User's Guide

SA2110 Power Quality Analyzer

Introduction

SA2110 power quality analyzer adopts DSP＋ARM dual processor hardware platform and embedded operation system, 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-touch 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)
- Both key and touch screen operations are supported
- 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.
- Invert efficiency
- 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 32GB memory card.
- WIFI communication is supported.

The Analyzer and its accessories

- SA2110 Power Quality Analyzer 1
- U disk (PC software + manual) 1
- Measurement Guide 1
- 2-meter-long Voltage Test Leads (with 4mm caliber banana plug) 5
- Alligator Clips 5
- Power adapter 1
- Power cord 1
- Soft Carry Bag 1
- Hang strap 1
- Sticker of input port 1
- Colorful identification clips (used on clamps) 20

Options

- Package

- M53-1 Hard Protection Case

-AC Current Transformer

- C01-5A
- C02-100A
- C03-200A
- C04-1000A

-AC/DC Current Transformer

- C05-1000AD

-AC Rogowski Coil

- C06-1500A
- C07-3000A
- C08-6000A

-Voltage Magnetic Connector

-Beidou/GPS receiver

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 instructions of the manual before use of the Analyzer and its accessories. Read all instructions carefully.
- During live-line work, at least two people must be present, one operate while the other supervise.
- Do not operate the Analyzer around explosive gas, vapor or in environments with a relative humidity greater than 90%.
- Use the Analyzer as specified, or the protection provided by the Analyzer might be impaired.
- Use only insulated current clamps, test leads and power adaptor as supplied with the Analyzer, or indicated as suitable for the Analyzer.
- Before use, inspect the Analyzer, current clamps, voltage test leads, power adaptor 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 current clamps, 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), voltage test leads, Alligator Clips, current clamps and power adapter for measurement..
- Do not apply voltages in excess of the marked ratings of the voltage test leads 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.

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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.

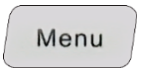
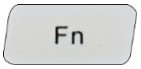
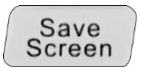
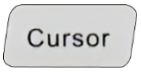
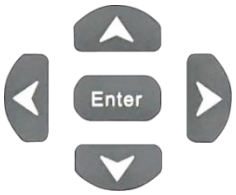
Chapter 1 Getting started

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

1.1 Overview of the Analyzer

①: touch screen
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 5 seconds, the Analyzer will be forced to power off.**
	**Brightness adjustment: Press this button repeatedly to adjust the lightness of the screen.**
	**Main menu key: enter into main menu interface quickly.**
	**Setup key：enter into interface of parameter setting quickly.**
	**Function key: turn on/off the function icon.**
	**Save key: save screenshot.**
	**Cursor key：turn on/off the cursor icon in some functions.**
	**Run/Hold key：After measurement begins, switch between run/hold data refresh, run data refresh is enable by default.**
	**Direction key: can move cursor** **Enter key：press this key to confirm current select**
	**Charge indicator:red: still in charging** **green: charge completely**

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

Icon function

	Main menu icon, function same as Menu
	Setup icon, function same as Setup
	Screenshot icon, function same as Save Screen
	Run/Hold icon, function same as Run/Hold
	Function icon, function same as Fn
	Battery capacity indicator, greenindicates enough, red indicates low.
	Charge indicator.
	Charge Complete.
	USB flash disk has connected.
	Wired network has connected.
	Wireless network has connected.
	Logger is running.
	The device is already connected to GPS/BDS to realize system time synchronization.

1.3 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 once every three months.

1.4 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.**

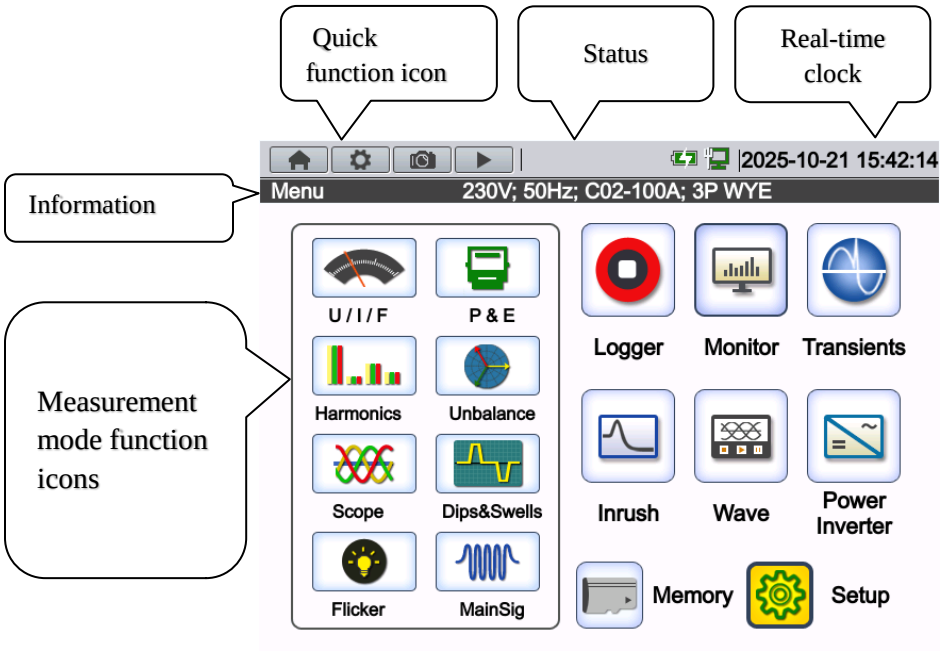
Next make the voltage connections: start with **GND** and then succession **N**, **L1/A**, **L2/B** and **L3/C**.

For 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.

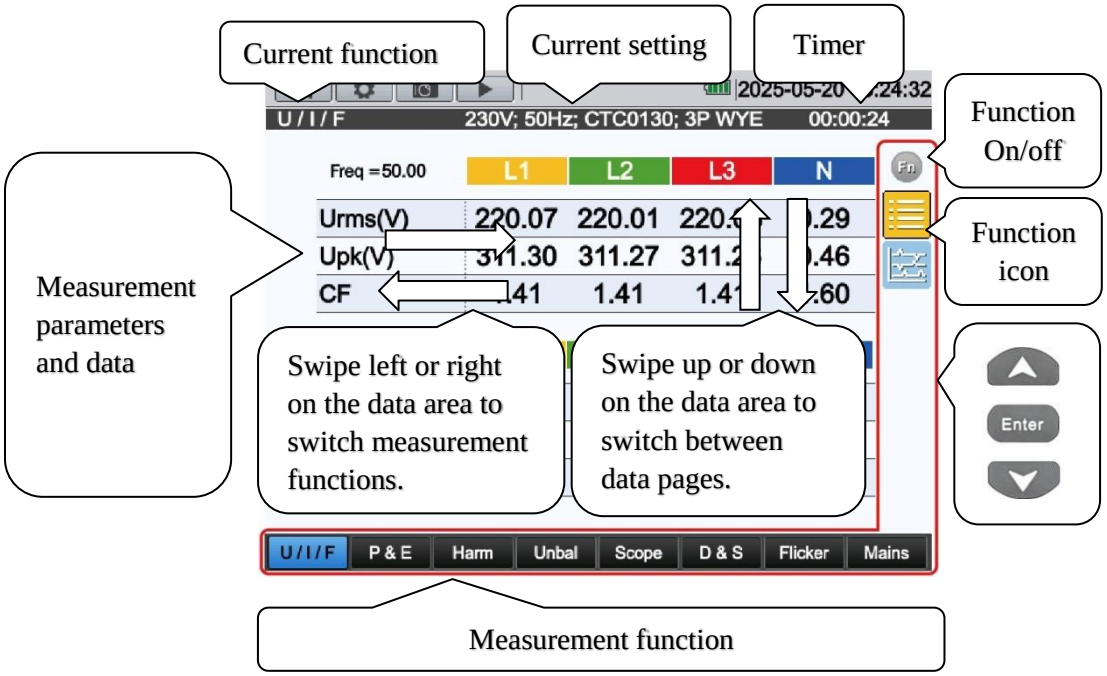
1.5 Rapid Overview of Measuring Modes

✧ **MENU**



Press Power key, Analyzer display the main menu, on the left side are the measurement mode function icons, you can touch icons or use the direction key to select the measurement function you want to access. In measurement mode, you can only view the real-time data, but can't save, you can press【Save screen】to save screenshot.

✧ **Measurement Interface**



The table interface provides a quick overview of the measurement values in the voltage/current/frequency modes.

Interface information:

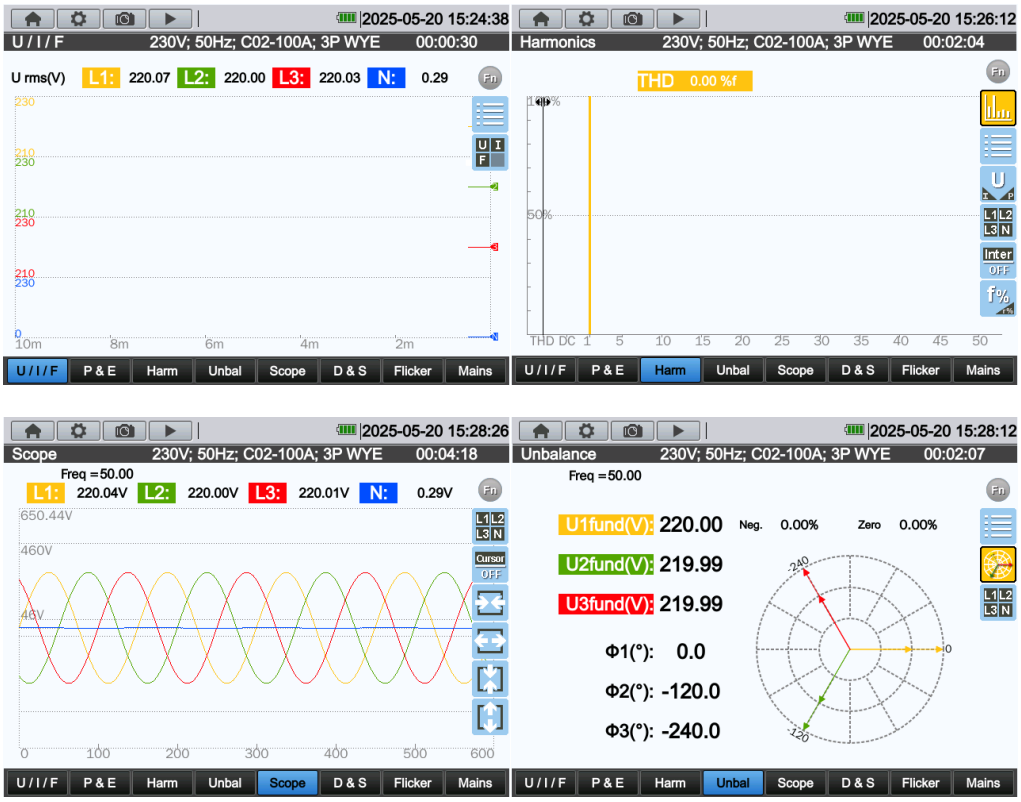
① The information bar indicates the current measurement function and the settings of Analyzer. Once the measurement timer starts, it continues running even when switching between different measurement functions to view data.

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

③ Measurement function option lies in the bottom of the interface.

④ Function option lies on the right side of the interface, different measurement functions have different operation options.

Measurement results have different types of different interfaces.


2025-05-20 15:24:38
U / I / F
230V; 50Hz; C02-100A; 3P WYE
00:00:30
U rms(V)
L1: 220.07
L2: 220.00
L3: 220.03
N: 0.29
Fn
U I F
U / I / F
P & E
Harm
Unbal
Scope
D & S
Flicker
Mains
2025-05-20 15:26:12
Harmonics
230V; 50Hz; C02-100A; 3P WYE
00:02:04
THD 0.00 %f
Fn
L1 L2 L3 N
Inter OFF
50%
THD DC 1 5 10 15 20 25 30 35 40 45 50
U / I / F
P & E
Harm
Unbal
Scope
D & S
Flicker
Mains
2025-05-20 15:28:26
Scope
230V; 50Hz; C02-100A; 3P WYE
00:04:18
Freq =50.00
L1: 220.04V
L2: 220.00V
L3: 220.01V
N: 0.29V
Fn
L1 L2 L3 N
Cursor OFF
650.44V
460V
46V
0 100 200 300 400 500 600
U / I / F
P & E
Harm
Unbal
Scope
D & S
Flicker
Mains
2025-05-20 15:28:12
Unbalance
230V; 50Hz; C02-100A; 3P WYE
00:02:07
Freq =50.00
Fn
U1fund(V): 220.00
Neg. 0.00%
Zero 0.00%
U2fund(V): 219.99
U3fund(V): 219.99
Φ1(°): 0.0
Φ2(°): -120.0
Φ3(°): -240.0
240
0
-120
L1 L2 L3 N
U / I / F
P & E
Harm
Unbal
Scope
D & S
Flicker
Mains

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 for hanging the Analyzer, the installation as below picture show:

2.2 Power on/off

Press the Power key, 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 5s in power on status.

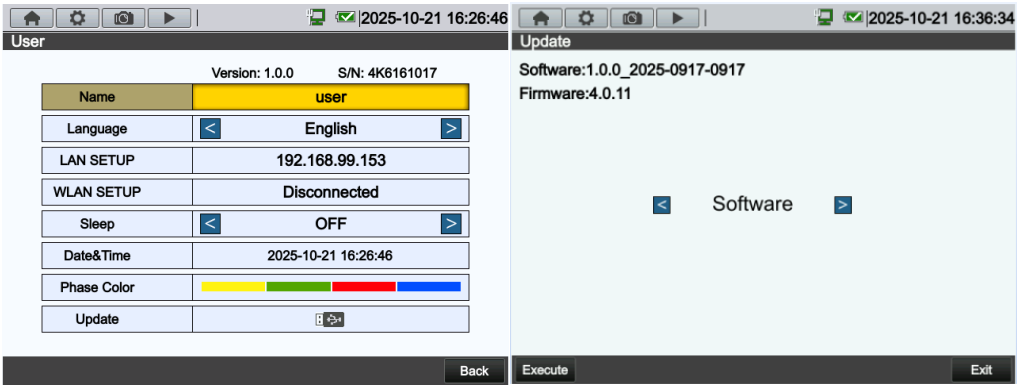
2.3 Display Brightness

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 the <User > interface from the 【SETUP】 interface, select the <Update> to enter into update interface.



There are two types of update file including Software and Firmware. 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, please feedback to manufacturer.
"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.

2.5 Input Connections

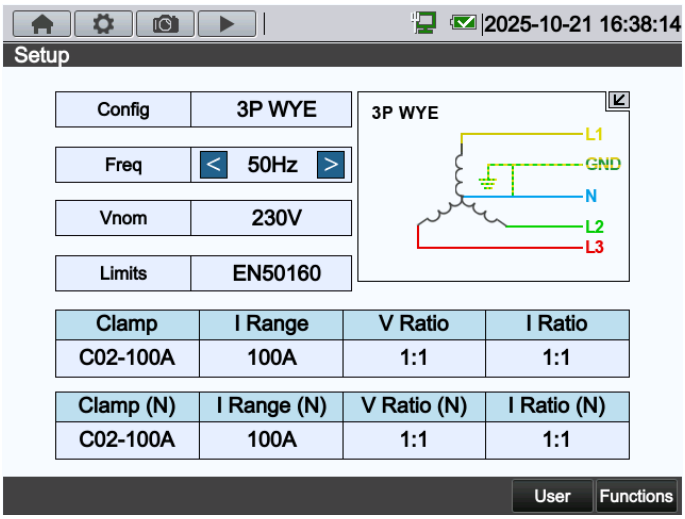
Check that the Analyzer setup meets the characteristics of the system under test. This concerns: wiring configuration, nominal frequency, nominal voltage, current clamp and ratio of PT&CT.

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 1.4

2.6 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. The 【**SETUP**】 key or click  accesses menus to view and change Analyzer settings.

The settings interfaces allows you to configure the wiring, nominal frequency, nominal voltage, monitor limits, current clamps model , N-phase current clamps model, etc.

Monitor limits

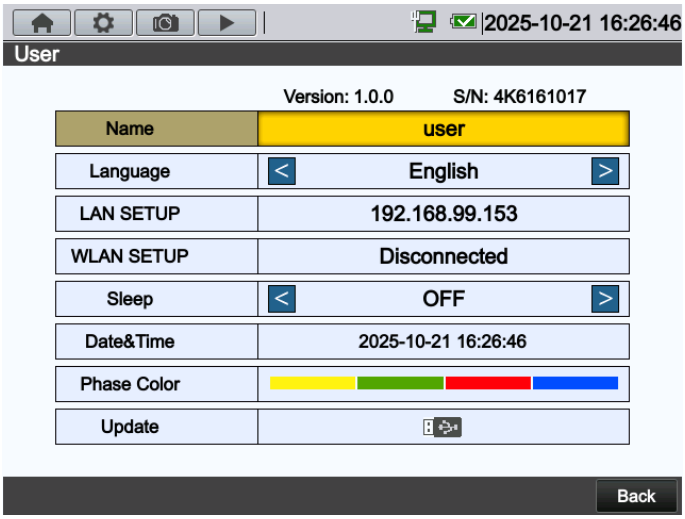
The Analyzer presets the limits according to EN50160 and GOST32144 standard. Besides,the users can modify under EN50160 or GOST32144 standard set of limits and save as user- defined set of limits.

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.
Mains Signaling	2 adjustable frequencies, each frequency has 2 probability percentages (100% and adjustable percentage), adjustable percentage of each adjustable upper limit.

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

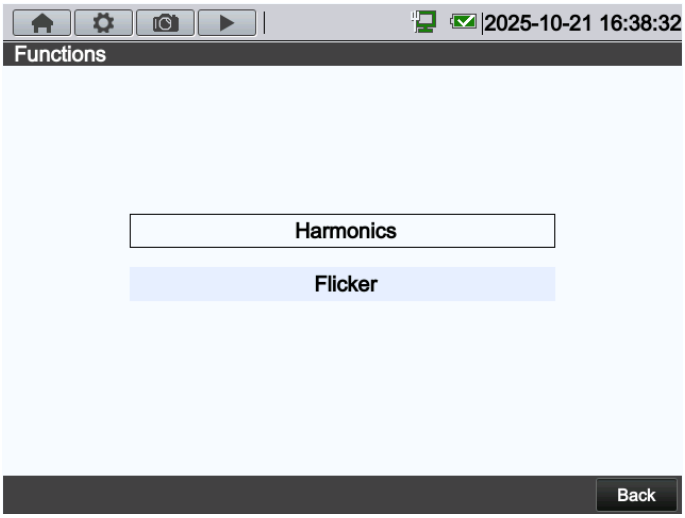
✧ **User Setting interface**



The user name, language,network setting, WIFI setting, sleep time, system time,phase color and upgrade 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.

✧ **Function Setting interface**



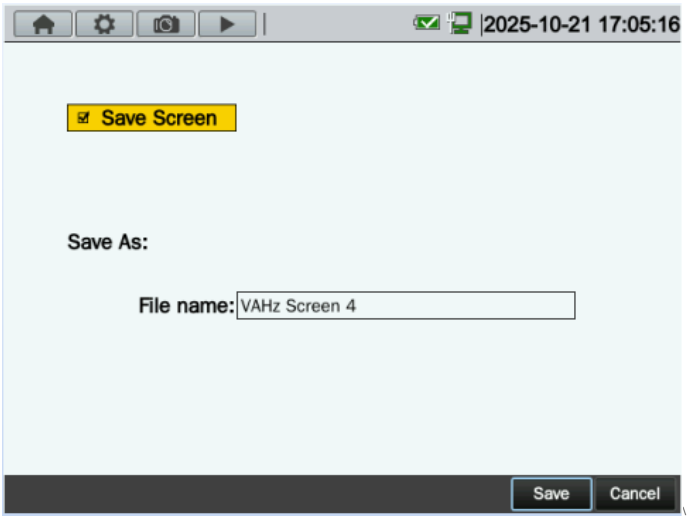
Harmonic and flicker parameters could be set in the function interface, K-factor calculation method with US and EU methods are available for user to select under the harmonic function. 120 V/60 Hz or 230 V/50 Hz weighted curves could be selected in the flicker function.

2.7 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.

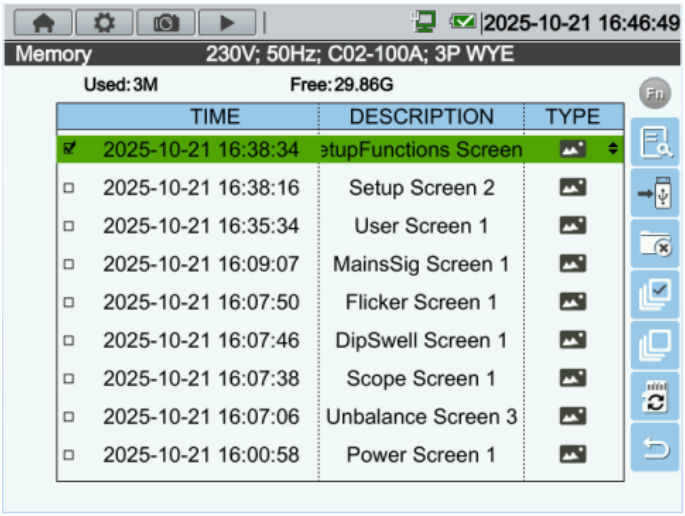
✧ **Save Screen interface**

Press 【**Save screen**】key can save current screenshot.



Select the file name to modify it to be the desired save name.

✧ **Save interface**



Select <save>in the main menu to access to the save list interface, which shows the save time, name and type of saved files. Click the screen or press【Fn】to recall the file operation options.

Function icons instruction:

: View selected saved file, only screenshot.

: Copy the selected file to U disk, insert U disk and start the operation until U disk icon display.

: Delete selected saved file.

: Select all files.

: Cancel the selection of all files.

: Format the SD card.

: Return the main screen.

✧ **Using PC software**

Installation requirement of PQA View_Setup

CPU: processor over 2GHz.

Memory: over 8G.

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

Hard disk: over 1GB.

Network card: 10M/100M network card.

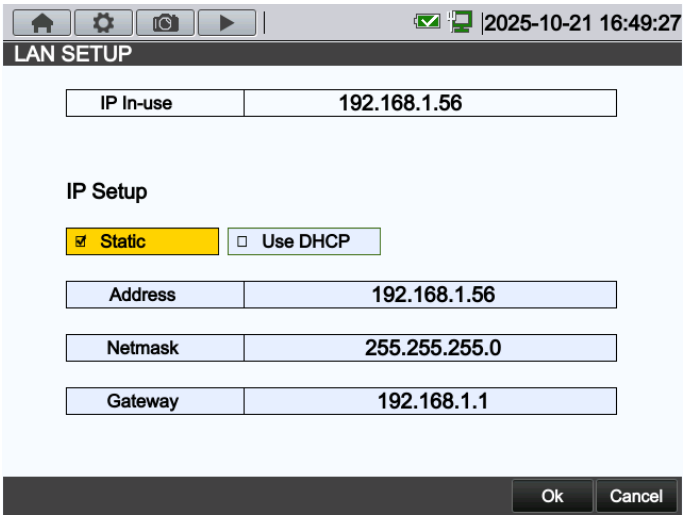
Operating system: Windows 7 or high version.

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 addition, 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.

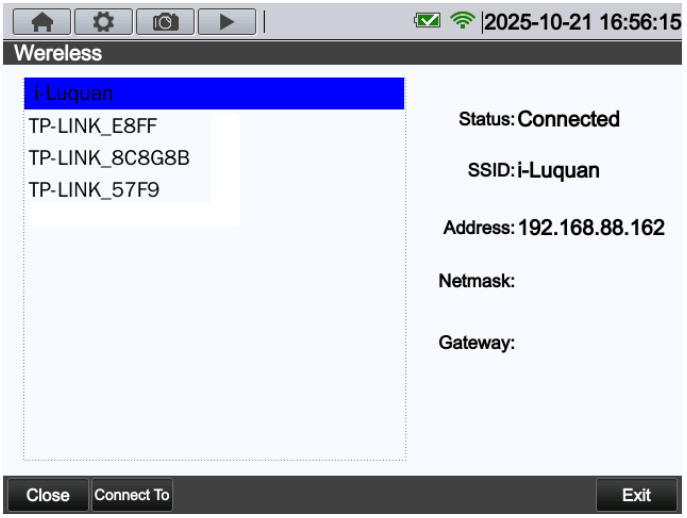
IP address in PC should be different from IP in Analyzer.

After a correct setting IP address for the analyzer, 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.

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

WLAN settings

Select〈WLAN SETUP〉in〈User〉option as below picture show:



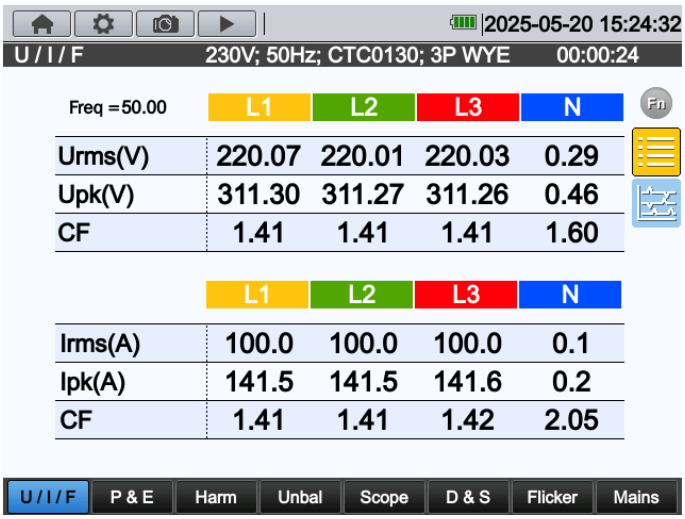
Open wireless network and select the wireless router that needs to be connected, click <Connect to>, it reminds user a successful connect if the assigned IP address display in the right of display. Connect laptop or computer with wireless function to the same wireless router, then run the PQA View software 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.

Chapter 3 Function Introduction

3.1 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.

✧ **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.

✧ **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.

After measurement begins, press【Save Screen】or click  to save current screenshot.

Press【Fn】or click  to open function list.

Function icons instruction:

 : Access to table.

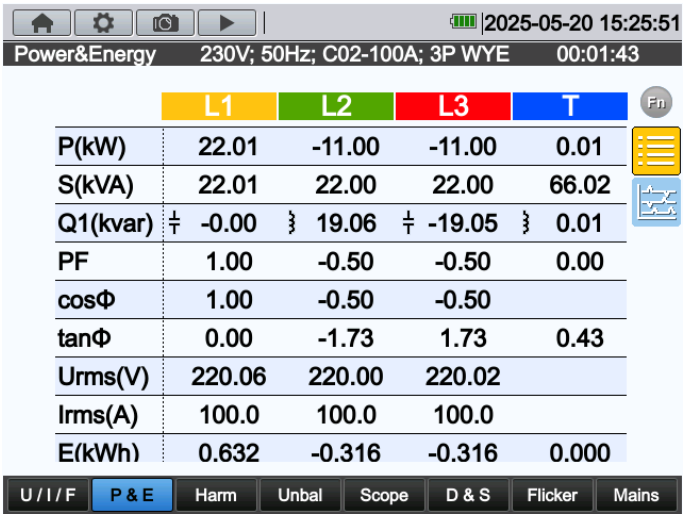
 : Access to trend.

 : Select parameters displayed on trend screen.

3.2 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.

：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

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.
E(kWh): active energy
E(kVAh): apparent energy
E(kvar)：reactive energy

Function icons instruction:

 : Access to table.

 : Access to trend.

: Select the parameters to be displayed on the trend interface.

: Reset the analyzer and clear the counting to zero.

3.3 Harmonics

Harmonics function measure and record harmonics and interharmonics up to the 100th, harmonic power up to 50th. 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. K factor is displayed on the header of the harmonic current screen. K factor is a numerical value qualified the potential loss caused by the harmonic current in the transformer. High order harmonics have greater influences than low order harmonics. The calculation method of K factor can be selected in the <Setup> screen.

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

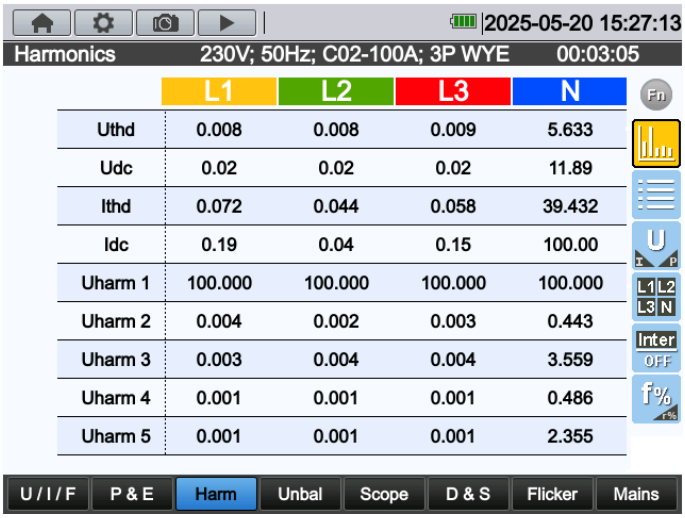
✧ **Bar Graph Screen**

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. The display can show the percentage of each harmonic ratio.

Click corresponding position on the screen or use【◄】【►】arrow keys to position the Cursor on particular bar. The screen header will show voltage/current, percentage frequency and phase angle corresponding to the harmonic. If not all bars are shown on the screen, view the next bars by moving the Cursor to the extreme left or right of the screen.

✧ **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:

: Access to graph.

: Access to table.

: Switch among voltage, current and power display.

: Select phase to be displayed.

: Turn on/off interharmonic display.

: the percentage of harmonic component and fundamental signal.

: the percentage of harmonic component and signal RMS value.

3.4 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.

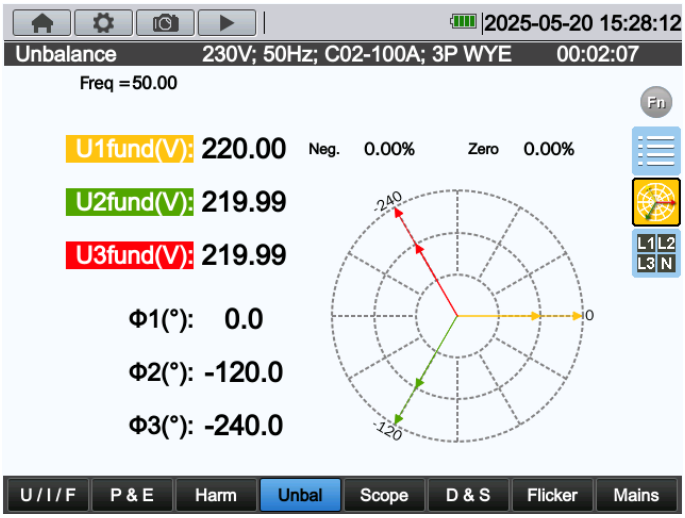
✧ **Table**

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 icons instruction:

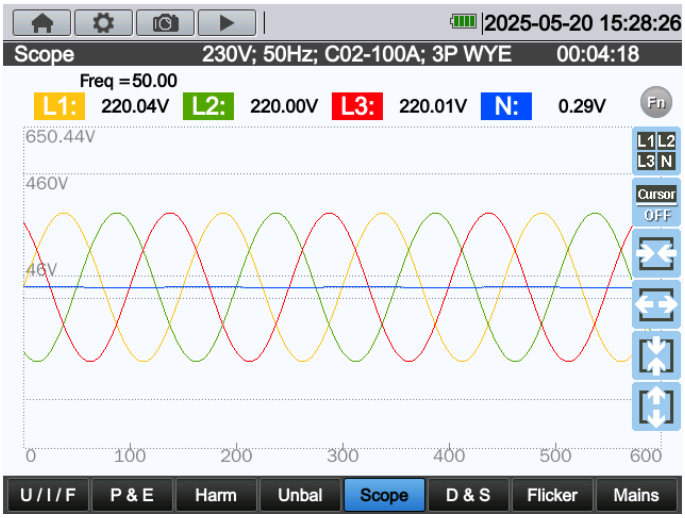
: Access to table interface.

: Access to phasor interface.

: Select the phases desired to display in the phasor interface.

3.5 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 icons instruction:

: Select the waveform to be displayed

: Open/close the cursor function.

: Horizontally zoom in/out waveform.

: Vertically zoom in/out the waveform.

: Open the cursor, move cursor to the left or right.

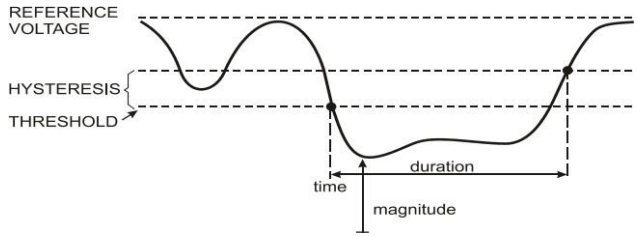
3.6 Dips and Swells

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

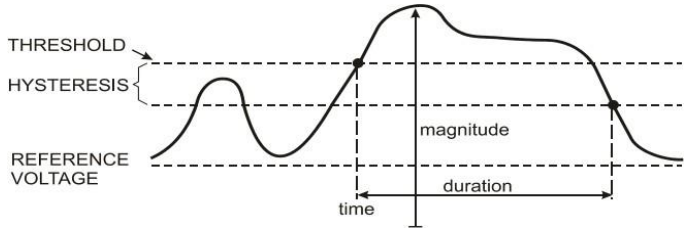
Dips and Swells are fast deviations from the normal voltage. Duration may vary from a half cycle to a few seconds.

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. The following figure explains this.

✧ **Characteristics of a voltage dip**

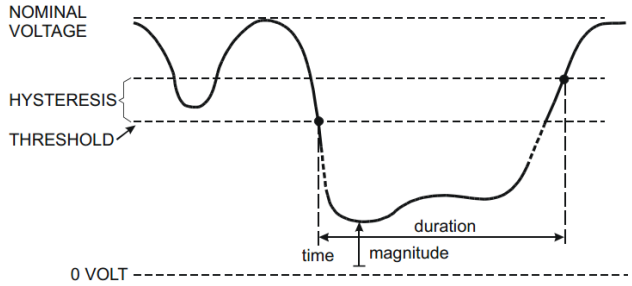


✧ **Characteristics of a voltage swell**



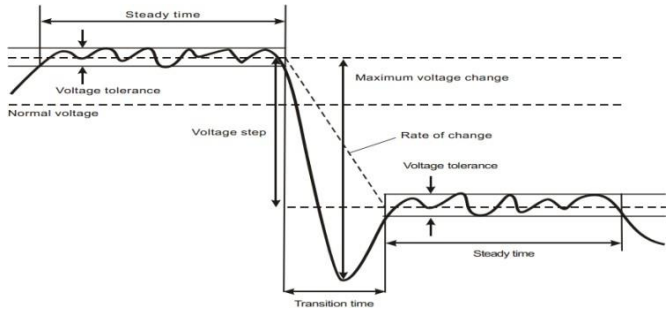
During an Interruption the voltage sinks well below its nominal value. In 3-phase systems, an Interruption begins when the voltages on all phases are below threshold and ends when one phase is equal to or above the interruption threshold plus hysteresis. The trigger conditions for interruptions are threshold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

✧ **Characteristics of a voltage interruption**

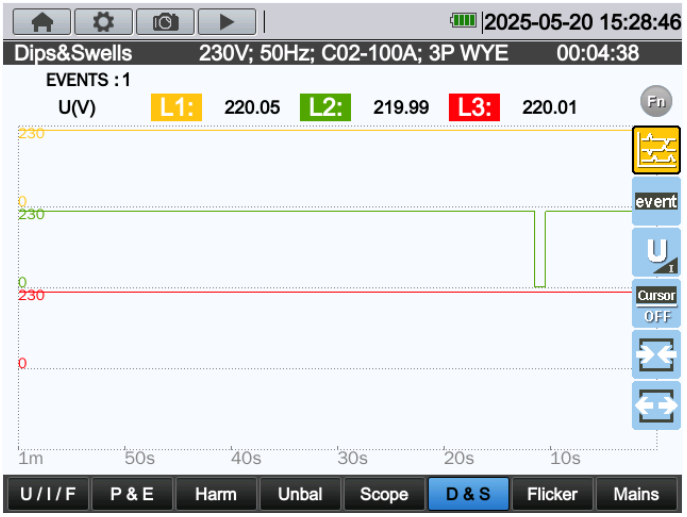


Rapid voltage changes are quick transitions of the RMS voltage between two steady-states. Rapid voltage changes are captured based on steady voltage tolerance, steady time, minimum compensation and minimum rate detected. When voltage change exceeds dip or swell threshold, it is considered as Dip or Swell 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 the following figure.

✧ **Characteristics of a rapid voltage change**



✧ **Trend**



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

Function keys instruction:

: Access to Trend.

: Access to Events tables.

: Switch between voltage and current parameters display.

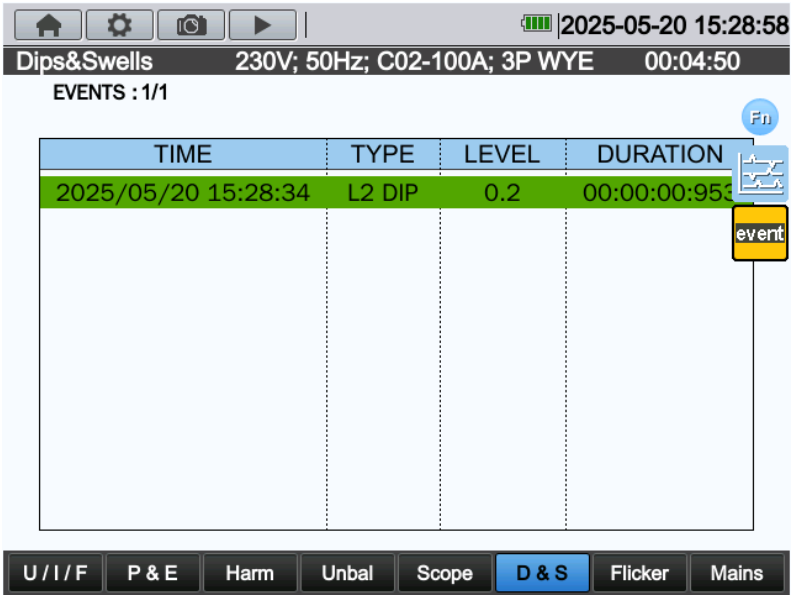
: Open /close Cursor function.

: Horizontally zoom in/out trend graph.

: Open the cursor, move cursor to the left or right.

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

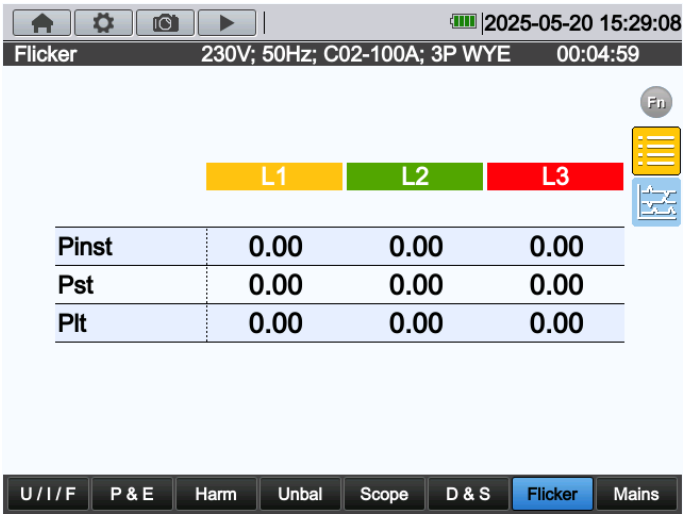
RVC changing of fast voltage

3.7 Flicker

Flicker is the cumulative effect of voltage fluctuations over a period of time, which is reflected through the visual sensation caused by unstable lighting illuminance, and is mainly measured by the short-term flicker Pst and the long-term flicker Plt. The measurement algorithm complies with the IEC 61000-4-15. The larger the flicker reading is, the more unpleasant feeling caused by the brightness changing from the majority people. Two weighting curves can be selected between 120 V/60 Hz and 230 V/50 Hz. The Trend screen shows changes of instantaneous flicker sensation level over time.

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

✧ **Table**



Parameters instruction:

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

Function icons instruction:

: Access to Table interface.

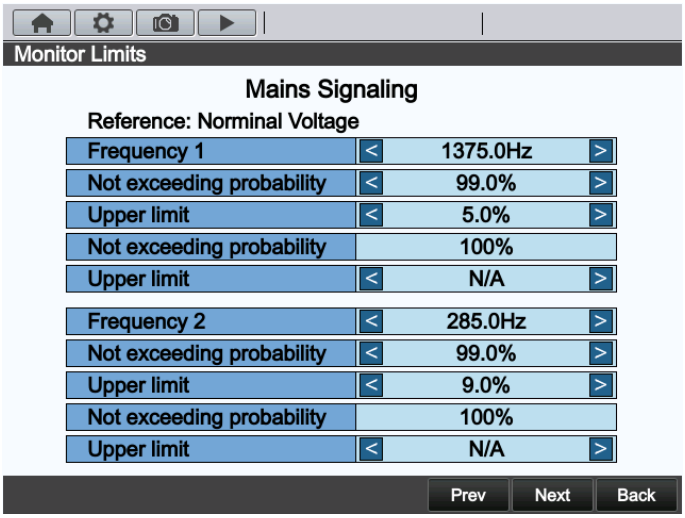
: Access to trend interface.

3.8 Mains Signaling

Power distribution system usually transfer control signal to remotely turn on and off the instrument (Ripple control). And the control signal's frequency is usually higher than the normal 50Hz and 60Hz, which can be up to 3kHz, but its amplitude is far lower than the nominal voltage's amplitude. Control signal only appears when remote control instrument is needed.

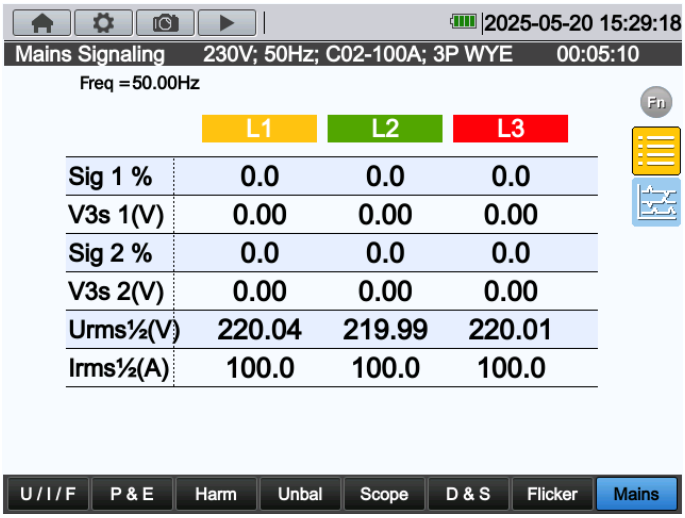
This function can capture the control signal voltages under two different frequencies. The frequency range for the 50 Hz system is 60.0 to 2500.0 Hz and for the 60 Hz system is 70.0 to 3000.0 Hz.

Frequency 1 and Frequency 2 can be set by pressing 【SETUP】key, click <Limits> as following pictures shown.



After frequency setting completed, then return to Limits interface, click <Store> to store this setting.

✧ **Mains Signaling running interface**



Parameters instruction:

Sig 1 %: Voltage percentage of signal 1.

V3s 1(V): 3S average voltage of signal 1.

Sig 2 %： Voltage percentage of signal 2.

V3s 2(V): 3S average voltage of signal 2.

Urms1/2(V): RMS value of voltage half cycle.

Irms1/2(A): RMS value of current half cycle.

Function icons instruction:

: Access to Table interface.

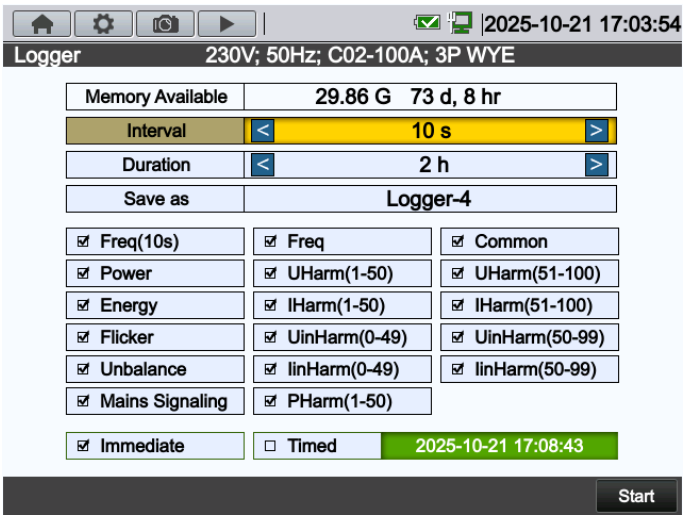
: Access to Trend interface.

: Select the parameters desired to display in Trend.

3.9 Logger

Logger function is used to record a group of measurement data as your selected parameter, the interval selected from 1s to 60 minutes. 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. Select <Logger> in the main menu screen to enter into logger setting interface.

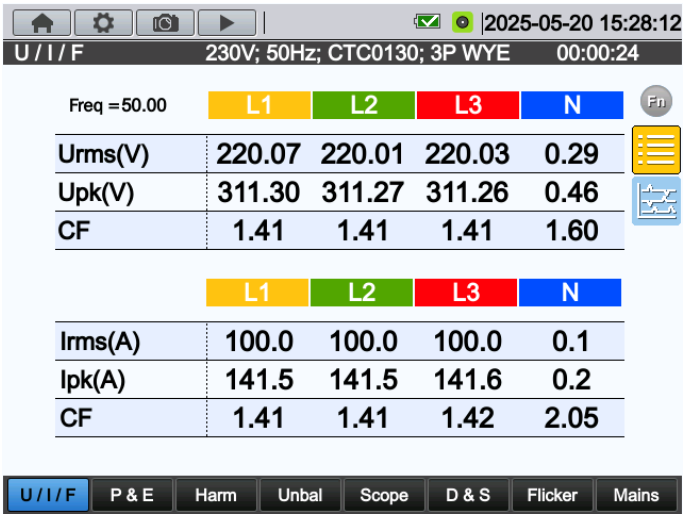
✧ **Logger setting interface**



Here user can check remaining storage space, choose the needed logger parameters, set record interval, duration time and name of stored file, choose to start immediately or at a set time.

The record file is saved in the set folder as PQA2 format. Copy record file to PC, you could open and view by the provided PQA View software in U disk. The maximum recording time depends on the remaining storage space and time interval.

✧ **Logger Running Interface**



When Logger is running, the display screen is the same as the measurement screen, the status icon shows that the data is being recorded, this allows user to view real time data while recording. During the recording, press【Menu】or 【Setup】 key, dialog box will pop up to remind user whether to stop the current record, you can stop the record in advance according to the prompt, or click the area outside the dialog box to back the current record.

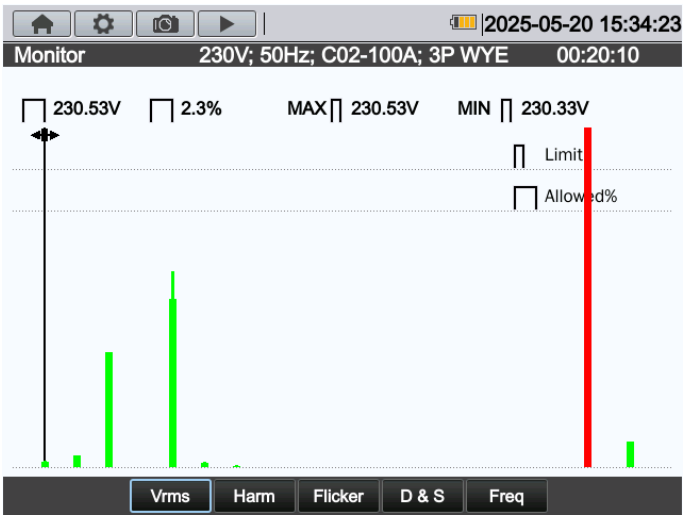
3.10 Monitor

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.

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.

✧ **Monitor Running Interface**



Parameters include:

①RMS voltages

②Harmonics

③Flicker

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

⑤Unbalance, and Frequency

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 L1/A,L2/B,L3/C.The parameters Dips/Interruptions/Rapid Voltage Changes/Swells and Unbalance/Frequency have a single bar for each parameter representing performance across three phases. The bigger difference the relevant parameters from the nominal value, the wider the bar become. The bar will change from green to red if the measurement value exceed the permitted limit requirements.

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 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.

The below signs used in the title bar.

 : the setting x% limit value

 : 100% limit value

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.

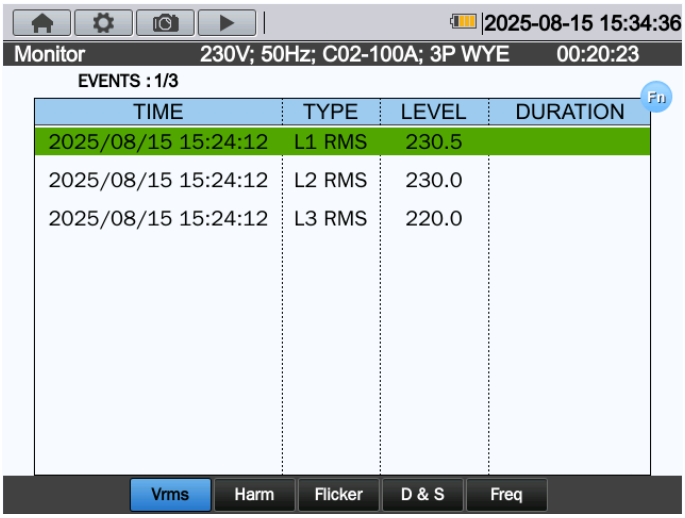
The table below gives a survey of the aspects of Power Quality Monitoring:

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

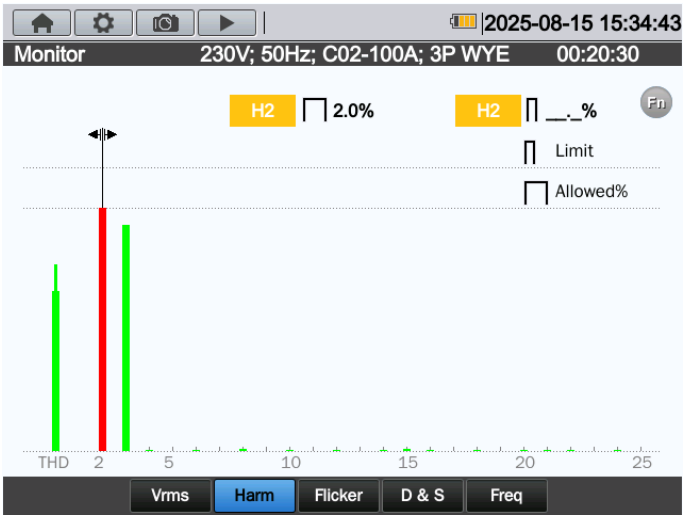
Monitor details can be viewed through the function options at the bottom:

- **RMS voltages screen**



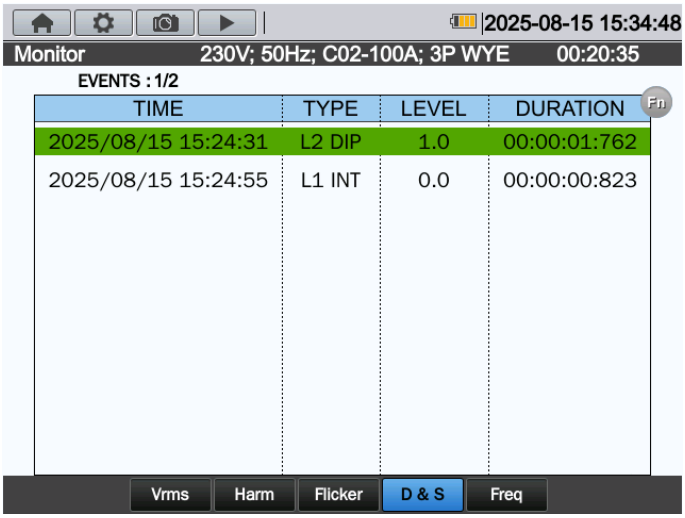
RMS voltages screen displays peak values of the RMS voltage for each phase during the measurement period.

✧ **Harmonics Screen**



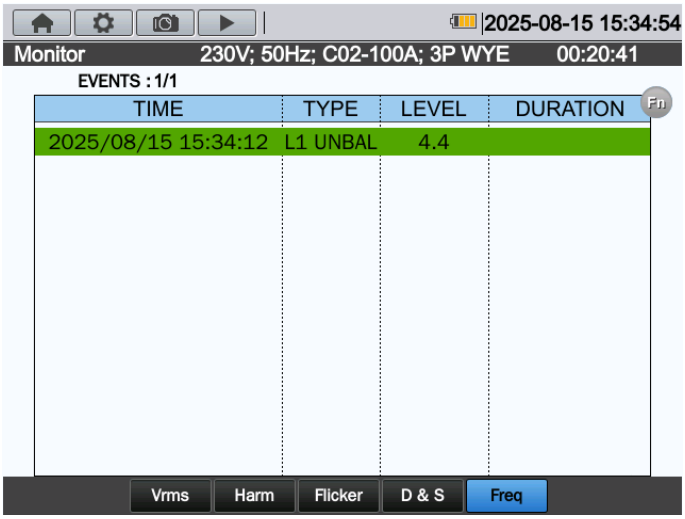
Harmonics screen displays the Bar Graphs for 25 harmonics and Total Harmonic Distortion (THD) of each phase. Each Bar Graph has a wide base (representing an adjustable limit of e.g. 95%) and a narrow top (representing the limit of 100%). A Bar Graph changes from green to red if the limits for that harmonic are violated.

✧ **Dips & Swells Screen**



Dips & Swells screen displays the event lists during the measurement, including time, type, level and duration.

✧ **Frequency and Unbalance Screen**



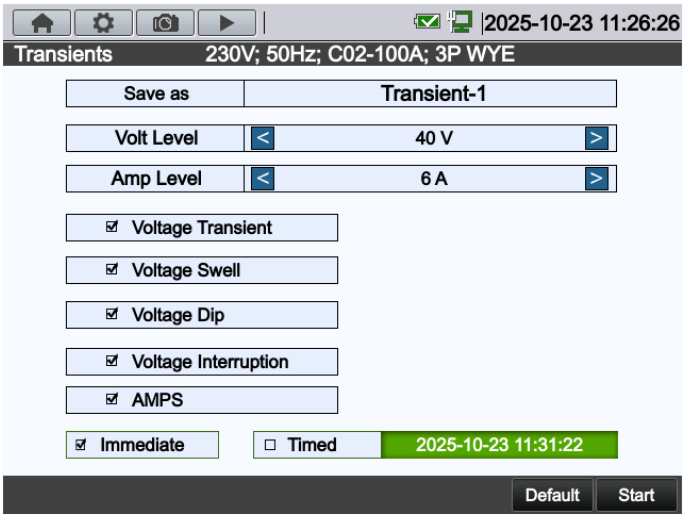
Frequency and Unbalance screen displays the event lists during the measurement, including time, type and level.

3.11 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.

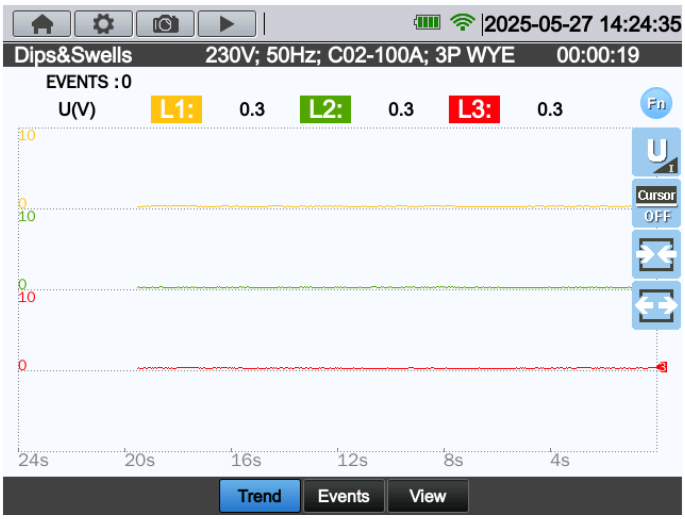
The sample rate is 200kS/s. The Analyzer can capture voltage waveforms at a precise time, this allows you to see the waveforms during transients. In Transients function, the analyzer's voltage input circuit can capture signals with amplitude up to 6kV.

✧ **Setting interface**



Enter Transients function, you can set the trigger voltage and current, select one or more trigger events, choose to start measurement immediately or timed.

✧ **Trend screen**



Trend screen displays the half cycle RMS voltage (Vrms1/2) and the half cycle RMS current (Arms1/2).

Function icons instruction:

: Switch between voltage and current display.

: Open/ close cursor

: Horizontally zoom in/out trend graph.

 : Open the cursor, move cursor to the left or right.

In addition, there is an event table screen.

✧ **Table screen**

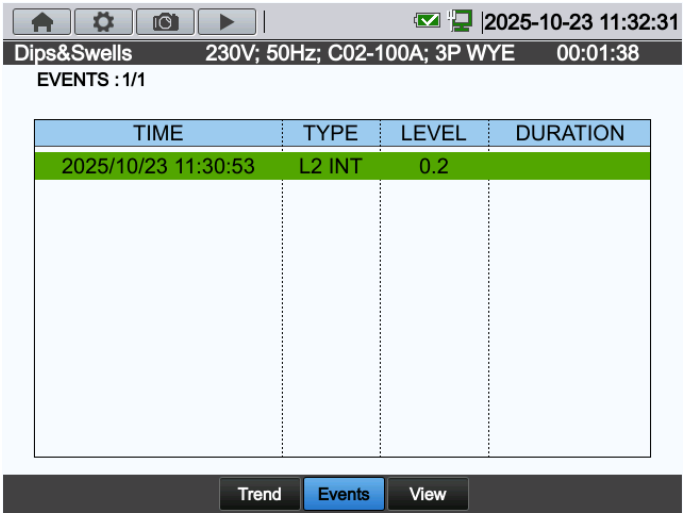
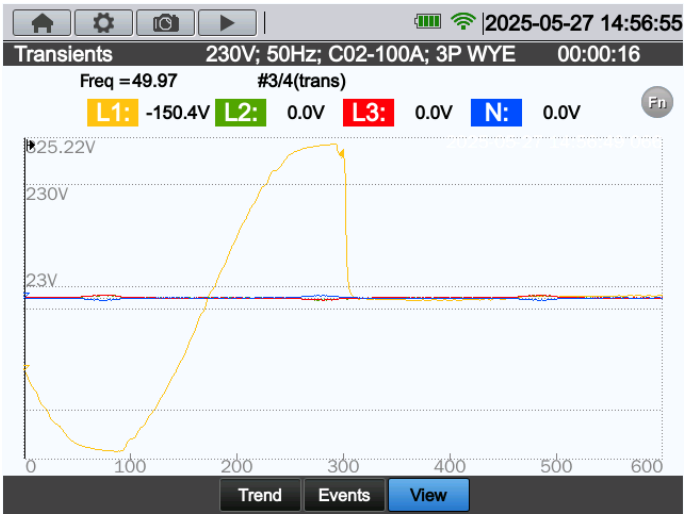


Table screen displays the key characteristics of event, such as: start time, type, level, duration.

View function can View the captured waveforms on the Analyzer.

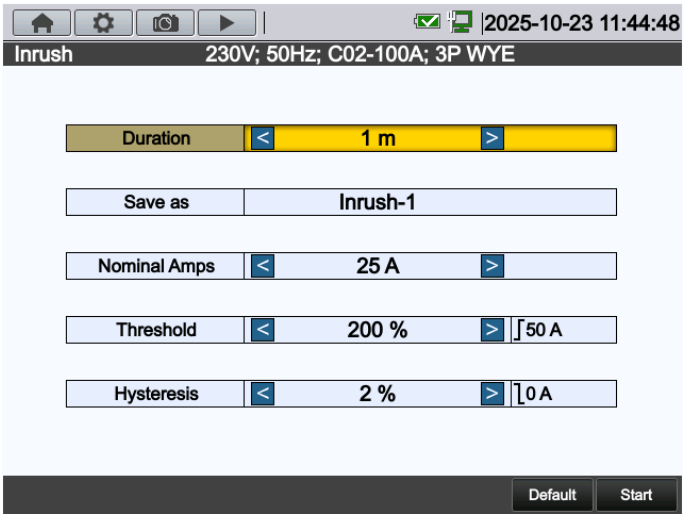
✧ **View screen**



3.12 Inrush currents

Inrush currents are surge currents that occur when a large, or low-impedance load comes on line. For example the start-up current in induction motors can be several times than the normal working current. Enter Inrush function, first set the inrush duration time, nominal current, threshold and hysteresis.

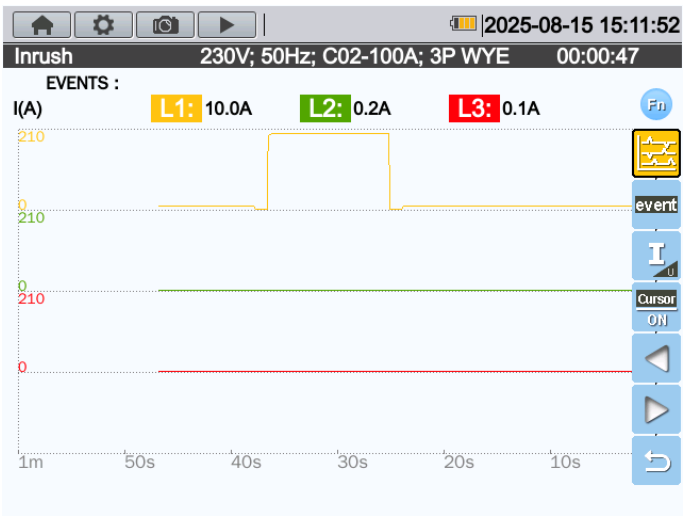
✧ **Setting interface**



The setting value for the duration time should be higher than the expected inrush duration time to ensure to capture the entire event process. Nominal current is the normal operating current of the circuit. Threshold is the current level that triggers the trend capture, when half cycle RMS current exceed the setting limits, Inrush current occurs, when half cycle RMS current is lower than threshold minus hysteresis, Inrush current ends.

After the measurement began, the trend gradually appeared on the right side of the screen, the 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.

✧ **Trend screen**



Function icons instruction:

: Access to trend screen.

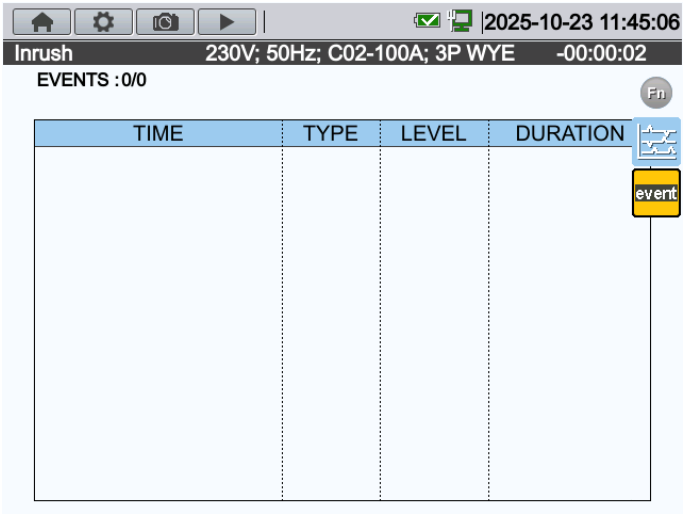
: Access to events list

: Switch between voltage and current display.

: Open/ close cursor

: Open the cursor,move cursor to the left or right.

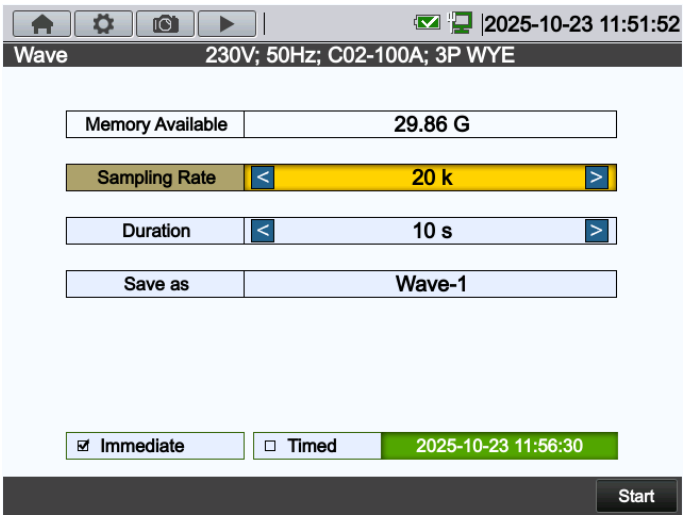
✧ **Events list**



3.13 Wave Record

The waveform of voltage and current could be recorded through this function, the sample rate is up to 20kS/s and the duration time is settable up to10 minutes.

✧ **Setting interface**



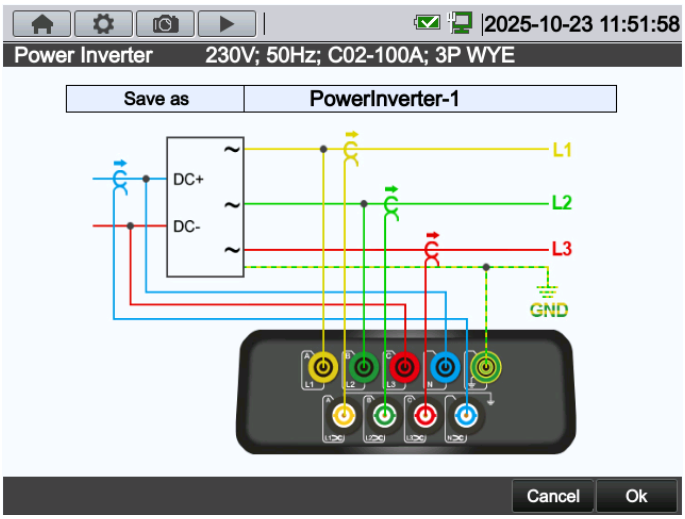
The file with WAV format could be generated after finishing recording and user could review it

through PC software.

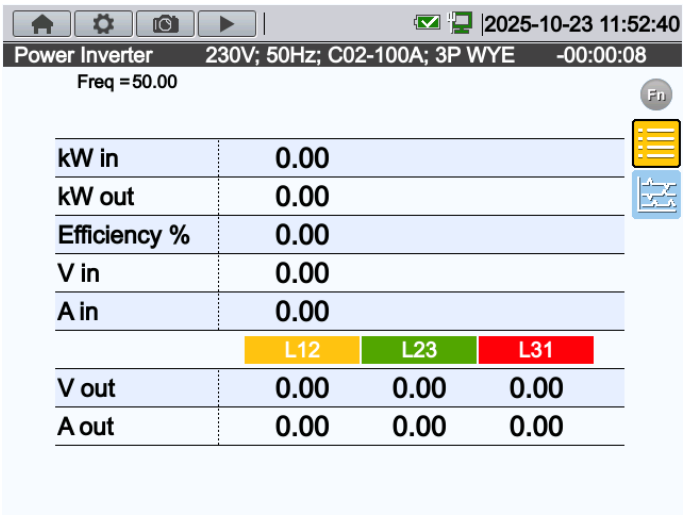
3.14 Inverter Efficiency

This function measure the energy efficiency of the inverter when it inverts single phase direct current to three phase alternative current. For example: solar power system, variable speed drivers and uninterruptible power supply systems. The required unbalance of the three phase AC output voltage should be less than 0.5%. To check the balance status of output voltage from inverter, please use the unbalance function in chapter 3.4.

✧ **Connections**



Enter this function, a clear illustration will appear to guide you how to connect the current and voltage probes to the system. A DC current clamp and three AC current clamps are required in the measurement. Select the current clamps in the <Setup>interface, N phase select DC current clamp.



Parameters instruction:

kW in: Input DC current power

kW out: Output AC current power

Efficiency %: Inverter efficiency

V in: Input DC voltage

A in: Input DC current

V out: Output AC voltage (RMS)

A out: Output AC current (RMS)

Function icons instruction:

 : Access to Table interface.

 : Access to Trend interface.

3.15 Data Flag

During the dips, swells and interruptions, the measurement results of some parameters may be unreliable, the data flag function could avoid the same signal event being used repeatedly in different parameters measurements and indicate the accumulated value may be unreliable.

When monitor or logger function is running, the measurement data will be flagged if the signal reaches to the setting event trigger threshold. You can choose whether use the flagged data when use the PC software to analyze data.

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: 15

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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	5MΩ

5.3 Current Input

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

5.4 Sampling System

Resolution	16 bits
Sampling rate	200kS/s, 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, harmonic power, K factor
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
Mains Signaling	Averaged relative signaling voltage and absolute signaling voltage within 3s on two optional frequencies.
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 120~400Vrms 400~1000Vrms	0.001Vrms 0.01Vrms 0.1Vrms	Udin<100V: ±0.2V Udin>100V: ±(Udin ×0.2%)
Note: Udin: nominal voltage, range 100V~690V			
Vpk	1~1400Vpk	0.01Vpk	±5% of nominal voltage
V(CF)	1.0~>2.8	0.01	±5%
Arms (current clamps error not include) 10mV/A 1mV/A Flexible current clamps	 0~150 A 1 A~2000 A 10 A~6000 A	According to the range of current clamps × current ratio, totally 5digits	 ±(0.1%reading+0.05%range) ±(0.1%reading+0.05%range) ±(0.1%reading+0.1% range)
A(CF)	1~10	0.01	±5%
Note: Accuracy of using current clamps measurement=accuracy of analyzer + accuracy of current clamps(CT) For example: measuring 1000 A with C07-3000A current clamp, the accuracy calculation is as follows: At the center position, the accuracy is: ±(0.1% ×1000 + 0.1% ×6000 + 1% ×1000) = ±17 A. At other positions, the accuracy is: ±(0.1% ×1000 + 0.1% ×6000 + 3% ×1000) = ±37 A.			

Below CT represents the accuracy of current clamps.			
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	Ref to Vrms	±0.5% nominal voltage
Arms1/2	According to current Clamps	Ref to Arms	±(0.2%reading+ 0.2%range+CT)
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) Interharmonic order(400Hz) Harmonic order (50/60Hz) Interharmonic order(50/60Hz) THD Frequency Phase	1~12 No 1~100 0~99 0.0~100.0% 0~6000Hz -180 °~180 °	 0.01% 0.01Hz 0.1 °	 ±2.5% 0.1Hz ±n×0.1 °(n represents harmonic order)
Absolute voltage	0~1000V	Ref to Vrms	±5% reading (harmonics >1% nominal value) ±0.05% nominal value (harmonics <1% nominal value)
Absolute current	According to current clamps	Ref to Arms	±5% reading (harmonics >3% nominal value) ±0.05% measurement range (harmonics <3% nominal value)

Harmonic power(50/60Hz) Harmonic power(400Hz)	1-50th 1-12th	Min 0.01kW	±(5%+ n×2% +CT) (n represents harmonic order)
K factor	1-50	0.01	±10% (Irms≥1%current range)

Power and energy	Measurement range	Resolution	Accuracy
P, S, Q1,	Depends on clamp and nominal voltage	Min 0.01kW	±(1%±10 counts+CT)
PF	0~1	0.01	±0.01
cosΦ	0~1	0.01	±0.01
kWh, kVAh, kvarh	Depends on clamp and nominal voltage		±(1%±10 counts+CT)

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	0.00~30.00%	0.01%	±0.1%
Current unbalance	0.00~30.00%	0.01%	±1%
Voltage phase	-360°~0°	0.1°	±0.1°
Current phase	-360°~0°	0.1°	±0.5°

Transients	Measurement range	Resolution	Accuracy
Vpk	±6000Vpk	0.01V	±15%
Vrms	10~1000Vrms	0.01V	±2.5%
Minimum test time	5μs		
Sampling rate	200kS/s		

Inrush current	Measurement range	Resolution	Accuracy
Arms	According to current clamps	Ref to Arms	±(1%±CT)
Inrush duration time	1~32 min settable	10ms	±20ms

Mains Signaling	Measurement range	Resolution	Accuracy

Threshold level	Threshold value, limit value and Signaling lasting time can be programmed according to the two signaling frequency.		
Signaling frequency	60~3000 Hz	0.1 Hz	
Relative V%	0% ~ 100%	0.1%	±0.4%
Absolute V3s (3s average)	0.0 ~ 1000 V	0.1 V	±5% of Nominal voltage

Logger	
Duration Time	2hrs ~ 1 year, depends on the recording items and time interval
Interval	1s ~ 60mins
Memory	Data stored in Micro SD card, 32GB

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 touch screen
Size	5.6 inch
Resolution	640×480

Brightness	Adjustable

Memory	
Flash memory	1G
Micro SD	Standard 32GB

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

Environment	
Working temperature	0℃~ 45 ℃
Storage temperature	-10 ℃~45 ℃
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	W×H×D ≤200mm ×270mm×68mm
Weight	Approximate 2 kg

Power	
Model	M20-1202
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
C01-5A	AC:0~5A	10mV/A	0.2%	Φ8
C02-100A	AC:0~100A	10 mV/A	0.2%	Φ8
C03-200A	AC:1~200A	1 mV/A	0.2%	Φ13
C04-1000A	AC:1~1000A	1 mV/A	1.0%	Φ52
C05-1000AD	AC/DC:1~1000A	1 mV/A	3.0%	30x35
C06-1500A	AC:10~1500A	100 mV/1000A	0.5%+(1% position error)	Φ110
C07-3000A	AC:15~3000A	65 mV/1000A	1.0%+(2% position error)	Φ160
C08-6000A	AC:20~6000A	65mV/1000A	1.0%+(2% position error)	Φ250