Three Phase Power Quality Meter

PEM5000 Series

User Manual

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Contents

1 PRODUCT OVERVIEW 1

2 FUNCTIONS AND MODEL SELECTION 1

2.1 FUNCTION 1

2.2 TECHNICAL SPECIFICATIONS 7

3 MODELS AND NAMING RULES 11

3.1 NAMING RULES 11

3.2 MODELS 12

4 DIMENSIONS, INSTALLATION AND WIRING 14

4.1 DIMENSIONS 14

4.2 PRECAUTIONS 16

4.3 TERMINAL DESCRIPTION 16

4.4 WIRING MODES 18

5 RECORDING 25

5.1 DATA LOGGER 25

5.2 EVENT RECORDING 26

5.3 WAVEFORM RECORDING 28

5.4 RECORD MANAGEMENT 29

6 OPERATION AND DISPLAY 31

6.1 FUNCTION OVERVIEW 32

6.2 INTERFACE OVERVIEW 33

6.3 PARAMETER SETTINGS SCREEN 35

6.4 POWER SYSTEM SETTINGS 37

6.5 SYSTEM SETTINGS 51

6.6 USER SETTINGS 61

6.7 RESET 67

6.8 MEASUREMENT SCREEN 69

6.9 VOLTAGE AND CURRENT SCREEN 70
6.10 POWER SCREEN 71
6.11 ENERGY SCREEN 72
6.12 HARMONICS SCREEN 73
6.13 WAVEFORM SCREEN 75
6.14 PHASOR DIAGRAM SCREEN 77
6.15 UNBALANCE SCREEN 78
6.16 DEMAND SCREEN 79
6.17 RECORDING SCREEN 81
6.18 DATA LOGGER 82
6.19 WAVEFORM RECORDER 85
6.20 RECORD MANAGEMENT 87
6.21 STORAGE CAPACITY 92
7 OPERATION AND MENU STRUCTURE 94
7.1 MEASUREMENT MODULE 94
7.2 RECORDING MODULE 97
7.3 SETTINGS MODULE 98

1 Product Overview

The PEM5000 three phase multifunction power quality meter measures and meters single phase or three phase electrical systems and monitors power quality. It measures voltage, current, power, energy, power factor, harmonics and unbalance, with four current inputs for A, B, C and N. PEM5353 accepts Rogowski coils or compatible mV-output CTs; PEM5553 accepts 1 A / 5 A CTs. Do not mix these input types.

The meter provides six-tariff metering, demand statistics, phase sequence detection, minimum/maximum values, event logging, digital inputs and relay outputs. RS-485 (Modbus RTU) and Ethernet (Modbus TCP) enable integration with host systems for energy management, power monitoring and distribution panels.

2 Functions and Model Selection

2.1 Function

Model	PEM5353-A	PEM5553-A	PEM5353-D	PEM5553-D	PEM5353-H	PEM5553-H
CT Type	Rogowski coil / mV CT	1 A / 5 A CT	Rogowski coil / mV CT	1 A / 5 A CT	Rogowski coil / mV CT	1 A / 5 A CT
Auxiliary Supply	85 – 305V AC / 100 – 430V DC	85 – 305V AC / 100 – 430V DC	18 – 36V DC	18 – 36V DC	90 – 528V AC	90 – 528V AC
Real-time Measurements						

Phase voltage	U1, U2, U3, AVG, U0 (zero-sequence voltage)
Line-to-line voltage	U12,U23,U31,AVG
Current	I1, I2, I3, AVG; neutral current I_N is measured or calculated according to the wiring mode
Frequency	F1, F2, F3, Σ (overall)
Power factor	PF PF1, PF2, PF3, Σ (overall)
Fundamental power factor	DPF DPF1, DPF2, DPF3, Σ (overall)
Active power	P1, P2, P3, Σ (total)
Reactive power	Q1, Q2, Q3, Σ (total)
Apparent power	S1, S2, S3, Σ (total)
Energy	
Imported active energy	EP1, EP2, EP3, Σ (total). Display limits and rollover behavior depend on the firmware.
Exported active energy	EP1, EP2, EP3, Σ (total). Display limits and rollover behavior depend on the firmware.
Forward reactive energy	EQ1, EQ2, EQ3, Σ (total). Display limits and rollover behavior depend on the firmware.
Reverse reactive energy	EQ1, EQ2, EQ3, Σ (total). Display limits and rollover behavior depend on the firmware.

Apparent energy	ES1, ES2, ES3, ∑ (total). Display limits and rollover behavior depend on the firmware.
Tariff energy	ET1, ET2, ET3, ET4, ET5, ET6. Display limits and rollover behavior depend on the firmware.
Demand	
Demand	Total active, reactive and apparent power
Maximum total active power demand	Maximum demand and timestamp
Maximum total reactive power demand	Maximum demand and timestamp
Maximum total apparent power demand	Maximum demand and timestamp
Harmonics	
Voltage harmonics (%)	THD (U1, U2, U3), odd and even harmonics (U1, U2, U3), individual orders 1 – 50 (U1, U2, U3)
Current harmonics (%)	THD (I1, I2, I3), odd and even harmonics (I1, I2, I3), K-factor (I1, I2, I3), individual orders 1 – 50 (I1, I2, I3)
Voltage harmonic values	Total harmonics and individual orders 1 – 50 (U1, U2, U3)
Current harmonic values	Total harmonics and individual orders 1 – 50 (I1, I2, I3)

Maximum and Minimum Values	
Phase voltage	Each phase and average
Line-to-line voltage	Each phase and average
Current	Each phase and average
Active power	Each phase and total power
Reactive power	Each phase and total power
Apparent power	Each phase and total power
Unbalance	
Voltage unbalance	Negative sequence, zero sequence
Current unbalance	Negative sequence, zero sequence
Current K-factor and Crest Factor	
Current K-factor parameters	K-factor calculation method / EU parameter e / EU parameter q
Current K-factor	A/B/C phase current K-factor
Current crest factor	A/B/C phase current crest factor
Voltage crest factor	A/B/C phase voltage crest factor
Phasor Diagram	
Phasor diagram	Voltage and current phasor display

Phase sequence	Voltage, current
Voltage angle	U1,U2,U3
Current angle	I1,I2,I3
Voltage/current angle	UI1,UI2,UI3
Event Parameters	
Swell, dip and interruption events	Voltage swell / voltage dip threshold / voltage interruption threshold
Phase labels	Phase label names / phase colors
Data Logger	Instantaneous values / energy / demand / harmonics / unbalance
Waveform Recorder	Configurable sampling rate and duration
Energy threshold alarm	■
DI/DO	■
Modbus RTU	■
Modbus TCP	■

1) Recording and Storage Functions — Data Record Types

Item	Status
Recording start time	Configurable

Recording end time	Configurable
Recording interval	Configurable

2) Basic Data Records

Data category	Contents
Real-time measurement records	Voltage, current, zero sequence, frequency, power, power factor and fundamental power factor
Energy records	Forward/reverse active and reactive energy; apparent energy
Demand records	Selected demand, maximum demand and timestamp, saved as configured
Harmonic records	Voltage/current THD, odd/even harmonics, fundamental and orders 2 – 50
Unbalance records	Voltage/current negative and zero sequence

3) Harmonic Data Records

Type	Contents
Voltage harmonics	THD, odd/even harmonics, fundamental and orders 2 – 50
Current harmonics	THD, odd/even harmonics, K-factor, fundamental and orders 2 – 50

4) Event Records

Event item	Contents
Event type	System event types
Recorded information	Event time, recovery time and corresponding value

5) File Formats

Data record format: CSV

Event record format: CSV

6) Recording Notes

Records are generated only when recording is enabled.

Data can be exported for analysis or reports.

2.2 Technical Specifications

	PEM5353-A	PEM5553-A	PEM5353-D	PEM5553-D	PEM5353-H	PEM5553-H

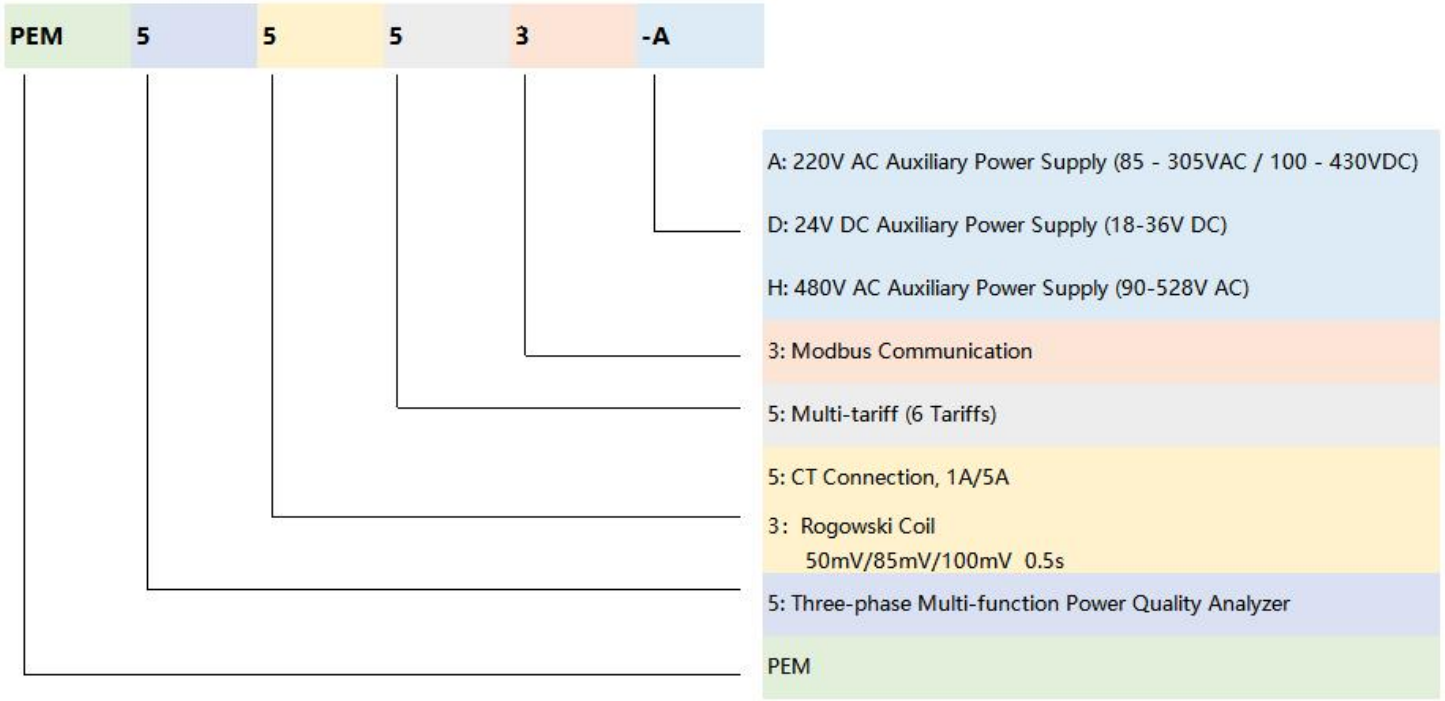
CT Connection	Rogowski coil	1 A / 5 A CT Rated secondary current 1 A / 5 A	Rogowski coil	1 A / 5 A CT Rated secondary current 1 A / 5 A	Rogowski coil	1 A / 5 A CT Rated secondary current 1 A / 5 A
Rogowski Coil	50 / 85 / 100mV /kA@50Hz(0-7000A),@60Hz(0-6000A)	Not applicable	50 / 85 / 100mV /kA@50Hz(0-7000A),@60Hz(0-6000A)	Not applicable	50 / 85 / 100mV /kA@50Hz(0-7000A),@60Hz(0-6000A)	Not applicable
Measured voltage	L-N: 0 ~ 720VAC					
Frequency range	45-65 Hz 1P+N, 3P,3P+N					
Measurement Accuracy						
Current accuracy	Meter: ±0.1%; system error depends on sensor ratio and phase errors					
Voltage accuracy	±0.2% (within the effective measurement range)					
Power frequency	±0.01% (45–65 Hz); power factor ±0.005					
Active and apparent power	Nominal measurement error ±0.5%					
Reactive power	Nominal measurement error ±1%					
Active and apparent energy	Active energy: nominal Class 0.5S; apparent energy: ±0.5%; sensor effects are additional					
Reactive energy	Nominal measurement error ±1%; class as specified in the model test documentation					
Digital Signals						
Relay outputs	2 electromagnetic relay outputs; contact rating: 3 A at 30 V DC, 3 A at 250 V AC					

Digital inputs	2 dry-contact inputs, optically isolated (5 kVrms)
Communication	RS-485: Modbus RTU, 2400–38400 bit/s; Ethernet: Modbus TCP
Storage	
Storage type	TF card
Storage capacity	32 GB
Data export	USB export (USB drive must use FAT32)
Mechanical Characteristics	
Dimensions	96 × 96 × 94 mm
Weight	~850g
Environmental Conditions	
Operating temperature	-20℃ ~ +70℃
Storage temperature	-40℃ ~ +85℃
Humidity	5–95% RH (non-condensing)
Pollution degree	Pollution degree 2 (IEC 60664-1)
Overvoltage category	Category III; rated operating voltage is stated on the nameplate. The 720 V measurement limit does not define permitted connection conditions.
Dielectric strength	Power-frequency withstand: 4 kV AC / 1 min, subject to the test conditions for each circuit
Altitude	≤3000 m (IEC 61010-1)

Protection rating	IP20 (IEC 60529)
Technical Reference Standards	IEC 61557-12; IEC 62053-22 (active energy); IEC 62053-23/-24 (reactive energy, as applicable); IEC 61000-4-30 (measurement methods); IEC 61010-1/-2-030. Specific compliance is subject to the test documentation.

3 Models and Naming Rules

3.1 Naming Rules



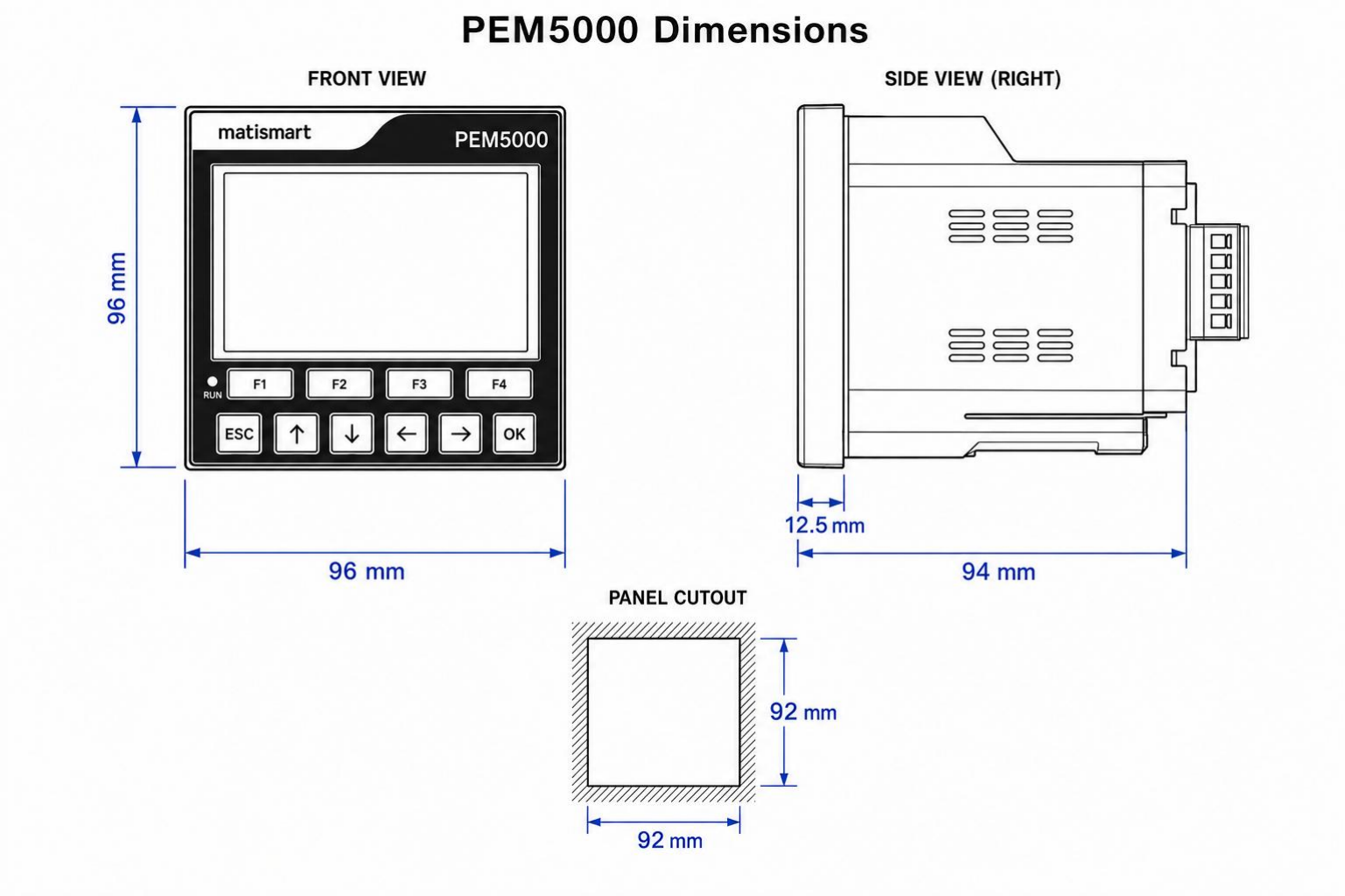
3.2 Models

Model	Function Description	Current Input Terminals	Auxiliary Supply
PEM5353-A	Three phase multifunction power quality meter; Rogowski coil / mV CT input; six tariffs, multiple measurements, Modbus RTU/TCP, DI/DO	Separate sensor terminals	220 V AC auxiliary supply (85–305 V AC / 100–430 V DC)
PEM5553-A	Three phase multifunction power quality meter; 1 A / 5 A CT input; six tariffs, multiple measurements, Modbus RTU/TCP, DI/DO	Screw-type current terminals	220 V AC auxiliary supply (85–305 V AC / 100–430 V DC)
PEM5353-D	Three phase multifunction power quality meter; Rogowski coil / mV CT input; six tariffs, multiple measurements, Modbus RTU/TCP, DI/DO	Separate sensor terminals	24 V DC auxiliary supply (18–36 V DC)
PEM5553-D	Three phase multifunction power quality meter; 1 A / 5 A CT input; six tariffs, multiple measurements, Modbus RTU/TCP, DI/DO	Screw-type current terminals	24 V DC auxiliary supply (18–36 V DC)
PEM5353-H	Three phase multifunction power quality meter; Rogowski coil / mV CT input; six tariffs, multiple measurements, Modbus RTU/TCP, DI/DO	Separate sensor terminals	480 V AC auxiliary supply (90–528 V AC)

PEM5553-H	Three phase multifunction power quality meter; 1 A / 5 A CT input; six tariffs, multiple measurements, Modbus RTU/TCP, DI/DO	Screw-type current terminals	480 V AC auxiliary supply (90–528 V AC)

4 Dimensions, Installation and Wiring

4.1 Dimensions



4.2 Precautions

Follow these requirements to ensure safe, reliable and accurate operation:

(1) Isolate all relevant supplies and verify the absence of voltage before work. Installation and wiring must be performed by qualified electrical personnel. Provide suitable isolation and overcurrent protection for voltage circuits. Never open the secondary circuit of a 1 A / 5 A CT while primary current is flowing; securely short it before disconnection. Wire mV CTs and Rogowski coils to their output specifications; never connect them to 1 A / 5 A inputs. Use shielded twisted pair for RS-485 and verify A/B terminal markings.

(2) External wiring must match the meter wiring mode. Match the voltage and current channels for L1, L2 and L3. Verify phase sequence and sensor polarity against the actual wiring; do not rely solely on meter indications.

(3) Install current sensors according to their polarity markings, normally from supply to load. Reversed polarity changes the sign of active power and the direction of imported/exported energy.

4.3 Terminal Description

Terminal No.	Terminal Name	Function	Notes
1	I1+	Phase A current input +	Current input channel
2	I1−	Phase A current input −	
3	I2+	Phase B current input +	Current input channel
4	I2−	Phase B current input −	
5	I3+	Phase C current input +	Current input channel
6	I3−	Phase C current input −	

7	In+	Neutral N current input +	Neutral current input
8	NC	Unused	No function
9	In−	Neutral N current input −	Neutral current input
10	N / −	Auxiliary supply (negative)	-A: 85 – 305 V AC / 100 – 430 V DC; -D: 18 – 36 V DC; -H: 90 – 528 V AC
11	NC	Unused	No function
12	NC	Unused	No function
13	L / +	Auxiliary supply (positive)	
14	Vn	Measured voltage common reference N	Voltage input channel
15	NC	Unused	No function
16	V3	Phase C voltage input	Voltage input channel
17	NC	Unused	No function
18	V2	Phase B voltage input	Voltage input channel
19	NC	Unused	No function
20	V1	Phase A voltage input	Voltage input channel
21	DIC	Digital input common	2 dry-contact digital inputs
22	DI1	Digital input channel 1	Dry-contact input
23	DI2	Digital input channel 2	Dry-contact input

24	RNC	Relay 2 normally closed contact	Relay 2 output
25	RNO	Relay 2 normally open contact	
26	RCOM	Relay 2 common	
27	RCOM	Relay 1 common	Relay 1 output
28	RNO	Relay 1 normally open contact	
29	RNC	Relay 1 normally closed contact	
30	B	RS-485 terminal B	RS-485 interface
31	A	RS-485 terminal A	
32	LAN	Ethernet port	RJ45（Modbus TCP）
33	Flash Drive USB	USB drive port	Data export (USB storage)

4.4 Wiring Modes

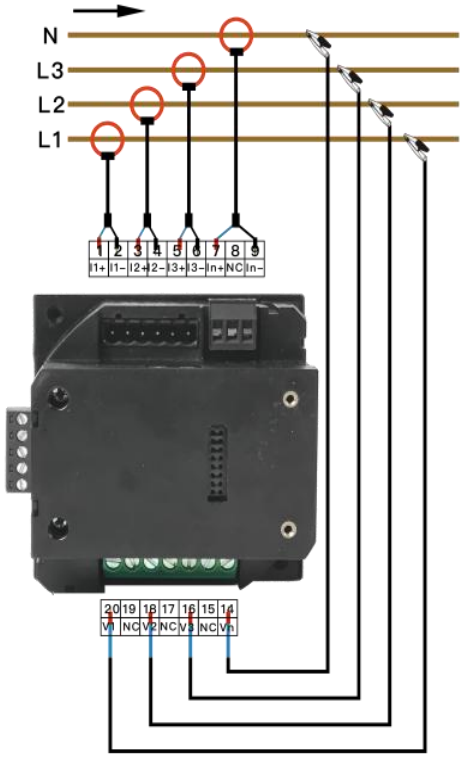
The meter supports the following standard power system connections. External wiring must match the configured wiring mode; otherwise measurement errors or phase sequence warnings may occur.

4.4.1 Three Phase Four Wire, 4 CTs (3P4W－4CT)

Four current sensors measure L1, L2, L3 and neutral N separately.

Neutral current I_N is measured directly by the N-channel sensor.

For four-wire systems requiring independent neutral current measurement. Neutral current is not the same as zero-sequence current.

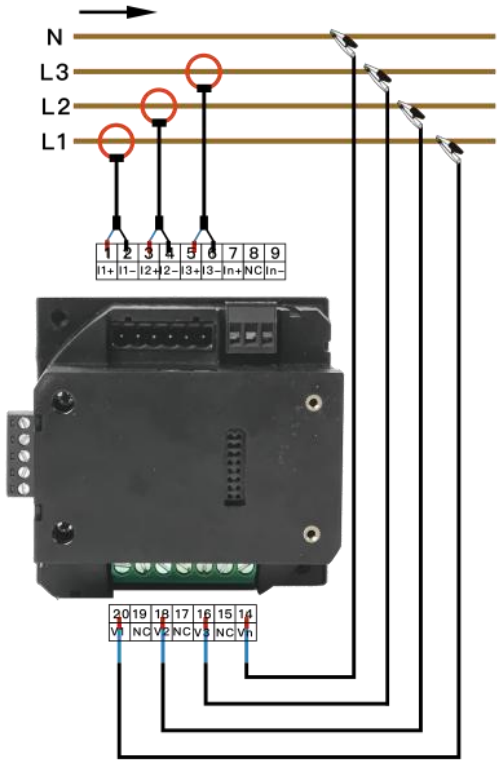


4.4.2 Three Phase Four Wire, 3 CTs (3P4W－3CT)

Three current sensors measure L1, L2 and L3.

With no other return paths, neutral current is calculated as i_N(t)=−[i_L1(t)+i_L2(t)+i_L3(t)].

For systems not requiring independent neutral current measurement. Fundamental zero-sequence current is one third of the phasor sum of the three fundamental phase currents.

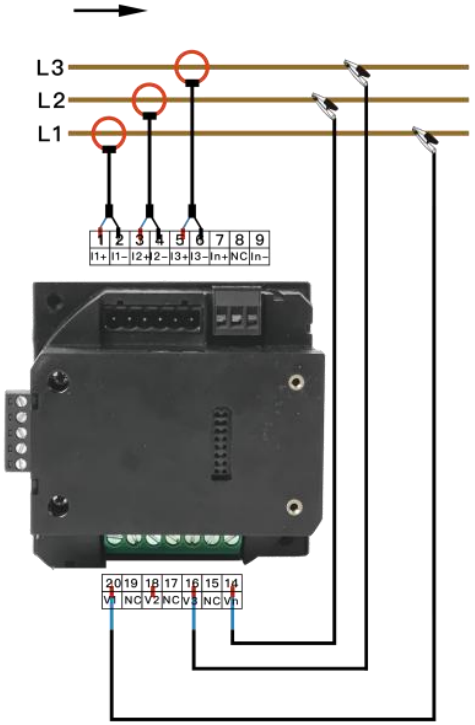


4.4.3 Three Phase Three Wire, 3 CTs (3P3W－3CT)

Three current sensors measure L1, L2 and L3.

All three phase currents are measured directly by their respective sensors.

For typical three-wire industrial three phase distribution systems.

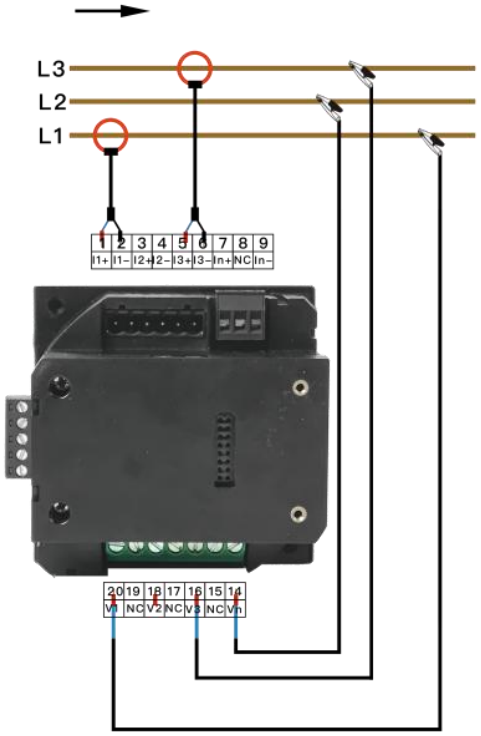


4.4.4 Three Phase Three Wire, 2 CTs (3P3W–2CT)

Two current sensors are installed on L1 and L3.

With no other return paths, L2 current is reconstructed as i_L2(t)= − [i_L1(t)+i_L3(t)]. Total active power uses the two-element measurement principle.

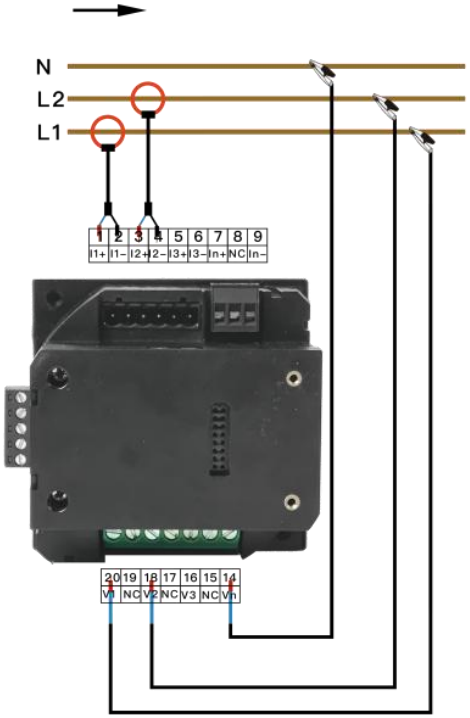
For three-wire systems with two CTs.



4.4.5 Single Phase Three Wire (1P3W)

Full 1P3W measurement requires two L－N voltage inputs and two corresponding current inputs. The diagram below shows only one L1－N branch.

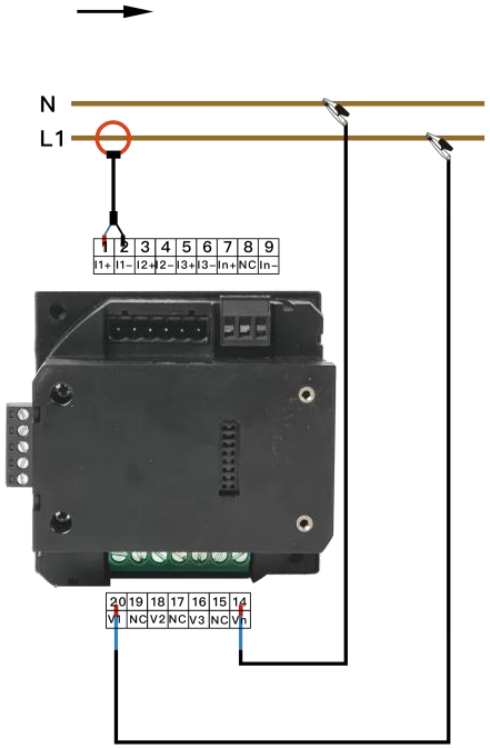
Use 1P2W to measure a single branch. Obtain the complete 1P3W wiring diagram from the manufacturer for the relevant input version.



4.4.6 Single Phase Two Wire (1P2W)

Uses the L－N voltage input and one current sensor.

For standard single phase supply circuits.


N
L1
1 2 3 4 5 6 7 8 9
I1+ I1- I2+ I2- I3+ I3- In+ NC In-
20 19 18 17 16 15 14
V1 NC V2 NC V3 NC Vn

5 Recording

The meter has 32 GB of internal storage for data, event and waveform records. All records are saved as CSV files, exported via USB drive and managed or deleted from the operating interface.

5.1 Data Logger

The meter supports basic data, voltage harmonic and current harmonic logging. Set the record name, start time, duration and interval. Recording starts automatically at the specified time and stops when complete. All records are saved as CSV files for further analysis and processing.

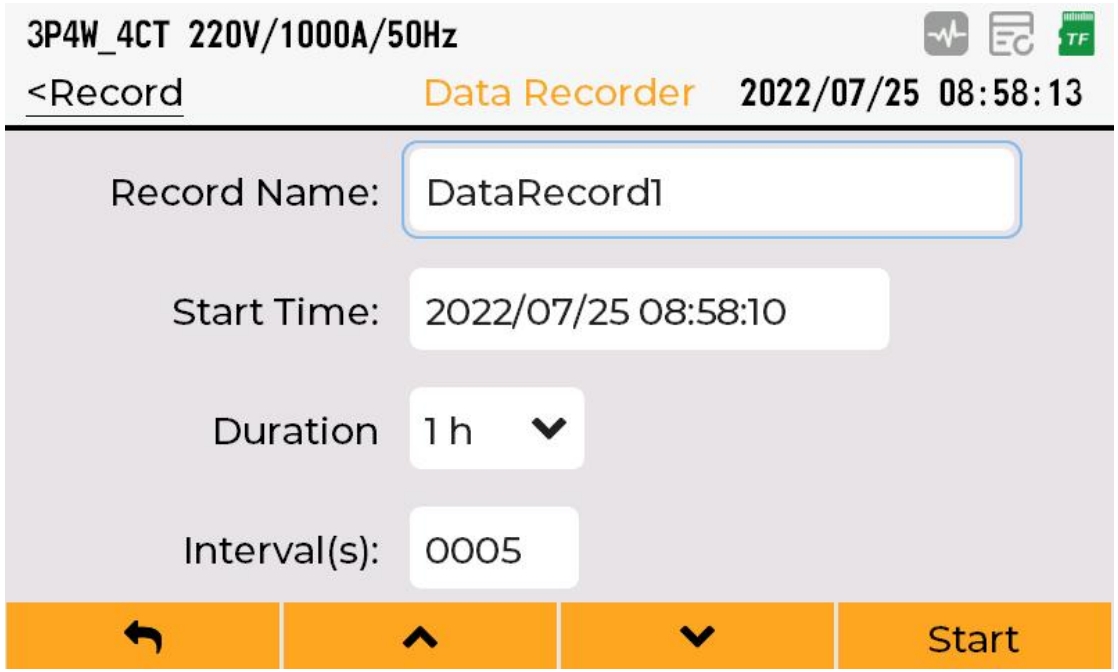


Figure 5-1 Data Logger

5.2 Event Recording

The meter records power quality events including voltage swells, dips, interruptions, frequency events, unbalance events and harmonic events. CSV event records include event type, start time, duration and magnitude.

Voltage swells and dips are short-duration increases and decreases in RMS voltage relative to a reference voltage, described by event voltage and duration using IEC 61000-4-30 terminology. They are not transient overvoltages.

Voltage swell: begins when the RMS voltage of any measured channel exceeds the swell threshold and ends when all channels fall below the threshold minus hysteresis. It is described by maximum voltage, duration and occurrence time.

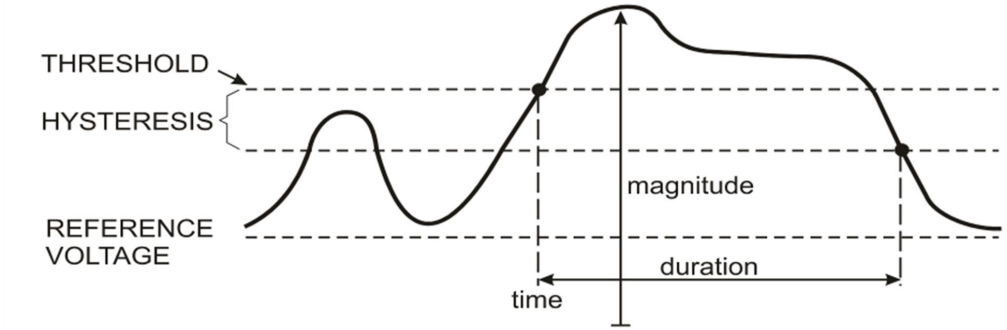


Figure 5-2 Voltage Swell

Voltage dip: begins when the RMS voltage of any measured channel falls below the dip threshold and ends when all channels recover above the threshold plus hysteresis. It is described by residual voltage, duration and occurrence time.

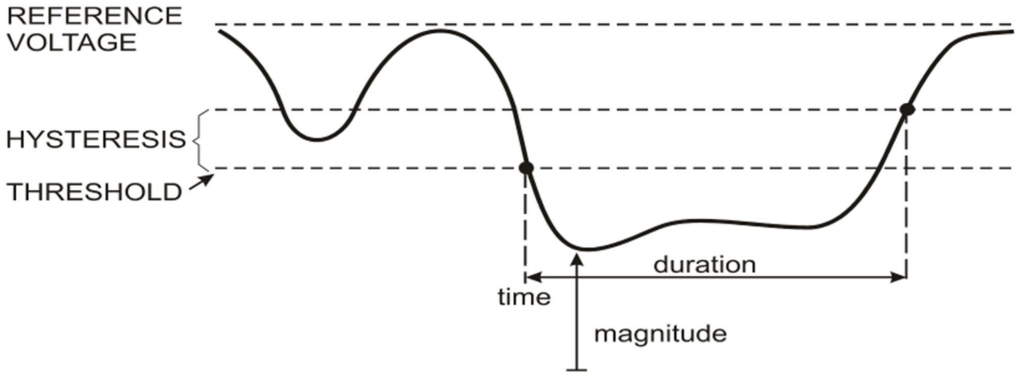


Figure 5-3 Voltage Dip

Voltage interruption: in a multiphase system, begins when all measured voltage channels fall below the interruption threshold and ends

when any channel recovers above the threshold plus hysteresis. Loss of voltage on one channel must be distinguished from a system interruption.

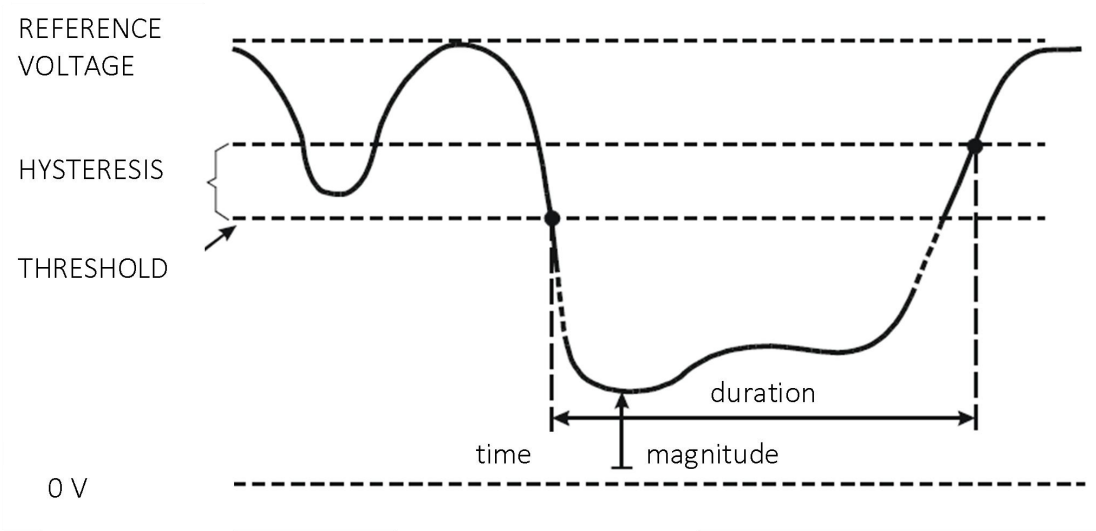


Figure 5-4 Voltage Interruption

Default thresholds are 110% for swell, 90% for dip and 5% for interruption. Hysteresis is 2% of reference voltage for each. These parameters are configurable; they are not fixed IEC limits for every application.

5.3 Waveform Recording

The meter records real-time three phase voltage and current waveforms in CSV format. Set the record name, start time, sampling rate and duration. Recording starts automatically at the specified time and stops when complete.

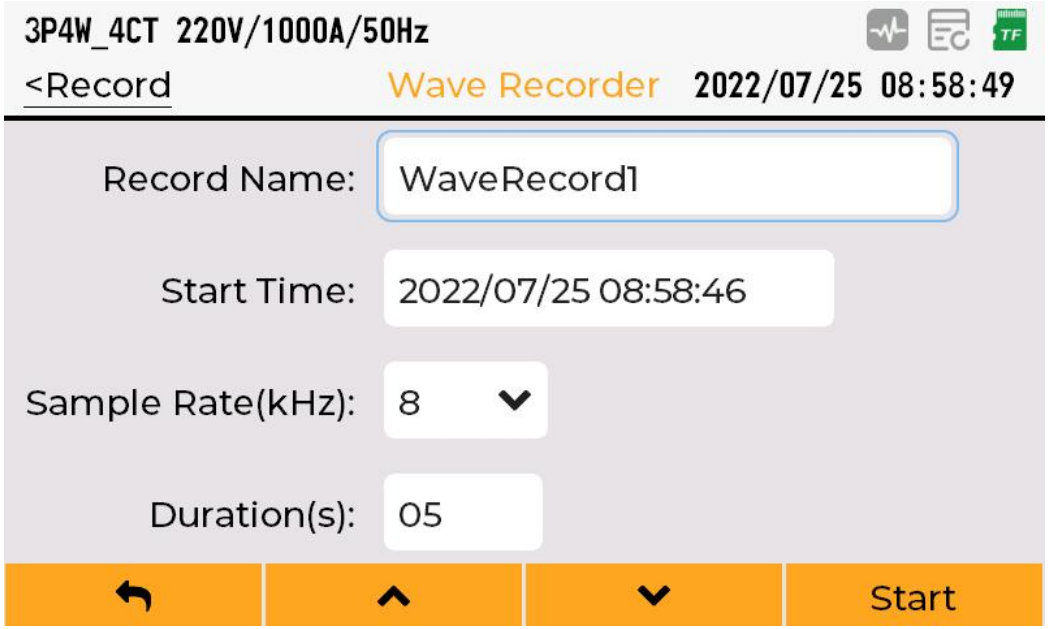


Figure 5-5 Waveform Recorder

5.4 Record Management

Manage all record files, including deletion and export to a FAT32 USB drive. Saved records can be viewed and maintained from the operating interface.

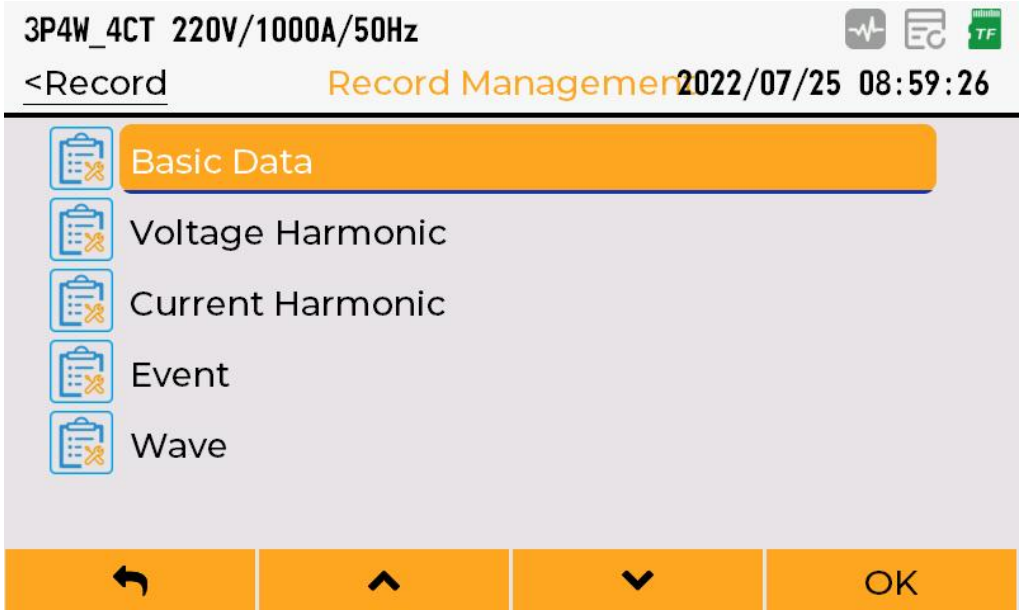


Figure 5-6 Record Management

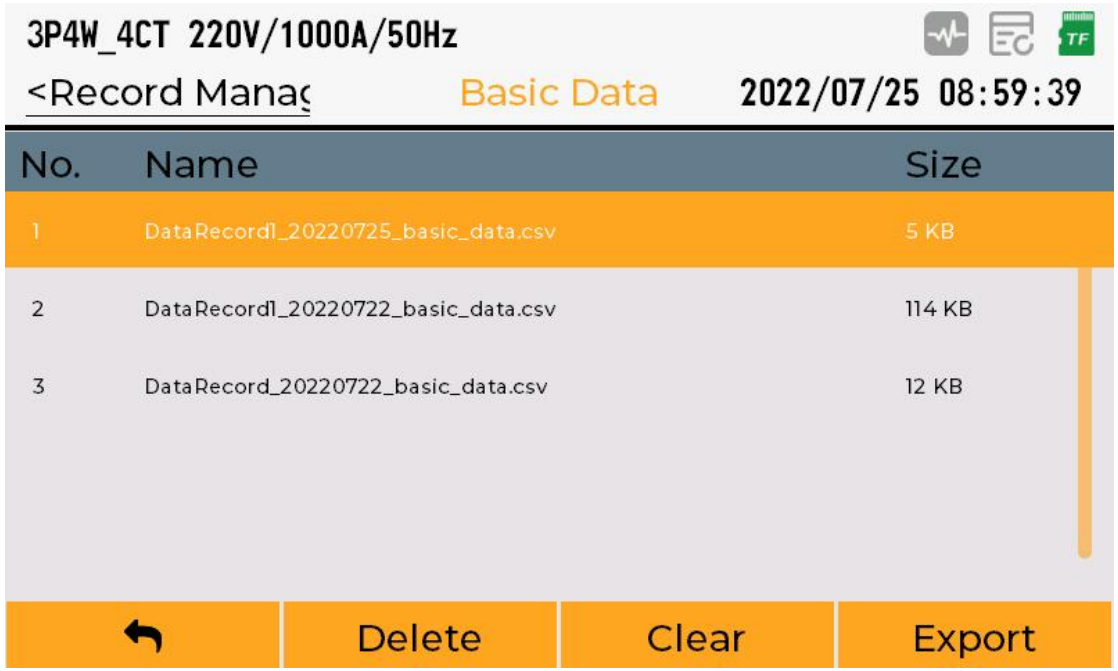


Figure 5-7 Data Records

6 Operation and Display

This chapter explains the interface structure, functional areas and parameter configuration, including the settings, measurement and recording screens.

6.1 Function Overview

The operating interface has three main sections: Settings, Measurement and Recording. Table 6-1 summarizes their functions.

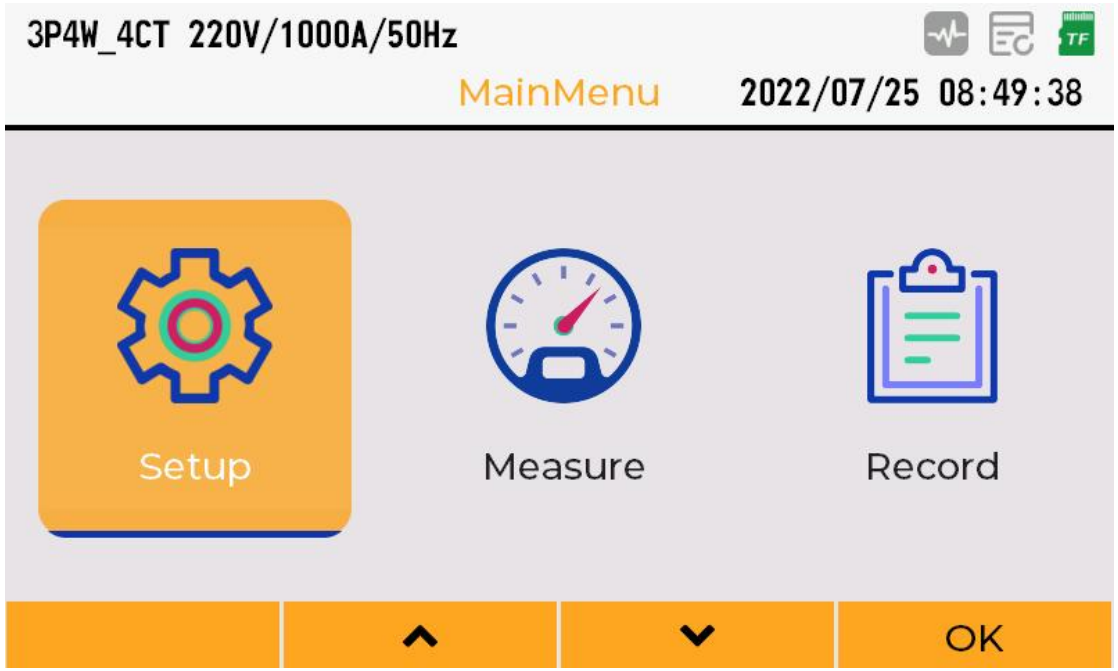


Figure 6-1 Main Screen

Table 6-1 Main Screen Functions

Screen	Main Functions
Settings screen	Configure wiring mode, VT/CT parameters, event thresholds, communication and user parameters
Measurement screen	Display voltage, current, power and energy; harmonic percentages and bar graphs, waveforms, phasor diagrams, unbalance and demand
Recording screen	Data logger and waveform recorder; export/delete records; format storage

6.2 Interface Overview

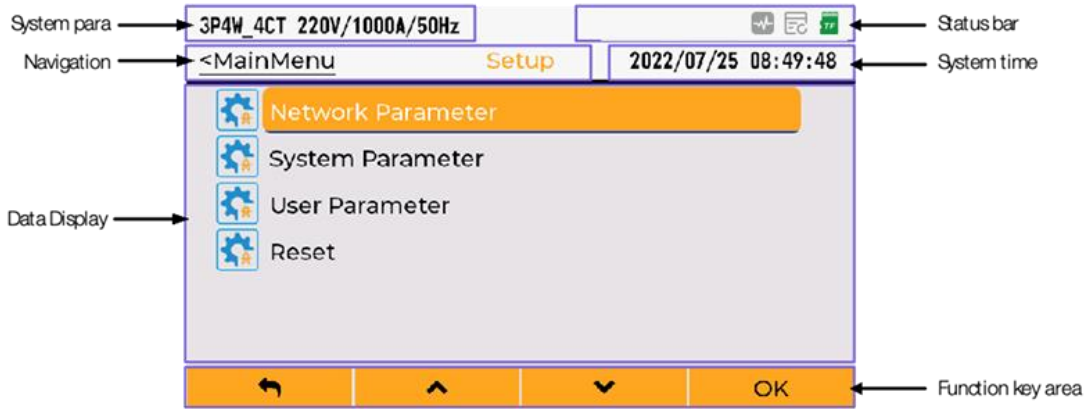


Figure 6-2 Interface Overview

The interface consists of six main areas:

1. System parameter bar: wiring mode, nominal voltage, CT type, nominal current and power frequency.
2. Navigation bar: current screen location and parent path.
3. Status bar: operating status. Table 6-2 explains the icons.
4. System time bar: current system time.
5. Data area: measurements or settings for the selected menu.
6. Function key bar: functions assigned to F1 – F4, which vary by screen.

Table 6-2 Status Bar Icons

Function	Icon	Description
Ethernet status		No Ethernet cable detected: icon hidden
		Cable detected, no connection: gray icon
		Cable detected, connected: green icon
USB drive status		No USB drive inserted or recognized: icon hidden
		USB drive initialized successfully: icon shown
Waveform recording status		Gray: waveform recording not started
		Green: waveform recording in progress
		Yellow: waveform recording complete
Data recording status		Gray: data recording not started
		Green: data recording in progress
		Yellow: data recording complete
Memory card status		TF card fault: card not detected or card error
		TF card full: free space required

	TF	TF card normal

6.3 Parameter Settings Screen

6.3.1 Introduction

Configure wiring mode, power system parameters, transformer parameters, event thresholds, communication and user parameters.



Figure 6-3 Settings Screen

6.3.2 Key Operation

- Use the arrow keys to select a parameter.
- Press [Enter] to edit; the value flashes.
- Use the arrow keys to change the value.
- Press [Enter] again to save.
- Press [Back] to exit the current screen.

6.4 Power System Settings

Configure wiring mode, power frequency, nominal voltage, voltage/current transformers, low-signal cutoffs, harmonic thresholds, event parameters, demand and the CO_2 emission factor.

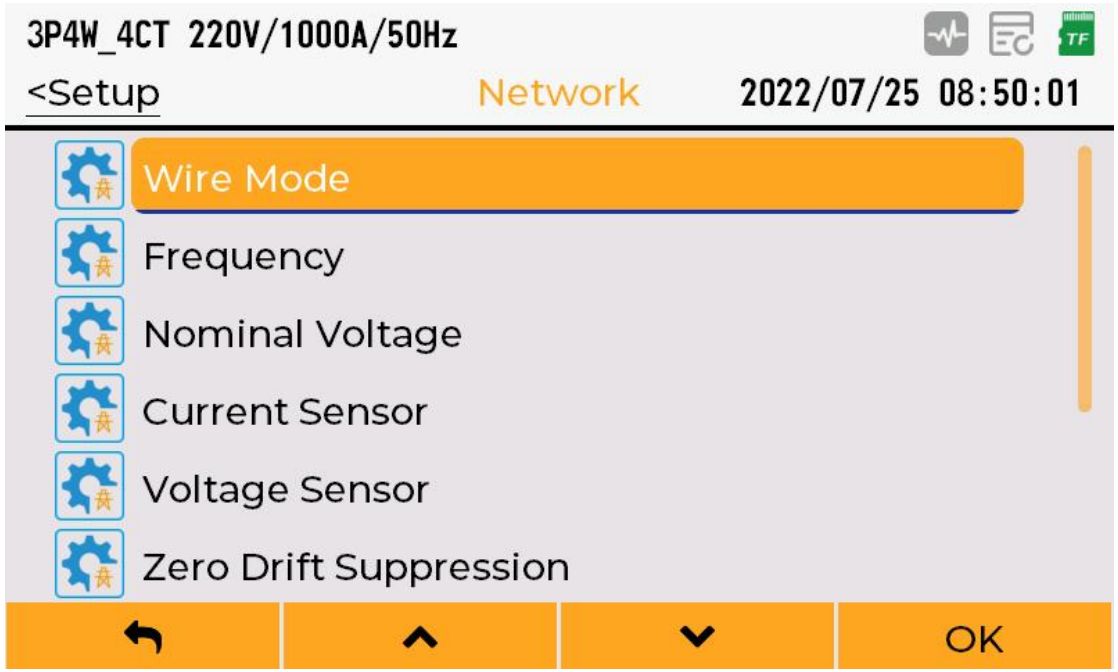


Figure 6-4 Power System Parameters

6.4.1 Wiring Mode

Supported wiring modes:

- 3P4W_4CT
- 3P4W_3CT
- 3P3W_3CT
- 3P3W_2CT

- 1P3W
- 1P2W

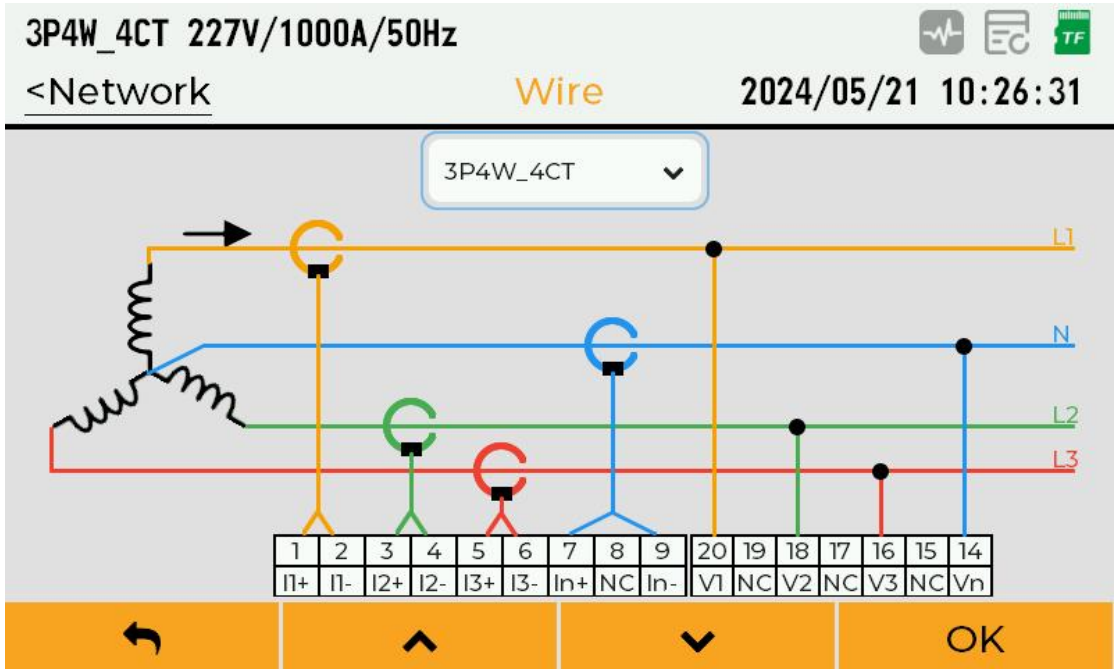


Figure 6-5 Wiring Mode Configuration

6.4.2 Power Frequency

Options:

- 50 Hz

- 60 Hz

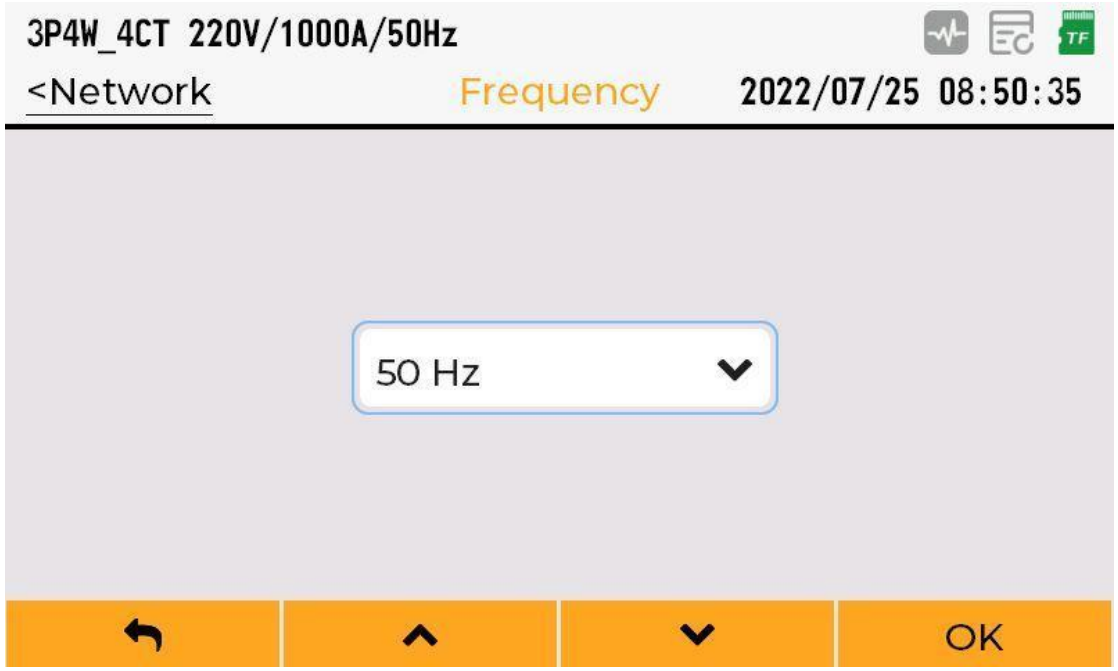


Figure 6-6 Frequency Configuration

6.4.3 Nominal Voltage

- Reference voltage setting range: 1 – 99 999 V (including ratio conversion). This is not the voltage range permitted for direct terminal connection.
- Used as the reference for swell, dip and interruption detection.

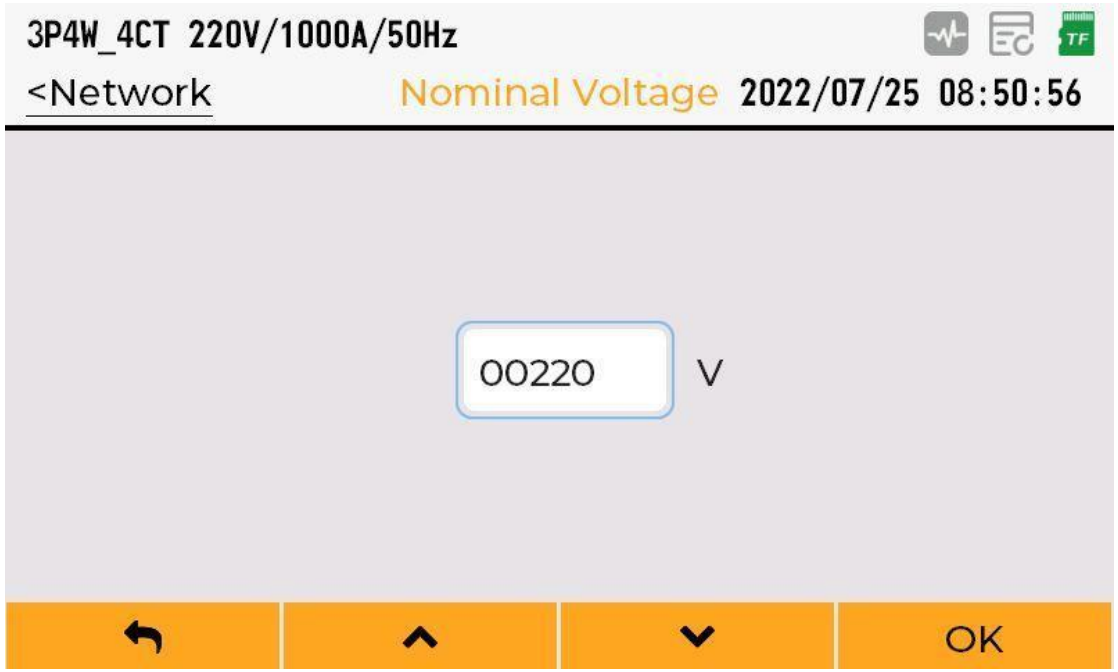


Figure 6-7 Nominal Voltage Configuration

6.4.4 Current Transformer Settings

Set the sensor type, sensitivity, nominal current and ratio to match the hardware input. Software settings cannot change the hardware input type.

Parameter	Description
Sensor type	PEM5353: Rcoil = Rogowski coil, CT = mV CT; PEM5553: 1 A / 5 A input
Sensitivity	Rogowski coil: mV/kA (reference frequency required); mV CT: mV/A

Nominal current	Range: 1 – 99999 A
Ratio	0.0001 – 1000.0

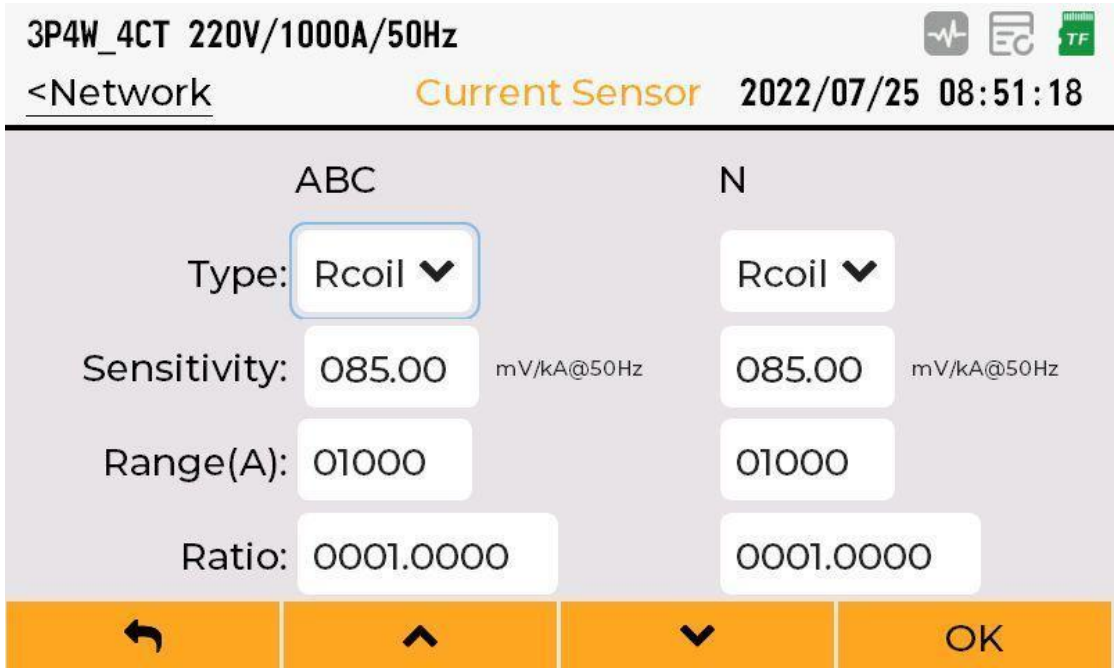


Figure 6-8 Current Transformer Configuration

6.4.5 Voltage Transformer Settings

Configure the voltage transformer ratio.

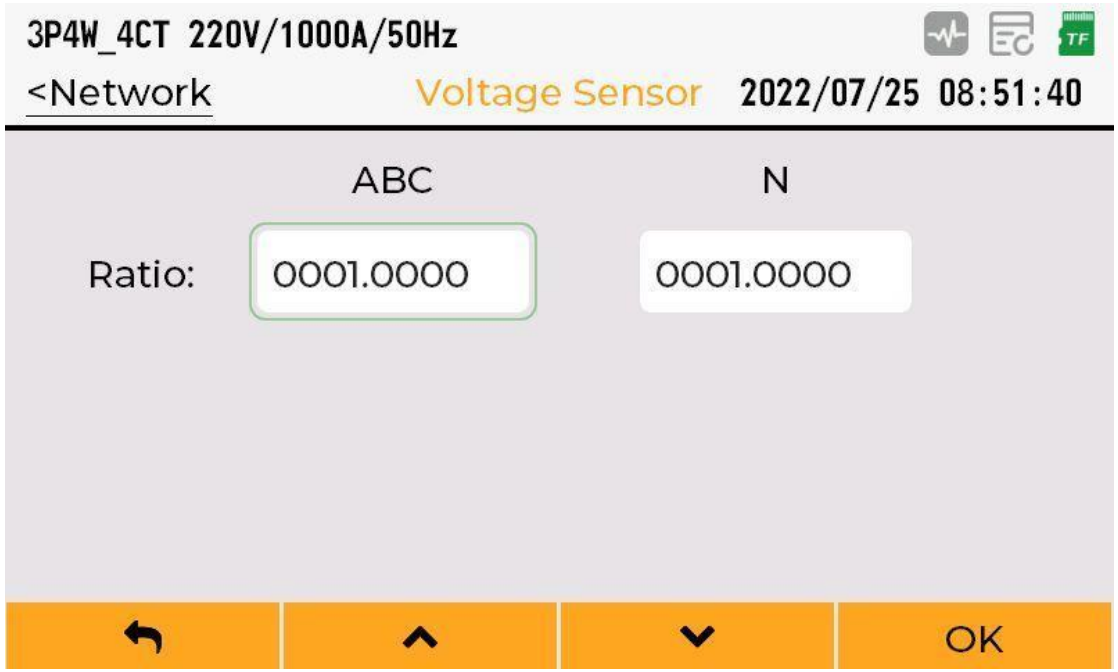


Figure 6-9 Voltage Transformer Configuration

6.4.6 Low-signal Cutoff Settings

Values below the cutoff are displayed as zero to reduce low-signal fluctuations. Voltage and current cutoffs range from 0% to 10% of reference voltage or nominal current. This is not sensor zero calibration; an excessive threshold masks real low-level signals.

- Voltage cutoff: 0% – 10% of reference voltage.
- Current cutoff: 0% – 10% of nominal current.

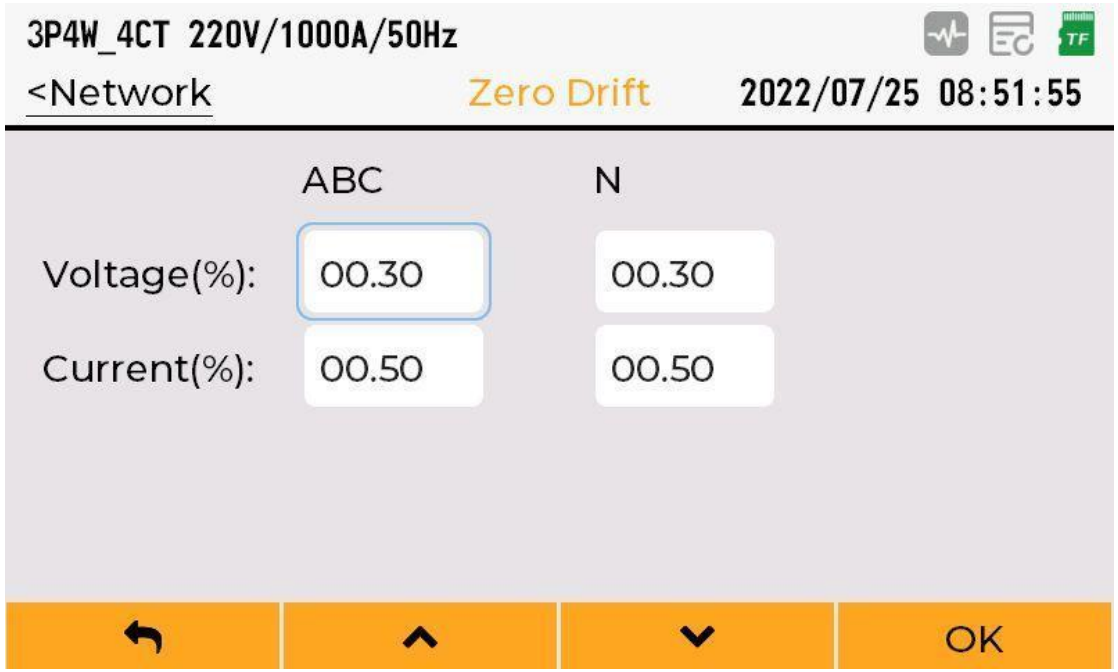


Figure 6-10 Low-signal Cutoff Settings

6.4.7 Harmonic Calculation Threshold

The harmonic threshold sets the minimum voltage/current for FFT calculation. Below this threshold, harmonic analysis is disabled to avoid unstable results from no-load conditions, low signals or noise. The range is 0%–10% of nominal voltage/current. FFT harmonic calculation is not performed below the threshold.

- Range: 0% – 10%

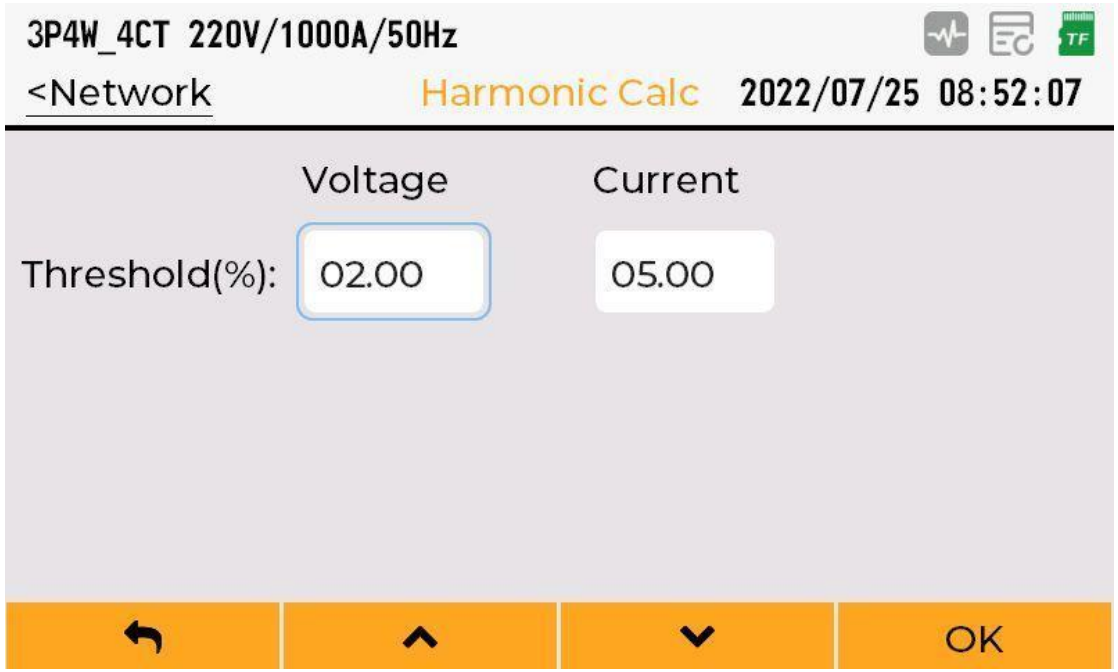


Figure 6-11 Harmonic Calculation Threshold

6.4.8 Event Parameter Settings

Configurable event thresholds are listed in Table 6-4.

Table 6-4 Event Parameters

Parameter	Setting Range	Default	Notes
Voltage swell threshold (%)	105.0~140.0	110	Relative to nominal voltage
Voltage swell hysteresis (%)	1.0~6.0	2	Relative to nominal voltage

Voltage dip threshold (%)	75.0~95.0	90	Relative to nominal voltage
Voltage dip hysteresis (%)	1.0~6.0	2	Relative to nominal voltage
Voltage interruption threshold (%)	1.0~10.0	5	Relative to reference voltage; default 5%
Voltage interruption hysteresis (%)	1.0~6.0	2	Relative to nominal voltage
Overfrequency threshold (%)	100.1~120.0	101	Relative to nominal frequency
Underfrequency threshold (%)	50.0~99.9	99	Relative to nominal frequency
Overvoltage threshold (%)	101.00~200.00	110	Relative to nominal voltage
Undervoltage threshold (%)	1.00~99.00	90	Relative to nominal voltage
Overcurrent threshold (%)	101.00~200.00	110	Relative to nominal current
Undercurrent threshold (%)	1.00~99.00	90	Relative to nominal current
Voltage unbalance threshold (%)	0.01~99.99	4	
Current unbalance threshold (%)	0.01~99.99	10	
Voltage THD threshold (%)	0.01~99.99	5	
Voltage even harmonic threshold (%)	0.01~99.99	5	
Voltage odd harmonic threshold (%)	0.01~99.99	5	
Current THD threshold (%)	0.01~99.99	5	
Current even harmonic threshold (%)	0.01~99.99	5	
Current odd harmonic threshold (%)	0.01~99.99	5	



Figure 6-12 Event Parameter Configuration

6.4.9 Demand Settings

Table 6-5 Demand Parameters

Parameter	Description
Calculation method	Fixed / sliding
Calculation interval	Range: 1 – 60 minutes

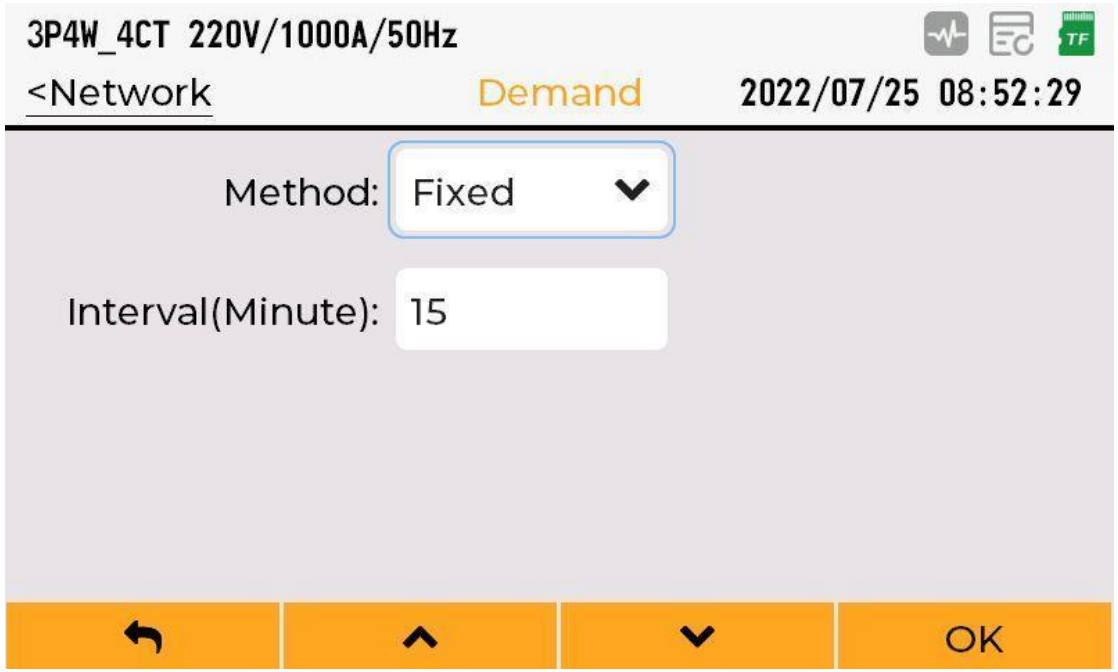


Figure 6-13 Demand Settings

6.4.10 CO_2 Emission Factor

Range: 0 – 9999.99 kg CO_2 /MWh. Multiply factors expressed in kg CO_2 /kWh by 1000 before entry.

Parameter	Setting Description
Unit	kg CO_2 /MWh; 1 MWh = 1000 kWh
Factor source	Electricity emission factor recognized for the applicable region and reporting year
Accounting boundary	Select the corresponding imported active energy according to the accounting scope

Conversion	CO_2 (kg) = energy (kWh) × factor (kg CO_2 /MWh) ÷ 1000
Usage notes	Use the applicable factor and verify units. The calculated value is not a direct CO_2 measurement.

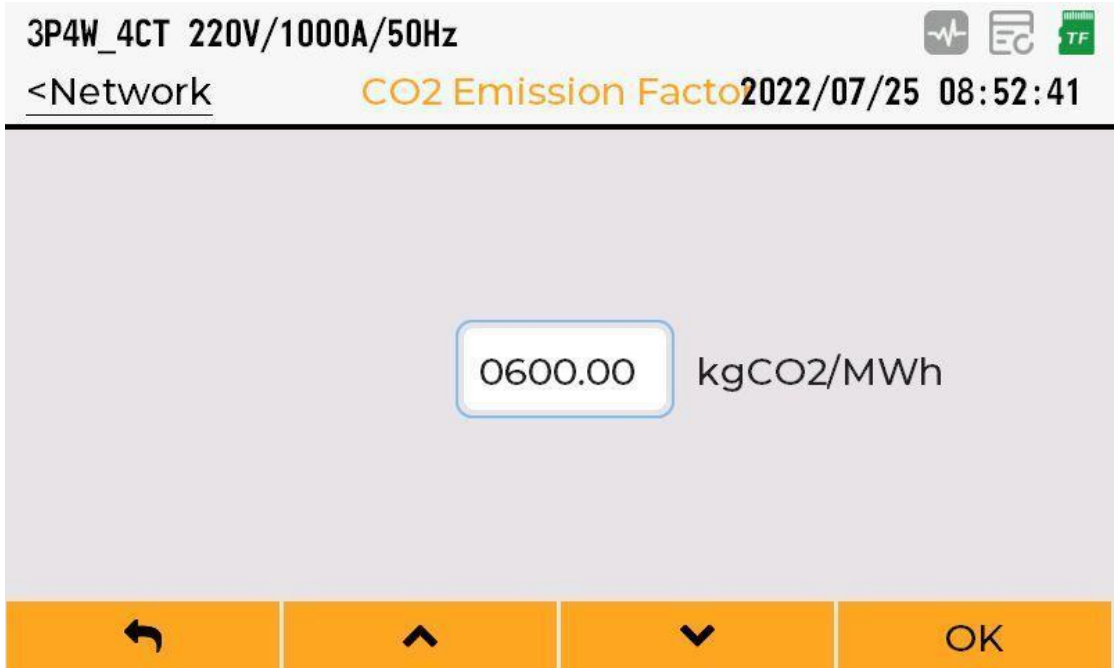


Figure 6-14 CO_2 Emission Factor Settings

6.4.11 K-factor Settings

K-factor relates current harmonics to additional transformer losses. US and EU methods differ and their results are not directly equivalent. K-factor does not directly indicate actual temperature rise.

EU parameters e and q are dimensionless. e is the ratio of fundamental eddy-current loss to the corresponding DC resistance loss, range 0–0.20. q is an exponent related to winding construction and frequency, range 1.00–2.00. Select values from transformer documentation; e is not a time-smoothing coefficient.

US and EU calculation methods are supported.

Editable EU parameters:

- e: 0 – 0.20, dimensionless
- q: 1.00 – 2.00, dimensionless

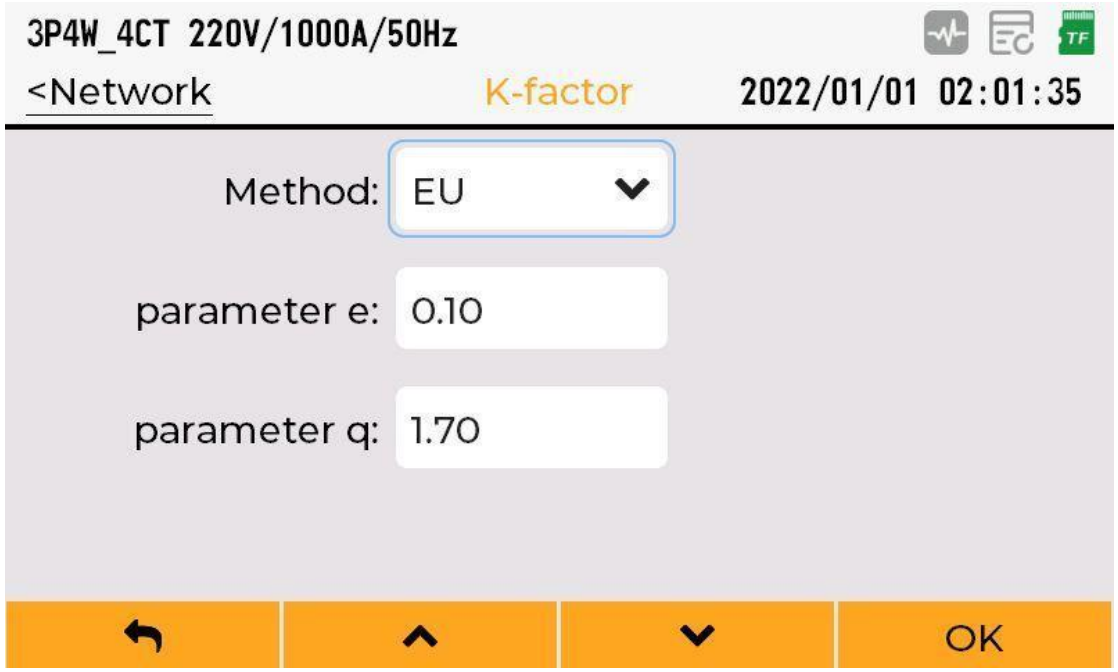


Figure 6-15 K-factor Settings

6.5 System Settings

View system information and configure communication, clock, display, keypad and language.

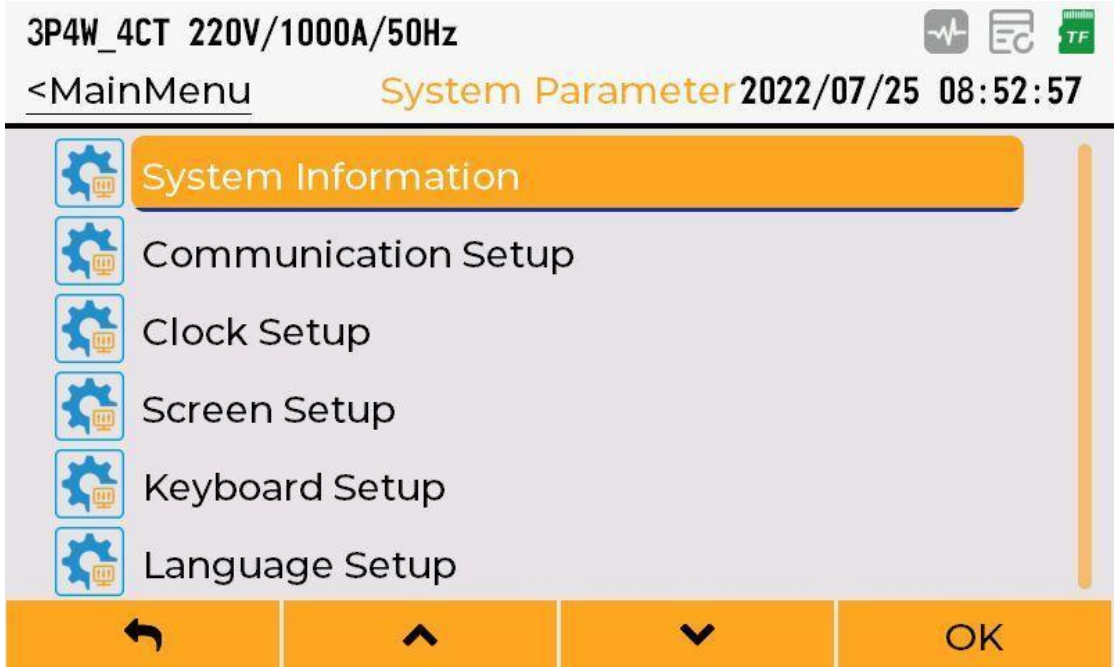


Figure 6-16 System Parameters

6.5.1 System Information

Displays model, serial number, firmware version, hardware version and Ethernet parameters.

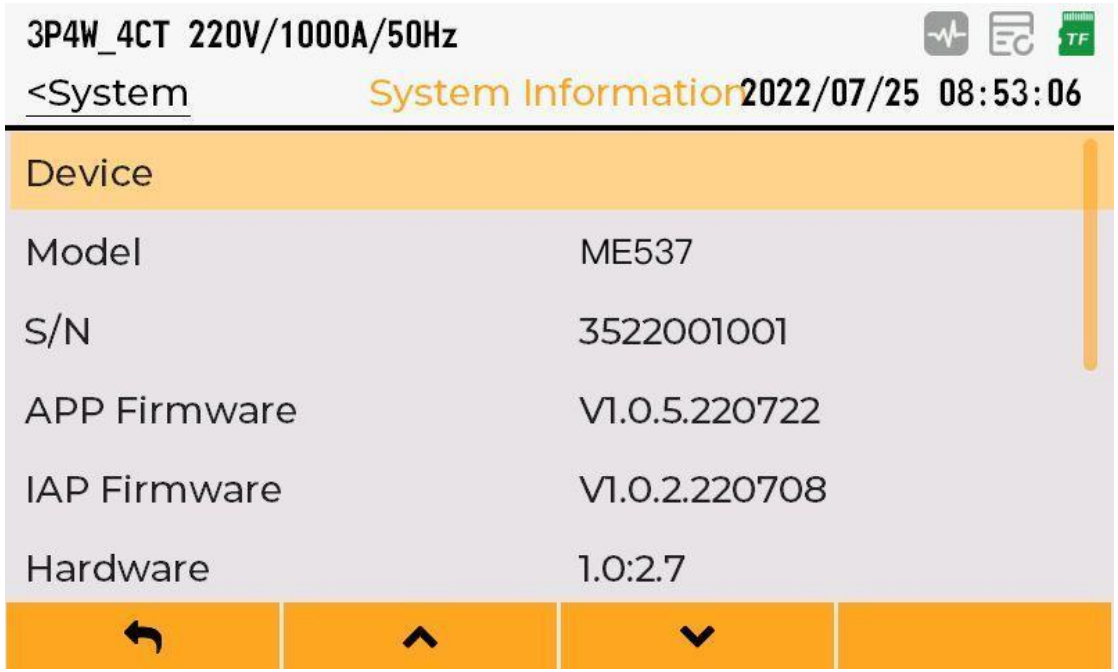


Figure 6-17 System Information

6.5.2 Communication Settings

Configure Ethernet, Modbus TCP and RS-485.

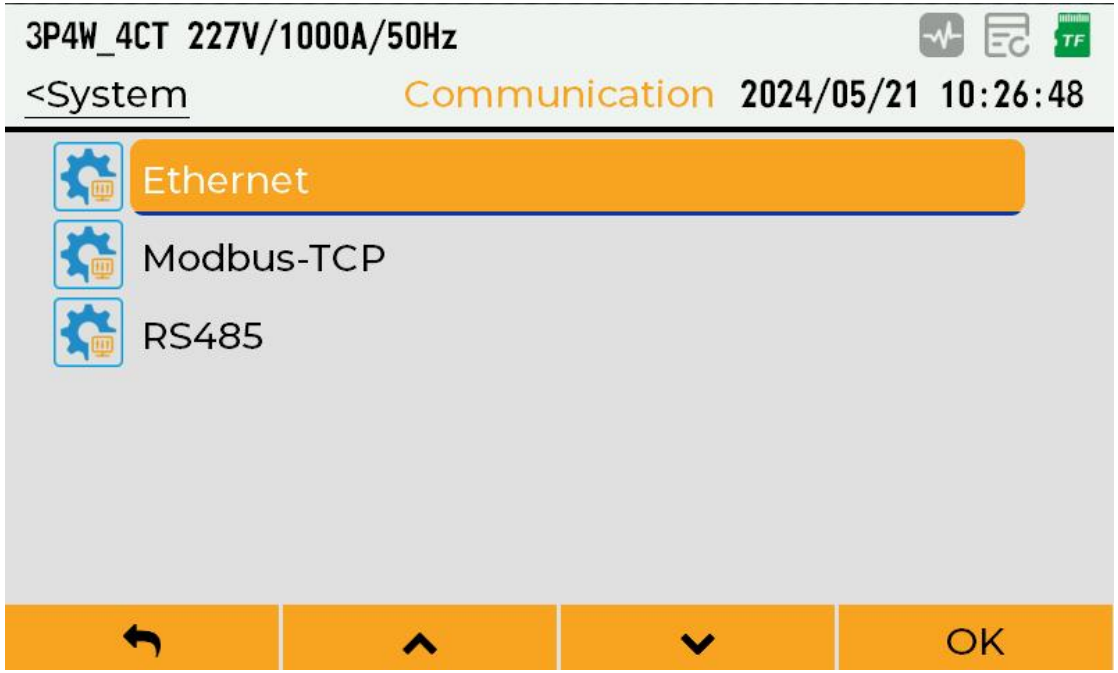


Figure 6-18 Communication Settings

- Ethernet: DHCP disabled by default; IP = 192.168.1.55

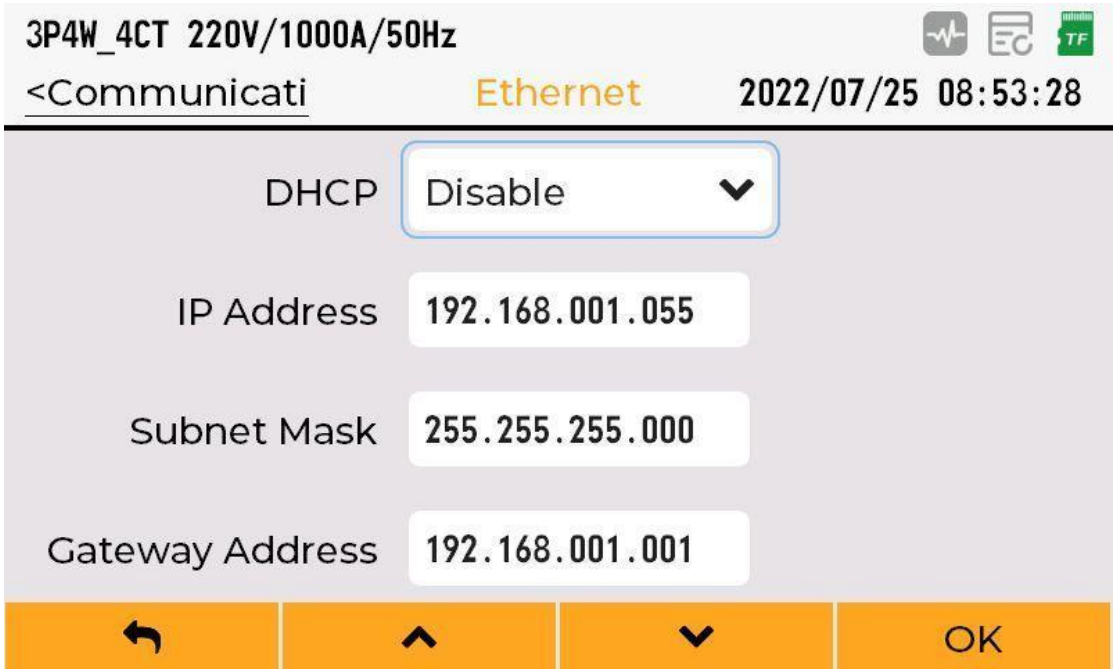


Figure 6-19 Ethernet Settings

- Modbus TCP: enable/disable and port number

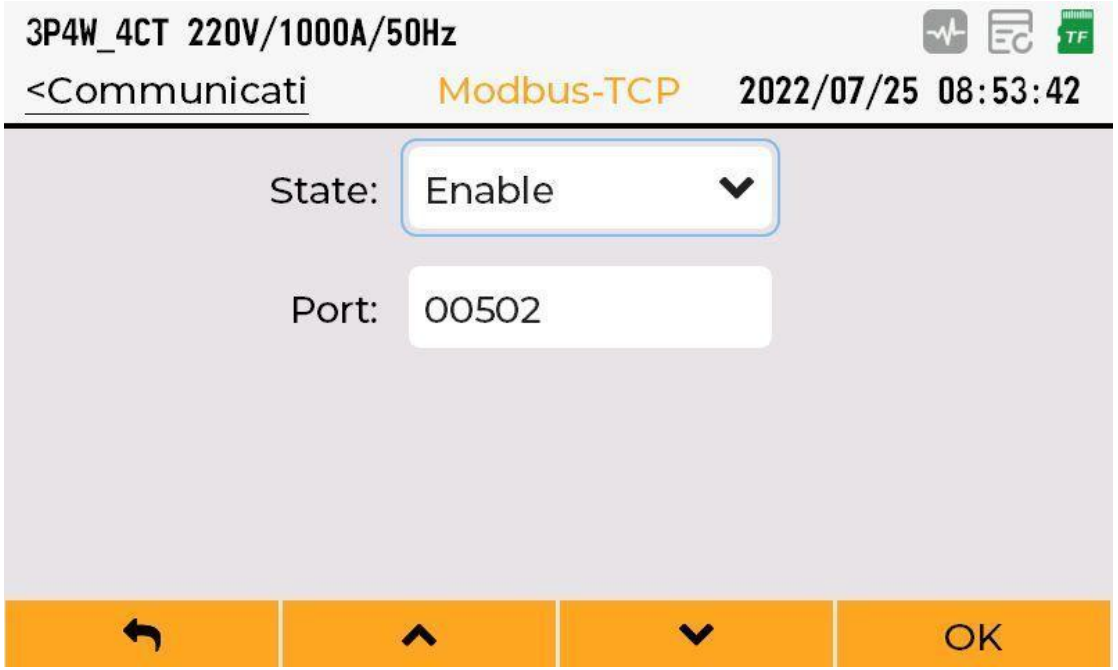


Figure 6-20 Modbus TCP Settings

- RS-485: address, baud rate, parity and stop bits

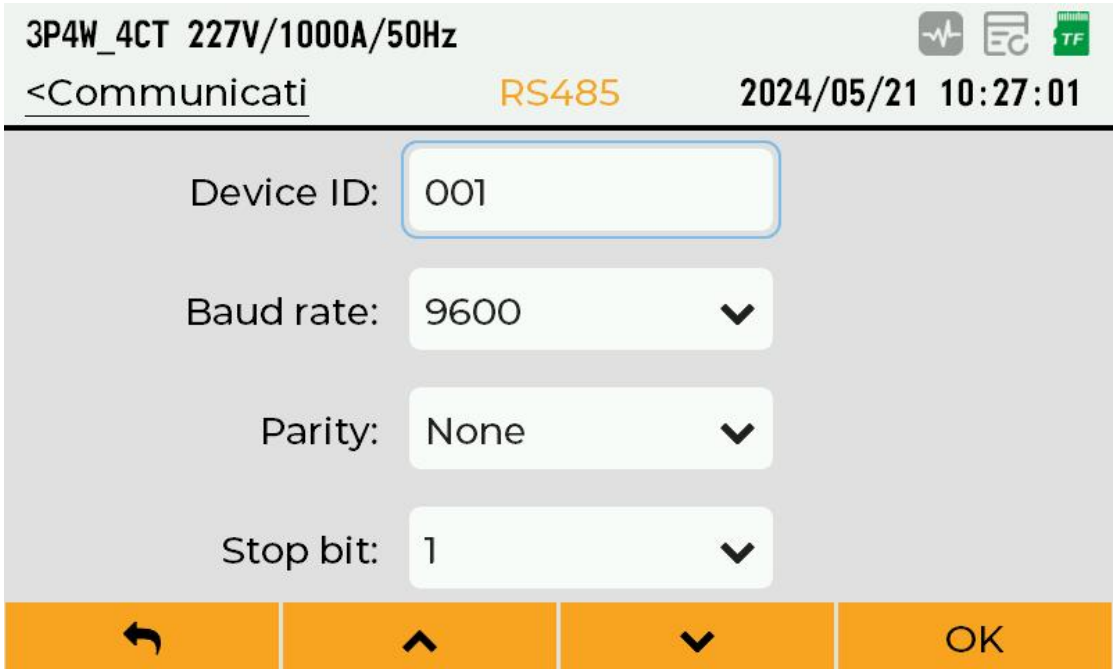


Figure 6-21 RS-485 Settings

6.5.3 Clock Settings

Date formats:

- yyyy/mm/dd
- mm/dd/yyyy
- dd/mm/yyyy

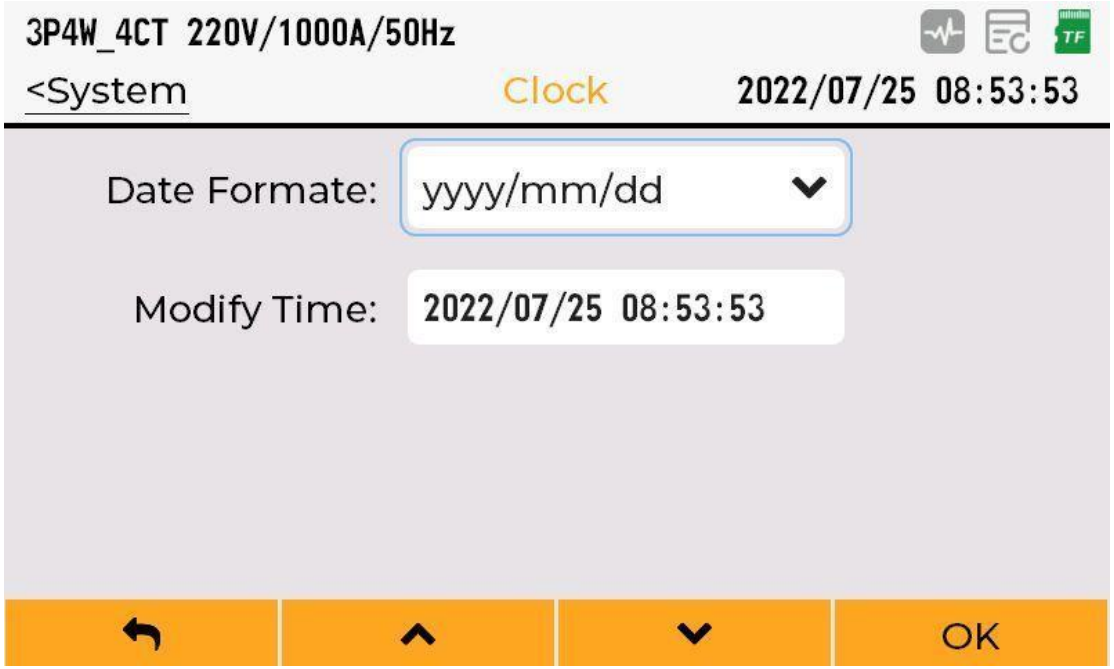


Figure 6-22 Clock Settings

6.5.4 Display Settings

* Backlight brightness: 1 – 5

* Auto screen off: disabled, 1/5/10/30 minutes

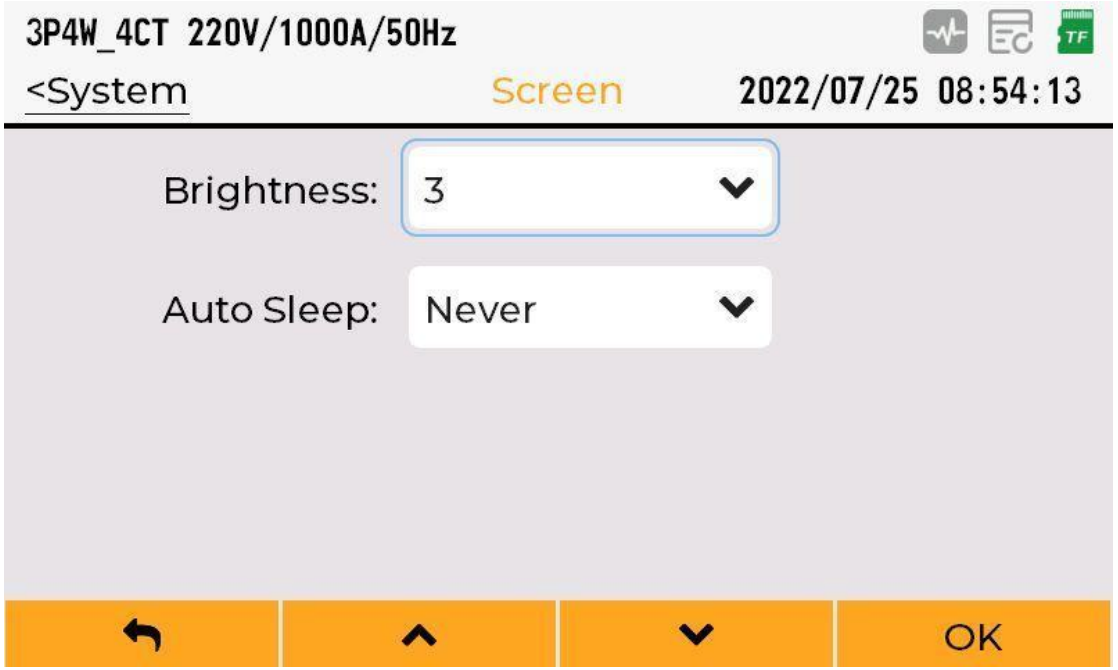


Figure 6-23 Display Settings

6.5.5 Keypad Settings

Configure key tones and automatic lock time.

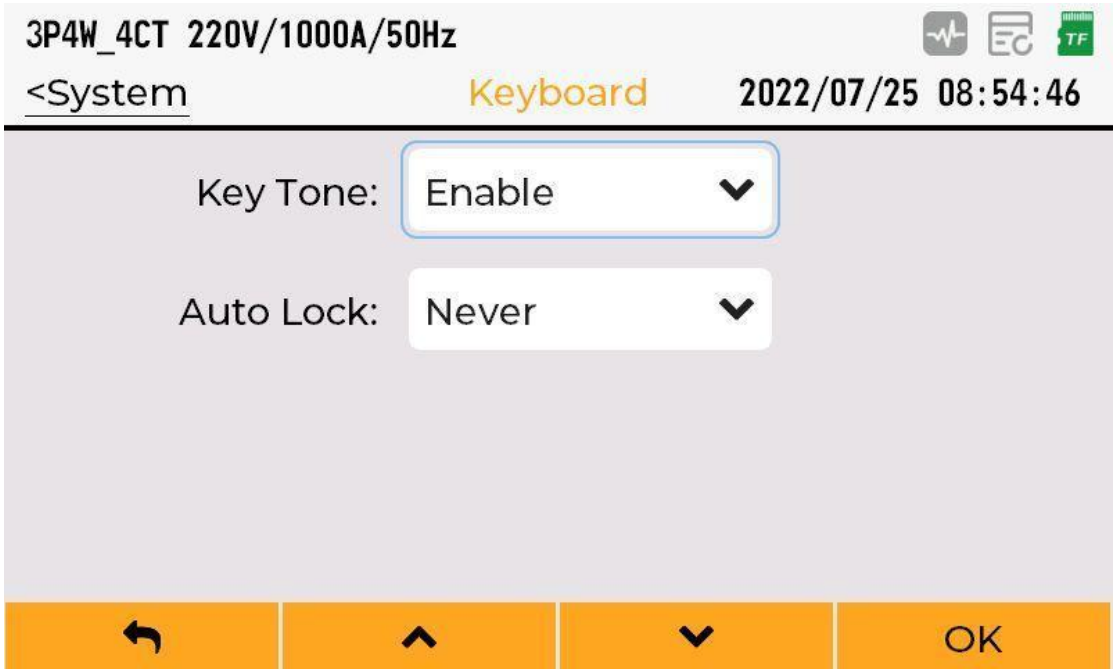


Figure 6-24 Keypad Settings

6.5.6 Language Settings

Supported: Simplified Chinese, English, Traditional Chinese, French, Russian, Spanish and Portuguese

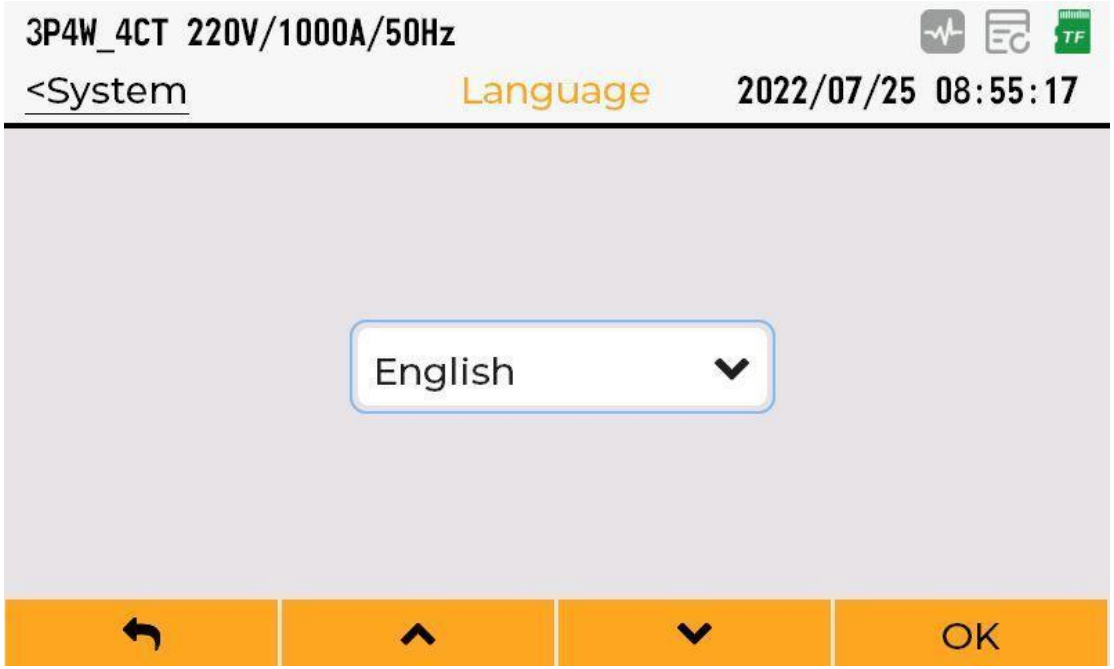


Figure 6-25 Language Settings

6.6 User Settings

Configure user information, phase labels and phase colors.

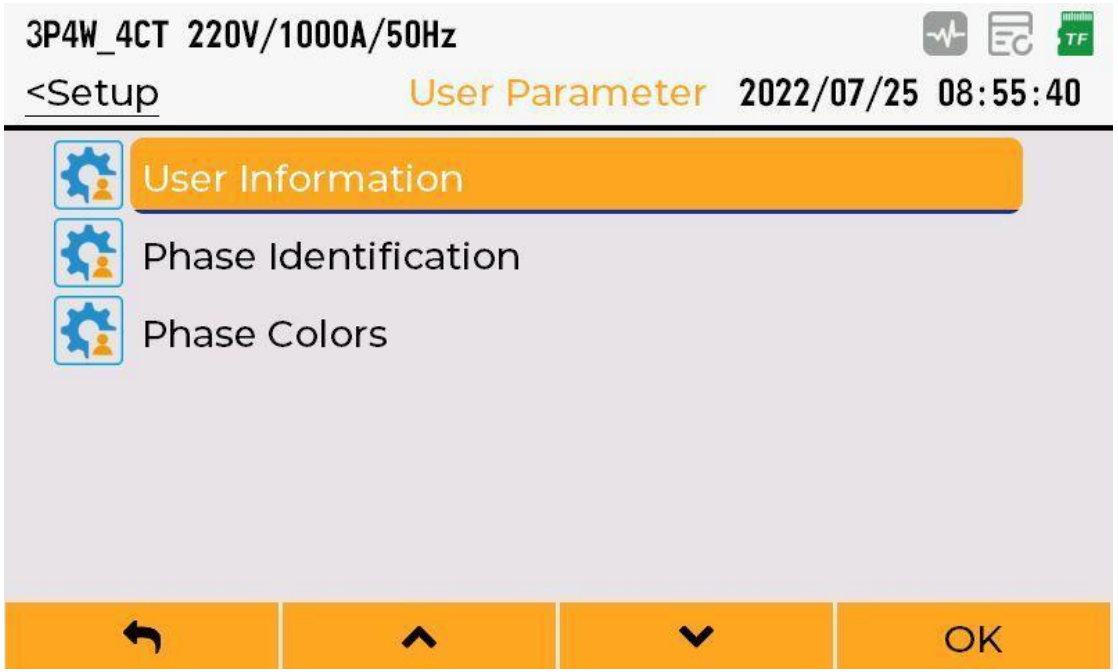


Figure 6-26 User Parameters

6.6.1 User Information

Set the user name, location and other information attached to records.

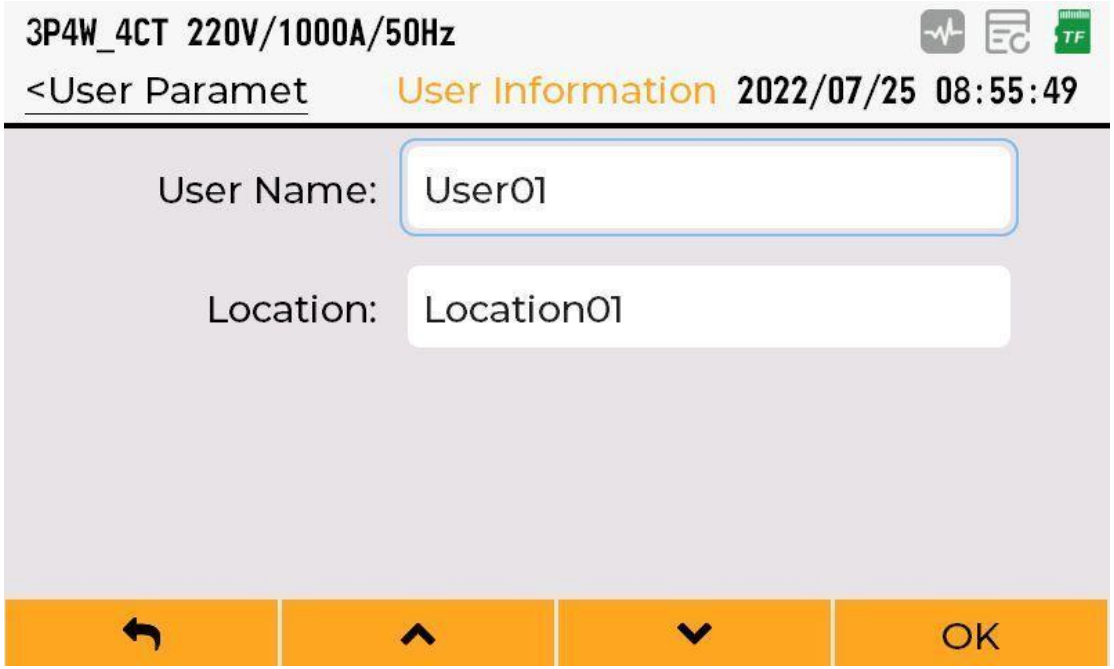
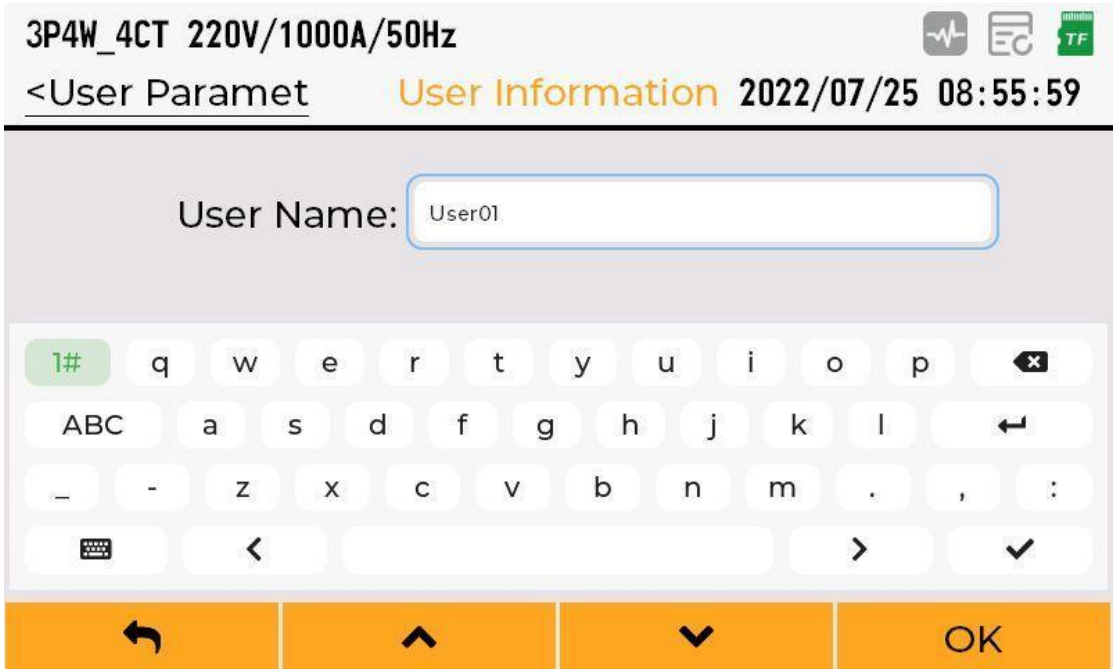


Figure 6-27 User Information Settings



6.6.2 Phase Label Settings

Choose ABC or L1/L2/L3 phase labels; N denotes the neutral conductor.

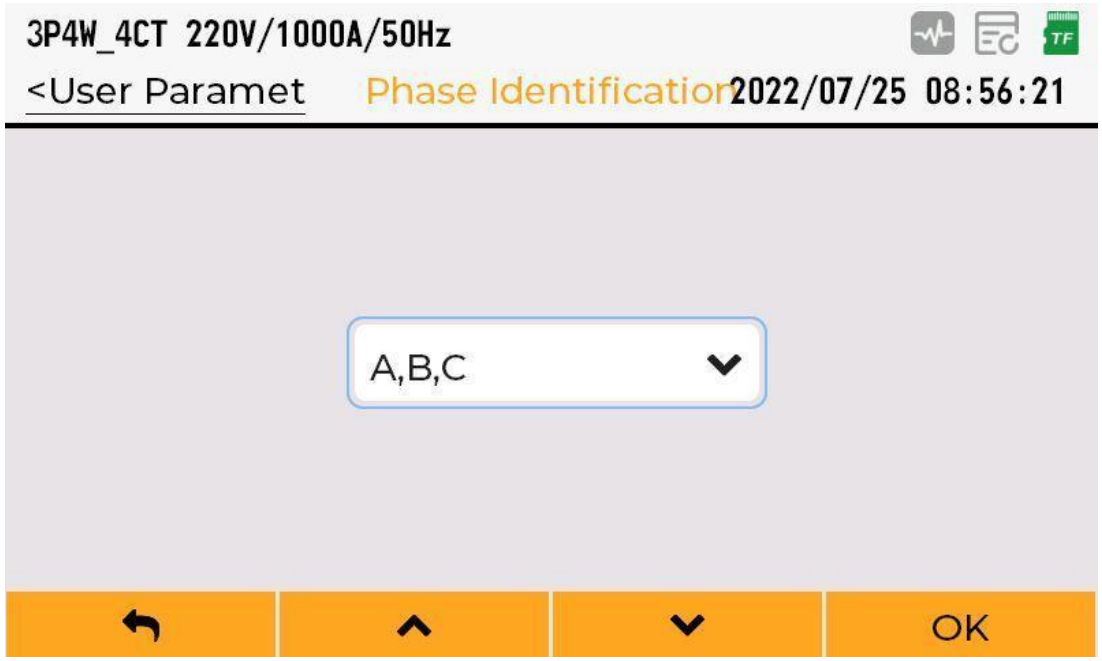


Figure 6-28 Phase Label Settings

6.6.3 Phase Color Settings

Options:

- China preset
- US preset
- IEC preset
- Custom

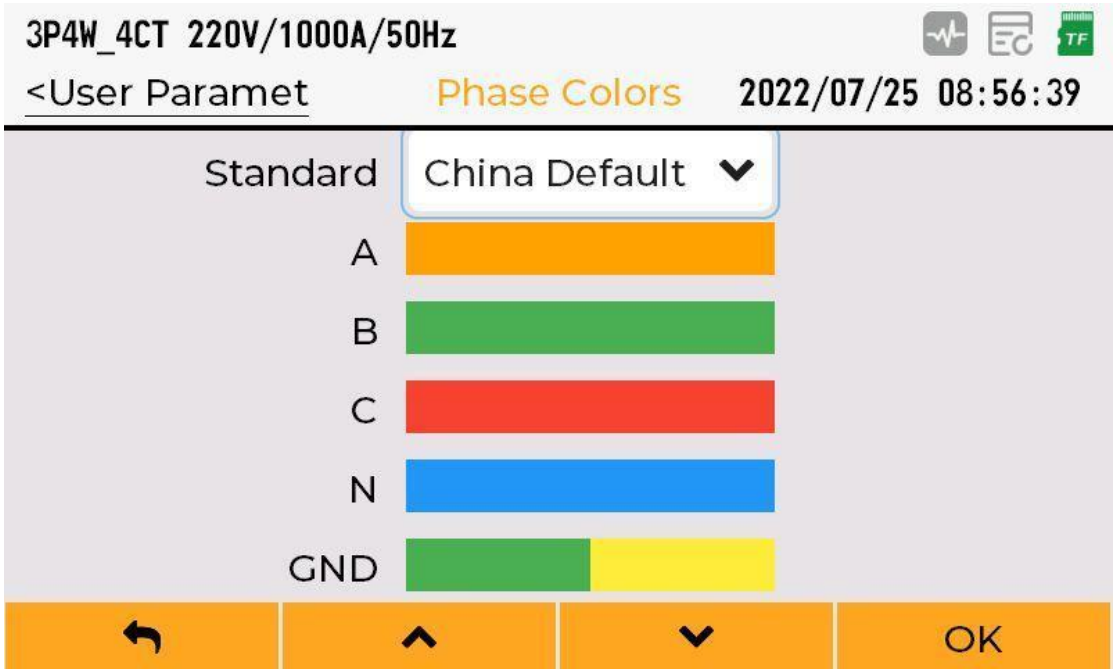


Figure 6-29 Phase Color Settings



Figure 6-30 Custom Phase Colors

6.7 Reset

Options:

- Restore factory settings
- Reset energy
- Reset maximum demand

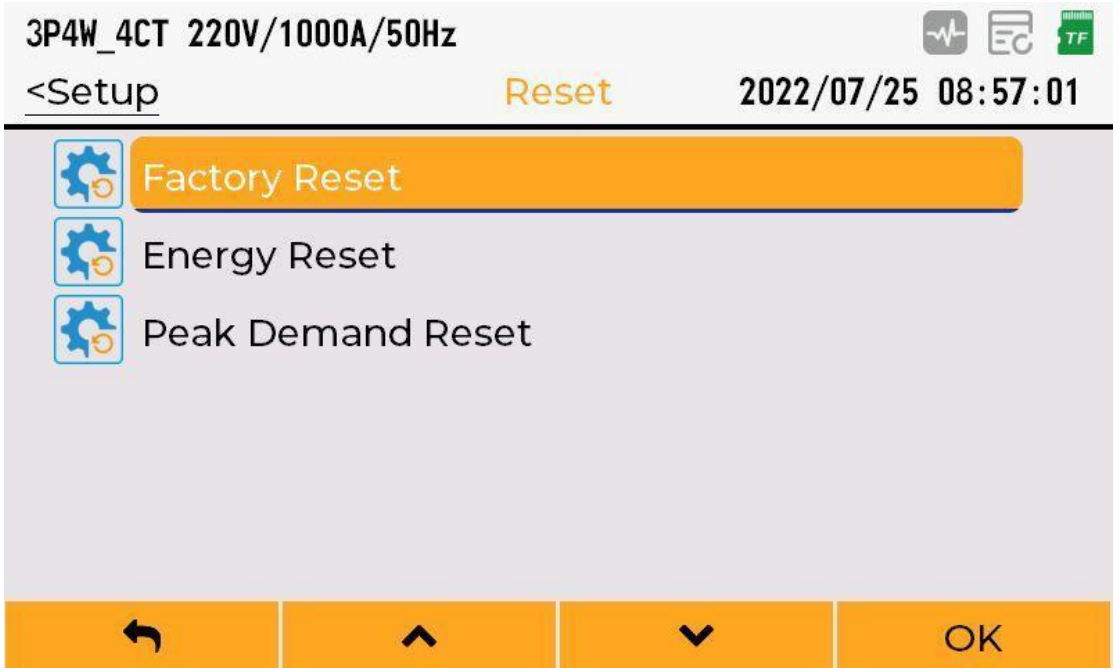


Figure 6-31 Reset Screen

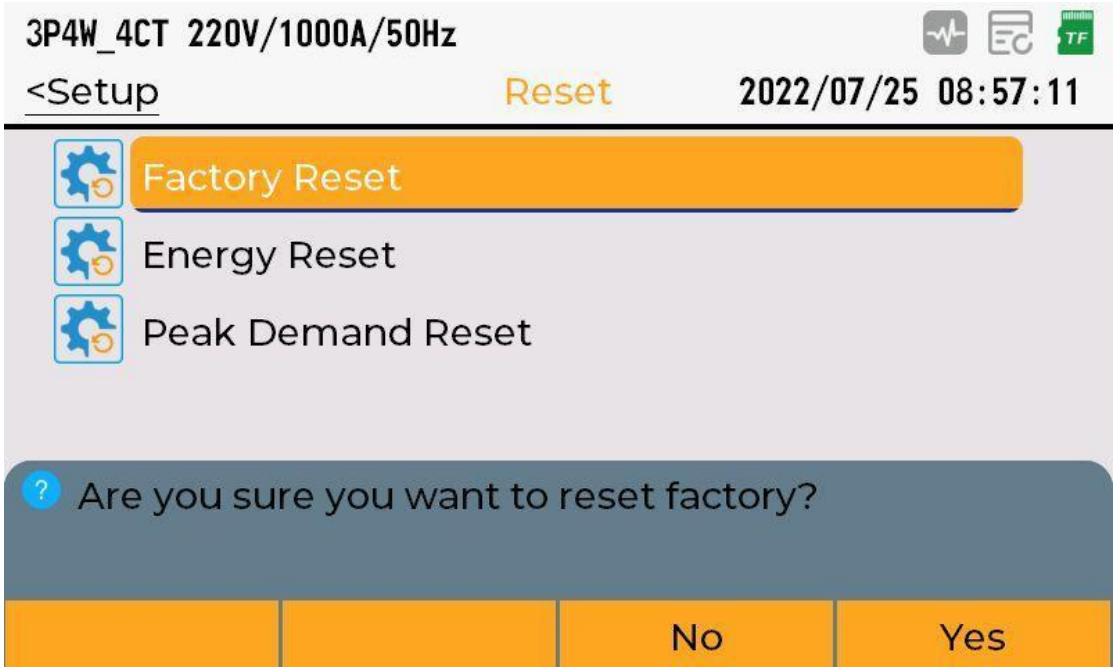


Figure 6-32 Confirmation Screen

6.8 Measurement Screen

6.8.1 Introduction

Displays all electrical measurements, including voltage, current, power, energy, harmonics, waveforms, phasors, unbalance and demand.

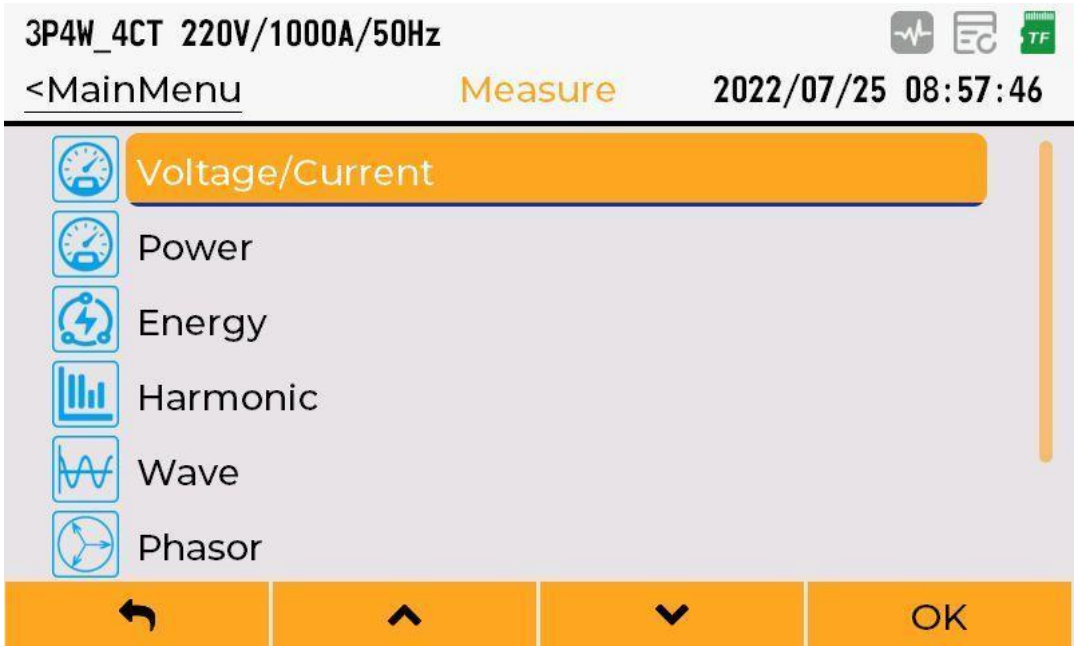


Figure 6-33 Measurement Screen

Use arrow keys to change pages, [Enter] to open and [Back] to exit.

6.9 Voltage and Current Screen

Displays phase voltage, line-to-line voltage, frequency, current, peak values, crest factors and K-factor.

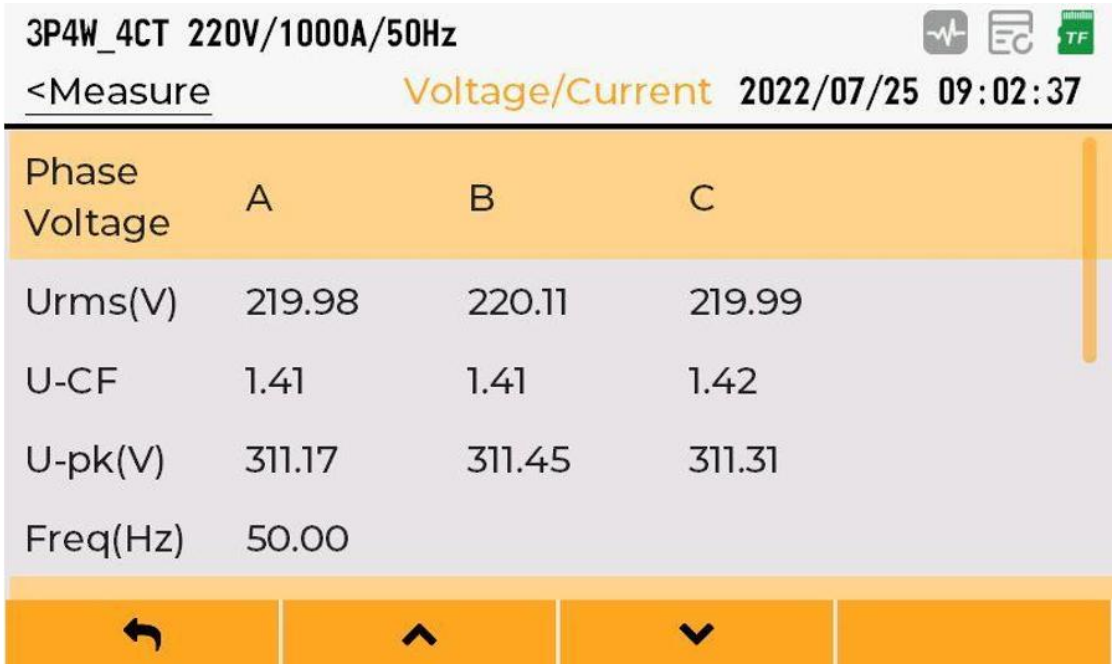


Figure 6-34 Voltage and Current

6.10 Power Screen

Displays active power P, reactive power Q, apparent power S, power factor PF and fundamental power factor (displacement factor) DPF. PF and DPF differ under nonsinusoidal conditions.

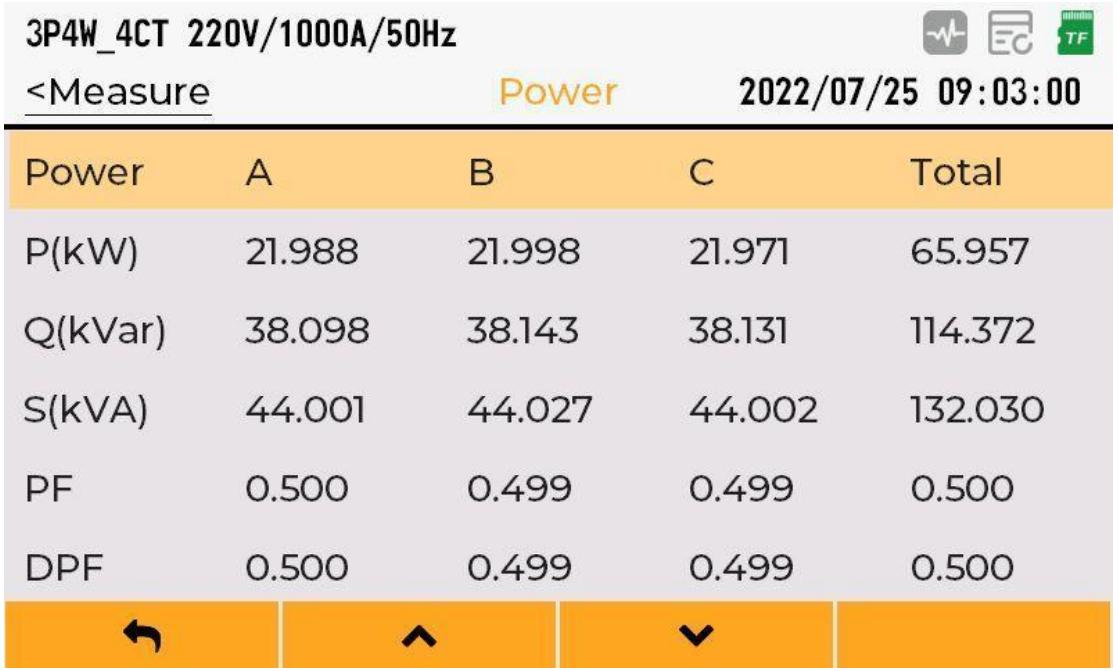


Figure 6-35 Power

6.11 Energy Screen

Displays:

- Imported active energy EP_imp
- Exported active energy EP_exp
- Forward reactive energy EQ_imp (according to the Q sign convention)
- Reverse reactive energy EQ_exp (according to the Q sign convention)

- Apparent energy ES, in VAh or kVAh
- Estimated CO_2 emissions, calculated from energy and emission factor

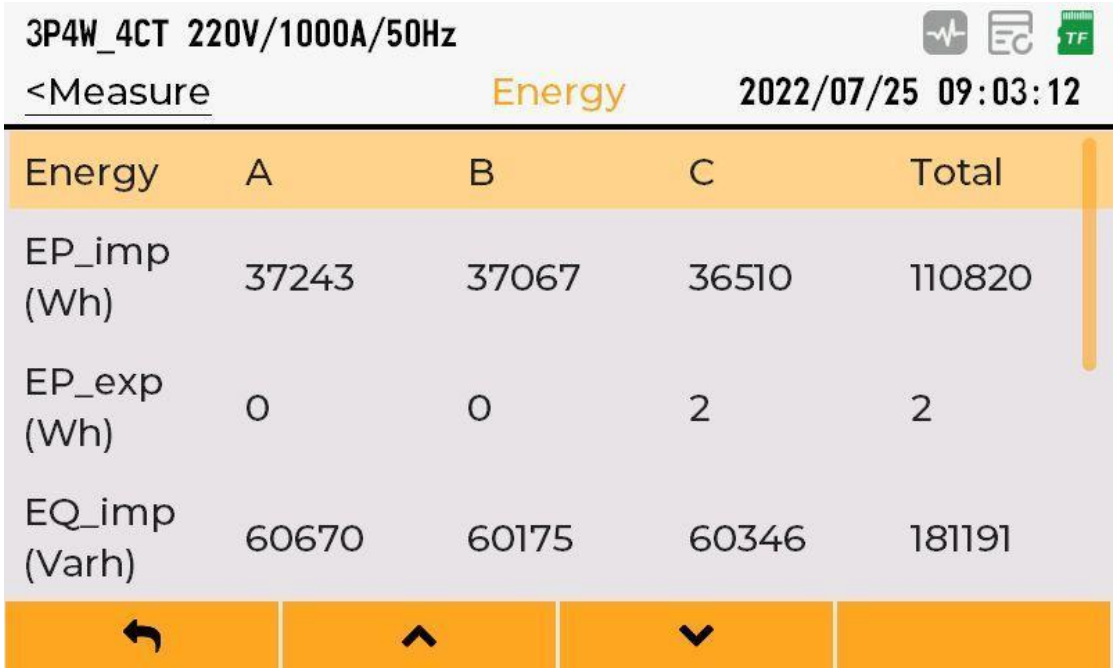


Figure 6-36 Energy

6.12 Harmonics Screen

Displays total harmonic distortion THD, the fundamental and harmonic orders 2 – 50:

- Bar graph
- Numerical values

- Cursor inspection
- Zoom

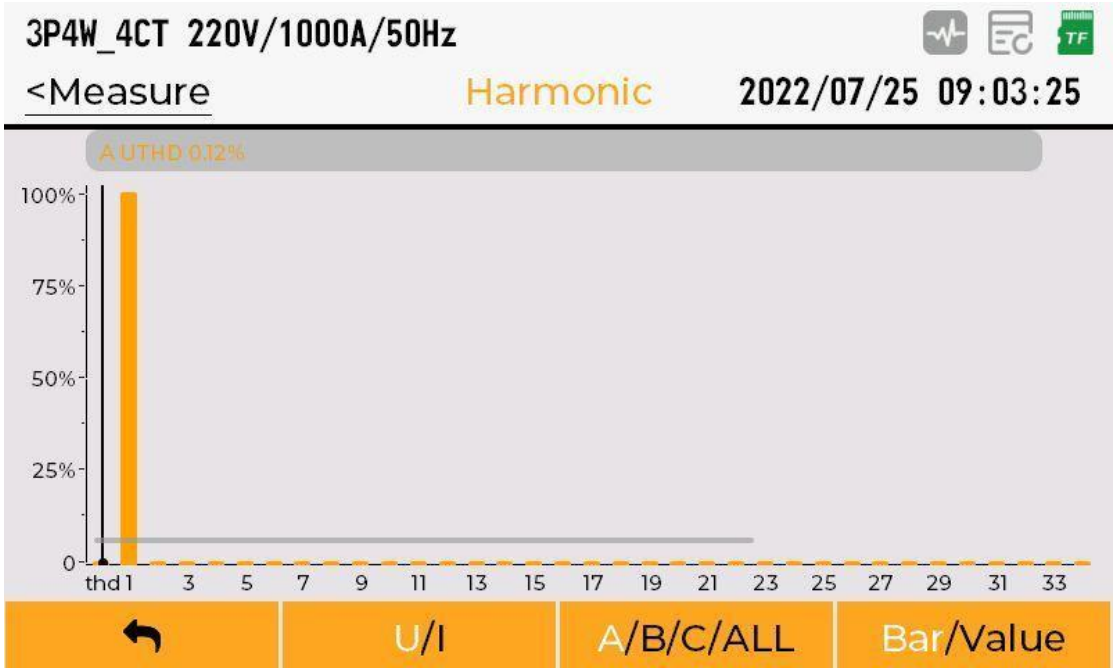


Figure 6-37 Harmonic Bar Graph

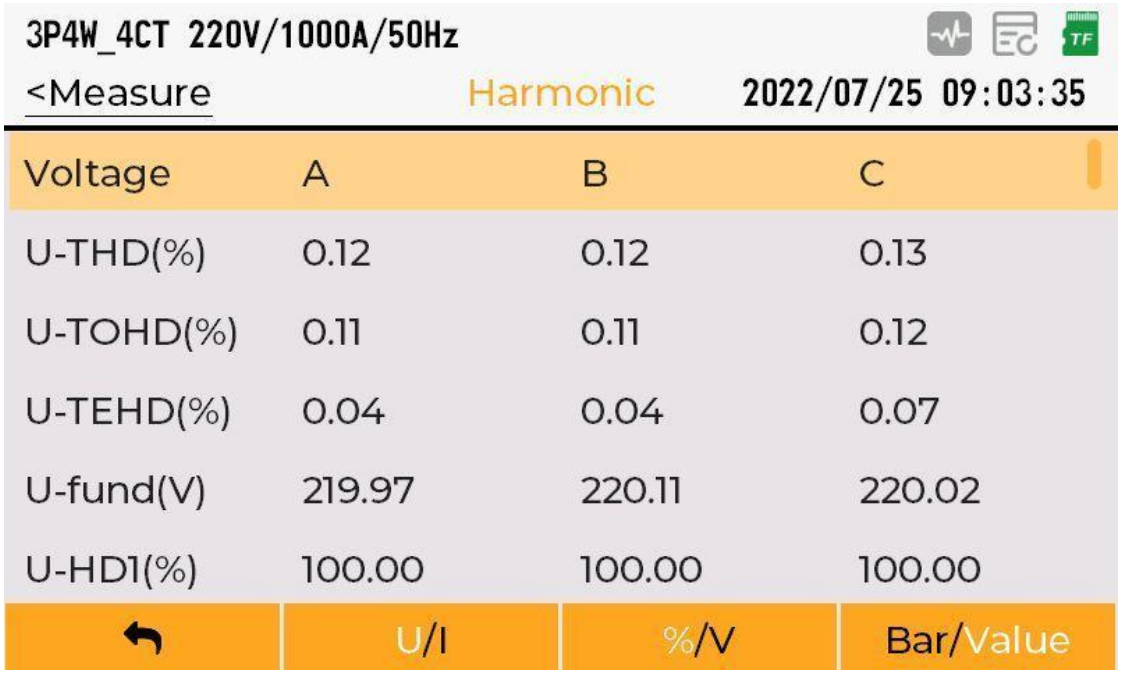


Figure 6-38 Harmonic Values

6.13 Waveform Screen

Displays three phase voltage and current waveforms. Options:

- Refresh / hold
- Voltage / current / all
- Zoom

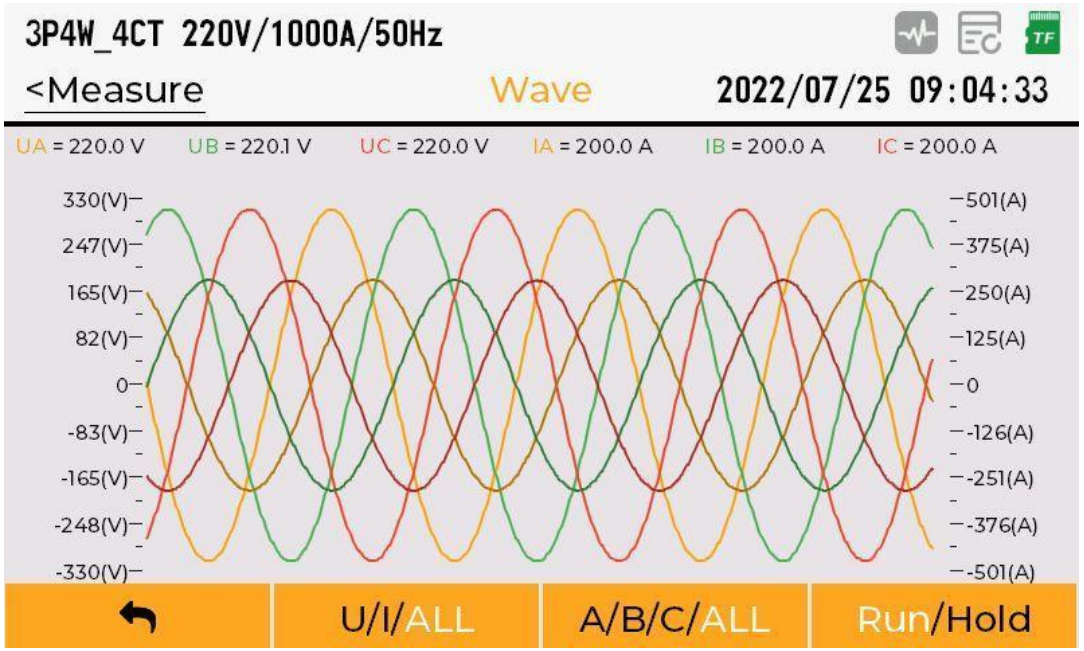


Figure 6-39 Voltage and Current Waveforms

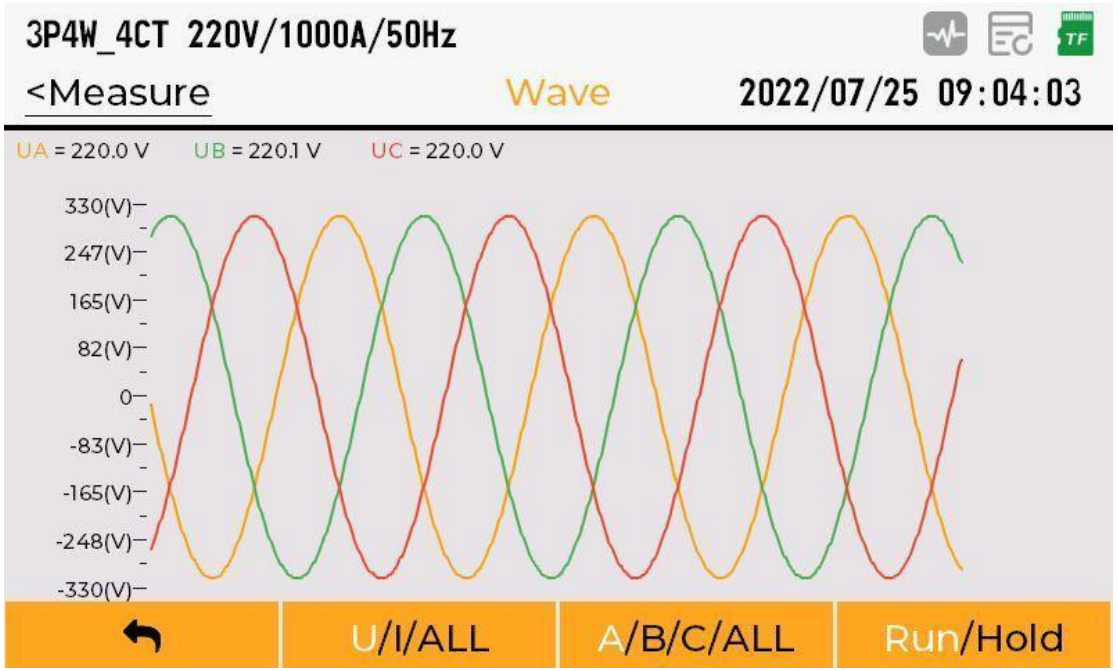


Figure 6-40 Voltage Waveforms

6.14 Phasor Diagram Screen

Displays voltage/current phasor relationships, with L1 voltage as the reference.

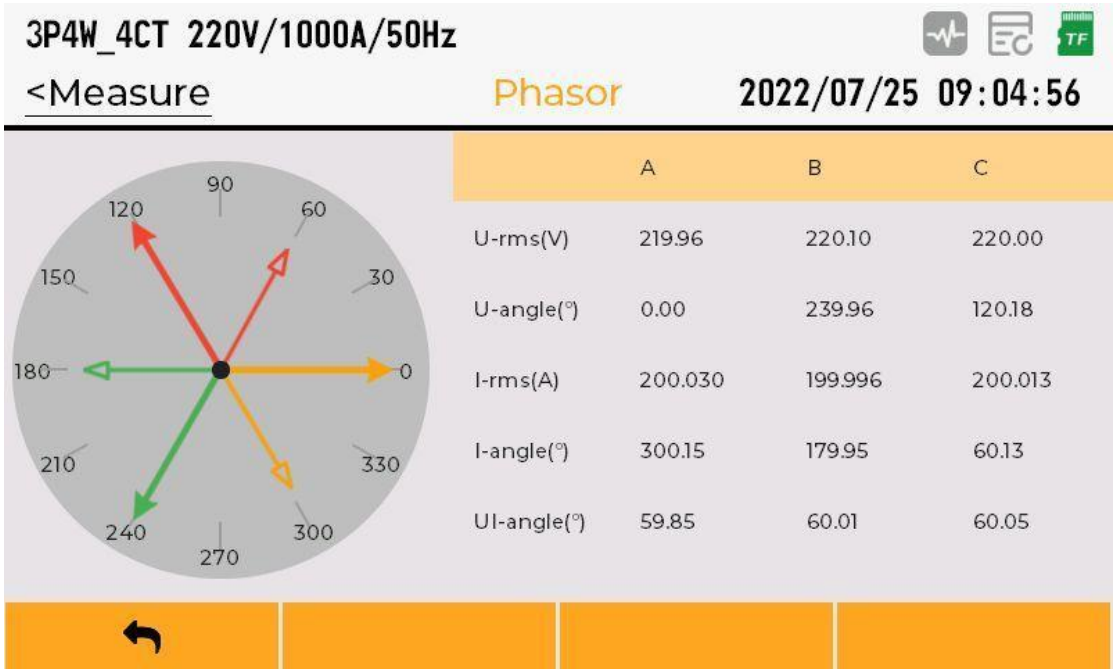


Figure 6-41 Phasor Diagram

6.15 Unbalance Screen

Displays voltage/current negative- and zero-sequence unbalance as the ratio of the corresponding sequence component to the positive-sequence component.



Figure 6-42 Unbalance

6.16 Demand Screen

Displays current and maximum demand; supports page navigation and switching.

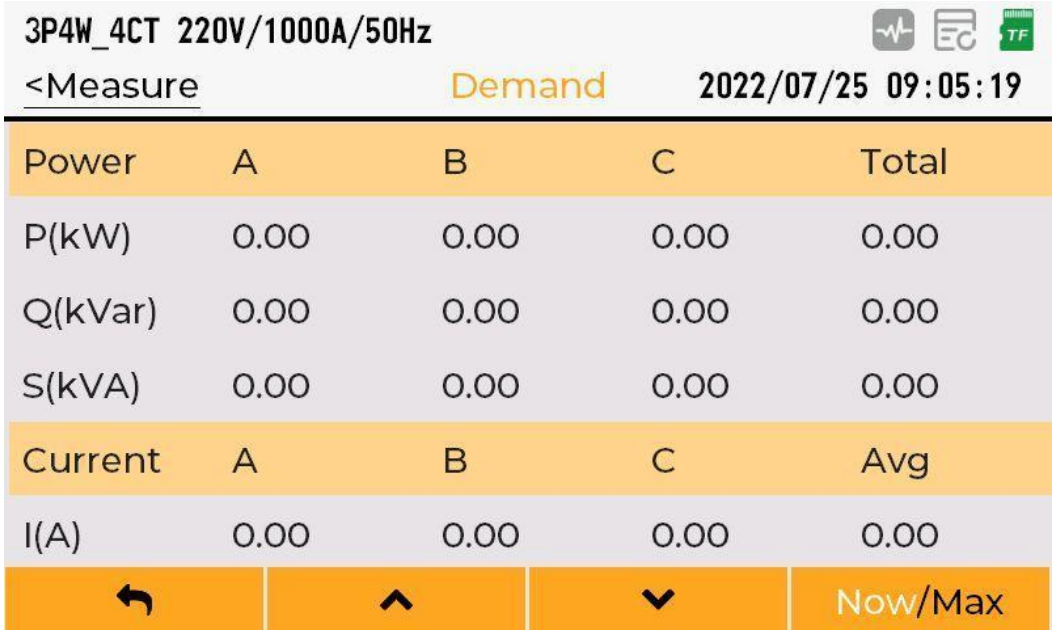


Figure 6-43 Current Demand



Figure 6-44 Maximum Demand

6.17 Recording Screen

Access data logging, waveform recording, record management and storage management.

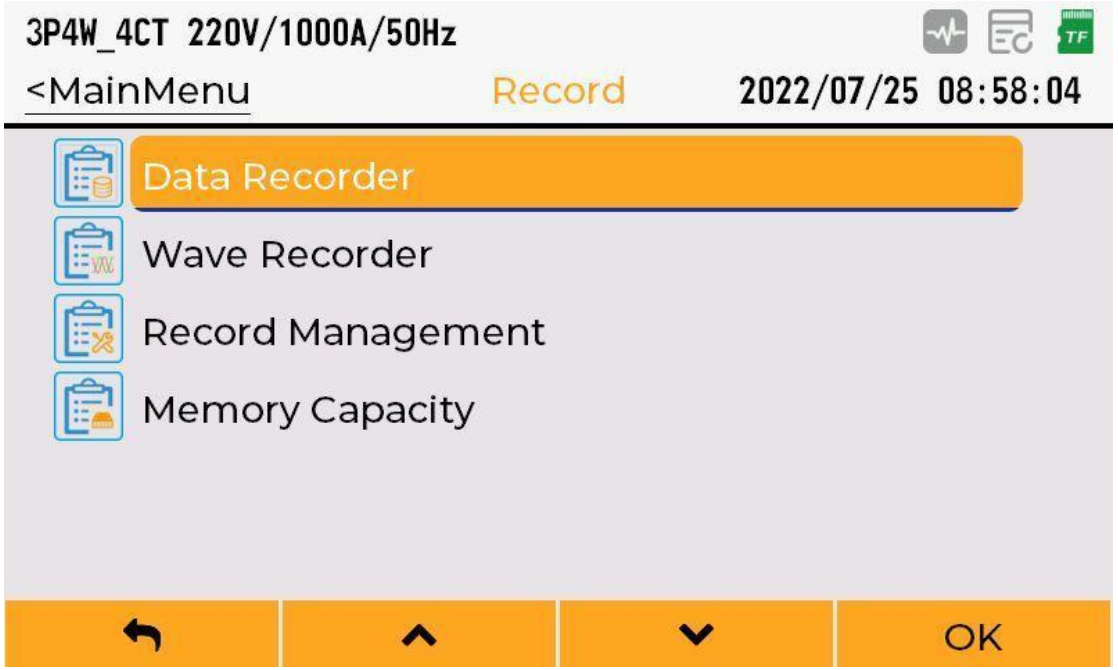


Figure 6-45 Recording Screen

Key operation is the same as described above.

6.18 Data Logger

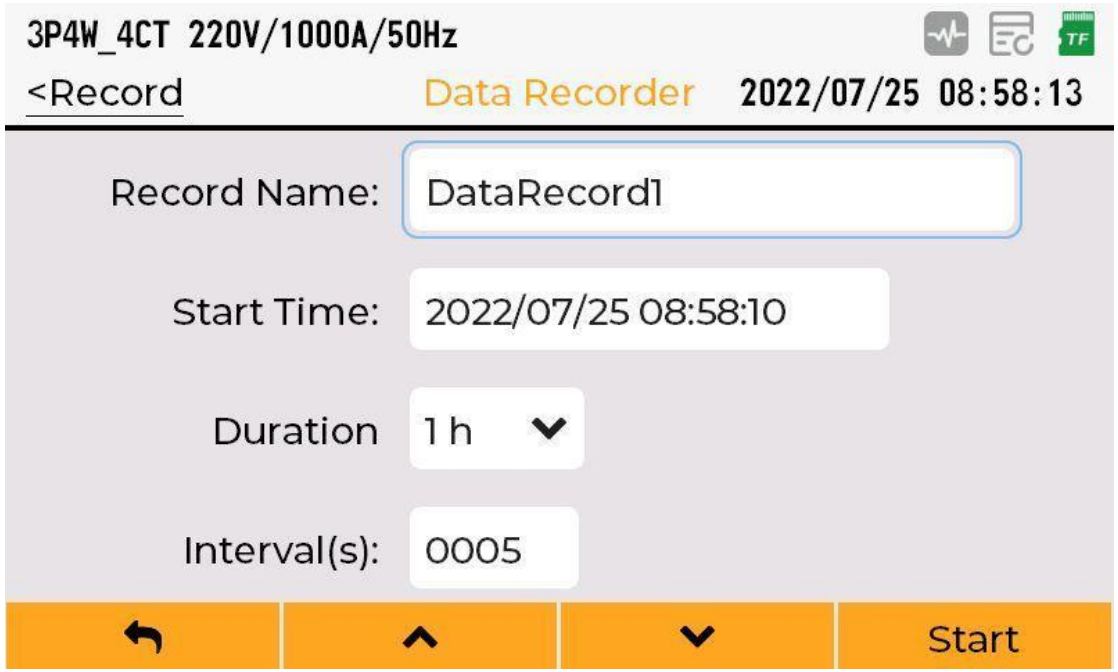
Records basic data, voltage harmonics and current harmonics.

- Record name: up to 20 characters. The recording start time is added automatically to distinguish files.
- Start time: sets when recording begins. When [Start] is pressed, a start time earlier than “current time + 10 seconds” is automatically adjusted to “current time + 10 seconds” to ensure proper startup.

- Duration: 1h / 2h / 4h / 8h / 16h / 24h / 2d / 7d / 30d / 3mo / 6mo / 12mo / Max. Max records continuously until stopped manually or storage is full.
- Recording interval: default 60 s; range 5 – 9999 s. This is not the demand period and does not automatically imply interval averaging.

Settings:

- Name (up to 20 characters)
- Start time
- Duration (1h – 12mo or Max)
- Recording interval (5 – 9999 s)


3P4W_4CT 220V/1000A/50Hz
<Record
Data Recorder
2022/07/25 08:58:13
Record Name:
DataRecord1
Start Time:
2022/07/25 08:58:10
Duration
1 h
Interval(s):
0005
Start

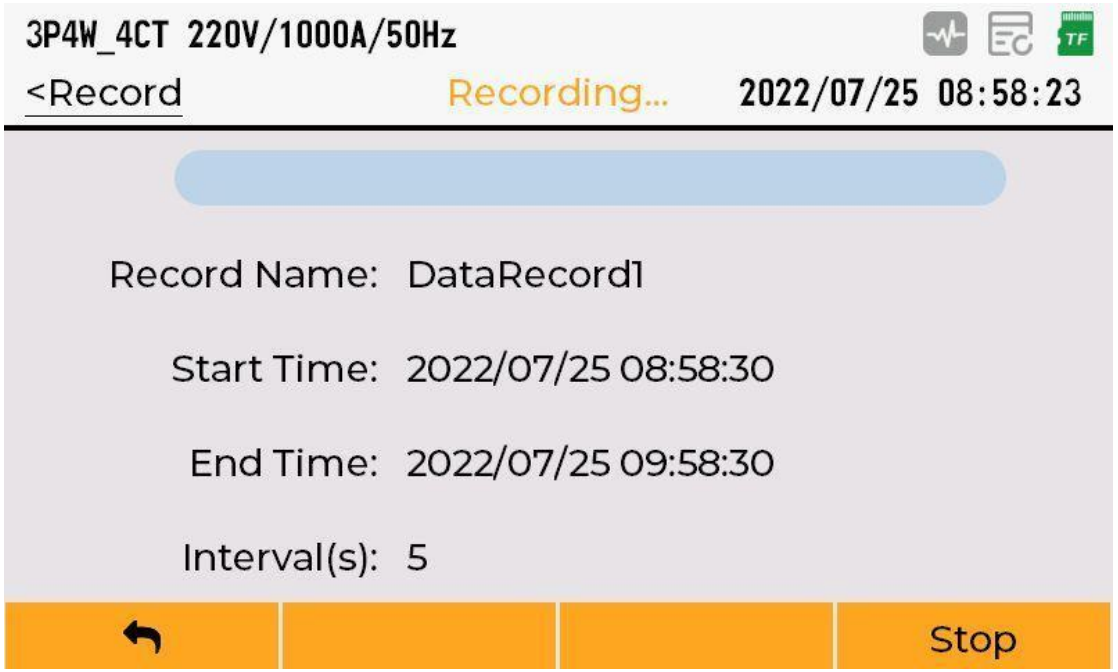


Figure 6-46 Data Logger

6.19 Waveform Recorder

The waveform recorder captures real-time three phase voltage and current waveforms at the scheduled time.

- Record name: up to 20 characters. The recording start time is automatically added to distinguish waveform files.
- Start time: sets when waveform acquisition begins. When [Start] is pressed, a time earlier than “current time + 10 seconds” is automatically adjusted to “current time + 10 seconds” to ensure proper recording.
- Sampling rate (kHz): 1 / 2 / 4 / 8 kHz. Corresponding maximum recording durations:
  - 1 kHz → 40 seconds

- 2 kHz → 20 seconds
- 4 kHz → 10 seconds
- 8 kHz → 5 seconds

- Higher sampling rates allow shorter recording durations.

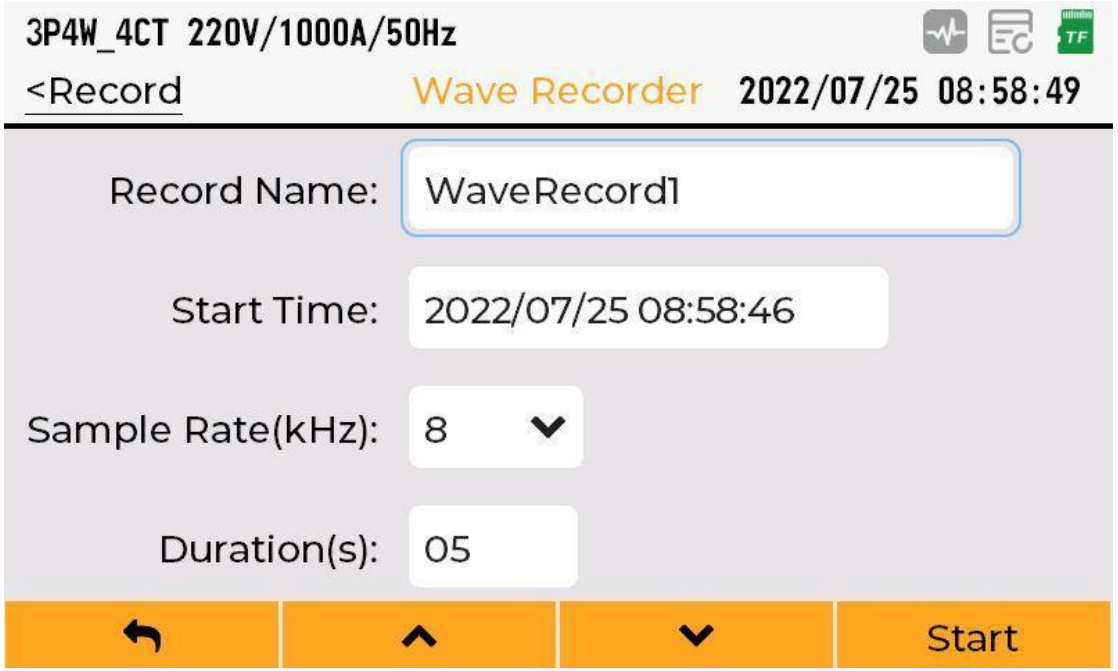




Figure 6-47 Waveform Recorder

6.20 Record Management

Export, delete or delete all records.

Insert a FAT32 USB drive to export records.

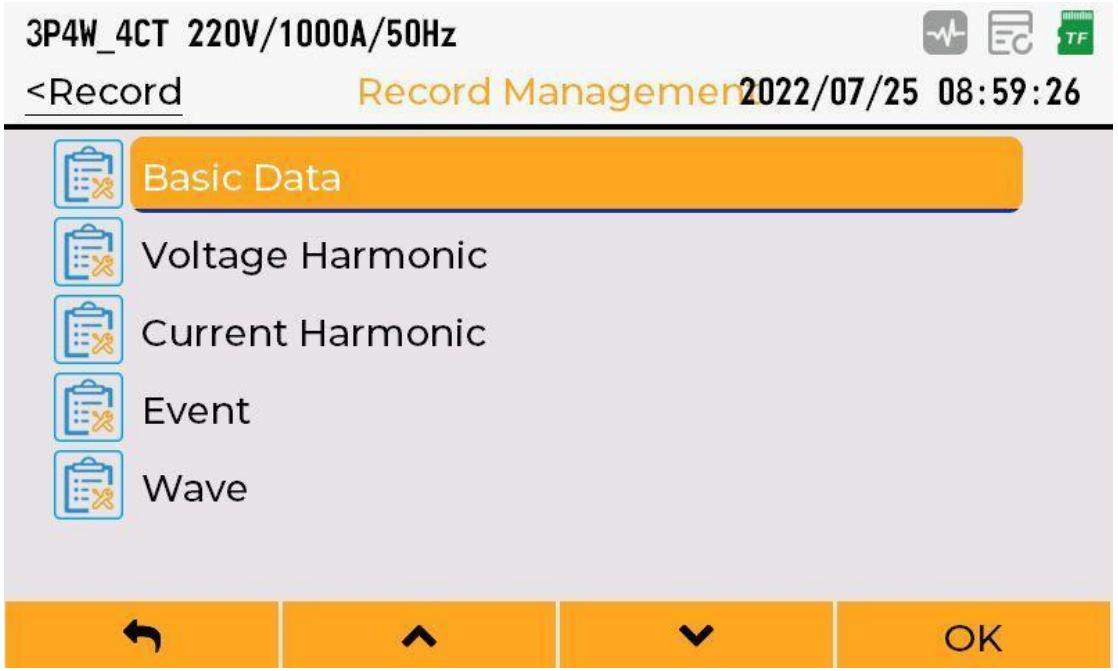


Figure 6-48 Record Management

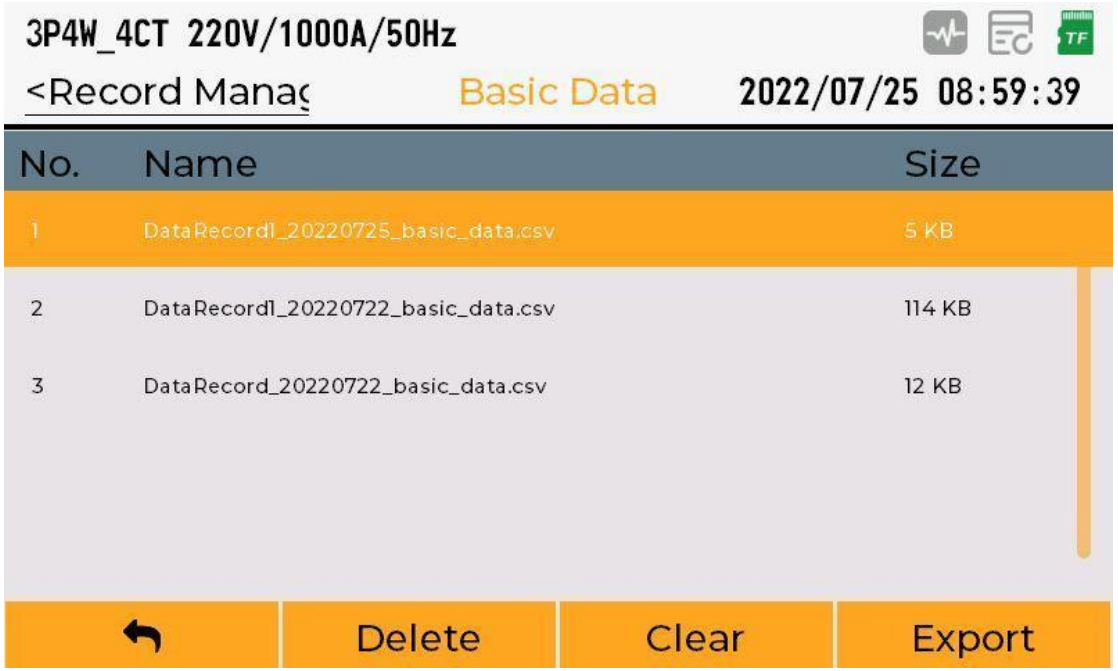


Figure 6-49 Export Basic Data Records

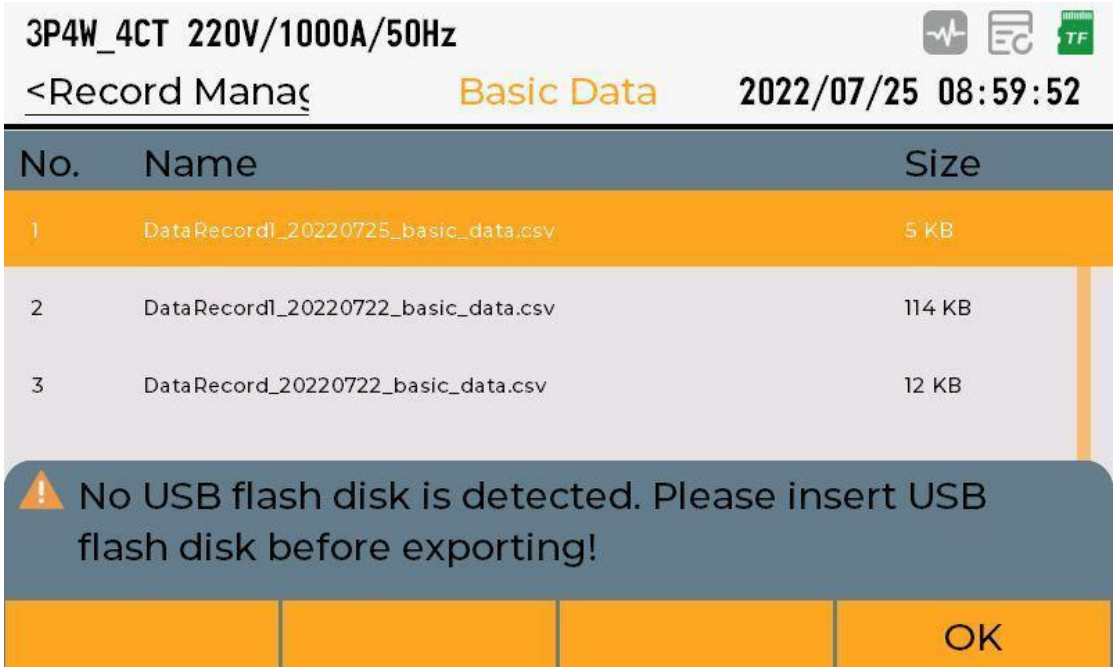


Figure 6-50 USB Drive Detection



Figure 6-51 Delete Current Record



Figure 6-52 Delete All Records

6.21 Storage Capacity

Displays storage usage. Formatting erases record files; back up records before proceeding.

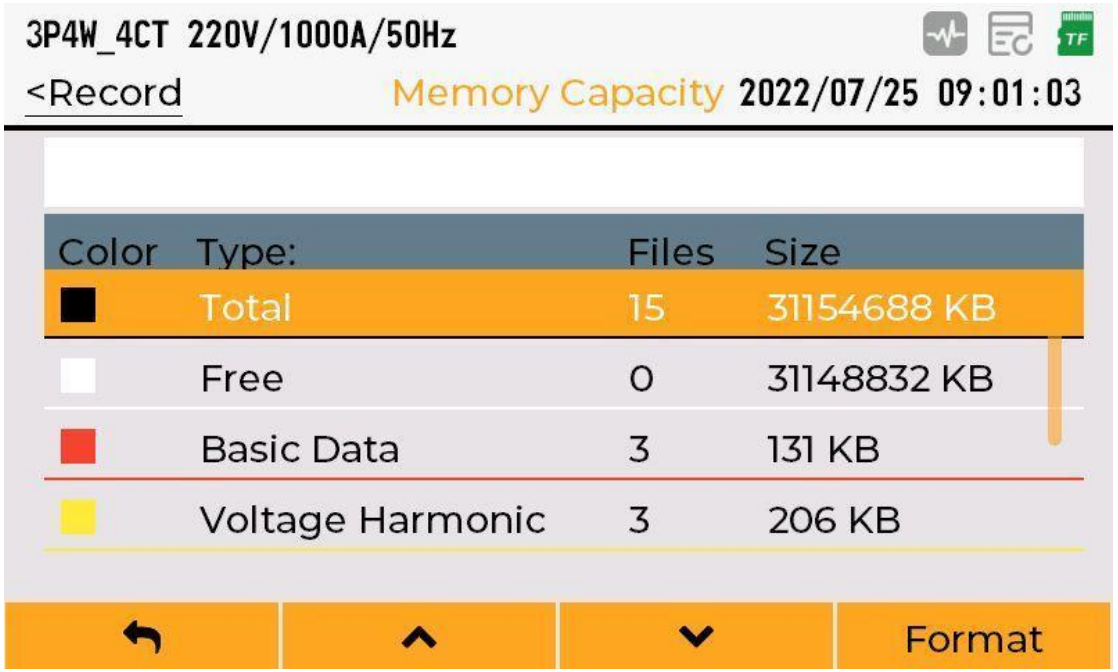


Figure 6-53 Storage Capacity

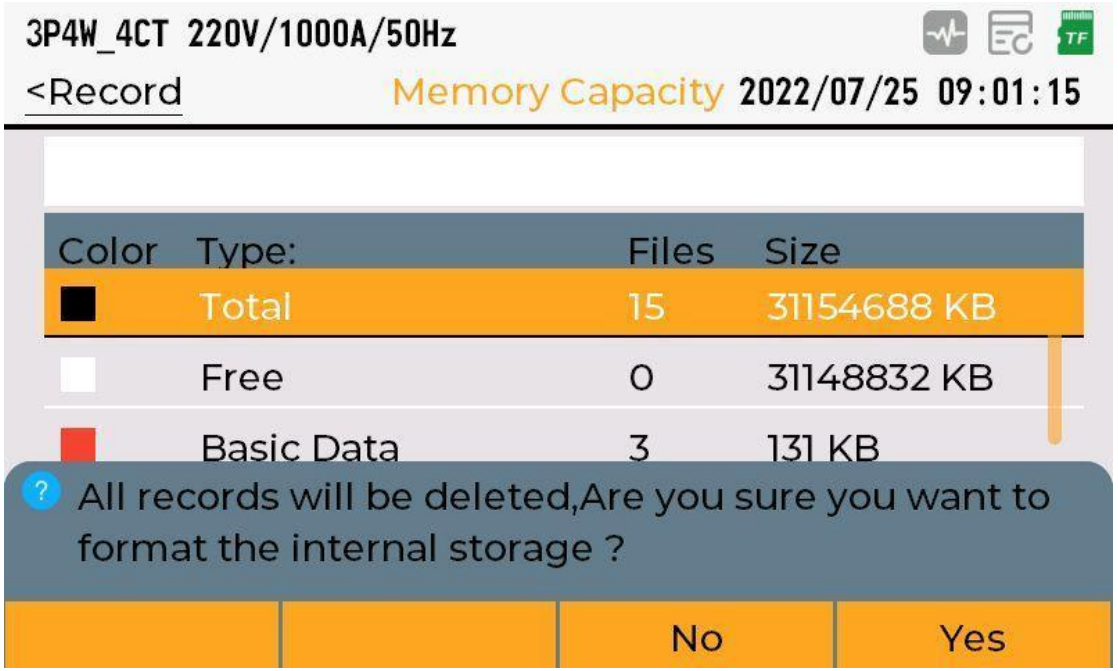


Figure 6-54 Format Storage

7 Operation and Menu Structure

Meter Navigation Menu

7.1 Measurement Module

Module	Category	Function	Description
Measurement Module	Voltage / current	Phase voltage U	RMS (V)
		Voltage crest factor CF	Crest Factor

		Voltage peak pk	Voltage Peak
		Line-to-line voltage U12/U23/U31	Three phase line-to-line voltage
		Power frequency F	50/60Hz
		RMS current I	RMS current
		Current crest factor I-CF	Ratio of peak current to RMS current
		Current K-factor KF	Harmonic heating factor
	Power	Active power P	kW
		Reactive power Q	kvar
		Apparent power S	kVA
		Power factor PF	Total power factor
		Fundamental power factor DPF	Fundamental power factor (displacement factor)
	Energy	Imported active energy EP_imp	kWh
		Exported active energy EP_exp	kWh
		Forward reactive energy EQ_imp	kvarh
		Reverse reactive energy EQ_exp	kvarh

		Apparent energy ES	VAh
		CO_2 emissions	Estimated from energy and emission factor
	Harmonics	Total harmonics THD (V/I)	Voltage/current THD (%)
		Odd/even harmonics	Calculated automatically
		Voltage harmonic orders 1 – 50	Magnitude / percentage
		Current harmonic orders 1 – 50	Magnitude / percentage
	Waveforms	Three phase voltage waveforms	Real-time display
		Three phase current waveforms	Real-time display
		Overlaid voltage/current waveforms	Zoom and hold
	Phasors	Voltage phasor diagram	Phase angle display
		Current phasor diagram	Phase angle display
	Unbalance	Voltage unbalance	Negative sequence, zero sequence
		Current unbalance	Negative sequence, zero sequence
	Demand	Current demand	Current / maximum
		Power demand	Current / maximum

7.2 Recording Module

Module	Category	Function	Description
Recording Module	Data Logger	Record name	Up to 20 characters
		Start time	Automatically adjusted to current time + 10 s
		Duration	1h – 12mo or Max
		Recording interval	5 – 9999 seconds
	Waveform Recorder	Record name	Same as above
		Start time	Same as above
		Sampling rate	1/2/4/8 kHz
		Maximum sampling duration	40/20/10/5 seconds
	Record Management	Basic data records	Browse / export / delete
		Voltage harmonic records	Same as above
		Current harmonic records	Same as above
		Event Recording	Same as above
		Waveform records	Same as above
	Storage Capacity	Total capacity	Internal Flash / TF
		Free capacity	Visual display
		Basic data usage	Shown by category
		Voltage harmonic usage	Shown by category
		Current harmonic usage	Shown by category
		Waveform usage	Shown by category
		Format	Erase all records

7.3 Settings Module

7.3.1 Power System Parameters

Category	Function	Description
Wiring mode	3P4W_4CT / 3P4W_3CT / 3P3W_3CT / 3P3W_2CT / 1P3W / 1P2W	Must match actual wiring
Power frequency	50Hz / 60Hz	System operating frequency
Nominal voltage	1 – 99999V	Reference for event thresholds
Current transformer	Type	Rcoil / CT
	Sensitivity	mV/kA or mV/A
	Nominal current	1 – 99999 A
	Ratio	0.0001 – 1000

Voltage transformer	Ratio setting	Enter VT ratio
Low-signal cutoff	Voltage/current zero drift	0 – 10%
Harmonic threshold	FFT threshold	0 – 10%
Event parameters	Swell, dip, interruption, frequency, harmonics, unbalance, etc.	All adjustable
Demand parameters	Method (fixed/sliding), interval	1 – 60 min
CO_2 emission factor	0 – 9999.99	kg CO_2 /MWh; set for the applicable region and year
K-factor	US/EU, e/q parameters	e: 0 – 0.20; q: 1.00 – 2.00; both dimensionless

7.3.2 System Parameters

Category	Function	Description
System information	Model, serial number, version, MAC address	Device parameters
Ethernet settings	IP, subnet mask, gateway, automatic assignment	DHCP / static

Modbus TCP	Status, port number	Default port: 502
RS-485	Address, baud rate, parity, stop bits	Modbus RTU
Clock	Date format, time adjustment	yyyy/mm/dd
Display	Backlight brightness, screen-off time	1–5; disabled–30 min
Keypad	Key tones, automatic key lock	Disabled / 1–5 min
Language	7 languages	Simplified Chinese / English / Traditional Chinese / French / Russian / Spanish / Portuguese

7.3.3 User Parameters

Category	Function	Description
User information	User name, location	Written to record files
Phase labels	ABC / L1L2L3	Selectable display format
Phase colors	China / US / IEC / custom	Screen colors do not replace on-site conductor identification

7.3.4 Reset

Function	Description
Restore factory settings	Restore all defaults
Reset energy	Reset energy only
Reset maximum demand	Clear maximum demand values

8 Revision History

Version	Revision Date	Section / Page	Description of Changes	Reason	Prepared by	Reviewed by	Approved by	Notes
V1.0	2025-02-19	Entire document	Initial release	New document	Zhang Jianwei			
V1.2	26-06-15	2.2	Voltage range changed to 720 V	Technical specifications	Zhang Jianwei			
V1.3	26-06-25	4.1	Product dimensions		Zhang Jianwei			

Instructions:

1. Use version numbers such as V1.0, V1.1 and V2.0. Use a minor version for small revisions and a major version for significant structural or functional changes.

2. Describe what changed in “Description of Changes” and why it changed in “Reason”.

3. Complete preparation, review and approval before issuing a controlled document, and retain the revision history.