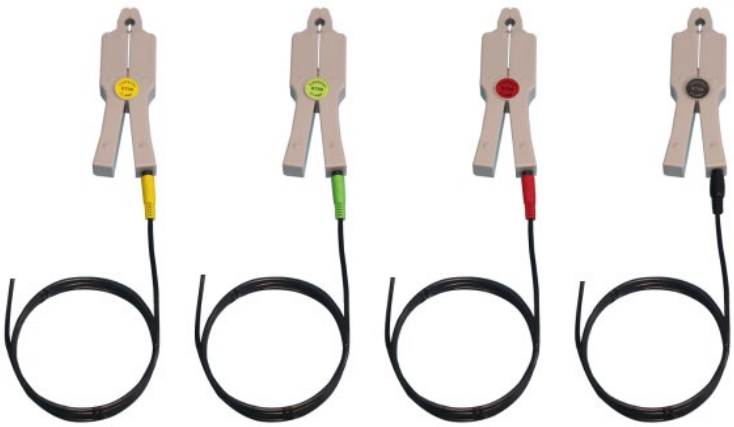
MQ21
Power quality analyzer

V1.0.210630


MQ21
Phase Voltage
UA 220.0 V
UB 220.0 V
UC 220.0 V
AVG 220.0 V
USB
Run
Alarm
Comm
Record



Contents

1 Product description

MQ21, the power quality analyzer externally connected with open type Rogowski coil or voltage CT, it can realize no dismantling wire test, facilitate engineering test, simplify test steps, save construction cost, and is also more convenient for the inspection and maintenance of distribution system. MQ21 supports systems of single-phase and three-phase: it can measure multiple electrical parameters such as voltage, current, harmonic, energy, power factor and active power on the power grid of phase A, B, C and phase N. With standard configuration of RJ45 and RS485 communication interfaces, through standard Modbus TCP and Modbus RTU protocols, 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.	MQ21
Type	Three phase power quality analyzer
Supported types of current sensor	Rogowski coil, Voltage-output current clamp
Wiring mode	3ϕ_WYE_4CT, 3ϕ_WYE_3CT, 3ϕ_DELTA_3CT,3ϕ_DELTA_2CT,1ϕ
Storage	16GB Micro SD card，USB data download (default storage interval: 1 minute)
Harmonic	51 times
Application	power analysis， energy measurement
Display screen	1.3-inch color OLED
Weight	Approx 400g
Dimension	L*W*D：13*9.5*5.6CM
Color	White
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	
Electric source	Electricity from major loop, 90～528VAC
External battery	External 18650 lithium battery
Power consumption	
Max power consumption	2.5W
Connecting terminal type	
ABC phase current input	SATA interface
N-phase current input	5.08 terminal
Voltage input	7.62 spacing terminals
Power supply	Electricity from major loop, 90～528V

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 phases)
energy	Active energy, reactive energy, apparent energy(each phase, sum value of three phases) Exceeds 999.9GWh, energy value cleared to "0" automatically
Line voltage	Between phases
Angle between line voltages	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)
Temperature and humidity	
Temperature	3 channels(optional)
Humidity	1 channel
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

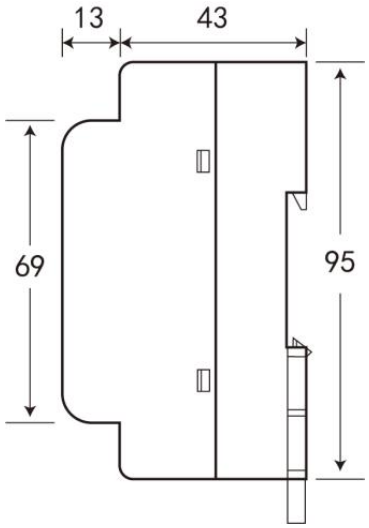
General data record	
Record interval setting	5 ~ 9999s (default 60s)
Data format	CSV
Storage capacity	Micro SD card: 16GB
	Storage duration: 3 years (using 16GB SD card, once / 60s)
Recorded data	Basic data Voltage harmonic Current harmonic
Event data record	
Data format	CSV

Recorded data	Event type Start time Duration Amplitude value Voltage RMS 1 / 2 value of each phase Voltage waveform of each phase

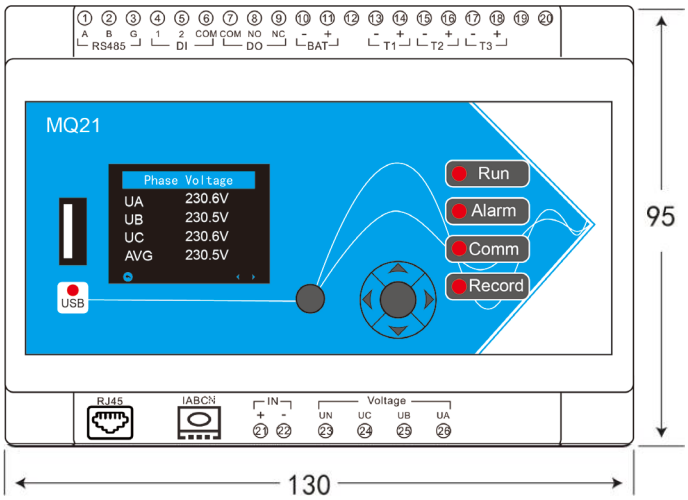
3 Accuracy and certification

Measurement accuracy		
Rogowski coil	Current measurement accuracy	0.5%(1%～120% rated current) (＜10A, accuracy not guaranteed)
	Current gear	600A(6A～720A): TRC-36 (50mV/kA@50Hz)
		3000A(10A～3600A): NRC-150 (85mV/kA@50Hz)
		6000A(20A～7200A): NRC-200 (50mV/kA@50Hz)
ST08 current clamp	Current measurement accuracy	0.5%(100mA～10A)
		1%(10mA～100mA), (＜10mA, accuracy not guaranteed)
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）
Products expiry		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		
EN 62052-11, EN61557-12, EN 62053-21, EN 62053-22, EN 62053-23, EN 50470-1, EN 50470-3, EN 61010-1, EN 61010-2, EN 61010-031		

4 Outline and dimensions

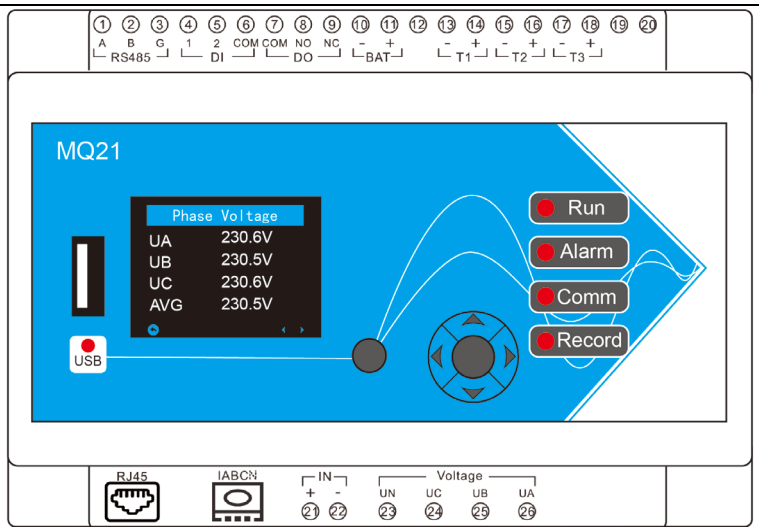


Unit：mm



5 Port definition

MQ21 is equipped with abundant interfaces to realize different functions.



Port definitions as follows:

Interface No.	Interface name	Interface definition	Interface function	Remarks
1	A	RS485 A	RS485 Interface	RS485 Interface
2	B	RS485 B		
3	G	RS485 GND		
4	1	Digital input channel 1	Digital input interface	Dry contact input
5	2	Digital input channel 2		
6	COM	Common terminal of digital input channel		
7	COM	Digital output common terminal	Digital output interface	Digital output interface
8	NO	Digital output normally open terminal		
9	NC	Digital output normally closed terminal		
10	BAT-	3.7V rechargeable lithium battery -	External connecting 3.7V rechargeable lithium battery	Non rechargeable lithium battery is forbidden.
11	BAT+	3.7V rechargeable lithium battery +		
12				Reserve
13	T1-	Temperature sensor channel 1 input-	Temperature sensor channel 1 input	External K-type thermocouple
14	T1+	Temperature sensor channel 1 input+		
15	T2-	Temperature sensor channel 2 Input-	Temperature sensor channel 2 Input	External K-type thermocouple
16	T2+	Temperature sensor channel 2 Input+		
17	T3-	Temperature sensor channel 3 input-	Temperature sensor channel 3 input	External K-type thermocouple
18	T3+	Temperature sensor channel 3 input+		
19			Reserve	Reserve
20			Reserve	Reserve
21	IN+	Phase N current input+	Phase N current input channel	The phase N current can be connected to the sensor separately.
22	IN-	Phase N current input-		
23	UN	Phase N voltage input	Voltage input channel	Voltage input channel
24	UC	Phase C voltage input		
25	UB	Phase B voltage input		
26	UA	Phase A voltage input		
RJ45	RJ45	Ethernet interface	Ethernet interface	Ethernet interface
IABCN	IABCN	ABCN current input	ABCN current input	SATA interface N-phase current can be connected to this port or (IN+,IN-)

5.1 Power supply

MQ21 is powered directly through ABCN voltage channel. The power supply voltage range: 90～528VAC, 45~60Hz, Mam power consumption 2.5W.

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

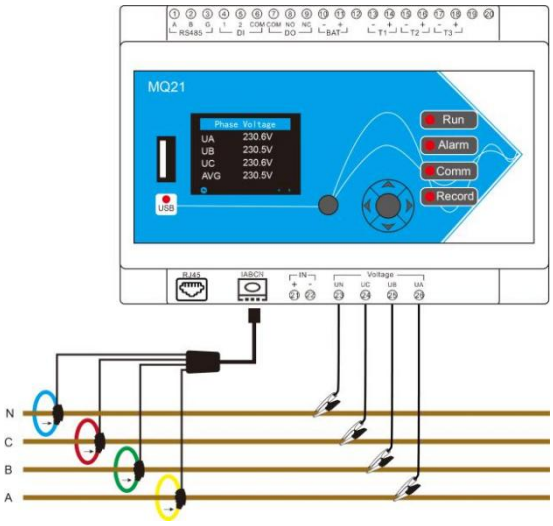
5.2 Voltage current input

The analyzer supports 5 wiring modes: 3ϕ_WYE_4CT, 3ϕ_WYE_3CT, 3ϕ_DELTA_3CT, 3ϕ_DELTA_2CT, Single phase.

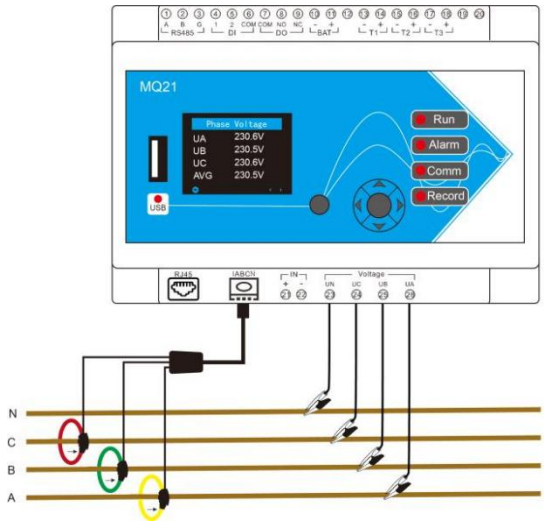
- The actual wiring mode of the analyzer must be consistent with the one configured inside the analyzer.
- 3ϕ_WYE_4CT need 4pcs current sensor, and N-phase current can be measured.

- 3ϕ_WYE_3CT need 3pcs current sensor, N-phase current cannot be measured.
- 3ϕ_DELTA_3CT need 3pcs current sensor, phase B current is acquired by sensor actual measurement.
- 3ϕ_DELTA_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 of 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 sensor current arrow points to the load end.

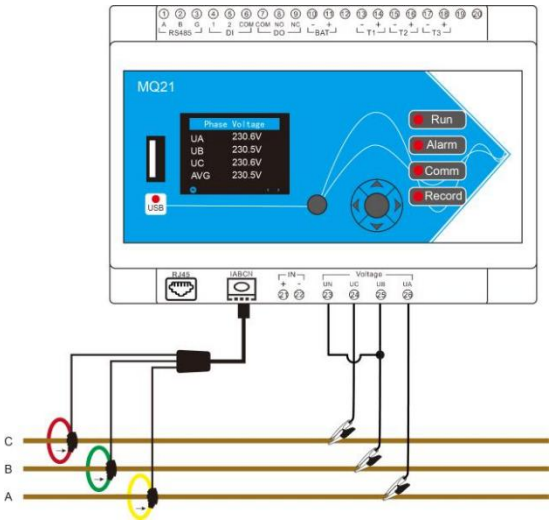
5.2.1 3ϕ_WYE_4CT Voltage and current wiring mode:



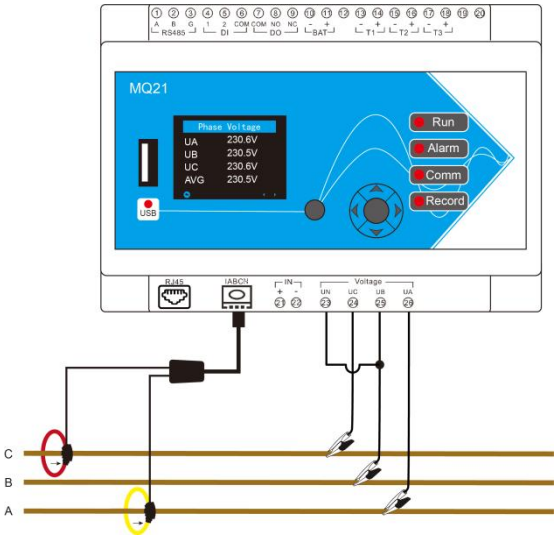
5.2.2 3ϕ_WYE_3CT Voltage and current wiring mode:



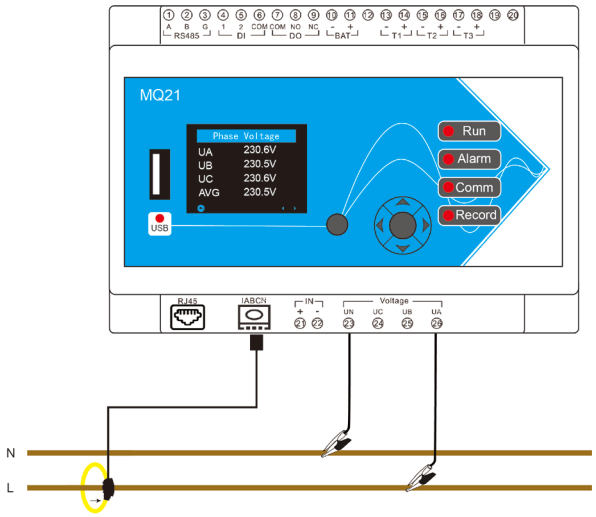
5.2.3 3ϕ_DELTA_3CT Voltage and current wiring mode:



5.2.4 3ϕ_DELTA_2CT Voltage and current wiring mode:

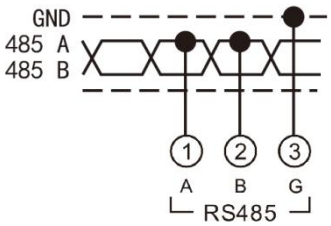


5.2.5 1φ voltage and current wiring mode:



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 by shielded twisted pair in the 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.

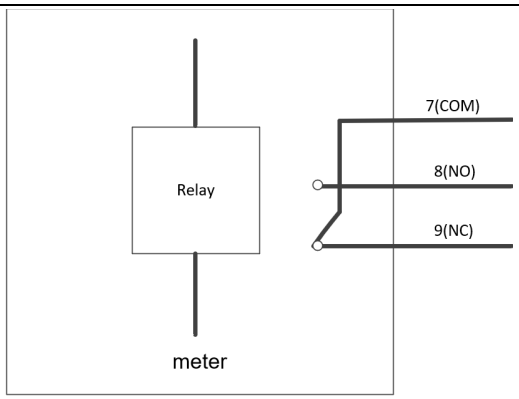


5.4 Digital output

The analyzer is equipped with a relay output, having normally open and normally closed two contacts. Connecting terminal identification is：COM，NO，NC, Where COM is the common contact, NO is the normally open contact and NC is the normally closed contact. The relay output can be controlled through RS485 / Modbus protocol.

RS485 / Modbus protocol controls the closing and opening of the normally open contact. When the normally open contact is closed, the normally closed contact is opened; When the normally open contact is open, the normally closed contact is closed. The closing status of the normally open contact of the relay is displayed on the I / O interface of the analyzer.

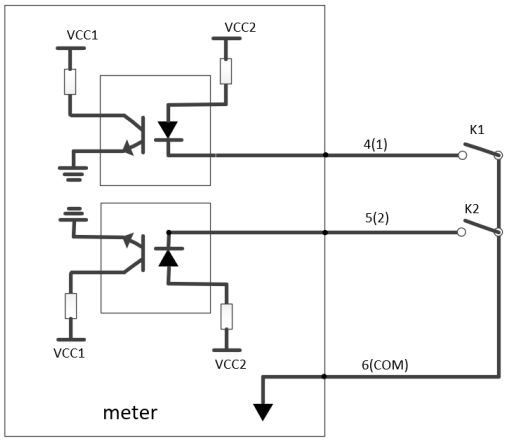
Max load capacity of relay：3A 30V DC，3A 250V AC。



Energy pulse output connection diagram

5.5 Digital input

The analyzer is equipped with two digital switching inputs, which are connected by passive dry contact. Connecting terminal identification is: 1, 2, COM, Where COM is the common contact. The status of two digital switching value inputs can be read through RS485 / Modbus protocol, and the status of digital switching value input can be displayed on the analyzer I / O interface.



Digital input connection diagram

5.6 Temperature sensor access

The analyzer is equipped with 3 temperature measurement channels and using external connecting K-type temperature sensor. The temperature sensor is internally isolated from the analyzer, but the three temperature sensors are not isolated, which need to be isolated externally.

6 Record

The analyzer has 16GB 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.

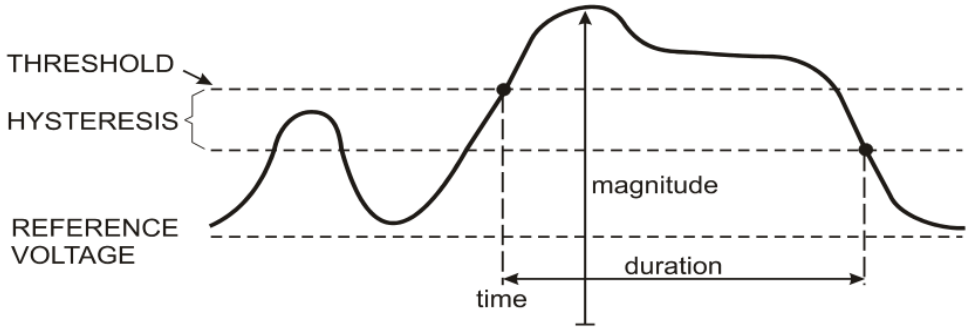
All record files can be exported through USB flash disk. All record files can be deleted by operating of the interface.

6.1 Event record

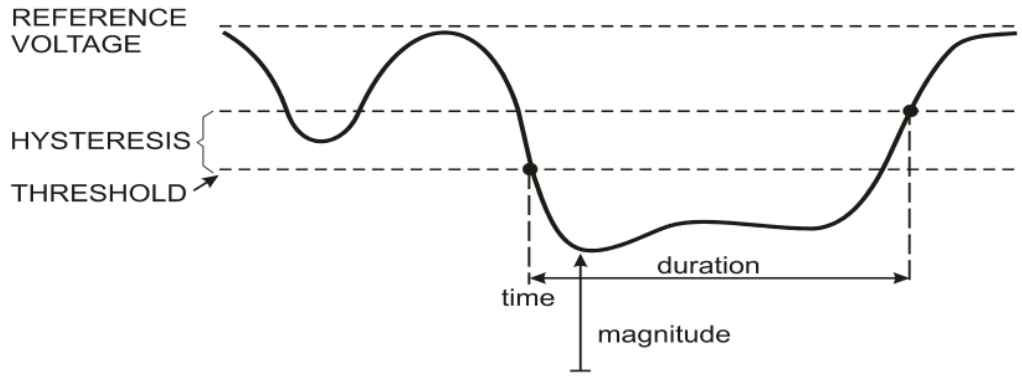
The event record only records the power quality (voltage swell and voltage dip). The swells and dip are the rapid changes of normal voltage, and the change range can be as high as 10 to 100 times of the voltage. The duration varies from half a cycle to several seconds as defined in EN61000-4-30. The analyzer allows you to set the nominal reference voltage for analyzing 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 figure below:



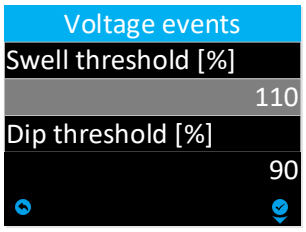
The voltage drops during the dip. In a three-phase system, when the voltage of one or more phases drops to the dip threshold, the dip begins; When the voltage of all phases is equal to or greater than the dip threshold plus Hysteresis, the dip stops. The trigger conditions of sudden drop are threshold 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 "configuration interface -- > power grid parameter -- > nominal voltage" for the setting of nominal voltage. Refer to "configuration interface -- > record -- > voltage event" for the setting of 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%)

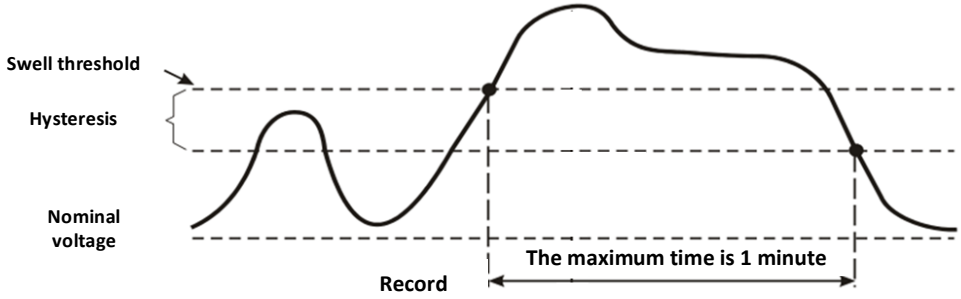


6.1.2 Swell and dip event RMS (1 / 2) and waveform

If the record storage function is enabled, the analyzer will store the RMS (1 / 2) and waveform of the swell and dip event into

the internal memory of the analyzer.

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



Event RMS(1/2) value recording

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

6.1.3 Read and export of Swell and dip event

Attention

The record storage must be enabled, otherwise the RMS value and waveform value of the event will not be stored in the internal memory, and cannot be read through Modbus RTU or Modbus TCP protocol. Refer to the interface "recording - > recording parameters".

There are 10 event cycle buffer queues in the analyzer, which will circularly store the latest events to the buffer, and can be read through Modbus RTU or Modbus TCP protocol. For specific operations, refer to "operation guide for reading swell and dip parameters".

If the record storage function is enabled, the analyzer will store the swell and dip events into the internal memory of the analyzer, and the events can be exported through USB flash disk. For specific operations, refer to "configuration interface -- > record -- > Download", and the RMS value and waveform value of the events can be exported respectively.

6.2 Record and export of measured values

Attention

The record storage must be enabled, otherwise the measurement will not be stored in the internal memory. Refer to the interface "record - > record parameters".

The types of measured values that can be recorded by the analyzer are: Basic measurement parameters, voltage harmonic data and current harmonic data. Data storage takes one day as a unit, and a corresponding new storage file will be generated every day.

If the measured value is to be recorded, the record storage function must be turned on. The interval between record enabling and record storage can be configured on the page of "configuration interface -- > record -- > record parameters"

All recorded measured values can be exported through USB flash disk. See "configuration interface -- > record -- > Download" for specific operations. Basic measured values, voltage harmonic data and current harmonic data can be exported

respectively

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 channel and current ABC channel 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 channel and current ABC channel can control the transmission of waveform by configuring whether the corresponding channel is enabled.

Attention

After the waveform server parameters are configured, the analyzer must be restarted before the parameters can take effect.

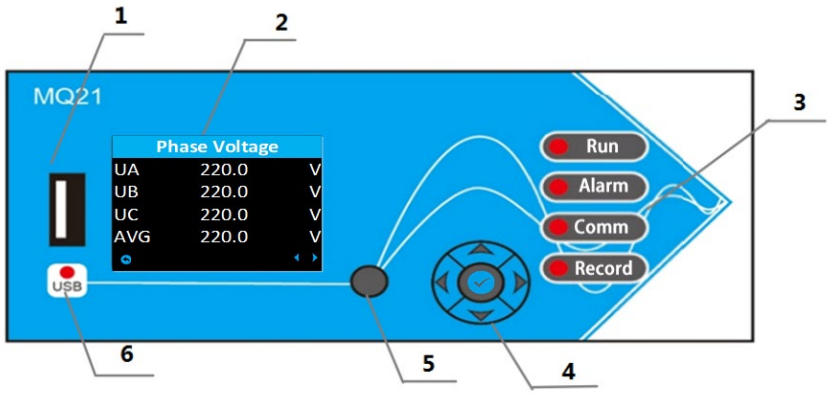
The format of UDP packets sent by each channel is as follows:

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

8 Operation and interface display

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

8.1 Display and push button



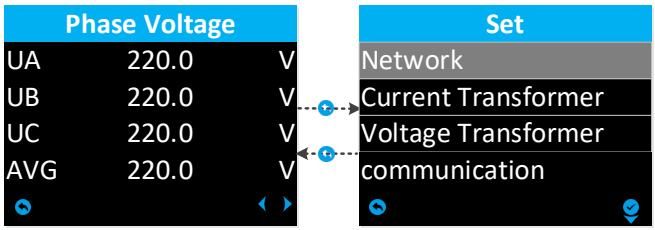
The analyzer adopts OLED display, 1 independent push button and 1 five way push button, as shown in the figure below:

Interface display description:

No.	Name	Description
1	USB flash disk insertion port	It is used to download analyzer data and update analyzer program through USB flash disk.
2	OLED display screen	Used to display various data and operation interfaces. The push button icon at the bottom of the display indicates the currently operable buttons.
3	Indicator light	Operation indicator: indicates whether the analyzer operates normally. During normal operation, the indicator light flashes.
		Alarm indicator: when the analyzer has alarm information, the indicator lights up.
		Communication indicator: this indicator flashes when Modbus communication is performed.
		Recording indicator: when the analyzer starts data recording, the indicator flashes; when it is not turned on, the indicator light goes out.
4	Five-way push button	The five-way push button has five functions: up, down, left, right and confirm. Five-way push button is used for the operation interface。
5	Return key	The return key is used to exit the current operation interface.
6	USB indicator	When the USB flash disk is inserted and the detection is successful, the indicator lights up. The indicator flashes when copying data or storing data to USB flash disk.

8.2 Display interface switching

The analyzer mainly consists of two types of display interfaces: data display interface and configuration interface. The two types of interfaces are switched by return key.



8.3 Measurement data display interface

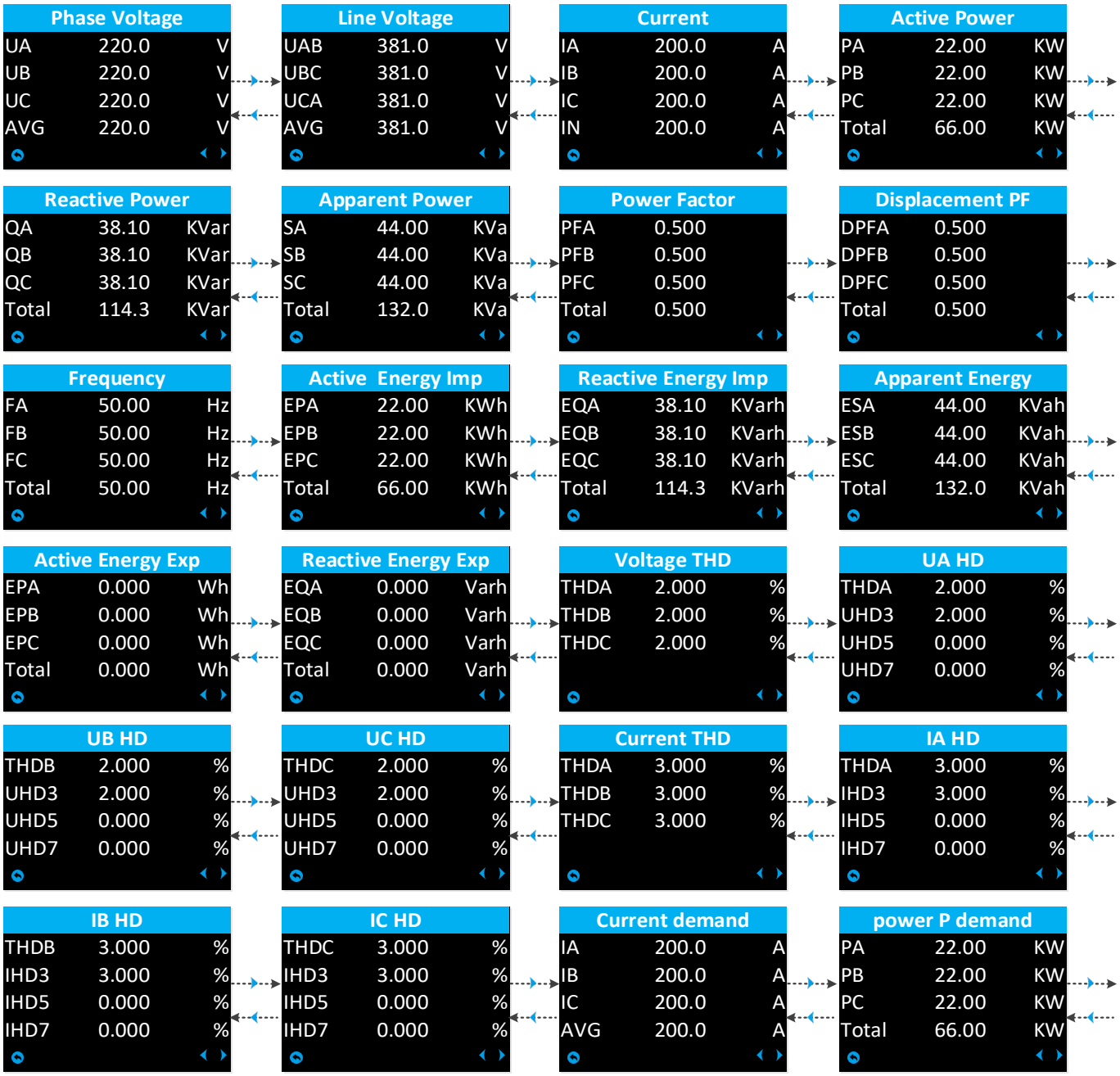
The measurement data display interface is used to display: voltage, current, power, power factor, frequency and other data. Switch the display of the interface by pressing or

The analyzer will have different display interfaces under different wiring modes (3ϕ_WYE_4CT, 3ϕ_WYE_3CT, 3ϕ_DELTA_3CT, 3ϕ_DELTA_2CT, single phase).

8.3.1 3ϕ_WYE_4CT, 3ϕ_WYE_3CT Display interface

3ϕ_WYE_4CT, 3ϕ_WYE_3CT Display interface distinctions

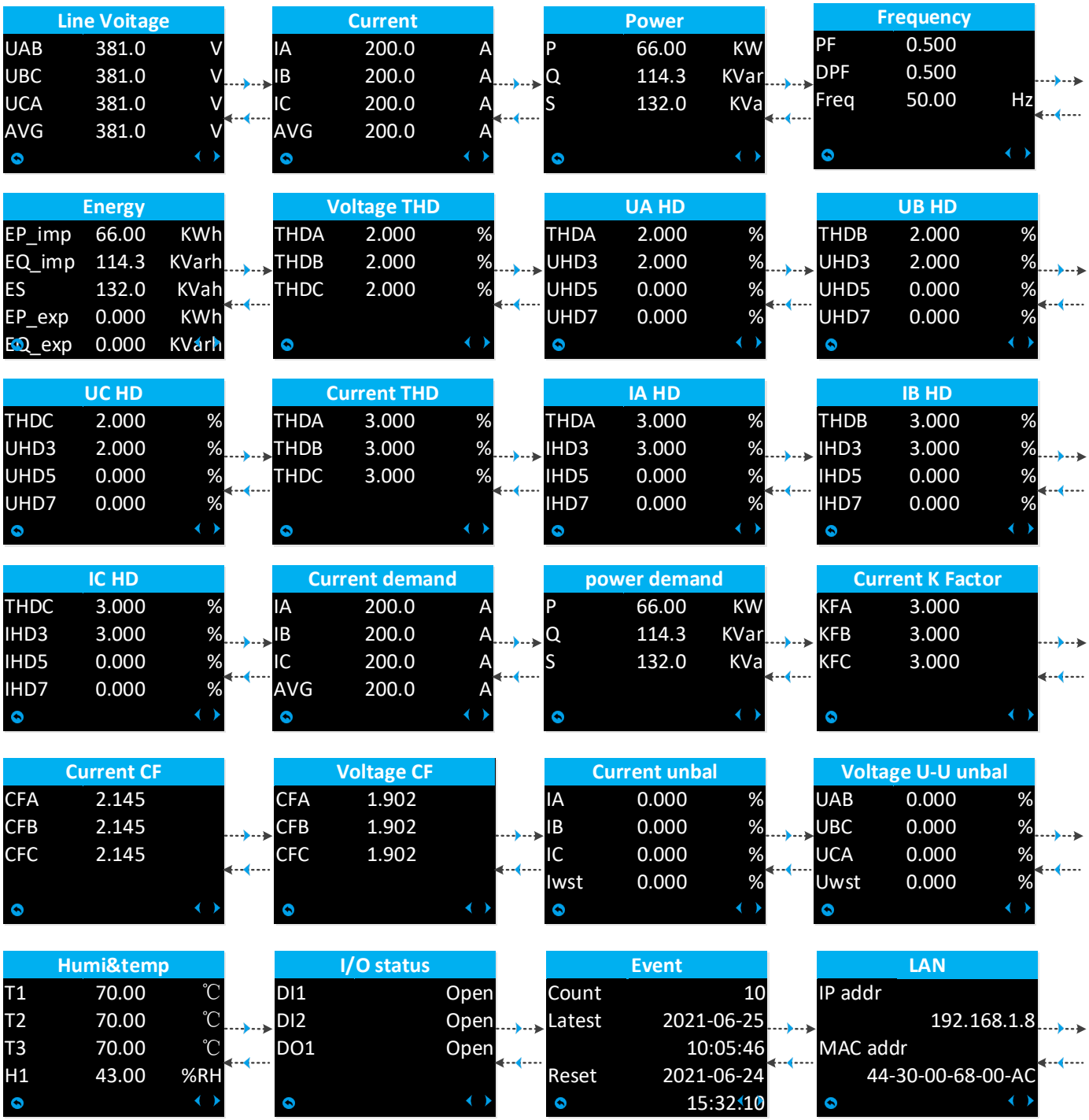
Wiring mode	N-phase current display
3ϕ_WYE_4CT	Yes
3ϕ_WYE_3CT	No



8.3.2 3ϕ_DELTA_3CT, 3ϕ_DELTA_2CT Display interface

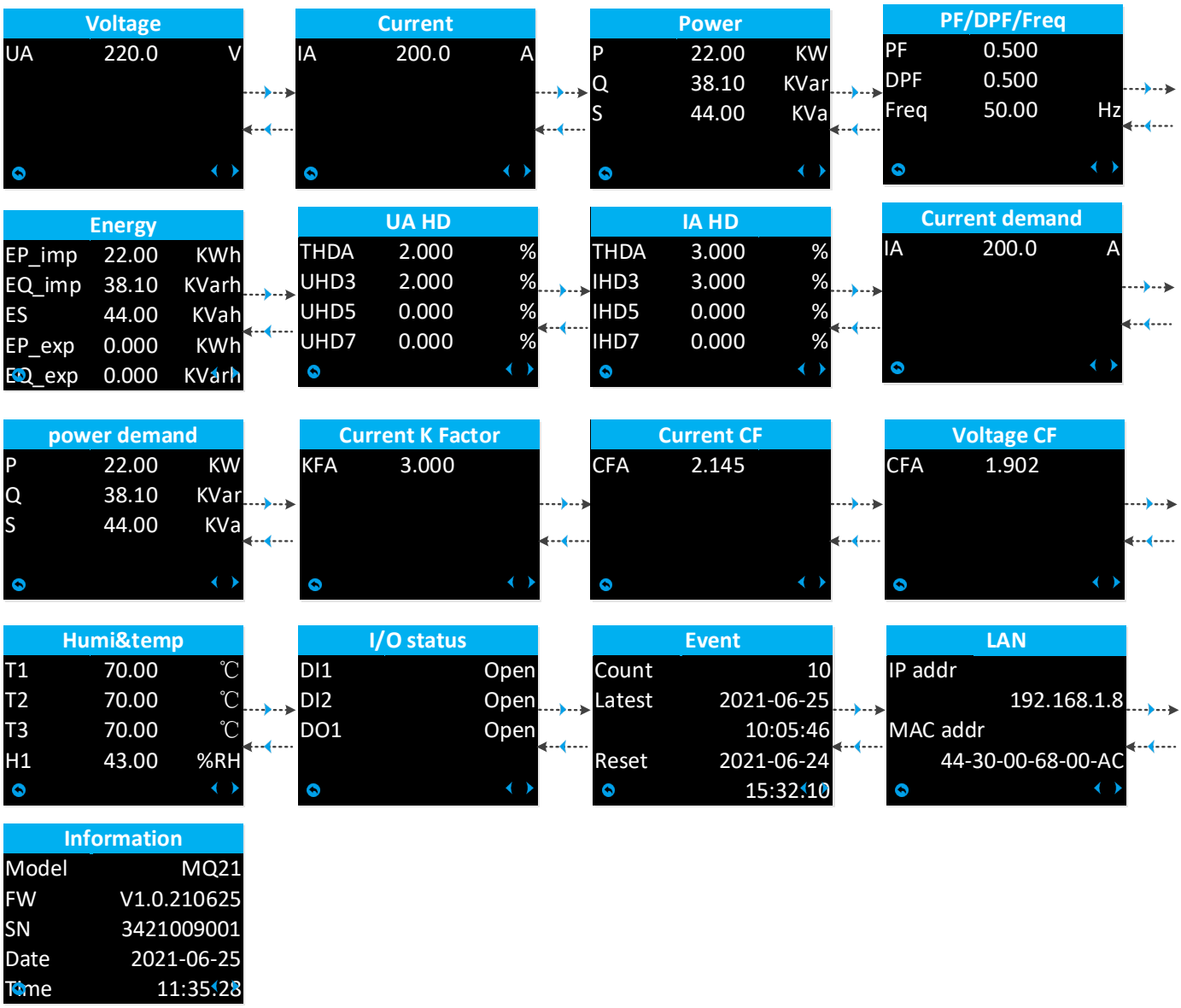
3ϕ_DELTA_3CT, 3ϕ_DELTA_2CT Display interface distinctions

Wiring mode	Access of phase B current value
3P3W_3CT	Directly obtained by phase B current sensor measurement
3P3W_2CT	Obtained by phase A and C current calculation



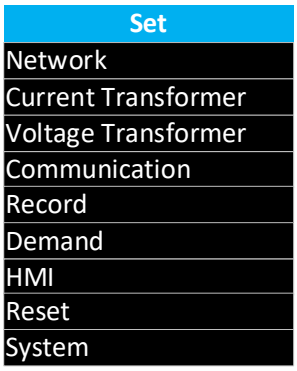
Information	
Model	MQ21
FW	V1.0.210625
SN	3421009001
Date	2021-06-25
Time	11:35:28

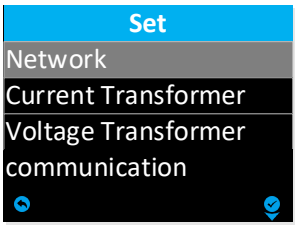
8.3.3 1φ display interface



8.4 Configuration interface

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

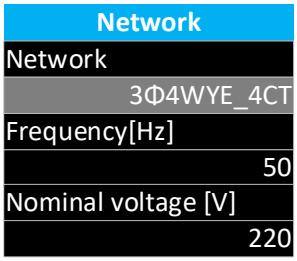


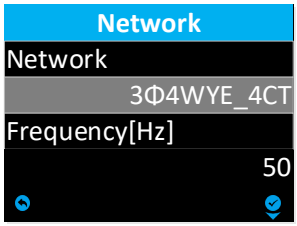


You can switch the selected content through key ▲ and key ▼, and press key ✓ to enter the setting interface.

8.4.1 Power grid parameter setting interface

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





The selected content can be switched through key ▲ and key ▼, press key ✓ to enter the setting interface, press key ↩ to exit the current interface, and the modified data will be saved automatically.

The wiring mode can be configured with the following parameters:

- 3ϕ_WYE_4CT
- 3ϕ_WYE_3CT
- 3ϕ_DELTA_3CT
- 3ϕ_DELTA_2CT
- Single phase

The frequency can be configured with the following parameters:

- 50
- 60

Nominal voltage configurable range:

1~10000。

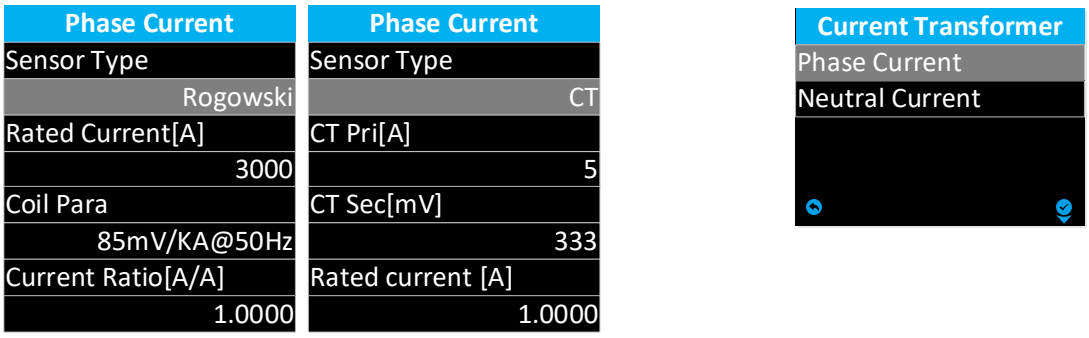
The nominal voltage is used for the detection of swell and dip events, which needs to be set according to the actual measured voltage value. Unreasonable nominal voltage will lead to incorrect detection of swell and dip events.

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 right figure, and the configurable parameters are as follows:



The selected content can be switched through key ▲ and key ▼, press key ✓ to enter the setting interface, press key ↩ to exit the current interface, and the modified data will be saved automatically.
When the transformer type is configured as "Rogowski coil":
Nominal current available in 3 gears: 600A, 3000A and 6000A
The coil parameters are automatically displayed with 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 and the nominal current at the primary side
CT Sec[mV]：Used to set the voltage output transformer, and the output voltage value at the secondary side max 707mV
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".

8.4.3 Voltage transformer setting interface

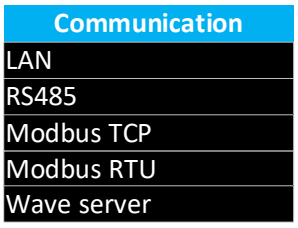
The current transformer setting interface is shown in the right figure, and the configurable parameters are as follows:

The selected content can be switched through key ▲ and key ▼, press key ✓ to enter the setting interface, press key ↩ to exit the current interface, and the modified data will be saved automatically.
The voltage transformation ratio is used to set the transformation ratio of the voltage transformer = the nominal voltage value at the primary side of the transformer / the output voltage value at the secondary side
If no voltage transformer is connected, this value is set to 1.0000.

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

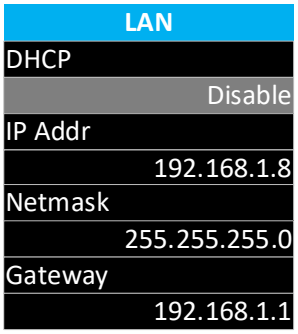
8.4.4 Communication setting interface

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

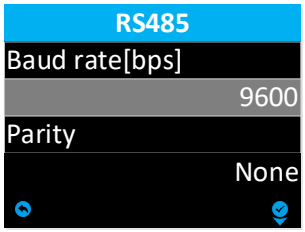


The selected content can be switched through key ▲ and key ▼, press key ✓ to enter the setting interface, and press key ↩ to exit the current interface.

LAN is used to configure Ethernet communication, IP address and other parameters of analyzer. When DHCP is enabled, the analyzer will automatically obtain the IP address from the router. At this time, the IP address and other parameters cannot be configured manually.



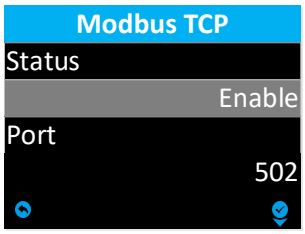
RS485 is used to configure the analyzer RS485 communication parameters. Baud rate settable parameters: 1200、2400、4800、9600、19200、38400、57600, etc. Configurable parameters of check bit: no check, odd check, even check, etc.



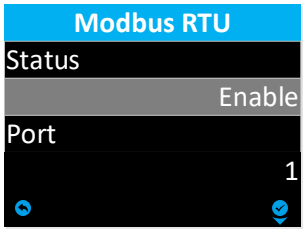
Modbus TCP is used to configure parameters such as Modbus TCP communication port number. When the configuration status is disabled, Modbus TCP is not available.

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".



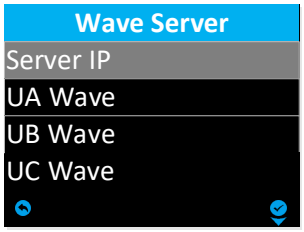
Modbus RTU is used to configure parameters such as address of Modbus RTU of the analyzer. When the configuration status is disabled, the Modbus RTU is not available.

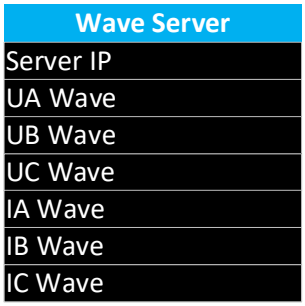


Waveform server is used to configure server parameters for receiving waveform sent by analyzer.

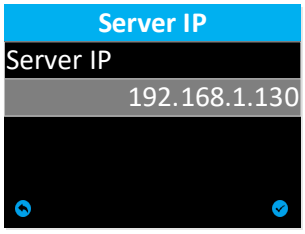
Attention

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"

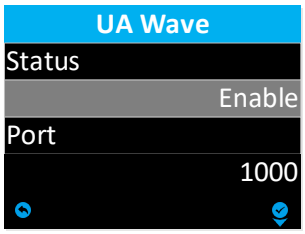




Waveform server address is used to configure the IP address of the server receiving the waveform.

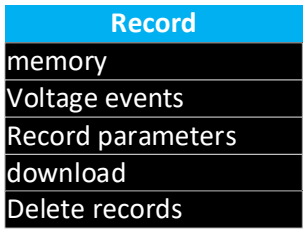


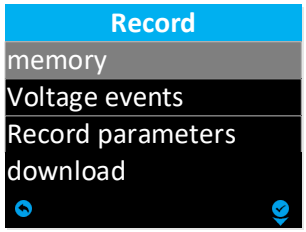
Phase A voltage waveform is used to configure the port number and other parameters of the server to receive phase A voltage waveform. When the configuration status is "disabled", the analyzer will not send corresponding waveform data.



8.4.5 Record setting interface

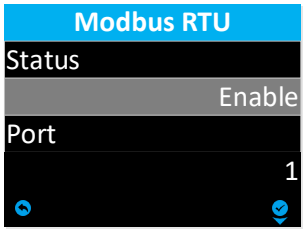
The record setting interface is shown in the right figure, and the configurable parameters are as follows:



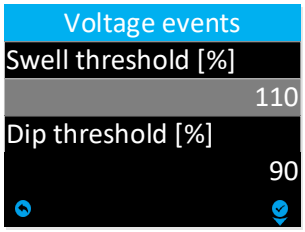


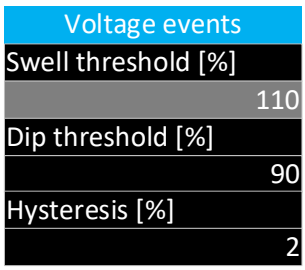
The selected content can be switched through key ▲ and key ▼, press key ✓ to enter the setting interface, and press key ↩ to exit the current interface.

The memory is used to display the internal memory udipe of the analyzer. The analyzer has a built-in 16GB memory.

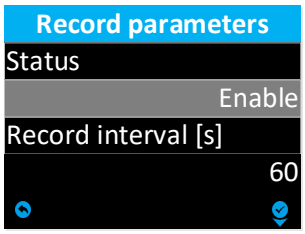


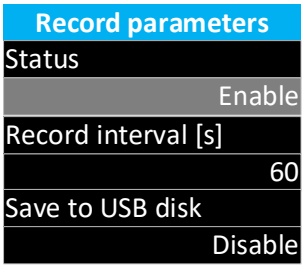
The voltage event is used to configure the swell and dip parameters. The percentage of swells, dips and Hysteresiss are relative to the nominal voltage [power grid parameters - > nominal voltage] .





Record parameters are used to configure whether data is stored in internal storage and storage interval.





"Status" is used to set whether data storage is enabled. When it is disabled, data will not be stored in internal memory.
"Storage interval [S]" is used to set how often data is stored.
When "store data to USB flash disk" is "enabled", if the external USB flash disk is inserted, the data will be stored to the external USB flash disk simultaneously.

Attention

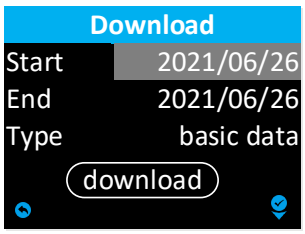
If the storage state is not enabled, the data cannot be stored in the internal memory, and the rms1 / 2 value and waveform of the event cannot be stored.
When the storage function is turned on, the "record indicator" of the analyzer will flash.

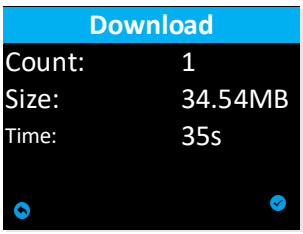
Download is used to export the data in the internal memory to the external USB flash disk.

Attention

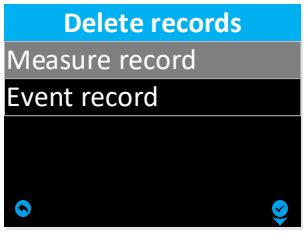
Two conditions must be met to enter the interface: 1. External USB flash disk must be inserted; 2. Data recording must be stopped.

Start sets the start date for downloading data.
End sets the end date for downloading data.
Type is used to set the downloaded data type. The configurable parameters are: basic data, voltage harmonic, current harmonic, event RMS and event waveform.





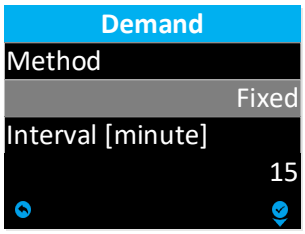
Delete record is used to delete records stored in internal memory.



"Measured value record" is used to delete records of basic data, voltage harmonic data and current harmonic data.
"Event record" is used to delete the RMS value of the event and the record of the event waveform.

8.4.6 Demand setting interface

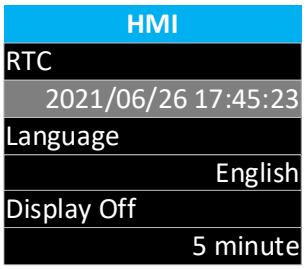
The configurable parameters in the demand setting interface are as follows:

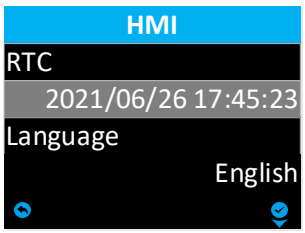


The selected content can be switched through key ▲ and key ▼, press key ✓ to enter the setting interface, and press key ↩ to exit the current interface.
Calculation method is used to set the calculation method of demand volume, which can be configured as fixed and sliding.
Interval [min] is used to set demand calculation interval, value range: 1-60 minutes。

8.4.7 Display setting interface

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

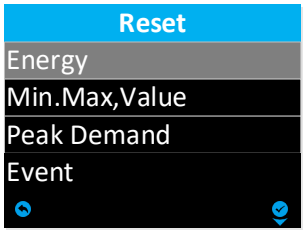




The selected content can be switched through key ▲ and key ▼, press key ✓ to enter the setting interface, and press key ↩ to exit the current interface.
Clock is used to set the analyzer clock.
Language is used to set the interface display language, configurable parameters: Chinese and English.
Screen off is used to set how long to turn off the screen display after the analyzer has no key operation. It can be configured as: normally on, 1 minute, 5 minutes, 10 minutes, 15 minutes and 30 minutes.

8.4.8 Reset setting interface

The configurable parameters in the reset setting interface are as follows::

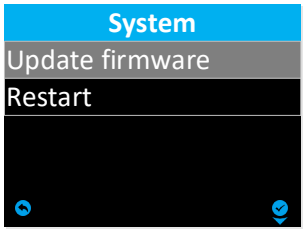


The selected content can be switched through key ▲ and key ▼, press key ✓ to enter the setting interface, and press key ↩ to exit the current interface.
energy is used to clear the stored energy of the analyzer.
The max and min. value are used to clear the max and min. values of parameters such as voltage, current and power.
Max demand is used to clean up statistical max demand.

Event is used to clean up statistical events. You can view event statistics in the "Event" interface of the data display interface。

8.4.9 System setting interface

The configurable parameters in the system setting interface are as follows:



The selected content can be switched through key ▲ and key ▼, press key ✓ to enter the setting interface, and press key ↩ to exit the current interface.
Update firmware is used to update the analyzer firmware through USB flash disk.
Restart is used to restart the analyzer. After some parameters are configured, restart is required to take effect.

9 Modbus Communication overview

Communication	
Communication interface	RJ45 、RS485
Communication protocol	Modbus TCP、Modbus RTU

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.

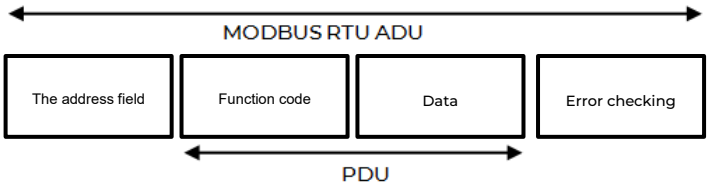
9.1 Modbus RTU communication parameters

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 method	–None –Odd –Even	None
Stop bit	1	1
Address	1–247	1

9.2 Modbus RTU data frame

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



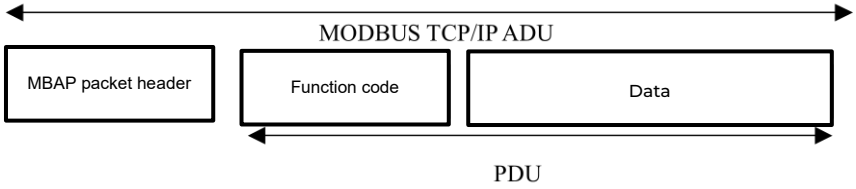
9.3 Modbus TCP communication parameters

Before Modbus TCP communication, 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

9.4 Modbus TCP / IP data frame

When transmitted over TCP / IP Ethernet, Modbus TCP / IP data frame includes mesdipe header, function code and data.



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

Field	Length	Description	Client	Server
Transaction meta identifier	2 bytes	ID of Modbus 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 mesdipe 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 domain 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.The Modbus client is set in the request.
This field. In the response, the server must return this field with the same value.

9.5 PDU request data format

Function code	Instructions
8-Bits	N×8-Bits

9.6 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 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, dips	Extended function code

9.7 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: writable through instruction register.
- Size: indicates how many 16 bit 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 details:

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 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	Configuration 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

9.8 Modbus TCP function code operation description

9.8.1 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:
Request data format:

Serial number	Name	Type	Range (decimal)	Description
1	Transaction unit ID	UInt16		High byte first (sending order)
2	Protocol identifier	UInt16	0=MODBUS	High byte first (sending order)
3	Data byte length	UInt16		High byte first (sending order)
4	Unit identifier	UInt8		
5	Function code	UInt8	16	
6	Register start address	UInt16	300	High byte first (sending order)
7	Number of registers	UInt16	1-123	High byte first (sending order)
8	Number of register bytes	UInt8		Number of registers * 2
9	Write value of register 1	UInt16	-	High byte first (sending order)
10	...	UInt16	-	High byte first (sending order)
11	Write value of register n	UInt16	-	High byte first (sending order)

Return data format:

Serial number	Name	Type	Range (decimal)	Description
1	Transaction unit ID	UInt16		High byte first (sending order)
2	Protocol identifier	UInt16	0=MODBUS	High byte first (sending order)
3	Data byte length	UInt16		High byte first (sending order)
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!

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 time (command = 1000, set to: 2019-5-9 12:01:00).

Serial number.	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 start address 300
7	Number of registers	UInt16	7	0007	
8	Number of register bytes	UInt8	14	0D	
9	Write value of register 300	UInt16	1000	03E8	Set time command 1000
10	Write value of register 301	UInt16	2019	07E3	Year=2019
11	Write value of register 302	UInt16	5	0005	Month=5
12	Write value of register 303	UInt16	9	0009	Day=9
13	Write value of register 304	UInt16	12	000C	Hour=12
14	Write value of register 305	UInt16	1	0001	Minute=1
15	Write value of register 306	UInt16	0	0000	Second=0

Sending the byte order 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, the following data will be returned:

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 register address	UInt16	012C	300
7	Number of registers	UInt16	0007	7

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

The function code (0x03 = 3) is used to read the analyzer register parameters. Its request data and return data format are as follows:

Request data format:

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

Return data format:

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

Sending the byte order 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

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

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

Request data format:

Serial No.	Name	Type	Range (decimal)	Description
1	Transaction unit ID	UInt16		High byte first (sending order)
2	Protocol identifier	UInt16	0=MODBUS	High byte first (sending order)
3	Data byte length	UInt16		High byte first (sending order)
4	Unit identifier	UInt8		
5	Function code	UInt8	100	
6	event number	UInt8	1-10	

Serial No.	Name	Type	Range (decimal)	Description
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 order)

Return data format:

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 data packet numbers	UInt16	1-65535	High byte first Each data packet contains a maximum of 128 data
11	Number of data	UInt16	1-128	High byte first
12	The 1st data	float32		High byte first
...	...	float32		High byte first
13	The Nth data	float32		High 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

Sending the byte order 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 4362A095 ...435C0000

Serial No.	Name	Type	Value (HEX)	Value (decimal)	Remarks
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 data packet numbers	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	

9.8.4 Error response

Error response data format:

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 supported by the analyzer is not used.
0x02	Illegal data address	The register data written or read is not the address range supported by the analyzer.
0x03	Illegal data value	The data value written to the register does not meet the requirements.
0x04	Analyzer error	An unknown error occurred

9.9 Modbus RTU function code operation instructions

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

Function code (0x10 = 16) is used to configure analyzer parameters. Its request and return data format are as follows:

Request data format:

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 order)
4	Number of registers	UInt16	1-123	High byte first (sending order)
5	Number of register bytes	UInt8		Number of registers * 2
6	Write value of register 1	UInt16	-	High byte first (sending order)
7	...	UInt16	-	High byte first (sending order)
8	Write value of register N	UInt16	-	High byte first (sending order)
9	CRC-16 check code	UInt16	-	Low byte first (sending order)

Return data format:

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 Check 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 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, Instruction + parameters total 7 registers are occupied
5	Data length	UInt8	14	0E	Number of configuration registers * 2
6	Write value of register 300	UInt16	1000	03E8	Instruction code 1001 for configuring time
7	Write value of register 301	UInt16	2019	07E3	Year=2019
8	Write value of register 302	UInt16	5	0005	Month=5
9	Write value of register 303	UInt16	9	0009	Day=9
10	Write value of register 304	UInt16	12	000C	Hour=12
11	Write value of register 305	UInt16	1	0001	Minute=1
12	Write value of register 305	UInt16	0	0000	Second=0
13	CRC-16 Check code	UInt16	64984	FDD8	Low byte first (sending order)

Sending the order of bytes 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
If the configuration data is correct, the following data will be returned:
01 10 01 2C 00 07 41 FE

Serial No.	Name	Type	Range (HEX)	Range (decimal)
1	Analyzer address	UInt8	01	1

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

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

The function code (0x03 = 3) is used to read the analyzer register parameters. Its request data and return data format are as follows:
Request data format:

Serial No.	Name	Type	Range (decimal)	Description
1	Analyzer address	UInt8	1-247	
2	Function code	UInt8	3	
3	Start register address	UInt16	-	High byte first (sending order)
4	Number of registers	UInt16	1-125	High byte first (sending order)
5	CRC-16 verification	UInt16	-	Low byte first (sending order)

Return data format:

Serial No.	Name	Type	Range (decimal)	Description
1	Analyzer address	UInt8	1-247	
2	Function code	UInt8	3	
3	Read register bytes	UInt8	-	Number of read 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 verification	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 verification	UInt16	32612	0x7F64	Low byte first (sending order)

Sending the order of 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

Serial No.	Name	Type	Hexadecimal	Decimal system
6	Phase C voltage	float32	435E0000	222V
7	CRC-16 verification	UInt16	14AC	

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

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

Request data format:

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 parameter data packet number	UInt16	1-65535	High byte first (sending order)
7	CRC-16 verification	UInt16	-	Low byte first

Return data format:

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 data packet numbers	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 verification	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 parameter data packet number	UInt16	1	0001	Read data packet 1
7	CRC-16 verification	UInt16	55471	D8AF	Low byte first (sending order)

Sending the order of 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 packets	UInt16	00C8	200	
7	Current data packet numbers	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
11	CRC-16 verification	UInt16	0BEA		

9.9.4 Error response

Error response data format:

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 verification	UInt16			Low byte first

Modbus error code:

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

9.10 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	Day
	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=3ϕ_WYE_4CT 1=3ϕ_WYE_3CT 2=3ϕ_DELTA_3CT 3=3ϕ_DELTA_2CT 4=1ϕ
	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= Rogowski coil access 1 = CT access
	W	1	UInt16	-	0,1,2	Rogowski coil current gear 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	IABC current ratio =actual ratio *10000

Setting IN current transformer parameters:

Instruction code	Operation	Size	Type	Unit	Range (decimal)	Description
1003	W	1	UInt16	-	0,1	IN current access mode 0= Rogowski coil access 1 = CT access
	W	1	UInt16	-	0,1,2	Rogowski coil current gear 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	INcurrent ratio =actural ratio*10000

Set RS485 communication parameters:

Instruction code	Operation	Size	Type	Unit	Range	Description

					(decimal)	
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

Setting voltage transformer parameters:

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

Clearing 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

Reset maximum demand：

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

Reset the maximum value:

Instruction code	Operation	Size	Type	Unit	Range (decimal)	Description
2003	W	1	UInt16	-	1	1: clearing max and min values of voltage and current 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 number Default: 1000
	W	1	UInt16	-	-	Phase B voltage waveform UDP port number Default: 1001
	W	1	UInt16	-	-	Phase C voltage waveform UDP port number Default: 1002
	W	1	UInt16	-	-	Phase A current waveform UDP port number Default:1003
	W	1	UInt16	-	-	Phase B current waveform UDP port number Default: 1004
	W	1	UInt16	-	-	Phase C current waveform UDP port number 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

Instruction code	Operation	Size	Type	Unit	Range (decimal)	Description
	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

9.10.1 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 number	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), Day (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=3ϕ_WYE_4CT 1=3ϕ_WYE_3CT 2=3ϕ_DELTA_3CT 3=3ϕ_DELTA_2CT 4=1ϕ
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 primary side input current value	86	R/WC	2	UInt32	A	

Register alias	Register Start address (decimal)	Operation Read / write	Size	Type	Unit	Description
IABC CT secondary side output voltage value	88	R/WC	2	UInt32	mV	
IABC current ratio	90	R/WC	2	UInt32	-	Actural 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
UABC voltage 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	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	秒	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

Register alias	Register Start address (decimal)	operation Read/write	Size	Type	Unit	Description
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 server:

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	-	

Temperature and humidity:

Register alias	Register Start address (decimal)	Operation Read/write	Size	Type	Unit	Description
Temperature of the 1st circuit	150	R	2	Float32	℃	External K-type thermocouple
Temperature of the 2nd circuit	152	R	2	Float32	℃	External K-type thermocouple
Temperature of the 3rd circuit	154	R	2	Float32	℃	External K-type thermocouple
Humidity	156	R	2	Float32	%RH	Ambient humidity

Digital input channel status:

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

Relay output status:

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	N-phase current
Current Avg	1008	R	2	Float32	A	Current average value of ABC three phase
Voltage						
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

Register alias	Register Start address (decimal)	Operation Read/write	Size	Type	Unit	Description
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	Phase C apparent power
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 reaches1.0 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 data units of the two 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 energy import
EPBImp	2002	R	2	UInt32	kWh	Phase B active energy import
EPCImp	2004	R	2	UInt32	kWh	Phase C active energy import
EPImp	2006	R	2	UInt32	kWh	Total active energy import
EPAExp	2008	R	2	UInt32	kWh	Phase A active energy export
EPBExp	2010	R	2	UInt32	kWh	Phase B active energy export
EPCExp	2012	R	2	UInt32	kWh	Phase C active energy export
EPExp	2014	R	2	UInt32	kWh	Total active energy export
Reactive energy						
EQAImp	2016	R	2	UInt32	kVARh	Phase A reactive energy import
EQBImp	2018	R	2	UInt32	kVARh	Phase B reactive energy import
EQCImp	2020	R	2	UInt32	kVARh	Phase C reactive energy import
EQImp	2022	R	2	UInt32	kVARh	Total reactive energy import

Register alias	Register Start address (decimal)	Operation Read/write	Size	Type	Unit	Description
EQAExp	2024	R	2	UInt32	kVARh	Phase A reactive energy export
EQBExp	2026	R	2	UInt32	kVARh	Phase B reactive energy export
EQCExp	2028	R	2	UInt32	kVARh	Phase C reactive energy export
EQExp	2030	R	2	UInt32	kVARh	Total reactive energy export
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 energy import
EPBImp	2504	R	4	UInt64	Wh	Phase B active energy import
EPCImp	2508	R	4	UInt64	Wh	Phase C active energy import
EPImp	2512	R	4	UInt64	Wh	Total active energy import
EPAExp	2516	R	4	UInt64	Wh	Phase A active energy export
EPBExp	2520	R	4	UInt32	Wh	Phase B active energy export
EPCExp	2524	R	4	UInt64	Wh	Phase C active energy export
EPExp	2528	R	4	UInt64	Wh	Total active energy export
Reactive energy						
EQAImp	2532	R	4	UInt64	VARh	Phase A reactive energy import
EQBImp	2536	R	4	UInt64	VARh	Phase B reactive energy import
EQCImp	2540	R	4	UInt64	VARh	Phase C reactive energy import
EQImp	2544	R	4	UInt64	VARh	Total reactive energy import
EQAExp	2548	R	4	UInt64	VARh	Phase A reactive energy export
EQBExp	2552	R	4	UInt64	VARh	Phase B reactive energy export
EQCExp	2556	R	4	UInt64	VARh	Phase C reactive energy export
EQExp	2560	R	4	UInt64	VARh	Total reactive energy export
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= Fixed
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						

Register alias	Register start address (decimal)	Operation Read/write	Size	Type	Unit	Description
PADemand	3020	R	2	Float32	kW	Current active power demand of phase A
PAPeakDemand	3022	R	2	Float32	kW	Active power peak demand 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
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
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
QSUMDemand	3076	R	2	Float32	kVar	Current total reactive power demand
QSUMPeakDemand	3078	R	2	Float32	kVar	Total reactive power peak demand
QSUMPeakDemand Date	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
SBDemand	3092	R	2	Float32	kVa	Current apparent power demand

Register alias	Register start address (decimal)	Operation Read/write	Size	Type	Unit	Description
						of phase B
SBPeakDemand	3094	R	2	Float32	kVa	Apparent power peak demand of phase B
SBPeakDemandDate	3096	R	4	Date time	-	Phase B apparent power peak demand occurrence time
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
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
IAPeakDemand	3118	R	2	Float32	A	Phase A current peak demand
IAPeakDemandDate	3120	R	4	Date time	-	Phase A current peak demand occurrence time
IBDemand	3124	R	2	Float32	A	Phase B current demand
IBPeakDemand	3126	R	2	Float32	A	Phase B current peak demand
IBPeakDemandDate	3128	R	4	Date time	-	Phase B current peak demand occurrence time
ICDemand	3132	R	2	Float32	A	Phase C current demand
ICPeakDemand	3134	R	2	Float32	A	Phase C current peak demand
ICPeakDemandDate	3136	R	4	Date time	-	Phase C current peak demand occurrence time
IAvgDemand	3140	R	2	Float32	A	Three phase average current demand
IAvgPeakDemand	3142	R	2	Float32	A	Three phase average current peak demand
IAvgPeakDemand Date	3144	R	4	Date time	-	Three phase average current peak demand occurrence time

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

Register name	Register start address (decimal)	Operation	Size	Type	Unit	Description
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
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

Maximum 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	Current min value of Phase A
IBMin	6012	R	2	Float32	A	Current min value of phase B
ICMin	6014	R	2	Float32	A	Current min value of phase C
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

Register name	Register start address (decimal)	Operation	Size	Type	Unit	Description
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
Max/Min value of active power:						
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	Maximum value of three-phase total active power
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	Minimum value of three-phase total active power
Max/Min value of reactive power：						
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	Max value of three-phase total reactive power
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	Minimum value of three-phase total reactive power
Max/Min value of apparent power:						
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	Max value of three-phase total apparent power
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	Min value of three-phase total apparent power

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:						
IAUbl	7000	R	2	Float32	%	Phase A current unbalance
IBUbl	7002	R	2	Float32	%	Phase B current unbalance
ICUbl	7004	R	2	Float32	%	Phase C current unbalance
IwstUbl	7006	R	2	Float32	%	Three phase most unbalanced degree
Voltage unbalance::						
UAUbl	7010	R	2	Float32	%	UA-UN phase voltage unbalance
UBUbl	7012	R	2	Float32	%	UB-UN phase voltage unbalance
UCUbl	7014	R	2	Float32	%	UC-UN phase voltage unbalance
PhasewstUbl	7016	R	2	Float32	%	Phase voltage most unbalanced degree for three phases
UABUbl	7020	R	2	Float32	%	UA-UB line voltage unbalance
UBCUbl	7022	R	2	Float32	%	UB-UC line voltage unbalance
UCAUbl	7024	R	2	Float32	%	UC-UA line voltage unbalance
LinewstUbl	7026	R	2	Float32	%	Three phase line voltage most unbalanced degree

Swells and dips:

Mq21 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
Swells and dips parameters:						
Vnom	7100	R/WC	2	UInt32	V	Nominal voltage value
Swell Threshold	7102	R/WC	1	UInt16	%	Percentage of swell trigger threshold
Dip Threshold	7103	R/WC	1	UInt16	%	dip trigger threshold percentage
Hysteresis	7104	R/WC	1	UInt16	%	Hysteresis percentage
Newly generated event:						
New Event Number	7160	R/WC	1	UInt16	-	Number of newly generated events since last reset When only one event occurs, the start and end numbers are the same
Start Event Index	7161	R	1	UInt16	-	The starting number of the newly generated event, Range 1-10
EndEventIndex	7162	R	1	UInt16	-	End number of newly generated event, Range 1-10
LastResetDateTime	7163	R	4	Date time	-	Time when the event count was last cleared
10 latest events(loop covering):						
Event_1_Type	7200	R	1	UInt16	-	Event 1 type 1=Swell 2=dip
Event_1_StartTime	7201	R	4	Date time	-	Time of occurrence 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

Register name	Register start address (decimal)	Operation	Size	Type	Unit	Description
						1=Swell 2=dip
Event_2_StartTime	7210	R	4	Date time	-	Time of occurrence 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	-	Event 3 time of occurrence
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	-	Event 4 time of occurrence
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	-	Time of occurrence 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	-	Event 6 time of occurrence
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	-	Event 7 time of occurrence
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	-	Event 8 time of occurrence
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

Register name	Register start address (decimal)	Operation	Size	Type	Unit	Description
						2=dip
Event_9_StartTime	7273	R	4	Date time	-	Event 9 time of occurrence
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	-	Event 10 time of occurrence
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

9.11 Operation guide for reading parameters of swells and dips

1. Use 0x03 function code to read the address 7160-7162 of "newly generated event register" to judge whether there is a new event.
2. If a new event is generated, use 0x03 function code to read the basic parameters of the event, address 7200-7288, according to the number of newly generated events and the starting number of the event.
3. Use the 0x64 function code to read the rms1 / 2 value or waveform parameters of the event.
4. Use 0x10 function code to configure "reset event count" and start new event statistics.

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