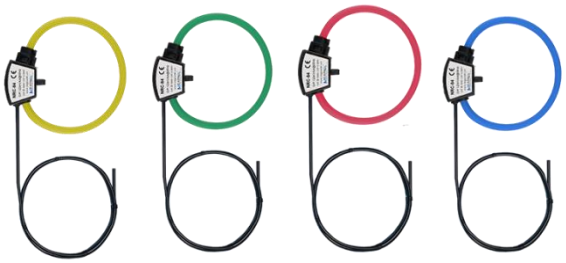
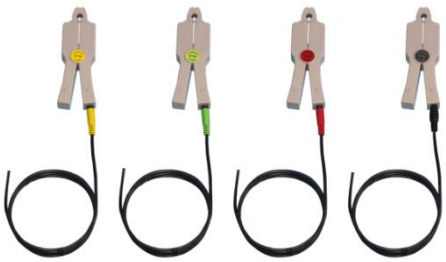
MQ31
Power quality analyzer

ROGOWSKI TECHNOLOGY (SHANGHAI) CO., LTD.


MQ31
MEATROL





Contents

1 Product description

MQ31 three-phase power quality analyzer, externally connected with open type Rogowski coil or voltage type CT, it can realize no dismantling wire test, simplify test steps, save construction cost, and is more convenient for engineering test as well as the inspection and maintenance of distribution system. MQ31 supports systems of single-phase and three-phase, it can measure multiple electrical parameters such as current, voltage, power factor, harmonic, active power, electric energy on the power grid of phase A, B, C and Neutral phase. With standard configuration of RJ45 interfaces (RS485 communication interfaces could be customized), through standard Modbus TCP (could be Modbus RTU protocol), it can be compatible with various configuration systems and transmit the electrical parameters collected by the front end to the system data center in real time.

Description	
Model No.	MQ31
Type	Three-phase power quality analyzer
Supported types of current sensor	Rogowski coil, Voltage-output current clamp
Wiring mode	3P4W(4CT), 3P4W(3CT), 3P3W(3CT), 3P3W(2CT), Single phase
Storage	32GB Micro SD card, USB DISK Download (Default storage interval: 1 minute)
Harmonic	Simultaneous 51 times
Application field	Power analysis, Electric energy measurement
Display screen	8-inch capacitive screen
Weight	Approx 5.5kg
Dimension	L*W*D：440x360x195MM
Color	Black
Input current	
Primary side current range	600A 0.5A ～ 720A 3kA 0.5A ～ 3600A 6kA 0.5A ～ 7200A
Secondary side current range （ ST08 current clamp or the same type）	1mA～10A
Input voltage value	$1/2^{25}$mV～707mV
Overload capacity	2V，10s/hours
Power supply	
Power supply	12V DC
Power consumption	
Max power consumption	10W
Connecting terminal type	
ABC phase current input	3.5mm Headphone jack
Voltage input	4mm Banana plug

2 Function

Measurement	
Voltage	UA, UB, UC, and average value
Current	IA, IB, IC, IN, and average value
Power	Active power, Reactive power, Apparent power (each phase, sum value of three phase)
Energy	Active energy, Reactive energy, Apparent energy (each phase, sum value of three phase) Exceeds 999.9GWh, energy value automatically cleared to “0”
Line voltage	Between phases
Angle between line voltage	Between phases
Angle between currents	Between phases
Power factor	Including harmonic power factor PF and fundamental power factor DPF (each phase, average value of three phases)
Max/Min.	
Voltage	Each phase, average value of three phases
Current	Each phase, average value of three phases

Power	Active power, Reactive power, Apparent power (each phase, sum value of three phases)
Unbalance degree	
Voltage	Each phase, the max unbalance degree of three phases
Current	Each phase, the max unbalance degree of three phases
Demand/Max Demand	
Current	Each phase, average value of three phases
Power	Active power, Reactive power, Apparent power (each phase, sum value of three phases)
Power quality	
Voltage swell	Start time, end time, amplitude value
Voltage dip	Start time, end time, amplitude value
Voltage harmonic value and percentage	Total harmonic, 1, 2, 3, 4.....51 (51st) harmonics
Current harmonic value and percentage	Total harmonic, 1, 2, 3, 4.....51 (51st) harmonics

General data record	
Time interval record setting	5～9999s (default 60s)
Data format	.CSV
Storage capacity	Micro SD card: 32GB
	Storage duration 3 years (using 32GB SD card, 1 time/60s）
Recorded data	Basic data Voltage harmonic Current harmonic
Event data record	
Data fromat	.CSV
Recorded data	Even type Start time Duration Amplitude value Voltage RMS1/2 value of each phase Voltage waveform of each phase

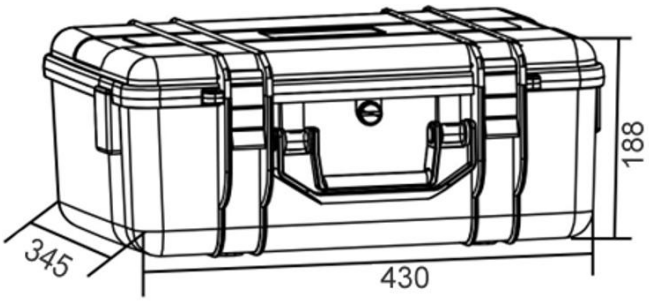
3 Accuracy and certification

Measurement accuracy		
Rogowski coil	Current measurement accuracy	0.5%(1%～120% rated current), (＜10A no guaranteed accuracy)
	Current gear	600A(6A～720A): Rogowski coil TRC-36， 50mV/kA
		3000A(10A～3600A): Rogowski coil NRC-150， 85mV/kA
		6000A(20A～7200A): Rogowski coil NRC-200， 50mV/kA
ST08 current clamp	Current measurement accuracy	0.5%(100mA～10A)
		1%(10mA～100mA，(＜10mA no guaranteed accuracy)
ABC Voltage measurement accuracy		0.2%(5～528V AC)
Power factor		±0.005
Active and apparent power		IEC62053-22 Class 0.5S
Reactive power		IEC62053-21 Class 2S
Frequency		0.01%(45～65Hz)
Active energy		IEC62053-22 Class 0.5S
Reactive energy		IEC62053-21 Class 2S
Environment condition		
Operating temperature		-25℃～+55℃
Storage temperature		-40℃～+85℃
Humidity range		5～95% RH，50℃(non-condensing)
Pollution level		2
Overvoltage capacity		III，applicable to the distribution system below 277/480VAC
Insulation strength		IEC61010-1

Altitude	3000m Max
Anti-pollution level	IP20（conforming to IEC 60629）
Product warranty	24 months
EMC（Electromagnetic compatibility）	
Electrostatic discharge	Level IV(IEC61000-4-2)
Radiation Immunity	Level III (IEC61000-4-3)
EFT Electrical Fast Burst Immunity	Level IV (IEC61000-4-4)
Surge immunity	Level IV (IEC61000-4-5)
Immunity to Conducted Disturbance	Level III (IEC61000-4-6)
Power frequency magnetic field immunity	0.5mT (IEC61000-4-8)
Conduction and Radiation	Class B (EN55022)
Standard compliance	
EN62052-11, EN61557-12, EN62053-21, EN62053-22, EN62053-23, EN50470-1, EN50470-3, EN61010-1, EN61010-2, EN61010-031	

4 Outline and dimensions

Unit：mm



5 Port definition

MQ31 is equipped with various interfaces to realize different functions.
Port definitions as follows:

Interface No.	Interface name	Interface definition	Interface function	Remarks
1	UA	Phase A voltage input	Voltage input channel	Voltage input channel
2	UB	Phase B voltage input		
3	UC	Phase C voltage input		
4	UN	Phase N voltage input		
5	IA	Phase A current input	Current input channel	Current input channel
6	IB	Phase B current input		
7	IC	Phase C current input		
8	IN	Phase N current input		
RJ45	RJ45	Ethernet interface	Ethernet interface	Upgrade program
USB	USB	USB2.0 interface	USB interface	Export data and upgrade program
RS485	RS485	RS485 interface	RS485 interface	Customized

5.1 Power supply

The MQ31 is powered by an adapter with an input voltage of 12V DC and a maximum power of 10W.

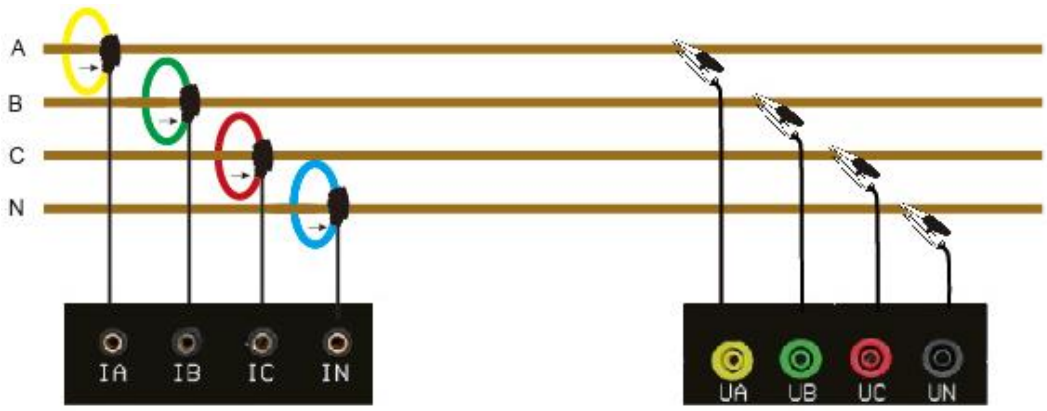
- Do not connect the analyzer when the cable is live;
- Before connecting the power supply, make sure whether the power supply voltage is within the required range, otherwise, the analyzer cannot normally work.

5.2 Voltage and current input

The analyzer supports 5 types of wiring mode: 3P4W-4CT, 3P4W-3CT, 3P3W-3CT, 3P3W-2CT, Single phase.

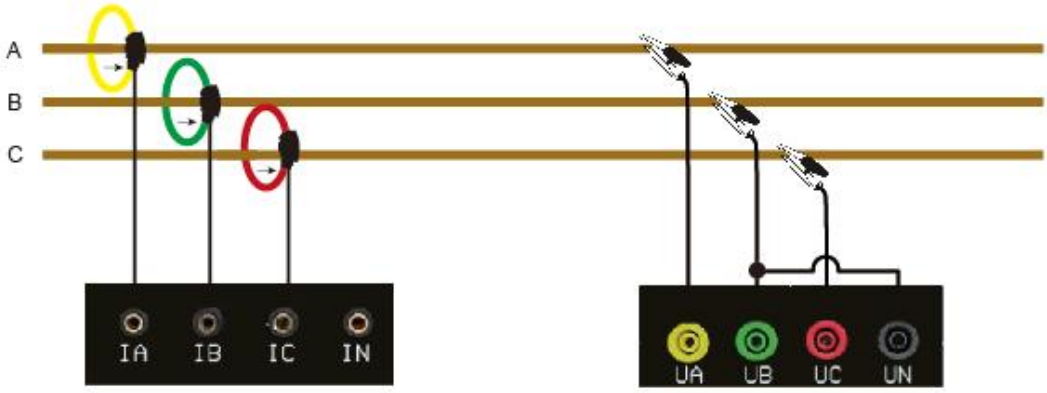
- The actual wiring mode of the analyzer must be consistent with the one configured inside the analyzer.
- 3P4W-4CT need 4pcs current sensor, N-phase current can be measured.
- 3P4W-3CT need 3pcs current sensor, N-phase current cannot be measured, it will be calculated by the system.
- 3P3W-3CT need 3pcs current sensor, Phase B current is acquired by actual sensor measurement.
- 3P3W-2CT need 2pcs current sensor, Phase B current is acquired by calculating.
- The phase sequence of voltage and current must correspond one by one, otherwise the measured data from the analyzer is incorrect.
- When using the current sensor, note that the direction of the current arrow on the sensor must be consistent with the actual current flow, that is, the current arrow of the sensor points to the load end.

5.2.1 3P4W_4CT Voltage and current wiring mode:

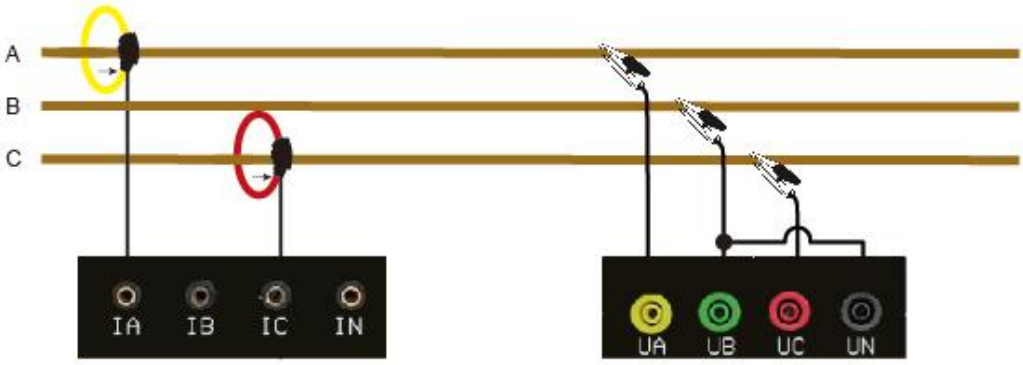


5.2.2 3P4W_3CT Voltage and current wiring mode:

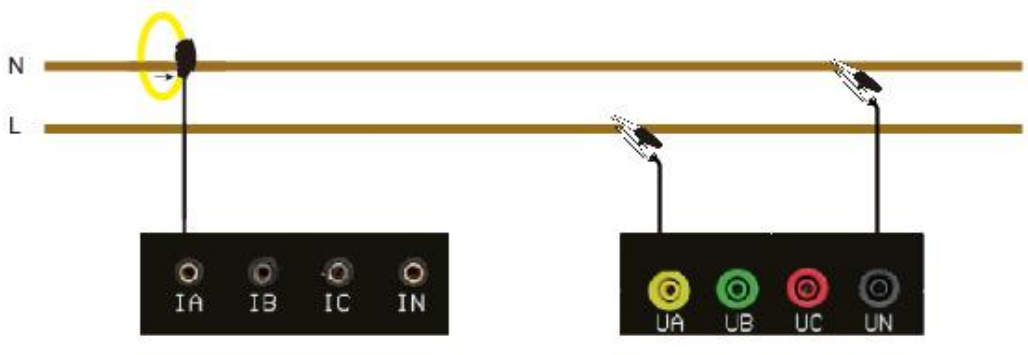
5.2.3 3P3W_3CT Voltage and current wiring mode



5.2.4 3P3W_2CT Voltage and current wiring mode



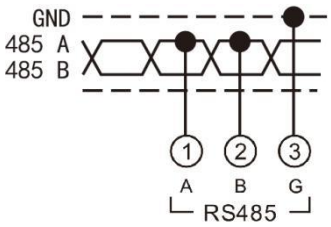
5.2.5 Single phase voltage and current wiring mode



5.3 RS485

The analyzer is equipped with one RS485 communication interface to support Modbus RTU protocol. The RS485 communication interface is required to be connected with shielded twisted pair in form of daisy chain. In the case of long-distance high-speed, a 120 Ω resistor needs to be connected in parallel at both ends of the daisy chain.

Note: This 485 interface is a non-standard function, and the analyzer supports TCP communication.
If RTU communication is necessary, customized export is required.



6 Record

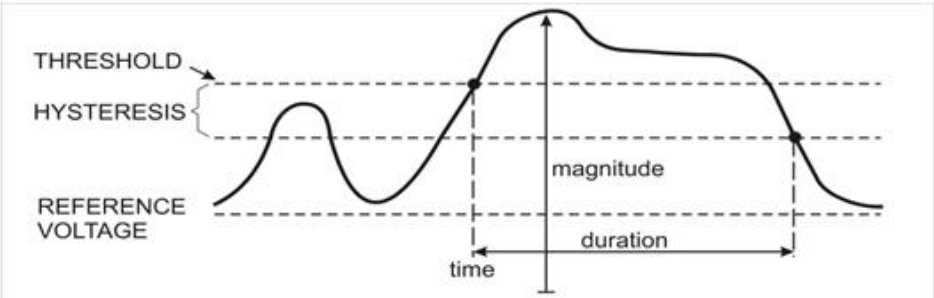
The analyzer has 32GB internal storage space for storing event records and measurement records. The event record is stored as a CSV file for RMS (1 / 2) of each event. and the waveform of each event is stored as a CSV file. The measurement records are stored as one CSV file for daily basic data, one CSV file for daily voltage harmonic data, and one CSV file for daily current harmonic data.

All recorded files can be exported through USB flash disk.。All recorded files can be deleted via operating interface.

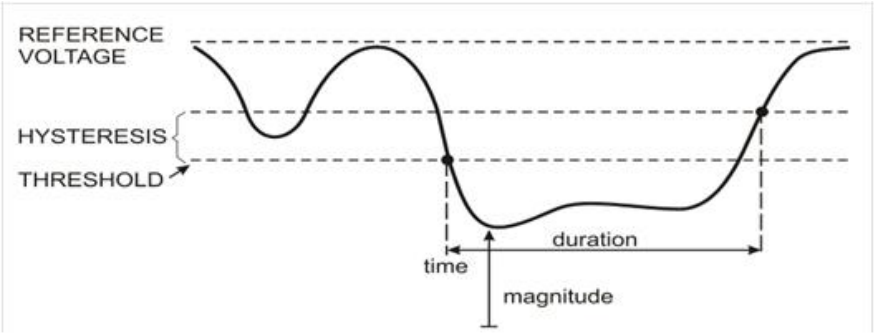
6.1 Event record

The event record only records the power quality（voltage swell and voltage dip）. The swells and dips are the rapid changes of normal voltage. and the changing range can be as high as 10 to 100 times of the voltage. The duration varies from half a cycle to several seconds as defined in EN61000-4-30. The analyzer is allowed to set the nominal reference voltage to analyze the reference value.

The voltage rises during the swell. In a three-phase system, when the voltage of one or more phases rises to the swell threshold, the swell begins; The swell stops when the voltage of all phases is equal to or less than the swell threshold minus Hysteresis. The trigger conditions of swell are threshold and Hysteresis. The swell is characterized by duration, amplitude and occurrence time, as shown in the below figure:



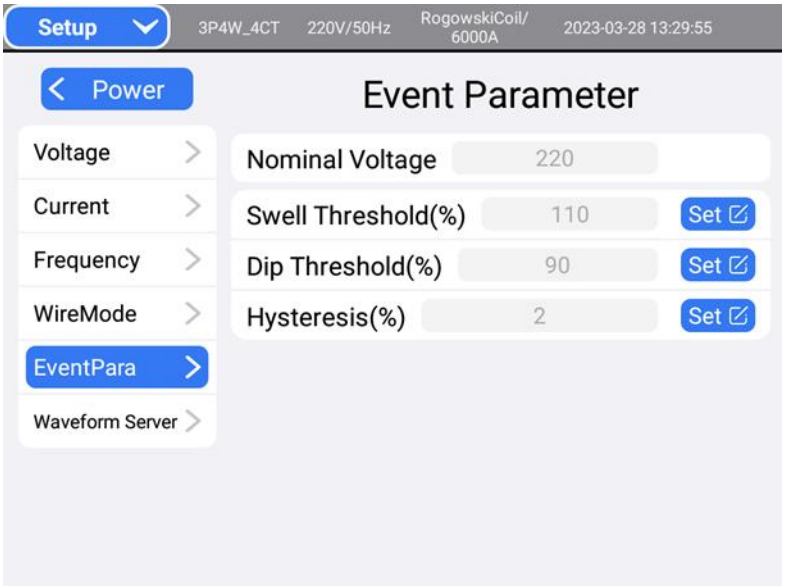
The voltage drops during the dip. In a three-phase system, when the voltage of one or more phases drops to the dip threshold, the dip begins; When the voltage of all phases is equal to or greater than the dip threshold plus Hysteresis, the dip stops. The trigger conditions of sudden drop are threshold and Hysteresis. Sudden drop is characterized by duration, amplitude and occurrence time.



6.1.1 Parameter setting of swell and dip

The same nominal voltage is used for swell and dip. Refer to “Setting--> Electric energy parameters --> Voltage parameters” for setting the nominal voltage. Refer to “Setting interface --> Electric energy parameters --> Event parameters” for setting the swell and dip threshold and Hysteresis.

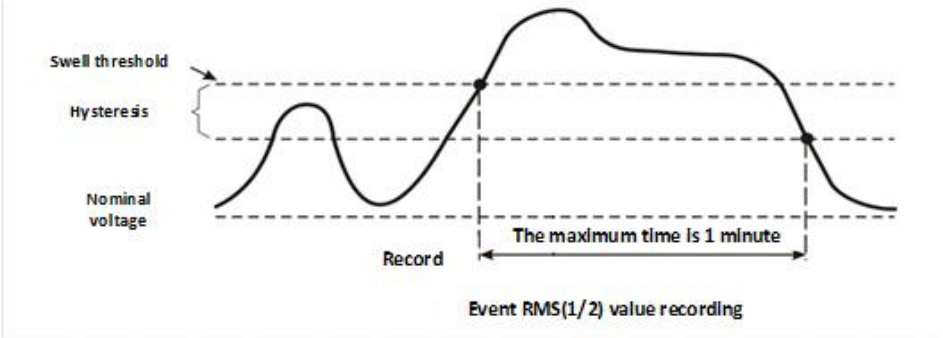
- Swell threshold: 105% to 140% (default: 110%)
- Dip threshold: 75% to 95% (default: 90%)
- Hysteresis: 1% to 6% (default 2%)



6.1.2 Swell and dip event RMS (1 / 2) and waveform

If the record storage function is enabled, the RMS (1 / 2) and waveform of the swell and dip event will be stored into the internal memory of the analyzer.

RMS (1/2) maximum records the value of 1 minute, as shown in the below figure:



The waveform recording adopts a fixed sampling rate of 8kHz, and the recording is divided into four parts: before the beginning of event, after the beginning of event, before the ending of event, after the ending of event.

The maximum total recording time of event waveform is 600ms				
Before the beginning of event	After the beginning of event	In the middle of the event	Before the ending of event	After the ending of event
100ms	200ms	-	200ms	100ms
number of sampling points 8000*0.1=800	number of sampling points 8000*0.2=1600	-	number of sampling points 8000*0.2=1600	number of sampling points 8000*0.1=800

7 Real time waveform of voltage and current

The analyzer can use UDP protocol through Ethernet. As a UDP client, the analyzer uploads the real-time sampling waveform of voltage and current to the specified port number of the specified server. Voltage ABC channels and current ABC channels are divided into 6 port numbers. The waveform sampling rate is 8kHz, and one UDP packet is generated for every 128 sampling points.

The IP address and port number of the waveform receiving server can be configured in the "configuration interface -- > communication -- > waveform server". The voltage ABC channels and current ABC channels can control the transmission of waveform by configuring whether the corresponding channel is enabled.

Attention

After the waveform server parameters are configured, they will not take effect until the analyzer is restarted.

The format of UDP packets sent by each channel is as follows:

Serial No.	Name	Type	No. of bytes	Range (decimal)	Description
1	UDP packet No.	UInt32	4	-	Low byte first (sending sequence)
2	1st sampling point	float32	4	-	Low byte first (sending sequence)
…	…	float32	4	…	…
3	The 128th sampling point	float32	4	-	Low byte first (sending sequence)

8 Operation and interface display

This section is used to describe the interface display, key combination operation and the configuration of analyzer.

8.1 Display and push button

as shown in the figure below:

The analyzer adopts capacitive touch screen display, as shown in the following figure:

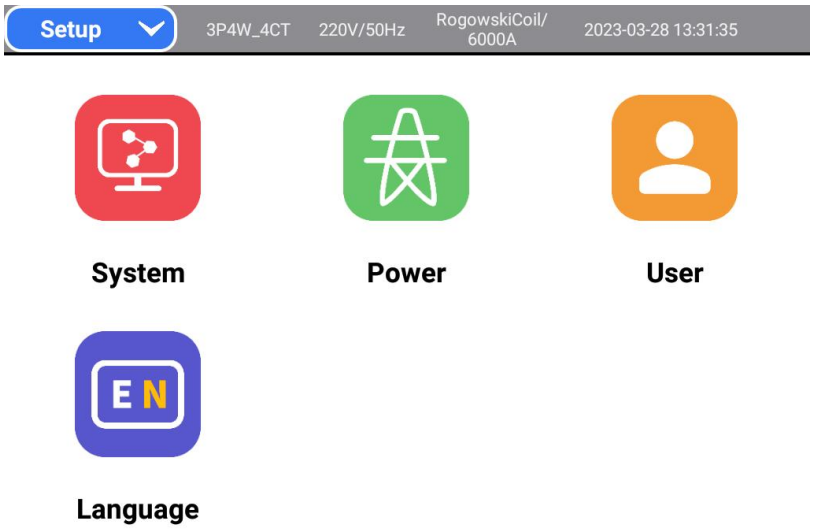
Interface display description

No.	Name	Description
1	status bar	Used to display wiring mode, voltage, frequency, time , sensor and its transformation ratio
2	Content window	Display all information
3	Interface switching key	Key for switching the content window

8.2 Display interface switching

The analyzer mainly has four types of display interfaces: real time viewing interface, configuration interface, storage record interface and recorder interface. The four types of interfaces can be switched through the "interface switching button" on the status bar.


3. Switch button
1.Status Bar
2.Content window
Realtime
3P4W_4CT
220V/50Hz
RogowskiCoil/ 6000A
2023-03-28 13:31:11
Waveform
U/I/F
Harmonic
Power/Energy
Unbalance
Drop-down toggle box
Realtime
Setup
Memory
Recorder


Setup
3P4W_4CT
220V/50Hz
RogowskiCoil/ 6000A
2023-03-28 13:31:35
System
Power
User
EN
Language

8.3 Measurement data display interface

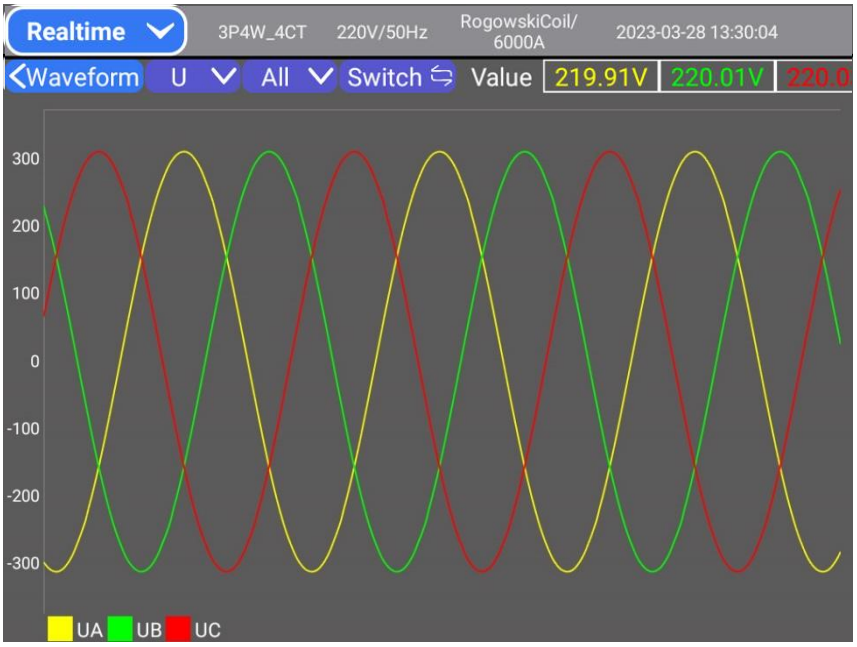
The measurement data display interface is used to display: voltage, current, power, power factor, frequency and other data.

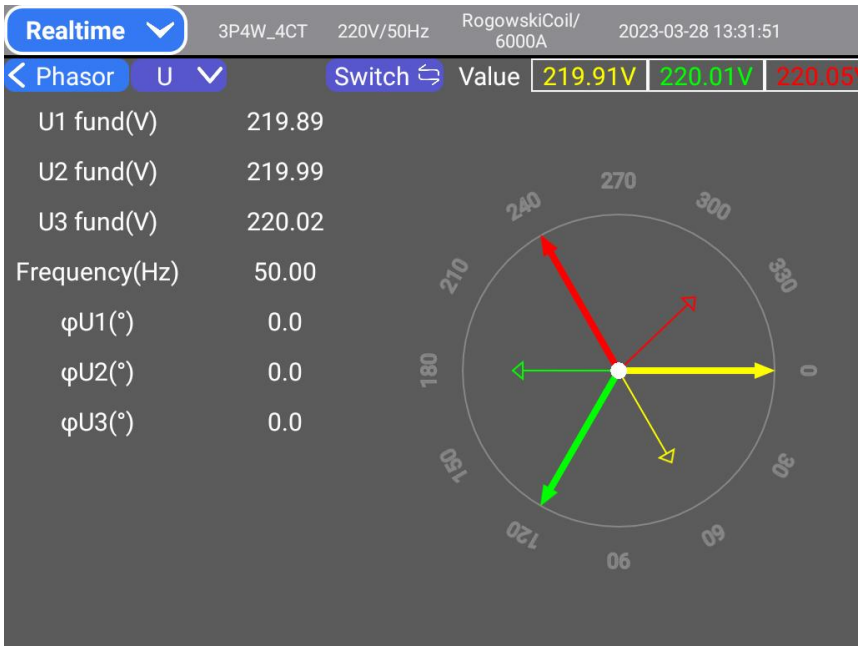
The analyzer will have different display interfaces under different wiring modes (3P4W-4CT, 3P4W-3CT, 3P3W-3CT, 3P3W-2CT, Single phase).

8.3.1 3P4W-4CT, 3P4W-3CT Display interface

3P4W-4CT, 3P4W-3CT Display interface distinctions

Wiring mode	N-phase current display
3P4W-4CT	Yes
3P4W-3CT	No





Realtime | 3P3W_3CT | 220V/50Hz | RogowskiCoil/ 6000A | 2023-03-28 13:44:32

U/I/F | Stop | Run

Line Voltage	L1-L2	L2-L3	L3-L1	
RMS(V)	380.770	380.601	381.378	
Crest Factor	1.389	1.387	1.391	
Frequency(Hz)	50.00	50.00	50.00	
Current	L1	L2	L3	
RMS(A)	159.466	160.797	0.852	
Crest Factor	1.416	1.417	1.556	
Demand	L1	L2	L3	Avg
Current Demand(A)	159.515	160.826	0.935	107.092

Realtime | 3P4W_4CT | 220V/50Hz | RogowskiCoil/ 6000A | 2023-03-28 13:32:03

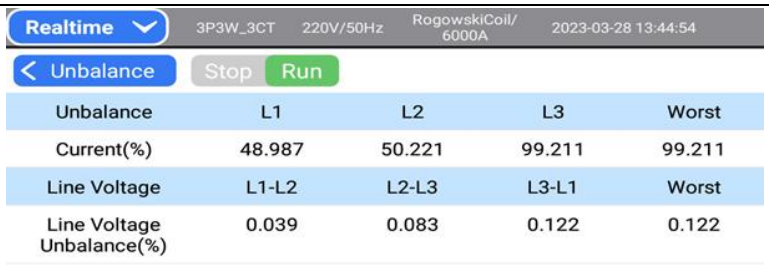
Harmonic | Stop | Run | U | Percentage | Switch

Harmonic	L1	L2	L3
UTHD(%)	1.563	1.550	1.565
UHD2(%)	0.025	0.017	0.006
UHD3(%)	0.040	0.035	0.019
UHD4(%)	0.002	0.002	0.006
UHD5(%)	0.860	0.859	0.858
UHD6(%)	0.000	0.002	0.002
UHD7(%)	0.921	0.925	0.929
UHD8(%)	0.002	0.004	0.003
UHD9(%)	0.013	0.010	0.013
UHD10(%)	0.003	0.003	0.003

Realtime | 3P3W_3CT | 220V/50Hz | RogowskiCoil/ 6000A | 2023-03-28 13:44:47

Power/Energy | Stop | Run

Power	Sum
Active Power(kW)	0.658
Reactive Power(kVAR)	60.851
Apparent Power(kVA)	60.851
PF	0.009
DPF	0.010
Energy	Sum
Active Energy Import(kWh)	45
Active Energy Export(kWh)	0

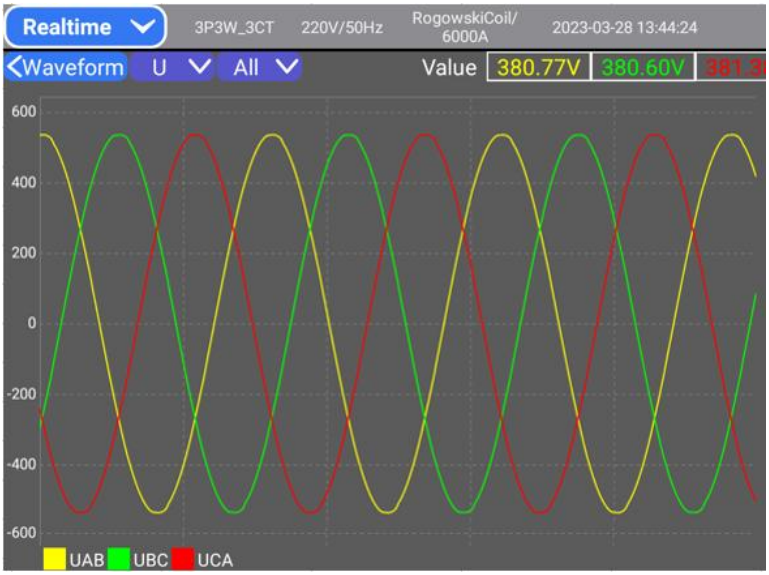


Unbalance	L1	L2	L3	Worst
Current(%)	48.987	50.221	99.211	99.211
Line Voltage	L1-L2	L2-L3	L3-L1	Worst
Line Voltage Unbalance(%)	0.039	0.083	0.122	0.122

8.3.2 3P3W-3CT, 3P3W-2CT Display interface

3P3W-3CT, 3P3W-2CT Display interface distinctions

Wiring mode	Acquisition method of phase B current value
3P3W_3CT	Directly measured by B-phase current sensor
3P3W_2CT	Obtained by phase A and C current calculation



Realtime | 3P3W_3CT | 220V/50Hz | RogowskiCoil/ 6000A | 2023-03-28 13:44:32

U/I/F | Stop | Run

Line Voltage	L1-L2	L2-L3	L3-L1	
RMS(V)	380.770	380.601	381.378	
Crest Factor	1.389	1.387	1.391	
Frequency(Hz)	50.00	50.00	50.00	
Current	L1	L2	L3	
RMS(A)	159.466	160.797	0.852	
Crest Factor	1.416	1.417	1.556	
Demand	L1	L2	L3	Avg
Current Demand(A)	159.515	160.826	0.935	107.092

Realtime | 3P3W_3CT | 220V/50Hz | RogowskiCoil/ 6000A | 2023-03-28 13:44:37

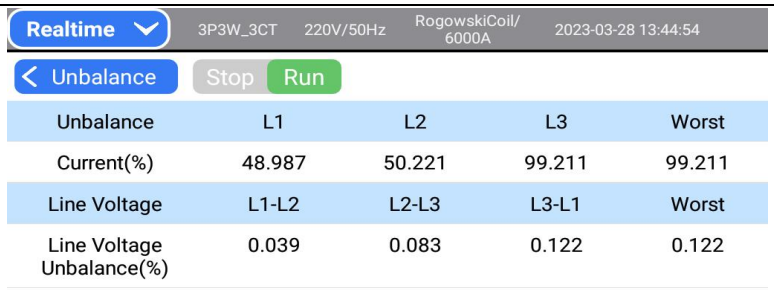
Harmonic | Stop | Run | U | Percentage | Switch

Harmonic	L1-L2	L2-L3	L3-L1
UTHD(%)	1.589	1.625	1.529
UHD2(%)	0.016	0.012	0.019
UHD3(%)	0.020	0.048	0.028
UHD4(%)	0.002	0.004	0.005
UHD5(%)	0.864	0.820	0.885
UHD6(%)	0.001	0.006	0.006
UHD7(%)	0.932	0.889	0.969
UHD8(%)	0.002	0.003	0.005
UHD9(%)	0.020	0.049	0.037
UHD10(%)	0.005	0.004	0.002

Realtime | 3P3W_3CT | 220V/50Hz | RogowskiCoil/ 6000A | 2023-03-28 13:44:47

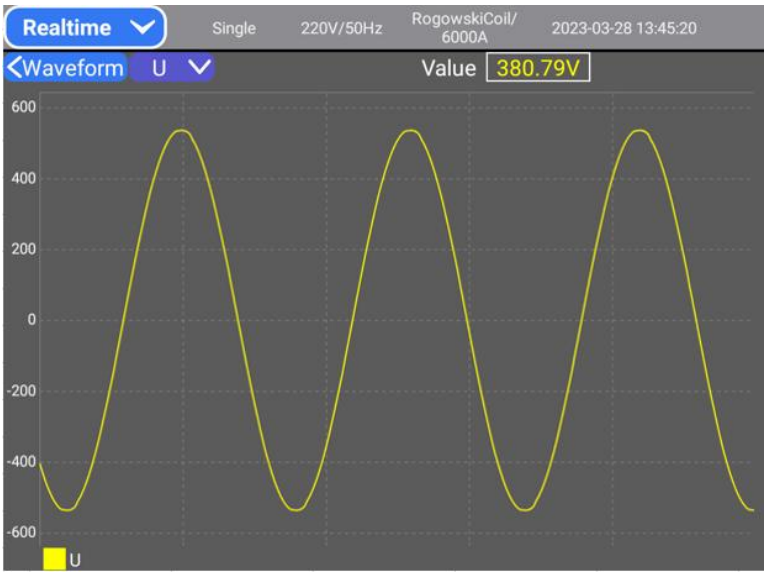
Power/Energy | Stop | Run

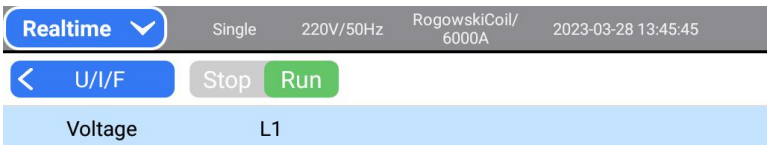
Power	Sum
Active Power(kW)	0.658
Reactive Power(kVAR)	60.851
Apparent Power(kVA)	60.851
PF	0.009
DPF	0.010
Energy	**Sum**
Active Energy Import(kWh)	45
Active Energy Export(kWh)	0



Unbalance	L1	L2	L3	Worst
Current(%)	48.987	50.221	99.211	99.211
Line Voltage	L1-L2	L2-L3	L3-L1	Worst
Line Voltage Unbalance(%)	0.039	0.083	0.122	0.122

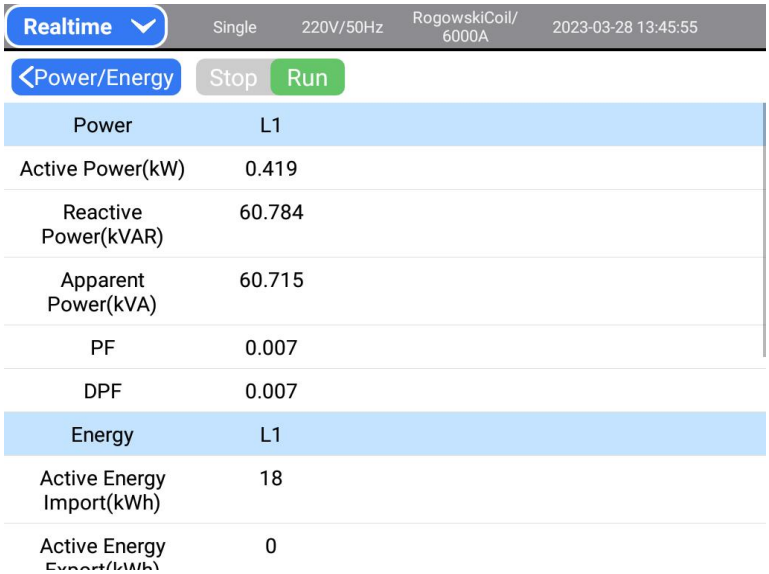
8.3.3 Single phase display interface

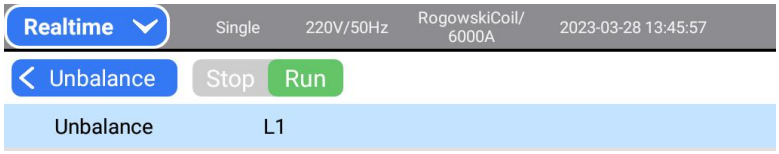




Voltage	L1
RMS(V)	380.802
Crest Factor	1.389
Frequency(Hz)	50.00
Current	L1
RMS(A)	159.432
Crest Factor	1.419
Demand	L1
Current Demand(A)	165.264


Realtime
Single
220V/50Hz
RogowskiCoil/ 6000A
2023-03-28 13:45:52
Harmonic
Stop
Run
U
Percentage
Switch
Harmonic L1
UTHD(%) 1.580
UHD2(%) 0.021
UHD3(%) 0.020
UHD4(%) 0.003
UHD5(%) 0.858
UHD6(%) 0.002
UHD7(%) 0.930
UHD8(%) 0.001
UHD9(%) 0.019
UHD10(%) 0.005


Realtime
Single
220V/50Hz
RogowskiCoil/ 6000A
2023-03-28 13:45:55
Power/Energy
Stop
Run
Power L1
Active Power(kW) 0.419
Reactive Power(kVAR) 60.784
Apparent Power(kVA) 60.715
PF 0.007
DPF 0.007
Energy L1
Active Energy Import(kWh) 18
Active Energy 0

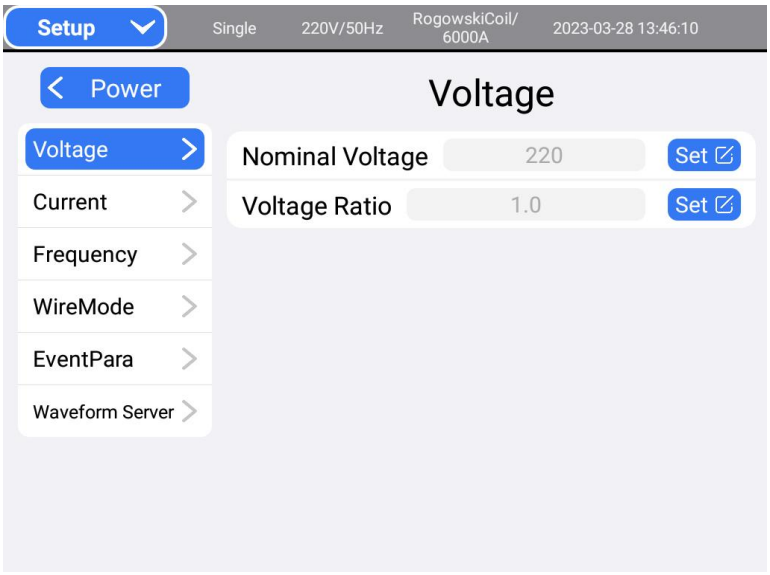

Realtime
Single
220V/50Hz
RogowskiCoil/ 6000A
2023-03-28 13:45:57
Unbalance
Stop
Run
Unbalance L1

8.4 Configuration interface

The analyzer setting interface is shown in the below figure, and the configurable parameters are as follows：

8.4.1 Power grid parameter setting interface

The power grid parameter setting interface is shown in the below figure, and the configurable parameters are as follows:



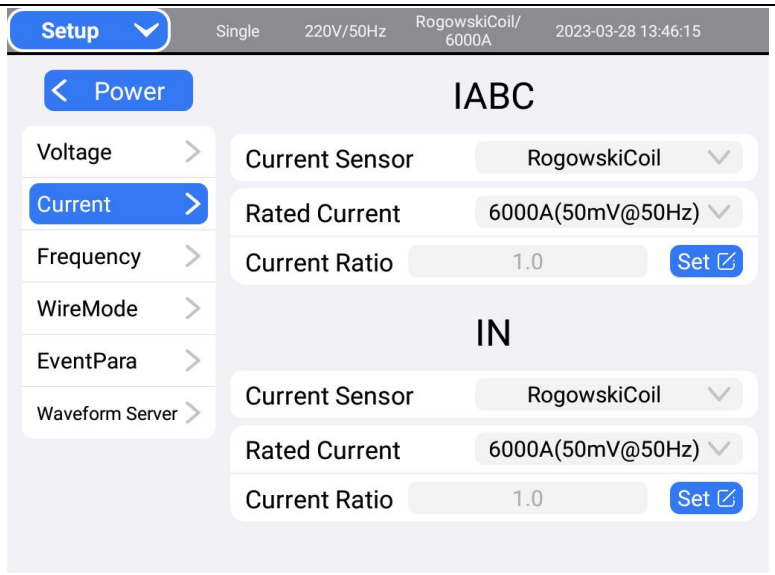
Click the Set button on the right to modify the data. After confirmation, the modified data will be saved automatically.
Nominal voltage configurable range：
1~10000
The nominal voltage is used for the detection of swell and dip events, which needs to be set according to the actual measured voltage value. Unreasonable nominal voltage will lead to incorrect detection of swell and dip events.
Voltage transformation ratio is used to set the transformation ratio of voltage transformer = Nominal voltage at primary side of transformer / Secondary side output voltage value.
If no voltage transformer is connected, then value is set to be 1.0000.

Attention

Before modifying parameters, the data recording function must be stopped. Refer to the interface "record - > record parameters".

8.4.2 Current transformer setting interface

The current transformer setting interface is shown in the below figure, and the configurable parameters are as follows



The following parameters can be selected for current sensors:

Rogowski coil

CT

When the transformer type is configured as "Rogowski coil":

The nominal current is available in 3 gears：

600A(50mV@50Hz)

3000A(85mV@50Hz)

6000A(50mV@50Hz)

The coil parameters are automatically displayed according to the selected gear and cannot be modified.

The current transformation ratio is used to set the transformation coefficient of the current.

When the transformer type is configured as "CT":

CT Pri[A]：Used to set the voltage output transformer, the nominal current at the primary side.

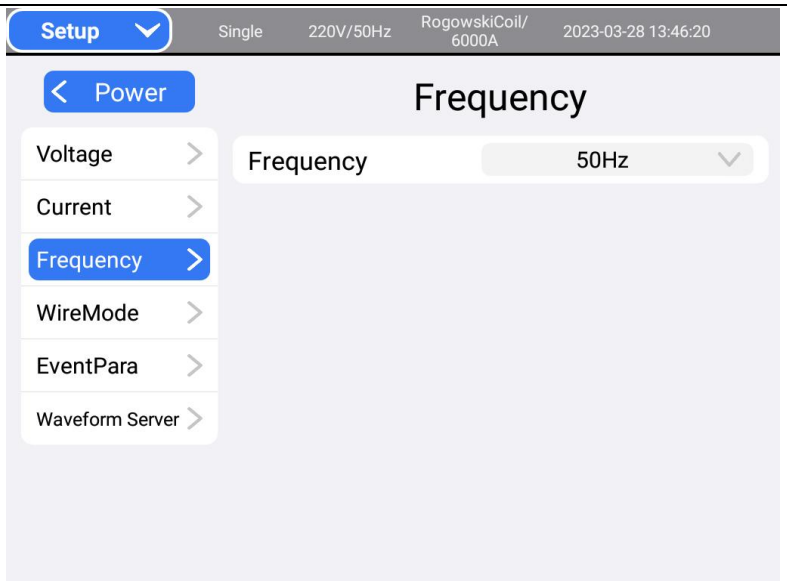
CT Sec[mV]：Used to set the voltage output transformer. The output voltage value at the secondary side is 707mv at most.

The current transformation ratio is used to set the transformation coefficient of the current.

The configuration parameters of N-phase current are similar to those of ABC phase.

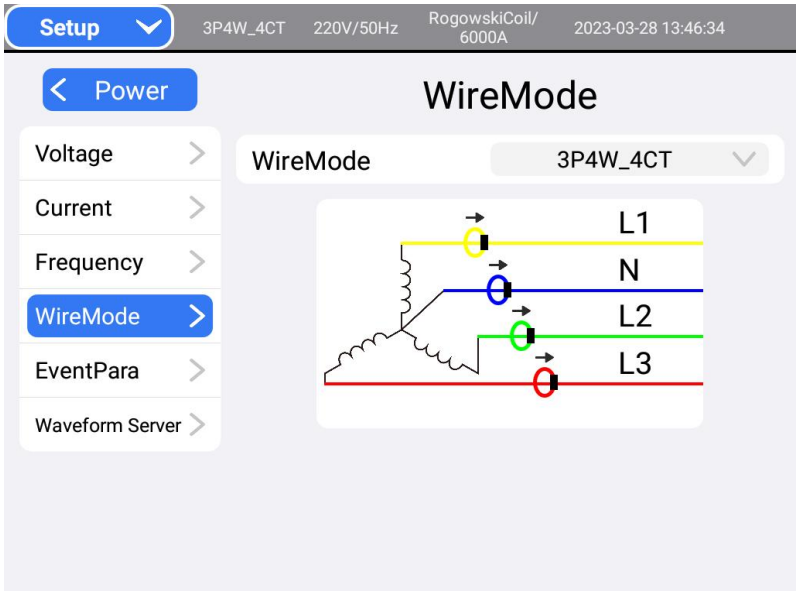
Attention

Before modifying parameters, the data recording function must be stopped. Refer to the interface "record - > record parameters".



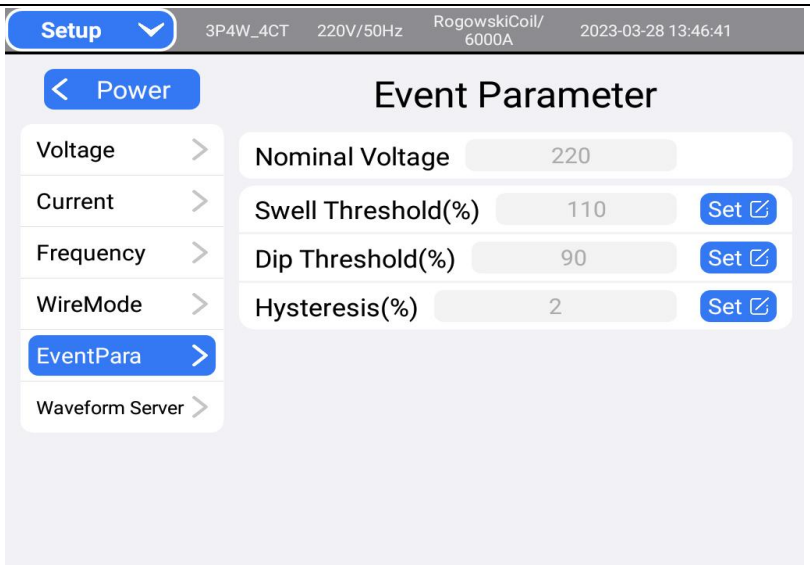
The frequency can be configured with the following parameters:

50Hz
60Hz



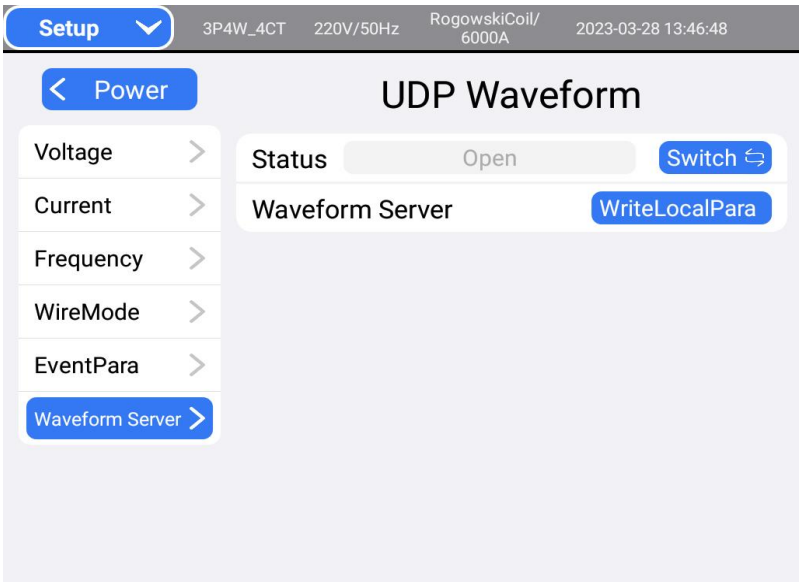
The following parameters can be selected for wiring mode:

Three phase 4 wire 4CT
Three phase 4 wire 3CT
Three phase three wire 3CT
Three phase three wire 2CT
Single phase



8.4.3 Communication setting interface

The communication setting interface is shown in the below figure, and the configurable parameters are as follows:



Waveform transmitting switch can be set as whether the real-time waveform is turned on.
The waveform server is used to configure receiving server parameters of the waveform sent by the analyzer.

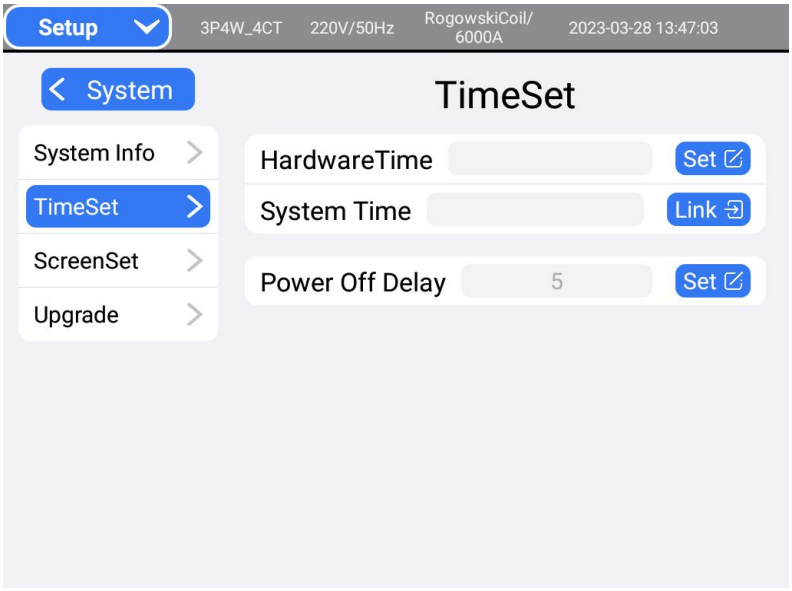
Attention
After modifying this parameter, the analyzer needs to be restarted before the parameter can take effect. The analyzer can be restarted through the interface "system - > Restart".

8.4.4 System information interface

The system information interface is shown in the below figure. You can view the following information:

8.4.5 Time setting interface

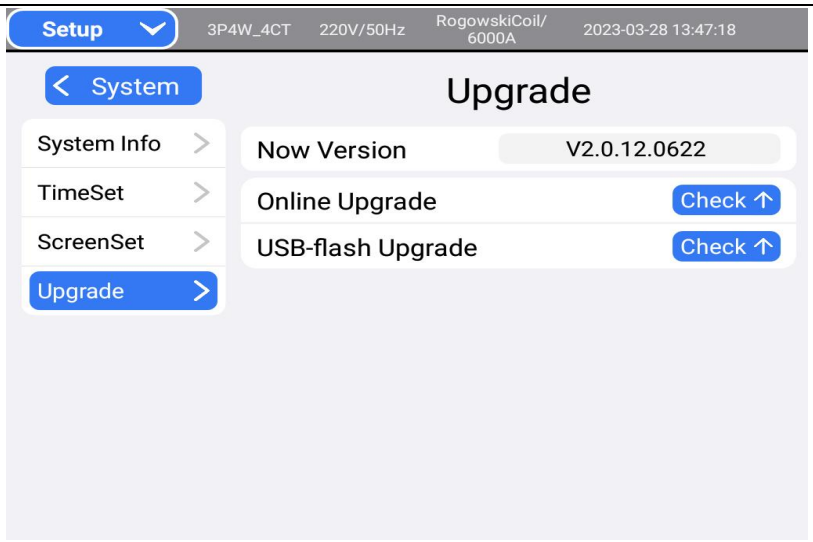
The time setting interface is shown in the right figure. You can view the following information:



Modifying the hardware time is to write the current screen time into the hardware. When the screen time is inaccurate, please jump to the system time for calibration and then modify the hardware time.

8.4.6 System upgrade interface

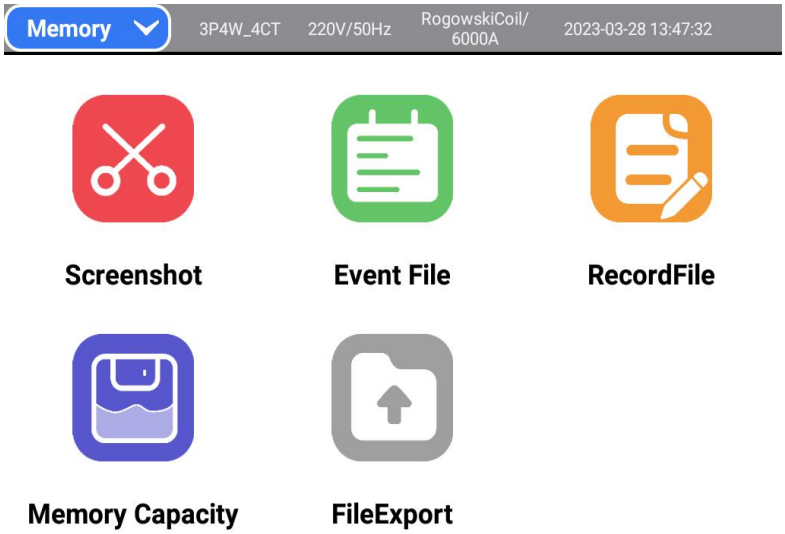
The system upgrade interface is shown in the below figure. You can view the following information：



Online upgrade function:
The RJ45 port needs to be connected to the network cable before the update can be detected. Do not click repeatedly when the network cable is not connected.
USB flash disk upgrade function:
First put the new installation package into the root directory of the USB flash disk and insert the USB flash disk in this interface.

9 Store record

The storage record interface includes: screenshot files, event files, record files, storage capacity, and file export.



9.1.1 Screenshot file

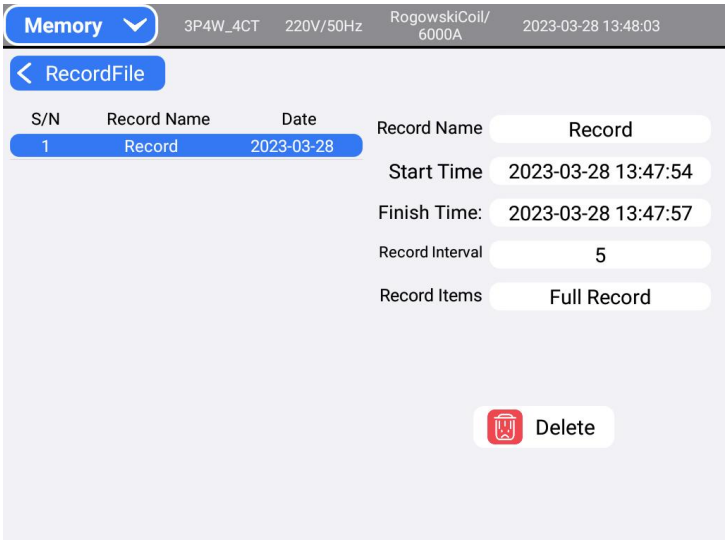
Screenshot file: The screenshot is captured using gestures, with two fingers sliding from right to left.

9.1.2 Event file

Event file: A file triggered by a voltage swell and dip. (The export button appears after the USB flash drive is inserted.)

9.1.3 Record documents

Record file: A file recorded by a recorder. (The export button appears after the USB flash drive is inserted.)

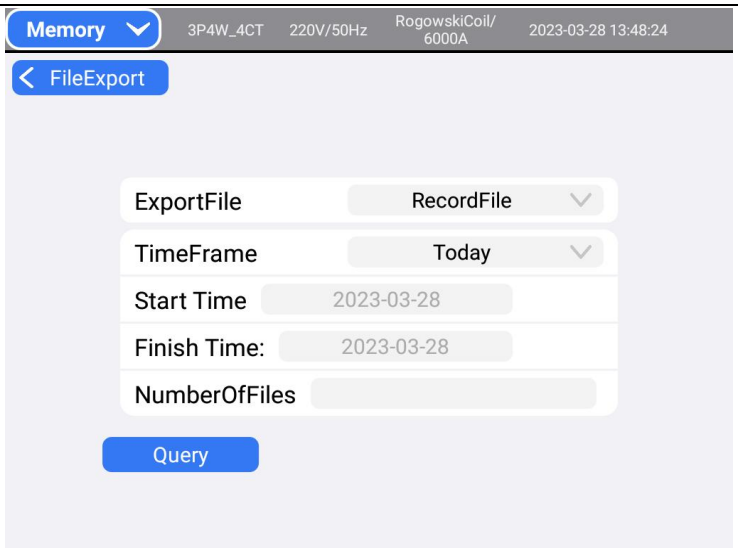


9.1.4 Storage capacity

Event File: View the disk space that has been used.

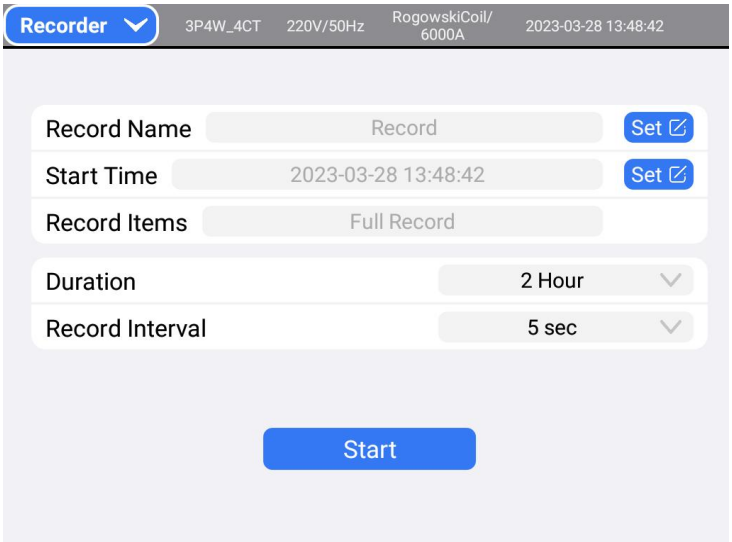
9.1.5 File Export

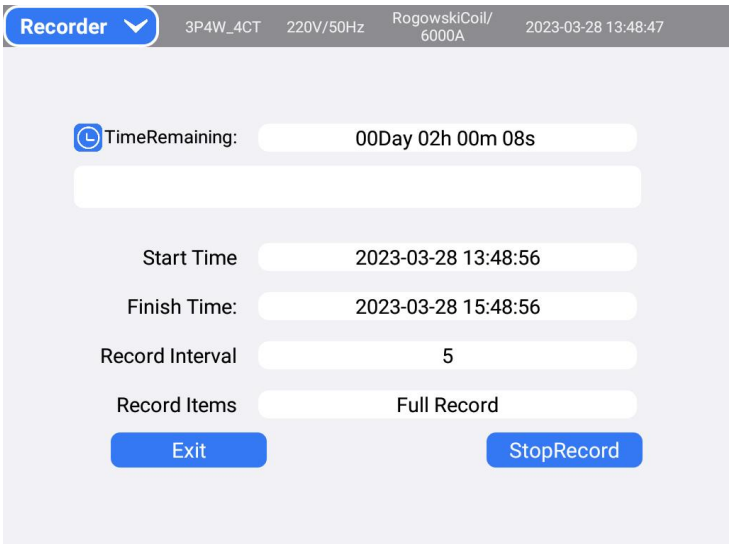
File Export: Export record files and event files. (The export button appears after the USB flash drive is inserted.)



10 Recorder

Record real-time electric energy data, and adjust the start time, duration, and statistical interval. Click Start Recording to enter the recording interface, where you can exit and background recording





11 Modbus Communication summary

Communication	
Communication interface	RJ45 、RS485(Customized)
Communication protocol	Modbus TCP、Modbus RTU(Customized)

The standard communication protocols Modbus TCP and Modbus RTU are adopted, and the function code 0x64 is extended to read the RMS1/2 value and waveform of the event.

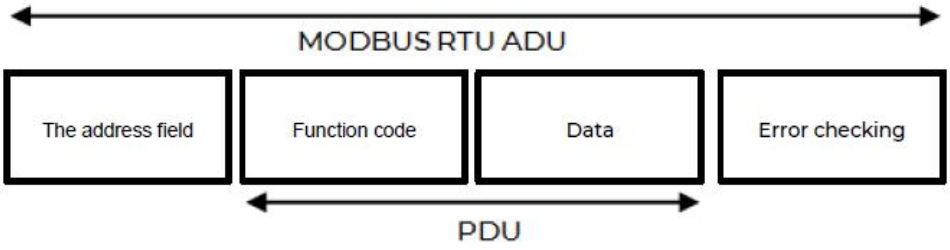
11.1 Modbus-RTU communication parameters

Before Modbus RTU communicating, the following parameters need to be set through the interface of the analyzer:

Parameter	Effective value	Default value
Baud rate	-1200 baud -2400 baud -4800 baud -9600 baud -19200 baud -38400 baud -57600 baud	9600 baud
Data bit	8	8
Parity type	– None – Odd – Even	None
Stop bit	1	1
Address	1–247	1

11.2 Modbus RTU data frame

The Modbus RTU data frame includes four parts: address field, function code, data and error checking.



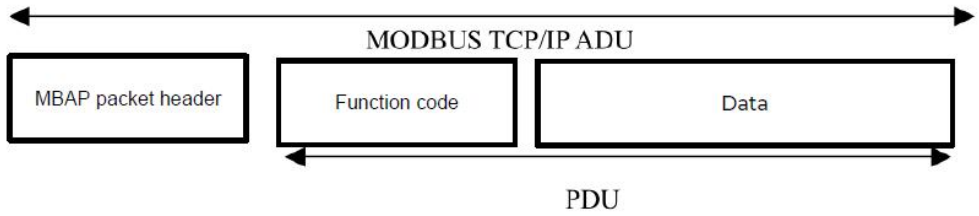
11.3 Modbus-TCP communication parameters

Before Modbus TCP communicating, the following parameters need to be set through the interface of the analyzer

Parameter	Effective value	Default value
IP address	-	192.168.1.8
Subnet mask	-	255.255.255.0
Default gateway Modbus protocol port No.	- -	192.168.1.1 502

11.4 Modbus TCP/IP data frame

When transmitted over TCP / IP Ethernet, Modbus TCP / IP data frame includes 3 parts: packet header, function code and data.



MBAP packet header (MBAP、Modbus Application Protocol、Modbus application Protocol) is divided into 4 fields with 7 bytes in total, as shown in the below figure:
MBAP packet header includes the following fields:

Field	Length	Description	Client	Server
Transaction meta identifier	2 bytes	MODBUS ID of the request / response transaction	Client startup	The server replicates from the received request.
Protocol identifier	2 bytes	0=MODBUS Protocol	Client startup	The server replicates from the received request.
Length	2 bytes	Number of bytes	Client startup（request）	Server (response) start
Unit identifier	1 bytes	The identification code of a remote slave connected on a serial link or other bus	Client startup	The server replicates from the received request.

The packet header is 7 bytes length:
Transaction identifier: used for transaction pairing. In response, the Modbus server copies the transaction identifier of the request.
Protocol identifier: used for multiplexing in the system. The Modbus protocol is identified by a value of 0.
Length: the length field is the number of bytes of the next field, including unit identifier and data field.
Unit identifier: this field is used for intra system routing. It is specially used for TCP-IP network and MODBUS string over Ethernet.
The gateway between row links communicates with the slave station of Modbus or MODBUS + serial link. Modbus client is set in the request.
This field. In the response, the server must return this field with the same value.

11.5 PDU request data format

Function code	Instructions
8-Bits	N×8-Bits

11.6 Function code

Function codes are used to indicate how the analyzer processes the instruction. The following table shows the available function codes and their descriptions

Function code		Name of function code	Function	Remarks
Decimal system	Hexadecimal			
3	03H	Read hold register	Used to read analyzer's parameters	
16	10H	Write multiple registers	Used to configure analyzer parameters	
100	64H	Read event parameter register	Used to read event parameters such as swells and dips	Extended function code

11.7 Register list

The register list has the following headers:

Register alias	Register address	Operation read / write	Size	Type	Unit	Description

- Register alias: used to refer to the meaning of a register.
- Register address: the address of Modbus data. The data address in this document is in decimal format.
- Operation: indicates the operation that can be performed by the register, R: read only; W: Writable; WC: register is writable through instruction.
- Size: indicates the size of how many 16 bits data are used.
- Type: the type of data encoding.
- Unit: the unit of the register value.
- Description: describes the function of this register.

Data type list:
The following table lists the data types used in this document

Type	Description	Range
UInt16	Unsigned 16-bit integer	0–65535
Int16	Signed 16-bit integer	-32768–+32767
UInt32	Unsigned 32-bit integer	0–4 294 967 295
UInt64	Unsigned 64- bit integer	0–18 446 744 073 709 551 615
UTF8	8-bit UTF encoding	Multibyte Unicode encoding
Float32	32-bit floating point	Standard IEEE floating point data (single precision)
Bitmap	–	–
Date Time	Time type	-
IPaddr	IP address	

Detailed explanation of date time:

Word	Bit															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	Year（2000–2099）															
2	Month (1–12)								Day (1–31)							
3	Hour (0–23)								Minute (0–59)							
4	Millisecond (0–59999)															

IPaddr 详解:

Word	Bit															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	addr1(0–255)								addr2(0–255)							
2	addr3(0–255)								addr4(0–255)							

eg:192.168.1.5

Word	Bit															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	192								168							
2	1								5							

Configure the analyzer through Modbus TCP or Modbus RTU.
You can use function code 16 to write instructions to the analyzer and configure analyzer's parameters.
Analyzer parameter configuration can only be configured by writing the corresponding data to the "configuration instruction register", that is, writing the corresponding data to the address starting from 300 to configure the corresponding parameters.

Configuration results:

The configuration results can be read through registers 424 and 425.

Register address	Content	Size (16 bits)	Data (example)
424	Configure instruction code	1	1001(set time)
425	Result	1	0 = Effective operation 80 =Invalid instruction code 81 = Invalid instruction parameter 82 = Number of invalid instruction parameters 83= Action not implemented

11.8 Modbus-TCP function code operation description

11.8.1 Operation description of function code（0x10=16）

Function code（0x10=16）is used to configure analyzer parameters.
The request and return data format of Modbus TCP is as follows:
The format of request data:

Serial No.	Name	Type	Range (decimal)	Description
1	Transaction unit ID	UInt16		High byte first (sending sequence)
2	Protocol identifier	UInt16	0=MODBUS	High byte first (sending sequence)
3	Data byte length	UInt16		High byte first (sending sequence)
4	Unit identifier	UInt8		

Serial No.	Name	Type	Range (decimal)	Description
5	Function code	UInt8	16	
6	Register start address	UInt16	300	High byte first (sending sequence)
7	Number of registers	UInt16	1-123	High byte first (sending sequence)
8	Number of register bytes	UInt8		Number of registers *2
9	Written value of register 1	UInt16	-	High byte first (sending sequence)
10	…	UInt16	-	High byte first (sending sequence)
11	Written value of register n	UInt16	-	High byte first (sending sequence)

Format of return data:

Serial No.	Name	Type	Range (decimal)	Description
1	Transaction unit ID	UInt16		High byte first (sending sequence)
2	Protocol identifier	UInt16	0=MODBUS	High byte first (sending sequence)
3	Data byte length	UInt16		High byte first (sending sequence)
4	Unit identifier	UInt8		
5	Function code	UInt8	16	
6	Register start address	UInt16	300	High byte first
7	Number of registers	UInt16	1-123	High byte first

Attention!
Function code（0x10=16）can only write data to the "configuration instruction register", that is, it can only write data to the register starting from address 300.
For example：
Configure analyzer's time (command = 1000, set to: 2019-5-9 12:01:00).

Serial No.	Name	Type	Value (decimal)	Value (HEX)	Description
1	Transaction unit ID	UInt16	0	0000	
2	Protocol identifier	UInt16	0	0000	
3	Data byte length	UInt16	21	0015	
4	Unit identifier	UInt8	1	01	
5	Function code	UInt8	16	10	
6	Start register address	UInt16	300	012C	Write register's starting address 300
7	Number of registers	UInt16	7	0007	
8	Number of register bytes	UInt8	14	0D	
9	Written value of register 300	UInt16	1000	03E8	Set command for time 1000
10	Written value of register 301	UInt16	2019	07E3	Year=2019
11	Written value of register 302	UInt16	5	0005	Month=5
12	Written value of register 303	UInt16	9	0009	Date=9
13	Written value of register 304	UInt16	12	000C	Hour=12
14	Written value of register 305	UInt16	1	0001	Minute=1
15	Written value of register 306	UInt16	0	0000	Second=0

The sequence for sending the bytes of TCP / IP packets is as follows:
00 00 00 00 00 15 01 10 01 2C 00 07 0E 03 E8 07 E3 00 05 00 09 00 0C 00 01 00 00
If the configuration data is correct, it will return to the following data:
00 00 00 00 00 06 01 10 01 2C 00 07

Serial No.	Name	Type	Range (HEX)	Range (decimal)
1	Transaction unit ID	UInt16	0000	0
2	Protocol identifier	UInt16	0000	0
3	Data byte length	UInt16	0006	6
4	Unit identifier	UInt8	01	1
5	Function code	UInt8	10	16
6	Start of register address	UInt16	012C	300
7	Number of registers	UInt16	0007	7

11.8.2 Operation description of function code（0x03=3）

Function code（0x03=3）is used to read the analyzer's register parameters. The format of its request data and return data are as follows:
Format of request data:

Serial No.	Name	Type	Range (decimal)	Description
1	Transaction unit ID	UInt16		High byte first (sending sequence)
2	Protocol identifier	UInt16	0=MODBUS	High byte first (sending sequence)
3	Data byte length	UInt16		High byte first (sending sequence)
4	Unit identifier	UInt8		
5	Function code	UInt8	3	
6	Start register address	UInt16	-	High byte first (sending sequence)
7	Number of registers	UInt16	1-125	High byte first (sending sequence)

Form of return data :

Serial No.	Name	Type	Range (decimal)	Description
1	Transaction unit ID	UInt16		High byte first (sending sequence)
2	Protocol identifier	UInt16	0=MODBUS	High byte first (sending sequence)
3	Data byte length	UInt16		High byte first (sending sequence)
4	Unit identifier	UInt8		
5	Function code	UInt8	3	
6	Read number of register bytes	UInt8	-	Number of read registers *2
7	Value of register 1		-	High byte first
8	…		-	High byte first
9	Value of register n		-	High byte first

For example：
Read the voltage values of A, B and C (the starting address of voltage register is 1010)

Serial No.	Name	Type	Range (decimal)	Range (HEX)	Description
1	Transaction unit ID	UInt16	0	0000	
2	Protocol identifier	UInt16	0	0000	
3	Data byte length	UInt16	6	0006	
4	Unit identifier	UInt8	1	01	
5	Function code	UInt8	3	03	
6	Start register address	UInt16	1010	03F2	
7	Number of registers	UInt16	6	0006	

The sequence of sending the bytes of TCP / IP packets is as follows：
00 00 00 00 00 06 01 03 03 F2 00 06
Return data：
00 00 00 00 00 0F 01 03 0C 43 5C 00 00 43 5C 00 00 43 5C 00 00

Serial No.	Name	Type	Hexadecimal	Decimal system
1	Transaction unit ID	UInt16	0000	0
2	Protocol identifier	UInt16	0000	0
3	Data byte length	UInt16	0006	6
4	Unit identifier	UInt8	01	1
5	Function code	UInt8	03	3
6	Read number of register bytes	UInt8	0C	12
7	Phase A voltage	float32	435C0000	220V
8	Phase B voltage	float32	435C0000	220V
9	Phase C voltage	float32	435C0000	220V

11.8.3 Operation description of function code（0x64=100）

The function code (0x64 = 100) is used to read the parameters of events such as swells and dips. The formats of its request data and return data are as follows:
Format of request data:

Serial No.	Name	Type	Range (decimal)	Description
1	Transaction unit ID	UInt16		High byte first (sending sequence)
2	Protocol identifier	UInt16	0=MODBUS	High byte first (sending sequence)
3	Data byte length	UInt16		High byte first (sending sequence)
4	Unit identifier	UInt8		
5	Function code	UInt8	100	
6	event number	UInt8	1-10	
7	Read parameter type	UInt8	1-2	1=Event RMS1/2 value 2=Event waveform
8	Read voltage channel type	UInt8	1-3	1=Phase A 2=Phase B 3=Phase C
9	Read the number of parameter data packet	UInt16	1-65535	High byte first (sending sequence)

Format of return data:

Serial No.	Name	Type	Range (decimal)	Description
1	Transaction unit ID	UInt16		High byte first
2	Protocol identifier	UInt16	0=MODBUS	High byte first
3	Data byte length	UInt16		High byte first
4	Unit identifier	UInt8		
5	Function code	UInt8	100	
6	Event number	UInt8	1-10	
7	Read parameter type	UInt8	1-2	1=Event RMS1/2 value 2=Event waveform
8	Read voltage channel type	UInt8	1-3	1=Phase A 2=Phase B 3=Phase C
9	Total number of data packets	UInt16	1-65535	High byte first
10	Current No. of data packet	UInt16	1-65535	High byte first Each data packet contains a max of 128 data
11	Number of data	UInt16	1-128	High byte first
12	The 1st data	float32		Low byte first
…	…	float32		Low byte first
13	The Nth data	float32		Low byte first n<=128

For example:
Read the value of phase A RMS1 / 2 of event 1:

Serial No.	Name	Type	Value (decimal)	Value (HEX)	Description
1	Transaction unit ID	UInt16	0	0000	
2	Protocol identifier	UInt16	0	0000	
3	Data byte length	UInt16	7	0007	
4	Unit identifier	UInt8	1	01	
5	Function code	UInt8	100	64	
6	Event number	UInt8	1	01	Event 1
7	Read parameter type	UInt8	1	01	RMS1/2 value
8	Read voltage channel type	UInt8	1	01	Phase A
9	Read the number of parameter data packet	UInt16	1	0001	Read data packet 1

The sequence for sending bytes of TCP / IP packets is as follows:
00 00 00 00 00 07 01 64 01 01 01 0001

Return data：
00 00 00 00 020B 01 64 01 01 01 00C8 0001 0080 95A06243 …00005C43

Serial No.	Name	Type	Value (HEX)	Value (decimal)	Description
1	Transaction unit ID	UInt16	0000	0	
2	Protocol identifier	UInt16	0000	0	
3	Data byte length	UInt16	020B	523	
4	Unit identifier	UInt8	01	1	
5	Function code	UInt8	64	100	
6	Event number	UInt8	01	1	Event 1
7	Read parameter type	UInt8	01	1	RMS1/2 value
8	Read voltage channel type	UInt8	01	1	Phase A
9	Total number of data packets	UInt16	00C8	200	
10	Current No. of data packet	UInt16	0001	1	
11	Number of data	UInt16	0080	128	
12	The 1st data	float32	4362A095	226.62	
…	…	float32	…	…	
13	The 128th data	float32	435C0000	220.00	

11.8.4 Error response

Data format of error response:

Serial No.	Name	Type	Decimal system	Hexadecimal	Description
1	Transaction unit ID	UInt16	0	0	
2	Protocol identifier	UInt16	0	0	
3	Data byte length	UInt16	3	0003	
4	Unit identifier	UInt8	1	01	
5	Function code	UInt8	(128+3) (128+16)	(0x80+0x03) (0x80+0x10)	
6	Error code	UInt8			

Modbus error codes：

Code(HEX)	Name	Meaning
0x01	Illegal function code	The function code used is not the one the analyzer supported.
0x02	Illegal data address	The register data written or read is not within the address range supported by the analyzer
0x03	Illegal data value	The data value written to the register does not meet the requirements.
0x04	Error of analyzer	An unknown error occurred

11.9 Modbus-RTU function code operation instructions

11.9.1 Operation description of function code（0x10=16）

Function code (0x10 = 16) is used to configure analyzer's parameters. The format of its request and return data is as follows:
Format of request data：

Serial No.	Name	Type	Range (decimal)	Description
1	Analyzer address	UInt8	1-247	
2	Function code	UInt8	16	
3	Register start address	UInt16	-	High byte first (sending sequence)
4	Number of registers	UInt16	1-123	High byte first (sending sequence)
5	Number of register bytes	UInt8		Number of registers *2
6	Written value of register 1	UInt16	-	High byte first (sending sequence)

Serial No.	Name	Type	Range (decimal)	Description
7	…	UInt16	-	High byte first (sending sequence)
8	Written value of register n	UInt16	-	High byte first (sending sequence)
9	CRC-16 checking code	UInt16	-	Low byte first (sending sequence)

Format of return data:

Serial No.	Name	Type	Range (decimal)	Description
1	Analyzer address	UInt8	1-247	
2	Function code	UInt8	16	
3	Register start address	UInt16	300	High byte first
4	Number of registers	UInt16	1-123	High byte first
5	CRC-16 checking code	UInt16	-	Low byte first

Attention!
The function code (0x10 = 16) can only write data to the "configuration instruction register", that is, it can only write data to the register starting from address 300.
For example：
Configure analyzer's time (command = 1000, set to: 2019-5-9 12:01:00).

Serial No.	Meaning	Type	Value (decimal)	Value (HEX)	Description
1	Analyzer address	UInt8	1	01	
2	Function code	UInt8	16	10	
3	Register start address	UInt16	300	012C	Start address of configuration register
4	Number of configuration registers	UInt16	7	0007	Configure Time, command + parameters total 7 registers are occupied
5	Data length	UInt8	14	0E	configure number of registers *2
6	Written value of register 300	UInt16	1000	03E8	Configure command code of time 1001
7	Written value of register 301	UInt16	2019	07E3	Year=2019
8	Written value of register 302	UInt16	5	0005	Month=5
9	Written value of register 303	UInt16	9	0009	Date=9
10	Written value of register 304	UInt16	12	000C	Hour=12
11	Written value of register 305	UInt16	1	0001	Minute=1
12	Written value of register 305	UInt16	0	0000	Second=0
13	CRC-16 checking code	UInt16	64984	FDD8	Low byte first (sending sequence)

The sequence for sending bites is as follows:
01 10 01 2C 00 07 0E 03 E8 07 E3 00 05 00 09 00 0C 00 01 00 00 D8 FD
It will return to the following data if configurating data is correct:
01 10 01 2C 00 07 41 FE

Serial No.	Name	Type	Range (HEX)	Range (decimal)
1	Analyzer address	UInt8	01	1
2	Function code	UInt8	10	16
3	Register start address	UInt16	012C	300
4	Number of registers	UInt16	0007	7
5	CRC-16 checking code	UInt16	41FE	

11.9.2 Operation description of function code（0x03=3）

The function code (0x03 = 3) is used to read the analyzer's register parameters. The format of these request data and return data is as follows:
Format of request data:

Serial No.	Name	Type	Range (decimal)	Description
1	Analyzer address	UInt8	1-247	
2	Function code	UInt8	3	

Serial No.	Name	Type	Range (decimal)	Description
3	Start register address	UInt16	-	High byte first (sending sequence)
4	Number of registers	UInt16	1-125	High byte first (sending sequence)
5	CRC-16 checking	UInt16	-	Low byte first (sending sequence)

Format of return data:

Serial No.	Name	Type	Range (decimal)	Description
1	Analyzer address	UInt8	1-247	
2	Function code	UInt8	3	
3	Read register bytes	UInt8	-	Read the No. of registers *2
4	Value of register 1		-	High byte first
5	…		-	High byte first
6	Value of register N		-	High byte first
7	CRC-16 checking	UInt16	-	Low byte first

For example:
Read the voltage values of A, B and C (the starting address of voltage register is 1010)：

Serial No.	Name	Type	Range (decimal)	Range (HEX)	Description
1	Analyzer address	UInt8	1	0x01	
2	Function code	UInt8	3	0x03	
3	Start register address	UInt16	1010	0x03F2	
4	Number of registers	UInt16	6	0x0006	
5	CRC-16 checking	UInt16	32612	0x7F64	Low byte first (sending sequence)

The sequence for sending bytes is as follows:：
01 03 03 F2 00 06 64 7F
Return data：
01 03 0C 43 5C 00 00 43 5D 00 00 43 5E 00 00 14 AC

Serial No.	Name	Type	Hexadecimal	Decimal system
1	Analyzer address	UInt8	01	1
2	Function code	UInt8	03	3
3	Read the numbers of register bytes	UInt8	0C	12
4	Phase A voltage	float32	435C0000	220V
5	Phase B voltage	float32	435D0000	221V
6	Phase C voltage	float32	435E0000	222V
7	CRC-16 checking	UInt16	14AC	

11.9.3 Operation description of function code（0x64=100）

The function code (0x64 = 100) is used to read the parameters of events such as swells and dips. The format of these request data and return data is as follows:
Format of request data:

Serial No.	Name	Type	Range(decimal)	Description
1	Analyzer address	UInt8	1-247	
2	Function code	UInt8	100	
3	Event number	UInt8	1-10	
4	Read parameter type	UInt8	1-2	1=Event RMS1/2 value 2=Event waveform
5	Read voltage channel type	UInt8	1-3	1=Phase A 2=Phase B 3=Phase C Note: when the wiring mode is single-phase, only phase A can be read.

6	Read the no. of parameter data packet	UInt16	1-65535	High byte first (sending sequence)
7	CRC-16 checking	UInt16	-	Low byte first

Format of return data:

Serial No.	Name	Type	Range (decimal)	Description
1	Analyzer address	UInt8	1-247	
2	Function code	UInt8	100	
3	Event number	UInt8	1-10	
4	Read parameter type	UInt8	1-2	1=Event RMS1/2 value 2=Event waveform
5	Read voltage channel type	UInt8	1-3	1=Phase A 2=Phase B 3=Phase C Note: when the wiring mode is single-phase, only phase A can be read.
6	Total number of data packets	UInt16	1-65535	High byte first
7	Current No. of data packet	UInt16	1-65535	High byte first The data packet contains 128 data at most
8	Number of data	UInt16	1-128	High byte first
9	The 1st data	float32		Low byte first
…	…	float32		Low byte first
10	The Nth data	float32		Low byte first n<=128
11	CRC-16 checking	UInt16	-	Low byte first

For example:
Read the value of phase A RMS1 / 2 of event 1.

Serial No.	Name	Type	Value (decimal)	Value (HEX)	Description
1	Analyzer address	UInt8	1	0x01	
2	Function code	UInt8	100	64	
3	Event number	UInt8	1	01	Event 1
4	Read parameter type	UInt8	1	01	RMS1/2 value
5	Read voltage channel type	UInt8	1	01	Phase A
6	Read the No. of parameter data packet	UInt16	1	0001	Read No. 1 data packet
7	CRC-16 checking	UInt16	55471	D8AF	Low byte first (sending sequence)

The sequence for sending bytes is as follows：
01 64 01 01 01 00 01 AF D8
Return data：
01 64 01 01 01 00C8 0001 0080 95A06243 …00005C43 0BEA

Serial No.	Name	Type	Value (HEX)	Value (decimal)	Description
1	Analyzer address	UInt8	01	1	
2	Function code	UInt8	64	100	
3	Event number	UInt8	01	1	Event 1
4	Read parameter type	UInt8	01	1	RMS1/2 value
5	Read voltage channel type	UInt8	01	1	Phase A
6	Total number of data packets	UInt16	00C8	200	
7	Current No. of data packet	UInt16	0001	1	
8	Number of data	UInt16	0080	128	
9	The 1st data	float32	4362A095	226.62	Low byte first
…	…	float32	…	…	
10	The 128th data	float32	435C0000	220.00	Low byte first

Serial No.	Name	Type	Value (HEX)	Value (decimal)	Description
11	CRC-16 checking	UInt16	0BEA		

11.9.4 Error response

Format of error response data:

Serial No.	Name	Type	Decimal system	Hexadecimal	Description
1	Analyzer address	UInt8	1-247	0x01-0xF7	
2	Function code	UInt8	(128+3) (128+16)	(0x80+0x03) (0x80+0x10)	
3	Error code	UInt8			
4	CRC-16 checking	UInt16			Low byte first

Modbus error code:

Code	Name	Meaning
0x01	Illegal function code	The function code used is not the one of 3 or 16 the analyzer supported
0x02	Illegal data address	The register data written or read is not within the address range supported by the analyzer.
0x03	Illegal data value	The data value written to the register does not meet the requirements.
0x04	Error of analyzer	An unknown error occurred

11.10 Configuration instruction list

Set analyzer time:

Instruction code	Operation	Size	Type	Unit	Range (decimal)	Description
1000	W	1	UInt16	-	2000-2099	Year
	W	1	UInt16	-	1-12	Month
	W	1	UInt16	-	1-31	Date
	W	1	UInt16	-	0-23	Hour
	W	1	UInt16	-	0-59	Minute
	W	1	UInt16	-	0-59	Second

Set system parameters:

Instruction code	Operation	Size	Type	Unit	Range (decimal)	Description
1001	W	1	UInt16	-	0,1,2,3,4	Wiring mode 0=3P4W 4CT 1=3P4W 3CT 2=3P3W 3CT 3=3P3W 2CT 4=Single phase
	W	1	UInt16	Hz	50,60	Grid frequency
	W	2	UInt32	V	-	Nominal voltage

Setting parameters of IABC current transformer:

Instruction code	Operation	Size	Type	Unit	Range (decimal)	Description
1002	W	1	UInt16	-	0,1	IABC Current access mode 0 = connect Rogowski coil 1 = connect CT
	W	1	UInt16	-	0,1,2	Current gear for Rogowski coil 0=600A（50mV@50Hz） 1=3000A（85mV@50Hz） 2=6000A（50mV@50Hz）

Instruction code	Operation	Size	Type	Unit	Range (decimal)	Description
	W	2	UInt32	A	1-999999	CT Primary side input current value
	W	2	UInt32	mV	1-707	CT Secondary side output voltage value
	W	2	UInt32	-	1-99999999	IABC current ratio = actual ratio *10000

Set parameters of IN current transformer：

Instruction code	Operation	Size	Type	Unit	Range (decimal)	Description
1003	W	1	UInt16	-	0,1	IN current access mode 0 = connect Rogowski coil 1 = connect CT
	W	1	UInt16	-	0,1,2	Current gear for Rogowski coil 0=600A（50mV@50Hz） 1=3000A（85mV@50Hz） 2=6000A（50mV@50Hz）
	W	2	UInt32	A	1-999999	CT Primary side input current value
	W	2	UInt32	mV	1-707	CT Secondary side output voltage value
	W	2	UInt32	-	1-99999999	IN current ratio = actual ratio *10000

Set RS485 communication parameters：

Instruction code	Operation	Size	Type	Unit	Range (decimal)	Description
1004	W	1	UInt16	-	1-247	Slave address
	W	1	UInt16	-	0,1,2,3,4,5,6	Baud rate 0=1200 bps 1=2400 bps 2=4800 bps 3=9600 bps 4=19200 bps 5=38400 bps 6=57600 bps
	W	R/WC	UInt16	-	0,1,2	Parity 0 = None 1 = Odd 2 = Even

Set parameters of voltage transformer：

Instruction code	Operation	Size	Type	Unit	Range (decimal)	Description
1005	W	2	UInt32	-	1-99999999	Voltage transformer ratio = actual ratio *10000

Set demand：

Instruction code	Operation	Size	Type	Unit	Range (decimal)	Description
1006	W	1	UInt16	-	0,1	Demand calculation method 0= Fixed type 1= Sliding type
	W	1	UInt16	Minute	1-60	Demand interval

Set record：

Instruction code	Operation	Size	Type	Unit	Range (decimal)	Description
1007	W	1	UInt16	-	0,1	Record switch 0= Forbidden 1= Enable
	W	1	UInt16	Second	1-65535	Data storage interval

Clear energy：

Instruction code	Operation	Size	Type	Unit	Range (decimal)	Description
2000	W	1	UInt16	-	100-103	100：Clear phase A energy 101：Clear phase B energy 102：Clear phase C energy 103：Clear all phase energy

Clear max demand：

Instruction code	Operation	Size	Type	Unit	Range (decimal)	Description
2002	W	1	UInt16	-	1	1：Clear max demand

Clear Max/Min.：

Instruction code	Operation	Size	Type	Unit	Range (decimal)	Description
2003	W	1	UInt16	-	1	1：clear max and min values of voltage, current and power

Clear event count：

Instruction code	Operation	Size	Type	Unit	Range (decimal)	Description
2010	W	1	UInt16	-	1	1：**Clear event count**

Set the parameters of swells and dips：

Instruction code	Operation	Size	Type	Unit	Range (decimal)	Description
2011	W	1	UInt16	%	105-140	Swell trigger threshold, relative to nominal voltage Default：110%
	W	1	UInt16	%	75-95	dip trigger threshold, relative to nominal voltage Default：90%
	W	1	UInt16	%	1-6	Threshold Hysteresis Default：2%

Set relay output：

Instruction code	Operation	Size	Type	Unit	Range (decimal)	Description
2012	W	1	UInt16	-	0,1	0= open circuit 1= closed

Set parameters of waveform receiving server：

Instruction code	Operation	Size	Type	Unit	Range (decimal)	Description
2020	W	2	IPaddr	-	-	Waveform reception UDP Server IP Default：192.168.1.8
	W	1	UInt16	-	-	Phase A voltage waveform UDP port No. Default：1000
	W	1	UInt16	-	-	Phase B voltage waveform UDP port No. Default：1001
	W	1	UInt16	-	-	Phase C voltage waveform UDP port No. Default：1002
	W	1	UInt16	-	-	Phase A current waveform UDP port No. Default：1003
	W	1	UInt16	-	-	Phase B current waveform UDP port No. Default：1004
	W	1	UInt16	-	-	Phase C current waveform UDP port No. Default：1005

Configure waveform data transmission：

Instruction code	Operation	Size	Type	Unit	Range (decimal)	Description
2021	W	1	UInt16	-	-	Phase A voltage waveform transmission switch 0=Closed 1=Open
	W	1	UInt16	-	-	Phase B voltage waveform transmission switch 0=Closed 1=Open
	W	1	UInt16	-	-	Phase C voltage waveform transmission switch 0=Closed 1=Open
	W	1	UInt16	-	-	Phase A current waveform transmission switch 0=Closed 1=Open
	W	1	UInt16	-	-	Phase B current waveform transmission switch 0=Closed 1=Open
	W	1	UInt16	-	-	Phase C current waveform transmission switch 0=Closed 1=Open

Restart the analyzer：

Instruction code	Operation	Size	Type	Unit	Range (decimal)	Description
6000	W	1	UInt16	-	6485	Restart analyzer instruction

11.10.1 Modbus register list

Analyzer：

Register alias	Register Start address (decimal)	Operation Read/write	Size	Type	Unit	Description
Analyzer model No.	50	R	20	UTF8	-	
Serial No.	70	R	2	UInt32	-	
Firmware Version	72	R	1	UInt16	-	Format: X.Y.ZTT
Date and time	73	R/WC	4	Date time	-	Reg.73: Year 2000-2099 Reg.74: Month (b15: b8), Date (b7: b0) Reg. 75: Hour (b15: b8), Minute (b7: b0) Reg. 76: millisecond

Power system：

Register alias	Register Start address (decimal)	Operation Read/write	Size	Type	Unit	Description
Wiring mode	80	R/WC	1	UInt16	-	0=3P4W 4CT 1=3P4W 3CT 2=3P3W 3CT 3=3P3W 2CT 4=Single phase
Grid frequency	81	R/WC	1	UInt16	Hz	
Nominal voltage	82	R/WC	2	UInt32	V	
IABC current access mode	84	R/WC	1	UInt16	-	0 = Rogowski coil 1 = CT
IABC Rogowski coil current gear	85	R/WC	1	UInt16	-	0=600A（50mV@50Hz） 1=3000A（85mV@50Hz） 2=6000A（50mV@50Hz）
IABC CT Rogowski coil current gear	86	R/WC	2	UInt32	A	
IABC CT secondary side output voltage value	88	R/WC	2	UInt32	mV	

Register alias	Register Start address (decimal)	Operation Read/write	Size	Type	Unit	Description
IABC current ratio	90	R/WC	2	UInt32	-	Actual current ratio =Read value/10000
IN current access mode	92	R/WC	1	UInt16	-	0=Rogowski coil 1=CT
IN Rogowski coil current gear	93	R/WC	1	UInt16	-	0=600A（50mV@50Hz） 1=3000A（85mV@50Hz） 2=6000A（50mV@50Hz）
IN CT primary side input current value	94	R/WC	2	UInt32	A	
IN CT secondary side output voltage value	96	R/WC	2	UInt32	mV	
IN current ratio	98	R/WC	2	UInt32	-	Actual current ratio = Read value /10000
UABColtage ratio	100	R/WC	2	UInt32	-	Actual voltage ratio = Read value /10000

RS485 communication parameters：

Register name	Register Start address (decimal)	Operation	Size	Type	Unit	Description
Slave address	102	R/WC	1	UInt16	-	1-247
Baud rate	103	R/WC	1	UInt16	-	Baud rate 0=1200 bps 1=2400 bps 2=4800 bps 3=9600 bps 4=19200 bps 5=38400 bps 6=57600 bps
Parity mode	104	R/WC	1	UInt16	-	0 = None 1 = Odd 2 = Even

SD card storage：

Register alias	Register Start address (decimal)	Operation Read/write	Size	Type	Unit	Description
SD card storage switch	110	R/WC	1	UInt16	-	0=Closed 1=Open
SD card storage interval	111	R/WC	1	UInt16	Second	Range：1-65535

Waveform data transmission enable：

Register alias	Register Start address (decimal)	Operation Read/write	Size	Type	Unit	Description
Phase A voltage waveform transmission switch	120	R/WC	1	UInt16	-	0=Closed 1=Open
Phase B voltage waveform transmission switch	121	R/WC	1	UInt16	-	0=Closed 1=Open
Phase C voltage waveform transmission switch	122	R/WC	1	UInt16	-	0=Closed 1=Open
Phase A current waveform transmission switch	123	R/WC	1	UInt16	-	0=Closed 1=Open
Phase B current waveform transmission switch	124	R/WC	1	UInt16	-	0=Closed 1=Open
Phase C current waveform transmission switch	125	R/WC	1	UInt16	-	0=Closed 1=Open

Set parameters of waveform receiving serve：

Register alias	Register Start address (decimal)	Operation Read/write	Size	Type	Unit	Description
Waveform receiving UDP Server IP	130	R/WC	2	IPaddr	-	
Phase A voltage waveform UDP port No.	132	R/WC	1	UInt16	-	
Phase B voltage waveform UDP port No.	133	R/WC	1	UInt16	-	
Phase C voltage waveform UDP port No.	134	R/WC	1	UInt16	-	
Phase A current waveform UDP port No.	135	R/WC	1	UInt16	-	
Phase B current waveform UDP port No.	136	R/WC	1	UInt16	-	
Phase C current waveform UDP port No.	137	R/WC	1	UInt16	-	

Status of digital input channel：

Register alias	Register Start address (decimal)	Operation Read/write	Size	Type	Unit	Description
Digital input 1	160	R	1	UInt16	-	0=Open circuit 1=Closed
Digital input 2	161	R	1	UInt16	-	0=Open circuit 1=Closed

Status of relay output：

Register alias	Register Start address (decimal)	Operation Read/write	Size	Type	Unit	Description
Relay output	165	R/WC	1	UInt16	-	0=Open circuit 1=Closed

Configure instruction register：

Register alias	Register Start address (decimal)	Operation Read/write	Size	Type	Unit	Description
Instruction code	300	R/W	1	UInt16	-	
Instruction parameter 001	301	R/W	1	UInt16	-	
Instruction parameter 002	302	R/W	1	UInt16	-	
…	…	R/W	1	UInt16	-	
Instruction parameter 123	423	R/W	1	UInt16	-	
Configuration instruction code	424	R	1	UInt16	-	
Configuration results	425	R	1	UInt16	-	0 = Effective operation 80 = Invalid instruction code 81 = Invalid instruction parameter 82 = Number of invalid instruction parameters 83= The operation was not performed

Basic data：

Voltage, current, power, power factor：

Register alias	Register Start address (decimal)	Operation Read/write	Size	Type	Unit	Description
Current						
IA	1000	R	2	Float32	A	Phase A Current
IB	1002	R	2	Float32	A	Phase B Current
IC	1004	R	2	Float32	A	Phase C Current
IN	1006	R	2	Float32	A	Phase N Current

Register alias	Register Start address (decimal)	Operation Read/write	Size	Type	Unit	Description
Current Avg	1008	R	2	Float32	A	Current average value of ABC three phase
Voltag						
UA	1010	R	2	Float32	V	UA-UN voltage
UB	1012	R	2	Float32	V	UB-UN voltage
UC	1014	R	2	Float32	V	UC-UN voltage
Phase Voltage Avg	1018	R	2	Float32	V	Phase voltage average value of ABC three phase
UAB	1020	R	2	Float32	V	UA-UB voltage
UBC	1022	R	2	Float32	V	UB-UC voltage
UCA	1024	R	2	Float32	V	UC-UA voltage
Line Voltage Avg	1026	R	2	Float32	V	Average value of three-phase line voltage
Power						
PA	1028	R	2	Float32	kW	Phase A active power
PB	1030	R	2	Float32	kW	Phase B active power
PC	1032	R	2	Float32	kW	Phase C active power
PTotal	1034	R	2	Float32	kW	Total active power
QA	1036	R	2	Float32	kVAR	Phase A reactive power
QB	1038	R	2	Float32	kVAR	Phase B reactive power
QC	1040	R	2	Float32	kVAR	Phase C reactive power
QTotal	1042	R	2	Float32	kVAR	Total reactive power
SA	1044	R	2	Float32	kVA	Apparent power of phase A
SB	1046	R	2	Float32	kVA	Apparent power of phase B
SC	1048	R	2	Float32	kVA	Apparent power of phase C
STotal	1050	R	2	Float32	kVA	Total apparent power
Power factor						
PFA	1052	R	2	Float32	-	Phase A power factor
PFB	1054	R	2	Float32	-	Phase B power factor
PFC	1056	R	2	Float32	-	Phase C power factor
PFTotal	1058	R	2	Float32	-	Total power factor
DPFA	1060	R	2	Float32	-	Fundamental power factor of Phase A
DPFB	1062	R	2	Float32	-	Fundamental power factor of Phase B
DPFC	1064	R	2	Float32	-	Fundamental power factor of Phase C
DPFTotal	1066	R	2	Float32	-	Total fundamental power factor
Frequency						
FreqA	1068	R	2	Float32	Hz	Phase A frequency
FreqB	1070	R	2	Float32	Hz	Phase B frequency
FreqC	1072	R	2	Float32	Hz	Phase C frequency
FreqTotal	1074	R	2	Float32	Hz	Three phase comprehensive frequency

Energy：

When the total energy reaches 1.0 x 10^9 kWh, 1.0 x 10^9 kVarh, or 1.0 x 10^9 kVah, the energy of each phase will be cleared automatically. There are two types of energy registers, one is UInt32 and the other is UInt64. The units of the two data are different, and the corresponding registers can be read as needed.

Register alias	Register Start address (decimal)	Operation Read/write	Size	Type	Unit	Description
UInt32 Energy						
Active energy						
EPAImp	2000	R	2	UInt32	kWh	Phase A active import energy
EPBImp	2002	R	2	UInt32	kWh	Phase B active import energy
EPCImp	2004	R	2	UInt32	kWh	Phase C active import energy

EPImp	2006	R	2	UInt32	kWh	Total active import energy
EPAExp	2008	R	2	UInt32	kWh	Phase A active export energy
EPBExp	2010	R	2	UInt32	kWh	Phase B active export energy
EPCExp	2012	R	2	UInt32	kWh	Phase C active export energy
EPExp	2014	R	2	UInt32	kWh	Total active export energy
Reactive energy						
EQAImp	2016	R	2	UInt32	kVARh	Phase A reactive import energy
EQBImp	2018	R	2	UInt32	kVARh	Phase B reactive import energy
EQCImp	2020	R	2	UInt32	kVARh	Phase C reactive import energy
EQImp	2022	R	2	UInt32	kVARh	Total reactive import energy
EQAExp	2024	R	2	UInt32	kVARh	Phase A reactive export energy
EQBExp	2026	R	2	UInt32	kVARh	Phase B reactive export energy
EQCExp	2028	R	2	UInt32	kVARh	Phase C reactive export energy
EQExp	2030	R	2	UInt32	kVARh	Total reactive export energy
Apparent energy						
ESA	2032	R	2	UInt32	kVAh	Apparent energy of phase A
ESB	2034	R	2	UInt32	kVAh	Apparent energy of phase B
ESC	2036	R	2	UInt32	kVAh	Apparent energy of phase C
ES	2038	R	2	UInt32	kVAh	Total Apparent energy

Register alias	**Register Start address (decimal)**	**Operation Read/write**	**Size**	**Type**	**Unit**	**Description**
UInt64 Energy						
Active energy						
EPAImp	2500	R	4	UInt64	Wh	Phase A active import energy
EPBImp	2504	R	4	UInt64	Wh	Phase B active import energy
EPCImp	2508	R	4	UInt64	Wh	Phase C active import energy
EPImp	2512	R	4	UInt64	Wh	Total active import energy
EPAExp	2516	R	4	UInt64	Wh	Phase A active export energy
EPBExp	2520	R	4	UInt32	Wh	Phase B active export energy
EPCExp	2524	R	4	UInt64	Wh	Phase C active export energy
EPExp	2528	R	4	UInt64	Wh	Total active export energy
Reactive energy						
EQAImp	2532	R	4	UInt64	VARh	Phase A reactive import energy
EQBImp	2536	R	4	UInt64	VARh	Phase B reactive import energy
EQCImp	2540	R	4	UInt64	VARh	Phase C reactive import energy
EQImp	2544	R	4	UInt64	VARh	Total reactive import energy
EQAExp	2548	R	4	UInt64	VARh	Phase A reactive export energy
EQBExp	2552	R	4	UInt64	VARh	Phase B reactive export energy
EQCExp	2556	R	4	UInt64	VARh	Phase C reactive export energy
EQExp	2560	R	4	UInt64	VARh	Total reactive export energy
Apparent energy						
ESA	2564	R	4	UInt64	VAh	Apparent energy of phase A
ESB	2568	R	4	UInt64	VAh	Apparent energy of phase B
ESC	2572	R	4	UInt64	VAh	Apparent energy of phase C
ES	2576	R	4	UInt64	VAh	Total Apparent energy

Demand：

Register alias	**Register Start address (decimal)**	**Operation Read/write**	**Size**	**Type**	**Unit**	**Description**
Basic parameters of demand						
DMDMethod	3000	R/WC	1	UInt16	-	Demand calculation method： 0=Sliding 1=Fiexd

Register alias	Register Start address (decimal)	Operation Read/write	Size	Type	Unit	Description
DMDInterval	3001	R/RC	1	UInt16	Minute	Demand interval
PDMD Reset Time	3002	R	4	Date time	-	Reset date and time peak demand
Power demand						
PADemand	3020	R	2	Float32	kW	Current active power demand of phase A
PAPeakDemand	3022	R	2	Float32	kW	Active power peak demand occurrence time of phase A
PAPeakDemandDate	3024	R	4	Date time	-	Active power peak demand occurrence time of phase A
PBDemand	3028	R	2	Float32	kW	Current active power demand of phase B
PBPeakDemand	3030	R	2	Float32	kW	Active power peak demand of phase B
PBPeakDemandDate	3032	R	4	Date time	-	Active power peak demand occurrence time of phase B
PCDemand	3036	R	2	Float32	kW	Current active power demand of phase C
PCPeakDemand	3038	R	2	Float32	kW	Active power peak demand of phase C
PCPeakDemandDate	3040	R	4	Date time	-	Active power peak demand occurrence time of phase C
PSUMDemand	3044	R	2	Float32	kW	Current total active power demand
PSUMPeakDemand	3046	R	2	Float32	kW	Total active power peak demand
PSUMPeakDemandDate	3048	R	4	Date time	-	Total active power peak demand occurrence time
QADemand	3052	R	2	Float32	kVar	Current reactive power demand of phase A
QAPeakDemand	3054	R	2	Float32	kVar	Reactive power peak demand of phase A
QAPeakDemandDate	3056	R	4	Date time	-	Phase A reactive power peak demand occurrence time A
QBDemand	3060	R	2	Float32	kVar	Current reactive power demand of phase B
QBPeakDemand	3062	R	2	Float32	kVar	Reactive power peak demand of phase B
QBPeakDemandDate	3064	R	4	Date time	-	Phase B reactive power peak demand occurrence time B
QCDemand	3068	R	2	Float32	kVar	Current reactive power demand of phase C
QCPeakDemand	3070	R	2	Float32	kVar	Reactive power peak demand of phaser C
QCPeakDemandDate	3072	R	4	Date time	-	Phase C reactive power peak demand occurrence time C
QSUMDemand	3076	R	2	Float32	kVar	Current total reactive power demand
QSUMPeakDemand	3078	R	2	Float32	kVar	Total reactive power peak demand
QSUMPeakDemandDate	3080	R	4	Date time	-	Total reactive power peak demand occurrence time
SADemand	3084	R	2	Float32	kVa	Current apparent power demand of phase A
SAPeakDemand	3086	R	2	Float32	kVa	Apparent power peak demand of phase A
SAPeakDemandDate	3088	R	4	Date time	-	Phase A apparent power peak demand occurrence time A
SBDemand	3092	R	2	Float32	kVa	Current apparent power demand of phase B
SBPeakDemand	3094	R	2	Float32	kVa	Apparent power peak demand of phase B
SBPeakDemandDate	3096	R	4	Date	-	Phase B apparent power peak

Register alias	Register Start address (decimal)	Operation Read/write	Size	Type	Unit	Description
				time		demand occurrence time B
SCDemand	3100	R	2	Float32	kVa	Current apparent power demand of phase C
SCPeakDemand	3102	R	2	Float32	kVa	Apparent power peak demand of phase C
SCPeakDemandDate	3104	R	4	Date time	-	Phase C apparent power peak demand occurrence time C
SSUMDemand	3108	R	2	Float32	kVa	Current total apparent power demand
SSUMPeakDemand	3110	R	2	Float32	kVa	Total apparent power peak demand
SSUMPeakDemandDate	3112	R	4	Date time	-	Total apparent power peak demand occurrence time
Current demand						
IADemand	3116	R	2	Float32	A	Phase A current demand A
IAPeakDemand	3118	R	2	Float32	A	Phase A current peak demand
IAPeakDemandDate	3120	R	4	Date time	-	Phase A current peak demand occurrence time A
IBDemand	3124	R	2	Float32	A	Phase B current demand B
IBPeakDemand	3126	R	2	Float32	A	Phase B current peak demand B
IBPeakDemandDate	3128	R	4	Date time	-	Phase B current peak demand occurrence time B
ICDemand	3132	R	2	Float32	A	Phase C current demand C
ICPeakDemand	3134	R	2	Float32	A	Phase C current peak demand C
ICPeakDemandDate	3136	R	4	Date time	-	Phase C current peak demand occurrence time C
IAvgDemand	3140	R	2	Float32	A	Average current demand of three phase
IAvgPeakDemand	3142	R	2	Float32	A	Average current peak demand of three phase
IAvgPeakDemand Date	3144	R	4	Date time	-	Average current peak demand occurrence time of three phase

Harmonic：

Register name	Register Start address (decimal)	Operation	Size	Type	Unit	Description
Current harmonic percentage：						
IATHD	4000	R	2	Float32	%	Phase A current total harmonic percentage
IBTHD	4002	R	2	Float32	%	Phase B current total harmonic percentage
ICTHD	4004	R	2	Float32	%	Phase C current total harmonic percentage
IAHD2	4006	R	2	Float32	%	Phase A current 2nd harmonic percentage
IBHD2	4008	R	2	Float32	%	Phase B current 2nd harmonic percentage
ICHD2	4010	R	2	Float32	%	Phase C current 2nd harmonic percentage
…	4012-4298	…	…	…	…	Phase ABC current 3-50th harmonic percentage
IAHD51	4300	R	2	Float32	%	Phase A current 51th harmonic percentage
IBHD51	4302	R	2	Float32	%	Phase B current 51th harmonic percentage
ICHD51	4304	R	2	Float32	%	Phase C current 51th harmonic percentage
Current harmonic value：						
IAHDV1	4400	R	2	Float32	A	Phase A current 1st harmonic current value
IBHDV1	4402	R	2	Float32	A	Phase B current 1st harmonic current value
ICHDV1	4404	R	2	Float32	A	Phase C current 1st harmonic current value
…	4406-4698	…	…	…	…	Phase ABC current 2-50th harmonic current value
IAHDV51	4700	R	2	Float32	A	Phase A current 51th harmonic current value
IBHDV51	4702	R	2	Float32	A	Phase B current 51th harmonic current value
ICHDV51	4704	R	2	Float32	A	Phase C current 51th harmonic current value
Voltage harmonic percentage：						
UATHD	5000	R	2	Float32	%	Phase A voltage total harmonic percentage
UBTHD	5002	R	2	Float32	%	Phase B voltage total harmonic percentage

Register name	Register Start address (decimal)	Operation	Size	Type	Unit	Description
UCTHD	5004	R	2	Float32	%	Phase C voltage total harmonic percentage
UAHD2	5006	R	2	Float32	%	Phase A voltage 2nd harmonic percentage
UBHD2	5008	R	2	Float32	%	Phase B voltage 2nd harmonic percentage
UCHD2	5010	R	2	Float32	%	Phase C voltage 2nd harmonic percentage
…	5012-5298	…	…	…	…	Phase ABC voltage 3-50th harmonic percentage
UAHD51	5300	R	2	Float32	%	Phase A voltage 51th harmonic percentage
UBHD51	5302	R	2	Float32	%	Phase B voltage 51th harmonic percentage
UCHD51	5304	R	2	Float32	%	Phase C voltage 51th harmonic percentage
Voltage harmonic value：						
UAHDV1	5400	R	2	Float32	V	Phase A voltage 1st Harmonic voltage value
UBHDV1	5402	R	2	Float32	V	Phase B voltage 1st Harmonic voltage value
UCHDV1	5404	R	2	Float32	V	Phase C voltage 1st Harmonic voltage value
…	5406-5698	…	…	…	…	Phase ABC voltage 2-50th Harmonic voltage value
UAHDV51	5700	R	2	Float32	V	Phase A voltage 51th Harmonic voltage value
UBHDV51	5702	R	2	Float32	V	Phase B voltage 51th Harmonic voltage value
UCHDV51	5704	R	2	Float32	V	Phase C voltage 51th Harmonic voltage value

Max/Min. value：

Register name	Register Start address (decimal)	Operation	Size	Type	Unit	Description
Current max / min：						
IAMax	6000	R	2	Float32	A	Phase A max current value
IBMax	6002	R	2	Float32	A	Phase B max current value
ICMax	6004	R	2	Float32	A	Phase C max current value
IAVGMax	6006	R	2	Float32	A	Average current max value of three phase
IAMin	6010	R	2	Float32	A	Phase A min current value
IBMin	6012	R	2	Float32	A	Phase B min current value
ICMin	6014	R	2	Float32	A	Phase C min current value
IAVGMin	6016	R	2	Float32	A	Average current min value of three phase
Voltage max/min：						
UAMax	6020	R	2	Float32	V	UA-UN phase voltage max value
UBMax	6022	R	2	Float32	V	UB-UN phase voltage max value
UCMax	6024	R	2	Float32	V	UC-UN phase voltage max value
Phase UAVGMax	6026	R	2	Float32	V	Max value of phase voltage average value for three phases
UAMin	6030	R	2	Float32	V	UA-UN phase voltage min value
UBMin	6032	R	2	Float32	V	UB-UN phase voltage min value
UCMin	6034	R	2	Float32	V	UC-UN phase voltage min value
UAVGMin	6036	R	2	Float32	V	Min value of phase voltage average value for three phases
UABMax	6040	R	2	Float32	V	UA-UB line voltage max value
UBCMax	6042	R	2	Float32	V	UB-UC line voltage max value
UCAMax	6044	R	2	Float32	V	UC-UA line voltage max value
LineUAVGMax	6046	R	2	Float32	V	Max value of line voltage average value for three phases
UABMin	6050	R	2	Float32	V	UA-UB line voltage min value
UBCMin	6052	R	2	Float32	V	UB-UC line voltage min value
UCAMin	6054	R	2	Float32	V	UC-UA line voltage min value
LineUAVGMin	6056	R	2	Float32	V	Min value of line voltage average value for three phases
Active power max/min：						
PAMax	6060	R	2	Float32	kW	Max value of active power for phase A
PBMax	6062	R	2	Float32	kW	Max value of active power for phase B
PCMax	6064	R	2	Float32	kW	Max value of active power for phase C
PSUMMax	6066	R	2	Float32	kW	Total active power max value of three phase

Register name	Register Start address (decimal)	Operation	Size	Type	Unit	Description
PAMin	6070	R	2	Float32	kW	Min value of active power for phase A
PBMin	6072	R	2	Float32	kW	Min value of active power for phase B
PCMin	6074	R	2	Float32	kW	Min value of active power for phase C
PSUMMin	6076	R	2	Float32	kW	Total active power min value of three phase
Reactive power max/min：						
QAMax	6080	R	2	Float32	kVar	Max value of reactive power for phase A
QBMax	6082	R	2	Float32	kVar	Max value of reactive power for phase B
QCMax	6084	R	2	Float32	kVar	Max value of reactive power for phase C
QSUMMax	6086	R	2	Float32	kVar	Total reactive power max value of three phase
QAMin	6090	R	2	Float32	kVar	Min value of reactive power for phase A
QBMin	6092	R	2	Float32	kVar	Min value of reactive power for phase B
QCMin	6094	R	2	Float32	kVar	Min value of reactive power for phase C
QSUMMin	6096	R	2	Float32	kVar	Total reactive power min value of three phase
Apparent power max/min：						
SAMax	6100	R	2	Float32	kVa	Max value of apparent power for phase A
SBMax	6102	R	2	Float32	kVa	Max value of apparent power for phase B
SCMax	6104	R	2	Float32	kVa	Max value of apparent power for phase C
SSUMMax	6106	R	2	Float32	kVa	Total apparent power max value of three phase
SAMin	6110	R	2	Float32	kVa	Min value of apparent power for phase A
SBMin	6112	R	2	Float32	kVa	Min value of apparent power for phase B
SCMin	6114	R	2	Float32	kVa	Min value of apparent power for phase C
SSUMMin	6116	R	2	Float32	kVa	Total apparent power min value of three phase

Unbalance degree:
Calculation method of unbalance degree: unbalance degree = (phase current - three-phase average current) / three-phase average current * 100%, three-phase most unbalance degree = max (phase current - three-phase average current) / three-phase average current * 100%.

Register name	Register Start address (decimal)	Operation	Size	Type	Unit	Description
Current unbalance degree:：						
IAUbl	7000	R	2	Float32	%	Phase A current unbalance degree
IBUbl	7002	R	2	Float32	%	Phase B current unbalance degree
ICUbl	7004	R	2	Float32	%	Phase C current unbalance degree
IwstUbl	7006	R	2	Float32	%	Three phase most unbalanced degree
Voltage unbalance degree：						
UAUbl	7010	R	2	Float32	%	UA-UN phase voltage unbalance degree
UBUbl	7012	R	2	Float32	%	UB-UN phase voltage unbalance degree
UCUbl	7014	R	2	Float32	%	UC-UN phase voltage unbalance degree
PhasewstUbl	7016	R	2	Float32	%	Phase voltage most unbalanced degree for three phases
UABUbl	7020	R	2	Float32	%	UA-UB line voltage unbalance degree
UBCUbl	7022	R	2	Float32	%	UB-UC line voltage unbalance degree
UCAUbl	7024	R	2	Float32	%	UC-UA line voltage unbalance degree
LinewstUbl	7026	R	2	Float32	%	Three phase line voltage most unbalanced degree

Swells and dips:

MQ31 has 10 event caches. The event storage adopts circular storage, and the new event will cover the old event.

Register name	Register Start address (decimal)	Operation	Size	Type	Unit	Description
Parameters of swells and dips：						
Vnom	7100	R/WC	2	UInt32	V	Nominal voltage value
SwellThreshold	7102	R/WC	1	UInt16	%	Percentage of swell trigger threshold
DipThreshold	7103	R/WC	1	UInt16	%	Percentage of dip trigger threshold

Register name	Register Start address (decimal)	Operation	Size	Type	Unit	Description
Hysteresis	7104	R/WC	1	UInt16	%	Hysteresis percentage
Newly generated event:：						
NewEventNumber	7160	R/WC	1	UInt16	-	Number of newly generated events since last clearance. The start and end numbers are same when only one event occurs.
StartEventIndex	7161	R	1	UInt16	-	The starting No. of the newly generated event. Range 1-10
EndEventIndex	7162	R	1	UInt16	-	End No. of newly generated event. Range 1-10
LastResetDateTime	7163	R	4	Date time	-	Time of event count of last clearance.
10 latest events (Cyclic coverage)：						
Event_1_Type	7200	R	1	UInt16	-	Event 1 type 1=Swell 2=Dip
Event_1_StartTime	7201	R	4	Date time	-	Occurrence time of event 1
Event_1_Duration	7205	R	2	UInt32	ms	Event 1 duration
Event_1_ Mag	7207	R	2	UInt32	V	Event 1 amplitude
Event_2_Type	7209	R	1	UInt16	-	Event 2 type 1=Swell 2=Dip
Event_2_StartTime	7210	R	4	Date time	-	Occurrence time of event 2
Event_2_Duration	7214	R	2	UInt32	ms	Event 2 duration
Event_2_ Mag	7216	R	2	UInt32	V	Event 2 amplitude
Event_3_Type	7218	R	1	UInt16	-	Event 3 type 1= Swell 2= Dip
Event_3_StartTime	7219	R	4	Date time	-	Occurrence time of event 3
Event_3_Duration	7223	R	2	UInt32	ms	Event 3 duration
Event_3_ Mag	7225	R	2	UInt32	V	Event 3 amplitude
Event_4_Type	7227	R	1	UInt16	-	Event 4 type 1= Swell 2= Dip
Event_4_StartTime	7228	R	4	Date time	-	Occurrence time of event 4
Event_4_Duration	7232	R	2	UInt32	ms	Event 4 duration
Event_4_ Mag	7234	R	2	UInt32	V	Event 4 amplitude
Event_5_Type	7236	R	1	UInt16	-	Event 5 type 1= Swell 2= Dip
Event_5_StartTime	7237	R	4	Date time	-	Occurrence time of event 5
Event_5_Duration	7241	R	2	UInt32	ms	Event 5 duration
Event_5_ Mag	7243	R	2	UInt32	V	Event 5 amplitude
Event_6_Type	7245	R	1	UInt16	-	Event 6 type 1= Swell 2= Dip
Event_6_StartTime	7246	R	4	Date time	-	Occurrence time of event 6
Event_6_Duration	7250	R	2	UInt32	ms	Event 6 duration
Event_6_ Mag	7252	R	2	UInt32	V	Event 6 amplitude
Event_7_Type	7254	R	1	UInt16	-	Event 7 type 1= Swell 2= Dip
Event_7_StartTime	7255	R	4	Date time	-	Occurrence time of event 7

Register name	Register Start address (decimal)	Operation	Size	Type	Unit	Description
Event_7_Duration	7259	R	2	UInt32	ms	Event 7 duration
Event_7_ Mag	7261	R	2	UInt32	V	Event 7 amplitude
Event_8_Type	7263	R	1	UInt16	-	Event 8 type 1= Swell 2= Dip
Event_8_StartTime	7264	R	4	Date time	-	Occurrence time of event 8
Event_8_Duration	7268	R	2	UInt32	ms	Event 8 duration
Event_8_ Mag	7270	R	2	UInt32	V	Event 8 amplitude
Event_9_Type	7272	R	1	UInt16	-	Event 9 type 1= Swell 2= Dip
Event_9_StartTime	7273	R	4	Date time	-	Occurrence time of event 9
Event_9_Duration	7277	R	2	UInt32	ms	Event 9 duration
Event_9_ Mag	7279	R	2	UInt32	V	Event 9 amplitude
Event_10_Type	7281	R	1	UInt16	-	Event 10 type 1= Swell 2= Dip
Event_10_StartTime	7282	R	4	Date time	-	Occurrence time of event 10
Event_10_Duration	7286	R	2	UInt32	ms	Event 10 duration
Event_10_ Mag	7288	R	2	UInt32	V	Event 10 amplitude

Current K-factor and crest factor：

Register name	Register Start address (decimal)	Operation	Size	Type	Unit	Description
Current K-factor：						
KFIA	8000	R	2	Float32	-	Current K-factor of phase A
KFIB	8002	R	2	Float32	-	Current K-factor of phase B
KFIC	8004	R	2	Float32	-	Current K-factor of phase C
Current crest factor：						
CFIA	8010	R	2	Float32	-	Current crest factor of phase A
CFIB	8012	R	2	Float32	-	Current crest factor of phase B
CFIC	8014	R	2	Float32	-	Current crest factor of phase C
Voltage crest factor:：						
CFUA	8020	R	2	Float32	-	Voltage crest factor of phase A
CFUB	8022	R	2	Float32	-	Voltage crest factor of phase B
CFUC	8024	R	2	Float32	-	Voltage crest factor of phase C

Angle of voltage and current：

Register name	Register Start address (decimal)	Operation	Size	Type	Unit	Description
Angle between phase voltage：						
UAB	8100	R	2	Float32	°	Angle between voltage of phase A and B
UBC	8102	R	2	Float32	°	Angle between voltage of phase B and C
UCA	8104	R	2	Float32	°	Angle between voltage of phase C and A
Angle between current：						
IAB	8110	R	2	Float32	°	Angle between current of phase A and B
IBC	8112	R	2	Float32	°	Angle between current of phase B and C
ICA	8114	R	2	Float32	°	Angle between current of phase C and A

Appendix 1: Noun interpretation

Date, Time
Voltage(V)
UTHD(%) : Voltage total harmonic
Current(A)
ITHD(%) : Current total harmonic
Frequency (Hz)
Power Factor
Active Power(W)
Reactive Power (Var)
Apparent Power (Va)
Active Energy (Wh)
Reactive Energy (Varh)
Apparent Energy (Vah)
Current Demand(A)
Current Peak Demand(A)&Date
Total Active Power Demand(W)
Total Active Power Peak Demand(W)&Date
Total Reactive Power Demand (Var)
Total Reactive Power Peak Demand (Var)&Date
Total Apparent Power Demand (Va)
Total Apparent Power Peak Demand (Va)&Date

UA, UB, UC, UAvg :
Phase A voltage, phase B voltage, phase C voltage, average voltage

UN, UTHDA, UTHDB, UTHDC, UTHDAvg :
Phase N voltage, voltage total harmonic of phase A, voltage total harmonic of phase B, voltage total harmonic of phase C, average value of voltage total harmonic

IA, IB, IC, IAvg, IN :
Phase A current, phase B current, phase C current, average current, phase N current

ITHDA, ITHDB, ITHDC, ITHDAvg :
Current total harmonic of phase A, current total harmonic of phase B, current total harmonic of phase C, average value of current total harmonic

FA, FB, FC, FAvg :
Phase A frequency, phase B frequency, phase C frequency, average frequency

PFA, PFB, PFC, PFTotal :
Phase A power factor, phase B power factor, phase C power factor, total power factor

PA, PB, PC, PSum :
Phase A active power, phase B active power, phase C active power, total active power

QA, QB, QC, QSum :
Phase A reactive power, phase B reactive power, phase C reactive power, total reactive

SA, SB, SC, SSum :
Phase A apparent power, phase B apparent power, phase C apparent power, total apparent power

EPA, EPB, EPC, EPSum :
Phase A active energy, phase B active energy, phase C active energy, total active energy

EQA, EQB, EQC, EQSum :
Phase A reactive energy, phase B reactive energy, phase C reactive energy, total reactive energy

ESA, ESB, ESC, ESSum :

Phase A apparent energy, phase B apparent energy, phase C apparent energy, total apparent energy

DmIA, DmIB, DmIC, DmIAVG：
Phase A current demand, phase B current demand, phase C current demand, average current demand

PDmIA , PDmIA_D/T：
Phase A current peak demand, phase A current peak demand date/time

PDmIB , PDmIB_D/T：
Phase B current peak demand, phase B current peak demand date/time

PDmIC , PDmIC_D/T：
Phase C current peak demand, phase C current peak demand date/time

PDmIAVG , PDmIAVG_D/T：
Peak demand of average current, peak demand of average current date/time

DmP, PDmP, PDmP_D/T：
Active power demand , max value of active power demand, max value of active power demand date/time

DmQ,PDmQ, PDmQ_D/T：
Reactive power demand, max value of reactive power demand, max value of reactive power demand date/time

DmS,PDmS, PDmS_D/T：
Apparent power demand, max value of apparent power demand, max value of apparent power demand date/time

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