ZLG

PA Series Power Analyzer

Reliable high-precision measurement tools in the field of new energy

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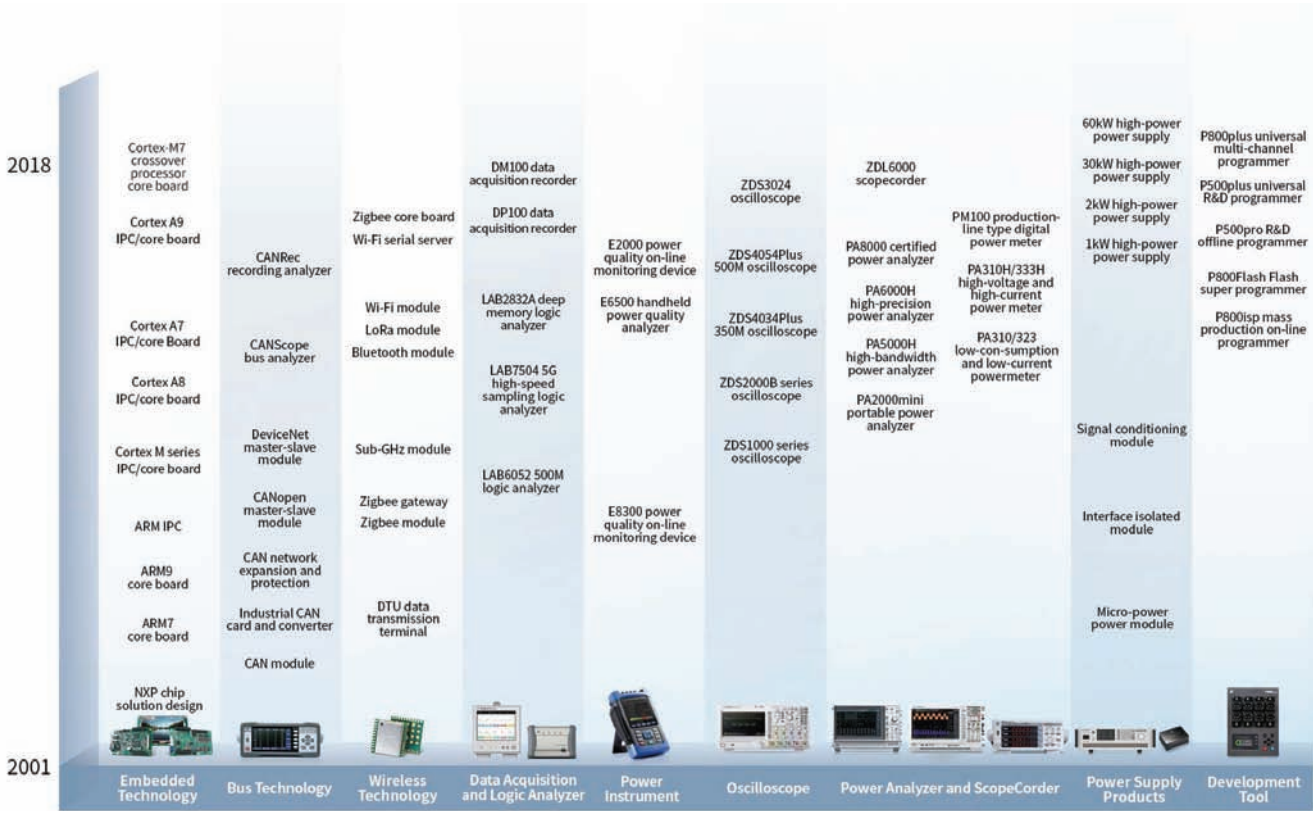
Professor Zhou Ligong, Academic Leader

Zhou Ligong, born in March 1964 and Hunan Province, is the founder of ZLG Technology Corp., Ltd. and Guangzhou ZHIYUAN Electronics Co., Ltd., a professor and a well-known technical expert in embedded system. He has published more than 40 university textbooks and monographs about embedded system technology and won 2 first prizes for provincial teaching achievement and 1 second prize for national teaching achievement.

Company Introduction

Guangzhou ZHIYUAN Electronics Co., Ltd. is affiliated with ZLG Group. It was founded in 2001 by Professor Zhou Ligong, a famous embedded system expert.

As a leading enterprise of industrial Internet ecosystem in China, ZLG ZHIYUAN Electronics specializes in industrial field and provides competitive professional solutions ranging from data acquisition, communication network, control implementation to cloud computing, help users create value. We focus on strategy, invest continuously in high-precision data acquisition, wireless communication, field bus and embedded control technology and drive innovation with user demand and cutting-edge technology to promote the industry progress. ZLG ZHIYUAN Electronics invest more than 20% of sales revenue in R&D every year. More than 55% of employees are engaged in innovation, research and development. Our company holds core positions in many standard organizations, creates value for the development of industrial Internet in China.



Roadmap for all-series products of ZHIYUAN Electronics

Product Selection for PA Series Power Analyzer

With the upgrade of energy utilization, there is a growing demand for higher accuracy and more reliable power measurement. As the biggest manufacturer of high-end instruments in China, ZHIYUAN Electronics can offer you a wide range of selections in various fields, such as PA8000 certified power analyzer, PA6000H and PA5000H enterprise-class power analyzers, and PA2000mini portable power analyzer, to meet all your needs in terms of power measurement.

	Product	Power Accuracy	Bandwidth	Sampling Rate	Number of Elements	Voltage, Current Value	Harmonic Order	Storage Capacity
Certified Analyzer	PA8000 	0.01%	DC/0.1Hz ~ 5MHz	2MS/s	• 7 power elements • Any element adaptable to motor element	1500V(1.33 crest factor), 5A/50A	500	60G
Enterprise-class Analyzers	PA6000H 	0.01%	DC/0.1Hz ~ 2MHz	2MS/s	• 7 power elements • Any element adaptable to motor element	1500V(1.33 crest factor), 5A/50A	500	60G
	PA5000H 	0.05%	DC/0.1Hz ~ 5MHz	2MS/s	• 7 power elements • Any element adaptable to motor element	1500V(1.33 crest factor), 5A/50A	500	60G
Portable Analyzer	PA2000mini 	0.05%	DC/0.1Hz ~ 500KHz	500KS/s	• 4 power elements • One optional motor element available • Optional battery component available	1500V(1.33 crest factor), 5A	256	4G

AC/DC Current Sensor (optional)

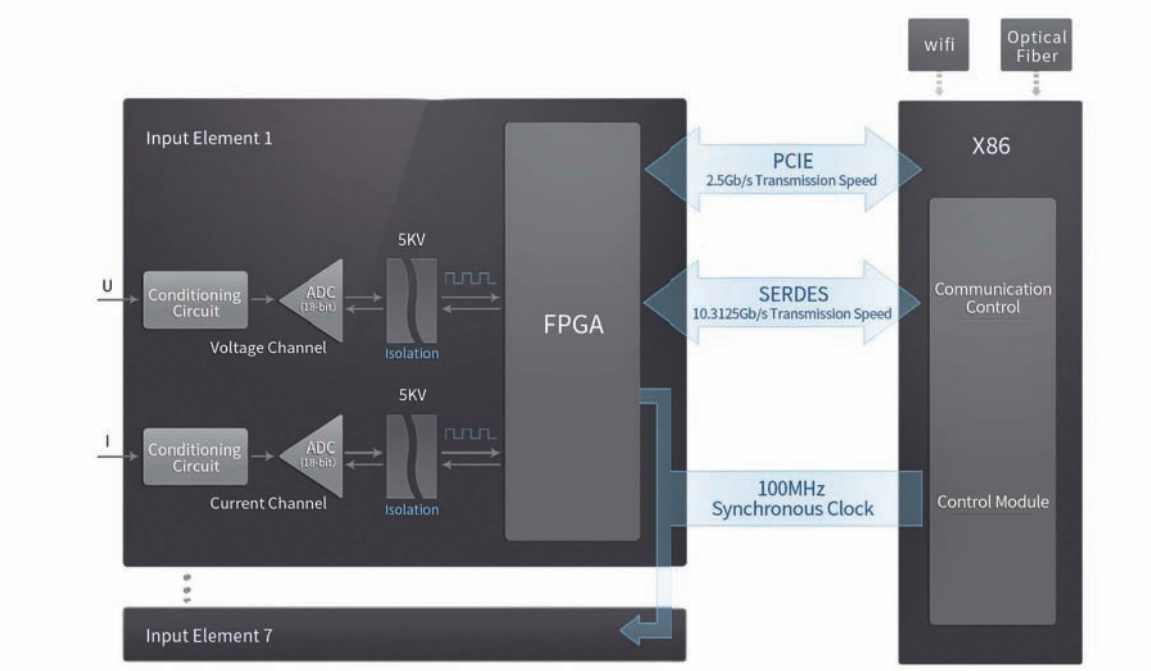
Brand	Appearance	Model Number	Sensor Type	Current	Transformation Ratio	Accuracy	Measurement Bandwidth
LEM		IT 60-S	AC/DC current sensor	DC: 0-60A; AC: 42 Arms	1:600	Accuracy: ±(0.05% of rdg + 30uA)	DC ~ 800KHz
		IT 200-S	AC/DC current sensor	DC: 0-200A; AC: 141 Arms	1:1000		DC ~ 500KHz
		IT 400-S	AC/DC current sensor	DC: 0-200A; AC: 141 Arms	1:2000		DC ~ 500KHz
		IT 700-S	AC/DC current sensor	DC: 0-700A; AC: 495 Arms	1:1750		DC ~ 100KHz
		IT 1000-S/SP1	AC/DC current sensor	DC: 0-1000A; AC: 707 Arms	1:1000		DC ~ 500KHz
CA		C117	AC current sensor	Current: 1000 Arms	1mV/A	Accuracy: 0.3% of rdg	30Hz ~ 5KHz
		PAC22	AC/DC current sensor	DC: 1400A; AC: 990A rms	10mV/A (150A) 1mV/A (1400A)	Accuracy: 1.5% of rdg Accuracy: 2% of rdg	DC ~ 10KHz
		D36N	AC current sensor	Current: 3000 Arms	1mV/A	Accuracy: 0.5% of rdg	30Hz ~ 5KHz

Note: For more current sensor selection, please refer to the Appendix “Tools and Accessories”.

Features and Advantages

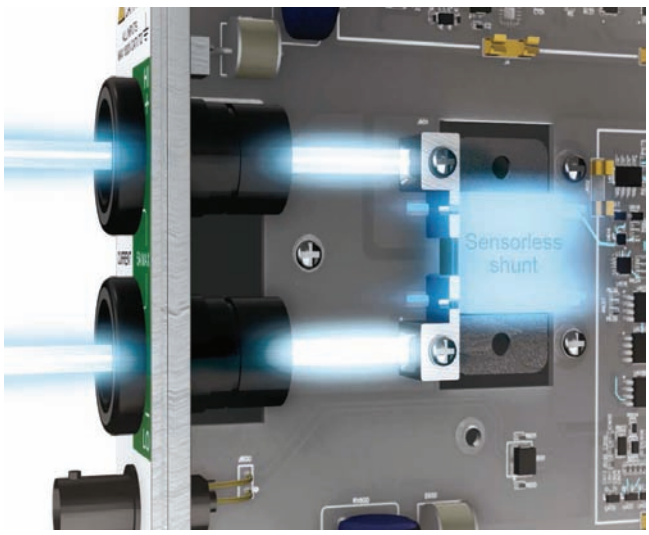
0.01% certified power measurement accuracy

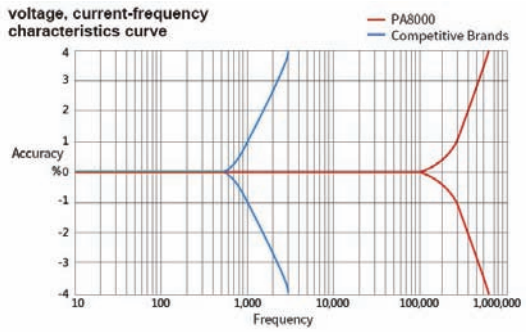
PA8000 is a certified power analyzer with up to 0.01% measurement accuracy and 5MHz bandwidth, which is the benchmark for energy efficiency measurement of inverters and power supplies, and is the basis for standard laboratory certification and testing.
In addition to the most advanced design architecture in the industry, an 18-bit ADC converter in the analog circuit and a 2MS/s high sampling rate technology are used by PA8000. Therefore, compared to traditional 16-bit power analyzers, the sampling resolution is increased by 4 times and the sampling rate is increased by 10 times, and the power analysis precision reached a new high level.



5M bandwidth for good frequency characteristics and stability

PA8000 is the industry's only power analyzer with 0.01% accuracy and up to 5MHz current and voltage frequency bandwidth, fully meeting the power measurement of high-speed switching devices (such as, SiC) in the future.
Current measurement has always been a problem in the field of high-bandwidth measurement. The Kelvin non-inductive shunt technology is used by the analyzer design to overcome this difficulty. The Kelvin node effectively avoids the contact resistance and thermal potential in the circuit, and the non-inductive shunt has a stray inductance of less than 5nH, which ensures the best high-frequency performance of the system.

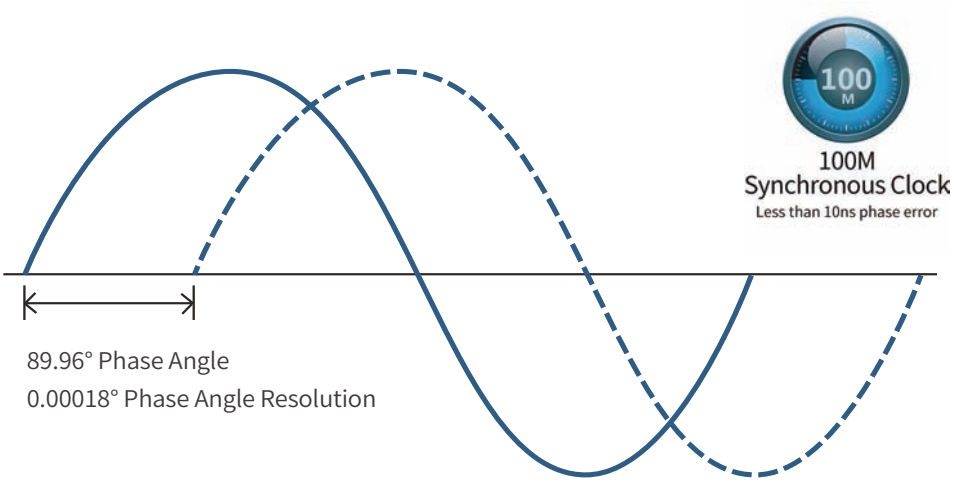




The PA8000 adopts an automatic amplitude-frequency response compensation technology, which significantly improves the amplitude-frequency response curve over the entire measurement frequency range, ensuring high-precision measurement even when measuring high-frequency signals. Furthermore, the PA8000 has also passed various verifications, which not only provides high-precision measurement function, but also ensure the consistency of each measurement.

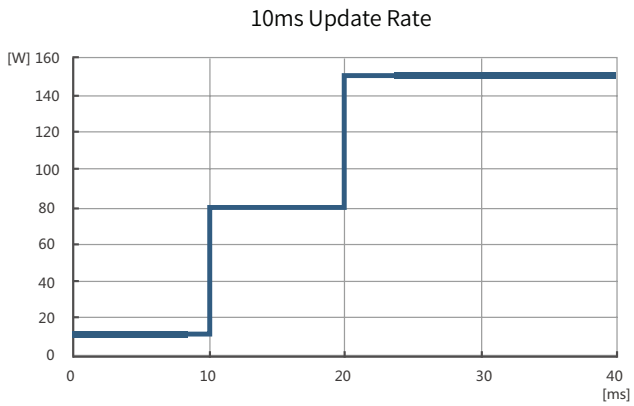
Phase measurement accuracy at low power factor

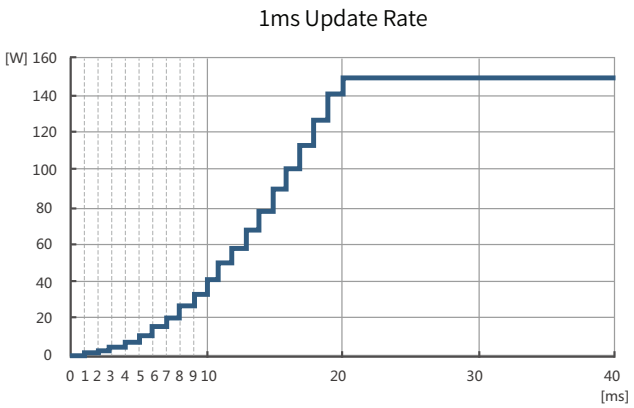
The PA8000 is a power analyzer that can perform high-precision measurements at very low power factor.
When the power factor of the system under test is very low, it is difficult for traditional instruments to make accurate measurements. The PA8000 has a 100M synchronous clock with high-stability temperature compensation inside, which avoids measurement errors introduced by temperature clock drift. At the same time, the sampling phase synchronization of each ADC channel is guaranteed, and the error introduced by the voltage and current phase angles during measurement is reduced. The error is within 10ns, which means that the voltage and current phase angle resolution can reach 0.00018° (50Hz typical value), the measurement accuracy of active power and power factor is guaranteed.



1ms high data update rate

PA8000 is the world's only power analyzer that can set a 1ms high data update rate.
The high-speed data acquisition mode of 1ms~5ms is added into PA8000. The 1ms data update rate can accurately capture the fast-changing transient signals and perfectly display the waveform details. For example, in the motor application, the PA8000 is able to completely measure the startup waveform of the motor, which can provide users with an important basis for evaluating the motor.
Furthermore, according to different industries, PA8000 can also customize the update rate ranging from 10ms to 20s (with 10ms minimum step) to meet the corresponding test requirements.
Note, this function is also available for PA6000H and PA5000H.

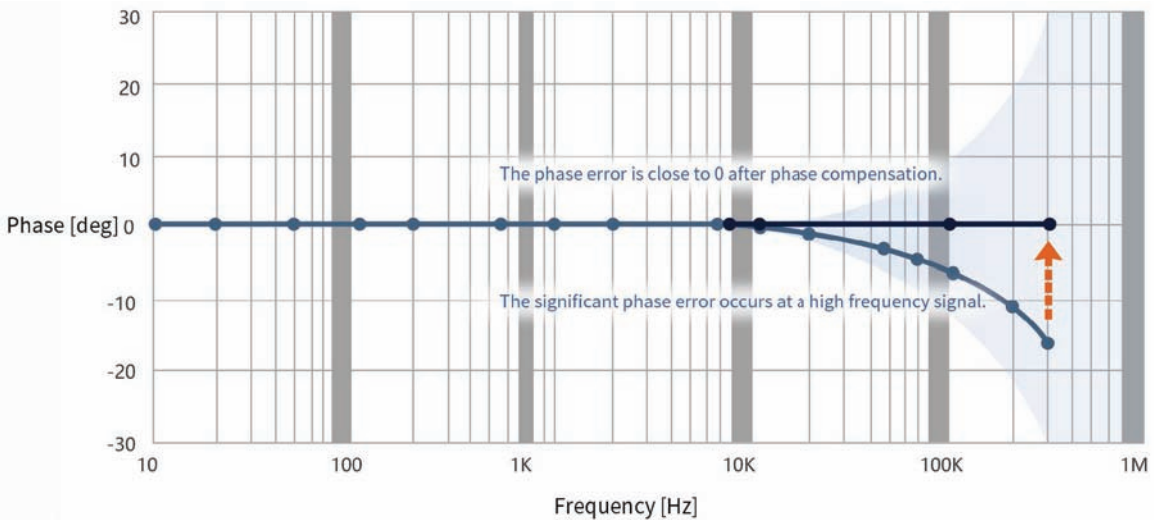




Current sensor phase compensation

PA8000 not only guarantees high power measurement accuracy when directly inputting voltage and current, but also ensures the measurement accuracy of the overall system when using a current sensor as an input.

Accurate power measurement not only requires high amplitude measurement accuracy, but also requires higher phase measurement accuracy. When a current sensor is used as the input, the phase error of the voltage and current is increased due to the delay of sensor itself. The phase compensation function of the PA8000 can correct the phase error caused by the sensor and improve the power measurement accuracy at high frequency and low power factor. Therefore, the PA series power analyzer can be paired up with a variety of sensors to ensure the power measurement accuracy of the overall system.



7 elements, each with its own large-scale FPGA processor

The PA8000 has 7 power measurement elements, each with its own large-scale FPGA processor, which can process and transmit data at high speed, ensuring that all 2MS/s front-end data is involved in the operation.

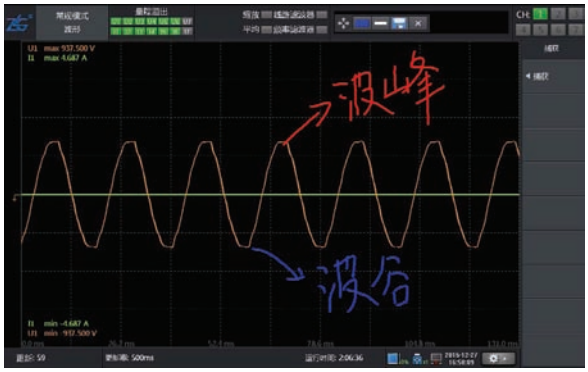
After the front-end ADC collects large-capacity data, the traditional approach is to directly use the DSP for arithmetic processing, while the DSP is a serial processor and it cannot perform real-time operations on the 2MS/s data. The PA8000 is the first to use a large-scale FPGA for processing. FPGA is a parallel processor, and it has a large number of IP cores to process data in parallel, which enhances data processing capability. At the same time, it can also transmit processed data to the CPU at a high speed, finally realizing the real-time measurement and calculation.

In addition, all 7 elements of PA8000 can use 5A, 50A and other range of power boards and motor boards, and the motor boards and the power boards can be combined in use arbitrarily.

Innovative Function

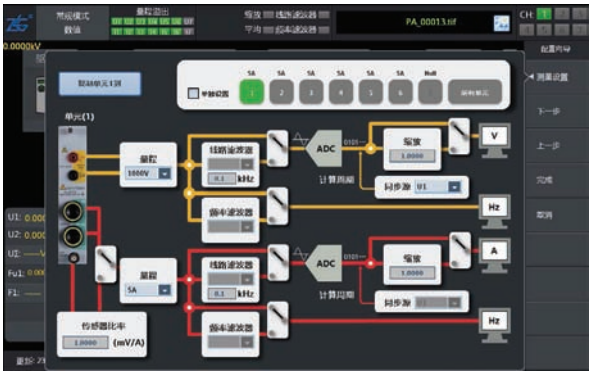
Handwritten Comment Function

The PA8000 provides handwritten comment function and on-the-spot annotation are just what you want.



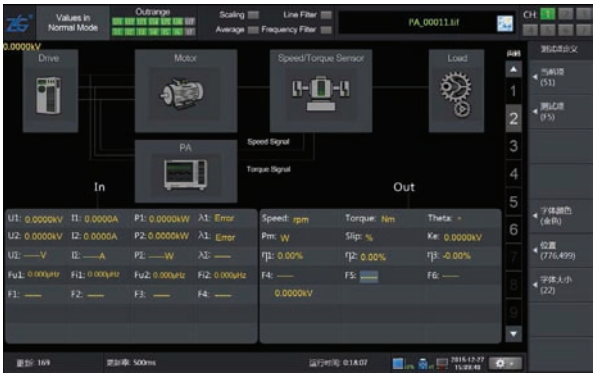
Graphic Configuration Interface

PA8000 adds a user-friendly graphic configuration interface, and the test setup is completed once.



User-defined Numeric Interface

Users can also customize the graphical display in the instrument, and the test items correspond to the values one by one at a glance.

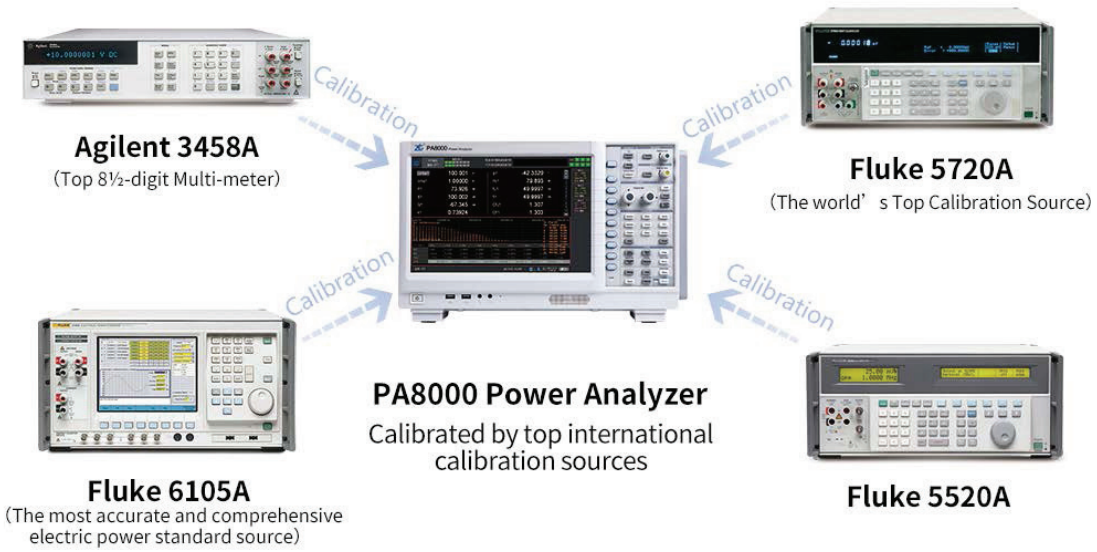


Touch-screen Operation

The 12.1-inch HD display plus touch controls provide a superior operating experience.

Strict Calibration System

The PA power analyzer is calibrated by a world-class calibration system, from the resistor component PMO to component aging, machine aging, testing, calibration, and retesting. The world's advanced standard sources are used for calibration in the calibration process, which ensures high accuracy and reliability of product measurement.

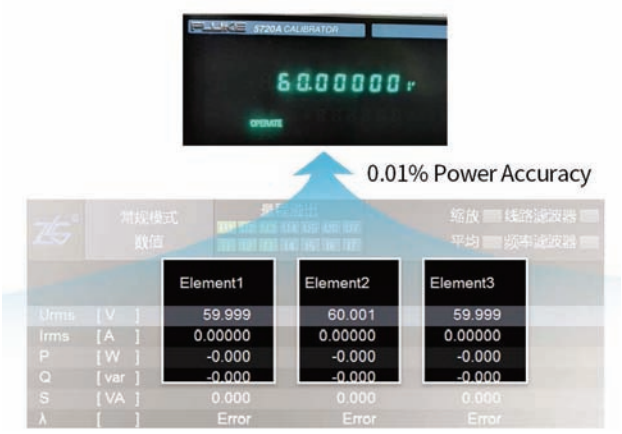


Testing and Certification Laboratory

As a leader in the field of electronic measurement, ZHIYUAN Electronics has introduced the PA8000 certified power analyzer with 0.01% basic accuracy, 5MHz bandwidth and 2MHz sampling rate to meet the requirements of traceability and precision certification for testing and certification laboratories.

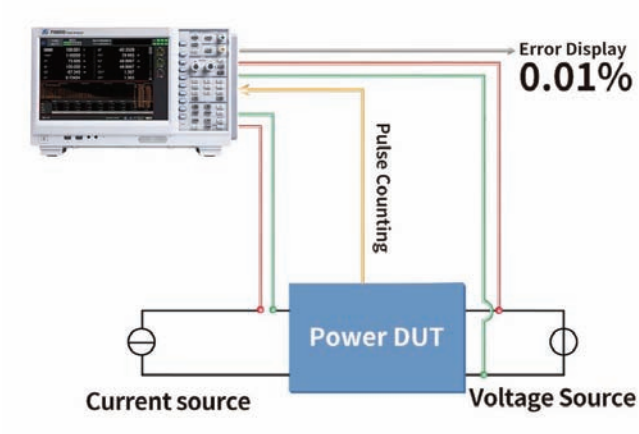
0.01% Power Measurement Accuracy

We are not satisfied with the 0.02% accuracy of the previous generation of power analyzers, and carry out the research of the next generation of data acquisition technology. The 18-bit ADC solution broke through the industry technical bottleneck. The PA8000 certified power analyzer finally achieved the world's highest power accuracy of 0.01%, which can meet the accuracy requirements of the testing and certification laboratory.



Electric Energy Pulse Counting Function

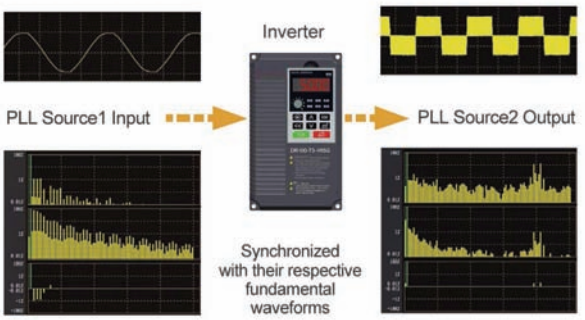
The PA8000 certified power analyzer can receive the electric energy pulse emitted by the energy meter to measure the accuracy of the energy meter. The verification specification conforms to the national standard GB/T 17215.701-2011, and the PA8000 also has the electric energy pulse output function.



Dual PLL Source Frequency-Multiplying Technology

According to the FFT algorithm, the sampling signal must be synchronized with the signal under test to accurately perform harmonic analysis on the signals.

The PA power analyzer synchronizes the sampling frequency with the signal frequency by introducing a PLL hardware circuit to obtain accurate harmonic measurement results. Moreover, the PA8000 certified power analyzer supports dual PLL source settings. Users can select different PLL sources for different measurement channels, which is convenient for simultaneous analysis of harmonics of input and output signals.



Unique Custom Data Update Rate

The power measurement process is a process of analyzing and calculating a data interval, and the setting of the data update rate will affect the size of the data interval. When the input and output signal cycles are not synchronized, the unreasonable update rate setting will result in inaccurate measurement results.

The PA8000's unique custom data update rate function allows users to customize the power measurement cycle in steps of a minimal of 1ms, which can avoid inaccurate measurement results due to unreasonable settings.

Complies with IEEE-1459power algorithm

The apparent power, power factors and other characteristic parameters calculated by the IEEE-1459 power algorithm will more realistically represent the true state of the system, providing a rich quantitative reference values for the analysis of non-sinusoidal systems, which is more targeted to improve and perfect the system.

FFT inter-harmonics analysis function

The PA8000 certified power analyzer can set the FFT resolution in the FFT function with a minimum resolution of 0.1Hz, and can display the value of each frequency point with the set resolution as the minimum step, and view the data of each inter-harmonic.

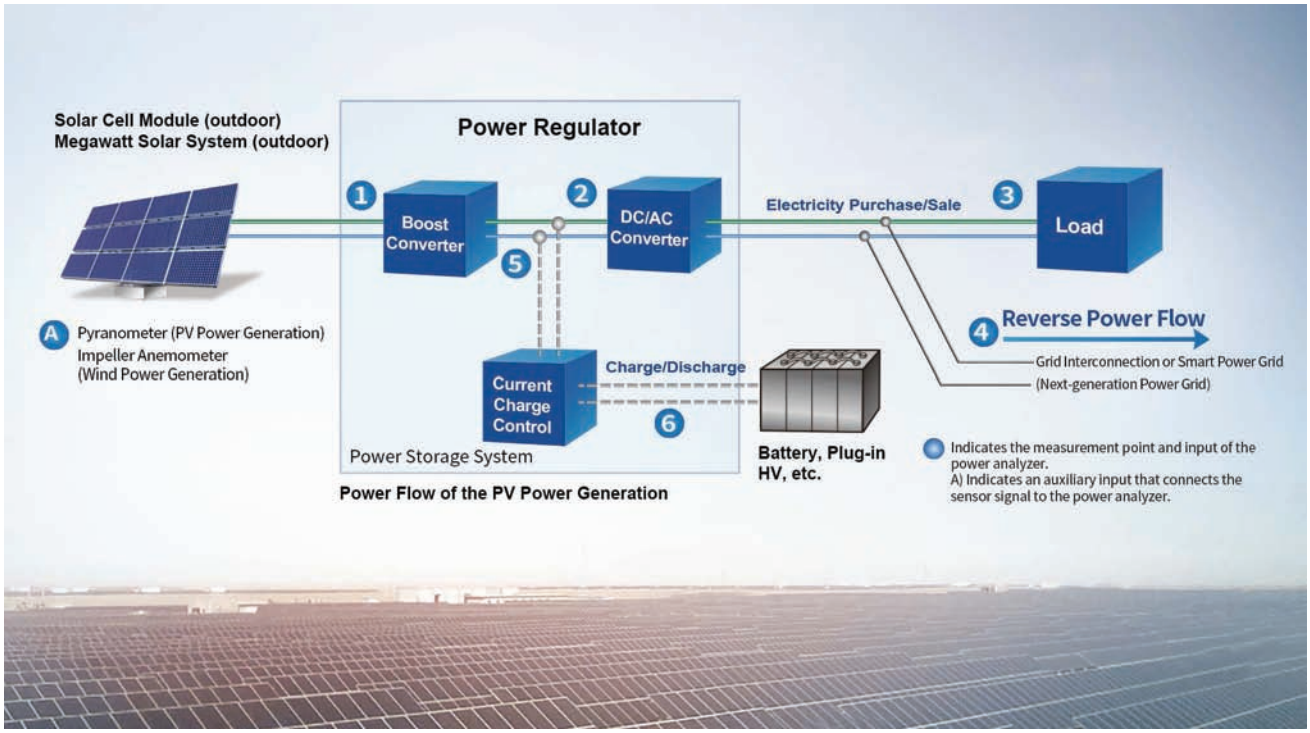
With its 0.01% power measurement accuracy, excellent test function and perfect test stability, the PA8000 certified power analyzer can meet all the requirements of instrument traceability and precision certification for institute of metrology, quality inspection institute and research institute.

Recommended Model: PA8000 Certified Power Analyzer

1. Certified-level 0.01% accuracy, 5M bandwidth
2. Custom update rate at the maximum of 1 ms
3. Harmonics up to 500th order, 60G solid state disk (SSD)
4. Dual PLL source synchronous measurement
5. Suitable for the power measurement of testing and certification laboratory that is very sensitive to measurement accuracy

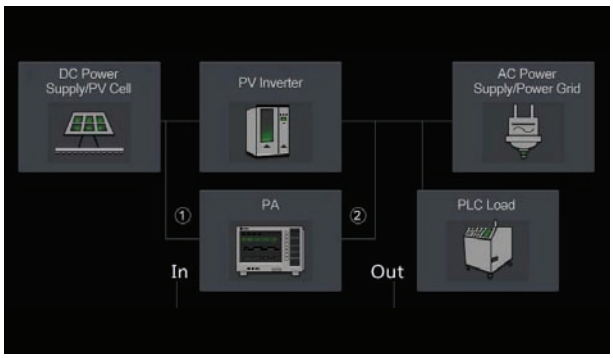
PV and Wind Power Industry

The PA6000H power analyzer provides up to 7 power input elements for accurate measurement of the input and output voltage, current, power and other electrical parameters of the new energy inverter. It can also provide accurate efficiency, harmonics, low voltage ride through (LVRT) tests and other functions.



Synchronous measurement at 0.01% power measurement accuracy

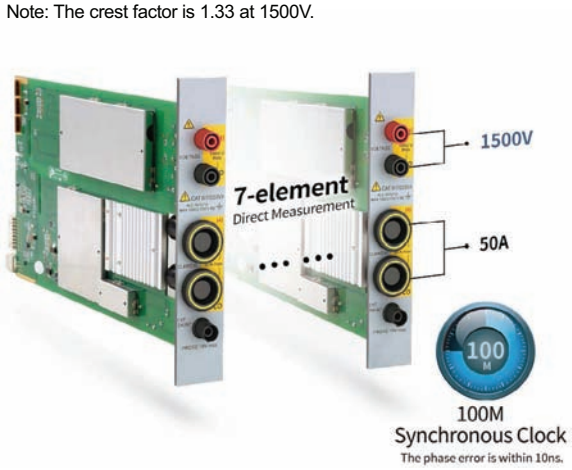
The PA6000H power analyzer uses the latest data acquisition technology and has breakthrough 0.02% power measurement accuracy. An instrument can perform power measurements at multiple points simultaneously, providing reliable data for efficiency testing of PV inverters and wind converters.



Direct measurement of up to seven 1500V/50A elements

The PA6000H power analyzer perfectly supports the test trend of 1500V DC voltage in the PV wind power industry. Its 100M synchronous clock can ensure that the phase error of each element is within 10ns, ensuring the measurement accuracy of active power and power factor.

Note: The crest factor is 1.33 at 1500V.



Low voltage ride through (LVRT) testing in the PV and wind power industries

ZHIYUAN Electronics has added special testing functions to the software for the PV and wind power industries, which not only can perfectly solve the LVRT test problem of the PV industry, but also exclusively adds the LVRT testing function of the wind power industry, helping users independently conduct LVRT tests on the converter of the wind power industry.

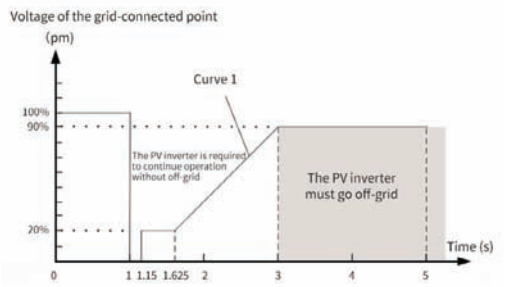
The LVRT process in the PV industry is as follows:

According to the requirements of GB/T 19964-2012, the LVRT testing in the PV industry should meet the following requirements:

(1) When the voltage of the grid-connected point drops to 0, if it can recover to 20% of the rated voltage within 150ms, the inverter must ensure that it does not go off-grid within this 150ms.

(2) If the voltage of the grid-connected point can recover from 20% of the rated voltage within 0.625s after falling, the inverter must ensure continuous operation for 625ms without off-grid.

(3) If the voltage of the grid-connected point can recover to 90% of the rated voltage within 2s after falling, the inverter must ensure continuous operation without off-grid.

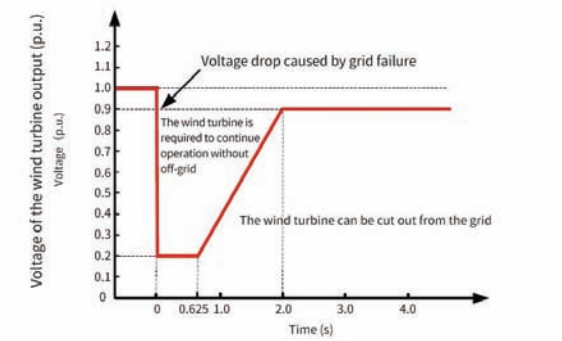


The LVRT process in the wind power industry is as follows:

According to the requirements of GB/T 19963-2011, the LVRT testing of the wind power converter should meet the following requirements:

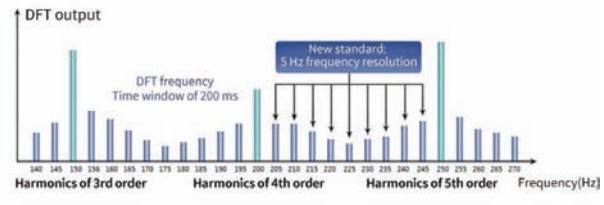
(1) When the voltage of wind turbine output falls to 20% of the rated voltage, the wind turbine should ensure continuous operation for 625ms without off-grid.

(2) IIf the voltage of the wind turbine output can recover to 90% of the rated voltage within 2s after falling, the wind turbine should ensure continuous operation without off-grid.

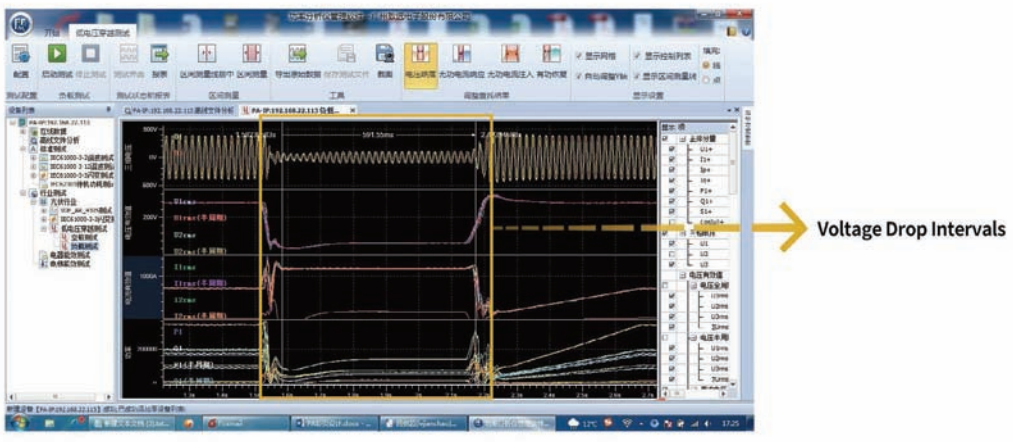


The wind power industry also has the latest LVRT testing standard: on the premise of IEC61000-4-7 harmonics algorithm, the following three data need to be calculated:

- The first 50 harmonic current components, and the sum of previous 50 harmonicsIIf the voltage of the wind turbine output can recover to 90% of
- Inter-harmonics current components below 2 kHz
- Current harmonic components of 2kHz-9kHz (harmonics of 180th order)



LVRT Data Analysis of the PAM Management Software (supports the latest standard of LVRT in the wind power industry):

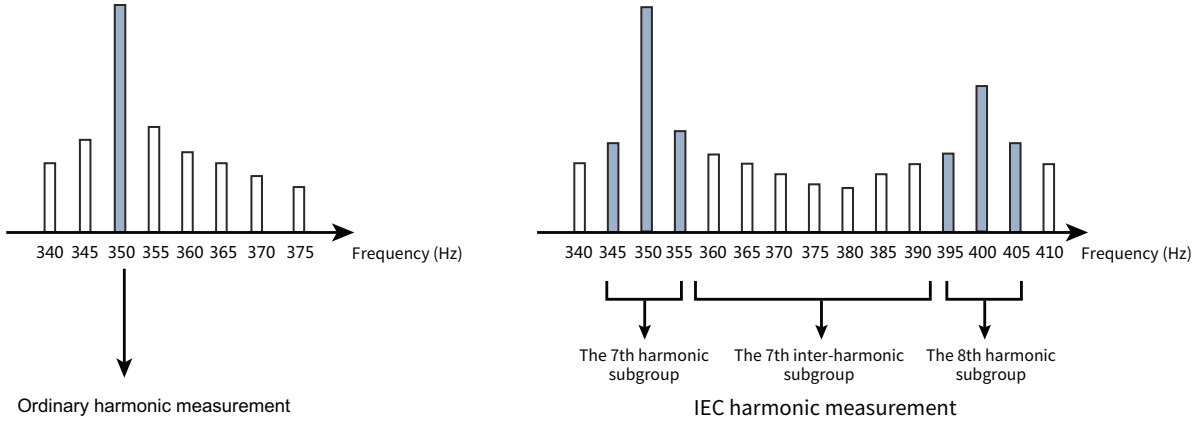


Supports IEC61000-4-7 harmonics testing standard and German VDE-AR-N4105 harmonic testing standard

IEC61000-4-7 is the harmonics, inter-harmonics measurement methods and measurement instrument technology standard for power supply system and grid-connected devices. It is the only standard that can accurately measure grid harmonics in the international power quality measurement standards. It is possible to analyze whether the harmonic content of the measurement object exceeds the standard according to the harmonic limit standard in the standard.

The spectrum analysis interval of the IEC harmonic measurement standard is 5Hz. The amplitude of the harmonic is determined by the root mean square of the harmonic subgroups. The requirements for the harmonics content are much stricter than the old standard of the ordinary harmonic test. It is more consistent with the distribution of harmonic contents in the real power grid. Combined with the limit value standard analysis of harmonic content in IEC61000-4-7, it can provide more authoritative harmonics analysis results.

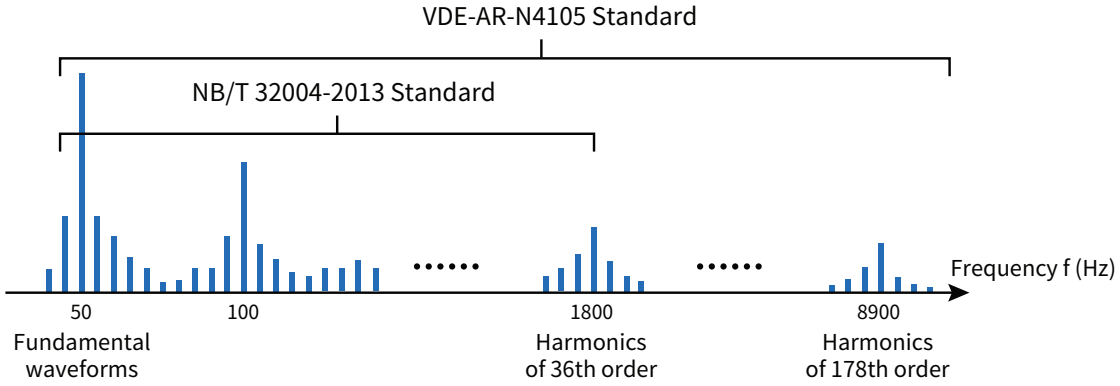
Take the 7th harmonic subgroup of the IEC harmonics testing standard as an example, $G_{350} = \sqrt{(F_{345})^2 + (F_{350})^2 + (F_{355})^2}$



German VDE-AR-N4105 harmonic testing standard

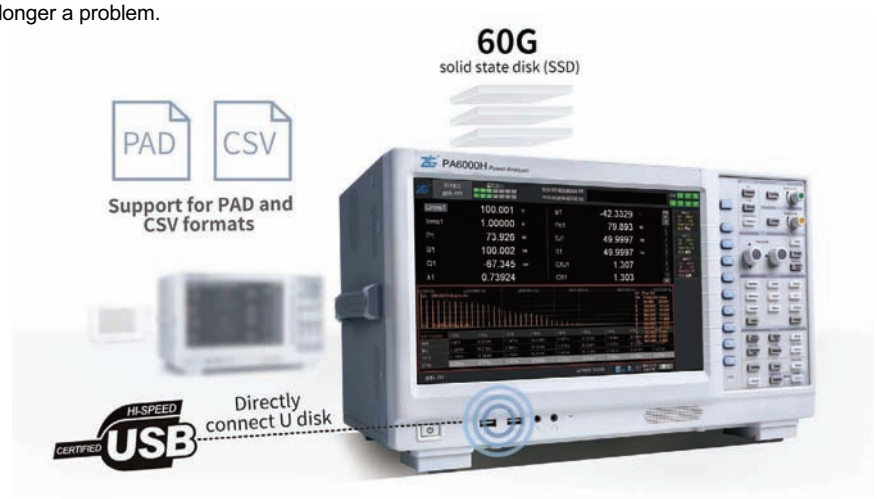
VDE-AR-N4105 is a new regulation for the grid-connected operation of low-voltage power supplies in Germany. The testing difficulty lies in the fact that the measured equipment must provide 178 harmonic measurement results for harmonic analysis. Since the VED-AR-N4105 low-voltage grid-connected standard requires the harmonic measurement range to cover the entire low-frequency domain (within 9KHz), the number of tests is 8900/50-1=178 (50Hz is the 1th harmonic).

The PA6000H series power analyzer supports both IEC and German N4105 harmonic testing standard, and can support up to 256th harmonic measurement (PA8000 and PA5000H can conduct 500 measurements), which can truly represent harmonic components and harmonic distortion factors (THD).



60G Data Storage and Excellent Data Format Analysis

The PA6000H power analyzer has a solid state disk (SSD) of up to 60G for massive data storage. Users can directly connect the USB flash drive to store all the desired data. The PAD and CSV formats are supported in various ways and the storage time is controlled at random, making storage no longer a problem.



On-site PV and Wind Power Acceptance

Many solar PV power stations and wind power stations are located in remote mountainous areas or on roofs where the environment is harsh, and even the power supply would become an issue. This requires a portable power analyzer with accurate measurement accuracy. The PAmini series power analyzer is small and has a battery. It can work continuously for 3 to 4 hours, which is very suitable for the on-site PV and wind power acceptance environment.

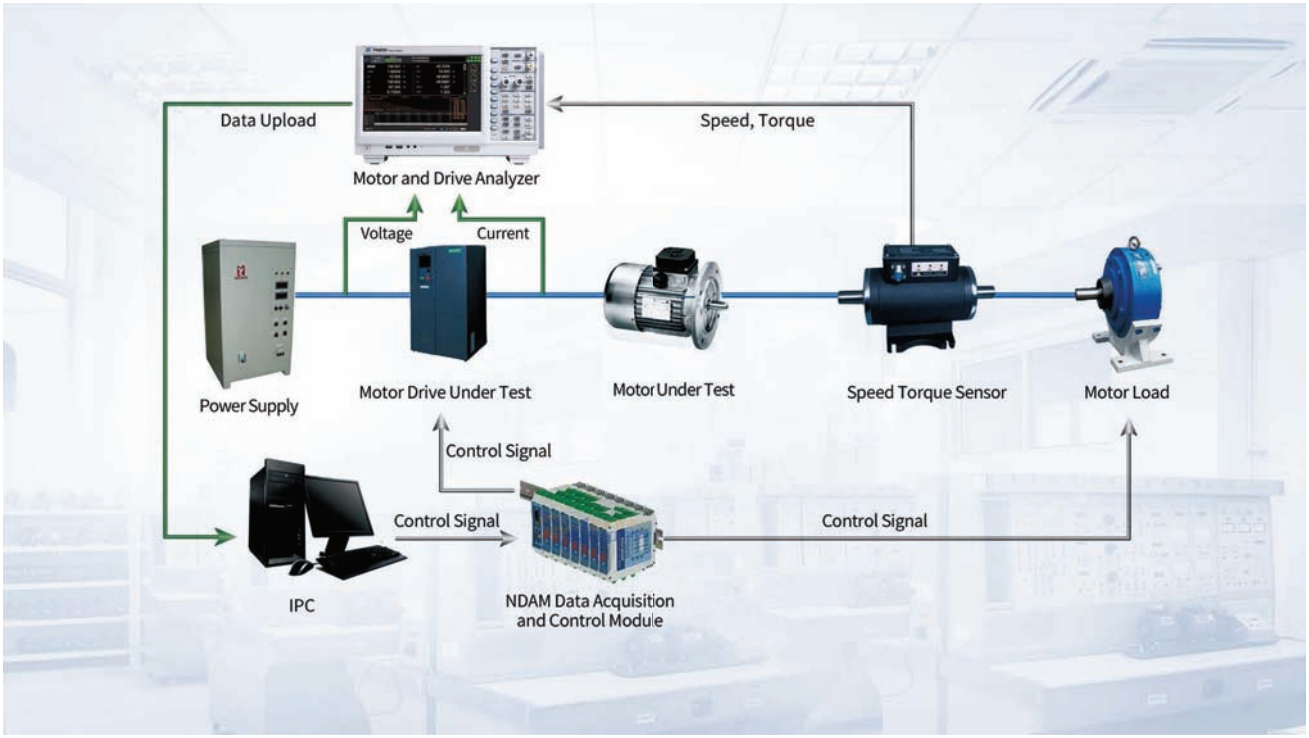
In the PV and wind power industry, users are mostly concerned about power and efficiency measurement accuracy. The PA6000H power analyzer has 0.01% power measurement accuracy and 60G data storage capacity, as well as the low-voltage ride-through testing function and maximum power point tracking (MPPT) measurement function attached in the software, can meet all testing demand of the PV and wind power industry.

Recommended Model: PA6000H

1. 0.01% accuracy, 2M bandwidth, 2MS/s sampling rate
2. Synchronous measurement of 7-channel power input element
3. Harmonics up to 500th order, 60G data storage
4. Support for low voltage ride-through (LVRT) test
5. Suitable for the power measurement of PV and wind power industry that is very sensitive to measurement accuracy

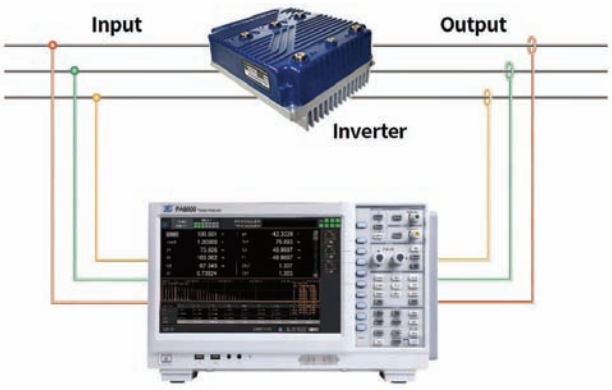
Inverter and Motor Industry

The PA8000 and PA5000H power analyzers can simultaneously perform power measurement of up to 7 points. By measuring the electric power and mechanical power of the inverter input and output, the efficiency of the inverter and the overall performance of the inverter and motor can be accurately evaluated.



Inverter Efficiency Test

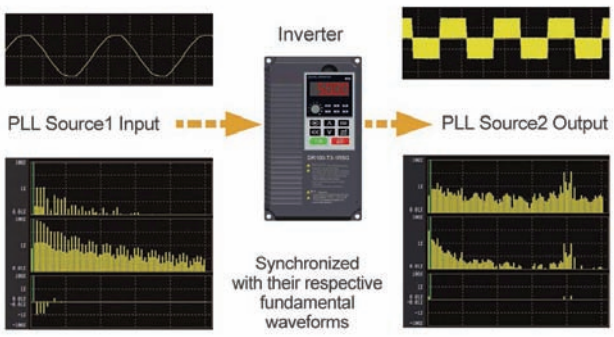
The PA8000 and PA5000H power analyzers provide 7 power input modules that support the simultaneous measurement of the inverter's input and output. Moreover, all the power input modules have same 100 MHz synchronous clock, which realizes the synchronization of the sampling phase, reduces the error introduced by the U and I angle, and guarantees the measurement accuracy of power and efficiency.



Dual PLL Source Frequency-multiplying Technology

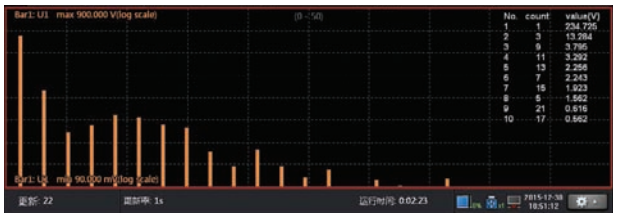
Due to the limitations of the discrete Fourier transformation, the simultaneous sampling method is used to ensure the accuracy of harmonic measurement.

The PA power analyzer synchronizes the sampling frequency with the signal frequency by introducing a PLL hardware circuit to obtain accurate harmonic measurement results. Moreover, the PA8000 and PA5000H power analyzer support dual PLL source. Users can select different PLL sources for different measurement channels, which is convenient for simultaneous analysis for harmonics of input and output signals.



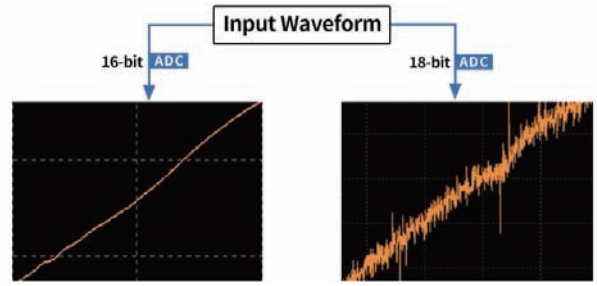
Harmonic up to 500th order

The PA8000 and PA5000H power analyzers have a bandwidth of DC/0.1Hz-5MHz and a sampling rate of 2 MS/s. Thanks to the dual PLL source frequency-multiplying technology, the harmonic measurement with faster speed and wider dynamic range can be realized; the voltage, current fundamental wave, power, phase, harmonic components and total harmonic distortion factor (THD) testing can be performed accurately in the harmonic mode; Harmonic analysis can be conducted on the fundamental signal of the inverter up to 5kHz, and the harmonic analysis order of the fundamental signal in the range of 0.5~640Hz can reach 500.



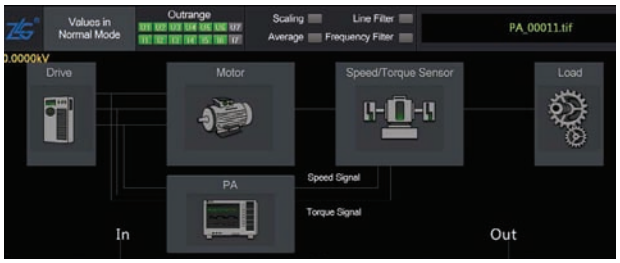
Conversion efficiency testing for an inverter with SiC

When performing the efficiency testing for a SiC semiconductor-mounted inverter, due to the output characteristics of the SiC semiconductor, there are many small power signals in the PWM waveform output from the inverter. At this time, a power analyzer with high resolution is required for the accurate measurement. The PA5000H has a 16-bit ADC and PA8000 has an 18-bit ADC with higher resolution, which can accurately measure this small power variation, making high-precision measurements possible.



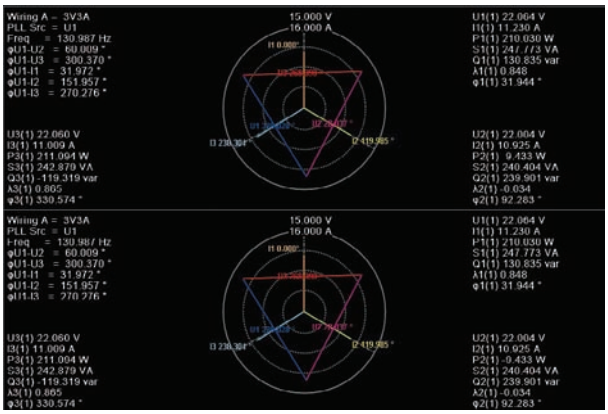
Motor Test

The PA8000 and PA5000H power analyzer can select one or several from 7 power boards and upgrade it or them to the motor testing board(s) (multiple-channel motor boards can be selected at the same time). Through the power board, motor board and torque speed sensor, the inverter and motor can be tested jointly, which greatly facilitates he development and testing of motor-related products.



Dual Vector Diagram Analysis

The PA8000 and PA5000H power analyzers can simultaneously measure and display the vector diagram of the inverter's three-phase input and output, and can analyze the phase angle relationship between input and out phases to accurately assess the influence of the input signal on the angular difference of the output signal.



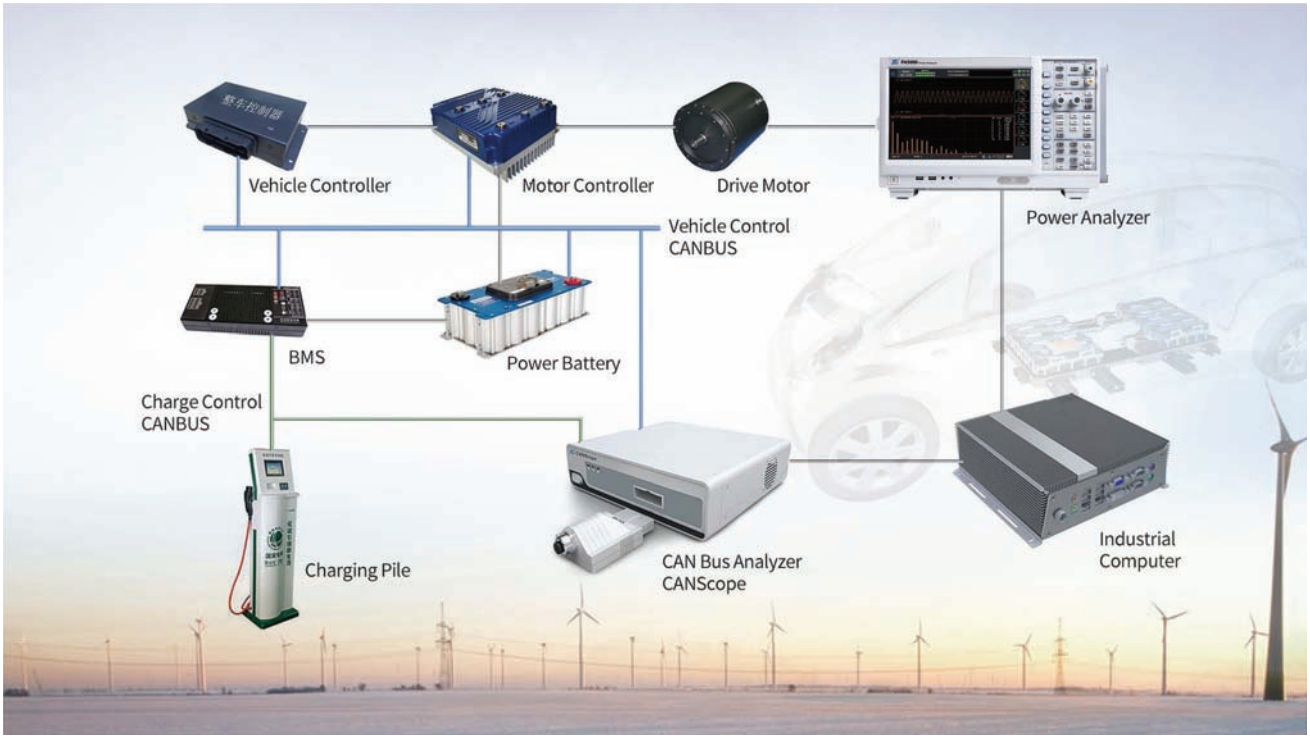
Because the inverter industry has high requirements for bandwidth, harmonic testing, efficiency measurement and storage capacity, the traditional power analyzer cannot meet these needs. The PA8000 and PA5000H power analyzers from ZHIYUAN Electronics feature 5MHz bandwidth, dual PLL source, and harmonics up to 500th order, as well as an exclusive 60G data storage capacity, can perfectly solve all the needs of the inverter industry.

Recommended Models: PA8000 and PA5000H

1. 0.01% accuracy, 5MHz bandwidth, 2M sampling rate
2. Synchronous measurement of 7-channel power input
3. Dual PLL source, harmonics up to 500th order, 60G data storage
4. Excellent power accuracy and angular accuracy
5. Suitable for the power measurement of inverter industry that is very sensitive to bandwidth and harmonic measurements

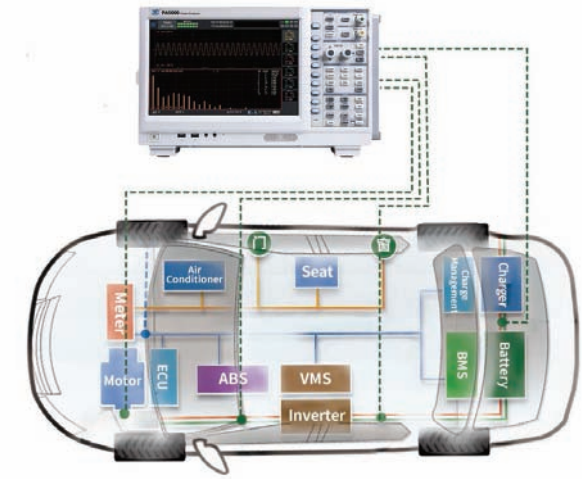
Electric Vehicle Industry

The motor drive system is the core of an electric vehicle. It is mainly composed of battery, inverter and drive motor. The electric vehicle testing platform built with the PA power analyzer can accurately assess the electric drive system of electric vehicle.
The PA5000H power analyzer supports the measurement of seven power inputs (the PAmini series supports four power boards and one motor board). It can assess the charge/discharge characteristics of the battery and the efficiency between the input and output of the inverter. Combined with a motor board, it can simultaneously monitor changes in voltage, current, power, speed and torque.



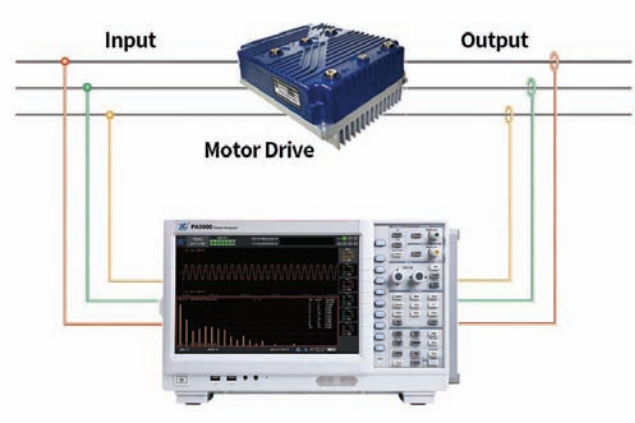
Efficiency Measurement of Electric Vehicle

With the powerful comprehensive analysis capability of the PA5000H power analyzer, a power analyzer can accurately test the power, efficiency, motor output and other electrical parameters of the electric vehicle, including the inverter efficiency, the motor efficiency and the conversion efficiency of battery DC-AC, etc...



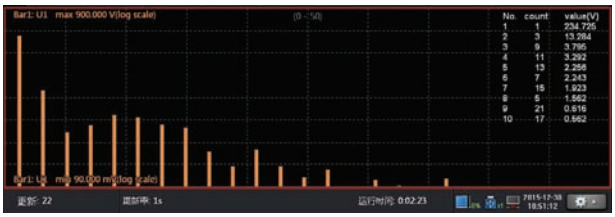
Drive Efficiency Test

The PA5000H power analyzer provides 7 power input boards that support the simultaneous measurement of the motor drive's input and output. Moreover, all the power input modules have same 100 MHz synchronous clock, which realizes the synchronization of the sampling phase, reduces the error introduced by the U and I angle, and guarantees the measurement accuracy of efficiency.



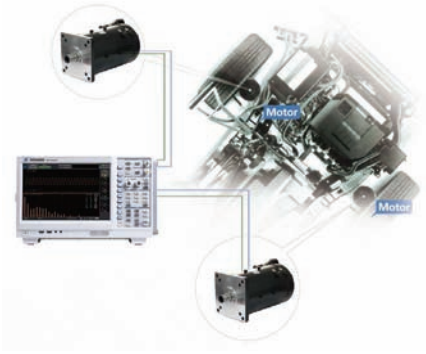
Harmonics up to 500th order

The PA5000H power analyzer has a bandwidth of DC/0.1Hz-5MHz. Thanks to the dual PLL source frequency-multiplying technology, the harmonic measurement with faster speed and wider dynamic range can be realized; the voltage, current fundamental wave, power, phase, harmonic components and total harmonic distortion factor (THD) testing can be performed accurately in the harmonic mode.



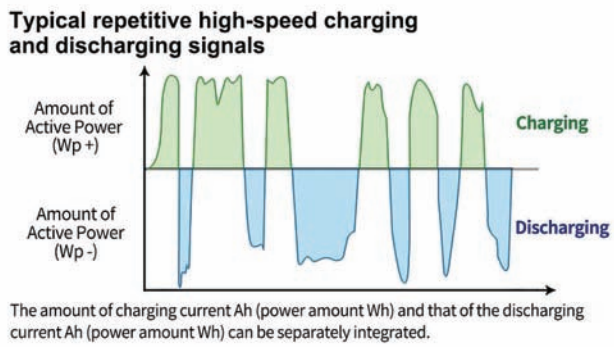
Multi-motor Test

The PA5000H power analyzer can select one or several from 7 power boards and upgrade it or them to the motor testing board(s) (both PA8000 and PA5000H can select multiple-channel motor boards). Through the power board and motor board, the gearbox (inverter) and motor inside the electric vehicle can be tested jointly, allowing users to measure the overall performance of motor system more accurately.



Full Data Recording and Measurement for Battery Charging and Discharging

The PA5000H power analyzer can assess the charging and discharging of battery through the integral function. It captures instantaneous positive and negative values at a high sampling rate of about 2MS/s for integral operation, which can help users reduce costs, improve the testing maintenance efficiency of inverter/motor while presenting the true characteristics of the battery.



New Energy Vehicle Testing Platform

The new-energy vehicle testing platform is based on the core components that electric vehicles actually use. With high-performance power testing system, CAN bus communication testing tool and professional testing software can realistically simulate and analyze the energy transmission states of the electric vehicle power system under various working conditions, which can be used as the scientific research and testing platform for research institutes, automotive industry, universities, and other fields.

With high conversion efficiency and clean energy consumption, the new energy electric vehicle industry is highly sought after. Due to excellent performance of the power analyzer, the new energy vehicle testing platform from ZHIYUAN Electronics can simultaneously test the vehicle efficiency of internal components inside the electric vehicle, which can perfectly solve all the requirements for the efficiency test of the electric vehicle industry.

Recommended Model: PA5000H

1. 0.05% accuracy, 5MHz bandwidth, 2MS/s sampling rate
2. Synchronous measurement of 7-channel power input element
3. Harmonics up to 500th order, 60G data storage
4. Excellent power accuracy and angular accuracy
5. Suitable for the power measurement of electric vehicle industry that is very sensitive to bandwidth and harmonic measurements

Charging Pile Industry

In recent years, with the increasing subsidies of the state to the new energy vehicle industry and the gradual improvement of support policies, the new energy vehicle industry has made great progress. The construction problem of supporting facilities such as charging piles is also urgently needed to be solved.

The PA power analyzer from ZHIYUAN Electronics can provide a comprehensive testing solution for the overall equipment of the charging pile, aiming to help users provide a strong basis for the design of the charging pile.

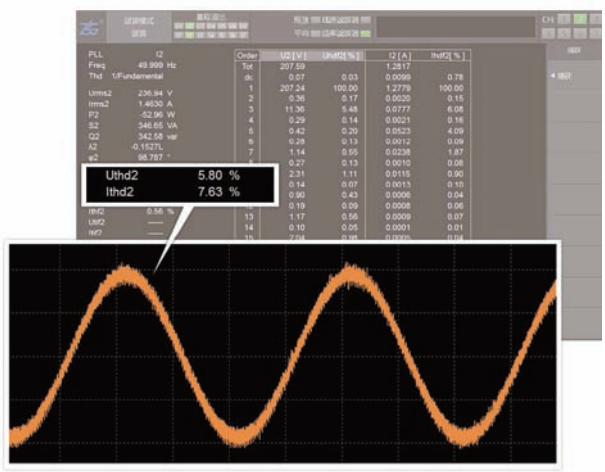
Efficiency Measurement of Charging Piles

The charging pile industry is currently subdivided into DC piles and AC piles. The AC charging pile is small in size and only provides power output. Meanwhile, the output voltage and current of DC charging pile can be adjusted in a wide range, so that the electric vehicles can be quickly charged.

The PA6000H power analyzer provides 7 power input boards that support the simultaneous measurement of the charging pile's input and output. Moreover, all the power input modules have same 100 MHz synchronous clock, which guarantees the measurement accuracy of power and efficiency.

Charging Pile Input Harmonic Measurement

Since the charging pile input is connected to the grid directly, it is also possible to directly input a large amount of harmonics back to the grid. In the new charging pile standard in 2015, it is specified that the total harmonic current content of the charging pile should not exceed 8% when the output power is 50% to 100% of the rated power. The PA6000H power analyzer can accurately test voltage, current, and total harmonic distortion (THD) factor in the harmonic mode.

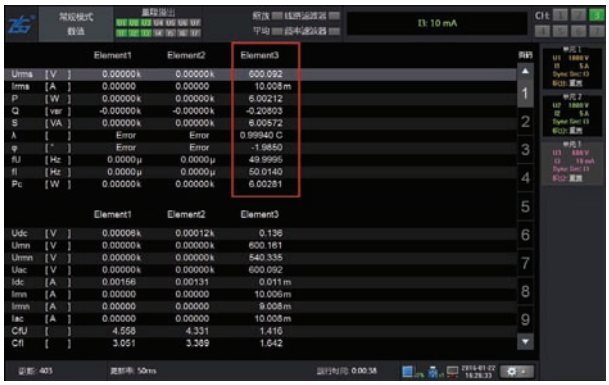


Output Power Requirements of Charging Pile

The voltage output error of the charging pile under constant voltage should not exceed ± 0.5%. When the current output is less than 30A, the error does not exceed ± 0.3A; and when the current output is greater than 30A, the error should not exceed ± 1%. The PA6000H power analyzer can make an accurate assessment of the output voltage and current of the charging pile through a trend graph.

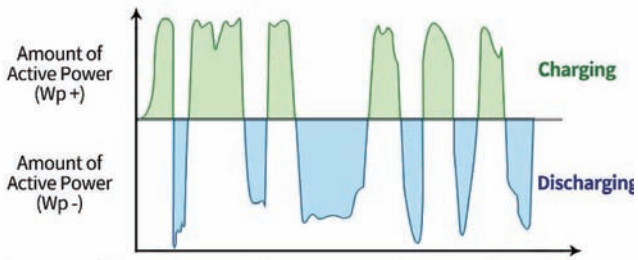
Standby Power Consumption Measurement of Charging Pile

When the charging pile is in the standby state, its overall power consumption should not exceed 0.15% of the rated output power. The PA6000H power analyzer has a minimum voltage range of 300mV, a current range of 10mA. It can easily measure small currents.



Complete record of the charging process of charging pile

The PA6000H power analyzer can record and assess the battery charging process through the integral function. It captures instantaneous positive and negative values at a high sampling rate for integral operation. The PA6000H power analyzer has a 60G data storage function, and all the data can be automatically saved during battery charging and discharging. While presenting the battery charging process, it can also provide users with professional charging data of the charging pile.



The amount of charging current Ah (power amount Wh) and that of the discharging current Ah (power amount Wh) can be separately integrated.

Average output current imbalance measurement of charging pile

When the charging pile uses multiple high-frequency switching rectifier modules to work in parallel, each module should share the load proportionally. When the average output current of each module is 50 % ~100 % of the rated current, the average current imbalance should not exceed ± 5%. The PA6000H power analyzer has 7 power measurement channels for simultaneous, real-time and accurate assessment of the average current imbalance of charging piles.

As an emerging industry, the charging pile industry has developed rapidly. With the official release of the national grid charging pile standard, the testing projects has gradually improved. The PA6000H is widely recognized by users for its high power measurement accuracy and excellent performance. Most importantly, it perfectly supports the latest industry standard in 2015, making it a perfect testing tool of charging piles.

Recommended Model: PA6000H

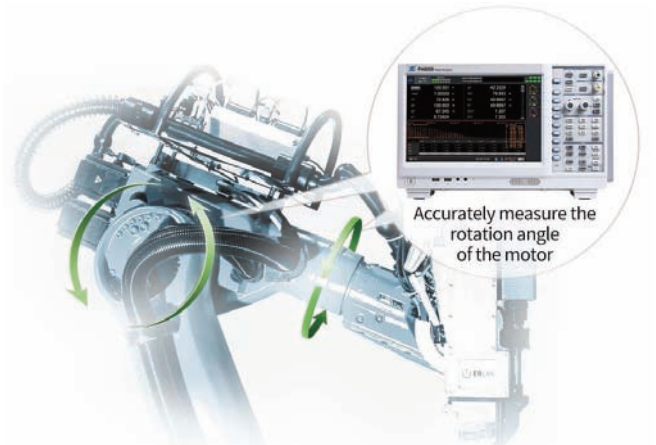
1. 0.01% accuracy, 2MHz bandwidth, 2MS/s sampling rate
2. Synchronous measurement of 7-channel power input element
3. Tests conforms to the latest charging pile industry standard
4. Suitable for the power measurement of charging pile industry that is very sensitive to accuracy and multiple-channel synchronous measurements

Robot Industry

With the development of technology, the robot industry in China has experienced a rapid development trend. The problem that it is hard to accurately measure the dynamic and static performance of the robot is exposed. The PA8000 and PA5000H power analyzers can make a series of professional tests in the robot industry to help users obtain a sound basis for robot design and optimization.

Position Measurement

The PA8000 and PA5000H power analyzers can measure and analyze the rotor rotation position of the motor inside the robot through the speed, torque and other input signals from the motor board. The unique algorithm can accurately measure the motor rotation angle, such as the rotation angle of the mechanical arm.

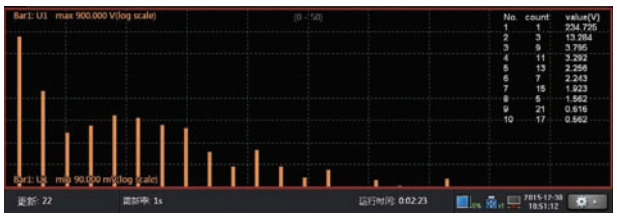


Multi-motor Test

The PA8000 and PA5000H can select multi-channel motor boards for synchronous measurement. Through the power board, motor board and torque-speed sensor, different motors inside the robot can be evaluated at the same time. Up to 7 motors can be measured at the same time. By using this joint debugging and testing method, users can more accurately measure the overall performance of the robot motor system.

Harmonics up to 500th order

The PA8000 and PA5000H power analyzers have a bandwidth of DC/0.1Hz-5MHz and a sampling rate of 2 MS/s. Thanks to the dual PLL source frequency-multiplying technology, the harmonic measurement with faster speed and wider dynamic range can be realized. In the harmonic mode, the harmonic of the inverter's fundamental signals up to 5 kHz can be measured. Up to 500th harmonic of the fundamental frequency can be measured.

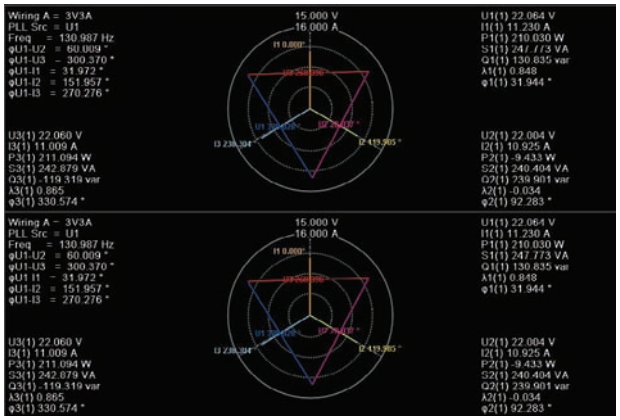


60G Data Storage and Excellent Data Format Analysis

The PA8000 and PA5000H power analyzers have a solid state disk (SSD) of up to 60G for massive data storage. The USB flash drive can be directly connected to store all the desired data. The PAD and CSV formats are supported in various ways and the storage time is controlled at random, making storage no longer a problem.

Dual Vector Diagram Analysis

The PA8000 and PA5000H power analyzers can simultaneously measure and display the vector diagram of the inverter's three-phase input and output, and can analyze the phase angle relationship between input and out phases to accurately assess the influence of the input signal on the angular difference of the output signal.



CAN Communication Fault Location

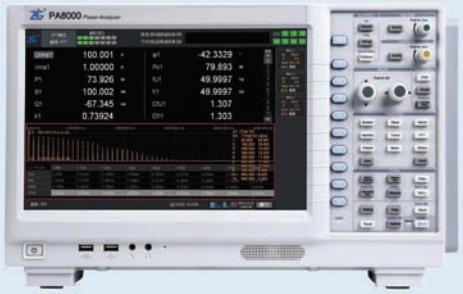
The CANScope-Pro analyzer from ZHIYUAN Electronics integrates mass storage oscilloscope, network analyzer, bit error rate analyzer, protocol analyzer and reliability testing tool to fully verify the correctness, reliability and rationality of the robot CAN network communication.

Recommended Products

The robot industry has high requirements for the control and testing of multi-motors, and needs to test multiple motors and drivers at the same time. Therefore, it requires a power analyzer that can measure multiple channels at same time. The PA8000 and PA5000H power analyzers feature 5M bandwidth, dual PLL source, and harmonics up to 500th order, as well as an exclusive 60G data storage capacity, and support the synchronous measurement of multi-channel motor board, which can perfectly solve all the needs of the robot industry.

Recommended Models: PA8000 and PA5000H

1. 0.01% accuracy, 5M bandwidth, 2MS/s sampling rate
2. Synchronous measurement of 7-channel power input element
3. Dual PLL source, harmonics up to 500th order, 60G data storage
4. Excellent power accuracy and angular accuracy
5. Suitable for the power measurement of robot industry that is very sensitive to bandwidth and harmonic measurements

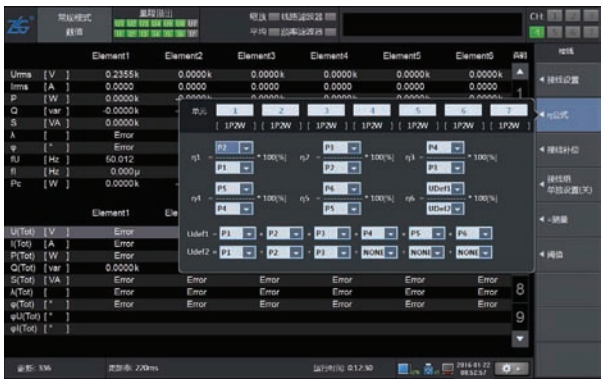


Power Supply Industry

Switching power supplies and UPS power supplies are among the most used power supplies. The switching power supply is the one that utilizes modern power electronic technology to control the ratio of time that the switch tube is turned on and off, and maintains a stable output voltage. It is widely used in almost all electronic products due to its small size, light weight and high efficiency. The UPS power supply utilizes the principle of inverter to provide a stable and uninterrupted power supply to the load. Both of them are indispensable in today's society.

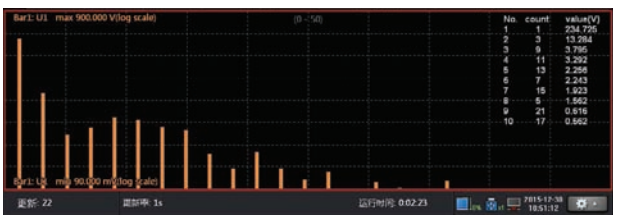
Conversion Efficiency Measurement

The PA5000H power analyzer supports a custom efficiency measurement formula and can display six efficiency measurement results simultaneously. It can simultaneously test the inverter circuit efficiency, AC/DC conversion efficiency, total power supply efficiency in the development and testing of power products.



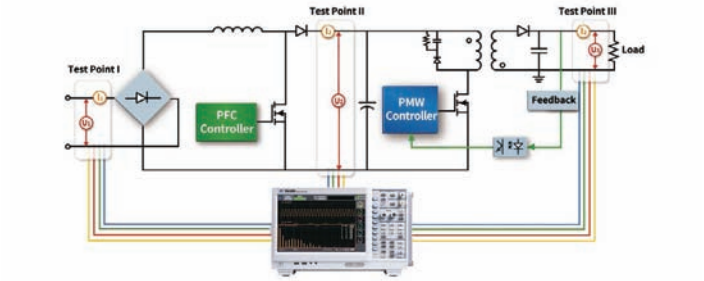
Harmonics up to 500th order

The PA5000H power analyzer has a bandwidth of up to 5MHz and a sampling rate of up to 2MS/s. It can measure harmonics up to 500th order, and simultaneously display the harmonic contents in the way of multiple combinations. Users can select the "Top Ten Harmonics" in the menu to view the top ten harmonics with highest energy among all the harmonics. Moreover, in order to facilitate users to perform more detailed analysis, we also design a function to view any harmonic value. This function allows users to check the value of each harmonic.



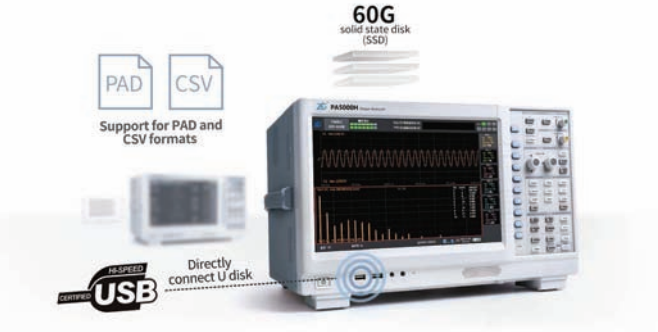
Rich Electrical Parameter Measurement

How to improve the power factor has been a difficult problem in the switching power supply industry. To improve the power factor, it is necessary to accurately measure various electrical parameters of the switching power supply. The PA5000H power analyzer can display voltage and current waveforms in real time. The rich electrical parameter display items allow users to analyze various performance indicators of the switching power supply, which helps users enhance the power factor design by providing powerful data support.



60G Data Storage and Excellent Data Format Analysis

The PA5000H power analyzer has a solid state disk (SSD) of up to 60G for massive data storage. Users can directly connect the USB flash drive to store all the desired data. The PAD and CSV formats are supported in various ways and the storage time is controlled at random, making storage no longer a problem.

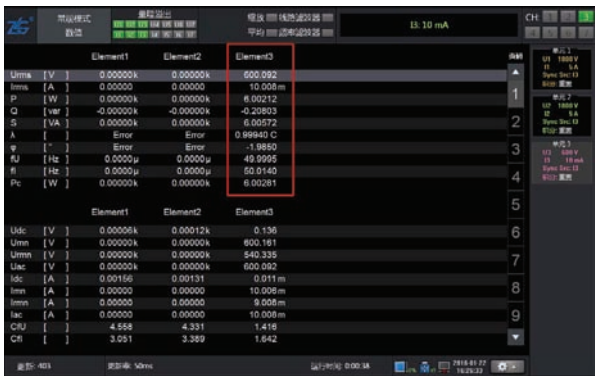


Waveform Playback Function

The PA5000H power analyzer can play back the recorded waveforms and data through the host computer software or local computer so that the waveform and data during storage can be reproduced. Furthermore, users can also set the playback speed, which greatly facilitates users to observe and analyze the measured data.

Standby Power Consumption Measurement

The standby power consumption is equally important in the power supply industry. When the power supply is in standby state, the current is very low. The conventional instruments cannot perform accurate measurements. The PA5000H power analyzer has a minimum voltage range of 1.5V and a minimum current range of 10mA, which fully meets the standby power consumption testing requirements of power supply industry.



Recommended Products

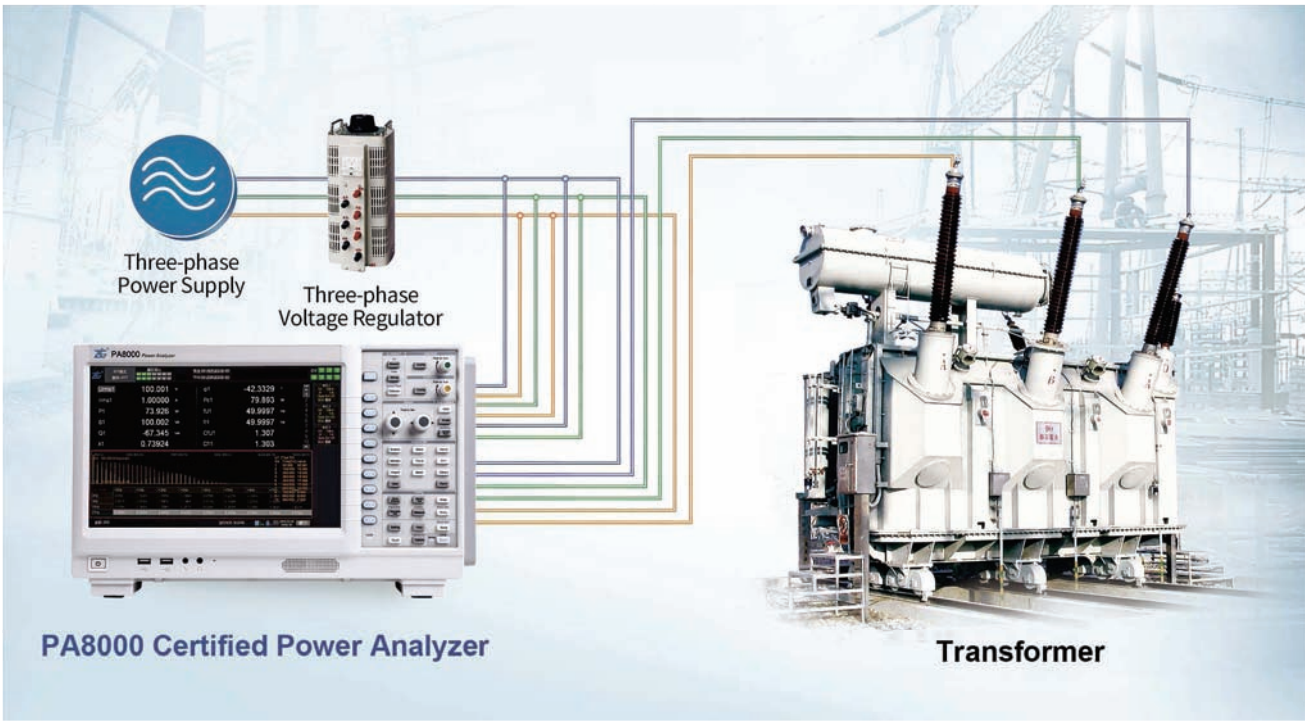
The output voltage, current, power, harmonic and conversion efficiency are the greatest concern for the power supply. How to accurately measure these parameters is the primary problem to solve. The PA5000H power analyzer from ZHIYUAN Electronics has 0.05% power measurement accuracy, 5M bandwidth and rich harmonic measurement function, which enable it to be widely applied to the development and testing of power products.

Recommended Model: PA5000H

1. 0.05% accuracy, 5MHz bandwidth, 2MS/s sampling rate
2. Synchronized measurement of 7-channel power input element
3. Dual PLL source, harmonics up to 500th order, 60G data storage capacity
4. Waveform recording and playback function
5. Widely applied to the development and design of switching power supply

Transformer Industry

In the power generation and distribution industries, the power supply department and transformer manufacturers particularly concern about the economic impact of transformer losses. If the specified no-load loss of transformer is exceeded, it will be subject to a large fine. Therefore, the accuracy of the measurement system becomes especially important. The higher the accuracy of the measuring instrument is, the more accurate the measurement results will be, and the fewer the fines are. The PA8000 and PA6000H power analyzers have excellent angular accuracy, and can still accurately measure power values under extremely low power factors, which can meet the testing requirement for transformers under no-load and loaded conditions, and accurately evaluate transformer losses and other parameters.



Load Test

In the transformer load test, phase difference between voltage and current is close to 90° and the power factor is close to 0. At this time, the conventional instruments cannot accurately measure the phase angle and the power value.

Ultra-high Angular Accuracy

Measurement Advantages

When the power factor of the transformer is only 0.01, the PA8000 certified power analyzer can still guarantee the power measurement accuracy of higher than 0.3% under the full range, which completely meets the load testing requirements of the power transformer.

No-load Test

In the transformer no-load test, the measurement current is very small--as low as 200μA, and conventional instruments cannot measure it accurately.

High-accuracy Measurement of Small Current

Measurement Advantages

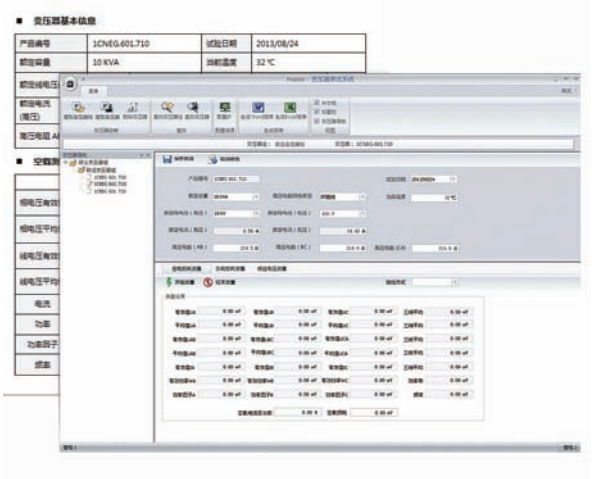
The PA8000 certified power analyzer has the minimum current range as low as 10mA, can accurately measurement small current of 150μA. It also has a basic current measurement accuracy of 0.01%, can accurately measure the no-load loss of large-capacity transformers.

Custom Conditional Trigger

The conditional trigger function enables the automatic measurement of transformer losses. Through setting the voltage of the measurement point, the measured data will be automatically saved when the voltage reaches the set value. In addition, the custom alarm function helps users find out the abnormal operation of the equipment in time. The PA8000 certified power analyzer provides an overvoltage alarm function for the transformer testing application.

Unique Auto-test Software for Transformers

In order to meet the unique testing requirements in the transformer field, ZHIYUAN Electronics has designed dedicated auto-test software for transformers based on the user's requirements.
The transformer testing system software collects and monitoring the test data in real time, realizes automatic data storage and calculation according to the set voltage value, and quickly generates key parameters and curves such as no-load loss and load loss, which provides reliable data support for the monitoring, acceptance and manufacture of transformers.

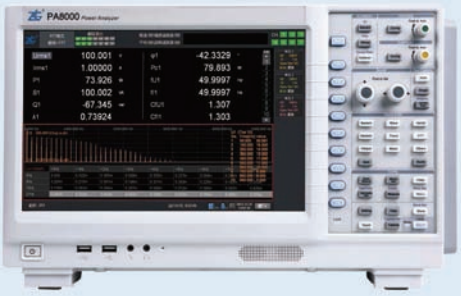


Recommended Products

In the transformer industry, manufacturers pay more attention to the economic impact of transformer losses. The PA8000 certified power analyzer can perform a series of power measurement for the no-load test and load test of transformer, and can also ensure high accuracy power measurement under extremely low power factor, which can meet the testing requirements of the transformer industry.

Recommended Model: PA8000 certified power analyzer

1. 0.01% accuracy, 5MHz bandwidth, 2MS/s sampling rate
2. Synchronized measurement of 7-channel power input element
3. Perfectly solves the problem of load tests and no-load tests
4. Standard transformer test software, support for report export
5. Suitable for the power measurement of transformer industry that is very sensitive to low power factor and low current tests

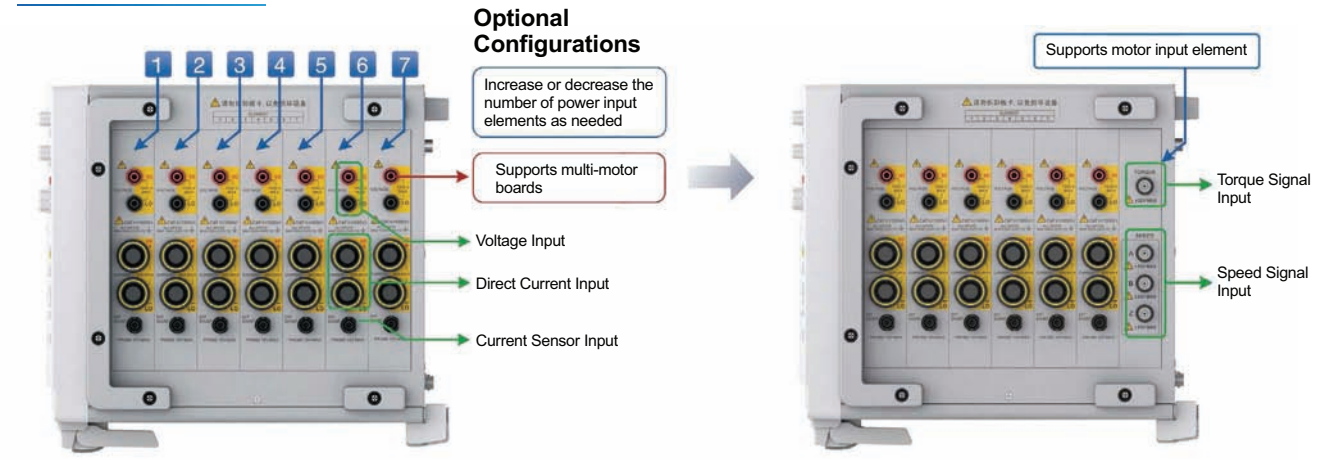


Interfaces

Input interfaces of PA-series Power Analyzer

The PA series power analyzer supports up to 7- phase power input for power measurement, can also configured as a model that supports motor signal input. The input terminals of PA series power analyzer use safety terminals to ensure the convenience and safety of on-site operation.

Supports up to 7-phase power input element

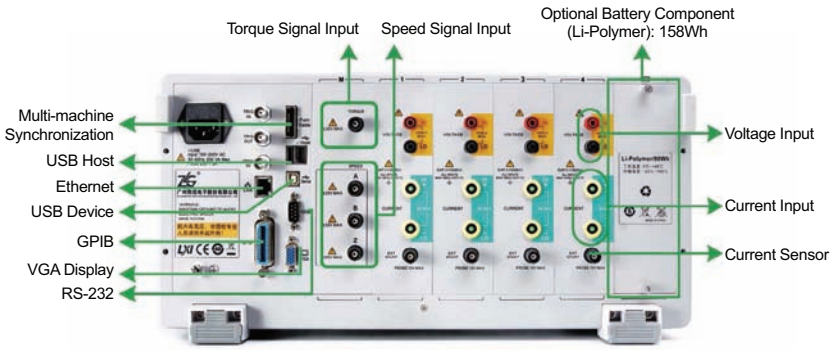


Power Input Version

Motor Version

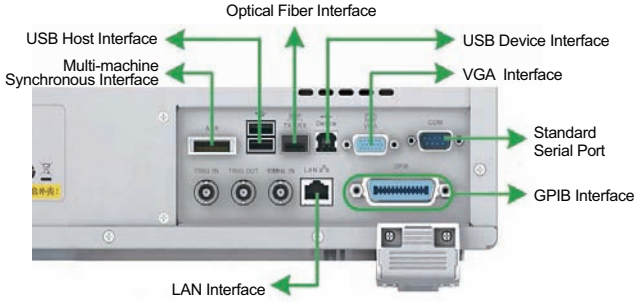
Input Interface of PAmini series Power Analyzer

The PAmini series power analyzer supports 4-phase power input and 1 motor input which can be flexibly combined by users.



Communication Interfaces

The PA series power analyzer provides 5 standard interfaces, including USB Host, USB-Device, Ethernet, GPIB and RS-232. The PA8000, PA5000H and PA6000H also support optical fiber interfaces, through which these power analyzers are remotely controlled. The PA series power analyzer provides USB-Host interface for external device connection, such as mouse, keyboard, USB flash drive, printer, and so on.



PA8000, PA5000H and PA6000H Interfaces

Specifications

Input Terminal Type

Parameter Description		
Voltage	Plug-in safety terminal (banana socket)	
Current	Direct input	Plug-in safety terminal (banana socket)
	Sensor input	Safety BNC terminal

Input Type

Parameter Descriptions	
Voltage	Floating input and resistor divider input
Current	Floating input and shunt input

Number of Input Element

Number of Input Element	
PA series power analyzer	Supports up to 7 power input elements, any of which can be optionally configured as a motor input.
PAmini series power analyzer	Supports up to 4 power input elements and one motor board.

Input Bandwidth

Bandwidth	DC, 0.1Hz~5MHz	PA8000, PA5000H
	DC, 0.1Hz~2MHz	PA6000H
	DC, 0.1Hz~500kHz	PA2000mini

Voltage Measurement Range

Input Parameters		Parameter Descriptions	
Voltage Measurement Range (rated)	PA8000 PA6000H	15V, 30V, 60V, 100V, 150V, 300V, 600V, 1000V, 1500V(1.33 crest factor)	Crest factor of 3
	PA5000H	15V, 30V, 60V, 100V, 150V, 300V, 600V, 1000V, 1500V(1.33 crest factor)	
	PA2000mini	300mV, 1V, 3V, 10V, 30V, 100V, 300V, 600V, 1000V, 1500V(1.33 crest factor)	
Continuous Maximum Allowable Input	PA8000 PA6000H	2000V peak value or 1500V RMS, whichever is smaller	
	PA5000H	2100V peak value or 1500V RMS, whichever is smaller	
	PA2000mini	2600V peak value or 1500V RMS, whichever is smaller	
Instantaneous Maximum Allowable Input (1s or less)	PA8000 PA6000H PA5000H	3000V peak value or 1600V RMS, whichever is smaller	
	PA2000mini	3000V peak value or 1600V RMS, whichever is smaller	
Impedance of Voltage Input	PA8000 PA6000H PA5000H	Input resistance: 2MΩ; input capacitance: 10pF	
	PA2000mini	Input resistance: 5 MΩ; input capacitance: 5 pF	

Note: The crest factor is 1.33 at 1500V.

Current Measurement Range

5A Input Element

5A Direct Input			
Input Parameters	Parameter Descriptions		
Current Measurement Range (rated)	PA8000 PA6000H PA5000H	10mA,20mA, 50mA, 100mA, 200mA, 500mA, 1A, 2A, 5A	Crest factor of 3
	PA2000mini	10mA, 30mA, 100mA, 300mA, 1A, 3A, 5A	
Continuous Maximum Allowable Input	15A peak value or 6.5A RMS, whichever is smaller		
Instantaneous Maximum Allowable Input (1s or less)	22.5A peak value or 10A RMS, whichever is smaller		
Impedance of Current Input	Input resistance: 100mΩ; input inductance: 0.07 H		
Sensor Input			
Sensor Input Range (rated)	PA8000 PA6000H PA5000H	50mV, 100mV, 200mV, 500mV, 1V, 2V, 5V, 10V	Crest factor of 3
	PA2000mini	30mV, 100mV, 300mV, 1V, 3V, 10V	
Continuous Maximum Allowable Input	PA8000 PA6000H PA5000H	The peak value should not exceed four times of the range and the RMS value may not exceed twice of the range.	
	PA2000mini	The peak value should not exceed five times of the range.	
Instantaneous Maximum Allowable Input (1s or less)	PA8000 PA6000H PA5000H	The peak value should not exceed five times of the range and the RMS value may not exceed three times of the range.	
	PA2000mini	The peak value should not exceed ten times of the range	
Sensor Input Impedance	PA8000 PA6000H PA5000H	Input resistance: 1 MΩ, input capacitance: 45 pF	
	PA2000mini	Input resistance: 1 MΩ, input capacitance: 40 pF	

50A Input Element

50A Direct Input			
Input Parameters	Parameter Descriptions		
Current Measurement Range (rated)	PA8000 PA6000H PA5000H	1A, 2.5A, 5A, 10A, 25A, 50A	Crest factor of 3
Continuous Maximum Allowable Input	90A peak value or 55A RMS, whichever is smaller		
Instantaneous Maximum Allowable Input (1s or less)	100A peak value or 60A RMS, whichever is smaller		
Instantaneous Maximum Allowable Input (20ms or less)	Peak value of 300A		
Impedance of Current Input	Input resistance: 5 mΩ; input inductance: 0.07 μH		
Sensor Input			
Sensor Input Range (rated)	50mV、100mV、200mV、500mV、1V、2V、5V、10V		Crest factor of 3
Continuous Maximum Allowable Input	The peak value should not exceed four times of the range and the RMS value may not exceed twice of the range.		
Instantaneous Maximum Allowable Input (1s or less)	The peak value should not exceed five times of the range and the RMS value may not exceed three times of the range.		
Current Input Impedance	Input resistance: 1 MΩ, input capacitance: 45 pF		

Common Mode Voltage

Maximum Continuous Common Mode Voltage	1000Vrms
Common Mode Rejection Ratio	120dB/50Hz

Filter

Line Filter	Optional OFF, 1MHz, 300KHz, and 100Hz~100kHz with the step of 100Hz	PA8000 PA6000H PA5000H
	OFF, 1 KHz, 10 kHz , 100 kHz, and 100Hz~50kHz with the step of 100Hz for digital filter	PA2000mini
Frequency Filter	Optional OFF, 100 Hz, 500 Hz and 1 kHz	PA8000 PA6000H PA5000H
	Optional OFF and 500 Hz	PA2000mini

Range Switching

Range	The range of each input element can be set separately.		
Auto-range	Range Upshift	PA8000 PA6000H PA5000H	Measured values of U and I exceed 108% of the rated range
			Peak values exceed 324% of the rated range
		PA2000mini	Measured values of U and I exceed 140% of the rated range
			Peak values exceed 330% of the rated range
	Range Downshift	Measured values of U and I are less than 30% of the rated range.	
		Peak values are less than 300% of the downshift range.	
Range	The range of input motor element can be set separately.		
Auto-range	Range Upshift	Measured values of the analog signals exceed 110% of the current range.	
	Range Downshift	Measured values of the analog signals are less than 30% of the current range.	

A/D Converter

Model	PA8000	PA6000H/PA5000H	PA2000mini
A/D Converter	18 bits	16 bits	16 bits
Sampling Rate	Approximately 2 MS/S	Approximately 2 MS/S	Approximately 500 KS/S

Monitor

Display Parameters	PA Power Analyzer
Monitor	12.1" color LCD display
Resolution	1280x800 pixels
Touch Screen	Supports touch screen operation
Display Update Rate	Same as data update rate
Display Parameters	**PAmini Series Power Analyzer**
Monitor	9" color LCD display
Resolution	800x480 pixels
Touch Screen	Supports touch screen operation
Display Update Rate	Same as data update rate

Accuracy

Basic Accuracy

The measurement accuracy of the power analyzer is obtained under the following conditions:

Temperature: 23± 5 °C ; Humidity:30-75% RH; Input Waveform: sine wave; Common Mode Voltage: 0V; Line Filter: OFF;λ (Power Factor): 1; Crest Factor:3; 30 minutes after warm-up; Zero calibration before measurement; f is frequency and unit is kHz. Data Update Rate: 500ms.

PA8000 series measurement accuracy for 5A power element(indicator± (% reading + % range))

Frequency Range of Input Signals	Current/Voltage/Sensor	Power
DC	0.05 + 0.05	0.05 + 0.10
0.1Hz ⩽ f < 30Hz	0.03 + 0.05	0.08 + 0.10
30Hz ⩽ f < 45Hz	0.03 + 0.03	0.05 + 0.05
45Hz ⩽ f < 66Hz	0.01 + 0.02	0.01 + 0.03
66Hz ⩽ f < 1kHz	0.03 + 0.03	0.05 + 0.05
1kHz ⩽ f < 10kHz	0.10 + 0.05	0.15 + 0.10
10kHz ⩽ f < 50kHz	0.20 + 0.10	0.30 + 0.20
50kHz ⩽ f < 100kHz	0.50 + 0.30	(0.01f + 0.2) + 0.3
100kHz ⩽ f < 500kHz	(0.005f + 0.3) + 0.5	(0.011f - 0.6) + 1.0
500kHz ⩽ f ⩽ 1MHz	(0.011f - 3.2) + 1.0	(0.04f - 16.1) + 2.0

PA8000 series measurement accuracy for 50A power element(indicator± (% reading + % range))

Frequency Range of Input signals	Current/voltage/Sensor	Power
DC	0.05 + 0.05	0.05 + 0.10
0.1Hz ⩽ f < 30Hz	0.03 + 0.05	0.08 + 0.10
30Hz ⩽ f < 45Hz	0.03 + 0.03	0.05 + 0.05
45Hz ⩽ f < 66Hz	0.01 + 0.02	0.01 + 0.03
66Hz ⩽ f < 1kHz	Voltage/sensor : 0.03 + 0.03 Current direct input: 0.05 + 0.04	Sensor: 0.05 + 0.05 Current direct input: 0.1+0.05
1kHz ⩽ f < 10kHz	Voltage/sensor :0.10 + 0.05 Current direct input:0.15 + 0.10	Sensor: 0.15 + 0.10 Current direct input: (0.1f + 0.2) + 0.2
10kHz ⩽ f < 50kHz	Voltage/sensor : 0.20 + 0.10 Current direct input: 0.30 + 0.10	Sensor: 0.30 + 0.20 Current direct input: (0.1f + 0.2) + 0.2
50kHz ⩽ f < 100kHz	Voltage/sensor :0.50 + 0.30 Current direct input:(0.15f-7.2) + 0.10	Sensor: (0.01f+0.2) + 0.3 Current direct input: (0.3f-9.5) + 0.3
100kHz ⩽ f < 200kHz	Voltage/sensor : (0.004f + 0.8) + 0.50 Current direct input: (0.07f+0.4) + 0.50	Sensor: (0.011f - 0.6) + 1.0 Current direct input: (0.9f + 11) + 1.0
200kHz ⩽ f < 500kHz	Voltage/sensor :(0.004f + 0.8) + 0.50	Sensor: (0.011f - 0.6) + 1.0
500kHz ⩽ f ⩽ 1MHz	Voltage/sensor : (0.01f - 2.2) + 1.0	Sensor: (0.04f -16.1) + 2.0

PA6000H series measurement accuracy for 5A power element (indicator ± (% reading + % range))

Frequency Range of Input Signals	Current/Voltage/Sensor	Power
DC	0.05 + 0.05	0.05 + 0.10
0.1Hz ⩽ f ＜ 30Hz	0.03 + 0.05	0.08 + 0.10
30Hz ⩽ f ＜ 45Hz	0.03 + 0.03	0.05 + 0.05
45Hz ⩽ f ＜ 66Hz	0.01 + 0.02	0.01 + 0.03
66Hz ⩽ f ＜ 1kHz	0.03 + 0.03	0.05 + 0.05
1kHz ⩽ f ＜ 10kHz	0.10 + 0.05	0.15 + 0.10
10kHz ⩽ f ＜ 50kHz	0.20 + 0.10	0.30 + 0.20
50kHz ⩽ f ＜ 100kHz	(0.004f+0.4) + 0.2	(0.012f+0.1) + 0.3
100kHz ⩽ f ＜ 500kHz	(0.006f+0.2) + 0.5	(0.013f-0.7) + 1.0
500kHz ⩽ f ⩽ 1MHz	(0.014f-4.3) + 1.0	(0.044f-17.2) + 2.0

PA6000H series measurement accuracy for 50A power element (indicator ± (% reading + % range))

requency Range of Input Signals	Current/Voltage/Sensor	Power
DC	0.05 + 0.05	0.05 + 0.10
0.1Hz ⩽ f ＜ 30Hz	0.03 + 0.05	0.08 + 0.10
30Hz ⩽ f ＜ 45Hz	0.03 + 0.03	0.05 + 0.05
45Hz ⩽ f ＜ 66Hz	0.01 + 0.02	0.01 + 0.03
66Hz ⩽ f ＜ 1kHz	Voltage/sensor : 0.03 + 0.03 Current direct input: 0.06 + 0.05	Sensor: 0.05 + 0.05 Current direct input: 0.1+0.05
1kHz ⩽ f ＜ 10kHz	Voltage/sensor :0.10 + 0.05 Current direct input: 0.20 + 0.10	Sensor: 0.15 + 0.10 Current direct input: (0.1f+0.2) + 0.2
10kHz ⩽ f ＜ 50kHz	Voltage/sensor :0.20 + 0.10 Current direct input: 0.30 + 0.10	Sensor: 0.30 + 0.20 Current direct input: (0.1f+0.2) + 0.2
50kHz ⩽ f ＜ 100kHz	Voltage/sensor : 0.50 + 0.30 Current direct input: (0.1f+0.2) + 0.10	Sensor: (0.012f+0.1) + 0.3 Current direct input: (0.3f-9.5) + 0.3
100kHz ⩽ f ＜ 200kHz	Voltage/sensor : (0.004f+0.8) + 0.50 Current direct input: (0.05f+5) + 0.50	Sensor: (0.013f-0.7) + 1.0 Current direct input: (0.9f+11) + 1.0
200kHz ⩽ f ＜ 500kHz	Voltage/sensor : (0.004f+0.8) + 0.50	Sensor: (0.013f-0.7) + 1.0
500kHz ⩽ f ⩽ 1MHz	Voltage/sensor : (0.01f-2.2) + 1.0	Sensor: (0.044f-17.2) + 2.0

PA5000H series measurement accuracy for 5A power element (indicator ± (% reading + % range))

Frequency Range of Input Signals	Current/Voltage	Power
DC	0.05+0.05	0.05+0.05
0.1Hz ⩽ f ＜ 30Hz	0.03 + 0.05	0.08+ 0.10
30Hz ⩽ f ＜ 45Hz	0.03 + 0.05	0.08+ 0.10
45Hz ⩽ f ＜ 66Hz	0.03 + 0.05	0.05 + 0.05
66Hz ⩽ f ＜ 1kHz	0.10 + 0.10	0.20 + 0.10
1kHz ⩽ f ＜ 10kHz	0.15 + 0.10	0.30 + 0.10
10kHz ⩽ f ＜ 50kHz	0.30 + 0.10	0.30 + 0.20
50kHz ⩽ f ＜ 100kHz	0.50 + 0.30	0.70 + 0.50
100kHz ⩽ f ＜ 500kHz	(0.004f+0.8) + 0.5	(0.02f-0.3) + 1.0
500kHz ⩽ f ⩽ 1MHz	(0.01f-2.2) + 1.0	(0.042f-12) + 2.0

PA5000H series measurement accuracy for 50A power element (indicator ± (% reading + % range))

Frequency Range of Input Signals	Current/Voltage/Sensor	Power
DC	0.05+0.05	0.05+0.05
0.1Hz ⩽ f ＜ 30Hz	0.03 + 0.05	0.08+ 0.10
30Hz ⩽ f ＜ 45Hz	0.03 + 0.05	0.08+ 0.10
45Hz ⩽ f ＜ 66Hz	0.03 + 0.05	0.05 + 0.05
66Hz ⩽ f ＜ 1kHz	Voltage/sensor: 0.10 + 0.10 Current direct input: 0.20 + 0.10	0.20 + 0.10
1kHz ⩽ f ＜ 10kHz	Voltage/sensor: 0.15 + 0.10 Current direct input:（0.10f + 0.2）+0.10	Sensor: 0.30 + 0.10 Current direct input:（0.10f + 0.2）+0.20
10kHz ⩽ f ＜ 50kHz	Voltage/sensor: 0.30 + 0.10 Current direct input:（0.10f + 0.2）+0.10	Sensor: 0.30 + 0.20 Current direct input:（0.10f + 0.2）+0.20
50kHz ⩽ f ＜ 100kHz	Voltage/sensor: 0.50 + 0.30 Current direct input:（0.10f + 0.2）+0.10	Sensor: 0.70 + 0.50 Current direct input:（0.30f-9.5）+0.50
100kHz ⩽ f ＜ 200kHz	Voltage/sensor: (0.004f+0.8) + 0.5 Current direct input:(0.05f+5.0) + 0.5	Sensor: (0.02f-0.3) + 1.0 Current direct input: (0.09f+11) + 1.0
200kHz ⩽ f ＜ 500kHz	Voltage/sensor: (0.004f+0.8) + 0.5	Sensor: (0.02f-0.3) + 1.0
500kHz ⩽ f ⩽ 1MHz	Voltage/sensor: (0.01f-2.2) + 1.0	Sensor: (0.042f-12) + 2.0

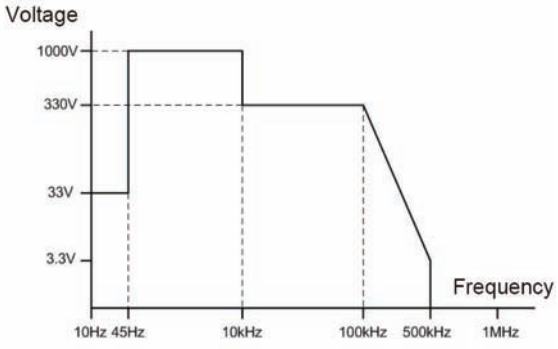
PA2000mini measurement accuracy (indicator ± (% reading +% of range))

Frequency Range of Input Signals	Current/Voltage/Sensor	Power
DC	Current direct input : 0.05 + 0.10+20μA Voltage/sensor input: 0.05 + 0.10	Current direct input : 0.05 + 0.10+20μA×Voltage reading Sensor input: 0.05 + 0.10
0.1Hz ⩽ f ＜ 30Hz	0.10+0.20	0.20+0.40
30Hz ⩽ f ＜ 45Hz	0.10 + 0.10	0.10 + 0.20
45Hz ⩽ f ＜ 66Hz	0.05 + 0.05	0.05+ 0.05
66Hz ⩽ f ＜ 1kHz	0.10 + 0.10	0.20 + 0.10
1kHz ⩽ f ＜ 10kHz	0.20+ 0.10	0.30 + 0.20
10kHz ⩽ f ＜ 50kHz	0.30+0.10	0.30+0.20
50kHz ⩽ f ＜ 100kHz	2.00+ 0.50	2.00+ 1.00
100kHz ⩽ f ＜ 500kHz	5.00+1.00	8.00+2.00

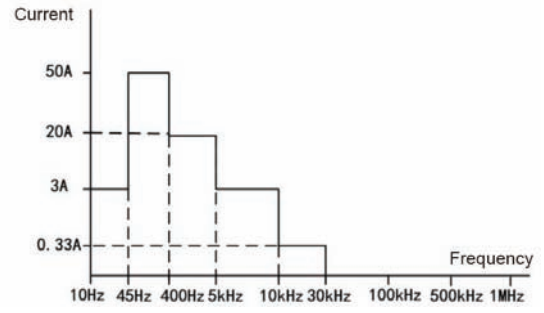
Note: please refer to the corresponding product user manual for additional errors.

Takes PA8000 for an example:

- The accuracy indicators for voltage and current signal measurement are related to the frequency and amplitude of the input signals:
  - All accuracy values in the range of 0.1~10Hz are reference values.
  - Voltage accuracy:
    - The voltage accuracy is reference value in the range of 500kHz~1MHz
    - The voltage accuracy is reference value in the range of 500kHz~1MHz
    - The voltage accuracy is reference value in the range of 500kHz~1MHz
    - The voltage accuracy is reference value in the range of 500kHz~1MHz



  - Current accuracy:
    - In the range of 10Hz~45Hz, the current accuracy is reference value when the current exceeds 3A.
    - In the range of 400Hz~1MHz, the current accuracy is reference value when the current exceeds 20A.
    - In the range of 5kHz~1MHz, the current accuracy is reference value when the current exceeds 3A.
    - In the range of 10kHz~1MHz, the current accuracy is reference value when the current exceeds 0.33V.
    - In the range of 30kHz~1MHz, the current accuracy is reference value.



- The accuracy of the waveform display data, Upk and Ipk is the above- mentioned accuracy plus 3% of the range (reference value). However, the input accuracy of external sensor is plus 3% of the range +5mV (reference value). The valid input range is within ± 300% of the range.
- Additional error of DC measurement
  - DC voltage accuracy plus 0.5mV, power accuracy plus 0.5mV*current reading
  - Input current accuracy of external sensor plus 50μV, power accuracy plus (50μV/ sensor range) *100%
  - 5A direct input current accuracy plus 5μA, power accuracy plus 5μA * voltage reading
  - 50A direct input current accuracy plus 250μA, power accuracy plus 250μA * voltage reading.
- Temperature variation
  - DC voltage accuracy plus 0.25mV/℃
  - DC current direct input accuracy plus the following value:
    - 5A input element: 2μA/℃
    - 50A input element: 100μA/℃
  - DC accuracy of external current sensor input plus 10μV/℃
  - DC power accuracy: additional voltage error * additional current error
- Effect of input signal self-heating (U is voltage (unit:V), I is current (unit: A)):
  - When the input voltage AC exceeds 400Vrms, the voltage and power accuracy is plus $2\times10^{-8}\times U^2$% of reading
  - When the input voltage DC exceeds 400Vrms, the voltage and power accuracy is plus 2×10-8×U^2% of reading+ $1\times10^{-8}\times U^2$% of range。
  - Current and power accuracy of 5A input element
    - When AC current is input, the accuracy of current and power is plus $7\times10^{-4}\times I^2$% of reading
    - When DC current is input, the accuracy of current and power is plus $7\times10^{-4}\times I^2$% of reading+ $0.8\times I^2$μA
  - Current and power accuracy of 50A input element
    - When AC current is input, the accuracy of current and power is plus $7\times10^{-4}\times I^2$% of reading
    - When DC current is input, the accuracy of current and power is plus $7\times10^{-6}\times I^2$% of reading+ $0.8\times I^2$mA

Even if the input current becomes small, the self-heating effect will always act until the internal shunt resistance temperature drops.

- The effect of data update rate on accuracy
  - All accuracies are plus 0.5% of reading when the data update rate is 10ms
  - All accuracies are plus 0.1% of reading when the data update rate is 50ms
  - All accuracies are plus 0.05% of reading when the data update rate is 100ms
- The effect of small range on accuracy
  - 10mA range of 5A element: Irms is within the allowable range (1~110%), and the current and power accuracy is plus 10mA*reading $(mA)^{-1}$*0.005%.
  - 0mA range of 5A element: Irms is within the allowable range (1~110%), and the current and power accuracy is plus 20mA*reading $(mA)^{-1}$*0.0015%.
  - 1A range of 50A element: Irms is within the allowable range (1~110%), and the current and power accuracy is plus 1A*reading $(A)^{-1}$*0.00125%.
  - 2.5A range of 50A element: Irms is within the allowable range (1~110%), and the current and power accuracy is plus 2.5A*reading $(mA)^{-1}$*0.0001%.
  - 1.5A range: Urms is within the allowable range (1~110%), and the voltage and power accuracy is plus 1.5V*reading $(V)^{-1}$*0.0003%.
- Input range
  - The amplitude of input signal should be within the allowable range:
    - Udc and Idc is within the 0~±110% of range
    - Urms and Irms is within the 1~110% of range
    - Urmn and Irmn is within the 10~110% of range
    - Urmn and Irmn is within the 10~110% of range

The synchronous source level should satisfy the input signal level of frequency measurement.

- Input display value
  - 140% of maximum display value voltage or current rated range
  - The minimum display value Urms, Uac and Irms are as low as 0.5% of the range
  - Urmn, Urmn, Irmn and Irmn are as low as 1% of the range
- The effect of line filter:
  - When the cutoff frequency (fc) is 100Hz~100kHz:

    Voltage/current
    - 0.1Hz~fc/2: $[(f/fc)^{4.2}\times60\%+(f/1000kHz)^2\times60\%]$ of reading
    - DC: 0.05% of range

    Power
    - 0.1Hz~fc/2: $[(f/fc)^{4.2}\times120\%+(f/1000kHz)^2\times120\%]$ of reading
    - DC: 0.1% of range
  - When the cutoff frequency (fc) is 300kHz:

    Voltage/current
    - 0.1Hz~fc/10: $(f/300kHz)^2\times60\%$ of reading
    - DC: 0.1% of range

    Power
    - 0.1Hz~fc/10: $(f/300kHz)^2\times120\%$ of reading
    - DC: 0.2% of range

▫ When the cutoff frequency (fc) is 1MHz:

Voltage/current

○ 0.1Hz~fc/10: $(f/1000kHz)^2$×60% of reading
○ DC: 0.05% of range

Power

○ 0.1Hz~fc/10: $(f/1000kHz)^2$×120% of reading
○ DC: 0.1% of range

▪ Angle error

Input waveform: 50 Hz sine wave. Common mode voltage: 0V. Line filter: OFF. Data update rate: 500ms.

▫ ±[|φ-cos-1(λ⁄1.0002) |+0.01]deg
Voltage and current are rated ranges.

▪ Temperature Coefficient

Ambient temperature: 5~18℃ or 28~40℃

▫ Temperature coefficient, plus ± 30ppm/℃ of reading.

▪ Accuracy of 12 months

▫ Accuracy of 12 months: accuracy of 6 months + (the reading error of accuracy of 6 months × 0.5).

Measurement Items

Item	Symbols and Meaning	
Voltage (V)	Urms: TRMS; Umn: ARV calibrated to RMS Udc: simple mean; Urmn: ARV; Uac: RMS voltage after removing the DC signal (not including PA2000mini)	Supports simultaneous measurement, crest factor up to 300
Current (A)	Irms: TRMS; Imn: ARV calibrated to RMS Idc: simple mean; Irmn: ARV; Iac: RMS current after removing the DC signal (not including PA2000mini)	Supports simultaneous measurement, crest factor up to 300
Apparent Power (VA)	S	
Reactive Power (var)	Q	
Power Factor	λ	
Phase Difference (°)	φ	
Frequency (Hz)	fU (FreqU): voltage frequency; fI (FreqI): current frequency	
Maximum and Minimum Voltage (V)	U + pk: maximum voltage,; U-pk: minimum voltage	
Maximum and Minimum Current (A)	I + pk: maximum current; I-pk: minimum current	
Crest Factor	CfU voltage crest factor; CfI current crest factor	
Corrected Power (W)	Pc (applicable standards IEC76-1 (1976), IEEE C57.12.90- 1993, IEC76-1 (1993))	
Efficiency	Measurement of efficiency n	
Integral	Time: Integral time; WP: sum of positive and negative watt-hour; WP+: sum of positive watt-hour (the amount of power consumption); WP-: sum of negative watt-hour (the amount of power returned to the grid); q: sum of the positive and negative ampere-hour; q+: sum of positive ampere-hour; q-: sum of negative ampere-hour; WS: volt-ampere hour; WQ: var hour, conducting ampere-hour integral by setting current mode to choose Irms, Imn, Idc, Iac or Irmn	
Custom Function	User-defined measurement function: F1~F20	

Measurement Mode

Normal Mode	PA8000 PA6000H PA5000H	Measures voltage, current, power, waveform computation and integral values. Users can use waveform display *8, bar graph *8, vector display *2 and X-Y diagram *2.
	PA2000mini	Measures voltage, current, power, waveform computation and integral values. Users can use waveform display *8, bar graph *8 and vector display *2.
Harmonic Mode	PA8000 PA6000H PA5000H	Performs up to 255 harmonic measurements for 1kHz fundamental wave frequency signals. Please use this function when perform harmonic measurements for those signals whose fundamental wave frequency is higher than the commercial power supply frequency. Harmonic display*3
	PA2000mini	Performs up to 80 harmonic measurements for 1kHz fundamental wave frequency signals. Please use this function when perform harmonic measurements for those signals whose fundamental wave frequency is higher than the commercial power supply frequency. Harmonic display*3
IEC Harmonic Measurement Mode	This mode complies with IEC61000-3-2 and IEC61000-4-7 international standards, and performs harmonic measurements.	
Voltage Fluctuation and Flicker Measurement Mode	This mode complies with IEC61000-3-3 and IEC61000-4-15 International standards, and performs voltage fluctuation and flicker measurements.	
FFT Mode	This mode can display the power spectrum of the input signal through FFT (Fast Fourier Transform). Please use this mode to check the frequency distribution of input signal.	
Cycle Mode	This mode can measure the voltage, current, power and other parameters of the AC input signal for each cycle.	

Measurement Function/Measurement Condition

Item	Specifications
Measurement Method	Digital multiplication
Crest Factor	The default value is 3
Measurement Interval	The interval is determined by the measurement function and operation. • The measurement interval is determined by the zero crossing point of the reference signal (synchronization source) (except the watt-hour integral value WP and the current integral value q during DC mode) • For harmonic measurement, the measurement interval is the time period from the beginning of the data update cycle to the 8192th point acquired at the harmonic sampling frequency.
Wiring Method	Select from the following five wiring modes (optional wiring method depends on the number of input elements installed): 1P2W (single-phase 2-wire), 1P3W (single-phase 3-wire), 3P3W (three-phase 3-wire), 3P4W (three-phase 4-wire), 3P3W (3V3A) (three-phase 3-wire, 3-voltage 3-current measurement).
Compensation Function	Efficiency compensation: compensates the instrument loss in the efficiency computation; Wiring compensation: compensates the instrument loss due to wiring.
Scale Coefficient	Set the conversion ratio of the current sensor, PT ratio and CT ratio in the range of 0.0001~99999.9999 when the instrument introduces external sensor, PT or CT.
Input Filter	Specified line filter or frequency filter
Average Function	Select exponential average or moving average • Exponential average: select the attenuation constant from 2, 4, 8, 16, 32, 64 • Moving average: select the average number from 8, 16, 32, 64, 128, 256
Data Update Rate	PA8000, PA6000H, PA5000H: Select from 10ms, 50ms, 100ms, 200ms, 500ms, 1s, 2s, 5s, 10s, 20s, and support the customization in the range of 1ms to 20s. PA2000mini: Select from 50ms, 100ms, 250ms, 500ms, 1s, 2s, 5s, 10s, 20s
Display Update Rate	Same as data update rate
Response Date	Same as data update rate
Hold	Maintain data display
Single measurement	Perform one measurement while the display is held.

Analog Input Parameters

Item	Specifications
Input Method	Safety BNC, floating, isolation, electrical isolation among A, B, Z of TORQUE and SPEED
Input Impedance	1MΩ±100kΩ
Measurement Range	1V, 2V, 5V, 10V, 20V
Cutoff Frequency (configurable)	100 Hz, 10 kHz, 50 kHz, OFF
Effective Measurement Range	±110%
Maximum Allowable Voltage	±22V
Number of bits	16bit
Maximum Common Mode Voltage	±42Vpeak
Sampling Rate	200kHz
Synchronous Source	U1~U6/I1~I6/EXT
Accuracy	± (0.05% of reading + 0.05% of range)
Temperature Drift	± 0.03% of range/°C

Pulse Frequency Input Parameters

Item	Specifications
Input Method	Safety BNC, floating, isolation, electrical isolation among A, B, Z of TORQUE and SPEED
Input Impedance	1MΩ±100kΩ
Frequency Range	1Hz~1MHz
Input Amplitude Range	±22Vpeak
Maximum Common Mode Voltage	±42Vpeak
Effective Amplitude	1V
Minimum High Pulse Width	Above 2.5 μS
Accuracy	± (0.05% of reading + 1 mHz)

Note: If the direction is not detected, the speed is input to the A terminal; if the direction is detected, the A and B phases of the rotary encoder are input to the A and B terminals, and the Z phase is input to the Z terminal of the rotary encoder for electrical phase angle measurement.

Harmonic Measurement

PLL Source Measurement of PA8000, PA6000H and PA5000H

Fundamental Wave Frequency of PLL source	Sampling Rate (S/s)	Window Width Relative to the FFT Data Length (fundamental wave frequency)	Maximum Harmonic Analysis Order	Maximum Harmonic Analysis Order
0.5~1Hz	f×8192	1	500	8192
1~5Hz	f×4096	2	500	8192
5~10Hz	f×2048	4	500	8192
10~640Hz	f×1024	8	500	8192
640~1.28kHz	f×512	16	255	8192
1.28kHz~2.56kHz	f×256	32	100	8192
2.56kHz~5 kHz	f×128	64	50	8192

PLL Source Measurement of PA2000mini

Fundamental Wave Frequency of PLL source	Sampling Rate (S/s)	Window Width Relative to the FFT Data Length (fundamental wave frequency)	Maximum Harmonic Analysis Order	Number of Sampling Points
10~20Hz	f×3200	3	128	9600
20~40Hz	f×1600	6	128	9600
40~55Hz	f×960	10	128	9600
55~75 Hz	f×800	12	128	9600
75~150Hz	f×480	20	128	9600
150Hz~440Hz	f×320	30	128	9600
440Hz ~1.1kHz	f×160	60	80	9600
1.1kHz~2.6kHz	f×80	120	40	9600

IEC Harmonic Measurement

PA8000, PA6000H and PA5000H Power Analyzer

Fundamental Wave Frequency of PLL source	Sampling Rate (S/s)	Window Width Relative to the FFT Data Length (fundamental wave frequency)	Maximum Harmonic Analysis Order	Number of Sampling Points
50Hz	f×3072	10	500	30720
60Hz	f×2560	12	500	30720

PA2000mini Power Analyzer

Fundamental Wave Frequency of PLL source	Sampling Rate (S/s)	Window Width Relative to the FFT Data Length (fundamental wave frequency)	Maximum Harmonic Analysis Order	Number of Sampling Points
50Hz	f×960	10	256	9600
60Hz	f×800	12	256	9600

Normal Harmonic/Harmonic/IEC Harmonic

PA8000, PA6000H and PA5000H Power Analyzer

	Harmonics in normal mode	Harmonics in harmonic mode	Harmonics in IEC mode
Input Signal	0.5Hz-1MHz	0.5Hz-5kHz	50 Hz or 60 Hz
Sampling Method	2MHz asynchronous sampling	PLL frequency-multiplying synchronous sampling	PLL frequency-multiplying synchronous sampling
Output Requirements	1. Sampling interval ≥ 250 ms, number of cycles > 10 2.SYNC source settings are correct	1. The input signal is 0.5 Hz ~ 5 kHz 2. PLL source settings are correct	1. The input signal is 50 Hz or 60 Hz grid signal 2.PLL source settings are correct
FFT points	40000	8192	30720

PA2000mini Power Analyzer

	Harmonics in normal mode	Harmonics in harmonic mode	Harmonics in IEC mode
Input Signal	0.5Hz-100kHz	10Hz-2.6KHz	50 Hz or 60 Hz
Sampling Method	200kHz asynchronous sampling	PLL frequency-multiplying synchronous sampling	PLL frequency-multiplying synchronous sampling
Output Requirements	1. Data update interval ≥ 250 ms, number of cycles > 10 2. SYNC source settings are correct	1. The input signal is 10 Hz ~ 2.6 kHz 2. SYNC source settings are correct 3. PLL source settings are correct	1. The input signal is 50 Hz or 60 Hz grid signalsignal 2. SYNC source settings are correct 3. PLL source settings are correct
FFT points	4000	9600	9600

FFT Computation Function

PA8000, PA6000H and PA5000H Power Analyzer

Item	Descriptions
Operand	The voltage, current, active power and reactive power of each input element; the active and reactive power of the wiring group Σ; the torque and speed signals of the motor input
Number of of Analysis	8 (FFT1-FFT8)
Frequency Resolution (Hz)	0.1, 0.125, 0.2, 0.25, 0.5, 0.625, 1, 1.25, 2, 2.5, 4, 5, 10, .20, 25, 40, 50, 100, 200, 250, 400, 500, 1000, 2000
Window Function	Rectangular Window, Hanning Window, Hamming Window, Blackman Window, Flat-top Window
Display Updates	FFT Measurement Cycle (maximum 10 s)

PA2000mini Power Analyzer

Item	Descriptions	
Operand	The voltage, current, active power and reactive power of each input element; the active and reactive power of the wiring group Σ; the torque and speed signals of the motor input	
Number of of Analysis	4 (FFT1, FFT2, FFT3, FFT4)	
Number of points	20000 points, 200000 points	
Computational Measurement Period	100ms or 1s	
Maximum Analysis Frequency	100kHz	
Frequency Resolution	1Hz, 10Hz	
Window Function	Rectangular Window, Hanning Window, Hamming Window, Blackman Window, Flat-top Window	
Sampling Rate/ Record Length	20k points	200k points
200kS/s	0.1s	1s
Sampling Clock	200kHz	
Display Update	FFT Measurement Cycle (maximum 10 s)	

Note: The measurement cycle is 1s when the number of FFT points is 200k; the measurement cycle is 100 ms when the number of FFT points is 20k.

Supported FFT Measurement Cycle

PA8000, PA6000H and PA5000H Power Analyzer

Sampling Rate/Record Length	1k Points	5k Points	10k Points	50k Points	100k Points	200k Points	400k Points	500k Points
2MS/s	0.5ms	2.5ms	5ms	25ms	50ms	100ms	200ms	250ms
1MS/s	1ms	5ms	10ms	50ms	100ms	200ms	400ms	500ms
500kS/s	2ms	10ms	20ms	100ms	200ms	400ms	800ms	1s
250kS/s	4ms	20ms	40ms	200ms	400ms	800ms	1.6s	2s
100kS/s	10ms	50ms	100ms	500ms	1s	2s	4s	5s
50kS/s	20ms	100ms	200ms	1s	2s	4s	8s	10s

Cycle Analysis Function

Parameters	Descriptions
Measurement Parameters	Synchronization source frequency, voltage, current, active power, apparent power, reactive power, power factor, speed, torque, mechanical power
Synchronization Source	Select U, I, Ext Clk, None
Number of Measurement Points	10~4000 (related to the number of input modules)
Timeout	24 hours, 1~3,600 s (in seconds)
Synchronization source Frequency Range	0.1Hz -1kHz

Integral Function

Mode	Optional manual, standard, continuous, real-time standard and real-time loop mode
WP ± Mode	Charging/discharging; electricity purchase/sale
Timer	Sets the timer to automatically stop the integration 0000h00m00s ~ 10000h00m00s
Stop Counting	The integration time and integration value will be maintained and the integration will be stopped when the integration time reaches its maximum value (10,000 hours) or the integral value reaches the maximum/ minimum display integration value (± 999999M)
Accuracy	± (power or current accuracy + time accuracy)
Time Accuracy	± 0.02% of reading

Waveform Sampling Data Storage Function

Storage Items	Voltage waveform, current waveform, computing waveform, FFT computation data, speed, torque analog, harmonic data, custom function
Storage Modes	Normal, real-time, integral synchronization, conditional trigger
Data Type	Numeric value, waveform, numeric value + waveform
File Type	CSV format, PAD format
Storage	U disk, internal SSD

Storage

Internal SSD capacity	PA8000 PA6000H PA5000H	60G storage space, support for long-time storage: more than 10,000 hours (general)
	PA2000mini	4G storage space, support for long-time storage: more than 660 hours (general)
USB storage interface	Supports USB storage interface	

General Characteristics

Functional System	Parameter Descriptions
Power Supply	100~240VAC
Power Supply Frequency	50Hz-60Hz
Rated Power	200VA
Fuse	T3AL250V, slow fuse, VDE/UL/CCC certification
Warm-up Time	≥ 30 min
Working Environment	5 °C to 40 °C, 20%~80% R.H.; no condensing
Storage Temperature	-20 °C to 50 °C
Transport Temperature	-20 °C to 50 °C
VGA Interface	Supports VGA interface
Communication Interface	GPIB, 1000Mbit LAN, RS-232, USB2.0 High Speed Device, USB2.0 High Speed Host , (support for U disk), SFP, trigger input/output, AUX
Backup Battery	CR2032 lithium battery. It maintains real-time clock operation
Safety	IIEC/EN 61010-1: 2010, IEC/ EN 61010-2-030:2010, measurement CAT II 1000V, Pollution Level 2
EMC	IEC/EN61326: 2013

Algorithms of Measurement Function

Item		Symbols and Meaning				
Measurement Function in Normal Measurement		**Calculation formulas and algorithms** (For information about formula symbols, please see the comments after this table)				
Voltage U [V]	True RMS Urms ARV calibrated to RMS Umn Simple mean Udc ARV Urmn AC component Uac	Urms	Umn	Udc	Urmn	Uac
		$\sqrt{\frac{1}{N}\sum_{n=1}^{N} u_n^2}$	$\frac{p}{2\sqrt{2}} \cdot \frac{1}{N}\sum_{n=1}^{N} \lvert u_n \rvert$	$\frac{1}{N}\sum_{n=1}^{N} u_n$	$\frac{1}{N}\sum_{n=1}^{N} \lvert u_n \rvert$	$\sqrt{Urms^2 - Udc^2}$
Current I[A]	True RMS Irms ARV calibrated to RMS Imn Simple mean Idc ARV Irmn AC component Iac	Irms	Imn	Idc	Irmn	Iac
		$\sqrt{\frac{1}{N}\sum_{n=1}^{N} i_n^2}$	$\frac{p}{2\sqrt{2}} \times \frac{1}{N}\sum_{n=1}^{N} \lvert i_n \rvert$	$\frac{1}{N}\sum_{n=1}^{N} i_n$	$\frac{1}{N}\sum_{n=1}^{N} \lvert i_n \rvert$	$\sqrt{Irms^2 - Idc^2}$
Active Power P [W]		$\frac{1}{N}\sum_{n=1}^{N} (u_n \times i_n)$ n is the number of sampling points, which is determined by the measurement interval				
Apparent Power S S[VA]	Type1, Type2	U × I(algebraic multiplication)				
	Type3	$\sqrt{P^2 + Q^2}$				
Reactive Power Q Q[var]	Type1, Type2	$s \cdot \sqrt{S^2 - P^2}$ s is -1 at the leading phase, 1 at the lagging phase				
	Type3	$Q = \sum_{k=\min}^{\max} [U_j(k) I_r(k) - U_r(k) I_j(k)]$ Ur(k) and Ir(k) are the real parts of U(k) and I(k) Uj(k) and Ij(k) are the imaginary parts of U(k) and I(k), and are valid only when harmonics are measured correctly				
Power Factor λ		P/S				
Phase Difference φ [°]		$\varphi = atan2(Q, P)$ Where the atan2 (y, x) represents the angle required for the $(\sqrt{x^2 + y^2}, 0)$ vector to rotate counterclockwise to (x, y)				
Voltage Frequency fU (FreqU) [Hz] Current Frequency fI (FreqI) [Hz]		Zero-crossing detection is used to measure the voltage frequency (fU) and current frequency (fI) Can measure any two frequencies of installed elements (fU and fI) simultaneously				
Maximum Voltage U + pk [V]		Maximum value in each data update cycle u(n)				
Minimum Voltage U-pk [V]		Minimum value in each data update cycle u(n)				
Maximum Current I + pk [A]		Maximum value in each data update cycle i(n)				
Minimum Current I-pk [A]		Minimum value in each data update cycle i(n)				
Voltage Crest Factor CfU Current Crest Factor CfI		$CfU = \frac{U_{pk}}{U_{rms}}$ Upk = | U + pk | or | U-pk |, whichever is greater. When the voltage mode is not RMS, it displays [------]		$CfI = \frac{I_{pk}}{I_{rms}}$ Ipk = | I + pk | or | I-pk |, whichever is greater. When the current mode is not RMS, it displays [------]		

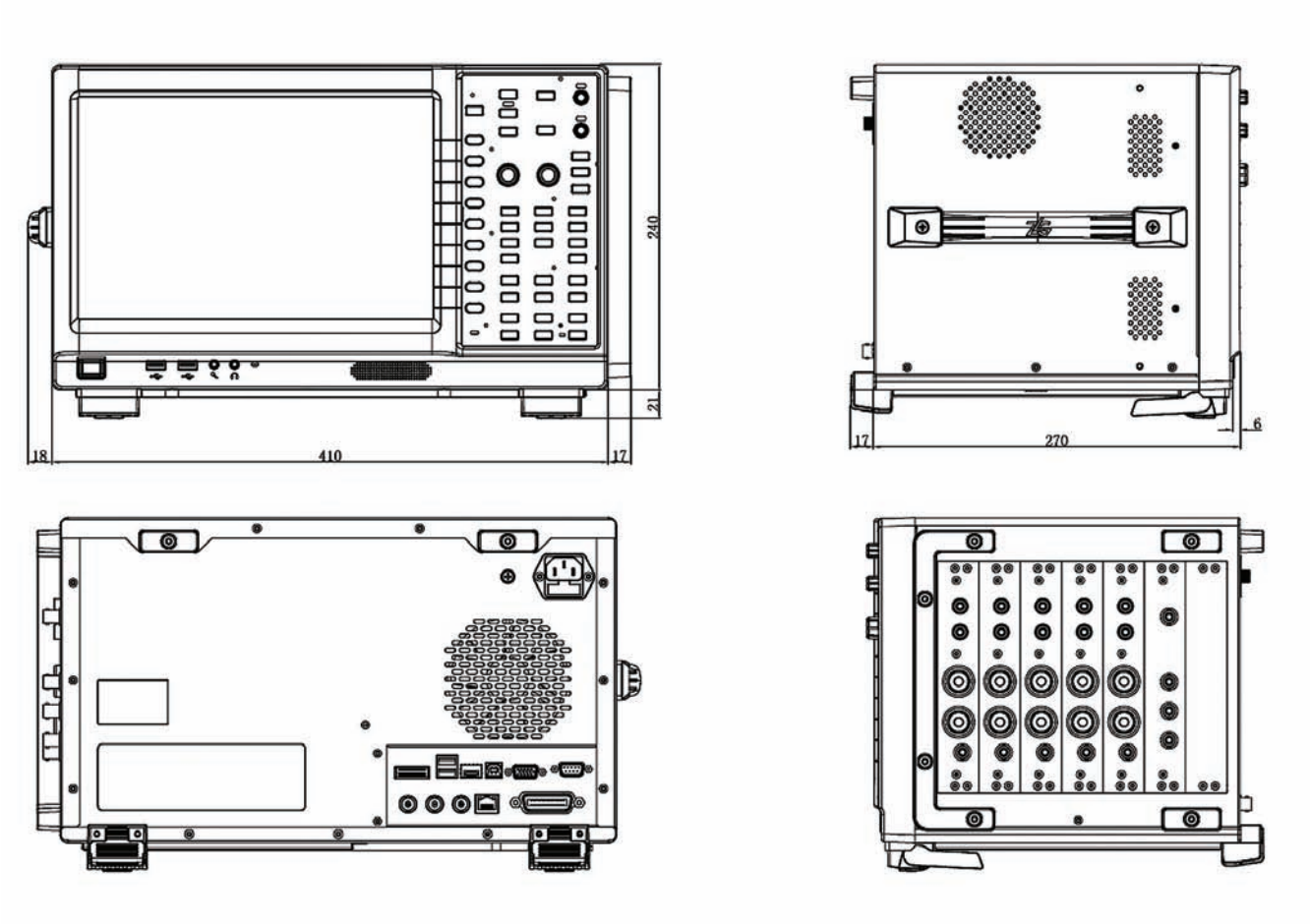
	Measurement function in normal measurement		Calculation formulas and algorithms (For information about formula symbols, please see the comments after this table)			
∑ Function	Wiring mode		Single-phase three-wire 1P3W	Three-phase three-wire 3P3W	three-voltage three-ammeter method 3P3W(3V3A)	Three phase four-wire 3P4W
	U∑[V]		(U1 + U2)/2		(U1 + U2 + U3) / 3	
	I∑[V]		(I1 + I2)/2		(I1 + I2 + I3) / 3	
	P∑[V]		P1 + P2			P1 + P2 + P3
	S∑[V]	TYPE1 TYPE2	S1 + S2	$\frac{\sqrt{3}}{2}(S1+S2)$	$\frac{\sqrt{3}}{3}(S1+S2+S3)$	S1 + S2 + S3
		TYPE3	$\sqrt{P\Sigma^2+Q\Sigma^2}$			
	Q∑[var]	TYPE1	Q1+Q2			Q1 + Q2 + Q3
		TYPE2	$\lvert Q\rvert = \sqrt{S^2 - P^2}$			
		TYPE3	Q1 + Q2			Q1 + Q2 +Q3
	Pc∑[var]		Pc1 + Pc2			Pc1 + Pc2 + Pc3
	WP∑[Wh]	WP∑	WP1+WP2			WP1+WP2+WP3
		WP+∑	WP+1 + WP+2			WP+1 + WP+2 +WP+3
		WP-∑	WP-1 + WP-2			WP-1 + WP-2 +WP-3
	q∑[Ah]	q∑	q1 + q2			q1 + q2 + q3
		q+∑	q+1 + q+2			q+1 + q+2 + q+3
		q-∑	q-1 + q-2			q-1 + q-2+ q-3
Motor Measurement Function	Motor output efficiency Eff		Eff = Pm / Pin			
	Motor loss Loss		Loss = Pin - Pm			
	Motor input power Pin		Pin = Uin × Iin			

Notes:

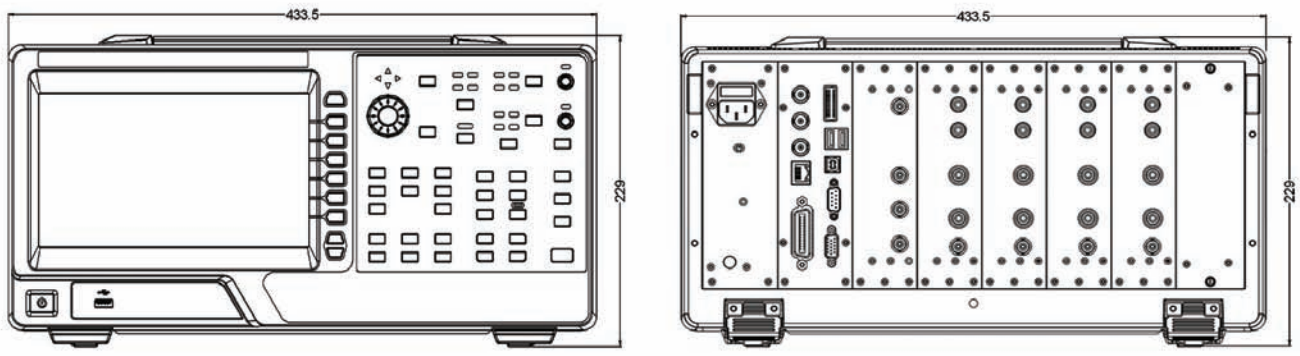
- u(n) represents the instantaneous value of the voltage (sampling data of the voltage signal).
- i(n) represents the instantaneous value of the current (sampling data of the current signal).
- AVG[ ] is an average calculation of the sampled data in [ ] within the measurement interval. There are two averaging methods for the power analyzer, which method is determined by the data update cycle.
- PΣA and PΣB represent the active power of the wiring group ΣA and ΣB respectively. The input elements assigned to the wiring group ΣA and ΣB vary according to the number of elements installed in the instrument and the wiring mode selected by the instrument.
- When the input element 1, 2 and 3 in the table form a wiring group, they are represented by number 1, 2 and 3 in the calculation formulas of UΣ, IΣ, PΣ, SΣ, QΣ, PcΣ, WPΣ and qΣ. If the element 2, 3 and 4 in the table form a wiring group, please replace 1, 2 and 3 with 2, 3 and 4 respectively.
- The S, Q, λ and φ of the power analyzer are calculated by the measured values of voltage, current and active power (but when TYPE3 is selected, Q is directly obtained from the sampled data). If a distorted waveform is input, there may be a difference between the measured value obtained from the instrument and the measured value obtained from other instruments that use different measuring principles.
- When calculating Q[var], Q is a negative (-) value when the current phase leads the voltage; Q is a positive (+) value when the current phase lags the voltage. The result of QΣ may be a negative value because it is derived from the signed Q value of each element.

Physical Dimensions

Dimensions of PA8000, PA6000H and PA5000H

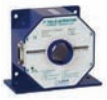
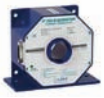
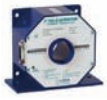
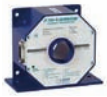


Dimensions of PA2000mini Power Analyzer



Tools and Accessories

LEM High Precision Current Sensor (0.05% level)

IT 60-S AC/DC Sensor	IT 200-S AC/DC Sensor	IT 400-S AC/DC Sensor	IT 700-S AC/DC Sensor	IT 1000-S/SP1 AC/DC Sensor
				
LEM DC: 0-60A AC: 60A peak Accuracy: ±(0.05% of rdg + 30 uA) Measurement bandwidth: DC-800 kHz Transformation ratio: 1: 600 Aperture: Φ26 mm Interface: DB9	LEM DC: 0-200A AC: 200A peak Accuracy: ±(0.05% of rdg + 30 uA) Measurement bandwidth: DC-500 kHz Transformation ratio: 1: 1000 Aperture: Φ26 mm Interface: DB9	LEM DC: 0-400A AC: 282Arms Accuracy: ±(0.05% of rdg + 30 uA) Measurement bandwidth: DC-500 kHz Transformation ratio: 1: 1200 Aperture: Φ26 mm Interface: DB9	LEM DC: 0-700A AC: 495Arms Accuracy: ±(0.05% of rdg + 30 uA) Measurement bandwidth: DC-100 kHZ Transformation ratio: 1: 1750 Aperture: Φ30 mm Interface: DB9	LEM DC: 0-1000A AC: 707Arms Accuracy: ±(0.05% of rdg + 30 uA) Measurement bandwidth: DC-500 kHz Transformation ratio: 1: 1000 Aperture: Φ30 mm Interface: DB9

LEM Low Precision Current Sensor (0.5% level)

LF 205-S/SP3 AC/DC Sensor	LF 205-S AC/DC Sensor	LF 505-S AC/DC Sensor	LF 1005-S AC/DC Sensor
			
LEM Current: 100Arms (DC/AC) Accuracy: ± 0.5% Measurement bandwidth: DC-100 kHZ Transformation ratio: 1: 1000 Aperture: Φ15.5 mm Interface: 3PIN	LEM Current: 200Arms (DC/AC) Accuracy: ± 0.5% Measurement bandwidth: DC-100 kHZ Transformation ratio: 1: 2000 Aperture: Φ15.5 mm Interface: 3PIN	LEM Current: 500Arms (DC/AC) Accuracy: ± 0.6% Measurement bandwidth: DC-100 kHZ Transformation ratio: 1: 5000 Aperture: Φ32.2 mm Interface: 3PIN	LEM Current: 1000Arms Accuracy: ± 0.4% Measurement bandwidth: DC-150 kHz Transformation ratio: 1: 5000 Aperture: Φ40.5 mm Interface: 3PIN

French CA Current Clamp

C117 AC Current Clamp	D36N AC Current Clamp	PAC22 AC/DC Current Clamp
		
Current: 100Arms, AC Accuracy: 0.3% Measurement bandwidth: 30 Hz < f <5 kHz Transformation ratio: 1 mV/A Aperture: Φ52 mm Interface: Φ4mm banana plug	Current: 3000Arms, AC Accuracy: 0.5% Measurement bandwidth: 30 Hz < f <5 kHz Transformation ratio: 1 mV/A Aperture: 50 x 135 mm - 64 x 100 mm Interface: Φ4mm banana female plug	Current: 1400A, DC/AC Accuracy: 1.5%, 2% Measurement bandwidth: DC-10 kHz Transformation ratio: 10 mV/A, 1 mV/A Aperture: Φ39 mm Interface: BNC

Current Clamp/Current Loop from ZLG ZHIYUAN Electronics

CTS5 AC Current Clamp	YX-CTS200 AC Current Clamp	CTS500 AC Current Clamp	CTS6000 AC Current Loop
			
Current: 5A AC AC accuracy: ± 0.3% rdg Measurement Bandwidth: 45 Hz-5 kHz Transformation ratio: 10 mV /A Interface: BNC	Current: 200A AC Amplitude accuracy: ± 0.3%rdg Transformation ratio: 1mV AC/A, 10mV AC/A Interface: BNC	Current: 500A AC AC accuracy: ± 0.3%rdg Measurement Bandwidth: 45Hz~5kHz Transformation ratio: 1 mV/A Interface: BNC	AC: 6000A rms Accuracy: ± 1.0% Bandwidth: 10Hz ≤ f ≤ 20kHz Transformation ratio: 50mV/A, 5mV/A, 0.5mV/A Interface: BNC

Test Connector and Cable (optional)

TA1002R	TA1003R	TA1004	TA1000	TP-DB9
				
MC Large alligator clip, Φ4mm safety plug, 1000V rated oltage, 32A maximum current, red	MC Φ4mm safety plug, stackable, can be connected to the test cable by screws, 1000V rated voltage, red	MC Safety BNC male banana jack adapter, with Φ4 mm safety plug. 1000 V rated voltage	MC Φ6mm banana plug with snap locking device and crimp ends	DB9 male to DB9 female connector, used with TP3000 series power kit, can be adapted to LEM IT series sensor, 3m
TA1002B	**TA1003B**	**TA1005**	**TA1006**	**TP-3PIN**
				
MC Large alligator clip, Φ4mm safety plug, 1000V rated voltage, 32A maximum current, black	MC Φ4mm safety plug, stackable, can be connected to the test cable by screws, 1000V rated voltage, black	MC Safety BNC female banana jack adapter, with Φ4 mm safety plug. 1000 V rated voltage	MC Φ6mm high current self-locking terminal block with snap locking device and terminal	DB9 male to 3PIN connector, used with TP3000 series power kit, can be adapted to LEM LF series sensor, 3m
TL1000R	**TL1000B**	**TL1005R**	**TL1005B**	**TL1001**
				
ZLG Safety test cable. Φ4 mm, safety banana plug. Safety level: 600 V, CAT III ~ 1000 V, CAT II/10A, 1.5 m test cable length, red	ZLG Safety test cable. Φ4 mm, safety banana plug. Safety level: 600 V, CAT III ~ 1000 V, CAT II/10A, 1.5 m test cable length, black	MC PAmini series current test cable. XKF-414, silicone, red, 1.5m length, male to female plug, 1000V CAT III (only for PAmini)	MC PAmini series current test cable. XKF-414, silicone, black, 1.5m length, male to female plug, 1000V CAT III (only for PAmini)	MC Motor test cable. Safety level: 600V, CAT II (300V, CAT III), 0.65m test cable length
TL1002R	**TL1002B**	**TL1006R**	**TL1006B**	**TL1004**
				
High current safety test cable, 60A maximum current, standard 2m, red, can be customized according to user needs	High current safety test cable, 60A maximum current, standard 2m, black, can be customized according to user needs	High current safety test cable, 10A maximum current, standard 2m, red (for power kit)	High current safety test cable, 10A maximum current, standard 2m, black (for power kit)	Changfeng Safety test cable. TL1004 Φ4mm, safety banana plug, 4 branch cables (red, black, yellow and green), L=1500mm

Measuring Lead Box

Product	Features
ZWA330 	ZWA330 wiring adapter is suitable for the voltage measurement of three phase equipment without neutral line, The 3V3A wiring mode is used internally, which meets CAT II standard.
ZWA340 	ZWA340 wiring adapter is suitable for the voltage measurement of three phase equipment without neutral line, The 3P4W wiring mode is used internally, which meets CAT II standard.

PAmini Power Adapter

Product	Features
PAmini-Adapter 	Charging the Pamini-Battery battery, and providing ± 15V/2A power for sensors such as LEM, without battery
PAmini-Adapter-B 	Charging the Pamini-Battery battery, and providing ± 15V/2A power for sensors such as LEM, with battery

Power Supply Kit

Product	Features
TP3001 	The LEM sensor is equipped with a power supply kit. It is suitable for IT series sensors when used with TP-DB9 cable; and suitable for LF series sensors when used with TP-3PIN cable.

Note: An optional three-phase TP3003 power supply kit is also available.

Lithium Battery

Product	Features
Lithium Battery for PAmini Series 	Supplying PAmini Series power analyzers for continuous operation of 3 to 4 hours

Current Sensor Accessories of Power Analyzer

Product	Features
PATV-33 	PATV-33 high-precision external shunt. Its main function is to convert the current signal into a voltage signal, with a resistance of about 3.3 Ω (the actual measured value correspond to each physical object), and the maximum allowable input current is 300 mA.

Power Analyzer Trolley Case

Product	特点
Trolley case for PA Series 	Applicable for all 7- channel desktop power analyzers, blue, 600 * 383 * 354 mm
Trolley case for PAmini Series 	Applicable for all Mini type power analyzers, blue, 505 * 350 * 320 mm

Rack Bracket for PA Series Power Analyzer

Product	Features
PA Series 19-inch Rack Brackets (left) 	19-inch rack bracket (left). It is used to fix all desktop power analyzers and 19-inch cabinets.
PA Series 19-inch Rack Brackets (right) 	19-inch rack bracket (right). It is used to fix all desktop power analyzers and 19-inch cabinets.
PAmini Series 19-inch Rack Brackets(Left, right) 	19-inch rack bracket (left, right). It is used to fix all Mini type power analyzers and racks.

Successful Application

Testing and Certification Laboratories

PV and Wind Power Industry

Inverter Industry

Motor Industry

Electric Vehicle Industry

Power Supply Industry

Robot Industry

Electrical Power Industry

Colleges and Universities

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