



# AQM2

## Power quality analyzer. User manual

V1. 03/2026

## Safety Precautions

### Use instructions

Please read this manual carefully before using the device and ensure you follow the instructions below:

#### NOTE:

- This device must be operated and maintained by qualified personnel who have read this manual.
- Before carrying out any internal or external work, disconnect all input signals and power supplies. Ensure that:
  - The secondary terminals of the voltage transformer are not short-circuited.
  - The secondary terminals of the current transformer are not open-circuited.
- Use suitable measuring equipment to confirm that there is no voltage present on any component of the device.
- The supplied electrical parameters must be within the rated range.
- Do not touch the terminals whilst the device is in operation.
- To use the communication function, connect the equipment to a secure network.

### Possible causes of failure or damage

- Operating environment outside the range
- Auxiliary voltage outside the range
- System frequency outside the range
- Input signal exceeding the maximum permitted value
- Incorrect polarity on voltage or current inputs
- Incorrect connections

This manual may not be reproduced without written permission. We accept no liability for errors or omissions. The contents are subject to change without notice.

## Contact information

#### S.A de Construcciones Industriales

C/Aragoneses, 15. 28108 – Alcobendas, Madrid. Spain

Tel. +34 915 190 245

[saci@saci.es](mailto:saci@saci.es) | [www.saci.es](http://www.saci.es)

## Contents

1. Introduction .....	5
1.1. Overview.....	5
1.2. Features.....	5
2. Technical Specification .....	7
3. Installation .....	8
3.1. Dimensions.....	8
3.2. Installation.....	9
3.3. Wiring .....	10
3.3.1. Typical Wiring Diagram.....	10
3.3.2. Voltage/Current Input Connection.....	11
3.3.3. Module Wiring .....	11
4. Operation .....	12
4.1. Panel .....	12
4.2. Display.....	14
4.2.1. Display Menu .....	14
4.2.2. Display Features.....	15
4.2.2.1. Real-time measurement .....	15
4.2.2.2. Energy metering.....	17
4.2.2.3. Power quality.....	18
4.2.2.4. Demand.....	23
4.2.2.5. Modules.....	24
4.2.2.6. SOE logs.....	25
4.2.2.7. Help.....	27
4.3. Setup .....	28
4.3.1. Setup menu.....	28
4.3.2. Basic parameter setup.....	30
4.3.3. Signal Input Setup .....	31
4.3.4. Communication Setup.....	32
4.3.5. Digital Input Setup .....	32
4.3.6. Relay Output Setup .....	32
4.3.7. Power quality threshold setup .....	33
4.3.8. PQ event setup .....	33
4.3.9. Module setup .....	34
4.3.10. Reset setup.....	34
4.3.11. Demand setup.....	34

- 4.3.12. Time setup ..... 35
- 4.3.13. EN50160 Setup ..... 35
- 5. Functions ..... 36
  - 5.1. Real-time measurements ..... 36
  - 5.2. Energy metering ..... 37
  - 5.3. Demand ..... 37
    - 5.3.1. Sliding Block Demand ..... 38
    - 5.3.2. Fixed Block Demand ..... 38
  - 5.4. Max/Min Values ..... 39
  - 5.5. Power Quality ..... 39
    - 5.5.1. Power Quality ..... 39
    - 5.5.2. Fundamental Wave Analysis ..... 39
    - 5.5.3. Crest Factor ..... 40
    - 5.5.4. K Factor ..... 40
    - 5.5.5. Voltage Deviation ..... 40
    - 5.5.6. Frequency Deviation ..... 40
    - 5.5.7. Harmonic and Inter-harmonic ..... 41
    - 5.5.8. Unbalance ..... 41
    - 5.5.9. Voltage Flicker ..... 42
    - 5.5.10. Voltage Swell, dip and Interruption ..... 42
    - 5.5.11. Rapid Voltage Change ..... 43
  - 5.6. Alarm ..... 44
  - 5.7. Event Log ..... 45
  - 5.8. Data Freezing ..... 48
  - 5.9. Address Mapping ..... 48
  - 5.10. Digital Input ..... 49
  - 5.11. Relay Output ..... 49
  - 5.12. Expansion Modules ..... 49

## 1. Introduction

### 1.1. Overview

The **AQM2** is a network analyser that offers:

- Precise measurement of electrical parameters
- Energy measurement
- Power quality monitoring

It complies with the **IEC 61000-4-30 Class A standard**.

It features input/output (I/O) modules for monitoring and control, integrating easily into systems for:

- Electrical supervision
- Energy management

### 1.2. Features

Functions		AQM2
Display Mode	TFT	5"
Real-time Measurement	3 phase voltage	●
	3 phase current	●
	Neutral current	●
	Active power	●
	Reactive power	●
	Apparent power	●
	Power factor	●
	Frequency	●
	Demand	●
	Max/Min values	●
	Phase angle	●
Energy Metering	Bi-directional active energy	●
	Bi-directional reactive energy	●
	Four-quadrant reactive electric energy	●
	Apparent energy	●
	Bi-directional tariff energy	●

Power Quality	Voltage deviation	●
	Frequency deviation	●
	Unbalance	●
	THD	●
	Harmonic ratio(2 <sup>nd</sup> -51 <sup>st</sup> )	●
	Inter-harmonic ratio	●
	Voltage flicker	●
	Rapid voltage change	●
	Voltage swell	●
	Voltage dip	●
	Voltage interruption	●
	Crest factor	●
	k-factor of current	●
	Transient capture	80μs
	ITIC/SEMI F47 curve	●
Alarms	Voltage	●
	Current	●
	Active power	●
	Reactive power	●
	Apparent power	●
	Power factor	●
	Frequency	●
Data Records	SOE log	1,024 events
	PQ event log	1,024 events
	Waveform record	1,024 events
	Data freeze	●
	EN50160 report	60 events
Input/Output	Digital input	4
	Relay output	4
Communication	RS485 interface	●
Time synchronization	IRIG-B	●
	Modbus- RTU	●
Optional Modules	FM2: 4 digital inputs	○

	FM3: 2 relay outputs	○
	FM11: RS485 port, Modbus-RTU protocol	○
	FM24: Ethernet port, Modbus-TCP, Webserver	○

[Note 1]: "-" - not available, "●"- available, "○" - optional.

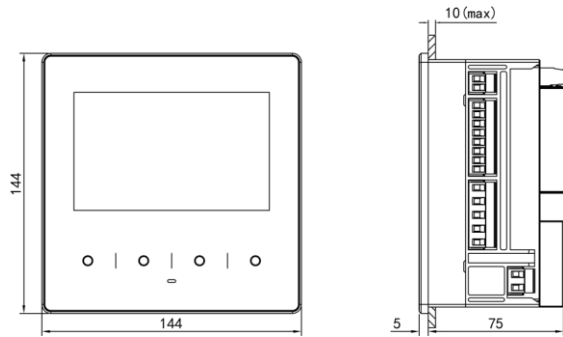
## 2. Technical Specification

Accuracy	
Voltage, Current	0.1%
Active Power, Reactive Power	0.2%
Power Factor	0.2%
Frequency	±0.01Hz
Active Energy	Cl. 0.2S
Reactive Energy	Cl. 2
Power Quality Parameters	IEC 61000-4-30 Cl. A
Environmental Characteristics	
Working Temperature	-25°C...+70°C
Storage Temperature	-25°C...+70°C
Relative Humidity	5%...95%RH, without condensation
Working Altitude	≤ 2000m (CAT III)
Pollution Degree	2
Mechanical Characteristics	
Dimension	144mm×144mm×80mm
Protection Degree	Front: IP54; rear housing: IP20
Safety Characteristics	
Measurement Category	300V (CAT III)
Safety	IEC 61010-1, double insulation
Auxiliary Power Supply	
Voltage	AC/DC 80V...270V
Frequency	50/60Hz ± 5Hz
Power Consumption	≤ 10VA
Voltage Input	
Rated Value	3×230/400 VAC
Starting Value	10 V
Overload	Continuous: 1.2Vn; instantaneous: 2Vn/1min
Frequency	45Hz...65Hz
Current Input	
Rated Value	3×.../1A or .../5A
Starting Value	10mA
Overload	Continuous: 2In; instantaneous: 20In/0.5s
Switching Input	
Number	4
Type	Dry contact
Relay Output	
Number	4
Contact Capacity	AC 250V/5A or DC30V/5A
Pulses of Electric Energy	
Number	1

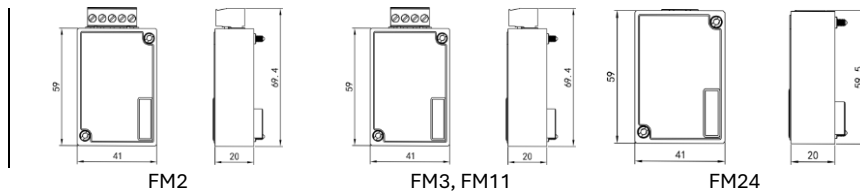
Type	Photocoupler isolation
<b>Communication Port</b>	
Number	1
Port	RS485
Baud rate	2.4kbps...115.2kbps
Protocol	Modbus-RTU
<b>Real-time Clock</b>	
Clock Drifting	≤ 0.5s/day
<b>Terminals</b>	
Torque	0.5N·m
<b>Standards</b>	
IEC 62586	Measurement of power quality in electrical supply systems
IEC 61557-12	Power measurement and monitoring devices (PMD)
IEC 61000-4-2	Electrostatic discharge immunity, Level 4
IEC 61000-4-3	Radio frequency field immunity, Level 3
IEC 61000-4-4	Immunity to fast electrical transients/bursts, Level 4
IEC 61000-4-5	Surge immunity, Level 4
IEC 61000-4-8	Power frequency magnetic field immunity, Level 4

### 3. Installation

#### 3.1. Dimensions

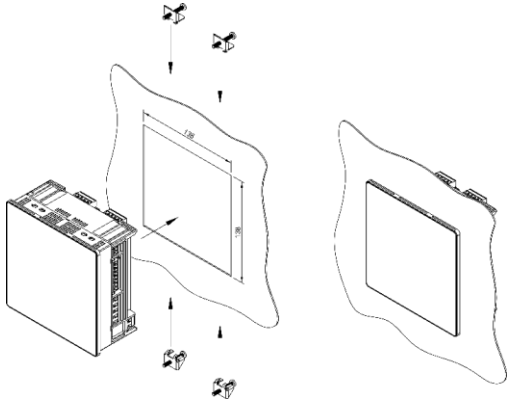


AQM2 (Dimensions in mm)

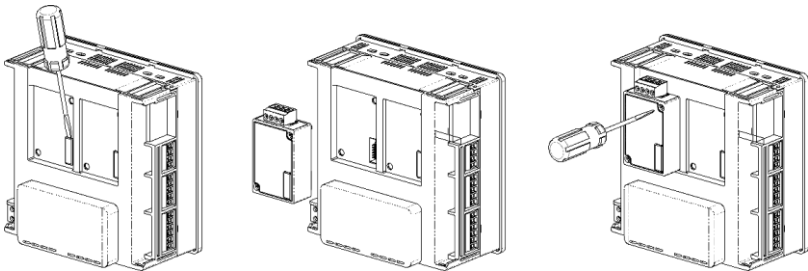


Modules (Dimensions in mm)

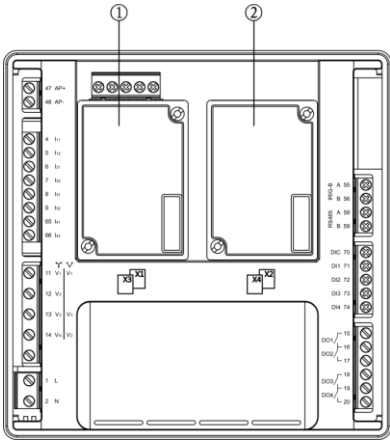
### 3.2. Installation



Installation Diagram. (Installation bracket screw torque 0.2~0.3N.m)



Module installation Diagram



Back-end Diagram

A maximum of 2 modules can be installed in each position.

A maximum of 1 communication module per position.

Each unit supports up to 4 modules.

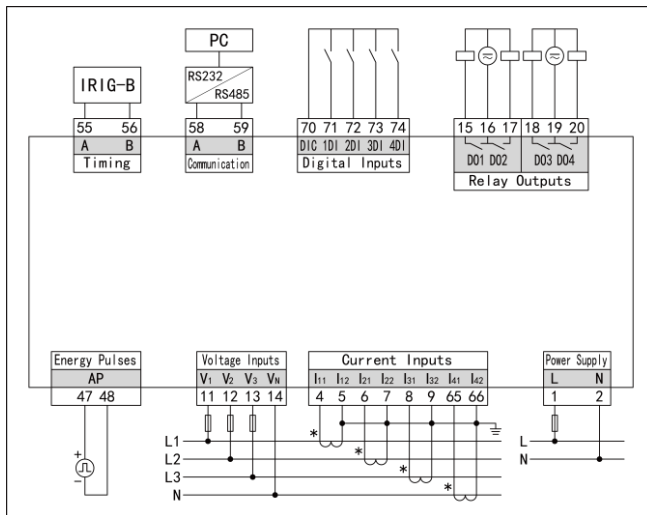
**Restrictions:**

FM11 and FM24 only in position ①.

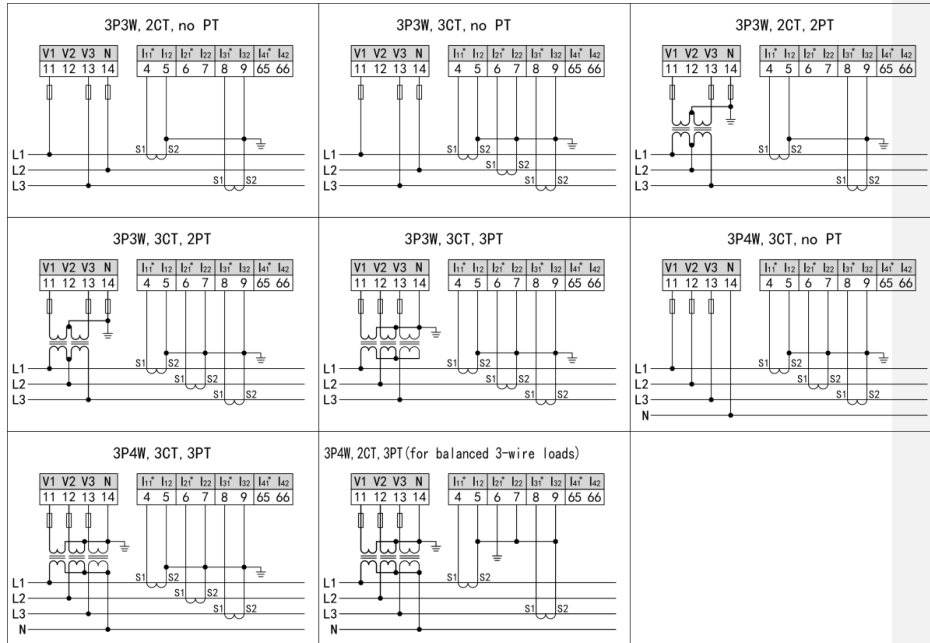
Modules can be freely combined within these conditions.

### 3.3. Wiring

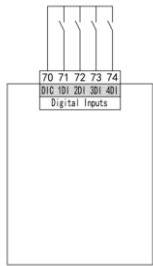
#### 3.3.1. Typical Wiring Diagram



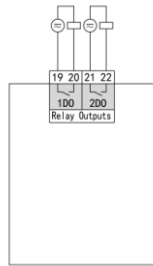
### 3.3.2. Voltage/Current Input Connection



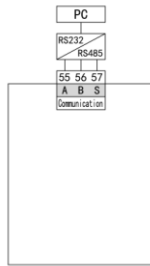
### 3.3.3. Module Wiring



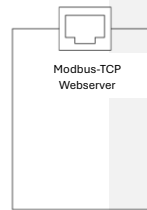
Module FM2



Module FM3



Module FM11



Module FM24

## 4. Operation

### 4.1. Panel

**Display:**

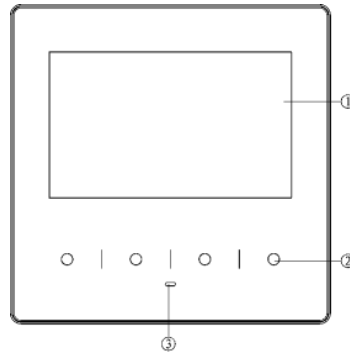
- Content indicator
- Page number
- Data window

**Buttons:**

- Used to configure settings

**LED:**



- Steady light: device powered
- Flashing: alarm active
- 






**Button functions**

Icons	Description
	Increase the selected data bits.
	Move down the options/page down/change parameters.
	Move in a circular way to the left to change or display data.
	Move in a circular way to the right to change or display data.
	Return directly to the "Main Menu" page, return to the previous menu or discard modifications.
	Enter the selected option.
	Confirm.
	Zoom in or out to display the image.
	Edit the options.
	Turn to next page.
	Invalidate the present button.


**Modification methods for values:**

Press “” to scroll through and edit the data digit, then press “” to increment the value of the current digit in a cyclical manner.

**Entering and exiting programming mode.****Entering programming mode:**

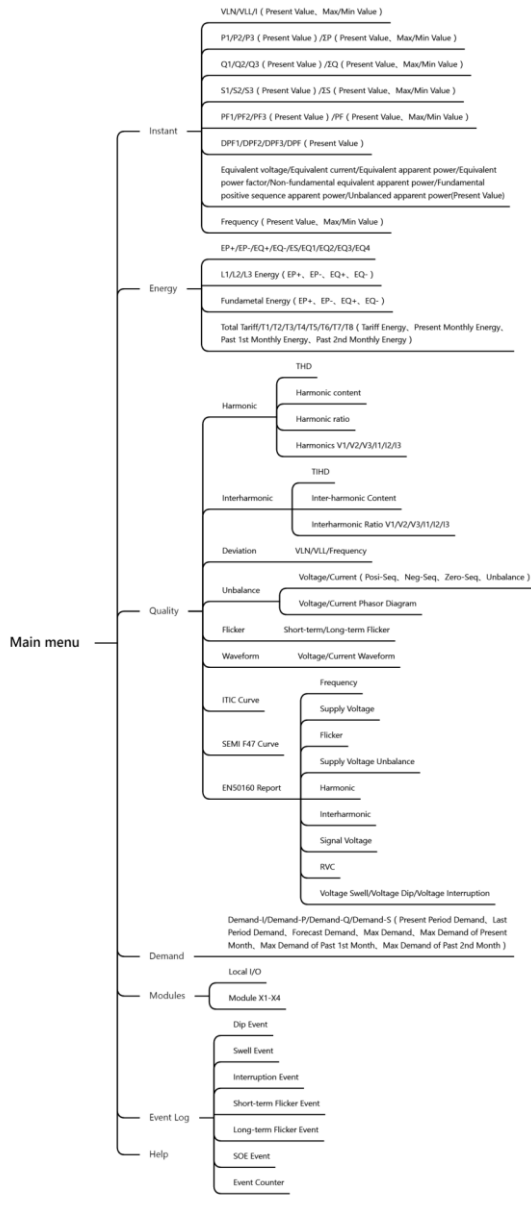
On the main interface, press “” and “” to change the selected item to “System Setup”, then press “” to access the configuration interface. Normally, users can access this by selecting “User Setup”. After entering the correct programming protection password, you will enter configuration mode and can begin adjusting the parameters (the default password is 0001, and can be changed as required).

**Exiting programming mode:**

Once you have returned to the top-level menu of the programming interface, press the “” button. The device will ask if you wish to save the changes. Select “Yes” to save and return to the main menu, or “No” to exit without saving the changes and return to the main menu.

## 4.2. Display

### 4.2.1. Display Menu



## 4.2.2. Display Features

### 4.2.2.1. Real-time measurement

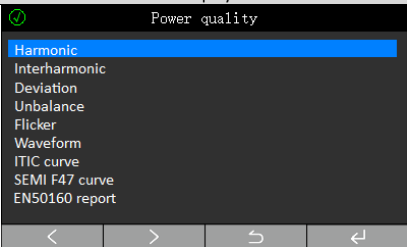
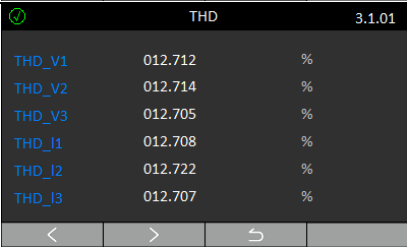
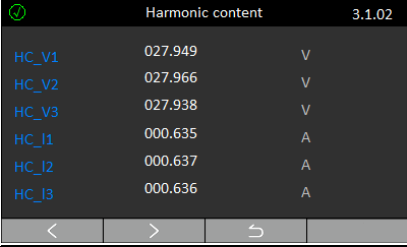

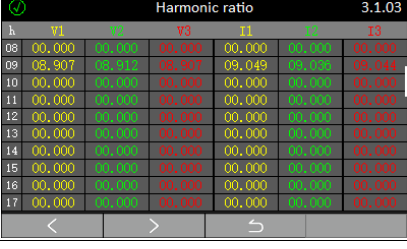
No.	Display	Description
1	<p>Real-time overview 1.01</p> <p>V1 219.022 V P1 1.092 kW  V2 218.391 V P2 1.087 kW  V3 218.594 V P3 1.093 kW  U12 378.594 V PF1 1.000  U23 378.469 V PF2 1.000  U31 378.952 V PF2 1.000  I1 4.9888 A Q -0.003 kvar  I2 4.9806 A S 3.273 kVA  I3 5.0033 A F 49.998 Hz</p>	Real-time measurement overview
2	<p>Voltage 1.02</p> <p>Max Min  V1 219.022 V 219.142 V 000.000 V  V2 218.391 V 220.042 V 000.000 V  V3 218.594 V 220.741 V 000.000 V  U12 378.594 V 379.154 V 000.000 V  U23 378.469 V 380.147 V 000.000 V  U31 378.952 V 379.986 V 000.000 V</p>	<p>Voltage</p> <p>Phase to neutral voltage  V1=219.022V  V2=218.391V  V3=218.594V</p> <p>Phase to phase voltage  U12=378.594V  U23=378.469V  U31=378.952V</p>
3	<p>Current 1.03</p> <p>Max Min  I1 4.9987 A 5.0010 A 0.0000 A  I2 5.0014 A 5.0014 A 0.0000 A  I3 4.9997 A 5.0003 A 0.0000 A  I4 0.0001 A 0.0007 A 0.0000 A</p>	<p>Current</p> <p>I1=4.9987A  I2=5.0014A  I3=4.9997A  Neutral current  I4=0.0001A</p>
4	<p>Active power 1.04</p> <p>Max Min  P1 1.1002 kW  P2 1.0997 kW  P3 1.1003 kW  P 3.3002 kW 3.3012 kW 0.0000 kW</p>	<p>Active power</p> <p>P1 =1.1002kW  P2=1.0997kW  P3=1.1003kW  P= 3.3002kW</p>
5	<p>Reactive power 1.05</p> <p>Max Min  Q1 -0.0002 kvar  Q2 0.0000 kvar  Q3 -0.0002 kvar  Q -0.0003 kvar 0.0003 kvar 0.0000 kvar</p>	<p>Reactive power</p> <p>Q1=-0.002kvar  Q2=0.000kvar  Q3=-0.002kvar  Q=-0.003kvar</p>

6	<p>Apparent power 1.06</p> <p>S1 1.1001 kVA</p> <p>S2 1.1006 kVA</p> <p>S3 1.1002 kVA</p> <p>S 3.3008 kVA 3.3008 kVA 0.0000 kVA</p>	<p>Apparent power</p> <p>S1=1.1001kVA</p> <p>S2=1.1006kVA</p> <p>S3=1.1002kVA</p> <p>S=3.3008kVA</p>
7	<p>Power factor 1.07</p> <p>PF1 1.0000</p> <p>PF2 1.0000</p> <p>PF3 1.0000</p> <p>PF 1.0000 1.0000 0.0000</p>	<p>Power factor</p> <p>PF1=1.000</p> <p>PF2=1.000</p> <p>PF3=1.000</p> <p>PF=1.000</p>
8	<p>Displacement power factor 1.08</p> <p>DPF1 1.000</p> <p>DPF2 1.000</p> <p>DPF3 1.000</p> <p>DPF 1.000</p>	<p>Displacement power factor</p> <p>DPF1=1.000</p> <p>DPF2=1.000</p> <p>DPF3=1.000</p> <p>DPF=1.000</p>
9	<p>Equivalent data 1.09</p> <p>Ue 219.978 V</p> <p>Ie 5.0001 A</p> <p>Se 3.300 kVA</p> <p>PFe 1.000</p> <p>SeN 0.081 kVA</p> <p>S1+ 3.299 kVA</p> <p>Su1 0.000 kVA</p>	<p>Equivalent data</p> <p>Equivalent voltage Ue=219.978V</p> <p>Equivalent current Ie= 5.0001A</p> <p>Equivalent apparent power Se=3.300kVA</p> <p>Equivalent power factor PFe=1.000</p> <p>Non-fundamental equivalent apparent power</p> <p>SeN=0.081kVA</p> <p>Fundamental positive sequence apparent power</p> <p>S1+=3.299kVA</p> <p>Unbalanced apparent power</p> <p>Su1=0.000kVA</p>
10	<p>Frequency 1.10</p> <p>F 50.000 Hz 50.000 Hz 00.000 Hz</p>	<p>Frequency</p> <p>F=50.000Hz</p>

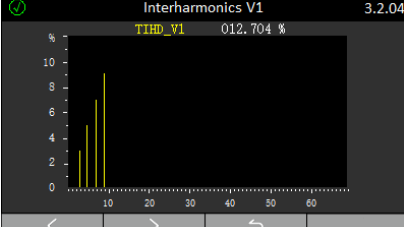
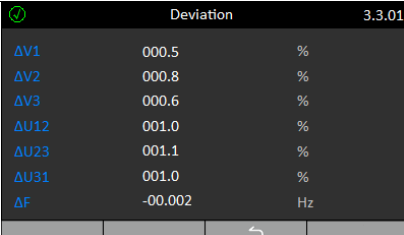
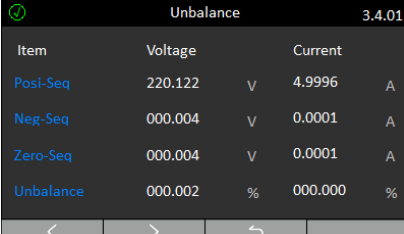
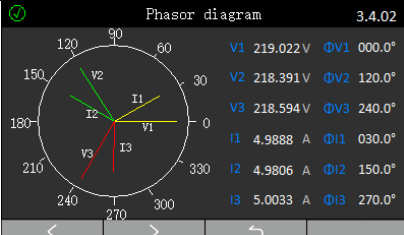
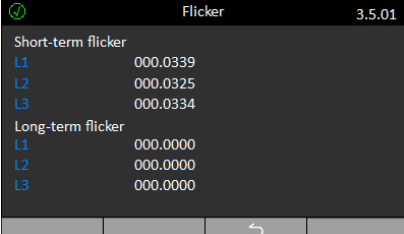
### 4.2.2.2. Energy metering

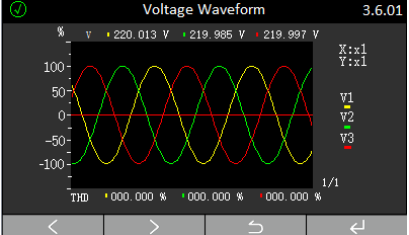
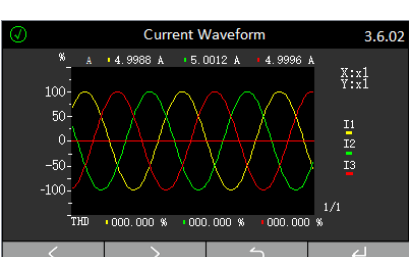
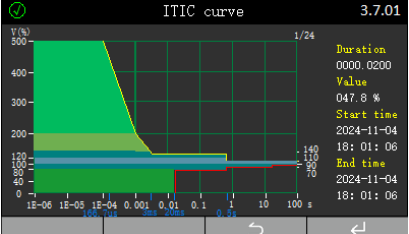
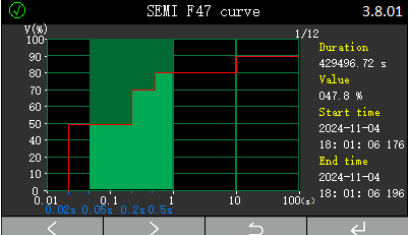
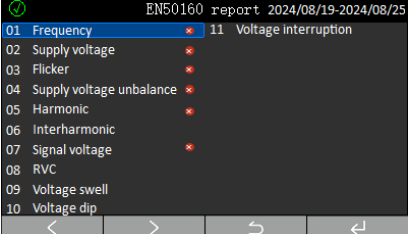
No.	Display	Description
1	<p>Energy overview 2.01</p> <p>EP+ 0000000007.994 kWh                      EP- 0000000000.965 kWh                      EQ+ 0000000001.671 kvarh                      EQ- 0000000005.210 kvarh                      ES 0000000015.809 kVAh                      EQ1 0000000001.650 kvarh                      EQ2 0000000000.021 kvarh                      EQ3 0000000000.000 kvarh                      EQ4 0000000000.000 kvarh</p>	Energy overview
2	<p>L1 energy 2.02</p> <p>EP+ 0000000002.672 kWh                      EP- 0000000000.322 kWh                      EQ+ 0000000000.550 kvarh                      EQ- 0000000001.739 kvarh</p>	L1 energy Import active energy EP+ = 2.672kWh Export active energy EP- = 0.322kWh Import reactive energy EP+ = 4.284kvarh Export reactive energy EP- = 1.814kvarh
3	<p>Fundamental energy 2.05</p> <p>EP+ 0000000007.964 kWh                      EP- 0000000000.949 kWh                      EQ+ 0000000001.651 kvarh                      EQ- 0000000000.000 kvarh</p>	Fundamental energy Fundamental import active energy EP+ = 7.964kWh Fundamental export active energy EP- = 0.949kWh Fundamental import reactive energy EQ+ = 1.651kvarh Fundamental export reactive energy EQ- = 0.000kvarh
4	<p>Tariff energy 2.06</p> <p>Σ 0000000117.952 kWh                      T1 0000000117.952 kWh                      T2 0000000000.000 kWh                      T3 0000000000.000 kWh                      T4 0000000000.000 kWh                      T5 0000000000.000 kWh                      T6 0000000000.000 kWh                      T7 0000000000.000 kWh                      T8 0000000000.000 kWh</p>	Tariff energy 8 tariffs energy

### 4.2.2.3. Power quality

No.	Display	Description																																																																													
1	 <p>Power quality</p> <ul style="list-style-type: none"> <li>Harmonic</li> <li>Interharmonic</li> <li>Deviation</li> <li>Unbalance</li> <li>Flicker</li> <li>Waveform</li> <li>ITIC curve</li> <li>SEMI F47 curve</li> <li>EN50160 report</li> </ul>	Power quality overview																																																																													
2	 <p>THD 3.1.01</p> <table border="1"> <tr><td>THD_V1</td><td>012.712</td><td>%</td></tr> <tr><td>THD_V2</td><td>012.714</td><td>%</td></tr> <tr><td>THD_V3</td><td>012.705</td><td>%</td></tr> <tr><td>THD_I1</td><td>012.708</td><td>%</td></tr> <tr><td>THD_I2</td><td>012.722</td><td>%</td></tr> <tr><td>THD_I3</td><td>012.707</td><td>%</td></tr> </table>	THD_V1	012.712	%	THD_V2	012.714	%	THD_V3	012.705	%	THD_I1	012.708	%	THD_I2	012.722	%	THD_I3	012.707	%	Total harmonic distortion(THD)																																																											
THD_V1	012.712	%																																																																													
THD_V2	012.714	%																																																																													
THD_V3	012.705	%																																																																													
THD_I1	012.708	%																																																																													
THD_I2	012.722	%																																																																													
THD_I3	012.707	%																																																																													
3	 <p>Harmonic content 3.1.02</p> <table border="1"> <tr><td>HC_V1</td><td>027.949</td><td>V</td></tr> <tr><td>HC_V2</td><td>027.966</td><td>V</td></tr> <tr><td>HC_V3</td><td>027.938</td><td>V</td></tr> <tr><td>HC_I1</td><td>000.635</td><td>A</td></tr> <tr><td>HC_I2</td><td>000.637</td><td>A</td></tr> <tr><td>HC_I3</td><td>000.636</td><td>A</td></tr> </table>	HC_V1	027.949	V	HC_V2	027.966	V	HC_V3	027.938	V	HC_I1	000.635	A	HC_I2	000.637	A	HC_I3	000.636	A	Harmonic content																																																											
HC_V1	027.949	V																																																																													
HC_V2	027.966	V																																																																													
HC_V3	027.938	V																																																																													
HC_I1	000.635	A																																																																													
HC_I2	000.637	A																																																																													
HC_I3	000.636	A																																																																													
4	 <p>Harmonic ratio 3.1.03</p> <table border="1"> <thead> <tr> <th>k</th> <th>V1</th> <th>V2</th> <th>V3</th> <th>I1</th> <th>I2</th> <th>I3</th> </tr> </thead> <tbody> <tr><td>02</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td></tr> <tr><td>03</td><td>02.987</td><td>02.988</td><td>02.989</td><td>03.004</td><td>02.997</td><td>02.999</td></tr> <tr><td>04</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td></tr> <tr><td>05</td><td>04.982</td><td>04.987</td><td>04.992</td><td>05.004</td><td>04.996</td><td>04.999</td></tr> <tr><td>06</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td></tr> <tr><td>07</td><td>06.986</td><td>06.992</td><td>06.998</td><td>07.024</td><td>06.997</td><td>06.999</td></tr> <tr><td>08</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td></tr> <tr><td>09</td><td>08.907</td><td>08.912</td><td>08.917</td><td>09.049</td><td>08.996</td><td>08.999</td></tr> <tr><td>10</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td></tr> <tr><td>11</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td></tr> </tbody> </table>	k	V1	V2	V3	I1	I2	I3	02	00.000	00.000	00.000	00.000	00.000	00.000	03	02.987	02.988	02.989	03.004	02.997	02.999	04	00.000	00.000	00.000	00.000	00.000	00.000	05	04.982	04.987	04.992	05.004	04.996	04.999	06	00.000	00.000	00.000	00.000	00.000	00.000	07	06.986	06.992	06.998	07.024	06.997	06.999	08	00.000	00.000	00.000	00.000	00.000	00.000	09	08.907	08.912	08.917	09.049	08.996	08.999	10	00.000	00.000	00.000	00.000	00.000	00.000	11	00.000	00.000	00.000	00.000	00.000	00.000	Harmonic ratio
k	V1	V2	V3	I1	I2	I3																																																																									
02	00.000	00.000	00.000	00.000	00.000	00.000																																																																									
03	02.987	02.988	02.989	03.004	02.997	02.999																																																																									
04	00.000	00.000	00.000	00.000	00.000	00.000																																																																									
05	04.982	04.987	04.992	05.004	04.996	04.999																																																																									
06	00.000	00.000	00.000	00.000	00.000	00.000																																																																									
07	06.986	06.992	06.998	07.024	06.997	06.999																																																																									
08	00.000	00.000	00.000	00.000	00.000	00.000																																																																									
09	08.907	08.912	08.917	09.049	08.996	08.999																																																																									
10	00.000	00.000	00.000	00.000	00.000	00.000																																																																									
11	00.000	00.000	00.000	00.000	00.000	00.000																																																																									
5	 <p>Harmonic ratio 3.1.03</p> <table border="1"> <thead> <tr> <th>k</th> <th>V1</th> <th>V2</th> <th>V3</th> <th>I1</th> <th>I2</th> <th>I3</th> </tr> </thead> <tbody> <tr><td>08</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td></tr> <tr><td>09</td><td>08.907</td><td>08.912</td><td>08.917</td><td>09.049</td><td>08.996</td><td>08.999</td></tr> <tr><td>10</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td></tr> <tr><td>11</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td></tr> <tr><td>12</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td></tr> <tr><td>13</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td></tr> <tr><td>14</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td></tr> <tr><td>15</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td></tr> <tr><td>16</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td></tr> <tr><td>17</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td></tr> </tbody> </table>	k	V1	V2	V3	I1	I2	I3	08	00.000	00.000	00.000	00.000	00.000	00.000	09	08.907	08.912	08.917	09.049	08.996	08.999	10	00.000	00.000	00.000	00.000	00.000	00.000	11	00.000	00.000	00.000	00.000	00.000	00.000	12	00.000	00.000	00.000	00.000	00.000	00.000	13	00.000	00.000	00.000	00.000	00.000	00.000	14	00.000	00.000	00.000	00.000	00.000	00.000	15	00.000	00.000	00.000	00.000	00.000	00.000	16	00.000	00.000	00.000	00.000	00.000	00.000	17	00.000	00.000	00.000	00.000	00.000	00.000	Harmonic ratio
k	V1	V2	V3	I1	I2	I3																																																																									
08	00.000	00.000	00.000	00.000	00.000	00.000																																																																									
09	08.907	08.912	08.917	09.049	08.996	08.999																																																																									
10	00.000	00.000	00.000	00.000	00.000	00.000																																																																									
11	00.000	00.000	00.000	00.000	00.000	00.000																																																																									
12	00.000	00.000	00.000	00.000	00.000	00.000																																																																									
13	00.000	00.000	00.000	00.000	00.000	00.000																																																																									
14	00.000	00.000	00.000	00.000	00.000	00.000																																																																									
15	00.000	00.000	00.000	00.000	00.000	00.000																																																																									
16	00.000	00.000	00.000	00.000	00.000	00.000																																																																									
17	00.000	00.000	00.000	00.000	00.000	00.000																																																																									

6	<p>Harmonics V1 3.1.04 THD_V1 012.712 %</p>	Harmonic bar																																																																													
7	<p>TIHD 3.2.01</p> <table border="1"> <tr><td>TIHD_V1</td><td>012.704</td><td>%</td></tr> <tr><td>TIHD_V2</td><td>012.712</td><td>%</td></tr> <tr><td>TIHD_V3</td><td>012.699</td><td>%</td></tr> <tr><td>TIHD_I1</td><td>012.706</td><td>%</td></tr> <tr><td>TIHD_I2</td><td>012.714</td><td>%</td></tr> <tr><td>TIHD_I3</td><td>012.708</td><td>%</td></tr> </table>	TIHD_V1	012.704	%	TIHD_V2	012.712	%	TIHD_V3	012.699	%	TIHD_I1	012.706	%	TIHD_I2	012.714	%	TIHD_I3	012.708	%	Total Inter-harmonic distortion																																																											
TIHD_V1	012.704	%																																																																													
TIHD_V2	012.712	%																																																																													
TIHD_V3	012.699	%																																																																													
TIHD_I1	012.706	%																																																																													
TIHD_I2	012.714	%																																																																													
TIHD_I3	012.708	%																																																																													
8	<p>Inter-harmonic content 3.2.02</p> <table border="1"> <tr><td>IHC_V1</td><td>027.949</td><td>V</td></tr> <tr><td>IHC_V2</td><td>027.966</td><td>V</td></tr> <tr><td>IHC_V3</td><td>027.938</td><td>V</td></tr> <tr><td>IHC_I1</td><td>000.635</td><td>A</td></tr> <tr><td>IHC_I2</td><td>000.637</td><td>A</td></tr> <tr><td>IHC_I3</td><td>000.636</td><td>A</td></tr> </table>	IHC_V1	027.949	V	IHC_V2	027.966	V	IHC_V3	027.938	V	IHC_I1	000.635	A	IHC_I2	000.637	A	IHC_I3	000.636	A	Inter-harmonic content																																																											
IHC_V1	027.949	V																																																																													
IHC_V2	027.966	V																																																																													
IHC_V3	027.938	V																																																																													
IHC_I1	000.635	A																																																																													
IHC_I2	000.637	A																																																																													
IHC_I3	000.636	A																																																																													
9	<p>Interharmonic ratio 3.2.03</p> <table border="1"> <thead> <tr><th>ih</th><th>V1</th><th>V2</th><th>V3</th><th>I1</th><th>I2</th><th>I3</th></tr> </thead> <tbody> <tr><td>01</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td></tr> <tr><td>02</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td></tr> <tr><td>03</td><td>02.987</td><td>02.986</td><td>02.985</td><td>03.004</td><td>02.987</td><td>02.986</td></tr> <tr><td>04</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td></tr> <tr><td>05</td><td>04.982</td><td>04.981</td><td>04.980</td><td>05.004</td><td>04.982</td><td>04.981</td></tr> <tr><td>06</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td></tr> <tr><td>07</td><td>06.966</td><td>06.965</td><td>06.964</td><td>07.024</td><td>06.966</td><td>06.965</td></tr> <tr><td>08</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td></tr> <tr><td>09</td><td>08.907</td><td>08.911</td><td>08.907</td><td>09.049</td><td>08.908</td><td>08.911</td></tr> <tr><td>10</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td></tr> </tbody> </table>	ih	V1	V2	V3	I1	I2	I3	01	00.000	00.000	00.000	00.000	00.000	00.000	02	00.000	00.000	00.000	00.000	00.000	00.000	03	02.987	02.986	02.985	03.004	02.987	02.986	04	00.000	00.000	00.000	00.000	00.000	00.000	05	04.982	04.981	04.980	05.004	04.982	04.981	06	00.000	00.000	00.000	00.000	00.000	00.000	07	06.966	06.965	06.964	07.024	06.966	06.965	08	00.000	00.000	00.000	00.000	00.000	00.000	09	08.907	08.911	08.907	09.049	08.908	08.911	10	00.000	00.000	00.000	00.000	00.000	00.000	Inter-harmonic ratio
ih	V1	V2	V3	I1	I2	I3																																																																									
01	00.000	00.000	00.000	00.000	00.000	00.000																																																																									
02	00.000	00.000	00.000	00.000	00.000	00.000																																																																									
03	02.987	02.986	02.985	03.004	02.987	02.986																																																																									
04	00.000	00.000	00.000	00.000	00.000	00.000																																																																									
05	04.982	04.981	04.980	05.004	04.982	04.981																																																																									
06	00.000	00.000	00.000	00.000	00.000	00.000																																																																									
07	06.966	06.965	06.964	07.024	06.966	06.965																																																																									
08	00.000	00.000	00.000	00.000	00.000	00.000																																																																									
09	08.907	08.911	08.907	09.049	08.908	08.911																																																																									
10	00.000	00.000	00.000	00.000	00.000	00.000																																																																									
10	<p>Interharmonic ratio 3.2.03</p> <table border="1"> <thead> <tr><th>ih</th><th>V1</th><th>V2</th><th>V3</th><th>I1</th><th>I2</th><th>I3</th></tr> </thead> <tbody> <tr><td>08</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td></tr> <tr><td>09</td><td>08.907</td><td>08.911</td><td>08.907</td><td>09.049</td><td>08.908</td><td>08.911</td></tr> <tr><td>10</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td></tr> <tr><td>11</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td></tr> <tr><td>12</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td></tr> <tr><td>13</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td></tr> <tr><td>14</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td></tr> <tr><td>15</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td></tr> <tr><td>16</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td></tr> <tr><td>17</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td><td>00.000</td></tr> </tbody> </table>	ih	V1	V2	V3	I1	I2	I3	08	00.000	00.000	00.000	00.000	00.000	00.000	09	08.907	08.911	08.907	09.049	08.908	08.911	10	00.000	00.000	00.000	00.000	00.000	00.000	11	00.000	00.000	00.000	00.000	00.000	00.000	12	00.000	00.000	00.000	00.000	00.000	00.000	13	00.000	00.000	00.000	00.000	00.000	00.000	14	00.000	00.000	00.000	00.000	00.000	00.000	15	00.000	00.000	00.000	00.000	00.000	00.000	16	00.000	00.000	00.000	00.000	00.000	00.000	17	00.000	00.000	00.000	00.000	00.000	00.000	Inter-harmonic ratio
ih	V1	V2	V3	I1	I2	I3																																																																									
08	00.000	00.000	00.000	00.000	00.000	00.000																																																																									
09	08.907	08.911	08.907	09.049	08.908	08.911																																																																									
10	00.000	00.000	00.000	00.000	00.000	00.000																																																																									
11	00.000	00.000	00.000	00.000	00.000	00.000																																																																									
12	00.000	00.000	00.000	00.000	00.000	00.000																																																																									
13	00.000	00.000	00.000	00.000	00.000	00.000																																																																									
14	00.000	00.000	00.000	00.000	00.000	00.000																																																																									
15	00.000	00.000	00.000	00.000	00.000	00.000																																																																									
16	00.000	00.000	00.000	00.000	00.000	00.000																																																																									
17	00.000	00.000	00.000	00.000	00.000	00.000																																																																									

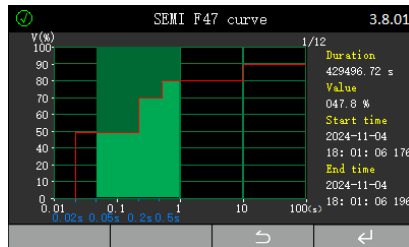
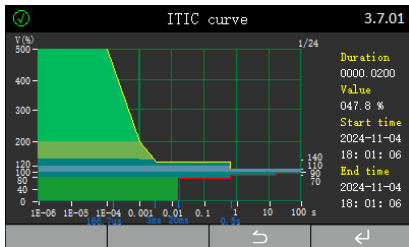
11		Inter-harmonic bar																								
12	 <table border="1" data-bbox="247 683 635 862"> <thead> <tr> <th>Item</th> <th>Value</th> <th>Unit</th> </tr> </thead> <tbody> <tr> <td>ΔV1</td> <td>000.5</td> <td>%</td> </tr> <tr> <td>ΔV2</td> <td>000.8</td> <td>%</td> </tr> <tr> <td>ΔV3</td> <td>000.6</td> <td>%</td> </tr> <tr> <td>ΔU12</td> <td>001.0</td> <td>%</td> </tr> <tr> <td>ΔU23</td> <td>001.1</td> <td>%</td> </tr> <tr> <td>ΔU31</td> <td>001.0</td> <td>%</td> </tr> <tr> <td>ΔF</td> <td>-00.002</td> <td>Hz</td> </tr> </tbody> </table>	Item	Value	Unit	ΔV1	000.5	%	ΔV2	000.8	%	ΔV3	000.6	%	ΔU12	001.0	%	ΔU23	001.1	%	ΔU31	001.0	%	ΔF	-00.002	Hz	Voltage deviation Frequency deviation
Item	Value	Unit																								
ΔV1	000.5	%																								
ΔV2	000.8	%																								
ΔV3	000.6	%																								
ΔU12	001.0	%																								
ΔU23	001.1	%																								
ΔU31	001.0	%																								
ΔF	-00.002	Hz																								
13	 <table border="1" data-bbox="247 929 635 1108"> <thead> <tr> <th>Item</th> <th>Voltage</th> <th>Current</th> </tr> </thead> <tbody> <tr> <td>Posl-Seq</td> <td>220.122 V</td> <td>4.9996 A</td> </tr> <tr> <td>Neg-Seq</td> <td>000.004 V</td> <td>0.0001 A</td> </tr> <tr> <td>Zero-Seq</td> <td>000.004 V</td> <td>0.0001 A</td> </tr> <tr> <td>Unbalance</td> <td>000.002 %</td> <td>000.000 %</td> </tr> </tbody> </table>	Item	Voltage	Current	Posl-Seq	220.122 V	4.9996 A	Neg-Seq	000.004 V	0.0001 A	Zero-Seq	000.004 V	0.0001 A	Unbalance	000.002 %	000.000 %	Unbalance									
Item	Voltage	Current																								
Posl-Seq	220.122 V	4.9996 A																								
Neg-Seq	000.004 V	0.0001 A																								
Zero-Seq	000.004 V	0.0001 A																								
Unbalance	000.002 %	000.000 %																								
14	 <table border="1" data-bbox="247 1176 635 1355"> <thead> <tr> <th>Item</th> <th>Value</th> <th>Angle</th> </tr> </thead> <tbody> <tr> <td>V1</td> <td>219.022 V</td> <td>000.0°</td> </tr> <tr> <td>V2</td> <td>218.391 V</td> <td>120.0°</td> </tr> <tr> <td>V3</td> <td>218.594 V</td> <td>240.0°</td> </tr> <tr> <td>I1</td> <td>4.9888 A</td> <td>030.0°</td> </tr> <tr> <td>I2</td> <td>4.9806 A</td> <td>150.0°</td> </tr> <tr> <td>I3</td> <td>5.0033 A</td> <td>270.0°</td> </tr> </tbody> </table>	Item	Value	Angle	V1	219.022 V	000.0°	V2	218.391 V	120.0°	V3	218.594 V	240.0°	I1	4.9888 A	030.0°	I2	4.9806 A	150.0°	I3	5.0033 A	270.0°	Phasor diagram			
Item	Value	Angle																								
V1	219.022 V	000.0°																								
V2	218.391 V	120.0°																								
V3	218.594 V	240.0°																								
I1	4.9888 A	030.0°																								
I2	4.9806 A	150.0°																								
I3	5.0033 A	270.0°																								
15	 <table border="1" data-bbox="247 1422 635 1601"> <thead> <tr> <th>Category</th> <th>Item</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td rowspan="3">Short-term flicker</td> <td>L1</td> <td>000.0339</td> </tr> <tr> <td>L2</td> <td>000.0325</td> </tr> <tr> <td>L3</td> <td>000.0334</td> </tr> <tr> <td rowspan="3">Long-term flicker</td> <td>L1</td> <td>000.0000</td> </tr> <tr> <td>L2</td> <td>000.0000</td> </tr> <tr> <td>L3</td> <td>000.0000</td> </tr> </tbody> </table>	Category	Item	Value	Short-term flicker	L1	000.0339	L2	000.0325	L3	000.0334	Long-term flicker	L1	000.0000	L2	000.0000	L3	000.0000	Flicker							
Category	Item	Value																								
Short-term flicker	L1	000.0339																								
	L2	000.0325																								
	L3	000.0334																								
Long-term flicker	L1	000.0000																								
	L2	000.0000																								
	L3	000.0000																								

16		Voltage waveform
17		Current waveform
18		ITIC curve
19		SEMI F47 curve
20		EN50160 report

**ITIC/SEMI F47 Curves**

The ITIC and SEMI F47 curves specify the ability of equipment to withstand power supply's voltage disturbances. Their significance lies in being the benchmarks for assessing the tolerance of power equipment to voltage interference and voltage disturbances in power supply systems.

For the ITIC curve interface displayed by the device, the horizontal axis represents the duration of transient voltage event, and the vertical axis represents the voltage percentage (relative to nominal voltage). The upper curve represents the tolerance of equipment to voltage swells, and the lower curve represents the tolerance of equipment to voltage dips. The area between them represents the normal running range. As shown in the figure below, this interface shows the amplitude-duration distribution of a single transient event.



For the SEMI F47 curve interface displayed by the device, the horizontal axis represents the duration of transient voltage event, and the vertical axis represents the voltage percentage (relative to nominal voltage). The specification stipulates the tolerance time of equipment to voltage dips. The area above red solid line represents that the equipment must ensure normal continuous running under such interference.

The equipment can run continuously for 0.02s at 0% of the nominal value, 0.2s at 50% of the nominal value, 0.5s at 70% of the nominal value, 1s at 80% of the nominal value, and 10s at 90% of the nominal value. As shown in the figure below, this interface shows the amplitude-duration distribution of a single transient event.

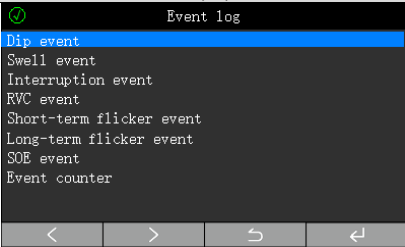
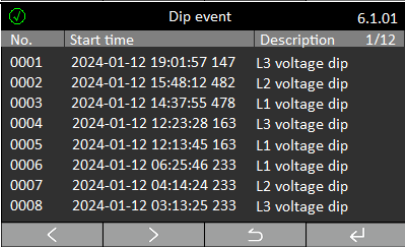
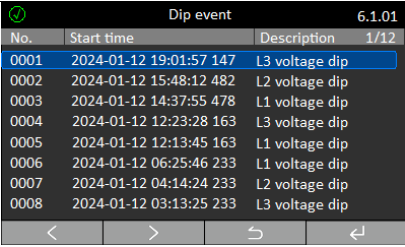
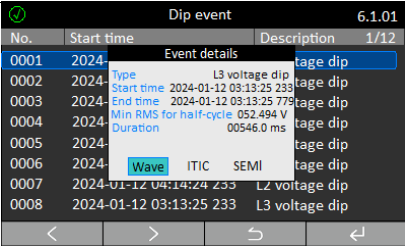
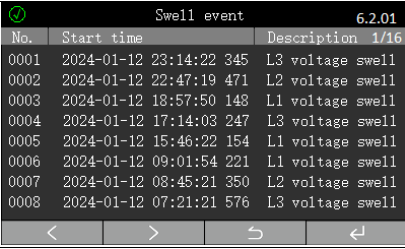
### 4.2.2.4.Demand

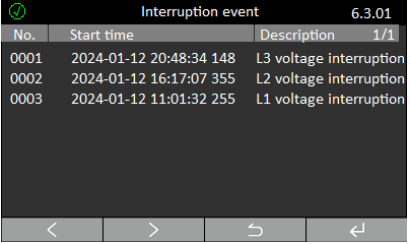
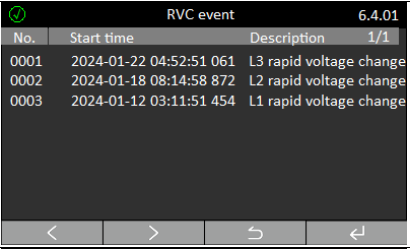
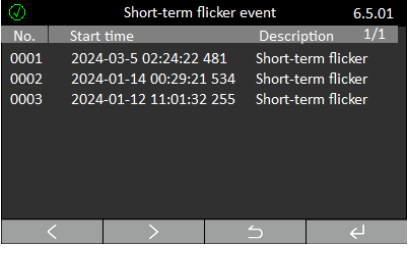
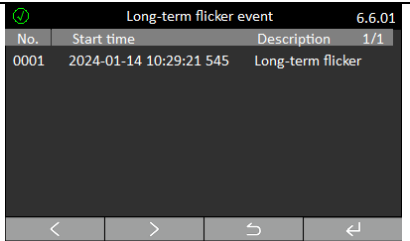
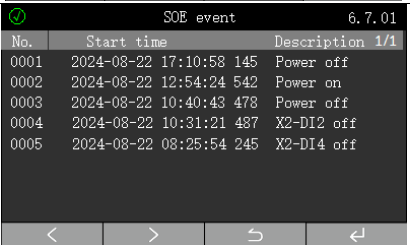
No.	Display	Description																		
1	<p>Present period demand 4.01</p> <table border="1"> <tr><td>I1</td><td>4.9877</td><td>A</td></tr> <tr><td>I2</td><td>4.9794</td><td>A</td></tr> <tr><td>I3</td><td>5.0022</td><td>A</td></tr> <tr><td>P</td><td>3.271</td><td>kW</td></tr> <tr><td>Q</td><td>-0.004</td><td>kvar</td></tr> <tr><td>S</td><td>3.272</td><td>kVA</td></tr> </table>	I1	4.9877	A	I2	4.9794	A	I3	5.0022	A	P	3.271	kW	Q	-0.004	kvar	S	3.272	kVA	<p>Present period demand</p> <p>I1=4.9877A I2=4.9794A I3=5.0022A P=3.271kW Q=-0.004kvar S=3.272kVA</p>
I1	4.9877	A																		
I2	4.9794	A																		
I3	5.0022	A																		
P	3.271	kW																		
Q	-0.004	kvar																		
S	3.272	kVA																		
2	<p>Previous period demand 4.02</p> <table border="1"> <tr><td>I1</td><td>4.9877</td><td>A</td></tr> <tr><td>I2</td><td>4.9794</td><td>A</td></tr> <tr><td>I3</td><td>5.0022</td><td>A</td></tr> <tr><td>P</td><td>3.271</td><td>kW</td></tr> <tr><td>Q</td><td>-0.004</td><td>kvar</td></tr> <tr><td>S</td><td>3.272</td><td>kVA</td></tr> </table>	I1	4.9877	A	I2	4.9794	A	I3	5.0022	A	P	3.271	kW	Q	-0.004	kvar	S	3.272	kVA	<p>Previous period demand</p> <p>I1=4.9877A I2=4.9794A I3=5.0022A P=3.271kW Q=-0.004kvar S=3.272kVA</p>
I1	4.9877	A																		
I2	4.9794	A																		
I3	5.0022	A																		
P	3.271	kW																		
Q	-0.004	kvar																		
S	3.272	kVA																		
3	<p>Forecast demand 4.03</p> <table border="1"> <tr><td>I1</td><td>4.9877</td><td>A</td></tr> <tr><td>I2</td><td>4.9794</td><td>A</td></tr> <tr><td>I3</td><td>4.9999</td><td>A</td></tr> <tr><td>P</td><td>3.271</td><td>kW</td></tr> <tr><td>Q</td><td>-0.004</td><td>kvar</td></tr> <tr><td>S</td><td>3.272</td><td>kVA</td></tr> </table>	I1	4.9877	A	I2	4.9794	A	I3	4.9999	A	P	3.271	kW	Q	-0.004	kvar	S	3.272	kVA	<p>Forecast demand</p> <p>I1=4.9877A I2=4.9794A I3=4.9999A P=3.271kW Q=-0.004kvar S=3.272kVA</p>
I1	4.9877	A																		
I2	4.9794	A																		
I3	4.9999	A																		
P	3.271	kW																		
Q	-0.004	kvar																		
S	3.272	kVA																		
4	<p>Max Demand 4.04</p> <table border="1"> <tr><td>I1</td><td>4.9895</td><td>A</td></tr> <tr><td>I2</td><td>4.9815</td><td>A</td></tr> <tr><td>I3</td><td>5.0049</td><td>A</td></tr> <tr><td>P</td><td>3.273</td><td>kW</td></tr> <tr><td>Q</td><td>0.004</td><td>kvar</td></tr> <tr><td>S</td><td>3.273</td><td>kVA</td></tr> </table>	I1	4.9895	A	I2	4.9815	A	I3	5.0049	A	P	3.273	kW	Q	0.004	kvar	S	3.273	kVA	<p>Max demand</p> <p>I1=4.9895A I2=4.9815A I3=5.0049A P=3.273kW Q=0.024kvar S=3.273kVA</p>
I1	4.9895	A																		
I2	4.9815	A																		
I3	5.0049	A																		
P	3.273	kW																		
Q	0.004	kvar																		
S	3.273	kVA																		

### 4.2.2.5.Modules

No.	Display	Description
1	<p>Local I/O 5.01</p> <p>Digital inputs</p> <p>DI1 Status monitor </p> <p>DI2 Status monitor </p> <p>DI3 Status monitor </p> <p>DI4 Status monitor </p> <p>Digital outputs</p> <p>DO1 Alarm </p> <p>DO2 Off </p> <p>DO1 Off </p> <p>DO2 Off </p>	Local I/O
2	<p>Module X1 5.02</p> <p>FM2 (4DI) Ver.173A</p> <p>DI1 Pulse count 0000000006</p> <p>DI2 Status monitor </p> <p>DI3 Status monitor </p> <p>DI4 Status monitor </p>	Expansion module FM2
3	<p>Module X2 5.03</p> <p>FM11 (RS485) Ver.173A</p> <p>Address 002</p> <p>Baud rate 57600 bps</p> <p>Data format N.8.1</p> <p>Protocol Modbus-RTU</p>	Expansion module FM3
4	<p>Module X3 5.04</p> <p>FM3 (2DO) Ver.1101</p> <p>DO1 On </p> <p>DO2 Off </p>	Expansion module FM11
5	<p>Module X4 5.05</p> <p>FM24 (ETHERNET) Ver.1000</p> <p>DHCP No</p> <p>Port 00502</p> <p>Local IP 192.168.001.254</p> <p>Mask 255.255.255.000</p> <p>Gate Way 192.168.001.001</p> <p>MAC 00-00-00-00-00-00</p>	Expansion module FM24

### 4.2.2.6. SOE logs

No.	Display	Description																											
1	 <p>Event log</p> <ul style="list-style-type: none"> <li>Dip event</li> <li>Swell event</li> <li>Interruption event</li> <li>RVC event</li> <li>Short-term flicker event</li> <li>Long-term flicker event</li> <li>SOE event</li> <li>Event counter</li> </ul>	SOE logs overview																											
2	 <p>Dip event 6.1.01</p> <table border="1"> <thead> <tr> <th>No.</th> <th>Start time</th> <th>Description</th> </tr> </thead> <tbody> <tr><td>0001</td><td>2024-01-12 19:01:57 147</td><td>L3 voltage dip</td></tr> <tr><td>0002</td><td>2024-01-12 15:48:12 482</td><td>L2 voltage dip</td></tr> <tr><td>0003</td><td>2024-01-12 14:37:55 478</td><td>L1 voltage dip</td></tr> <tr><td>0004</td><td>2024-01-12 12:23:28 163</td><td>L3 voltage dip</td></tr> <tr><td>0005</td><td>2024-01-12 12:13:45 163</td><td>L1 voltage dip</td></tr> <tr><td>0006</td><td>2024-01-12 06:25:46 233</td><td>L1 voltage dip</td></tr> <tr><td>0007</td><td>2024-01-12 04:14:24 233</td><td>L2 voltage dip</td></tr> <tr><td>0008</td><td>2024-01-12 03:13:25 233</td><td>L3 voltage dip</td></tr> </tbody> </table>	No.	Start time	Description	0001	2024-01-12 19:01:57 147	L3 voltage dip	0002	2024-01-12 15:48:12 482	L2 voltage dip	0003	2024-01-12 14:37:55 478	L1 voltage dip	0004	2024-01-12 12:23:28 163	L3 voltage dip	0005	2024-01-12 12:13:45 163	L1 voltage dip	0006	2024-01-12 06:25:46 233	L1 voltage dip	0007	2024-01-12 04:14:24 233	L2 voltage dip	0008	2024-01-12 03:13:25 233	L3 voltage dip	Dip event logs
No.	Start time	Description																											
0001	2024-01-12 19:01:57 147	L3 voltage dip																											
0002	2024-01-12 15:48:12 482	L2 voltage dip																											
0003	2024-01-12 14:37:55 478	L1 voltage dip																											
0004	2024-01-12 12:23:28 163	L3 voltage dip																											
0005	2024-01-12 12:13:45 163	L1 voltage dip																											
0006	2024-01-12 06:25:46 233	L1 voltage dip																											
0007	2024-01-12 04:14:24 233	L2 voltage dip																											
0008	2024-01-12 03:13:25 233	L3 voltage dip																											
3	 <p>Dip event 6.1.01</p> <table border="1"> <thead> <tr> <th>No.</th> <th>Start time</th> <th>Description</th> </tr> </thead> <tbody> <tr><td>0001</td><td>2024-01-12 19:01:57 147</td><td>L3 voltage dip</td></tr> <tr><td>0002</td><td>2024-01-12 15:48:12 482</td><td>L2 voltage dip</td></tr> <tr><td>0003</td><td>2024-01-12 14:37:55 478</td><td>L1 voltage dip</td></tr> <tr><td>0004</td><td>2024-01-12 12:23:28 163</td><td>L3 voltage dip</td></tr> <tr><td>0005</td><td>2024-01-12 12:13:45 163</td><td>L1 voltage dip</td></tr> <tr><td>0006</td><td>2024-01-12 06:25:46 233</td><td>L1 voltage dip</td></tr> <tr><td>0007</td><td>2024-01-12 04:14:24 233</td><td>L2 voltage dip</td></tr> <tr><td>0008</td><td>2024-01-12 03:13:25 233</td><td>L3 voltage dip</td></tr> </tbody> </table>	No.	Start time	Description	0001	2024-01-12 19:01:57 147	L3 voltage dip	0002	2024-01-12 15:48:12 482	L2 voltage dip	0003	2024-01-12 14:37:55 478	L1 voltage dip	0004	2024-01-12 12:23:28 163	L3 voltage dip	0005	2024-01-12 12:13:45 163	L1 voltage dip	0006	2024-01-12 06:25:46 233	L1 voltage dip	0007	2024-01-12 04:14:24 233	L2 voltage dip	0008	2024-01-12 03:13:25 233	L3 voltage dip	Dip event logs
No.	Start time	Description																											
0001	2024-01-12 19:01:57 147	L3 voltage dip																											
0002	2024-01-12 15:48:12 482	L2 voltage dip																											
0003	2024-01-12 14:37:55 478	L1 voltage dip																											
0004	2024-01-12 12:23:28 163	L3 voltage dip																											
0005	2024-01-12 12:13:45 163	L1 voltage dip																											
0006	2024-01-12 06:25:46 233	L1 voltage dip																											
0007	2024-01-12 04:14:24 233	L2 voltage dip																											
0008	2024-01-12 03:13:25 233	L3 voltage dip																											
4	 <p>Dip event 6.1.01</p> <table border="1"> <thead> <tr> <th>No.</th> <th>Start time</th> <th>Description</th> </tr> </thead> <tbody> <tr><td>0001</td><td>2024-01-12 03:13:25 233</td><td>L3 voltage dip</td></tr> <tr><td>0002</td><td>2024-01-12 03:13:25 233</td><td>L3 voltage dip</td></tr> <tr><td>0003</td><td>2024-01-12 03:13:25 233</td><td>L3 voltage dip</td></tr> <tr><td>0004</td><td>2024-01-12 03:13:25 233</td><td>L3 voltage dip</td></tr> <tr><td>0005</td><td>2024-01-12 03:13:25 233</td><td>L3 voltage dip</td></tr> <tr><td>0006</td><td>2024-01-12 03:13:25 233</td><td>L3 voltage dip</td></tr> <tr><td>0007</td><td>2024-01-12 04:14:24 233</td><td>L2 voltage dip</td></tr> <tr><td>0008</td><td>2024-01-12 03:13:25 233</td><td>L3 voltage dip</td></tr> </tbody> </table> <p>Event details for 0001:</p> <ul style="list-style-type: none"> <li>Type: L3 voltage dip</li> <li>Start time: 2024-01-12 03:13:25 233</li> <li>End time: 2024-01-12 03:13:25 233</li> <li>Min RMS for half-cycle: 052.494 V</li> <li>Duration: 00546.0 ms</li> <li>Waveform: ITIC SEMI</li> </ul>	No.	Start time	Description	0001	2024-01-12 03:13:25 233	L3 voltage dip	0002	2024-01-12 03:13:25 233	L3 voltage dip	0003	2024-01-12 03:13:25 233	L3 voltage dip	0004	2024-01-12 03:13:25 233	L3 voltage dip	0005	2024-01-12 03:13:25 233	L3 voltage dip	0006	2024-01-12 03:13:25 233	L3 voltage dip	0007	2024-01-12 04:14:24 233	L2 voltage dip	0008	2024-01-12 03:13:25 233	L3 voltage dip	Dip event logs
No.	Start time	Description																											
0001	2024-01-12 03:13:25 233	L3 voltage dip																											
0002	2024-01-12 03:13:25 233	L3 voltage dip																											
0003	2024-01-12 03:13:25 233	L3 voltage dip																											
0004	2024-01-12 03:13:25 233	L3 voltage dip																											
0005	2024-01-12 03:13:25 233	L3 voltage dip																											
0006	2024-01-12 03:13:25 233	L3 voltage dip																											
0007	2024-01-12 04:14:24 233	L2 voltage dip																											
0008	2024-01-12 03:13:25 233	L3 voltage dip																											
5	 <p>Swell event 6.2.01</p> <table border="1"> <thead> <tr> <th>No.</th> <th>Start time</th> <th>Description</th> </tr> </thead> <tbody> <tr><td>0001</td><td>2024-01-12 23:14:22 345</td><td>L3 voltage swell</td></tr> <tr><td>0002</td><td>2024-01-12 22:47:19 471</td><td>L2 voltage swell</td></tr> <tr><td>0003</td><td>2024-01-12 18:57:50 148</td><td>L1 voltage swell</td></tr> <tr><td>0004</td><td>2024-01-12 17:14:03 247</td><td>L3 voltage swell</td></tr> <tr><td>0005</td><td>2024-01-12 15:46:22 154</td><td>L1 voltage swell</td></tr> <tr><td>0006</td><td>2024-01-12 09:01:54 221</td><td>L1 voltage swell</td></tr> <tr><td>0007</td><td>2024-01-12 08:45:21 350</td><td>L2 voltage swell</td></tr> <tr><td>0008</td><td>2024-01-12 07:21:21 576</td><td>L3 voltage swell</td></tr> </tbody> </table>	No.	Start time	Description	0001	2024-01-12 23:14:22 345	L3 voltage swell	0002	2024-01-12 22:47:19 471	L2 voltage swell	0003	2024-01-12 18:57:50 148	L1 voltage swell	0004	2024-01-12 17:14:03 247	L3 voltage swell	0005	2024-01-12 15:46:22 154	L1 voltage swell	0006	2024-01-12 09:01:54 221	L1 voltage swell	0007	2024-01-12 08:45:21 350	L2 voltage swell	0008	2024-01-12 07:21:21 576	L3 voltage swell	Swell event logs
No.	Start time	Description																											
0001	2024-01-12 23:14:22 345	L3 voltage swell																											
0002	2024-01-12 22:47:19 471	L2 voltage swell																											
0003	2024-01-12 18:57:50 148	L1 voltage swell																											
0004	2024-01-12 17:14:03 247	L3 voltage swell																											
0005	2024-01-12 15:46:22 154	L1 voltage swell																											
0006	2024-01-12 09:01:54 221	L1 voltage swell																											
0007	2024-01-12 08:45:21 350	L2 voltage swell																											
0008	2024-01-12 07:21:21 576	L3 voltage swell																											

6	 <table border="1"> <thead> <tr> <th>No.</th> <th>Start time</th> <th>Description</th> <th>1/1</th> </tr> </thead> <tbody> <tr> <td>0001</td> <td>2024-01-12 20:48:34</td> <td>L3 voltage interruption</td> <td></td> </tr> <tr> <td>0002</td> <td>2024-01-12 16:17:07</td> <td>L2 voltage interruption</td> <td></td> </tr> <tr> <td>0003</td> <td>2024-01-12 11:01:32</td> <td>L1 voltage interruption</td> <td></td> </tr> </tbody> </table>	No.	Start time	Description	1/1	0001	2024-01-12 20:48:34	L3 voltage interruption		0002	2024-01-12 16:17:07	L2 voltage interruption		0003	2024-01-12 11:01:32	L1 voltage interruption		Interruption event logs								
No.	Start time	Description	1/1																							
0001	2024-01-12 20:48:34	L3 voltage interruption																								
0002	2024-01-12 16:17:07	L2 voltage interruption																								
0003	2024-01-12 11:01:32	L1 voltage interruption																								
7	 <table border="1"> <thead> <tr> <th>No.</th> <th>Start time</th> <th>Description</th> <th>1/1</th> </tr> </thead> <tbody> <tr> <td>0001</td> <td>2024-01-22 04:52:51</td> <td>L3 rapid voltage change</td> <td></td> </tr> <tr> <td>0002</td> <td>2024-01-18 08:14:58</td> <td>L2 rapid voltage change</td> <td></td> </tr> <tr> <td>0003</td> <td>2024-01-12 03:11:51</td> <td>L1 rapid voltage change</td> <td></td> </tr> </tbody> </table>	No.	Start time	Description	1/1	0001	2024-01-22 04:52:51	L3 rapid voltage change		0002	2024-01-18 08:14:58	L2 rapid voltage change		0003	2024-01-12 03:11:51	L1 rapid voltage change		RVC event logs								
No.	Start time	Description	1/1																							
0001	2024-01-22 04:52:51	L3 rapid voltage change																								
0002	2024-01-18 08:14:58	L2 rapid voltage change																								
0003	2024-01-12 03:11:51	L1 rapid voltage change																								
8	 <table border="1"> <thead> <tr> <th>No.</th> <th>Start time</th> <th>Description</th> <th>1/1</th> </tr> </thead> <tbody> <tr> <td>0001</td> <td>2024-03-5 02:24:22</td> <td>Short-term flicker</td> <td></td> </tr> <tr> <td>0002</td> <td>2024-01-14 00:29:21</td> <td>Short-term flicker</td> <td></td> </tr> <tr> <td>0003</td> <td>2024-01-12 11:01:32</td> <td>Short-term flicker</td> <td></td> </tr> </tbody> </table>	No.	Start time	Description	1/1	0001	2024-03-5 02:24:22	Short-term flicker		0002	2024-01-14 00:29:21	Short-term flicker		0003	2024-01-12 11:01:32	Short-term flicker		Short term flicker event logs								
No.	Start time	Description	1/1																							
0001	2024-03-5 02:24:22	Short-term flicker																								
0002	2024-01-14 00:29:21	Short-term flicker																								
0003	2024-01-12 11:01:32	Short-term flicker																								
9	 <table border="1"> <thead> <tr> <th>No.</th> <th>Start time</th> <th>Description</th> <th>1/1</th> </tr> </thead> <tbody> <tr> <td>0001</td> <td>2024-01-14 10:29:21</td> <td>Long-term flicker</td> <td></td> </tr> </tbody> </table>	No.	Start time	Description	1/1	0001	2024-01-14 10:29:21	Long-term flicker		Long term flicker event logs																
No.	Start time	Description	1/1																							
0001	2024-01-14 10:29:21	Long-term flicker																								
10	 <table border="1"> <thead> <tr> <th>No.</th> <th>Start time</th> <th>Description</th> <th>1/1</th> </tr> </thead> <tbody> <tr> <td>0001</td> <td>2024-08-22 17:10:58</td> <td>Power off</td> <td></td> </tr> <tr> <td>0002</td> <td>2024-08-22 12:54:24</td> <td>Power on</td> <td></td> </tr> <tr> <td>0003</td> <td>2024-08-22 10:40:43</td> <td>Power off</td> <td></td> </tr> <tr> <td>0004</td> <td>2024-08-22 10:31:21</td> <td>X2-DI2 off</td> <td></td> </tr> <tr> <td>0005</td> <td>2024-08-22 08:25:54</td> <td>X2-DI4 off</td> <td></td> </tr> </tbody> </table>	No.	Start time	Description	1/1	0001	2024-08-22 17:10:58	Power off		0002	2024-08-22 12:54:24	Power on		0003	2024-08-22 10:40:43	Power off		0004	2024-08-22 10:31:21	X2-DI2 off		0005	2024-08-22 08:25:54	X2-DI4 off		SOE logs
No.	Start time	Description	1/1																							
0001	2024-08-22 17:10:58	Power off																								
0002	2024-08-22 12:54:24	Power on																								
0003	2024-08-22 10:40:43	Power off																								
0004	2024-08-22 10:31:21	X2-DI2 off																								
0005	2024-08-22 08:25:54	X2-DI4 off																								

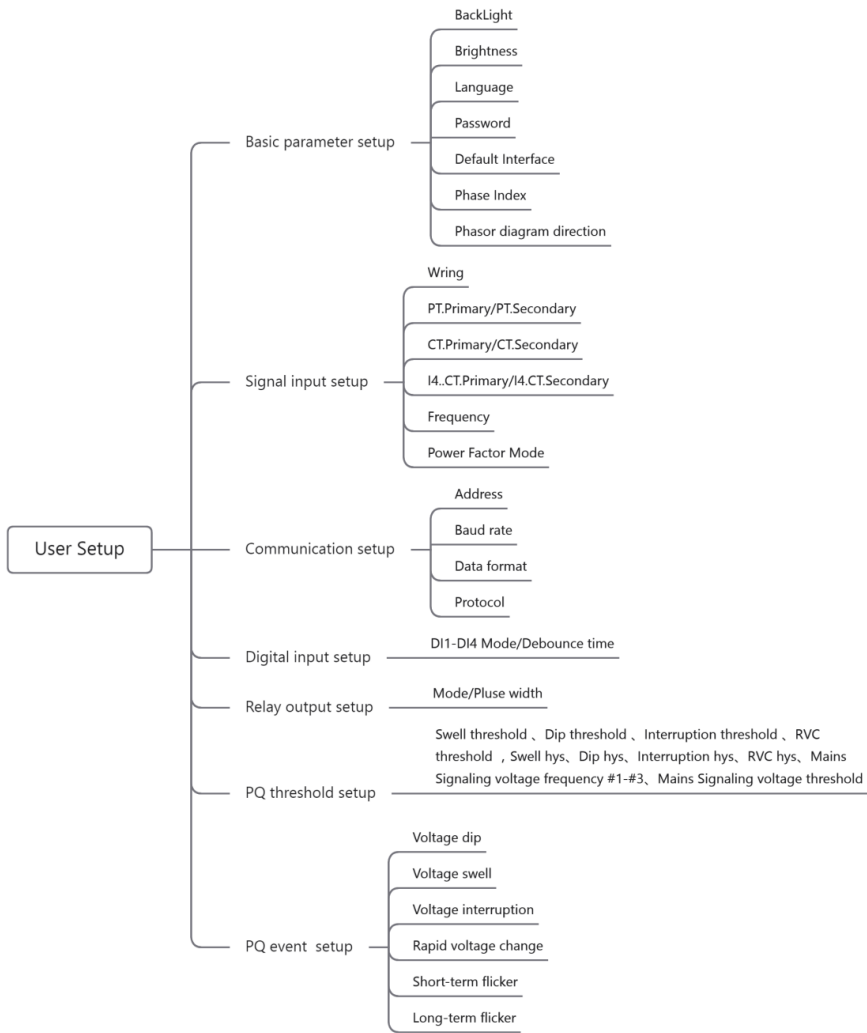
11			Event counter
	No.	Event type	Number
	0001	Dip event	0095
	0002	Swell event	0125
	0003	Interruption event	0003
	0004	RVC event	0003
	0005	Short-term flicker event	0003
	0006	Long-term flicker event	0001

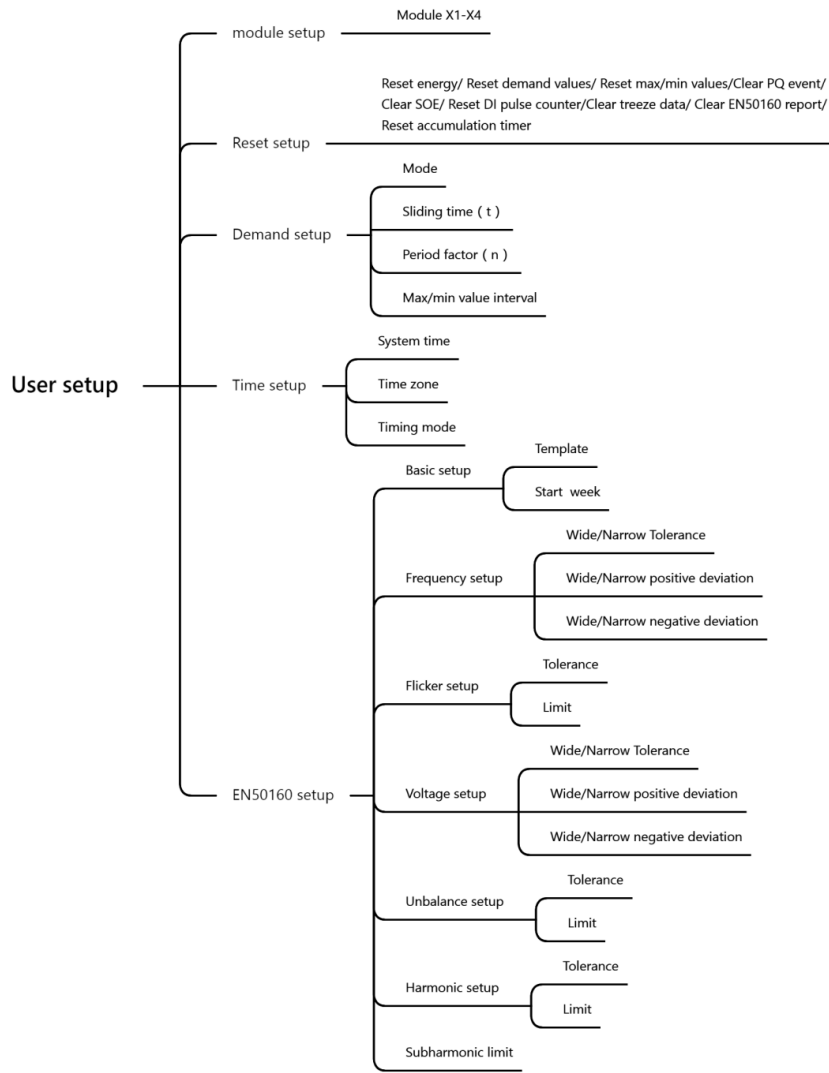
### 4.2.2.7.Help

No.	Display	Description
1		Help

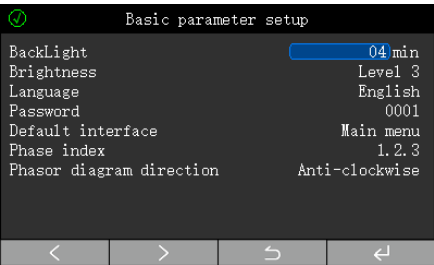
### 4.3. Setup

#### 4.3.1. Setup menu





### 4.3.2. Basic parameter setup

Display	Menu1	Menu2	
	BackLight	01... 99min 00 - always on	
	Brightness	Level 1...Level5	
	Language	English	
	Password	0000...9999	
	Default interface	Main menu	
		Instant overview	
		Voltage	
		Current	
		Active power	
		Reactive power	
Apparent power			
Power factor			
Frequency			
Energy overview			
L1/L2/L3 energy			
Fundamental energy			
Tariff energy			
Present monthly energy			
THD			
Harmonic content			
Harmonic ratio			
Inter-harmonic content			
Inter-harmonic ratio			
Deviation			
Unbalance			
Phasor diagram			
Flicker			
Voltage Waveform			
Current Waveform			
Present demand			

		Last demand Predicted demand Max demand Max demand of present month Digital I/O Module X1...X4 About
	Phase index	a.b.c
	Phasor diagram direction	Clock wise / Anti clock wise

### 4.3.3. Signal Input Setup

Display	Menu1	Menu2
	Wiring mode	3P3W/3P4W
	PT Primary	1...999999V
	PT Secondary	1...600V
	CT Primary	1...999999A
	CT Secondary	1...6A
	I4. CT Primary	1...999999A
	I4.CT Secondary	1...6A
	Frequency	50Hz/60Hz
	Power factor mode	IEC-C/IEEE-C/IEC-P

### 4.3.4. Communication Setup

Pantalla	Menu1	Menu2
	Slave Address	1...247
	Baud rate	2400 bps... 115200 bps
	Data format	E81, O81, N81, N82
	Protocol	Modbus-RTU

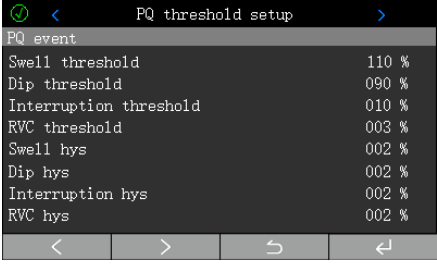
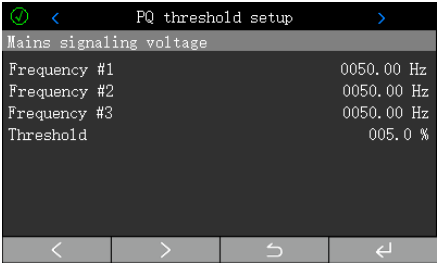
### 4.3.5. Digital Input Setup

Pantalla	Menu1	Menu2
	Mode	Status monitor/ Pulse counting
	Debounce time	10...1000ms

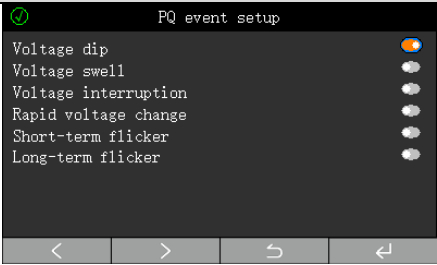
### 4.3.6. Relay Output Setup

Display	Menu1	Menu2
	Mode	Off/On/Alarm
	Pulse width	0.1...999.9s

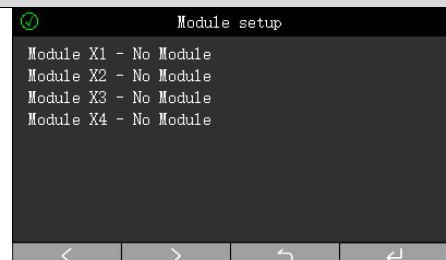
### 4.3.7. Power quality threshold setup

Display	Menu1	Menu2
 <p>                     PQ threshold setup                      PQ event                      Swell threshold 110 %                      Dip threshold 090 %                      Interruption threshold 010 %                      RVC threshold 003 %                      Swell hys 002 %                      Dip hys 002 %                      Interruption hys 002 %                      RVC hys 002 %                 </p>	Swell threshold	100...180%
	Dip threshold	0...-100%
	Interruption threshold	0...100%
	RVC threshold	1...6%
	Swell hysteresis	0...10%
	Dip hysteresis	0...10%
	Interruption hysteresis	0...10%
	RVC hysteresis	0...3%
 <p>                     Mains signaling voltage                      Frequency #1 0050.00 Hz                      Frequency #2 0050.00 Hz                      Frequency #3 0050.00 Hz                      Threshold 005.0 %                 </p>	Mains signaling voltage frequency	50.0...2575.0Hz
	Mains signaling voltage threshold	0.3...1 00%

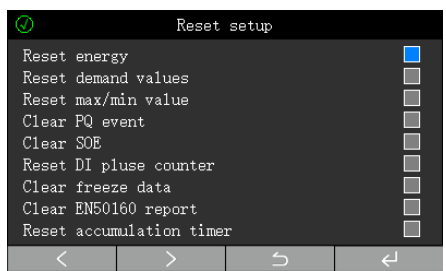
### 4.3.8. PQ event setup

Display	Menu1	Menu2
 <p>                     PQ event setup                      Voltage dip <input checked="" type="checkbox"/>                      Voltage swell <input type="checkbox"/>                      Voltage interruption <input type="checkbox"/>                      Rapid voltage change <input type="checkbox"/>                      Short-term flicker <input type="checkbox"/>                      Long-term flicker <input type="checkbox"/> </p>	Swell	Enable/Disable
	Dip	Enable/Disable
	Interruption	Enable/Disable
	RVC	Enable/Disable
	Short term flicker	Enable/Disable
	Long term flicker	Enable/Disable

### 4.3.9. Module setup

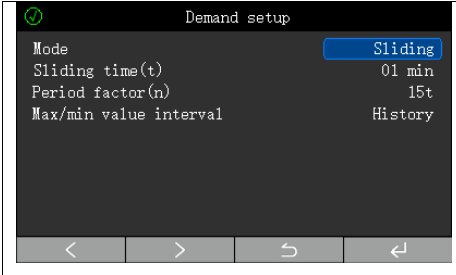
Display	Menu1
	Module setup

### 4.3.10. Reset setup

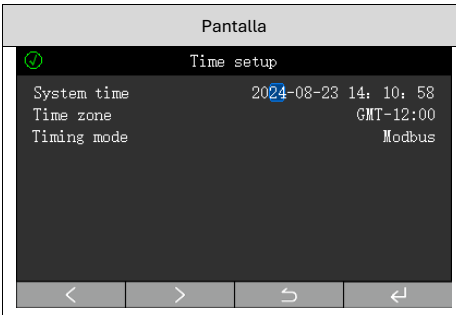
Pantalla	Menu1	Menu2
	Reset energy values	Enable/Disable
	Reset demand values	Enable/Disable
	Reset max/min values	Enable/Disable
	Clear PQ event logs	Enable/Disable
	Clear SOE logs	Enable/Disable
	Reset DI pulse counter	Enable/Disable
	Clear freeze data	Enable/Disable
	Clear EN50160 report	Enable/Disable
	Reset accumulation timer	Enable/Disable

### 4.3.11. Demand setup

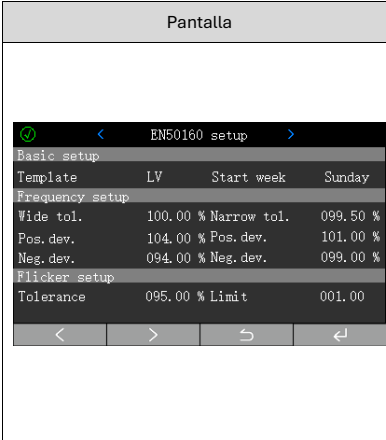
Display	Menu1	Menu2
	Mode	Sliding block/Fixed block
	Sliding time	1min...60 min

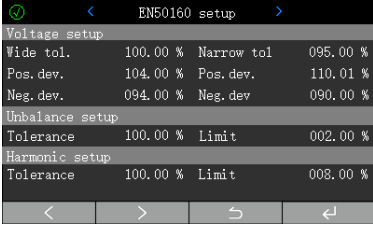
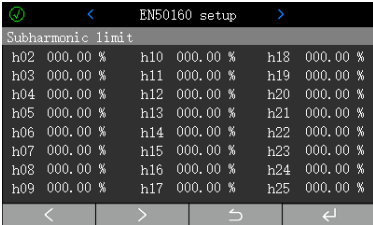
 <p>Demand setup</p> <ul style="list-style-type: none"> <li>Mode: Sliding</li> <li>Sliding time(t): 01 min</li> <li>Period factor(n): 15t</li> <li>Max/min value interval: History</li> </ul>	Period factor	1t...30 t
	Max/min interval	Historic /1/5/15/30/60/1440 min

### 4.3.12. Time setup

Pantalla	Menu1	Menu2
 <p>Time setup</p> <ul style="list-style-type: none"> <li>System time: 2024-08-23 14: 10: 58</li> <li>Time zone: GMT-12:00</li> <li>Timing mode: Modbus</li> </ul>	System time	Year/Month/day/hour/minute/second
	Time zone	GMT-12:00 ...GMT+13
	Timing mode	Modbus/IRIG-B/Web /NTP

### 4.3.13. EN50160 Setup

Pantalla	Menu1	Menu2	Menu3	
 <p>EN50160 setup</p> <ul style="list-style-type: none"> <li>Basic setup</li> <li>Template: LV Start week: Sunday</li> <li>Frequency setup</li> <li>Wide tol.: 100.00 % Narrow tol.: 099.50 %</li> <li>Pos. dev.: 104.00 % Pos. dev.: 101.00 %</li> <li>Neg. dev.: 094.00 % Neg. dev.: 099.00 %</li> <li>Flicker setup</li> <li>Tolerance: 095.00 % Limit: 001.00</li> </ul>	Basic update	Template	LV/MV/HV	
		Start week	Monday...Sunday	
		Frequency setup	Wide/Narrow Tolerance	0...100%
			Wide/Narrow positive deviation	0...200%
		Flicker setup	Wide/Narrow negative deviation	0...100%
			Tolerance	0...100%
	Voltage setup	Limit	0...100	
		Wide/Narrow Tolerance	0...100%	
		Wide/Narrow positive deviation	0...200%	

		Wide/Narrow negative deviation	0...100%
	Unbalance setup	Tolerance	0...100%
		Limit	0...100%
	Harmonics setup	Tolerance	0-100%
THD limit setup	Limit	0-100%	
	Subharmonic limit	0...200%	

## 5. Functions

### 5.1. Real-time measurements

The device can measure the full electric parameters of power grid.

Measurement		Phase	Total	Max	Min	Average	Demand
Voltage	Phase voltage	●	—	●	●	●	—
	Line voltage	●	—	—	—	●	—
	Fundamental voltage	●	—	—	—	—	—
Current	Current	●	—	●	●	●	●
	Neutral current	—	●	●	●	—	—
	Fundamental current	●	—	—	—	—	—
Power	Active power	●	●	●	●	●	●
	Reactive power	●	●	●	●	●	●
	Apparent power	●	●	●	●	●	●
Power factor		●	●	●	●	—	—
Frequency		—	●	●	●	—	—

## 5.2. Energy metering

The device can measure different types of energy, specifically:

- Bidirectional active/reactive energy
- Fundamental active/reactive energy
- Reactive energy in four quadrants
- Apparent energy
- Energy by tariff

The device allows to configure 8 daily tariffs, weekly tariffs or 12 time-of-use tariffs, as well as up to 90 variable public holidays.

When the switchover time is reached, or when the year/month registers for the change are set directly to 0xFFFF, the current tariff will be replaced by the backup tariff and the switchover time register will be cleared (the device will always operate on the current tariff).

The following energy values are recorded per tariff:

- Current total energy / T1 / T2 / T3 / T4 / T5 / T6 / T7 / T8
- Total energy / T1 / T2 / T3 / T4 / T5 / T6 / T7 / T8 for the current month
- Total historical energy / T1 / T2 / T3 / T4 / T5 / T6 / T7 / T8 from 1 to 12 months prior

## 5.3. Demand

The device can provide:

- Current period demand
- Previous period demand
- Peak demand
- Peak demand for the current month
- Peak demand for the previous month
- Peak demand for the last 2 months

It offers two calculation methods:

- Sliding window
- Fixed window

The relevant settings can be configured via communication.

The device can measure basic demand values, including:

- 6 fixed values: (I1, I2, I3, P, Q, S)
- 10 optional values (see communication manual)

Demand can be calculated using two methods: sliding window and fixed window. The time parameters involved are:

- t: sliding time (minutes)
- T: calculation period or interval (minutes)

**Sliding block demand:**

Every t minutes, the average demand value over the last T minutes is calculated, evaluated, recorded and the automatic monthly demand reading is taken.

**Fixed block demand:**

Every T minutes, the average demand over the last T minutes is calculated, evaluated, recorded, and the monthly demand reading is taken automatically.

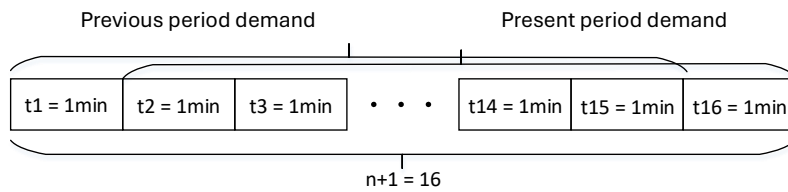
### 5.3.1. Sliding Block Demand

The settings relating to the sliding calculation are as follows:

- **Mode:** Sliding block
- **Sliding time (t):** “1” minute
- **Period factor (n):** Set to “15”

The calculation method is shown in Figure 5.2.1.1:

- **Demand for the previous period** = (dmdt1 + dmdt2 + ... + dmdt14 + dmdt15) / 15
- **Demand for the current period** = (dmdt2 + dmdt3 + ... + dmdt15 + dmdt16) / 15



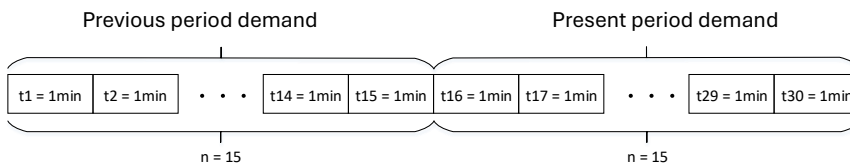
### 5.3.2. Fixed Block Demand

The settings for the fixed-block calculation are as follows:

- **Mode:** Fixed block
- **Sliding time (t):** “1” minute
- **Period factor (n):** “15”

The calculation method is shown in Figure 5.2.2.1:

- **Demand for the previous period** = (dmdt1 + dmdt2 + ... + dmdt14 + dmdt15) / 15
- **Demand for the current period** = (dmdt16 + dmdt17 + ... + dmdt29 + dmdt30) / 15



## 5.4. Max/Min Values

The device provides two types of maximum and minimum values: interval values and historical values. When the interval time is set to “0”, these are historical values; when it is not “0”, these are interval values. For example, if the interval is set to 15 minutes and the current time is 12:20, the values displayed by the device correspond to the period from 12:00 to 12:15.

The device provides basic maximum and minimum data, including:

- 15 fixed maximum values
- 15 fixed minimum values
- 34 programmable values

## 5.5. Power Quality

### 5.5.1. Power Quality

The device can monitor and analyse the quality of the power grid, including the following parameters:

- Voltage deviation
- Frequency deviation
- Harmonics
- Interharmonics
- Unbalance
- Flicker
- Surges (swell)
- Voltage dips
- Outages
- Rapid voltage changes

### 5.5.2. Fundamental Wave Analysis

The device can provide the following fundamental data:

- Split-phase fundamental phase/line voltage
- Split-phase fundamental current
- Split-phase/total fundamental active power
- Split-phase/total fundamental reactive power
- Split-phase/total fundamental apparent power
- Split-phase/total fundamental power factor

### 5.5.3. Crest Factor

The device calculates the crest factor by analyzing a complete voltage and current cycle to provide crest factors of three-phase voltage and current:

$$\text{Crest factor} = \text{Peak value} / \text{r.m.s value}$$

### 5.5.4. K Factor

The device calculates the k-factor based on the calculated harmonic data of current to provide k-factor of three-phase current:

$$k = \frac{\sum_{h=2}^{h=h_{\max}} I_h^2 h^2}{I_{th}^2}$$

Where **h** refers to the harmonic order, **I<sub>h</sub>** represents the harmonic distortion value for the **h**th-order current harmonic, and **I<sub>th</sub>** represents the total harmonic distortion value. The device is capable of measuring harmonics from the 2nd to the 51st order; therefore, **h<sub>max</sub> = 51**.

### 5.5.5. Voltage Deviation

Changes in the running mode of power supply and distribution system and slow variations in load will cause the voltage at various points of the system to change accordingly. The difference between voltage at each point and rated voltage is known as voltage deviation, which is usually expressed as a percentage. The calculation method is as follows:

$$\Delta U = \frac{U - U_N}{U_N} \times 100\%$$

$\Delta U$  - voltage deviation

$U$  - actual voltage

$U_N$  - rated voltage

### 5.5.6. Frequency Deviation

Frequency deviation refers to the difference between actual value and nominal value of system frequency under normal running conditions in the power system. The calculation method is as follows:

$$\text{Frequency deviation} = \text{Actual frequency} - \text{Nominal frequency}$$

### 5.5.7. Harmonic and Inter-harmonic

#### Harmonics

Perform Fourier series decomposition on the periodic alternating quantity to obtain components with frequencies that are integer multiples of the fundamental frequency higher than 1.

#### Inter-harmonics

Perform Fourier series decomposition on the periodic alternating quantity to obtain components with frequencies that are not equal to integer multiples of the fundamental frequency higher than 1.

The device provides the following harmonic data:

- Split-phase 2<sup>nd</sup> ... 51<sup>st</sup> voltage/current harmonic ratio
- voltage/current THD
- voltage/current harmonics content
- Split-phase harmonic active power
- Split-phase harmonic reactive power
- Split-phase 1<sup>st</sup> ... 50<sup>st</sup> inter-harmonic ratio of voltage/current
- Voltage/current inter-harmonics content

### 5.5.8. Unbalance

For four-wire three-phase systems, the device calculates the voltage and current imbalance based on the calculated positive and negative sequence components.

$$U_{nb2} = \frac{U_2}{U_1} \times 100$$

$$U_{nb0} = \frac{U_0}{U_1} \times 100$$

$$I_{nb2} = \frac{I_2}{I_1} \times 100$$

$$I_{nb0} = \frac{I_0}{I_1} \times 100$$

For three-phase, three-wire systems, the device calculates the voltage and current imbalance based on the maximum and average voltage and current values.

$$U_{nb} = \frac{\max(U) - U_{avg}}{U_{avg}} \times 100$$

$$Inb = \frac{\max(I - I_{avg})}{I_{avg}} \times 100$$

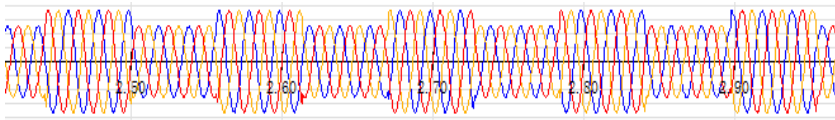
The device also simultaneously provides the real and imaginary components of the fundamental voltage and current waveforms.

### 5.5.9. Voltage Flicker

The human visual response to unstable lighting caused by voltage fluctuations (lamp flickering) is known as flicker. In other words, **flicker** reflects the impact of lighting flickering due to voltage variations on human visual perception.

The device provides short-term and long-term flicker values along with timestamps. Specifically:

- The update cycle for short-term flicker is **10 minutes**
- The update cycle for long-term flicker is **2 hours**



Waveform Screenshot of Voltage Flicker

### 5.5.10. Voltage Swell, dip and Interruption

**Swell:** Under standard frequency conditions, the root mean square (RMS) value of the voltage rises to between 1.1 and 1.8 times the nominal voltage.

**Dip:** Under standard frequency conditions, the root mean square (RMS) value of the voltage drops to between 0.1 and 0.9 times the nominal voltage.

**Voltage interruption:** Under standard industrial frequency conditions, the root mean square (RMS) value of the voltage falls below 0.1 times the nominal voltage for a period not exceeding 1 minute.

The device offers the following functions:

- Overvoltage, dip and interruption events per phase
- Start and end times, duration and extreme values of the events
- Waveform records of the events

The device allows the following parameters to be configured:

- Event triggering
- Selection and configuration of event data sources
- Configuration of event thresholds, hysteresis and detection duration

**Voltage dip:** Under standard frequency conditions, the rms voltage drops to between 0.1 and 0.9 times the nominal voltage.

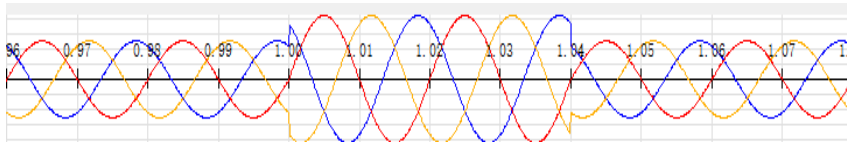
**Voltage interruption:** Under standard frequency conditions, the rms voltage falls below 0.1 times the nominal voltage for a period not exceeding 1 minute.

The device offers the following functions:

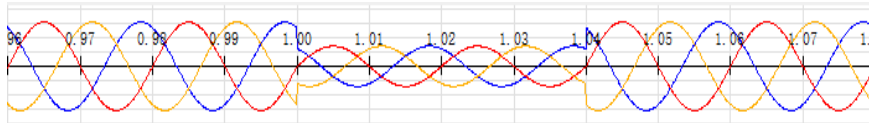
- Overvoltage, dip and interruption events per phase
- Start and end times, duration and extreme values of events
- Waveform records of events

The device allows the following parameters to be configured:

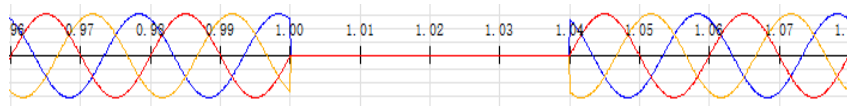
- Event triggering
- Selection and configuration of event data sources
- Configuration of event thresholds, hysteresis and detection duration



Waveform Screenshot of Voltage Swell



Waveform Screenshot of Voltage dip



Waveform Screenshot of Voltage Interruption

### 5.5.11. Rapid Voltage Change

Rapid voltage change refers to a rapid transition in the effective value of voltage between two stable voltage states, with the maximum change in effective voltage value not exceeding the threshold for voltage swell or dip.

The device provides the following functions:

- Rapid change events of split-phase/total voltage
- Occurrence and end time, duration,  $\Delta U_{max}$  and  $\Delta U_{ss}$  of rapid voltage change event
- Waveform recordings during a rapid voltage change event

The device provides the following relevant parameter Setup:

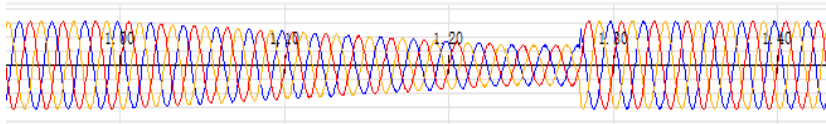
- Event judgment enable setting
- Event judgment threshold and hysteresis setting

**ΔUmax:** It refers to the maximum absolute value of difference between the last Uavg before an RVC event starts and any Urms during the event. For a multiphase system, it refers to maximum value among ΔUmax of all phases.

**ΔUss:** It refers to the absolute value of difference between the last Uavg before an event starts and the first Uavg after the event ends. For a multiphase system, the maximum value among all phases is taken.

**Uavg:** It refers to the arithmetic mean of 100 consecutive Urms.

**Urms:** It refers to the effective value of voltage half-wave.



Waveform Screenshot of Rapid Voltage Change

### 5.6. Alarm

The device can provide independent alarms with configurable activation, limit, hysteresis and delay settings. When an alarm is triggered, the value of the corresponding entry in the communication address table will be updated accordingly.

Alarm parameters include voltage, current, power, THD, etc.

**Alarm activation conditions:**

1. The relevant alarm is enabled.
2. The value is greater than the threshold for upper limit alarms; or less than the threshold for lower limit alarms.
3. The duration exceeds the set delay time.

**Alarm deactivation conditions:**

- The value is below the threshold minus the hysteresis for upper limit alarms.
- The value is above the threshold plus the hysteresis for lower limit alarms.

Alarm item:

LN-Voltage	2 <sup>nd</sup> ... 51 <sup>st</sup> current harmonic ratio
LL-Voltage	2 <sup>nd</sup> ... 51 <sup>st</sup> voltage harmonic content
Current	2 <sup>nd</sup> ... 51 <sup>st</sup> current harmonic content
N-phase Current	1 <sup>st</sup> ... 50 <sup>st</sup> voltage inter-harmonic ratio
Total Apparent Power	1 <sup>st</sup> ... 50 <sup>st</sup> current inter-harmonic content

Tabla con formato

Total Active Power	DI1 ON
Total Reactive Power	DI1 OFF
Total Power Factor	DI2 ON
Zero-sequence voltage unbalance	DI2 OFF
Negative-sequence voltage unbalance	DI3 ON
Zero-sequence current unbalance	DI3 OFF
Negative-sequence current unbalance	DI4 ON
Fundamental Voltage	DI4 OFF
Fundamental Current	X1-DI1 ON
Voltage Deviation	X1-DI1 OFF
Frequency	X1-DI2 ON
Frequency Deviation	X1-DI2 OFF
THD-V	X1-DI3 ON
TOHD-V	X1-DI3 OFF
TEHD-V	X1-DI4 ON
THD-I	X1-DI4 OFF
TOHD-I	X2-DI1 ON
TEHD-I	X2-DI1 OFF
TIHD-V	X2-DI2 ON
TOIHD-V	X2-DI2 OFF
TEIHD-V	X2-DI3 ON
TIHD-I	X2-DI3 OFF
TOIHD-I	X2-DI4 ON
TEIHD-I	X2-DI4 OFF
HC_V	X3-DI1 ON
HC_I	X3-DI1 OFF
IHC_V	X3-DI2 ON
IHC_I	X3-DI2 OFF
Present demand-P	X3-DI3 ON
Present demand-Q	X3-DI3 OFF
Present demand-S	X3-DI4 ON
Present demand-PF	X3-DI4 OFF
Forecast demand-P	X4-DI1 ON
Forecast demand-Q	X4-DI1 OFF
Forecast demand-S	X4-DI2 ON
Forecast demand-PF	X4-DI2 OFF
Short-term flicker	X4-DI3 ON
Long-term flicker	X4-DI3 OFF
Rapid voltage change	X4-DI4 ON
2 <sup>nd</sup> ... 51 <sup>st</sup> voltage harmonic ratio	X4-DI4 OFF

## 5.7. Event Log

The device provides 1,024 data records for querying, where each record can be divided into two parts i.e., event + occurrence time. The event is divided into a high byte (event classification) and a low byte (specific event), as shown in the following table:



High byte	Event Classification	Low byte	Specific Events
0x00	No event	—	—
0x01	Power on/off event	0x00	Power off
		0x01	Power on
0x02	Over-limit start event	—	See communication manual
0x03	Over-limit end event	—	
0x04	DI event	0x00	DI1 ON
		0x01	DI1 OFF
		0x02	DI2 ON
		0x03	DI2 OFF
		0x04	DI3 ON
		0x05	DI3 OFF
		0x06	DI4 ON
		0x07	DI4 OFF
		0x08	X1-DI1 ON
		0x09	X1-DI1 OFF
		0x0A	X1-DI2 ON
		0x0B	X1-DI2 OFF
		0x0C	X1-DI3 ON
		0x0D	X1-DI3 OFF
		0x0E	X1-DI4 ON
		0x0F	X1-DI4 OFF
		0x10	X2-DI1 ON
		0x11	X2-DI1 OFF
		0x12	X2-DI2 ON
		0x13	X2-DI2 OFF
		0x14	X2-DI3 ON
		0x15	X2-DI3 OFF
		0x16	X2-DI4 ON
		0x17	X2-DI4 OFF
		0x18	X3-DI1 ON
		0x19	X3-DI1 OFF
		0x1A	X3-DI2 ON
		0x1B	X3-DI2 OFF
0x1C	X3-DI3 ON		
0x1D	X3-DI3 OFF		
0x1E	X3-DI4 ON		

		0x1F	X3-DI4 OFF
		0x20	X4-DI1 ON
		0x21	X4-DI1 OFF
		0x22	X4-DI2 ON
		0x23	X4-DI2 OFF
		0x24	X4-DI3 ON
		0x25	X4-DI3 OFF
		0x26	X4-DI4 ON
		0x27	X4-DI4 OFF
0x05	DO event	0x00	DO1 ON
		0x01	DO1 OFF
		0x02	DO2 ON
		0x03	DO2 OFF
		0x04	DO3 ON
		0x05	DO3 OFF
		0x06	DO4 ON
		0x07	DO4 OFF
		0x08	X1- DO1 ON
		0x09	X1- DO1 OFF
		0x0A	X1- DO2 ON
		0x0B	X1- DO2 OFF
		0x0C	X2- DO1 ON
		0x0D	X2- DO1 OFF
		0x0E	X2- DO2 ON
		0x0F	X2- DO2 OFF
		0x10	X3- DO1 ON
		0x11	X3- DO1 OFF
		0x12	X3- DO2 ON
		0x13	X3- DO2 OFF
		0x14	X4- DO1 ON
		0x15	X4- DO1 OFF
		0x16	X4- DO2 ON
		0x17	X4- DO2 OFF

0x06	Meter operation event	0x00	Setup change
		0x01	Reset energy values
		0x02	Reset demand values
		0x03	Reset max/min values
		0x05	Clear SOE logs
		0x07	Reset DI pulse counter
		0x09	Reset running timer
		0x0A	Clear PQ event
		0x0B	Clear EN50160 report
		0x0C	Clear freeze data
		0xFF	Clear all records

### 5.8. Data Freezing

The device allows data to be frozen, including:

- 5 fixed data points (imported active energy, exported active energy, imported reactive energy, exported reactive energy and apparent energy)
- 20 optional data points

The freezing interval can be set to: 1 min, 5 min, 15 min, 30 min, 60 min or 1440 min.

### 5.9. Address Mapping

The device has **60 registers** whose addresses can be programmed.

For example, if the master system wishes to read the values of the following in a single frame:

- Phase V1 voltage
- Phase V2 voltage
- Phase V3 voltage
- Average phase voltage

It can be configured as follows:

- Custom setting 1/2 → “0x0006” / “0x0007” (V1 address)
- Custom setting 3/4 → “0x0008” / “0x0009” (V2 address)
- Custom setting 5/6 → “0x000A” / “0x000B” (V3 address)
- Custom setting 7/8 → “0x000C” / “0x000D” (average voltage address)

Once the configuration is complete, the master system can read 8 addresses directly from **0x6D00** to obtain all this data in a single frame.

## 5.10. Digital Input

The digital input module adopts the dry contact mode. Since it is equipped with an built-in power source, the device can be used to monitor the state of the circuit breaker, accumulate the pulses of energy without external power source.

## 5.11. Relay Output

The relay output allows you to select three modes:

- OFF mode
- Alarm mode
- Remote control mode

## 5.12. Expansion Modules

- FM2: 4 digital inputs
- FM3: 2 relay outputs
- FM11: RS485, Modbus-RTU
- FM24: BACnet/IP communication

The device supports expansion modules, including **FM2, FM3, FM11 y FM24**.