User's Guide

数英仪器 Digital Instruments

SA2200 Power Quality Analyzer

Suin Instruments Co.,Ltd. 12/2018

Introduction

SA2200 power quality analyzer adopts DSP＋ARM dual processor hardware platform and embedded operation system (uClinux), which can calculate a large number of electrical parameters and process all data quickly. The device offers extensive and powerful measurements functions to check power distribution system, so it can detect quality of power grid and electrical characteristics rapidly and conveniently. The analyzer has large-screen color LCD display interface, and easy-to-use keyboard.

Main features:

- Waveform real-time display(4 voltages/4 currents)
- Half cycle RMS measurement (voltage and current)
- intuitive operation
- variety of optional current clamps
- Measure DC component
- Measurement of harmonics can be up to 100 times.
- Transient capture
- Vector, Trend, Bar Graph and events table display
- Active power, reactive power, apparent power and energy, shift power factor and true power factor
- Three-phase unbalance (voltage and current)
- Flicker
- Inrush current
- Detection and record of Dips& Swells, Voltage Rapid Change, Interruption.
- Detect according to EN50160 or grid with user-defined limit.
- data storage and screenshots (can be replayed or output to a PC)
- Through the LAN interface PC can keep real-time remote communication with the Analyzer, operate the Analyzer and download measurement data.
- Built-in 32G memory card.
- WIFI communication is supported.

The Analyzer and its accessories

- SA2200 Power Quality Analyzer 1
- CD (PC software + manual) 1
- Voltage Test Leads 5
- Alligator Clips 5
- Power adapter 1
- Power cord 1
- Soft Carry Bag 1
- Hang strap 1

Options

AC Current Transformer

- KLC8C-5A (5A)
- CTC0080 (50A)
- CTC0130 (100A)
- CTC1535 (1000A)

AC Rogowski Coil

- SY-1500A (1500A)
- PY-3000A (3000A)
- SY-6000A (6000A)

AC/DC Current Transformer

- ETCR035AD (1000A)

General Safety Information

The Analyzer is designed and produced according to IEC61010-1 strictly, and complies with CAT III 1000V, CAT IV 600V and pollution degree II. Learn about below safety precautions to avoid personal injury, and damage to the Analyzer or any other products connected to it.

To avoid electrical shock or fire:

- Review the manual before use of the Analyzer and its accessories.
- Read all instructions carefully.
- Avoid working alone.
- Do not operate the Analyzer around explosive gas, vapor or moist environment.
- Use the Analyzer as specified, or the protection provided by the Analyzer might be impaired.
- Use only insulated current probes, test leads and adaptors as supplied with the Analyzer, or indicated as suitable for the Analyzer.
- Keep your fingers behind the finger guard on the probes.
- Before use, inspect the Analyzer, voltage probes, test leads and accessories for mechanical damage and replace when damaged. Look for cracks or missing plastic. Pay special attention to the insulation surrounding the connectors.
- Verify operation of the Analyzer by measuring known voltage.
- Remove all probes, test leads and accessories that are not in use.
- Always connect the power adapter first to the AC outlet before connecting it to the Analyzer.
- Do not touch high voltage: voltage>AC RMS 30V, or DC 60V.
- Use the ground input only to ground the Analyzer and do not apply any voltage.
- Do not apply input voltage above the rating of the Analyzer.
- Only use correct measurement standard category (CAT), rated voltage and current probes, test lead and adapter for measurement.
- Do not apply voltages in excess of the marked ratings of the voltage probes or current clamps.
- Comply with local and national safety standard. In dangerous environment where the live wires are exposed, personal protection equipment such as approved rubber gloves, facial protection and flame-retardant clothing must be used to prevent electric shock and arc discharge damage.
- Pay special attention when connecting or removing flexible current probes: power down the device being tested or put on suitable protection suit.

- Do not insert metal objects into connectors.
- Use only power adapter provided by the Analyzer.

Note: The information in this manual may be slightly modified without further notice. This document may contain technical inaccuracies or typographical errors. This document only guides instrument using, and we will don't guarantee for any form of it.

Chapter 1 Getting started

User could learn the basic operation of the device through this chapter.

1.1 Overview of the Analyzer

①: display area
②: keyboard area
③: charge indicator
④: voltage input terminal
⑤: input terminal of current clamp
⑥: GND input terminal
⑦: power adapter interface
⑧: GPS/BEIDOU receiver interface
⑨: USB-Host interface
⑩: LAN interface

1.2 Function Description of Keys

	**1. Power on/ off function. 2. Mandatory power off: in power on status, press this key for about 10 seconds, the Analyzer will be forced to power off.**
	**Brightness adjustment: Press this button repeatedly to adjust the lightness of the screen.**
	**Function key: specific function based on screen menu bar.**
	**Direction key: can move cursor and zoom waveform** **Entry key: press this key to confirm current select**
	**Oscilloscope shortcut key: fast into the oscilloscope function.**
	**Main menu shortcut key: enter into main menu interface quickly.**
	**Monitor function key: enter into monitor function.**
	**Shortcut key of parameter setting: enter into interface of parameter setting quickly.**
	**Files management key: enter into files management interface.**
	**Save key: in measurement status, press this key to save screenshot and measurement data.**
	**Charge indicator: red: still in charging** **green: charge completely**

In below text, use【*】to represent corresponding key.

Charge the battery and prepare for use

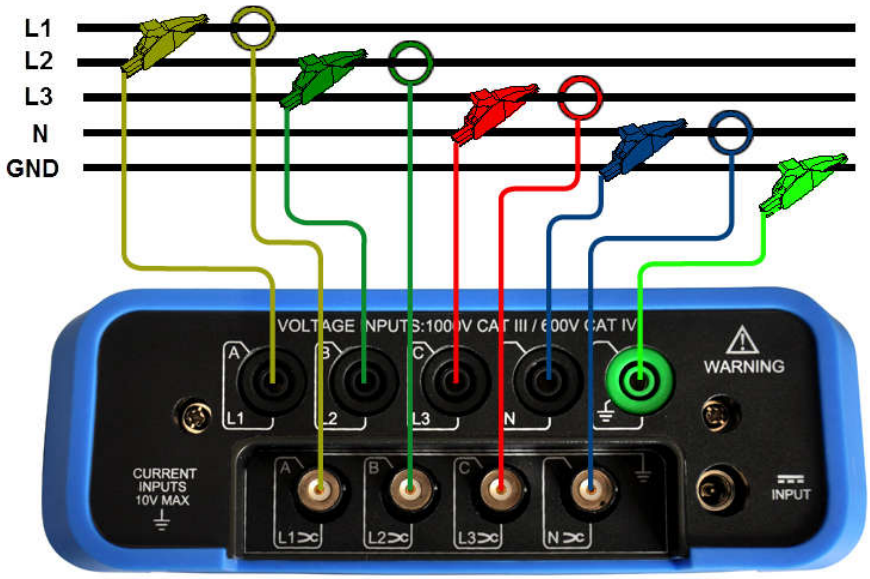
At delivery, the built in chargeable battery may be empty and it is recommend to charge it before use. A full charge for the first time takes at least 6 hours. When the charging indicator

color changing from red to green, it reminds user the battery is fully charged. The Analyzer automatically cuts off charging when the battery is fully charged. Before use, check that the adapter voltage and frequency range match the local line power range. To prevent decrease of batter capacity, charge it at least twice a year.

Icon in state indicator bar

	Battery capacity indicator, green indicates enough, red indicates low.
	Charge indicator.
	Charge Complete.
	USB flash disk has connected.
	Wired network has connected.
	Wireless network has connected.

1.3 Input Connections



The Analyzer has 4 BNC-inputs for current clamps and 5 banana-inputs for voltages. For a 3-phase system, make the connections as above picture show.

First put the current clamps around the conductors of phase **L1/A, L2/B, L3/C** and **N.**

The clamps are marked with an arrow indicating the correct signal polarity.

Next make the voltage connections: start with **GND** and then succession **N**, **L1/A**, **L2/B** and **L3/C**. For correct measuring results, always connect the Ground input.

For single phase measurements, please use current input terminal **L1/A**, **GND**, **N** and voltage inputs terminal **L1/A**. **Voltage phase L1/A is the reference phase for all measurement.**

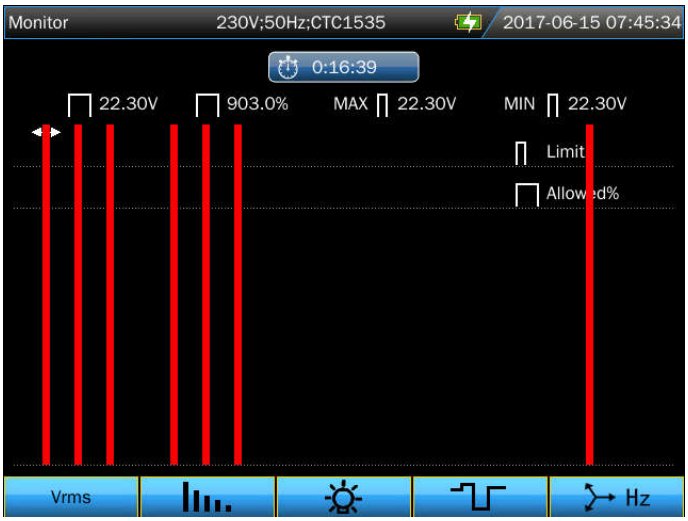
1.4 Rapid Overview of Measuring Modes

✧ **MENU**

Below measurements are available with 【**MENU**】 key:

✧ **MONITOR**

Press 【**MONITOR**】key can enter into monitor function, can monitor parameters of RMS, harmonic, flick, Dips&Swell, interruption, unbalance and frequency. The bar graph screen is as blow picture shown:



1.5 Screen and Function Keys

The Analyzer has different screen types to present measuring results.

✧ **Table screen**

Table screen gives an instantaneous overview of important numerical measuring values under **Volts/Amps/Hertz** mode.

Screen information:

① The screen header shows current measurement mode, some information will display in scroll.

② Table in the middle of the screen display the measurement parameters and value, which depends on measurement mode, phase number and wiring configuration.

③ Function option lies in the bottom of the screen, corresponding to 【**F1**】~ 【**F5**】key.

Function keys instruction:

【**F4**】: Open Trend screen.

【**F5**】: Switch between RUN and HOLD.

✧ Trend screen

Trend screen shows the measurement value which is changing along with time change. Horizontal axis stands for the time, the Trend chart is forming from screen's right to left gradually.

Function key instruction:

【F1】:Switch to the displaying parameters
【F4】:Return to table screen.
【F5】:Switch between RUN and HOLD.

Chapter 2 Basic Operations

2.1 Tilt Stand and Hang Strap

The tilt stand allows user to view the screen at an angle when place device on a flat surface. A hang strap is supplied with the Analyzer as below picture show:

2.2 Power on/off

Press the Power key and a single beep can be heard, then the screen shows initial interface. Press the Power key in power on state, the Analyzer will prompt user whether power off the device, the device will power off after your confirm.

Mandatory power off: The analyzer will be forced to power off if user press Power key about 10s in power on status.

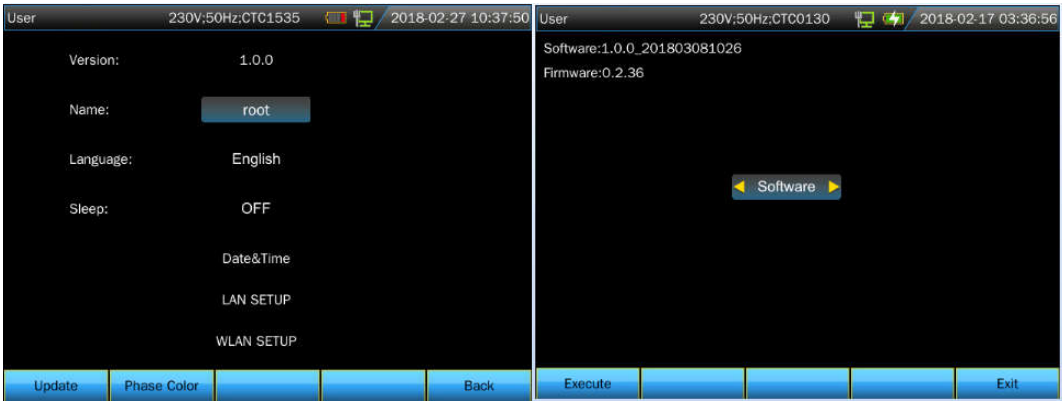
2.3 Display Brightness

The Analyzer provides 4 degrees of brightness, which is adjustable by pressing the brightness adjustment key. Low brightness is suggested to save the battery power when powered by the battery.

2.4 Update Firmware

If any defective was found during the use of the Analyzer, please contact the customer service representative to get the update files.

Place the update files under the root directory of U disk, then insert to the Analyzer. After the U-disk is recognized by device, enter into user configuration interface from main menu, press 【F1】to enter into update interface.



There are tree types of update file including Software, Firmware and System. Select you wanted files to update, the Analyzer will give prompt after finishing update, then plug out the U disk, power off the Analyzer then power on to complete the update.

Error codes in right of below table are possible to pop up during update process, coming with the solution in the left area.

Error code	Solution
"ErrCode: 0000 XXXX"	May be Flash damage, please replace Flash.
"ErrCode: 0001 XXXX"	SPI FLASH model are not supported, please check the update file.
"ErrCode: 0003"	Error Verify of firmware data, please check the update file.
"ErrCode: 0005 XXXX"	Abnormal status, please feedback XXXX to manufacturer.
"ErrCode: 0010"	Serious overtime. Don't outage and power off. Please firmware update again.
"ErrCode: 0011"	Please try to firmware update again.
XXXX means the detail error message,please feedback to manufacturer.	

2.5 Input Connections

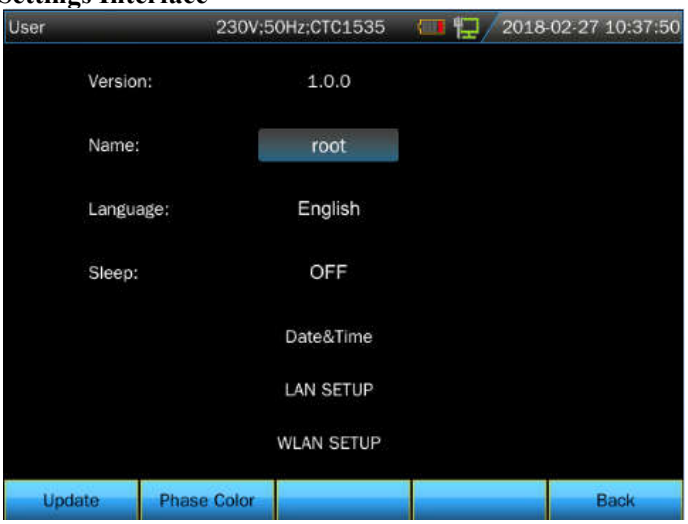
Check that the Analyzer setup meets the characteristics of the system under test. This concerns: wiring configuration, nominal frequency, nominal voltage, current clamp ratio and range.

The Analyzer has 4 BNC inputs for current clamps and 5 banana-inputs for voltages. De-energize power systems before making connections whenever possible, always use proper personal safety equipment.

For the connection of 3-phase system, please refer to chapter 1.3.

2.6 User Settings

✧ **User Settings Interface**



The user name, language, sleep time, system time, and network setting could be set in this interface by keys of【▲】【▼】【◄】【►】and【ENTER】keys.

Sleep time: if there is no any key's operation after setting sleep time and when the setting time goes off, the brightness of device will be reduced at lowest level automatically, which will extend the device working time when only battery-powered. Once operate device again, the brightness can resume to original setting.

✧ **Phase colors**

Press 【F2】to set phase color according to local country standard for phase color definition. Different phase, different color, to represent measurement value of each phase. The default phase color settings of L1/A, L2/B, L3/C, N and GND separately are yellow, green, red, blue and green.

2.7 Setup Analyzer

✧ **Setting interface**

After power on, current setting will be displayed on the top of the screen. Check if the Date and Time of the system clock are correct. Also the wiring configuration must match the configuration of the power system to be checked. The **【SETUP】** key accesses menus to view and change Analyzer settings.

The settings are grouped in four functional sections which are explained respectively as below:

【F1】: set wiring configuration. **【F2】**: set nominal frequency.
【F3】: set nominal voltage. **【F4】**: set clamp type.
【F5】: to set monitor limit value: recall, save and define the limit value required in monitoring the power quality.

Monitor limits

The Analyzer presets a set of limits according to EN50160 standard, and reserves two user-defined options, which the users can modify under EN50160 standard set of limits and save as user-defined set of limits.

Limits	**Adjustments**
Voltage	2 probability percentages (100% and adjustable): each with adjustable upper and lower limits.
Harmonics	For 2-25 harmonics and THD 2 probability percentages (100% and adjustable): each with adjustable upper limit.
Flicker	Weighing curve (lamp type). 2 probability percentages (100% and adjustable): adjustable percentage with adjustable upper limit.
Dips (*)	Threshold, hysteresis, allowed number of week.

Swells (*)	Threshold, hysteresis, allowed number of week.
Interruption (*)	Threshold, hysteresis, allowed number of week.
Rapid Voltage Change (*)	Voltage tolerance, steady time, minimum step, minimum rate, allowed number of week.
Unbalance	2 probability percentages (100% and adjustable): adjustable percentage with adjustable upper limit.
Frequency	2 probability percentages (100% and adjustable): each with adjustable upper and lower limits.

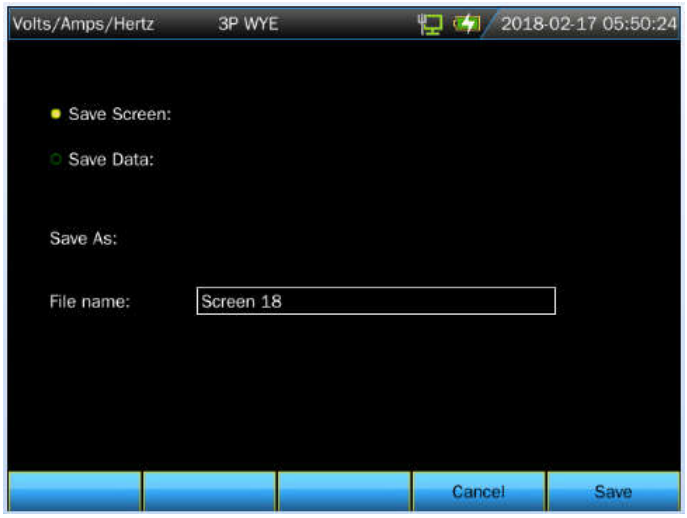
(*): Setups are also valid for measuring mode.

2.8 Using Memory and PC

The Analyzer can save screens and data into its memory, and the users can view, delete and copy them. The Analyzer can also be connected with a PC, through which the remote control of the Analyzer is available.

✧ **SAVE interface**

Press 【**SAVE**】key can save current screenshot or measurement data.



Use 【▲】【▼】keys to select the type of the saved files.

Use 【**ENTER**】key to enter into edit interface to edit the file name.

Press 【**F5** 】to complete the saving, and return to the original interface.

✧ **MEMORY interface**

The MEMORY button accesses to the save list interface, which shows the save time, name and type of saved files. Press【▲】【▼】 keys to select specified files. After accessing to the save interface, insert a U disk and wait for a few seconds, then U disk icon display on the state bar, then "TO USB" characters become lighted, press 【F2】 to copy the current selected flies to the U disk, then there is a progress bar to prompt the copy process,. When finish the copy, plug off the U disk then inset it to the PC to view.

Function keys instruction:

【F2】:Copy file to U disk after inserting a U disk and the characters of the key become lighted.

【F3】: View selected saved file.

【F4】: Delete selected saved file.

【F5】: Return to previous interface.

✧ **Using PC software**

Installation requirement of PQA_Setup

CPU: processor over 1GHz.

Memory: over 2G.

Displayer: VGA or higher resolution monitor (resolution 1024×768 or above is recommended).

Hard disk: over 100M.

Network card: 10M/100M network card.

Operating system: Windows Vista or high version.

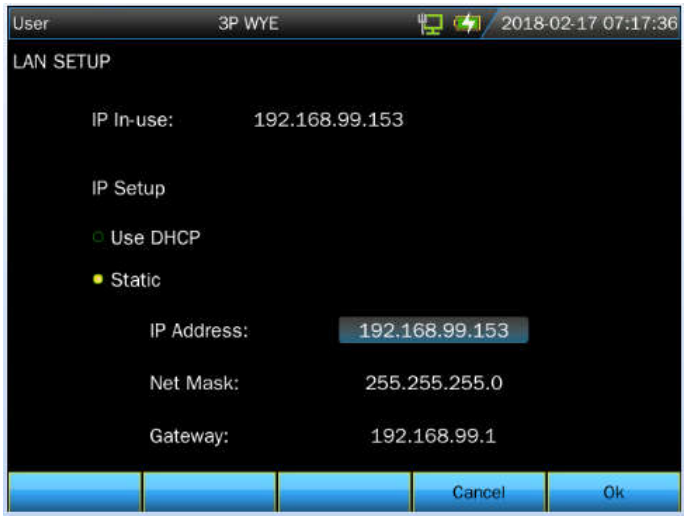
Microsoft Office version: Office 2007 or above.

Network Settings

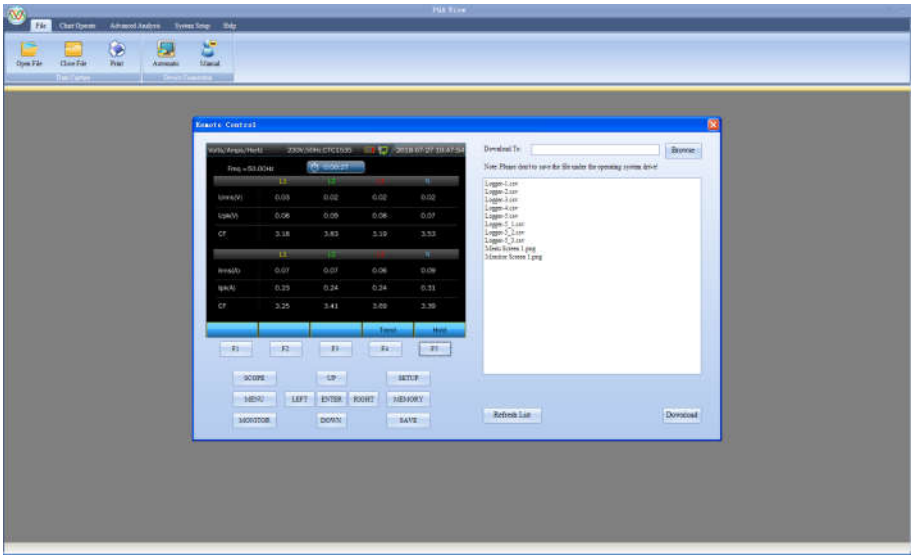
The LAN interface is configured to realize communication between device and PC.

The Analyzer is equipped with a LAN interface for communication with a PC. With supplied PC software, user can remote control analyzer, download saved files, analyze the data and create report on PC. In additional, user can also use the PC software to view the data and screenshot copied from a U disk.

Select 【LAN SETUP】in 【User】option as below picture shown:

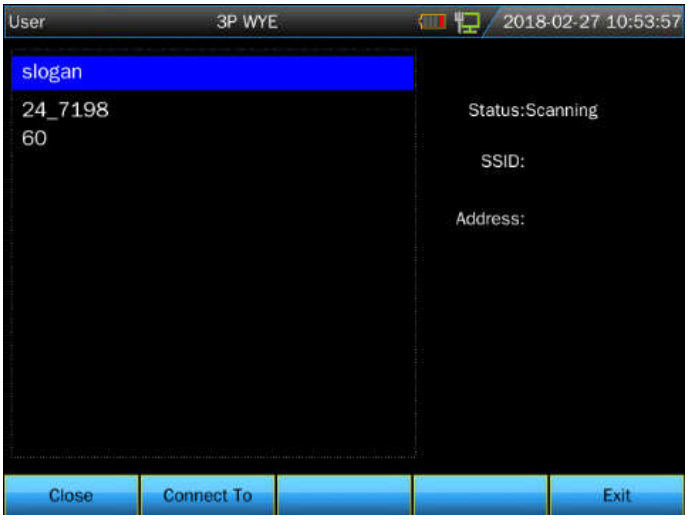


Connect the Analyzer with PC by one piece of net cable, set IP address of Analyzer and PC to different, but should be in the same network segment. For example: IP address in PC is 192.168.1.XXX, while IP address in the Analyzer also should be 192.168.1.XXX accordingly. After a correct setting IP address for the analyzer, access the analyzer to the network by one new cable. Open PQA View software, select 【auto connection】or 【manual connection】(input IP address manually)in 【file】option, after a successful connecting, an operating interface which simulate the analyzer will pop up and user can download the saved file in device as below picture shown.



WLAN settings

Select 【WLAN SETUP】in 【User】option as below picture show:



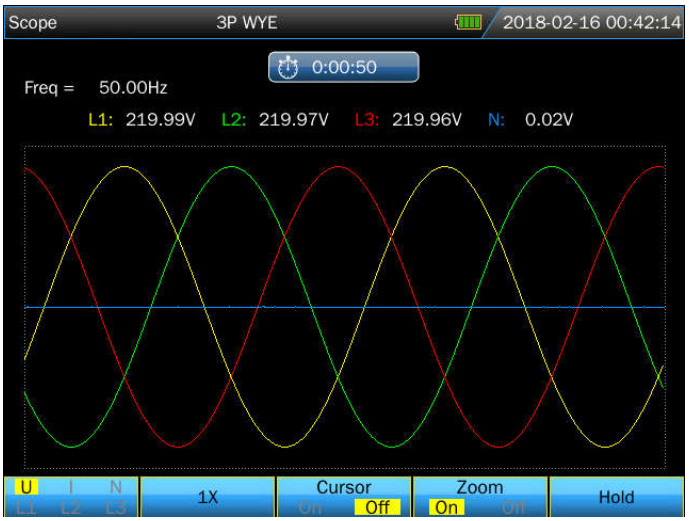
【**F1**】: Open/close wireless network.
【**F2**】: Access to the selected wireless network
【**F5**】: Exit wireless network settings
Open wireless network and select the wireless router that needs to be connected, it reminds user a successful connect if the assigned IP address display in the right of display. Connect laptop or computer with wireless function to the same wireless router, then run the PQA View software in the PC, select 【auto connection】or 【manual connection】(input IP address manually)in 【file】option, to realize the remote control the Analyzer and download the measured data.

After PQA_Setup is installed, select 【**User Manual**】in 【help】option to check how to use the PC software naming PQA View.

Chapter 3 Function Introduction

3.1 Scope

Scope mode shows voltages and currents in the power system under test by means of waveforms. Also numerical values are shown such as phase voltages, phase currents and frequency etc. The Scope waveform screen offers an oscilloscope style of display of voltage and current waveforms with a fast update rate. The screen header shows the related rms voltage/current values. Channel **L1/A** is the reference channel.



Function keys instruction:

【F1】: Select the waveform to be displayed: U displays all voltages and I displays all currents. L1, L2, L3 and N (neutral) simultaneously display voltage and current of the selected phase.

【F2】: Press this key to adjust the waveform display automatically according to screen to get a better observation effect.

【F3】: Enable or disable the cursor. After enable the cursor, the waveform value at the Cursor position are displayed in the screen header. Move cursor by pressing【◄】or【►】key.

【F4】: Open/close the Zoom function. After open the Zoom function, zoom waveform though pressing direction keys.

【F5】: Switch between HOLD and RUN.

After starting measurement, press【SAVE】key to save current screenshot or measured data.

3.2 Voltage/Current/Frequency

This function is used for measuring steady voltage, current, frequency and crest factors. The Crest Factor (CF) indicates the amount of distortion; a CF of 1.41 means no distortion and

higher than 1.8 means high distortion. Use this screen to get a first impression of power system performance before examining the system in detail with other measuring modes.

✧ **Table screen**

The number of columns in the Table screen depends on the power system configuration. The figures in the Table screen are present values that may update constantly. Changes in these values over time are recorded as soon as the measurement is turned on. The recording is visible in the Trend screen.

Press 【SAVE】key to save current screenshot or measured data after staring measurement.

Function keys instruction:

【**F4**】: Access to the Trend screen

【**F5**】: Switch between HOLD and RUN

✧ **Trend**

The trend records the data measured in the latest ten minute, then the curve formed from the right side. Reading in the header is correspond to the latest values formed in the right side.

Function keys instruction:

【F1】: Switch parameters that the current Trend screen displays, the header shows content being displayed.

【F4】: Return to the Table screen.

【F5】: Switch between RUN and HOLD.

3.3 Dips and Swells

Dips and Swells records Swells, Dips, Interruptions, and Rapid Voltage Changes.

Dips and Swells are fast deviations from the normal voltage. Magnitude may be ten up to one hundred of volts. Duration may vary from a half cycle to a few seconds as defined in IEC61000-4-30.

During a dip the voltage drops, during a swell the voltage rises. In 3-phase systems, a dip begins when the voltage on one or more phases drops below the dip threshold and ends when all phases are equal to or above the dip threshold plus hysteresis. A swell begins when the voltage on one or more phases rises up to the swell threshold and ends when all phases are equal to or below the swell threshold minus hysteresis. The trigger conditions for dips and swells are threshold and hysteresis. Dips and Swells are characterized by duration, magnitude and time of occurrence. Figure 3-3-1and 3-3-2 explains this.

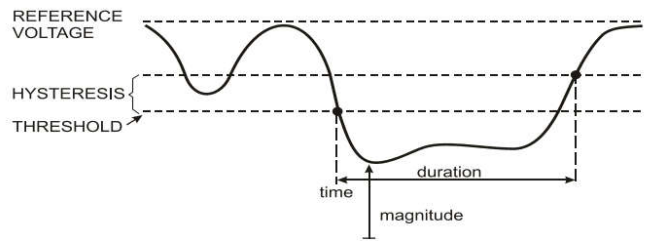


Fig.3-3-1 Characteristics of a voltage dip

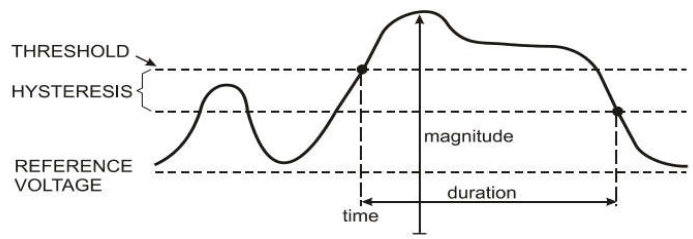


Fig. 3-3-2 Characteristics of a voltage swell

During an Interruption the voltage sinks well below its nominal value. In 3-phase systems, an Interruption begins when the voltages on all phases are below threshold and ends when one phase is equal to or above the interruption threshold plus hysteresis. The trigger conditions for interruptions are threshold and hysteresis. Interruptions are characterized by duration, magnitude and time of occurrence. Figure 3-3-3 explains this.

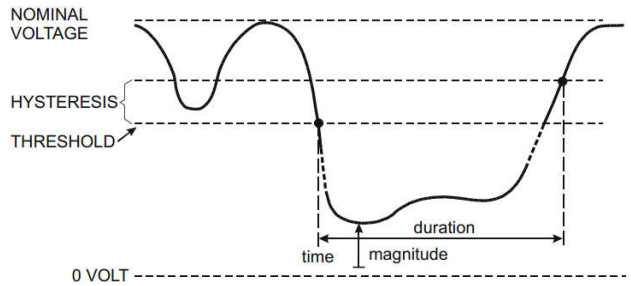


Fig. 3-3-3 Characteristics of a voltage interruption

Rapid voltage changes are quick transitions of the RMS voltage between two steady-states. Rapid voltage changes are captured based on steady voltage tolerance, steady time, minimum compensation and minimum rate detected. When voltage change exceeds dip or swell threshold, it is considered as Dip or Swell instead of Rapid Voltage Change. The events list shows voltage step change and transient time. The detailed events list shows maximum voltage change over nominal voltage. Voltage change trend is shown in Fig. 3-3-4.

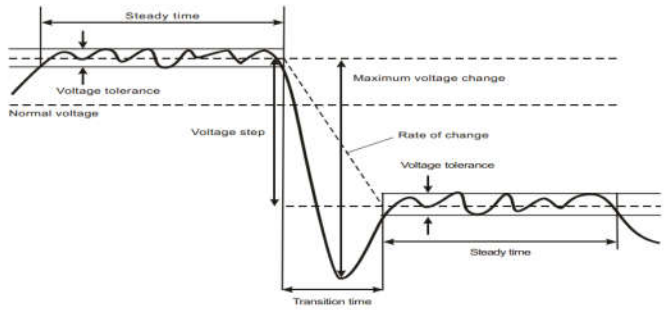


Fig. 3-3-4 Characteristics of a rapid voltage change

In addition to the voltage, current is also recorded. This allows you to see cause and effect of deviations. Function key 【F2】 accesses event tables where voltage events are listed in sequence.

✧ **Trend**

Both voltage and current are recorded to help user to observe causation of causing deviation.

Function keys instruction:

【F1】: Switch between voltage and current trends, the header shows parameters being displayed.

【F2】: Access to Events tables

【F3】: Open /close cursor, remove cursor by 【◄】【►】key after cursor is opened.

【F4】: Open /close Zoom function.

【F5】: Switch between RUN and HOLD.

Event criteria such as threshold, hysteresis and others are preset, but they may be adjusted. The adjustment menu is reached via the 【SETUP】 key and limits setup.

✧ **Events tables**

The Events table lists all the limits of phase voltages. Thresholds according to international standards or user –definable thresholds can be used. The Events table records major event characteristics: start time, duration, voltage magnitude, event type, and occurrence phase etc.

The below abbreviation is used in the events tables,

DIP voltage dip

SWL voltage swell

INT voltage interrupt

RVC changing of fast voltage

3.4 Harmonics

Harmonics function measure and record harmonics and interharmonics up to the 100th. Related data such as DC components and (THD) Total Harmonic Distortion, are measured. Harmonics are periodic distortions of voltage, current or power sinewave. Waveform can be considered as a combination of various sinewaves with different frequencies and magnitudes. The Analyzer also measures its effect that harmonic component contribute to complete signal. The measured value is displayed by bar graph. Harmonics are often caused by non-linear loads such as DC power supplies in computers, TV's and adjustable speed motor drives. Harmonics can cause transformers, conductors, and motors to overheat.

Note: In nominal frequency 400Hz, the harmonics can only measure up to 12 times and interstitial harmonic is unavailable.

✧ **Bar Graph Screen**

The Bar Graph display shows the percentage contribution of each of the components related to the fundamental or full signal. A signal without distortion should show a 1st harmonic at 100% while the others are at 0: in practice this will not occur because there always is a certain amount of harmonics resulting in distortion.

A sinewave becomes distorted when harmonics components are added to it. Distortion is represented by the Total Harmonic Distortion (THD) percentage. The display can also show the percentage of the DC component and each harmonic ratio.

【◄】【►】 arrow keys are used to position the Cursor on particular bar. The screen header will show harmonic voltage/current, harmonic component ratio, frequency and phase angle. If not all bars are shown on the screen, you can bring the next set within the viewing area by moving the Cursor off the left or right end of the screen.

Function keys instruction:

【F1】: Selection of harmonics type: voltage, current.

【F2】: Selection of bar set to be displayed: L1, L2, L3, N or all

【F3】: Interharmonics display on/off

【F4】: Acess to table screen

【F5】: Switch between RUN and HOLD.

✧ **Table Screen**

The table screen lists all the harmonic parameters, including Harmonic Voltage, Harmonic Current, Interharmonic Voltage and Interharmonic Current. Select next page with up/down keys.

Function keys instruction:

【F3】: select %f or %r to display harmonic.

【F4】: Return to bar graph of harmonic

【F5】: Switch between RUN and HOLD.

Instruction:

%f: the percentage of harmonic component and fundamental signal.

%r: the percentage of harmonic component and signal RMS value.

3.5 Power and Energy

Power and Energy displays a table with all important power parameters. The related Trend screen shows the changes over time of all measuring values in the table. The power measurement is compliant with IEEE1459.

✧ **Table screen**

Parameters instruction:

P (kW): active power.
S (kVA): apparent power, multiply voltage RMS by current RMS.
Q1 (kvar): reactive power of fundamental waveform.
PF: power factor, divide active power by apparent power.
cosΦ: displacement power factor, the cosine value of angle between fundamental voltage and current.
tanΦ: the ratio divided reactive power by active power.
Urms: voltage root mean square.
Irms: current root mean square.

: inductive load : capacitive load

Q1: the computing method is as below:

Reactive vector power of fundamental: $Q_{1X} = U_{1X} \cdot I_{1X} \cdot \sin(\varphi u_{1X} - \varphi i_{1X})$

Reactive system power of fundamental: $Q_1^+ = 3 \cdot U_1^+ \cdot I_1^+ \sin(\varphi u_1^+ - \varphi i_1^+)$

Superscript + stands for the positive sequence component

Function keys instruction:

【F3】: To pop up table under Power & Energy screen that showing electricity usage of each phase and the total.

【F4】: Open the Trend screen.

【F5】: Switch between RUN and HOLD.

✧ **Power & Energy screen**

Parameters instruction:

kWh: active energy
kVAh: apparent energy
kvar: reactive energy

Function keys instruction:

【F2】: the number shown on the display will be reset to 0

【F3】:Close power table screen.

【F4】: Open the Trend.

【F5】: Switch between RUN and HOLD.

3.6 Flicker

Flicker quantifies the luminance fluctuation of lamps caused by supply voltage variations. The Analyzer design strictly meets the **IEC61000-4-15** Flicker Meter model. The Analyzer converts duration and magnitude of voltage variations into an 'annoyance factor' caused by the

resulting flicker of a 60W lamp. A high flicker reading means that most people would find the luminance changes irritating. The voltage variation can be relatively small. The measurement is optimized to lamps powered by **120V/60Hz** or **230V/50Hz**. The Trend screen shows changes of instantaneous flicker sensation level over time.

Note: Flicker function is not applied to 400Hz power system measurement.

✧ **Table**

Function keys instruction:

【F4】: To open PF5 Trend screen

【F5】: Switch between RUN and HOLD

Parameters instruction:

Pinst: Instantaneous flicker
Pst: Short-term flicker severity (measured in ten minutes).
Plt: Long-term flicker severity (measured in two hours).

3.7 Unbalance

Unbalance displays phase relations between voltages and currents. Measuring results are based upon the fundamental frequency component (50 or 60Hz, use symmetrical components). In a 3-phase power system, the phase shift between voltages and between currents should be close to 120°. Unbalance mode offers a measurement table and a vector diagram screen.

✧ **Table**

Function keys instruction:

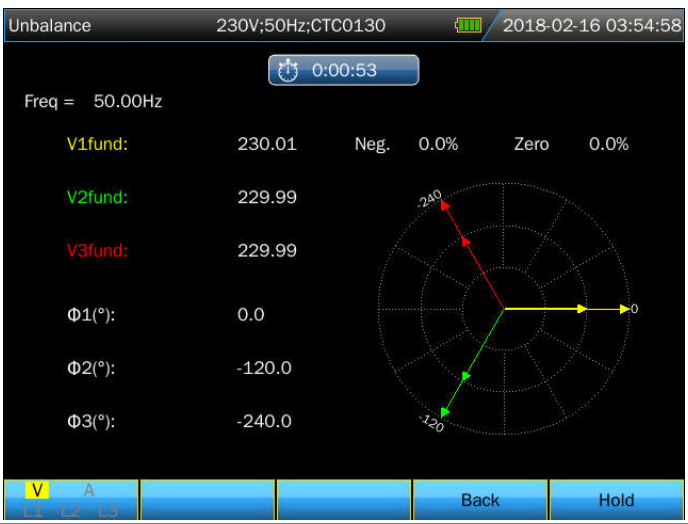
【F4】: Open Phasor screen.

【F5】: Switch between RUN and HOLD.

Parameters instruction:

Uneg: Negative sequence voltage unbalance
Ineg: Negative sequence current unbalance
Uzero: Zero-sequence voltage unbalance
Izero: Zero-sequence current unbalance
Ufund: Fundamental voltage **Ifund:** Fundamental current
ΦU(°): Fundamental voltage angle **ΦI(°):** Fundamental current angle
ΦI-U(°): The angle between fundamental voltage and current
The angle of each phase voltage and current is relative to angle of reference voltage L1/A.

✧ **Phasor**



Shows the phase relation between voltages and currents in a vector diagram divided in 30 degree sections. The vector of the reference voltage **L1/A** points to the horizontal direction. Additional numerical values are given: negative voltage and negative current unbalance percentage, unbalance percentage of zero sequence voltage and zero sequence current, fundamental phase voltage and current, frequency, phase angles.

Function keys instruction:

【**F1**】: Switch measured parameters, **V** displays all voltages; **A** displays all currents. **L1**, **L2**, **L3** give simultaneous display of phase voltage and current.

【**F4**】: Return to unbalance table screen.

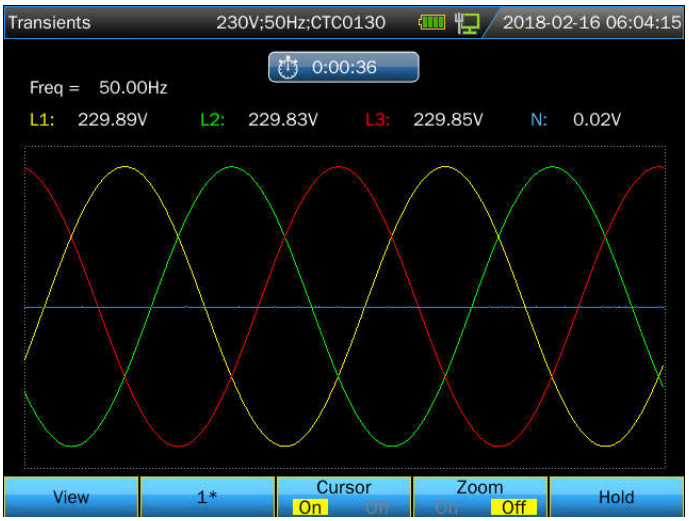
【**F5**】: Switch between RUN and HOLD.

3.8 Transients

The Analyzer can capture waveforms at high-resolution during a variety of disturbances. The Analyzer will give a snapshot of the voltage and current waveforms at the precise time of the disturbance. This allows you to see the waveforms during transients.

Transients are fast spikes on the voltages waveform. Transients can have so much energy that sensitive electronic equipment can be affected or even damaged. A waveform is captured each time that the voltage exceeds the setting limits. A maximum of 100 events can be captured. The sample rate is 163.84kS/s.

✧ **Waveform display**



Function keys instruction:

【**F1**】: Playback captured Transients waveforms.

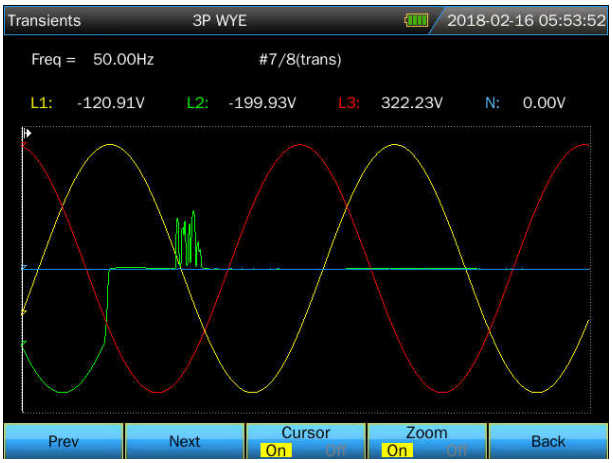
【**F2**】: Let waveform adapt to the size of screen automatically

【F3】: Open/ close cursor

【F4】: Open/ close Zoom function

【F5】: Switch between RUN and HOLD

The following figure shows the captured transient events:



3.9 Inrush currents

Inrush currents can be captured by the Analyzer. Inrush currents are surge currents that occur when a large, or low-impedance load comes on line. Normally the current will stabilize after some time when the load has reached normal working condition. For example the start-up current in induction motors can be ten times the normal working current. Inrush is a 'single shot' mode that records current and voltage Trends after a current event has occurred. An Inrush occurs when the current waveform exceeds adjustable limits. The Trends builds up from the right of the screen. Pretrigger information allows you to see what occurred in advance of the inrush.

✧ **Trend display**

Use the arrow keys in the inrush current function to adjust the trigger limits: expected inrush time, nominal current, threshold and hysteresis. The maximum current determines the vertical height of the current display windows. Threshold is the current level that triggers the trend capture. The inrush time is the time between trigger and the time that the current falls to the value indicated by Hysteresis and is indicated on the trend display between two vertical markers. The screen header displays the rms of all phases during the inrush time. If the Cursor is on, the rms measuring values at the Cursor are displayed.

Function keys instruction:

【F1】: Switch parameters to be displayed.

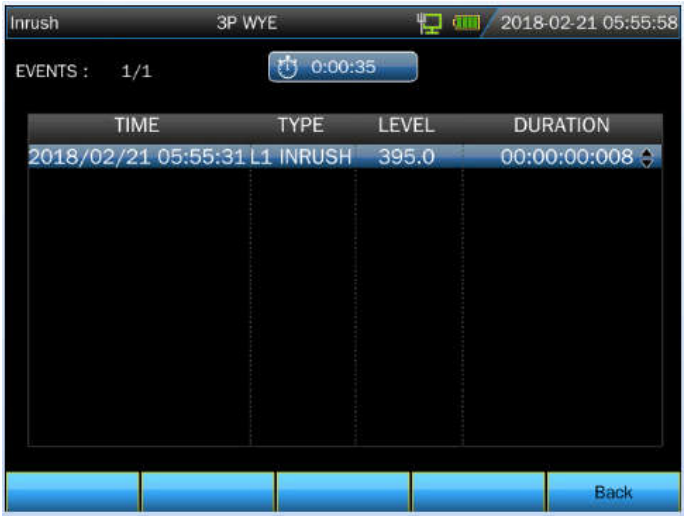
【F2】: Access to inrush current events list

【F3】: Open/ close cursor

【F4】: Open/ close Zoom function

【F5】: Switch between RUN and HOLD

✧ **Events list**



3.10 Wave Record

The waveform of voltage and current could be recorded through this function, the sample rate is up to 20k and the duration time is settable. The parameters in below screen shown could be set.

The file with WAV format could be generated after finishing recording and user could review it through PC software.

3.11 Logger

Logger function is used to record a group of measurement data as your selected parameter, the interval selected from 1s to 1hour. When each interval ends, the maximum, minimum and average of selected parameters are recorded to memory and then start next interval recording. The whole process lasts as you selected duration time and the record parameter are all selectable for users.

Press 【MENU】key, use direction key to select logger function, press 【**ENTER**】key to enter into logger setting interface.

Here user can check remaining storage space, choose the needed logger parameters, set record interval, duration time and name of stored file. Then press 【F5】 to start.

The record file is saved in Micro SD card as CSV format, which can be opened as EXCEL table by Office 2007 or advanced version in PC. Each logger file is allowed to record 7200 data at most, every 7200 data will be generated as one file, for example, set logger interval 1s, logger duration 4 hours, it will generate 2 logger files as Logger 1.csv and Logger -1_1.csv.

Press 【F2】 can enter into parameter setting interface, use direction key and 【ENTER】 key to select the recording parameters, then press 【F5】 to confirm.

✧ **Table Screen**

The table screen displays all the real time measurement data as selected parameters. With left/right key to refer to next page for view of the data.

Function keys instruction

【F4】: Save recording data

【F5】: To stop logger

3.12 Monitor

Note: Monitor function is not applied to 400Hz power system measurement.

Power Quality Monitoring displays a Bar graph screen. This screen show whether important Power Quality parameters meet requirements. Parameters include:

①RMS voltages

②Harmonics

③Flicker

④Dips&Swells (SWL, DIP), Interruptions (INT), Rapid Voltage Changes(RVC)

⑤Unbalance, and Frequency

Power Quality Monitoring is usually done during a long observation period. Minimum duration of the measurement is 2 hours. An usual measuring period is 1 week.

Most of the Bar Graphs have a wide base indicating adjustable time related limits (for instance 95% of time within limit) and a narrow top indicating a fixed 100% limit. If one of both limits is violated, the related bar changes from green to red. Dotted horizontal lines on the display indicate the positions of 100% limit and the adjustable limit.

The meaning of the bar graphs with a wide base and a narrow top is explained below by way of example this is done for the RMS voltage. This voltage for instance has a nominal value of 220V with a tolerance of ±15% (tolerance range between 187 … 253V). The momentary RMS voltage is constantly monitored by the Analyzer, it calculates an average from these measuring values across 10 minutes observation periods, and these averages are compared against the tolerance range.

The 100% limit means that the 10-minute averages must always (i.e. 100% of time or with 100% probability)be within range. The bar graph will turn to red if a 10-minute average crosses the tolerance range.

The adjustable limit of for instance 95% (i.e. 95% probability) means that 95% of the 10-minute averages must be within tolerance. The 95% limit is less stringent than the 100% limit. Therefore the related tolerance range usually is tighter. For 220V this for instance can be ±10% (tolerance range between 198V … 242V).

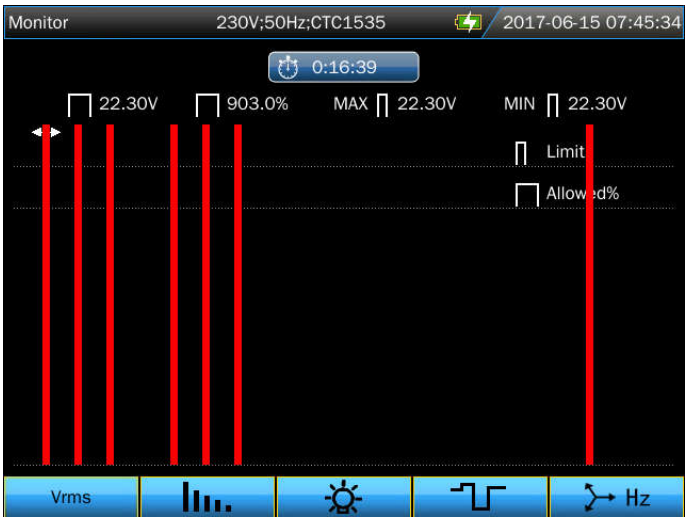
The bars for Dips/Interruptions/Rapid Voltage Changes/Swells are narrow and indicate the number of limits violations that occurred during the observation period. The allowed number is adjustable (for instance to 20 Dips/week). The bar turns to red if the adjusted limit is violated.

You can use a pre-defined set of limits or define your own. An example of a pre-defined set is that according to the EN50160 standard.

The table below gives a survey of the aspects of Power Quality Monitoring:

Parameter	Available Bar Graphs	Limits	Averaging Interval
V rms	3, one for each phase	Probability 100%: upper & lower limits Probability x %: upper & lower limits	10 minutes
Harmonics	3, one for each phase	Probability 100%: upper limit Probability x %: upper limit	10 minutes
Flicker	3, one for each phase	Probability 100%: upper limit Probability x %: upper limit	2 hours
Dips&Swells/INT/RVC	4, one for each parameter covering all 3 phases	Allowed number of events	1/2 cycle rms based
Unbalance	1, covering all 3 phases	Probability 100%: upper limit Probability x %: upper limit	10 minutes
Frequency	1, measured on Reference Voltage Input A/L1	Probability 100%: upper & lower limits Probability x %: upper & lower limits	10 seconds

✧ **Power Quality Monitor Screen**



Power Quality Monitoring is reached via the 【MONITOR】 key, and Immediate or Timed start is settable. With the direction keys you can position the Cursor on a particular Bar Graph. Measuring data belonging to the bar is shown in the screen header.

The Power Quality parameters rms voltages, Harmonics, and Flicker have a bar for each phase. From left to right these three bars are related to the phases A (L1), B (L2), and C(L3). The parameters Dips/Interruptions/Rapid Voltage Changes/Swells and Unbalance/Frequency have a single bar for each parameter representing performance across three phases.

The below signs used in the title bar

: the setting x% limit value

: 100% limit value

Detailed measurement data is available under the Function keys:

【F1】: RMS voltage: events table, trends.

【F2】: Harmonics: bar graphs, events table, trends.

【F3】: Flicker: events table, trends.

【F4】: Dips&Swells/INT/RVC: events table, trends.

【F5】: Unbalance, frequency: events table, trends.

✧ **Events table**

The events table shows the events that occurred during the measurement with time of start, phase and duration. Events recording situation:

- V rms events: an event is recorded each time that a 10 minute aggregated RMS value violates its limits.
- Harmonics events: an event is recorded each time a 10 minute aggregated harmonic or THD violates its limit.
- Dips/Interruption/Rapid Voltage Change/Swells events: an event is recorded each time one of the items violates its limit.
- Unbalance and Frequency events: an event is recorded each time that a 10 minute aggregated RMS value violates its limit.

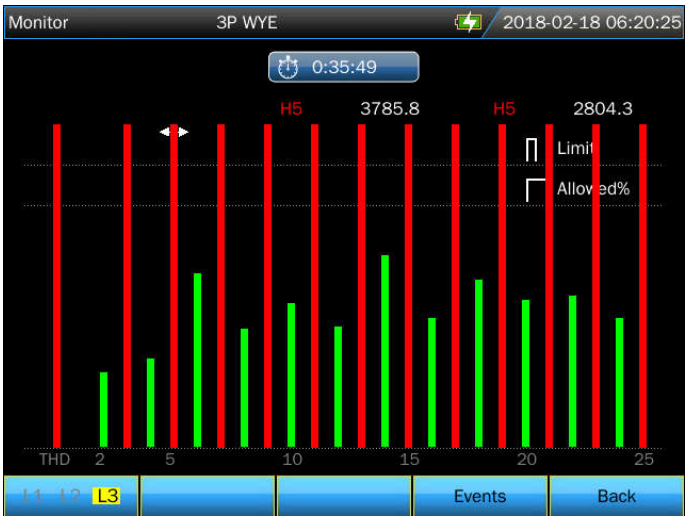
Function keys instruction:

【F3】: Open Trend Screen

【F4】: Switch between selected and all events.

【F5】: Return to previous menu.

✧ **Harmonics Bar Graph Screen**



The main system monitor display shows the worst harmonic for each of the three phases. Function key 【F2】 brings up a screen with Bar Graphs showing the percentage of time each phase spent within limits for 25 harmonics and Total Harmonic Distortion (THD). Each Bar Graph has a wide base (representing an adjustable limit of e.g. 95%) and a narrow top (representing the limit of 100%). A Bar Graph changes from green to red if the limits for that harmonic are violated.

Function keys instruction:

【**F1**】: Select Bar Graphs of **L1/A**, **L2/B** or **L3/C**

【**F4**】: Open events table.

【**F5**】: Return to previous menu.

Chapter 4 Service and Support

4.1 Warranty

Shijiazhuang Suin Instruments Co Ltd. will give one year's warranty to maintaining or replacing since consignment for the verified quality problem of the product.

Except for this explanation and the description in the warranty card, the company has no other warranty, in proclamation or in implication. Under no circumstances, the company will responsible for the direct, indirect or other secondary loss.

4.2 Contact us

If you have any questions or inconvenient during the use of our products please do not hesitate to contact us.

Monday to Friday 8:30-17: 00

Telephone: +86-311-83897147

Fax: +86-311-83897140

E-mail address: export@suintest.com

Website: www.suindigital.com

Chapter 5 Specifications

5.1 Frequency Measurement

Nominal frequency	Measurement range	Resolution	Accuracy
50Hz	42.50~57.50 Hz	0.01Hz	±0.01Hz
60Hz	51.00~69.00 Hz	0.01Hz	±0.01Hz
400Hz	320~480Hz	0.01Hz	±0.01Hz

Note: measured on Reference Voltage Input **L1/A**.

5.2 Voltage Input

Numbers of input	4 (3 phase + neutral)
Max continuous input voltage	1000Vrms
Range of nominal voltage	Selectable, 1V to 1000V according to IEC61000-4-30
Max pulse peak voltage	6kV
Input impedance	4MΩ

5.3 Current Input

Numbers of input	4 (3 phase + neutral)
Type	Clamp Current Sensor, with mV output
Max input voltage	10V
Input range	According to current clamps
Input impedance	100kΩ

5.4 Sampling System

Resolution	8 channels 16 bits AD
Sampling rate	163.84kS/s Typ. (nominal frequency), 8 channels sample synchronously
RMS sampling	4096 points for 10/12 cycles (according to IEC 61000-4-30)
PLL sync	4096 points for 10/12 cycles (according to IEC61000-4-7)

5.5 Measuring Modes and Parameters

Measurement mode	Measured parameters
Oscilloscope	Vrms、Arms、Vcursor、Acursor、Hz
Voltage/Current/Frequency	Vrms、Vpk、Arms、Apk、CF、 Hz
Dips&Swells	Vrms1/2, Arms1/2, capture up to 1000 events, include date, time, duration, magnitude and phase mark, and threshold is settable.

Harmonic	1-100, harmonic voltage, THD voltage, harmonic current, THD current, interharmonic voltage, interharmonic current
Power and energy	W、VA、var、PF、cosΦ、tanΦ、Vrms、 Arms、 kWh、kVAh、kvarh
Flicker	Pinst、Pst、Plt
Unbalance	Vneg, Vzero, Aneg, Azero, Vfund, Afund, Hz, V phase angle, A phase angle
Transient	Vrms, Vcursor
Inrush current	Inrush current, Inrush duration, Arms1/2, Vrms1/2
System monitoring	Vrms, Arms, Harmonic voltage, Total harmonic distortion voltage, Plt, Vrms1/2, Arms1/2, Vneg, Hz, Swells, Dips, Interruption, Rapid Voltage Change. All parameters are measured simultaneously according to EN50160 standard.
Logger	User-defined to select more parameter, and record of setting time interval

5.6 Measurement Range, Resolution, Accuracy

Voltage/Current/Frequency	Measurement range	Resolution	Accuracy
Vrms (AC+DC)	1~120Vrms 120~400 Vrms 400~1000Vrms	0.001Vrms 0.01Vrms 0.1Vrms	±0.1% of nominal voltage
Vpk	1~1400Vpk	0.01Vpk	±0.5% of nominal voltage
V(CF)	1.0~>2.8	0.01	±5%
Arms (current clamps error not include) 10mV/A 1mV/A 65mV/1000A(AC)	 0~150A 1~2000A 10~6000A	 0.01A 0.01A 0.01A	 ±0.1%±0.1A ±0.1%±0.1A ±0.1%±0.2A
A(CF)	1~10	0.01	±5%
Frequency 50Hz nominal Frequency 60Hz nominal Frequency 400Hz nominal	42.5~57.5 51~69 320~480	0.01Hz 0.01Hz 0.01Hz	±0.01Hz ±0.01Hz ±0.01Hz

Dips&Swells	Measurement range	Resolution	Accuracy
Vrms1/2	0~200% nominal voltage	0.01Vrms	±0.2%
Arms1/2	According to current clamps	0.01A	±1%

Threshold value	Threshold is settable according to nominal voltage percentage Detectable events type: Dips, Swells, Interruption, Voltage Rapid Change.		
Duration	hour-minute-second-microsecond	0.5 cycle	1 period

Harmonic	Measurement range	Resolution	Accuracy
Harmonic order (400Hz)	1~12		
Interharmonic order(400Hz)	No		
Harmonic order (50/60Hz)	1~100		
Interharmonic order(50/60Hz)	0~99		
Harmonic voltage %f	0.0~100.0%	0.01%	±0.1%±n×0.1%
Harmonic voltage %r	0.0~100.0%	0.01%	±0.1%±n×0.4%
Harmonic current %f	0.0~100.0%	0.01%	±0.1%±n×0.1%
Harmonic current %r	0.0~100.0%	0.01%	±0.1%±n×0.4%
THD	0.0~100.0%	0.01%	±2.5%
Frequency	0~6000Hz	0.01Hz	0.1Hz
Phase	-180°~180°	0.1°	±n×0.1°
Absolute voltage	0~1000V	0.01V	±1% reading (harmonics >1% nominal value) ±0.05% reading (harmonics <1% nominal value)
Absolute current	0~6000A	0.01A	±1% reading (harmonics >3% nominal value) ±0.05% reading (harmonics <3% nominal value)

Power and energy	Measurement range	Resolution	Accuracy
P, S, Q1, PF cosΦ	Max6000MW 0~1 0~1	0.1kW 0.01 0.01	±1%±10 counts ±0.01 ±0.01
kWh, kVAh, kvarh	Depends on clamp scaling and V nominal		±1%±10 counts

Flicker(50/60Hz)	Measurement range	Resolution	Accuracy
Pst (10 minutes) Plt (2 hours)	0.00~20.00	0.01	±5%

Unbalance	Measurement range	Resolution	Accuracy
Voltage unbalance	0.0~20.0%	0.1%	±0.1%
Current unbalance	0.0~20.0%	0.1%	±1%
Voltage phase	-360°~ 0°	0.1°	±0.1°
Current phase	-360°~ 0°	0.1°	±0.5°

Voltage transients	Measurement range	Resolution	Accuracy
Vpk	±6000Vpk	0.01V	±15%
Vrms	10~1000Vrms	0.01V	±2.5%
Minimum test time	6.5μs		
Sampling rate	163.84kS/s		

Inrush current	Measurement range	Resolution	Accuracy
Arms	According to current clamps	0.01	±1%±5 counts
Inrush duration time	1~32 min settable	10ms	±20ms

5.7 Wiring Combinations

1P+NEUTRAL	Single phase with neutral
1P Split Phase	Split phase
1P IT NO NEUTRAL	Single phase system with two phase voltages without neutral
3P WYE	3-phase 4-wire system, Y type
3P DELTA	3-phase 3-wire system delta (Delta)
3P IT	3-phase Y type without neutral
3P HIGH LEG	4-wire 3-phase delta system (Delta) with center tapped high leg
3P OPEN LEG	Open-delta (Delta) 3-wire system with two transformer windings
2-ELEMENT	3-phase 3-wire system without current sensor on phase L2/B (2 Watt meter method)
2.5-ELEMENT	3-phase 4-wire system without voltage sensor on phase L2/B

5.8 General Characteristics

Interface	
USB Host interface	Copy saved file to PC from a U disk, then analyze it with upper computer software.
LAN interface	For remote control of the Analyzer and measurement data transmission.

Screen	Color TFT LCD
Size	5.6 inch
Resolution	640×480
Brightness	Adjustable

Memory	
Flash memory	1G
Micro SD	Standard 32G

Case	
Drip and dust proof	IP53 degree. The IP rating refers to non-operation of the Product and does not indicate that the Product should be used around hazardous voltages in wet environments.

Standard	
Measurement method	IEC61000-4-30 A class
Measurement performance	IEC61000-4-30 A class
Power quality monitoring	EN50160
Flicker	IEC61000-4-15
Harmonic	IEC61000-4-7
Power measurement method	IEEE1459

Environment	
Working temperature	0°C~ 45°C
Storage temperature	-10°C~45°C
Humidity	90% relative humidity

Safety	
Complied with	IEC61010-1 Safety Degree: 600V CAT IV 1000V CAT III Pollution Degree: 2
Maximum voltage at voltage input	600V CAT IV 1000V CAT III
Maximum voltage at current input	10V

Mechanical	
Dimension	270mm × 190mm×66mm
Weight	2 kg

Power	
Adapter input	AC 100-240V 50/60Hz
Adapter output	DC 12V 2A
Battery	Lithium battery: 38.48Wh (7.4V 5200mAh)
Battery operating time	>8 hours (screen brightness is in level 3)
Battery charge time	6 hours

5.9 The specification of optional current clamps

Model	**Range**	**Turns ratio**	**Accuracy**	**Size** mm
KLC8C-5A	AC:5A	10mV/A	0.2%	Φ8
CTC0080	AC:50A	10 mV/A	0.2%	Φ8
CTC0130	AC:100A	1 mV/A	0.2%	Φ13
CTC1535	AC:1000A	1 mV/A	1.0%	Φ52
ETCR035AD	AC/DC: 1000A	1 mV/A	3.0%	30x35
SY-1500A	AC:1500A	100 mV/1000A	0.5%+(1% position error)	Φ110
PY-3000A	AC:3000A	65 mV/1000A	1.0%+(2% position error)	Φ160
SY-6000A	AC:6000A	65mV/1000A	1.0%+(2% position error)	Φ250