ES4000 Power Quality Analyzer



Ⅰ. Characteristic

ES4000 power quality analyzer is a three-phase, multi-functional, intelligent and simple man-machine operation comprehensive test instrument specially developed by our company for field testing. It has the characteristics of easy to use, large LCD color screen display, high resolution, Chinese and English bilingual operation interface, box-type structure shell and so on. It can measure 4 currents (ABC three-phase and neutral current), 4 voltages (ABC three-phase voltage and neutral-to-ground voltage), the peak value of current and voltage, the maximum and minimum values within a period of time, and the three-phase voltage. Balance, short-term voltage flicker, transformer K factor, active power, reactive power, apparent power, power factor, displacement power factor, active energy, reactive energy, apparent energy, harmonic ratio, total harmonic distortion Display the real-time waveform of current and voltage, phasor diagram, harmonic ratio bar chart; dynamically capture the instantaneous change of voltage and current, monitor starting current, monitor various power parameters and generate alarm list, record test data for a long time and generate trend curve functions such as graphs.

In the current power application, the faults caused by more and more large-scale electrical equipment and more and more complex power grid systems are becoming more and more complex, and it is more and more difficult to troubleshoot. The requirements are also getting higher and higher, so we provide this kind of measurement and analysis instrument that can troubleshoot complex power systems more quickly and accurately, and monitor and maintain power quality parameters more comprehensively and systematically.

ES4000 power quality analyzer adopts DSP+ARM dual-processor architecture, DSP is responsible for data acquisition and algorithm processing, ARM is responsible for communication protocol and human-machine interface processing; analog signal acquisition uses 2 pieces of ADI company's 4-channel synchronization with a resolution of 16 bits Sampling, to achieve the highest sampling rate of 1MSPS, to ensure the accuracy and information integrity of the channel, to ensure that any transient changes in the power grid will not be missed, and to detect transient waveforms, swells and sags, and instantaneous interruptions. Accurate; DSP operating frequency is above 200MHz, which can monitor the power grid in time and dynamically adjust the

sampling frequency to achieve synchronization of power frequency and sampling frequency; 5.6-inch LCD color screen display with a resolution of 640dots × 480dots, with different colors to display the parameters of each phase, Waveform diagrams, phasor diagrams, and harmonic ratio diagrams enable users to understand the state of power grid parameters more efficiently and intuitively. The built-in flash memory can simultaneously store 60 sets of screenshots, 150 sets of transient voltage/current capture waveforms, 12800 sets of alarm logs, and the startup current detection mode can continuously capture 100s of startup current waveforms. The built-in 2G memory card is used to store long-term trend curve records, and records 20 power parameters at the same time (can be selected according to needs).

Power quality analyzer, also known as **intelligent three-phase power quality analyzer**, **multi-functional power quality analyzer**, **three-phase power quality analyzer**, etc., is suitable for electric power, petrochemical, metallurgy, railway, industrial and mining enterprises, scientific research institutions, measurement departments, etc. . It is especially suitable for comprehensive analysis and diagnosis of all voltage, current, power, electrical energy, harmonics, phase and other electrical parameters.

Ⅱ. Basic Function Introduction

1. Test function：

Real-time display of waveforms (4 channels of voltage/4 channels of current)
Voltage and Current True RMS
Voltage DC component
Current and voltage peaks
Current and voltage max/min over time
Phasor Diagram Display
Measurement of harmonics of each phase, up to the 50th harmonic
Bar graph showing harmonic ratio of current and voltage of each phase
Calculation of Total Harmonic Distortion (THD)
Active/reactive/apparent power value and total value of each phase
Active/reactive/apparent energy value and total value of each phase
Transformer K Factor Calculation
Calculation of COSφ Displacement Power Factor (DPF) and Power Factor (PF)
flicker calculation
Three-phase unbalance calculation (voltage and current)

2. Capture and monitor functions:

It can capture and detect the instantaneous changes of grid voltage and current parameters, including voltage and current fluctuations, voltage and current swells, dips, short-term interruptions, transient overvoltages, inrush currents, and instantaneous current and voltage distortions. The instrument can store up to 150 sets of transient waveforms at the same time.

3. Start current monitoring:

It can monitor the inrush current of the line and the starting current when the electrical equipment is started, which is helpful for the correct design of the installed capacity. It can display the rising/falling curve of the effective value of the starting process, the envelope curve of the starting current, and the 4-way current and 4-way voltage waveforms. After triggering, it can record about 100s, and store all current and voltage instantaneous values and waveform curves of each cycle within 100s.

4. Record storage function:

All test parameters of basic test functions (Urms, Uthd, Ucf, Uunb, Hz, Vrms, Vthd, Vcf, Vunb, PST, Arms, Athd, Acf, Aunb, KF, W, VAR, VA, PF, COSφ, TANφ), the 50th harmonic of voltage, the 50th harmonic of current, a total of 123 parameters are recorded, and a trend curve graph is generated, which can record data for a long time as needed. (Select 20 parameters at the same time and record once every 5 seconds, about 300 days can be recorded)

5. Alarm function:

Limits can be set for the selected parameters as required, monitoring whether they exceed the limits, and alarm logs are generated when the limits are exceeded, such as voltage overvoltage, current overcurrent, unbalance exceeding the limit, a certain harmonic ratio exceeding the limit, frequency Over limit, active power over limit, total harmonic distortion over limit, etc., up to 40 groups of alarm monitoring parameters can be set, and each group can be set with different monitoring parameters (including 50 harmonics, a total of 123 different parameters) and limit value to set the minimum time for exceeding the limit. Up to 12800 groups of alarm log records can be stored.

6. Screenshot function:

On any test page, you can take a screenshot to store the current screen, and automatically save the recording time and the test mode you are in. Such as saving current and voltage waves, harmonic histograms, phasor diagrams, etc. Up to 60 groups of screenshots can be saved at the same time

7. Communication function:

The monitoring software can communicate with the computer through USB, and the monitoring software can display the waveform of the power quality analysis test in real time, and can read the detected and captured transient waveform, trend chart record, alarm list, test screenshots, etc.

8. Setting function:

Users can set the time and date, set the contrast and brightness of the display screen, and set the corresponding color of each phase line in the instrument;

The wiring method and grid type of the instrument can be set;

Different current clamps and different voltage test ratios can be selected;

Chinese menu or English menu can be selected.

9. Chinese/English help menu:

At each stage of the operation, you can press the "Help" button at any time to obtain relevant help information.

Ⅲ. Technical Specification

1. Baseline and working conditions

Amount of influence	Test items	Baseline conditions	working conditions
Ambient temperature	all parameters	（23±2）℃	-10℃～40℃
Relative humidity	all parameters	40%～60%	<80%
Phase voltage	all parameters	(100±1%)V	1.0V～1000V
Line voltage	True RMS value of line voltage	(200±1%)V	1.0V～2000V
Current	Measure the current true rms value	(5±1%)A	10mA～6000A
Grid frequency	all parameters	50Hz±0.1Hz	40Hz～70Hz
Phase shift	Active power and active energy	Cosϕ=1	Cosϕ:0.2～1.0
	Measuring reactive power and reactive energy	Sinϕ=1	Sinϕ:0.2～1.0
Harmonic	all parameters	<0.1%	0.0%～100%
Voltage unbalance	all parameters	<10%	0.0%～100%
Instrument operating voltage	all parameters	DC9.8V±0.1V	DC9.5V～10.5V
External electric	all parameters	Should be avoid	

and magnetic fields		
Measured lead position	Measure parameters related to current	The conductor under test is at the approximate geometric center of the jaw

2. General Specifications

Power supply	Rechargeable lithium battery pack 9.6V, external charger
Battery level indicator	battery symbol  grids and 5 grids to display the power, when the battery power is too low, it will automatically shut down after 1 minute
Power consumption	The current consumption is 490mA, and the battery works continuously for 10 hours
Display mode	LCD color screen, 640dots×480dots, 5.6 inches, display area 116mm×88mm
Instrument size	Length, width and thickness: 277.2mm×227.5mm×153 mm
Jaw size	FR008 pointed small current clamp: 7.5mm×13mm (model selection) FR020 round mouth current clamp: 20mm×20mm (type selection) FR050 round mouth current clamp: 50mm×50mm (model selection)
Number of channels	4-way voltage, 4-way current
Line voltage	1.0V～2000V
Phase voltage	1.0V～1000V
Current	FR008 Current clamp 10mA～10.0A FR020 Current clamp 0.10A～100A FR050 Current Clamp 1.0A～1000A Rogowski coil 10A～6000A Optional transformer, instrument port input current 1mA ~ 500mA
Frequency	40Hz～70Hz
Electricity parameters	W，VA，var，PF，DPF，cosϕ，tanϕ
Electric energy parameters	Wh，varh，Vah
Harmonic	Yes, 0 to 50 times
Total harmonic distortion	Yes, 0 to 50 times, each phase
Expert mode	Have
Transient record group number	150 groups
Voltage flicker	Have
Start current mode	Yes, 100 seconds
Three-phase unbalance	Have
Record	300 days (record 20 parameters at the same time, record 1 point every 5 seconds)
Minimum& Maximum record value	Yes, the maximum and minimum values within a period of time can be measured
Alarm	40 different types of parameter options, 12800 groups of alarm logs
Peak	Have
Phasor Diagram Display	automatic

Screenshot capacity	60
Menu language	Chinese English
Communication Interface	USB
Automatic shut-down	In the alarm/trend graph record/transient capture mode (waiting or in progress), the instrument does not automatically shut down
	In other test modes, if there is no key operation within 15 minutes, it will automatically shut down after 1 minute.
Backlight function	Yes, suitable for dark places and night use
Instrument quality	Host: 2.41Kg (with battery)
	FR008 pointed small current clamp: 168g×4
	FR020 round mouth current clamp: 252g×4
	FR050 round mouth current clamp: 463g×4
	FR300R Rogowski coil integrator: 280g×4
	Test lead and power adapter: 800g
	Total mass: about 10.8Kg (including packaging)
Voltage test lead length	3m
Current clamp wire length	2m
Working temperature and humidity	-10℃～40℃; below 80%Rh
Storage temperature and humidity	-10℃～60℃; below 70%Rh
Input resistance	Test voltage input impedance: 1MΩ
Pressure resistance	Withstand 3700V/50Hz sine wave AC voltage between instrument circuit and enclosure for 1 minute
Insulation	Between instrument line and sheath shell ≥10MΩ
Structure	Double insulation with insulating anti-vibration jacket
Suitable for safety regulations	IEC 61010 1000V Cat III / 600V CAT IV, IEC61010-031, IEC61326, Pollution Degree 2

3. Instrument Accuracy Description (Excluding Current Sensors)

The data below are presented under reference conditions and based on an ideal current sensor (perfectly linear and with no phase shift).

Measurement	Measuring range	display resolution	within the reference range maximum error
frequency	40Hz～70Hz	0.01Hz	±(0.03)Hz
Phase Voltage True RMS	1.0V～1000V	Minimum resolution 0.1V	±(0.5%+5dgt)
Line Voltage True RMS	1.0V～2000V	Minimum resolution 0.1V	±(0.5%+5dgt)
DC voltage	1.0V～1000V	Minimum resolution 0.1V	±(1.0%+5dgt)
Current RMS	10mA～6000A	Minimum resolution 1 mA	±(0.5%+5dgt)
Phase voltage peak	1.0V～1414V	Minimum resolution 0.	±(1.0%+5dgt)

		1V	
Line voltage peak	1.0V～2828V	Minimum resolution 0. 1V	±(1.0%+5dgt)
current peak	10mA～8484A	Minimum resolution 1 mA	±(1.0%+5dgt)
crest factor	1.00～3.99	0.01	±(1%+2dgt)
	4.00～9.99	0.01	±(5%+2dgt)
Active power	0.000W～9999.9kW	minimum resolution 0.001W	±(1%+3dgt) Cosϕ≥0.8
			±(1.5%+10dgt) 0.2≤Cosϕ<0.8
reactive power Inductive & Capacitive	0.000VAR～ 9999.9kVAR	minimum resolution 0.001VAR	±(1%+3dgt) Sinϕ≥0.5
			±(1.5%+10dgt) 0.2≤Sinϕ<0.5
inspecting power	0.000VA～ 9999.9kVA	minimum resolution 0. 001VA	±(1+3dgt %)
power factor	-1.000～1.000	0.001	±(1.5%+3dgt) Cosϕ≥0.5
			±(1.5%+10dgt) 0.2≤Cosϕ<0.5
Active energy	0.000Wh～ 9999.9MWh	minimum resolution 0.001Wh	±(1%+3dgt) Cosϕ≥0.8
			±(1.5%+10dgt) 0.2≤Cosϕ<0.8
reactive energy Inductive & Capacitive	0.000VARh～ 9999.9MVARh	minimum resolution 0.001VARh	±(1%+3dgt) Sinϕ≥0.5
			±(1.5%+10dgt) 0.2≤Sinϕ<0.5
apparent energy	0.000VAh～ 9999.9MVAh	minimum resolution 0.001VAh	±(1%+3dgt)
Phase angle	-179°～180°	1°	±(2°)
Tanϕ (VA≥50VA)	-32.76～32.76	minimum resolution 0. 001	ϕ:±(1°)
Displacement power factor (DPF)	-1.000～1.000	0.001	ϕ:±(1°)
Harmonic ratio Contains 1 to 50 ti mes (Vrms>50V)	0.0 %～99.9 %	0.1 %	±(1%+5dgt)
Harmonic angle (Vrms>50V)	-179°～180°	1°	±(3°) Harmonic 1～25th
			±(10°) Harmonic 26～50th
total harmonic ratio (THD or THD-F)≤50	0.0 %～99.9 %	0.1 %	±(1%+5dgt)

Distortion factor (DF or THD-R)≤50	0.0 %～99.9 %	0.1 %	±(1%+10dgt)
Transformer K factor	1.00～99.99	0.01	±(5 %)
Three-phase unbalance	0.0%～100 %	0.1 %	±(1 %)

4. Current clamp characteristics

Current clamp type	Current RMS	Current RMS maximum error	Phase angle ϕ Maximum error
FR008 Current Clamp	10mA～99mA	±(1 % + 3dgt)	±(1.5°),Arms≥20mA
	100mA～10.0A	±(1 % + 3dgt)	±(1°)
FR020 Current Clamp	0.10A～0.99A	±(1 % + 3dgt)	±(1.5°)
	1.00A～100A	±(1 % + 3dgt)	±(1°)
FR050 Current Clamp	1.0A～9.9A	±(2 % + 3dgt)	±(3°)
	10.0A～1000A	±(2 % + 3dgt)	±(2°)
Optional transformer	Instrument input current 1mA～500mA	Selected transformer error ±1 %	Selected transformer error ±(1°)
FR300R Rogowski coil integrator	10A～199A	±(1%+3dgt)	±(3°)
	200A～6000A	±(1%+3dgt)	±(2°)

Ⅳ. Packing List

Host	1 set
Instrument box	1
Current clamp	4 types of 4 each, 16 in total
Test line	5 (yellow, green, red, blue, black 1 each)
Alligator clip	5
Charger	1
USB data cable	1
Software CD	1
Manual, Warranty Card, Certificate of Conformity	1 set

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