PF8000 电功率分析仪

PF8000 Electrical Power Analyzer

PF8000实验室级高精度电功率分析仪是一款高精度、高采样率、宽带宽、多功能的功率分析仪，可为电动汽车、轨道交通、光伏、风电、电机、变频器、燃料电池和开关电源等多种产品的开发和测试提供帮助，提高产品研发和生产测试效率。

PF8000 electrical power analyzer is a power analyzer with high performance, high sampling rate and wide band width. It can help to develop and test products such as electric vehicles, high-speed railways, photovoltaic, wind power, motors, transformers, fuel cells, energy saving lamps, switching power supplies, and improve the efficiency of product R&D and production test.

最多支持8通道输入协同测量

Support up to 8 channel input synergy measurement

基本精度：0.01%读数
Basic accuracy: 0.03%

宽带宽：5MHz
Wide bandwidth: 5MHz

高采样率：2Ms/s
High sample rate: 2Ms/s

最多8个输入通道协同测量
8 input channels

2组PLL同步源
Two PLL synchronous source

500次谐波测量
500 harmonic measurement

10.1寸LCD触摸屏
10.1 inches LCD touch screen

大容量内存
large capacity memory

特点与优势 Characteristics and advantage

- **人性化设计、优质操作体验 Humanization Design, 10.1-inch**

  10.1英寸彩色LCD全触屏界面，1280*800高像素，操作方便、易于观察。
  10.1 inch color LCD full touch interface, high pixel of 1280*800, it is can easy operation platform with high-quality.

- **多样化数据显示方式 Multiple Date Display Modes**

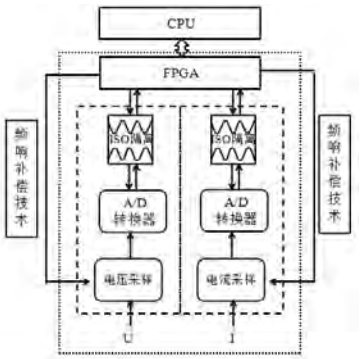
  多种数据显示方式包括数值、波形、效率图、趋势图、棒图和矢量图显示等，组合显示使得测量结果更加直观明了。
  Multiple data display modes include numeric value, waveform and bar graph, and combination display.

- **宽带宽，高稳定性 Wide Bandwidth and High Stability**

  带宽高达5MHz，完全满足高速开关信号的测量。高速测量模块采用高频高稳定度的传感器，有效保证电流高频性能。同时应用电压电流自动频响补偿技术，增强并保证高频信号测量时电压、电流的高精度测量。
  With 5MHz power bandwidths , it can satisfy the measurement of high speed switching signal. The high-speed measurement module uses sensors with high frequency and high stability to ensure the high frequency performance of current. It also has the automatic frequency response compensation technology.

- **FPGA处理器 FPGA Processor**

  功率测量与电机测量单元均配备高速高性能的FPGA处理器，执行多路同步时钟控制，极大提高了信号采样与数据处理，保证所有采样数据无遗漏实时运算，还原信号真实性。
  Measurement units of power and motor equipped with FPGA and multi-channel synchronous clock control, improve signal sampling and data processing, ensure that all sampled data have no omission of real-time operation, and restore the authenticity of the signal.

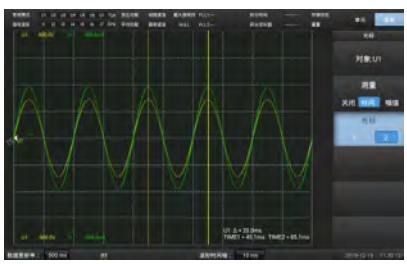


- **采样频率智能切换 Intelligent switching of sampling frequency**

  实时监测并分析被测信号源的信号频率，智能切换合适的采用频率进行信号采样。
  Intelligent switch the appropriate sampling frequency for signal sampling, by real-time monitoring and analyzing the measured signal

- **光标测量 Cursor Measurement**

  支持通过移动光标，测量波形上光标点的值。
  Measure the value of cursor point on the waveform by moving the cursor



- **数据存储/调出/回放 Save/Call/Playback Modes**

  支持测量数据和测量配置存储和触发存储，可通过PC软件读取调用；
  支持历史数据及波形在本机或PC软件上进行回放，回放速度可调。
  Save or call measurement data and setting parameters by PC testing software.
  Playback of historical data and waveform with controllabe speed.

- **多通讯接口及智能PC软件 Communication Interface and PC Software**

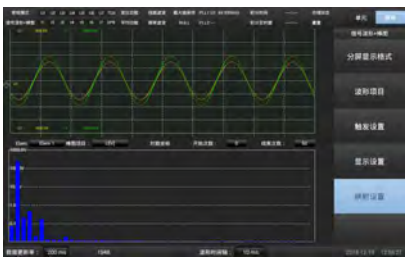
  提供USB、LAN、RS-232、GP-IB等多种通讯接口，以供客户根据实际情况选择。专用应用软件，快速配置测量参数，获取测量数据和波形。
  Provide communication interface includes USB, LAN, RS-232 and GP-IB. Provide special software which can fast test parameters configuration and datum & waveform acquisition, etc.

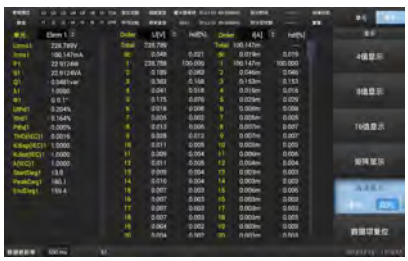
测试功能 Test Functions

- **最多支持8个输入通道，可独立或同步测量 Support up to 8 channels input synergy measurement**

单台仪器最多8个输入单元，可实现输入输出同步测量，测量所有输入单元的电压、电流和频率，任意通道均支持电机模块。每个通道自带FPGA处理器，控制双路ADC对电压电流进行完全同步控制，以保证采样相位的同步性，降低测量电压与电流相位差所引入的误差。采用同步时钟，保证各测量单元实现同步采样。高效的自动补偿技术能在全频段监测与补偿因测量引起的电压与电流相位差，保证有功功率和功率的高精度测量。

8 input channels can realize synchronous measurement of three-phase input and output including voltage, current and frequency. Motor modules are available in each channel. Each channel has its own FPGA which control two ADCs to control the voltage and current synchronously. Also, automatic compensation technology can ensure the high precision measurement of both active power and power.





- **最高500次谐波测量 500 orders harmonic measurement**

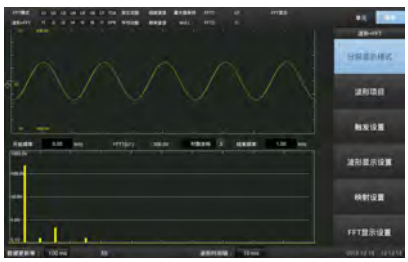
采用锁相环（PLL）同步技术，DC、0.1Hz~5MHz带宽，2MS/s高速采样，在谐波模式下可同时分析两组基波频率0.5Hz~2.6kHz的电压基波、电流基波、谐波成分和总谐波失真因素（THD）。可同时对输入、输出通道进行多谐波测量，最高可测500次谐波。

In harmonic mode, it can simultaneously analyze the fundamental wave and THD of two sets of signals whose fundamental wave frequency is within the range of 0.5Hz~2.6kHz. The bandwidth covers DC, 0.1HZ~5Mhz and the sample rate is 2MS/s. It can realize 500 orders harmonic measurement if correct PLL simultaneous source is chose.

- **FFT谐波分析功能 FFT Harmonic Analysis**

可同时执行2路FFT分析，并可在FFT功能中设置FFT运算点数以决定FFT测量区间，和选择时间窗口以减少频谱能量泄露。

Two FFT harmonics at one time. Can set FFT operation points to determine the measurement interval, and select time window to reduce harmonic energy leakage.



IEC谐波分析功能 IEC Harmonic Analysis

IEC谐波分析功能符合IEC61000-4-7与IEC61000-3-2标准，通过FFT功能实现谐波、间谐波测量，可用于检测家电及办公自动化设备的谐波是否符合IEC标准。

IEC harmonic analysis function meet the standard of IEC61000-3-2 and IEC61000-4-7, provide harmonic and interharmonic measurements that can be used to detect household appliances and office automation equipment.

Delta运算及双矢量图分析 Delta Operation and Double Vector Analysis

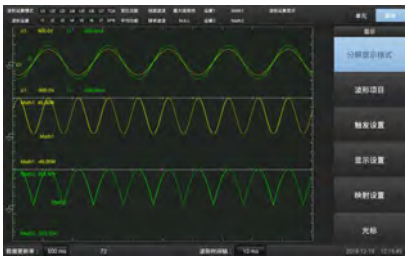
根据已测各单元电压电流瞬时测量值之和及之差，采用Delta运算功能，获得线电压和相电流等。同时显示三相矢量图。并可测量并显示变频器输入三相与输出三的矢量图，对输入、输出各相间的相角关系进行分析，准确评估输入信号对输出信号的角差影响。

As for electrical parameters which can't be measured directly, we can adopts the function of delta with parameters measured, such as line voltage and phase current, etc. Three-phase vector diagram can be used to analyze the phase angles. And can display the three-phase vector diagram of input and output, and analyze the phase angle relationship.

波形运算功能 Waveform Operation

对显示的波形进行加减运算，也可显示经过平方或平均的波形，可用于获取瞬时功率波形、去除运算波形噪声等。

Operate the displayed waveform to obtain the instantaneous power waveform, remove the waveform noice and etc..



周期分析功能 Cycle Analysis

以同步源信号为基准，计算交流输入信号每个周期的电压、电流、功率和其它参数。

Calculate the voltage, current, power and other parameters of each cycle of the AC input signal based on the synchronous source signal.

电压波动与闪变功能Fluctuation and Flicker

电压波动与闪变功能符合IEC61000-3-3和IEC61000-4-15的最新标准，可测得最大相对电压变化dmax、相对电压变化超过阈值的指尖Tmax、短时间闪烁值Pst、长时间闪烁值Plt，并获得瞬时闪烁视感IFS和累积概率函数CPF。

Can get the dmax, Tmax, Pst, Plt, IFS, CPF and other parameters relate to voltage fluctuation and flicker meeting the latest standards of IEC61000-3-3 and IEC61000-4-15.

电机测试功能 Motor test function

使用电机测量功能，可直测电机的转速、扭矩及机械功率。通过设定电机极数，可计算电机的电相角、同步速度和滑差；并且可利用本仪器测得的有功功率、频率和电机输出，计算电机效率和总效率。

Can get the speed, torque, mechanical power, electric phase angle, synchronous speed, slip and other parameters of the motor. In addition, the motor efficiency and total efficieny can be calculated.

符合IEEE-1459功率算法 IEEE-1459 power algorithm function

具备IEEE–1459功率算法功能，计算视在功率、功率因数等表征量，呈现系统的真实状态，为非正弦系统的分析，提供量化参考值。

The apparent power, power factor and other parameters are calculated from IEEE–1459 standard to present the real state of the system and provide quantitative reference value for the analysis of Non–sinusoidal System.

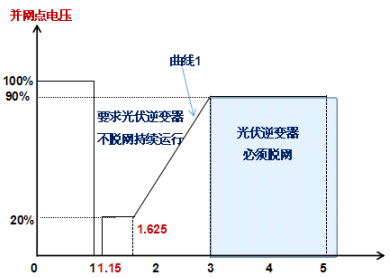
最大功率点跟踪及低电压穿越测试功能 MPPT/LVRT analysis function

在光伏发电中，执行MPPT控制可以有效利用光伏电池产生的电压，以求收获的功率最大化。瞬时峰值功率功能追踪功率正峰值与负峰值及其对应的电压与电流。

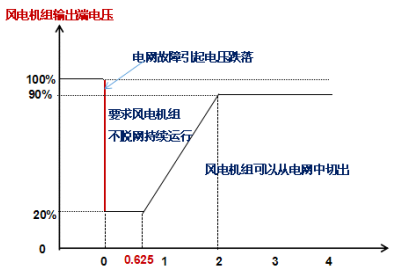
当电网发生故障导致并网点电压跌落时，所有连接的光伏/风电并网逆变器都应该在一定时间内保持与电网的连接，向电网输出无功功率，尽力维持电网电压，避免电网持续跌落造成电网供电瘫痪。因此，必须对逆变器进行低电压穿越（LVRT：Low-Voltage Ride Through）测试，检验其能否在并网点电压跌落时保持与电网持续连接。

In photovoltaic power generation, MPPT control can effectively utilize the voltage generated by photovoltaic cells to maximize the harvested power. Instantaneous peak power function can track positive and negative peaks of power and their voltages and currents.

When the fault occurs and the grid voltage drops, all photovoltaic/wind power inverters should keep connecting to the grid for a certain time to maintain the normal operation of the grid. So the LVRT analysis of inverters is necessary on the base of requirement of standards.



GB/T 19964–2012光伏行业低电压穿越测试要求



GB/T 19963–2011风电换流器低电压穿越测试要求

多种积分功能 Multiple integration function

可以测量电网的能源买卖或电池充放电。通过功率积分功能可以对正负瞬时值进行积分运算。当一个输入信号开始跌出预计的量程时，此功能可以自动调整量程，继续执行测量值的积分运算。支持手动积分、标准积分、连续（重复）积分、实时标准积分和实时连续（重复）积分，积分时间可设定。

Support multiple integration including manual, standard, continuous, real–time standard and real–time continuous, the integration time can be preset.

变比功能 Scaling function

可使用电压互感器（PT）、电流互感器（CT）或电压输出型电流传感器扩展量程，变比功能将测量结果直接换算成真实值显示。

Users can use the voltage transformer(PT), current transformer(CT), or voltage output type current sensor to extend the measurement range.

平均功能 Averaging function

当因被测信号不稳定而读数困难时，可使用平均（AVG）功能测量值进行平均运算后再显示输出。

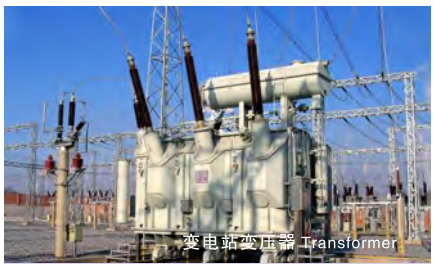
Users can use the averaging (AVG) function due to the instability of signal.

广泛应用于各行业能效评估

Widely used for efficiency evaluation of all industries


光伏风力 Photovoltaic and wind energy


逆变器 Inverter


变电站变压器 Transformer


LED灯 LED lamps


变频器
Variable-frequency Drive


电机
Electric Machinery


家用电器 Domestic Appliance


开关电源
SMPS


驱动电源
Driving power supply

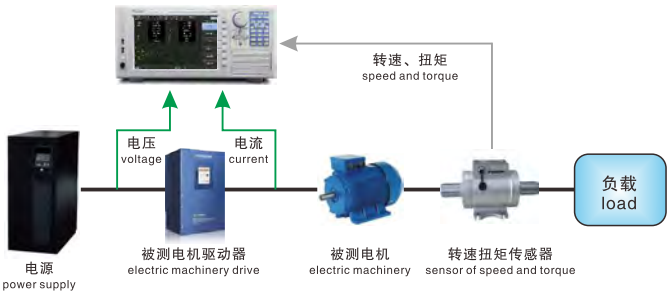

新能源汽车、充电桩 EV and EV charger

变频器、电机效率评估 Efficiency evaluation of inverter and electric machinery

PF8000谐波测量功能高达500次，两组PLL源同时测量两组输入信号谐波，8个通道同时测量，通过测量变频器输入输出的电功率和机械功率，可准确评估变频器的效率、电机驱动系统电能与机械能之间的转换效率。

本仪器可接受转速传感器及扭矩仪的模拟（直流电压）信号或脉冲信号；可设置电机级数计算电机同步速度与滑差；可使用有功功率、频率及电机输出计算电机效率及总效率。

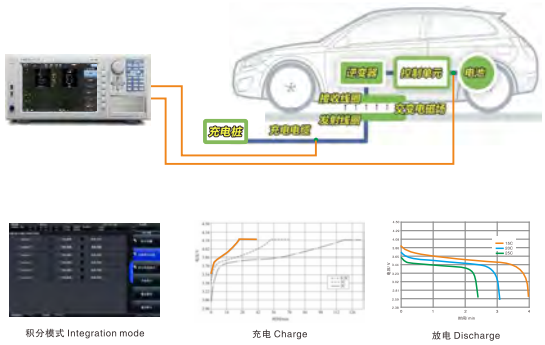
The harmonic measurement times of PF8000 is up to 500, two PLL sources work in the meantime as well as six input channels. The inverter efficiency and conversion efficiency between electrical energy and mechanical energy can be precisely evaluated by the input and output electrical energy and mechanical energy beforehand.



新能源汽车及充电桩性能评估 Electric vehicle and EV charger performance evaluation

电机驱动系统是电动汽车的核心，主要包括动力电池、变频器和驱动电机。以PF功率分析仪为核心搭建的电动汽车测试平台及充电桩测试系统，可对电动汽车电力驱动系统及充电机进行精确的测量和评估。

The motor drive system is the core of the electric vehicle, which mainly includes the power battery, the frequency converter and the driving motor. The electric vehicle testing platform, which is built on the core of the PF power analyzer, can accurately evaluate the electric drive system and the charger of the electric vehicle.



开关电源与UPS电源性能测试 SMPS and UPS performance evaluation

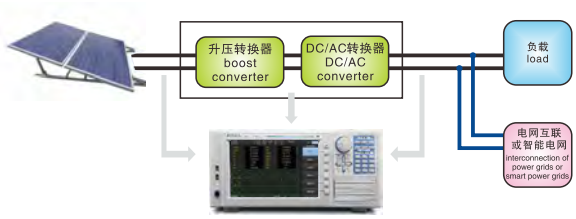
开关电源与UPS电源应用非常广泛。PF8000拥有0.01%功率测量精度、5MHz带宽及丰富的谐波测量功能，能准确测量电源的输出电压、电流、功率、谐波及转换效率等参数，也可满足电源待机功耗的测试需求。

SMPS and UPS are widely used and the power measurement accuracy of PF8000 is 0.01%, besides the bandwidth is 5MHz and there are abundant harmonic measurement functions which can not only precisely measure parameters including output voltage, current, power, harmonic and conversion efficiency, etc, butalso the standby power consumption of power supply.

光伏和风力发电设备转换效率测量 The measurement of photovoltaic and wind energy generating devices conversion efficiency

来自光伏发电和风力发电的可再生能源通过升压转换器和DC/AC转换器由直流电转换成交流电。PF8000能够提供最多8通道测量单元，可以测量每个转换器输入和输出的电压、电流、功率和频率，以及转换效率和充电效率，并具备最大功率点跟踪（MPPT）和低电压穿越（LVRT）测量功能。

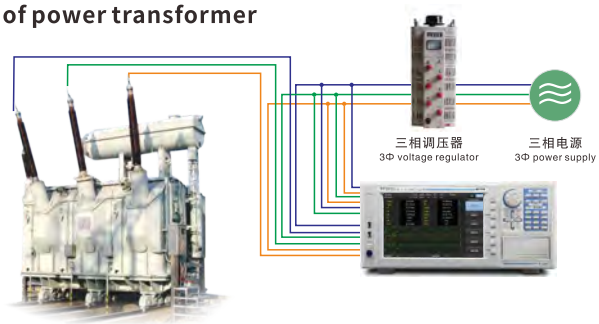
The DC electric power came from photo voltaic and wind energy can be converted to AC electric power by boost converter and DC/AC converter. There are 8 measurement channels of PF8000 which can measurement parameters of each converter like voltage, current, power, frequency both before and after the conversion. Also MPPT and LVRT test are supported.



电力变压器的高精度测量 The high accuracy measurement of power transformer

低功率因数下的高精度测量，满足变压器负载测试要求，准确评估变压器的损耗及其他参数。

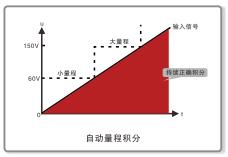
High accuracy measurement with low PF which satisfies the requirement of transformer load test and can precisely evaluate the loss as well as other parameters of transformer.



家用电器功耗准确测量 The accuracy measurement of power transformer

积分模式下自动量程功能，能准确评估家用电器各个运行状态下的功耗。
宽范围电压/电流输入，支持各种功率家电的功耗能量。
支持一台设备8个测量通道，可用于家电产品产线功率测量。
Auto range function in intergration mode, and evaluate the power consumption of domestic appliance under any running status.
Wide input range of voltage/current, and support for power consumption measurement of various powers.
One device with 8 measurement channels with which can be used in power evaluation of domestic appliance production line.





照明系统功率检测分析 Power detection and analysis in Lighting appliance

可精确测量LED灯电压、电流、功率和总谐波失真（THD）等。
Accuracy measurement of voltage, current, power, THD and other relevant parameters of LEDs.

技术参数 Specifications

型 号 Model	PF8000	PF6000	PF3000
输入单元	Element1~Element8可选配， 任意单元均可选配电机测试单元		Element1~Element4可选配，最多4+1通道
测量量程	电压： CF3: 15/30/60/100/150/300/600/1000/1500 [V] CF6: 7.5/15/30/50/75/150/300/500/750 [V]		电压： CF3: 1.5/3/6/10/15/30/60/100/150/300/600/1000[V] CF6: 0.75/1.5/3/5/7.5/15/30/50/75/150/300/500[V]
	电流：直接输入5A输入单元：(电流量程可定制) CF3: 10m/20m/50m/100m/200m/500m/1/2/5 [A] CF6: 5m/10m/25m/50m/100m/250m/500m/1/ 2.5 [A] 外部电流传感器输入： CF3: 50m/100m/200m/500m/1/ 2 / 5 / 10 [V] CF6: 25m/50m/100m/250m/500m/1/2.5/ 5 [V]		
	频率：DC，0.1Hz~1MHz， 带宽：5MHz（-3dB,典型值）		频率：DC，0.1Hz~500kHz， 带宽：5MHz（-3dB,典型值）
量程切换	固定/自动量程可选；各输入单元可独立设置量程		
采样率	2Ms/s		1Ms/s
基本精度	0.01%rdg+0.03%rng	0.03%rdg+0.05%rng	0.05%rdg+0.05%rng
瞬时最大允许输入值(≤1s)	电压：4.5Vpk和3kVrms中取较小值 电流：5A：15Apk和10Arms中取较小值 50A：150Apk和80Arms中取较小值		电压：3kVpk和1.5kVrms中取较小值 电流：5A：10Apk和7Arms中取较小值 20A：40Apk和25Arms中取较小值
连续最大允许输入值	电压：3kVpk和2kVrms中取较小值 电流：5A：10Apk和7Arms中取较小值 50A：100Apk和60Arms中取较小值		电压：2kVpk或1.1kVrms中取较小值 电流：5A：10Apk和5.5Arms中取较小值 20A：40Apk和22Arms中取较小值
滤波器	线路滤波器：OFF，500Hz，5.5kHz、50kHz、 0.1kHz~100kHz步进为0.1Hz 频率滤波器：OFF、ON		线路滤波器：OFF、500Hz、5kHz、50kHz 频率滤波器：OFF、100Hz、1kHz
A/D转换器	分辨率：18bit 采样周期：最高100ns	分辨率：16bit 采样周期：约为500ns	
数据更新率	10ms、50ms、100ms、200ms、500ms、1s、2s、5s、 10s或20s		50ms、100ms、200ms、500ms、1s、2s、5s、10s或 20s