS of 30A, whichever is lower</li><li><b>External current sensor input</b></li></ul> Peak value less than or equal to 5 times the range
A/D Converter	Simultaneous voltage and current input conversion <b>Resolution:</b> 16bit <b>Conversion speed (sampling period):</b> Approximately 10μs
Range Selection	Manual or Auto
Automatic Range Function	<b>Range up(When one of the following conditions is met)</b> <ul style="list-style-type: none"><li>Urms or Irms exceed 110% of the range</li><li>Upk or Ipk of the input signal exceed 330% of the range(660% for CF6)</li></ul> <b>Range down(When all the following conditions met)</b> <ul style="list-style-type: none"><li>Urms or Irms is less or equal to 30% of the measurement range</li><li>Upk or Ipk of the input signal is less than 300% of the lower range(600% or les For CF6)</li></ul>



Measurement Accuracy

Conditions: Temperature: 23±5°C; Humidity: 30 to 75%RH; Input waveform: Sine wave; Crest factor: 3; Common-mode voltage: 0V; Scaling function: OFF; Number of displayed digits: 5 digits; Frequency filter: Turn ON to measure voltage or current of 200 Hz or less; After 30 minutes of warm-up time has passed; Zero setting before wiring; Frequency f with unit kHz; within half a year after calibrated.

Format: ± (% of reading + % of range)

Frequency range	Voltage	Current	Active Power
DC	0.1+0.05	0.1+0.05	0.1+0.05
0.1Hz<f<45Hz	0.1+0.15	0.1+0.15	0.25+0.2
45Hz≤f≤66Hz	0.1+0.05	0.1+0.05	0.1+0.05
66Hz<f≤1kHz	0.1+0.15	0.1+0.15	0.15+0.15
1kHz<f≤10kHz	0.06*f+0.3	0.06*f+0.3	0.08*f+0.25
10kHz<f≤100kHz	0.04*f+0.5	0.04*f+0.5	0.07*f+0.5

Measurement Conditions

Item	Specification
Crest Factor	3 or 6
Measurement Period	Interval for determining the measurement function and performing calculations The measurement period is set by the zero crossing of the reference signal (When synchronization source is set to be None, measurement period becomes data update interval)
Sync Source	Voltage, Current, None
Measurement Mode	Select RMS(the true RMS value of voltage and current), MEAN (The rectified mean value calibrated to the RMS value of the voltage and the true RMS value of the current), DC (simple average of voltage and current)
Wiring System	1P2W, 1P3W, 3P3W, 3V3A, 3P4W However, the number of available wiring systems varies depending on the number of installed input elements
Scaling Factor	When inputting output from external current sensors, VT, or CT, set the current sensor conversion ratio, VT ratio, CT ratio, and power coefficient in the range from 0.001 to 9999
Line Filter	Select OFF or ON(cutoff frequency of 500Hz)
Frequency Filter	Select OFF or ON(cutoff frequency of 500Hz)
Average Function Operation	Exponential average: Select an attenuation constant from the values of 8, 16, 32, and 64 Linear average: Select the number of averages from the values of 8, 16, 32, and 64 Harmonic measurement: Only exponential averaging is available
Data Update Rate	100ms, 250ms, 500ms, 1s, 2s, 5s, Auto
Peak Measurement	Measure the peak (max/min) value of voltage, current or power from the instantaneous voltage, instantaneous current or instantaneous power that is sampled
Zero Setting	Remove the internal offset



## Display Function

Item	Specification
Display Type	7-segment LED
Displayed Items	Simultaneously display 4 items
Unit Symbols	m, k, M, V, A, W, VA, var, °, Hz, h±, TIME, %
Response Time	At maximum, 2 times the data update rate The time it takes to reach the accuracy of the final value when the displayed value changed from 0 to 100% or 100 to 0% of the rated range
Hold	Hold the displayed value
Single Update	Update the displayed value once each time the SINGLE key is pressed during Hold

## Frequency Measurement Function

Item	Specification	
Measured Source	The frequencies of voltages and currents for all input elements can be measured simultaneously	
Measurement Method	Frequency: Reciprocal method	
Frequency Measurement Range	Data Update Interval	Measurement Range
	0.1s	45Hz≤f≤100kHz
	0.25s	25Hz≤f≤100kHz
	0.5s	10Hz≤f≤100kHz
	1s	5Hz≤f≤100kHz
	2s	2Hz≤f≤100kHz
	5s	1Hz≤f≤100kHz
Frequency Accuracy	Requirements: When the input signal level is 30% or more of the measurement range if the crest factor is set to 3.(60% or more if the crest factor is set to 6) Frequency filter is ON when measuring voltage or current of 200Hz or less Accuracy: ±(0.06% of reading)	
Minimum Frequency Resolution	0.0001Hz	

## Integration Function

Item	Specification
Mode	Select Normal mode or Continuous mode
Timer	Automatically stop integration by setting a timer Selectable range: 00:00:00 ~ 10000:0:0
Integral Stop	If the integration time reaches the maximum integration time If the integration value reaches maximum/minimum display integration value
Accuracy	Fixed range: ±(Power accuracy (or current accuracy)+0.1% of reading) Auto range: The measurement will not be performed during range change After range changed: ±(power or current accuracy+ timer accuracy)
Timer Accuracy	±0.02%



Harmonic Measurement Function

Item	Specifications			
Measured Item	All installed elements			
Frequency Range	Fundamental frequency range of PLL source is 8Hz~1.5kHz PLL source: Voltage and current of each input unit			
Sample Rate, Window Width, and Upper Limit of the Measured Order	FFT Data Length 1024, Data Update Interval 100ms, 250ms			
	Fundamental frequency	Window width		Upper limit of measured order
	20Hz~40Hz	1		50
	40Hz~440 Hz	2		50
	440Hz~1KHz	10		50
	1KHz~1.5KHz	16		40
	FFT Data Length 1024, Data Update Interval 500ms,1s, 2s, 5s			
	Fundamental frequency	Window width		Upper limit of measured order
	8Hz~40 Hz	1		50
	40Hz~440 Hz	2		50
	20Hz~40Hz	10		50
	20Hz~40Hz	16		40
Accuracy of Harmonic Measurement (Indicator: ±% of reading + % of range)	Add the following accuracy to the accuracy at normal measurement When the line filter is off:			
	Fundamental frequency	Voltage	Current	Active Power
	8Hz≤f≤45Hz	0.15+0.25	0.15+0.25	0.15+0.5
	45Hz≤f≤440Hz	0.15+0.25	0.15+0.25	0.25+0.5
	440Hz≤f≤1KHz	0.2+0.25	0.2+0.25	0.4+0.5
	1KHz≤f≤1.5KHz	0.8+0.35	0.8+0.35	1.5+0.6

D/A Interface

Item	Specification
Output Voltage	±5V full scale(approximately ±7.5V maximum) against each rated values
Number of Output Channels	12 outputs
Output Items	Set for each channel U, I, P, S, Q, λ, Ø, Fu, fl, Upk, lpk, WP, WP±, q, q±, MATH
Accuracy	±(accuracy of each measurement item+0.2% of full scale)(FS=5V)
Minimum load	100kΩ
Update Interval	Same as the data update interval
Temperature coefficient	± 0.05%/°C at full scale
D/A Conversion Resolution	16-bit

External Hardware Interface

Item	Specification
D/A Terminal	±5V ; approximately ±7.5V(maximum) ; TTL level

Communication Interface

Item	Specification
Type B USB Interface	Conforms to the USB Rev.2.0; USBTMC-USB488(USB Test and Measurement Class Ver.1.0)
Ethernet Interface	RJ-45 connector; Conforms to IEEE802.3; Ethernet 100BASE-T, 100BASE-TX, 10BASE-T
RS-232 Interface	9-pin, D-Sub (plug); Conforms to EIA-574, standard of 9-pin EIA-232(RS-232)
GP-IB Interface	Confirms to IEEE Standard 488-1978 (JIS C 1901-1987); Confirms to the IEEE Standard 488.2-1992

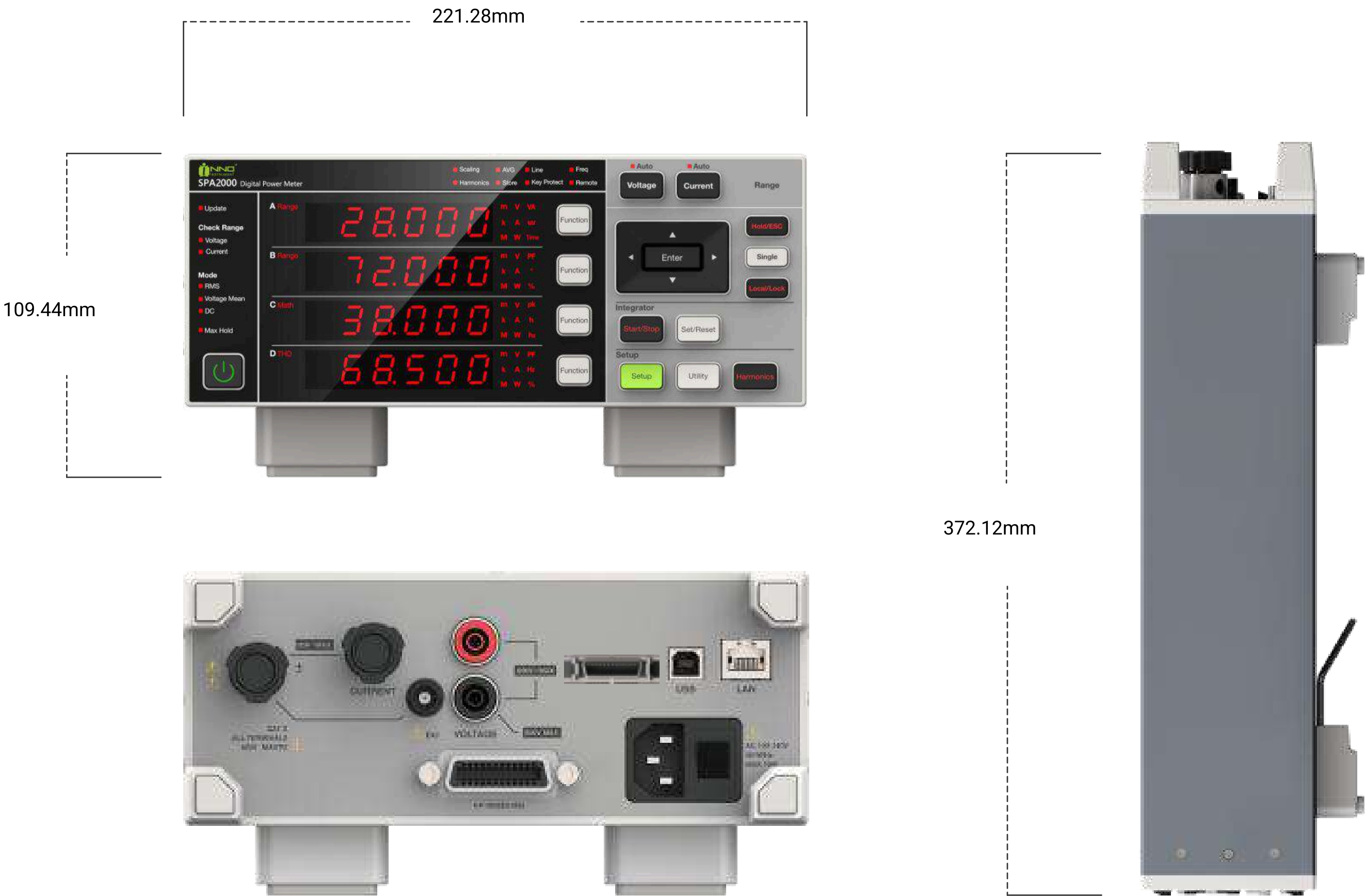


# General Specifications

Item	Specification
Dimensions	211.28mm*372.12mm*109.44mm(SPA1000/2000), 207.15mm*404.30mm*151.93mm(SPA3000)
Rated Supply Voltage	From 100 to 240V AC
Allowable Supply Voltage	From 85 to 264V AC
Rated Supply Frequency	50/60Hz
Allowable Supply Frequency Range	From 48 to 63Hz
Maximum Power Consumption	30VA(SPA1000/SPA2000), 50VA(SPA3000)
Preheating Time	Approximately 30 minutes
Operating Environment	<b>Temperature:</b> 5°C ~ 40°C <b>Humidity:</b> from 20% to 80%RH(no condensation)
Operating Altitude	2000m or less
Applicable Environment	Indoors
Storage Environment	<b>Temperature:</b> -25°C ~ 60°C <b>Humidity:</b> from 20% to 80%RH(no condensation)
Weight	About 4kg(SPA1000/SPA2000), About 6kg(SPA3000)
Battery Backup	Setup parameters are backed up with a lithium battery.

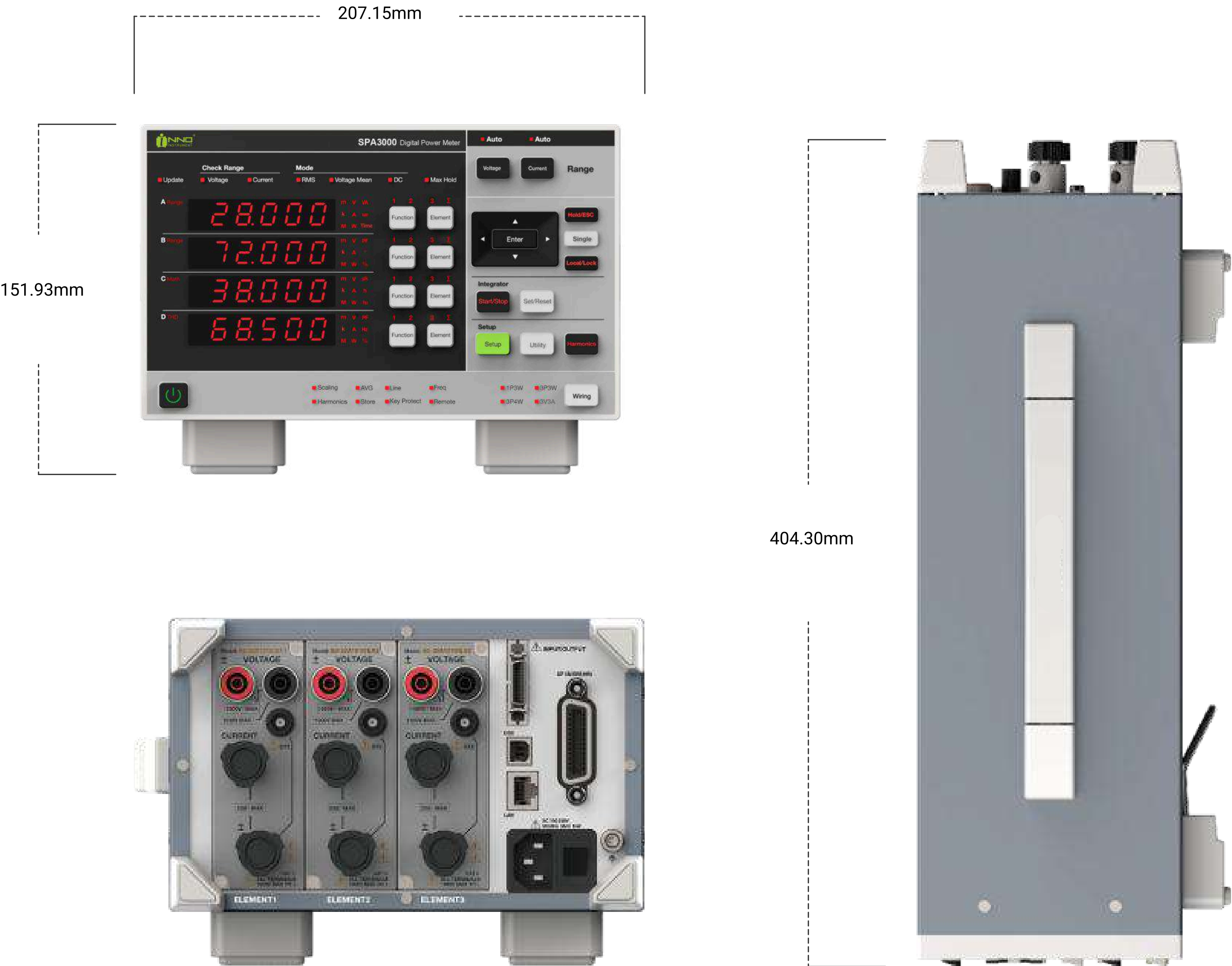


Dimensions of the Instrument - SPA1000/SPA2000







Dimensions of the Instrument - SPA3000















# Accessories

## Boxes

Model	Name	Sample	Usage
PTB01	Single-phase wiring test adapter box		Used for change-over of single-phase circuit, which is convenient for users to quickly measure electric energy parameters of the equipment
PTB03	Three-phase wiring test adapter box		Used for change-over of three-phase circuit, which is convenient for users to quickly measure electric energy parameters of the equipment (total length is about 2m)

## 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-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
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

\* Product specifications and models are subject to change without notice.



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