HMJK- Ⅱ 分接开关监测装置
TAP MONITOR

Product Manual

上海华明电力设备制造有限公司
ShangHai Huaming Power Equipment Co.,LTD

Preface

Welcome to use Huaming intelligent electronic devices!

Before using the HMJK - Ⅱ TAP MONITOR OLTC online monitoring device, please carefully read the user manual of this product. Be sure to pay attention to the following:

1. During the product harvest acceptance, the packing list is checked and accepted. Inspect the appearance of the device and retain evidence of transportation damage in order to claim compensation from the responsible party and protect your rights.

2. This user manual introduces the performance, functions, usage, maintenance, and other aspects of the device. The operating procedures and relevant indicators in this manual should be followed.

3. For first-time users of the device, please refer to the device drawings and pay attention to electrical safety.

4. Do not plug or unplug circuit board cards during live use of the equipment.

5. With the upgrading of technology and equipment, there may be some differences between the images, charts, and other data in this manual and the delivered products. These pictures are for reference only. Huaming reserves the right to provide technical specifications. If there are special purposes and functional requirements, please communicate with Huaming for special design solutions.

List

1. Synopsis

1.1 Device Introduction

HMJK - Ⅱ TAP MONITOR OLTC online monitoring device (hereinafter referred to as HMJK - Ⅱ) is an intelligent electronic device independently developed by Huaming for monitoring the status and faults of operating mechanisms and OLTC. For decades, OLTC have been using various outdated methods such as mechanical cam linkages, which have poor reliability and caused many OLTC accidents. As a socially responsible professional manufacturer of OLTC, Shanghai Huaming has summarized from different projects, learned and borrowed new technologies from different aspects, and designed and manufactured the HMJK - Ⅱ type tap changer monitoring device in combination with the HMJK - Ⅰ monitoring device.

The HMJK-II device can achieve real-time monitoring, analysis, and diagnosis of the operating status, gear information, and other aspects of the OLTC. It provides guidance for maintenance and early warning alarm signals to ensure the safe, reliable, stable, and efficient operation of the OLTC and transformer.

1.2 functional configuration

Basic functions：

- Measurement and calculation of single-phase voltage, current, frequency, power and other parameters of transformers；
- OLTC position information monitoring (BCD, 4-20mA)；
- Count the number of OLTC actions and action time；
- Motor current monitoring, waveform generation, and torque calculation；
- PT100 temperature signal acquisition; Oil temperature and oil pressure 4-20mA signal acquisition；
- Contact Wear and Life calculate prediction，And provide maintenance suggestions；

- Can be connected to the status signal of the oil filter;
- Monitor the vibration of the tap changer, generate waveform maps, and perform diagnostic analysis;
- Able to provide early warning and alarm for abnormal data, switch faults, etc;
- Communication protocol supports IEC61850 and Modbus;
- Web visualization OLTC monitoring system.
- Can be used in conjunction with HMIET - Ⅰ Automatic Voltage Regulator;

extended functions:

- Monitoring of micro water, acetylene, or hydrogen in OLTC oil;
- OLTC Voiceprint signal acquisition and analysis;
- Partial discharge monitoring, generating spectrogram analysis;
- Digital temperature and pressure three in one sensor;
- OLTC online monitoring system, supporting data uploading to SCADA and expanding transformer online monitoring;

1.3 Technical Characteristics

- The volume of HMJK-II device has been reduced to 3U chassis (width 442mm, height 133mm, depth 150mm), which can be installed separately in a wall mounted box or integrated inside the operating mechanism;
- Modular design, rear plug-in plug-in board, convenient wiring and installation, display and operation panel can be assembled separately;
- Adopting high-speed bus communication, real-time and efficient data processing;
- Input and output nodes can modify configurations according to user needs;

- Capable of forming waveforms such as motor current, vibration, and voiceprint, supporting storage and upload; Ability to analyze and diagnose waveforms;
- The device can upgrade the program through the network port and Rs232 serial port;

1.4 Ordering Instructions

- When placing an order, fill out the order specification sheet and provide valid information to facilitate the factory configuration of the equipment. After the equipment arrives at the site, it can be used directly without debugging;
- The extended monitoring function and related sensors of online monitoring equipment are optional items. Please clarify before placing an order;
- With the improvement and enhancement of the product, Shanghai Huaming reserves the right to make changes to the provided technical data and usage instructions;

2. Main technical parameters

2.1 Electrical parameters

2.1.1 Power supply

Standard	GB/T 8367-1987（IEC 60255-11:2008）
Input range	85-265V AC/DC two-way
Total power	<15W

2.1.2 Switching value input

Standard	IEC 60255-1:2009	
Rated voltage	110V DC	220V DC
Starting voltage	60.5V~77V	121V~154V
Rated current	1.1mA	1.1mA
Maximum current	300Vdc	
Withstand voltage	2000Vac，2800Vdc	

2.1.3 4~20mA DC current measurement

Range	4mA-20mA
Load resistance	75 Ω
Measurement error	±0.2% Full Range

2.1.4 AC Measurement

Current measurement	Level 0.5
Measuring range	0~10 A
Voltage measurement	Level 0.5
Measuring range	0~400 V

2.2 Environment Parameters

Standard	GB/T 14047-1993（IEC 60225-1:2009）
Operating temperature	-40°C~+70°C
Storage and	-45°C~+85°C
Relative humidity	5%~95%, no condensation or freezing inside the

2.3 Environment Parameters

RS-485	
Baud Rate	4800、9600、19200
Communication protocol	Modbus
Maximum load	32
Transmission distance	<500 m（Shielded twisted pair）

Ethernet Interface	
Connecting type	RJ-45 or fiber-optical Ethernet LC interface, multimode, wavelength 1310nm
Transmission rate	100Mbits/s，self-adaptive
Transmission standard	10Base-T/100Base-TX，100base-FX
Communication protocol	IEC 61850
Connecting type	Category 5 shielded network cable or multimode fiber

2.4 Type Tests

2.4.1 Environment test

Low temperature test	GB/T 2423.1-2008 Low temperature: 2h at -40°C
High temperature test	GB/T 2423.2-2008 High temperature: 2h at +70°C
Alternating damp heat test	GB/T 2423.4-2008 High temperature: 55°C, Low temperature: 20°C, RH 95%，2 loops of 12h+12h

2.4.2 Electrical insulation test

Insulation voltage	GB 14598.27-2008，2kV，50Hz，1 min
Insulation resistance	GB 14598.3-2006，>100MΩ at 500Vdc
Impulse voltage	GB 14598.3-2006，5KV
Overvoltage category	GB 14598.3-2006，category III

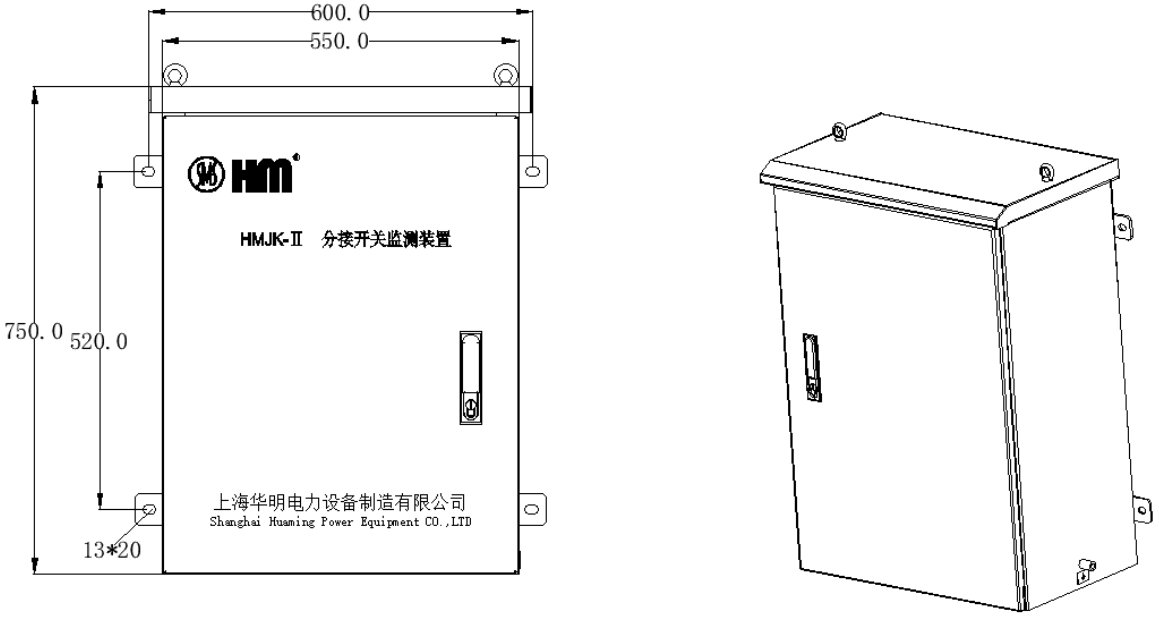
2.4.3 Electromagnetic compatibility test

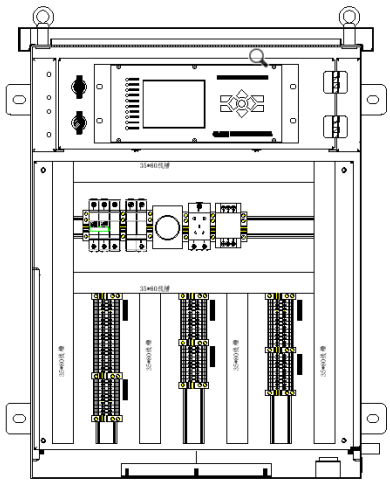
1MHz burst interference test	Level 3 （GB/T 17626-12-1998）
Electrostatic discharge test	Level 4 （GB/T 14598.14-2010）
Radiated electromagnetic field interference test	Level 3 （GB/T 17626.3-2006）
Fast transient interference test	Level A （GB/T 14598.10-2007）
Surge test	Level 4 （GB/T 17626.5-2008）
Radio frequency conducted interference test	Level 3 （GB/T 17626.6-2008）
Power frequency magnetic field immunity test	Level 5 （GB/T 17626.8-2006）
Pulsed magnetic field test	Level 5 （GB/T 17626.9-1998）
Damped oscillating magnetic field test	Level 5 （GB/T 17626.10-1998）

The auxiliary power port voltage drops, Short interruption	When it drops to 40% of the rated voltage, the device can be guaranteed to work normally within 300ms; short-term interruption: the device will not restart within 100ms

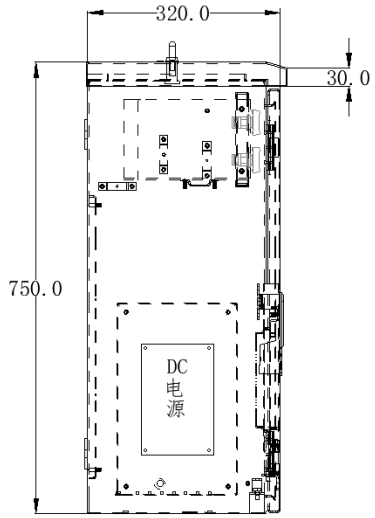
3. Hardware Description

3.1 Appearance and installation dimensions

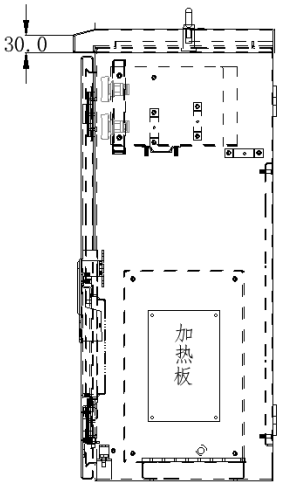




front view



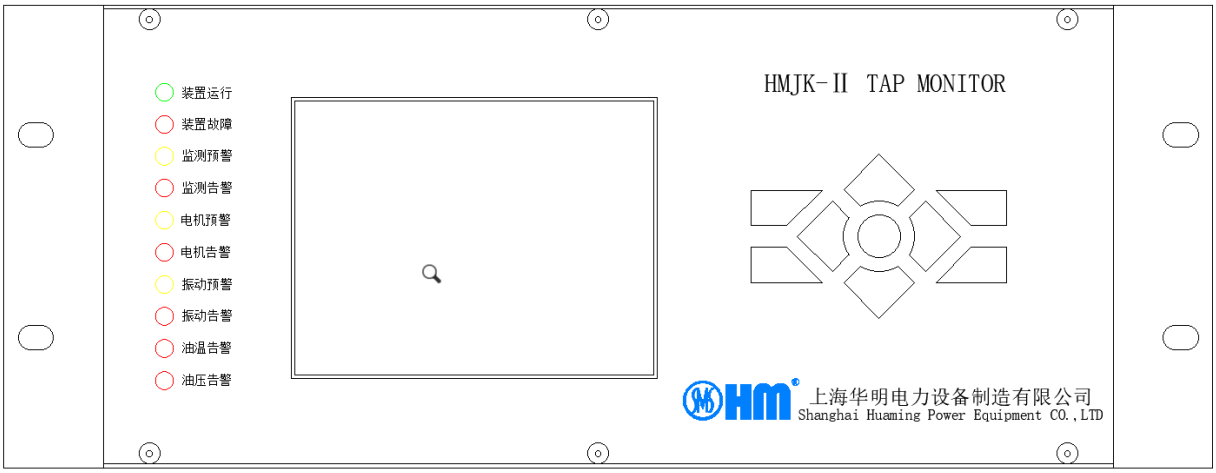
left view



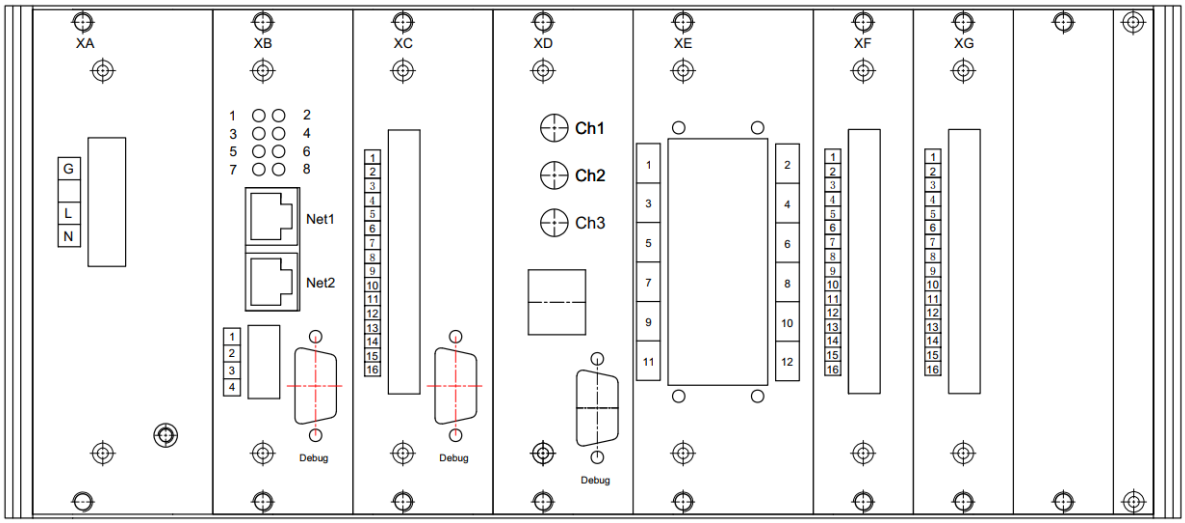
right view

The on load tap changer online monitoring cabinet is installed on the transformer body, and the intelligent electronic device can also be assembled with the operating mechanism. The cabinet protection level is IP55. The cabinet is equipped with terminal blocks, air switches, Lightning surge protector， heating plates, lighting lights, grounding copper bars, and temperature controllers. The cabinet configuration meets the requirements of on-site online monitoring.

3.2 Intelligent electronic devices



The intelligent electronic device adopts an all aluminum chassis design, with surface wire drawing treatment and aluminum shell oxidation. The circuit board is a rear plug-in installation, and the front panel is equipped with LCD, LED indicator lights, and buttons.



Device Backboard Terminal Definition Diagram

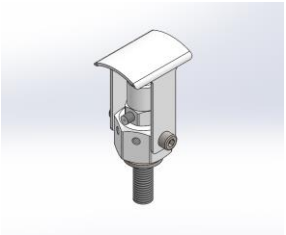
The hardware board of the device is configured from left to right in one go: power board, communication board, main control board, high-speed sampling board, AC quantity board, input board, output board;

3.3 Sensor configuration

3.3.1 Vibration sensor

Vibration monitoring adopts a vibration sensor connection device, which is installed on the top cover of the switch. Using the principle of bone conduction to obtain information on vibration transmission .The bolt type installation is simple and reliable, and can stably collect vibration signals of the OLTC tap changer and related components during gear shifting.And generate vibration waveforms, calculate and diagnose whether the action of the tap changer is abnormal through algorithms such as high and low frequency energy ratio, envelope peak value, and coincidence degree.

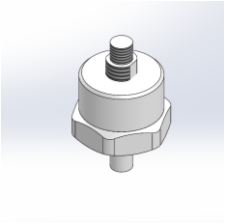
sensitivity	100mV/g
measuring range	±50g
Frequency range	0.5Hz~20kHz
self-resonant frequency	≥27kHz



3.3.2 Voiceprint sensor

Voiceprint monitoring adopts a broadband pickup sensor access device, which is installed on the top cover of the switch or the side of the transformer oil tank. The bolt type installation is simple and reliable, and the bone conduction signal transmission ensures stable collection of sound and vibration signals during the switch action process;

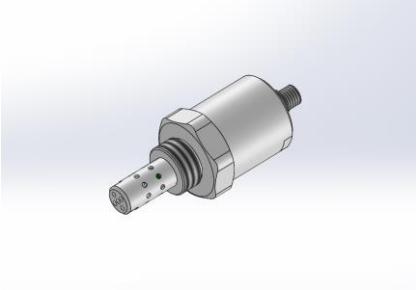
sensitivity	-37dBFS
measuring range	132dB
Frequency range	0.1Hz~80kHz



3.3.3 Acetylene content monitoring sensor in oil

Gas monitoring in oil is connected to a photoacoustic spectroscopy acetylene sensor, which requires separate power supply and independent installation. A local cabinet needs to be placed near the inlet and outlet oil pipes of the tap changer, and pipeline connections are used to ensure reliable sealing of the oil circulation;

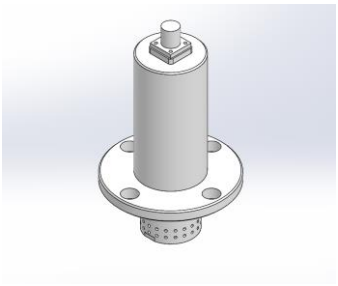
Measuring range	0~500ppm
Measurement accuracy	±0.1ppm

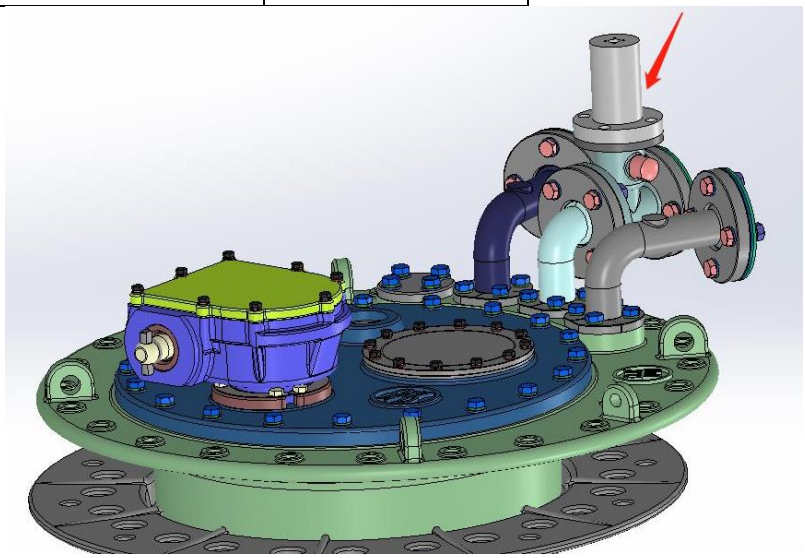


3.3.4 Oil temperature and oil pressure two in one sensor

The switch oil temperature and oil pressure monitoring adopts a digital pressure temperature two in one sensor, which can be installed at the bent oil pipe of the tap changer top cover. The Modbus communication protocol is used to transmit data to the online monitoring wall mounted box; It can also be used separately according to the renovation project.

Temperature measurement range	-40~120℃
Temperature measurement accuracy	±0.3℃
Pressure measuring range	0~300KPa
Pressure measurement accuracy	0.5%FS
Stability of stress testing (±%FS/year)	0.1

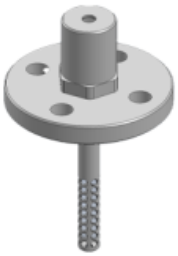




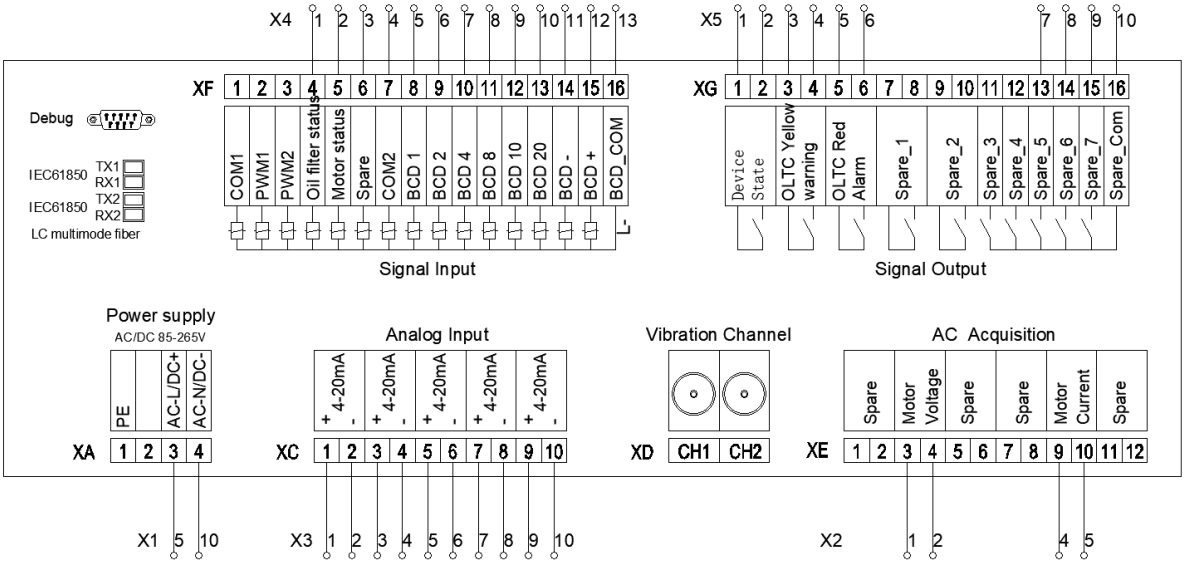
3.3.5 Micro water content and oil temperature monitoring sensors

Micro water content and oil temperature monitor sensors, installed on the top cover of OLTC, and the signal is introduced into the device through wiring.

Temperature Measuring range	-40~120℃
Measurement accuracy	±0.3℃
Micro water Measuring range	0~100ppm
Measurement accuracy	±5%
Power supply	DC 24V
Communication	Modbus



4. Wiring Instructions



- XA Power board:

Terminal group XA is a four core power terminal that includes a power input, supports AC/DC redundancy, and has an input voltage range of 85-265V AC/DC.

XA	
1	GND
2	
3	AC L / DC+
4	AC N/ DC-

- XC Main control board:

XC			
1	4-20mA_1 +	9	PT100_RTD+
2	4-20mA_1 -	10	PT100_RTD-
3	4-20mA_2 +	11	PT100_RTDC
4	4-20mA_2 -	12	NC
5	4-20mA_3 +	13	485_1A
6	4-20mA_3 -	14	485_1B
7	4-20mA_4 +	15	485_2A
8	4-20mA_4 -	16	485_2B

The main control board includes four 4-20mA analog signal acquisition channels, one PT100 measurement channel, and two RS485 communication channels.

- XD high-speed sampling board：

The high-speed sampling template is equipped with three vibration information acquisition channels, as well as one RJ45 Ethernet interface and one debugging interface; In conventional configuration, the vibration acquisition board only uses a single channel to collect vibration data, and the three channels can be suitable for one to three tap changer or special application situations; One RJ45 Ethernet interface for transmitting data and waveforms during extended voiceprint monitoring;

- XE AC quantity board：

The AC quantity board can provide AC quantity collection of transformer load voltage, load current, motor voltage, and motor current. Voltage collection range: AC 0~400V, current collection range 0~10A；

XE		
1	Load Voltage	2
3	Motor Voltage	4
5	Spare	6
7	Load Current	8
9	Motor Current	10
11	Spare	12

- XF Input board：

Each input board is equipped with one set of BCD signal input nodes, with the node source being DC110V. It also includes 5 sets of input signals, which can be freely configured or modified as needed.

XF			
1	In_24	9	BCD_2
2	PWM1	10	BCD_4
3	PWM2	11	BCD_8
4	Oil filter Status	12	BCD_10
5	Motor Status	13	BCD_20
6	Spare	14	BCD_-
7	Spare	15	BCD_+
8	BCD_1	16	BCD_Com

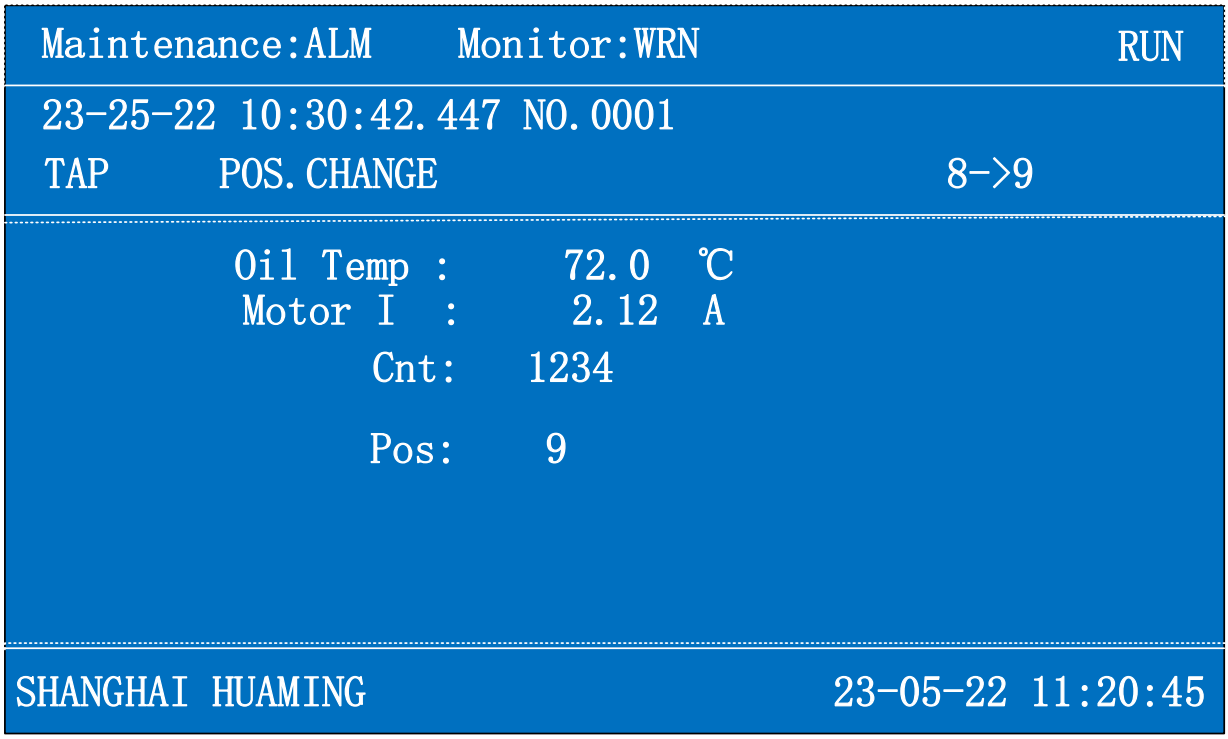
- XH Output board:

Each output board supports 10 dry node output signals, which can be configured as normally open or normally closed nodes according to requirements, with a breaking time of less than 10ms.

<table>
<tr><td colspan="4">XH</td></tr>
<tr><td>1</td><td rowspan="2">Device status signal</td><td>9</td><td rowspan="2">Output_2</td></tr>
<tr><td>2</td><td>10</td></tr>
<tr><td>3</td><td rowspan="2">Yellow warning signal</td><td>11</td><td>Output_3</td></tr>
<tr><td>4</td><td>12</td><td>Output_4</td></tr>
<tr><td>5</td><td rowspan="2">Red alarm signal</td><td>13</td><td>Output_5</td></tr>
<tr><td>6</td><td>14</td><td>Output_6</td></tr>
<tr><td>7</td><td rowspan="2">Output_1</td><td>15</td><td>Output_7</td></tr>
<tr><td>8</td><td>16</td><td>Com</td></tr>
</table>

5. Operating instructions

5.1 Main page description



The main page is shown in the figure. In the first row of the first part, the current device operating status is displayed, whether there are alarms, whether there are warnings, and whether the current working mode is "Run" or "DBG".

The second part is the content of the second line, which displays the latest event and its occurrence time, and records the detailed content of the event, such as "8-9 gear changes".

The third part is the real-time measurement display area in the middle, which displays the main monitoring values, such as the current "oil temperature", "motor current", "number of actions", "current gear" and other important information. When temperature monitoring function is not required, it can be turned off and not displayed on the homepage.

The fourth part is the bottom area, which mainly displays the company name of Shanghai Huaming and the current real-time time.

5.2 Instructions for use

5.2.1 Device working status

"WRN" stands for warning, triggered when the maintenance and upkeep items or monitored items or values of the device meet the warning conditions; "ALM" indicates an alarm, which is triggered when the maintenance or monitoring items of the device have reached the alarm conditions. When abnormal data is detected, an alarm signal will also be triggered.

"DBG" indicates that the current working mode of the device is debugging mode. In debugging mode, parameter settings, equipment debugging, and other operations can be performed. Modifying various parameters or fixed values in the system can only be done in debugging mode; "RUN" indicates that the device is working in running mode, with all logic and functions put into operation. It can operate the device control instructions in real time, and needs to be in running mode when debugging is completed and practical application is carried out; The device will perform a self check on the internal hardware circuit every time it starts up, and when a self check fault occurs, it will display "DERR" or "RERR".

Simultaneously press the "↑" and "↓" keys on the keyboard, enter the password, and switch between debugging mode and running mode. You can also switch between them in the menu "4.1".

When modifying configuration parameters, the "+" and "-" keys can be used to increase or decrease them. When modifying values, the "←" and "→" keys can be used to switch between digits.

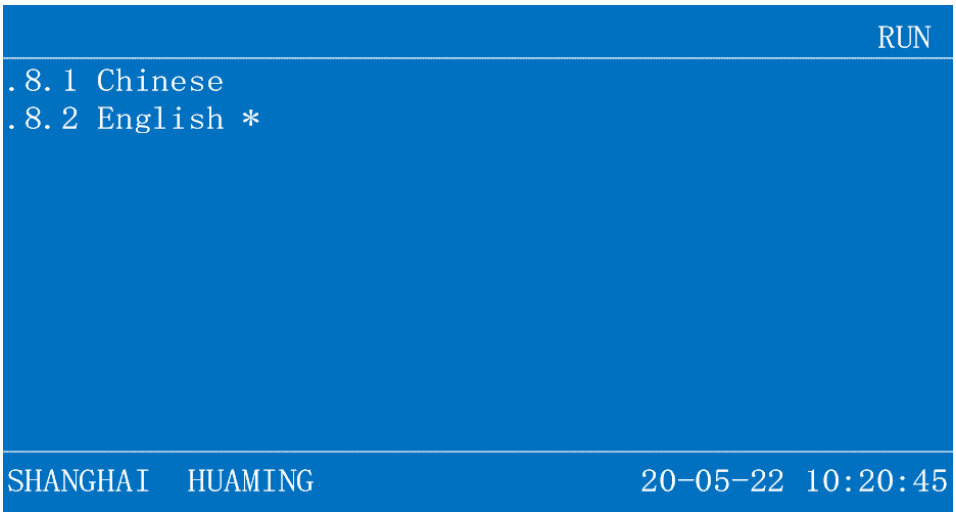
5.2.2 System event

The events generated by the system will be pushed to the main interface, which includes the time, type, and structure of the events. The reset button will reset the event information in the area. All saved events can be viewed in menu 2.1.

5.2.3 Real time measurement value

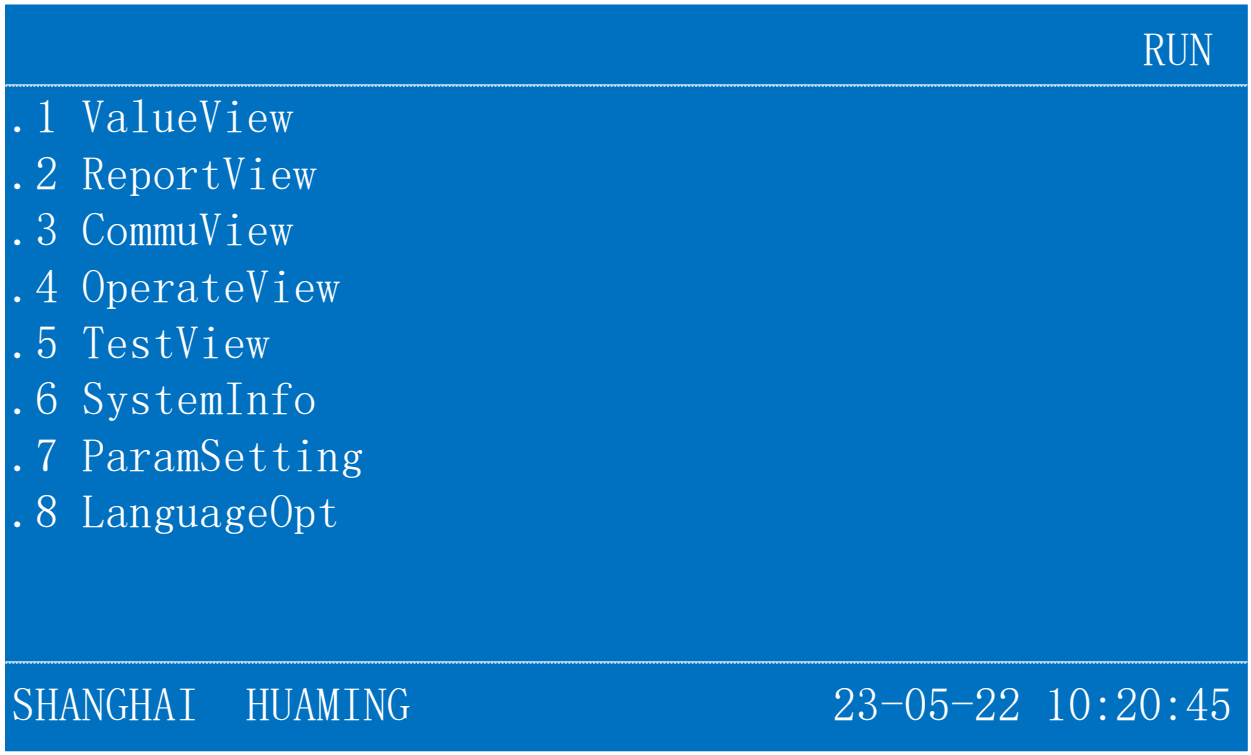
The homepage interface will display the real-time monitored values of the device, including motor current, oil temperature monitoring, number of actions, and current gear information. You can also view the data of input signals, output signals, analog signals, and other signals in the menu "1. Measurement Display".

5.2.4 Language



You can choose the desired language in the language settings, including Chinese and English.

5.3 Main Menu Description



.1 Value View，In this menu, you can view the status information of the switch, communication volume collection, input status display, output status display, analog quantity display, maintenance status display, motor monitoring display, and switch action statistics;

.2 Report View，This menu includes functions such as device log reports, curve reports, export logs, and export curves;

.3 Communication View，Can view the connection status of two Ethernet interfaces and 485 communication interfaces;

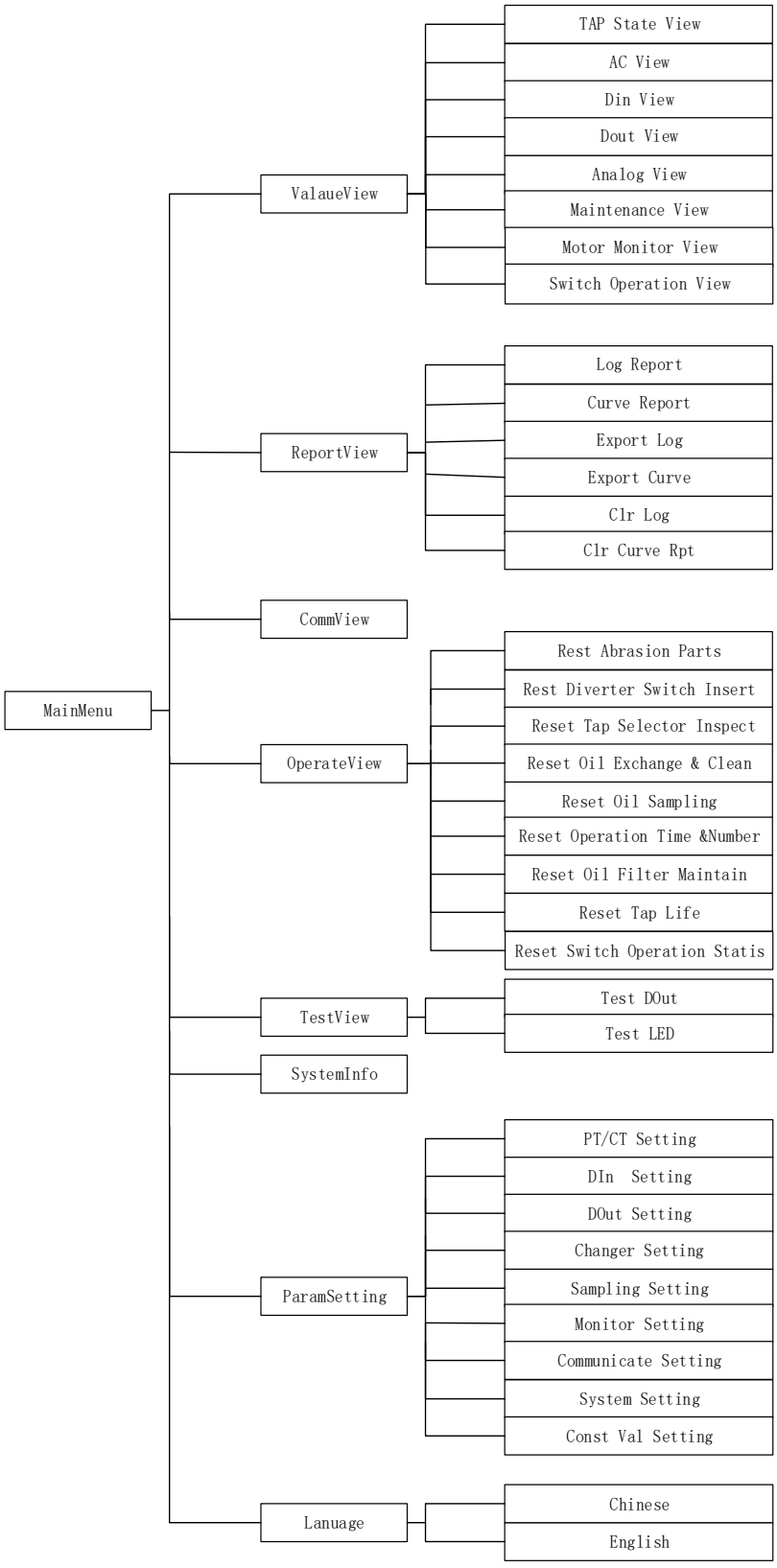
.4 Operate View，This menu includes reset operations for running/debugging status switching, as well as all maintenance items and switch switching statistics;

.5 Test View，Able to conduct lighting tests on the LED lights on the panel and simulate testing for opening and closing control of the output signal.

.6 System Info，The system information function displays the running information of the current program version number and other devices used;

.7 Param Setting， The system settings include functions such as setting the ratio of PTCT, setting the output node, setting the input node, setting the switch, setting the motor monitoring, setting the communication, setting the system parameters, and setting the fixed value. When modifying parameter settings, please note that it is necessary to be in debugging mode.

.8 Language， In the language settings, all menu functions can be selected, and the language is Chinese/English.


MainMenu
ValaueView
TAP State View
AC View
Din View
Dout View
Analog View
Maintenance View
Motor Monitor View
Switch Operation View
ReportView
Log Report
Curve Report
Export Log
Export Curve
Clr Log
Clr Curve Rpt
CommView
OperateView
Rest Abrasion Parts
Rest Diverter Switch Insert
Reset Tap Selector Inspect
Reset Oil Exchange & Clean
Reset Oil Sampling
Reset Operation Time &Number
Reset Oil Filter Maintain
Reset Tap Life
Reset Switch Operation Statis
TestView
Test DOut
Test LED
SystemInfo
ParamSetting
PT/CT Setting
DIn Setting
DOut Setting
Changer Setting
Sampling Setting
Monitor Setting
Communicate Setting
System Setting
Const Val Setting
Lanuage
Chinese
English

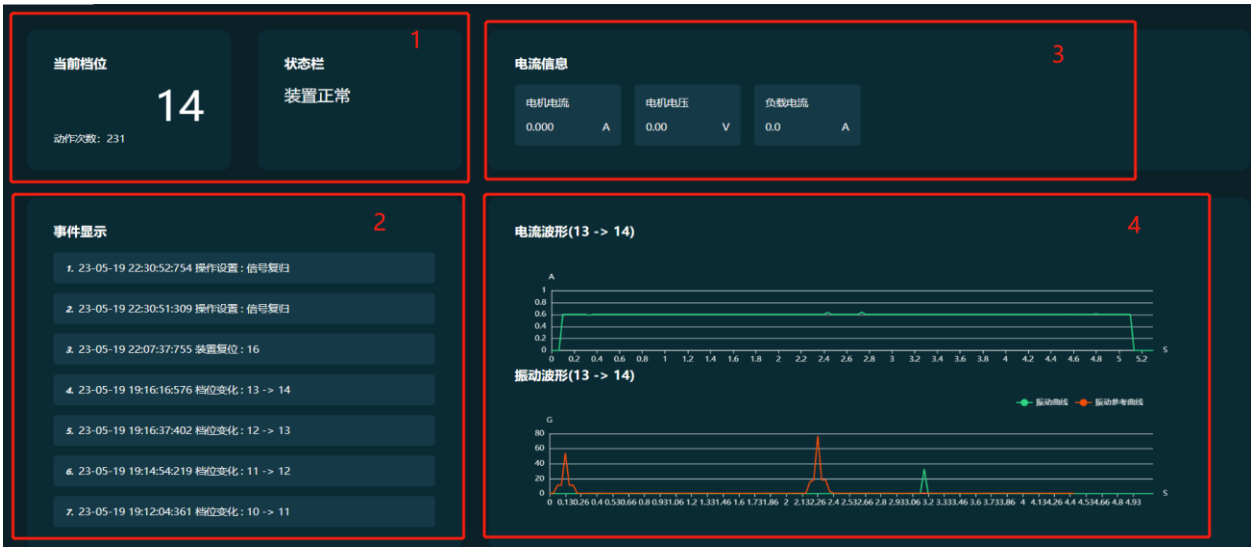
6. software system

6.1 Web Display System

The HMJK-II OLTC monitoring device is configured with a web page backend system, which includes three parts: system homepage, equipment information, and equipment parameters. Using a web page system, real-time device information, device parameters, tap changer gear information, and gear action changes can be viewed, supporting functions such as parameter modification.

6.1.1 System homepage

The system homepage mainly consists of four parts. The first part displays the current gear and number of actions of the tap changer, as well as the operating status of the device at this time; The second part is event display, displaying nearly 20 device operation logs, including gear changes and signal reset, etc; The third part is the display of traffic information, which displays the motor current, motor voltage, and load current; The fourth part displays the current waveform and vibration waveform of the latest gear switching action;



6.1.2 Device information

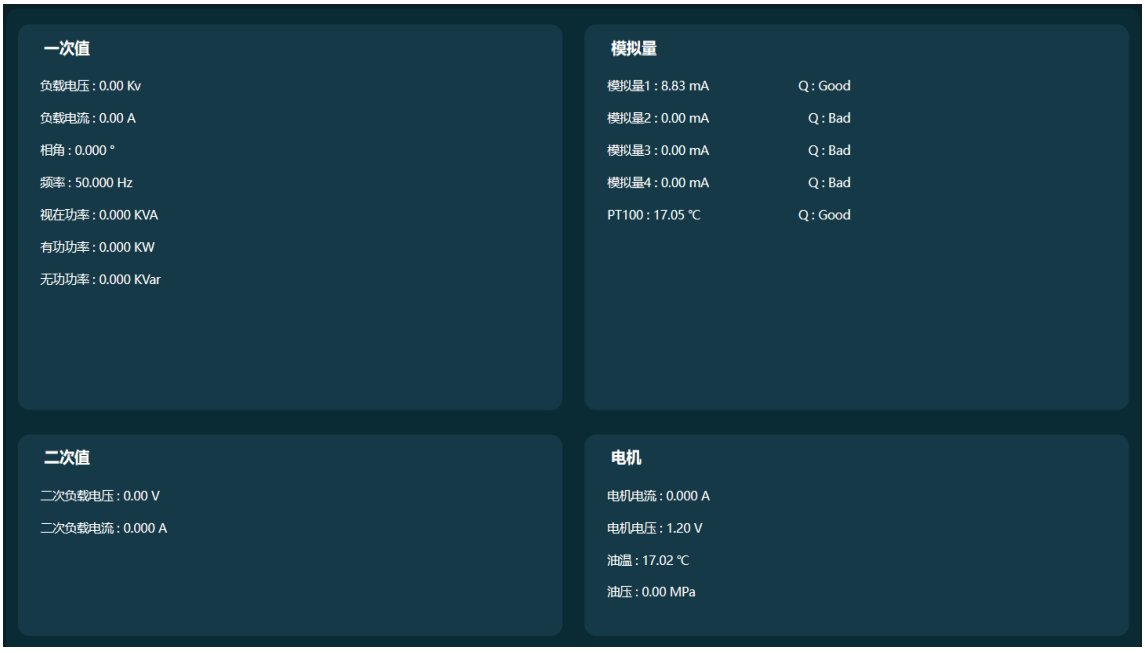
The device confidence includes 8 modules, namely "log display", "curve display", "status display", "measurement display", "input/output display", "maintenance display", "OLTC statistics", and "nameplate information". The Chinese and English modules in the header can be switched between Chinese and English languages by clicking. The detailed functions and display content are as follows:

Log display: displays information such as device gear action changes, system operation logs, status input and output logs, etc;

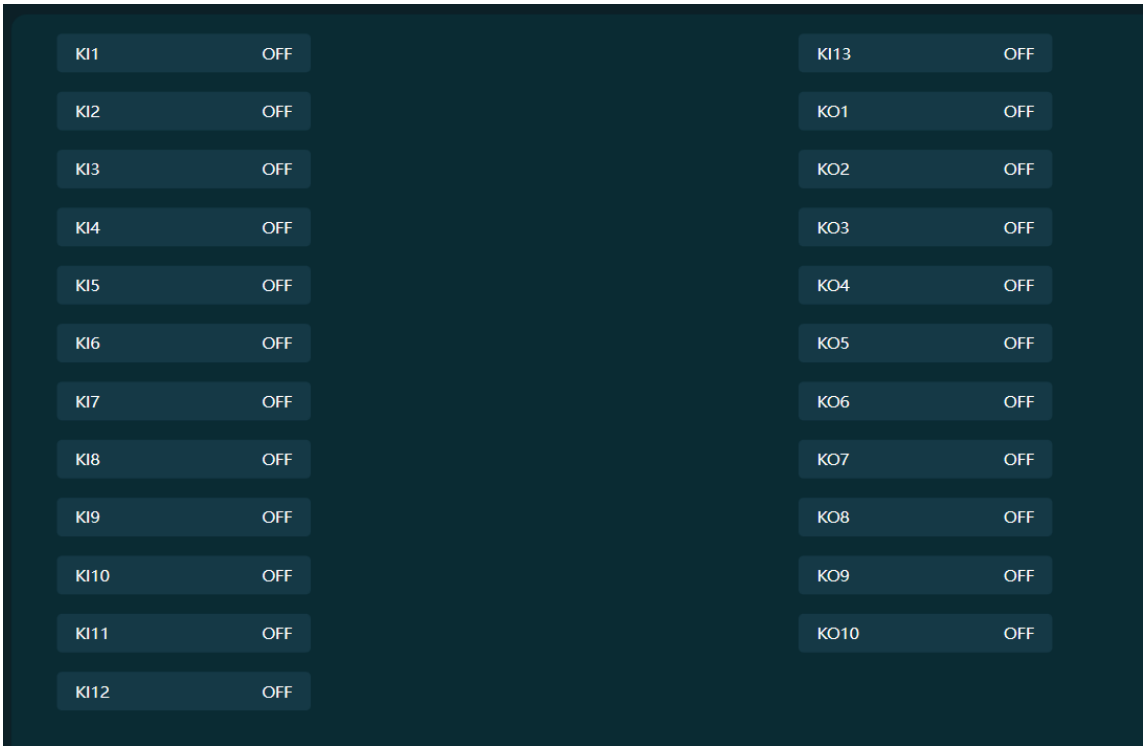
Curve display: Display the action time and current curve MAC of different gear shifts and gear adjustments, as well as the corresponding current waveform and vibration waveform;

Status display: This module displays all maintenance items, monitoring items, warning and alarm status of output signals, as well as equipment status;

Measurement display: displays the primary and secondary values collected by the AC flow rate, the status of the analog channel, as well as the measurement values and the measurement values of the driving motor;

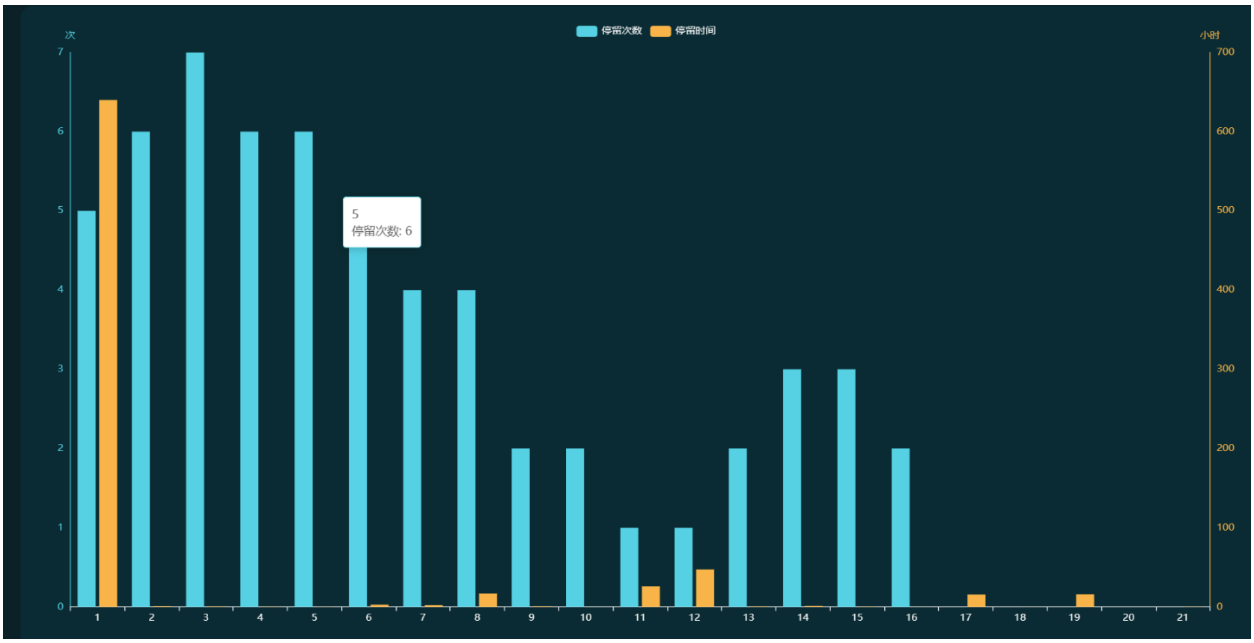


Input/output display: displays the status of all input/output nodes;

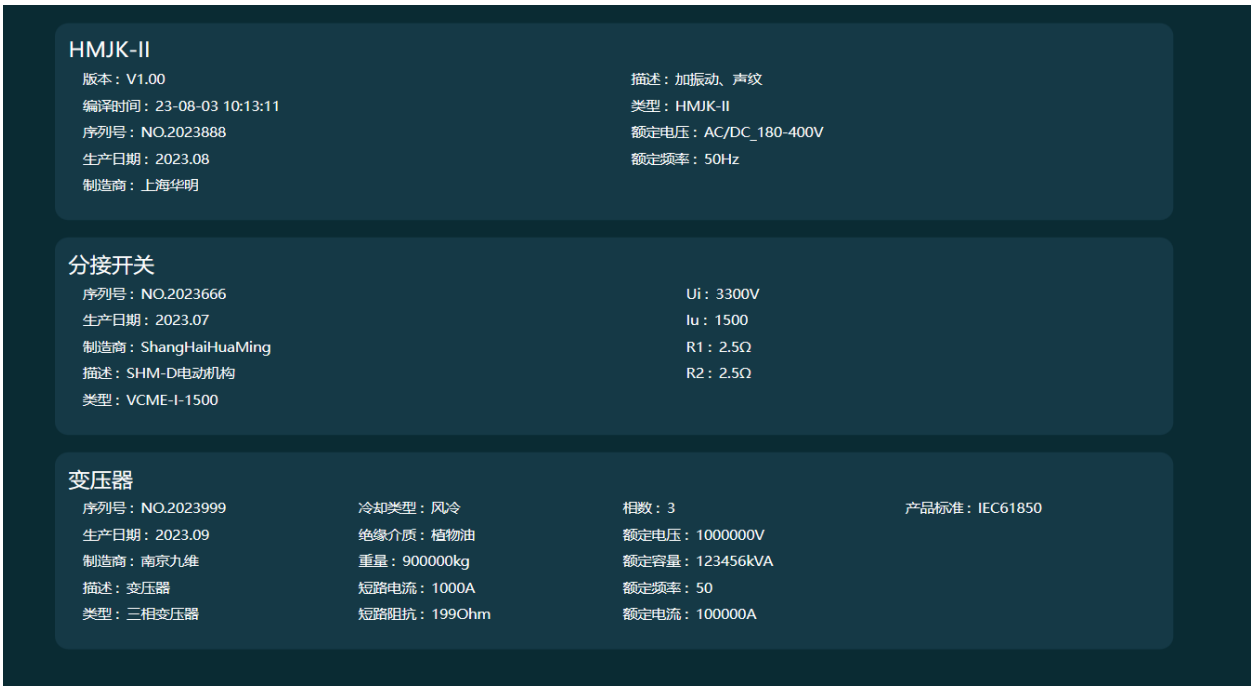


Maintenance display: displays the percentage of usage times and time corresponding to each maintenance type. When it reaches 80% of the set value, the equipment issues a maintenance warning signal. When it reaches 100% of the set value, the equipment issues a maintenance alarm and provides maintenance suggestions;

Switch switching statistics: This function module displays the statistics of the number of times (blue) and dwell time (yellow) for switching all gears during the current tap switch;



Nameplate: The electronic nameplate will display information about all devices, including HMJK monitoring equipment, tap changer related information, and transformer related information. This information will be configured and displayed at the factory, some of which are default items;

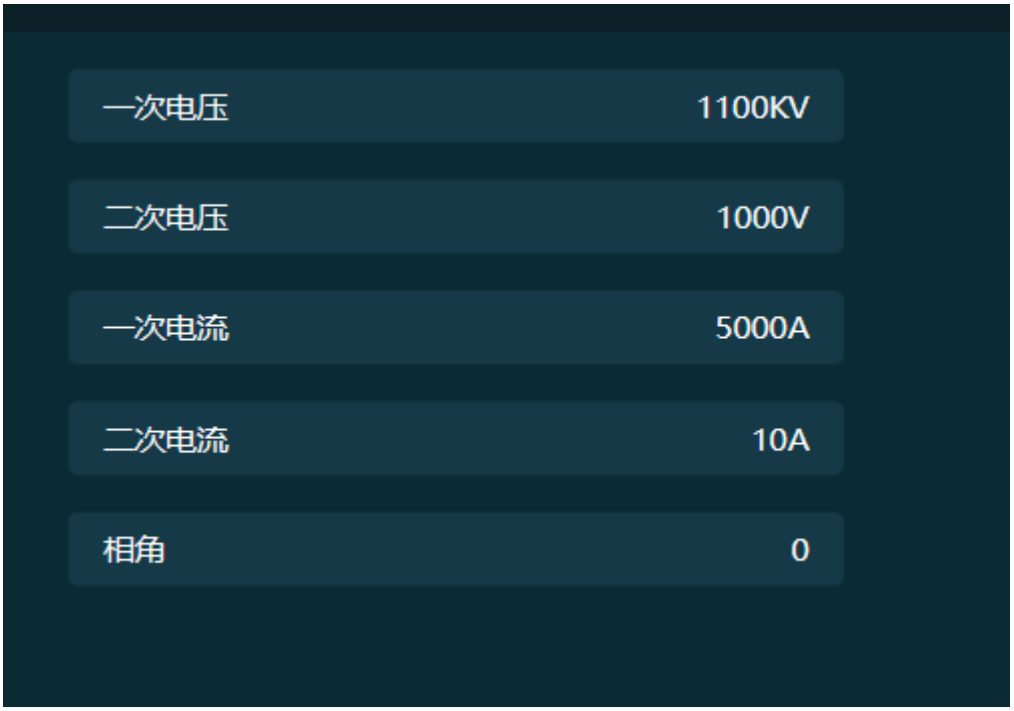


Note: The parameters shown above are for reference only.

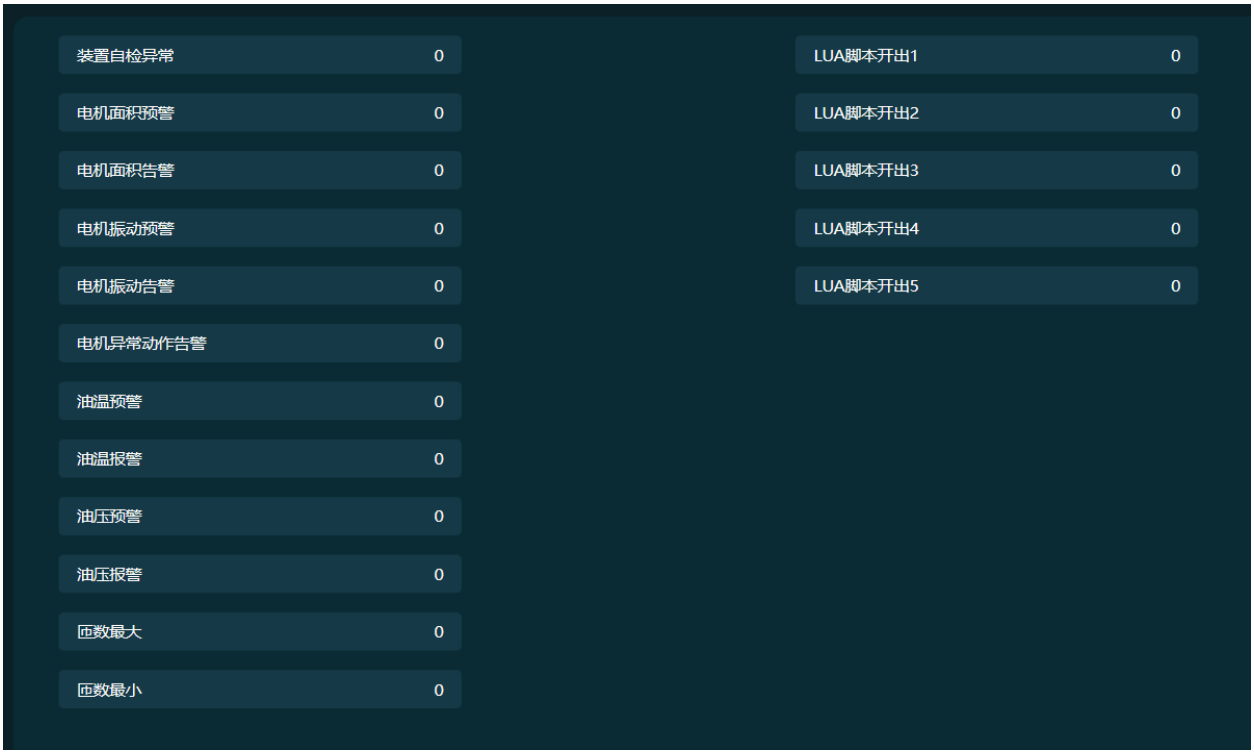
6.1.3 Equipment parameters

The device parameters contain numerical settings for 7 parameter modules, namely: "VT/CT Settings", "Output Settings", "OLTC Settings", "Sampling Accuracy Settings", "Monitoring Settings", "Communication Settings", and "System Settings".

VT/CT settings: The VT/CT settings mainly focus on VT and CT parameters. This function is used to monitor the low voltage side load current and load voltage. Some projects do not use this function and can ignore it.



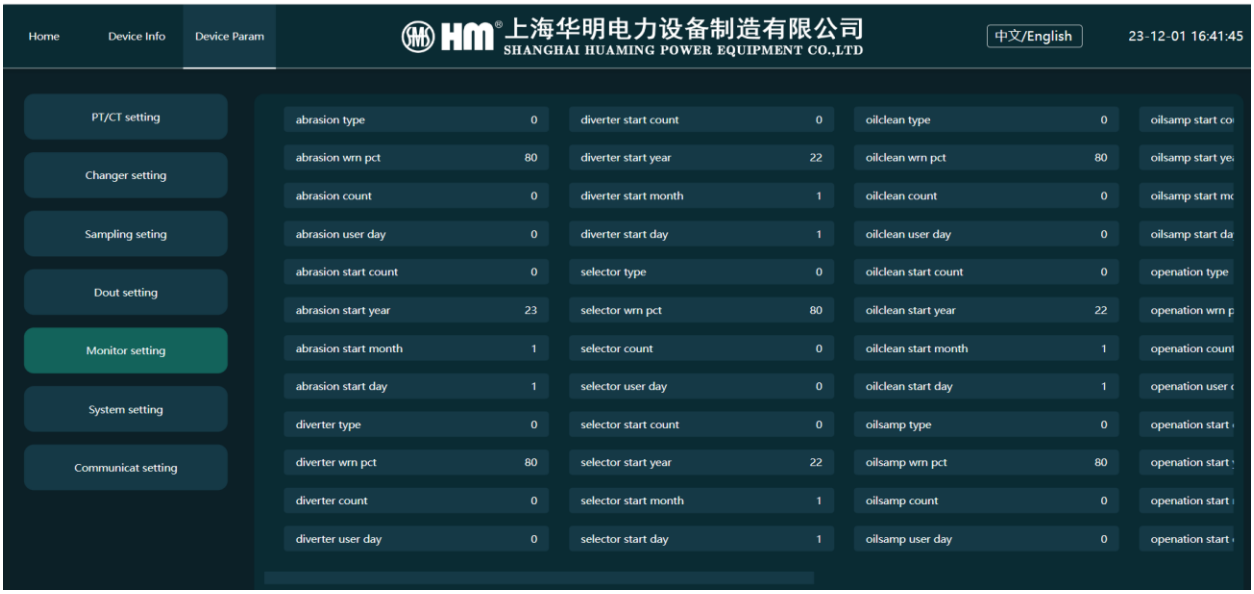
Output setting: The definition of signal output nodes can be set;



OLTC settings: The relevant parameters of the OLTC can be configured and calibrated;

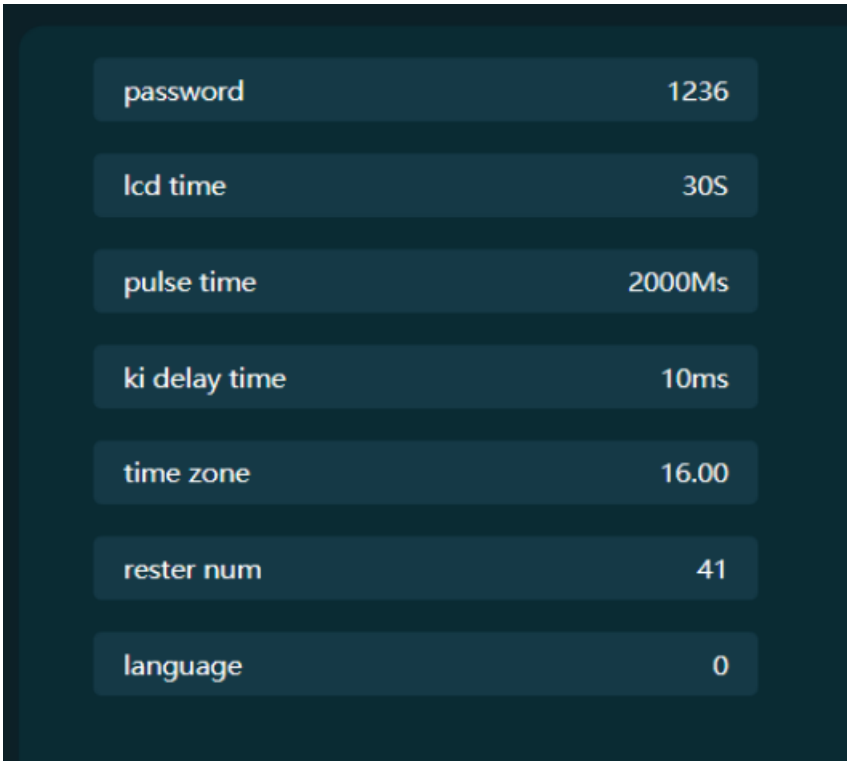
Sampling accuracy setting: Can calibrate secondary voltage, secondary current, 4-20mA data collection. Under normal circumstances, the equipment is calibrated during factory debugging and can be used directly on site;

Monitoring settings: In the monitoring settings, various maintenance types or monitoring items of the OLTC can be configured or modified according to maintenance standards, enterprise standards, or user usage, including usage frequency, usage time, percentage of warnings, percentage of alarms, whether to activate a certain monitoring item, and setting of related alarm limits;



Communication settings: Configure the IP addresses of two network ports;

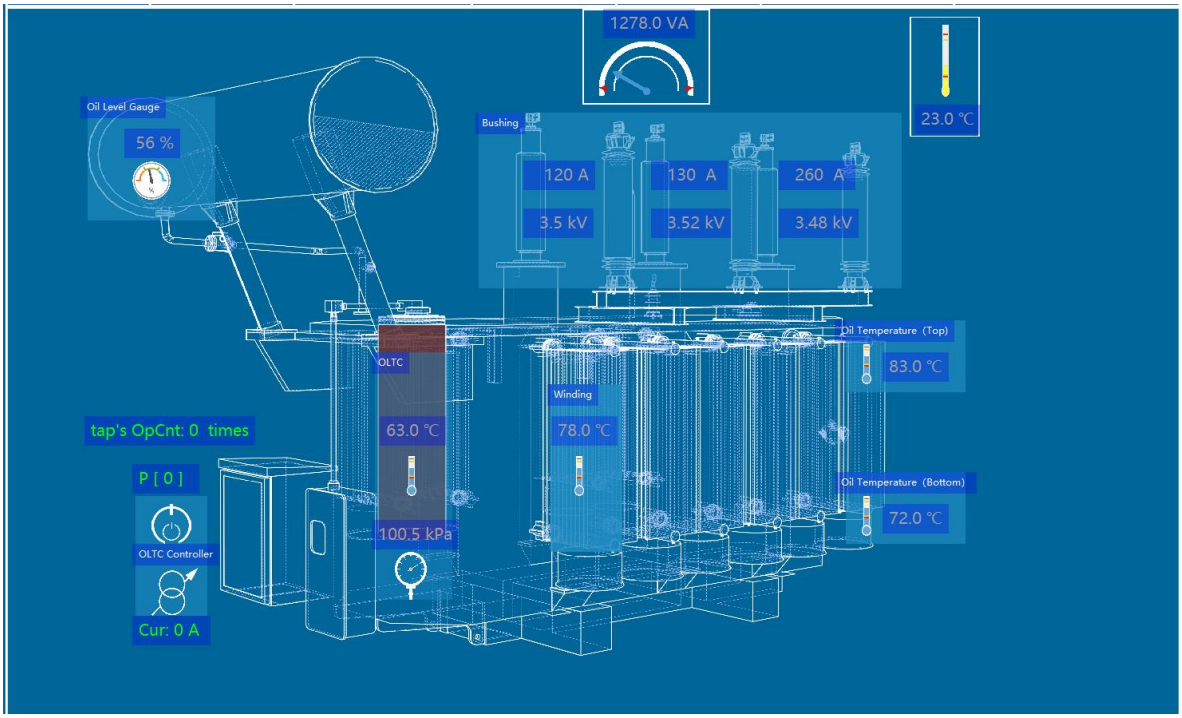
System settings: In system settings, it is the configuration of device usage and other functions, as shown below;



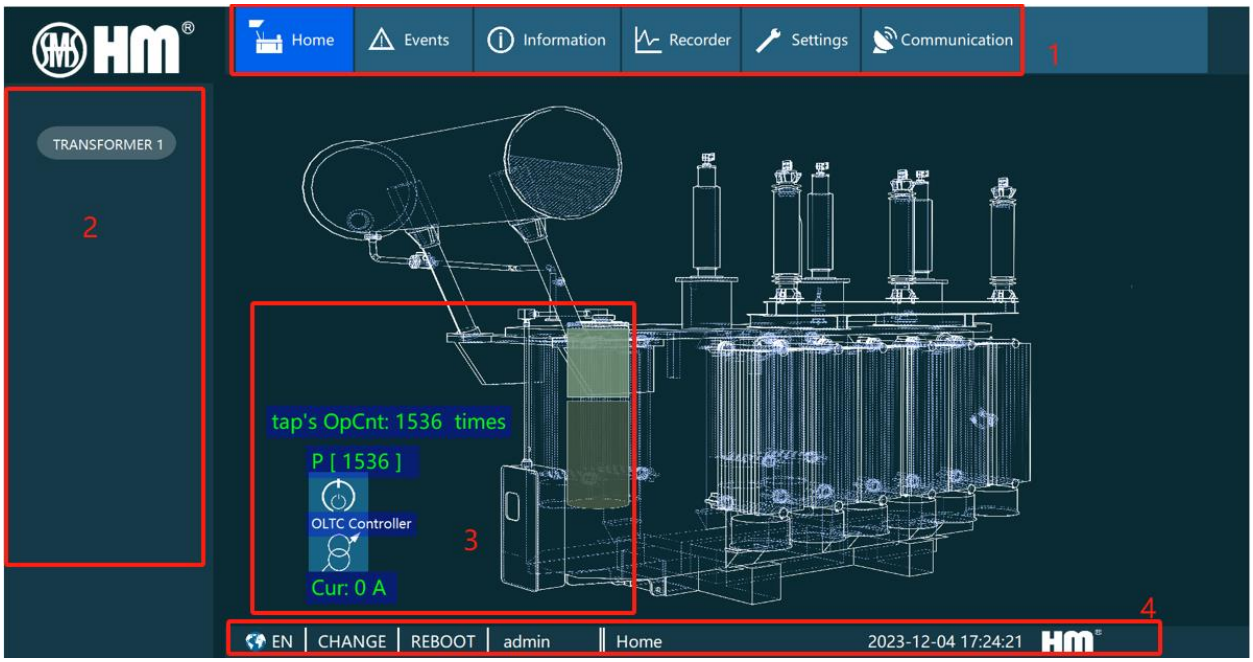
Note: The default password for the device is 1236, and it is not recommended to change it. If the backlight time is 0 seconds, it means it is always on.

6.2 PC monitoring and diagnostic system

The OLTC online monitoring backend system is an online analysis and diagnosis system used to monitor transformers and on load tap changers. It can monitor the normal operation of transformers while they are energized, without affecting their normal operation. This system mainly includes multiple signal acquisition points and their one-to-one correspondence through views. The real-time and efficient propagation speed makes the monitoring results more accurate. It can monitor the on load tap changer in real time, detect faults or abnormal situations in a timely manner, effectively avoid transformer faults or damage, and improve the reliability and service life of transformers and tap changers.



HMJK - Ⅱ can expand the comprehensive online monitoring of transformers and integrate with OLTC analysis and diagnosis systems to achieve comprehensive monitoring of transformers. This includes important information monitoring of transformers, such as bushing dielectric loss monitoring, DGA monitoring, oil temperature and oil pressure monitoring, oil level monitoring, partial discharge monitoring, etc. By collecting information from devices and sensors, transmitting it in real-time to the backend and analyzing and diagnosing the sampled data, warning and warning signals are given in case of abnormal or deteriorating trends in the data, and maintenance suggestions are proposed



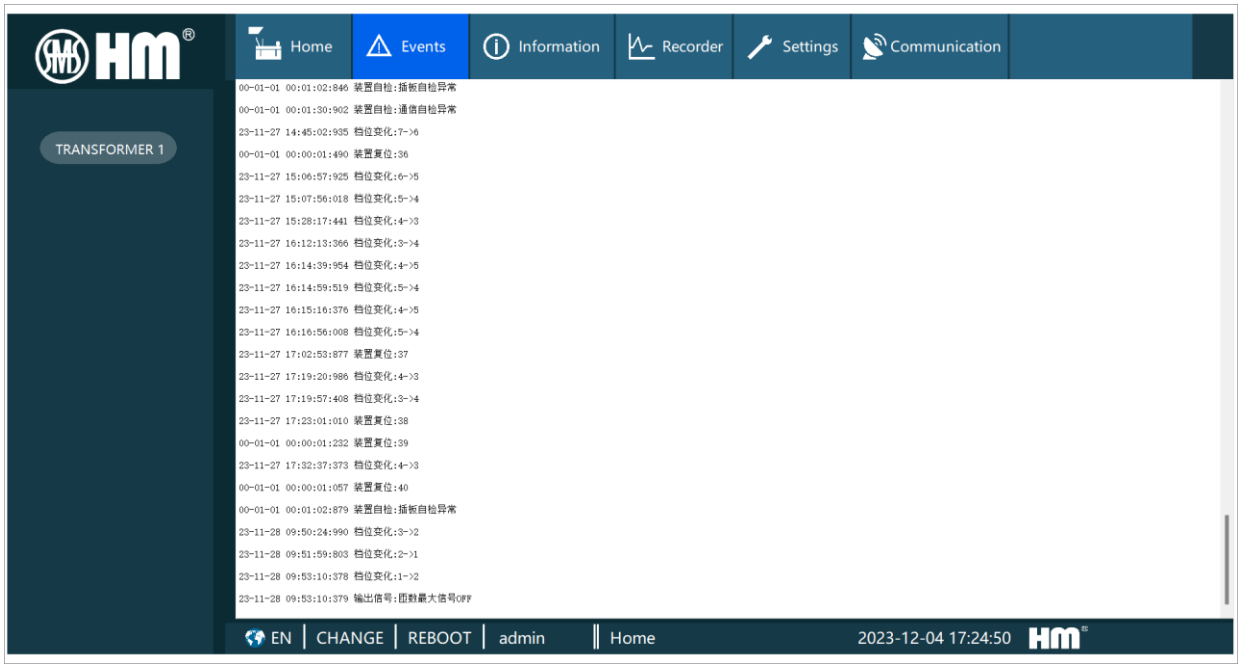
The OLTC online monitoring, analysis and diagnosis system homepage is mainly divided into four parts:

1: Menu bar, including homepage, events, information point table, curves, settings, and communication;

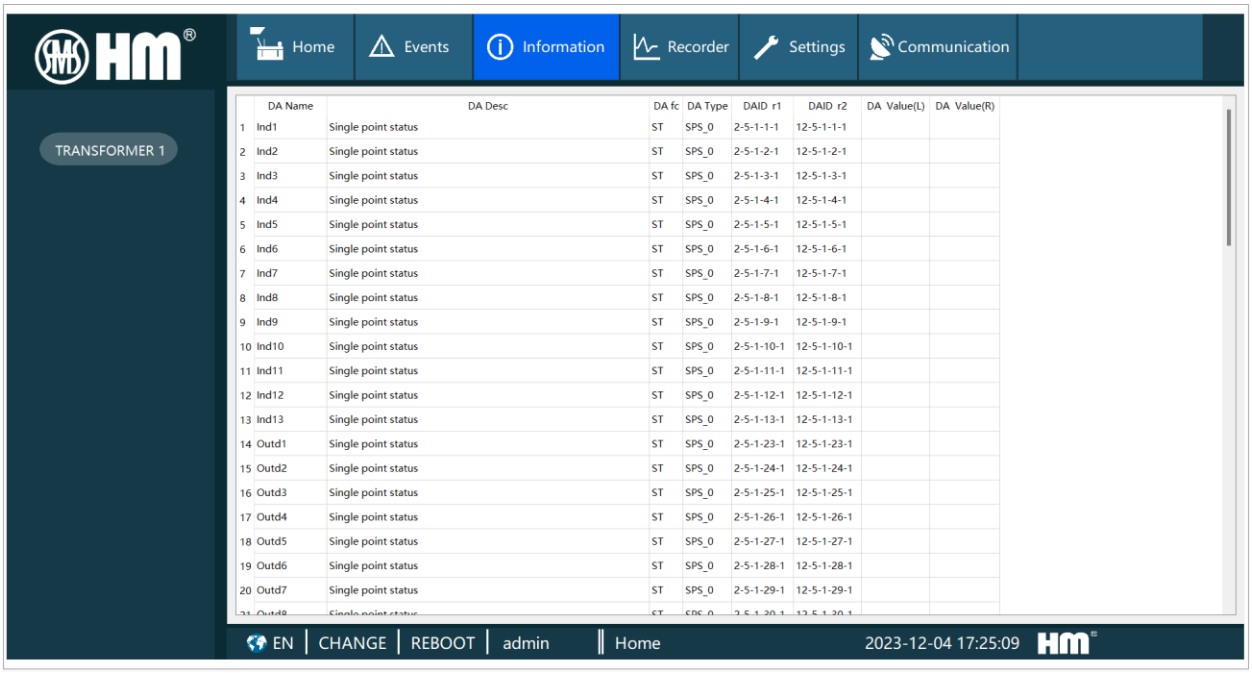
2: Navigation bar, can select Transformer 1 #, Transformer 2 #, or 1 # OLTC, 2 # OLTC;

3: Real time data display area: displays the current gear, number of actions, and motor current of OLTC. When there is no monitoring of other components of the extended transformer, other display views default to not displaying data;

4: Status display area: displays the current language selection, login user, stay page, and real-time time;

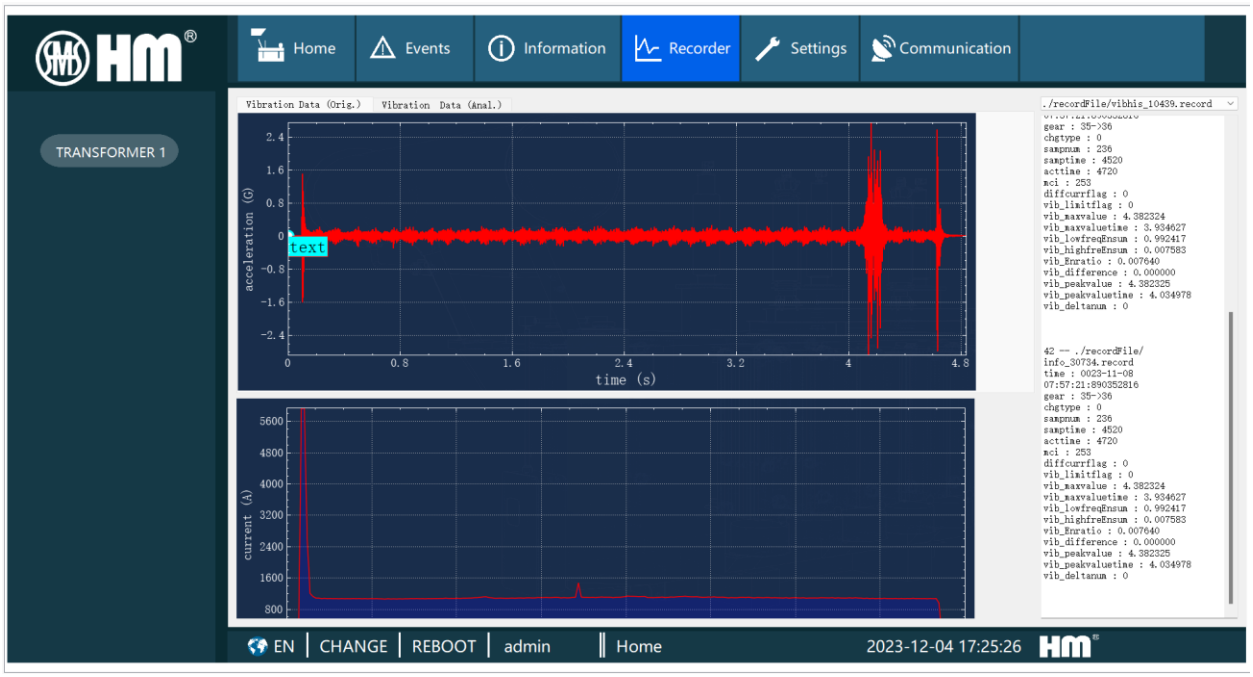


The time display page will update the events that occur on the device in real time, displaying the real-time time and corresponding types, including: device self check signal, device output signal, gear change, device status, etc;



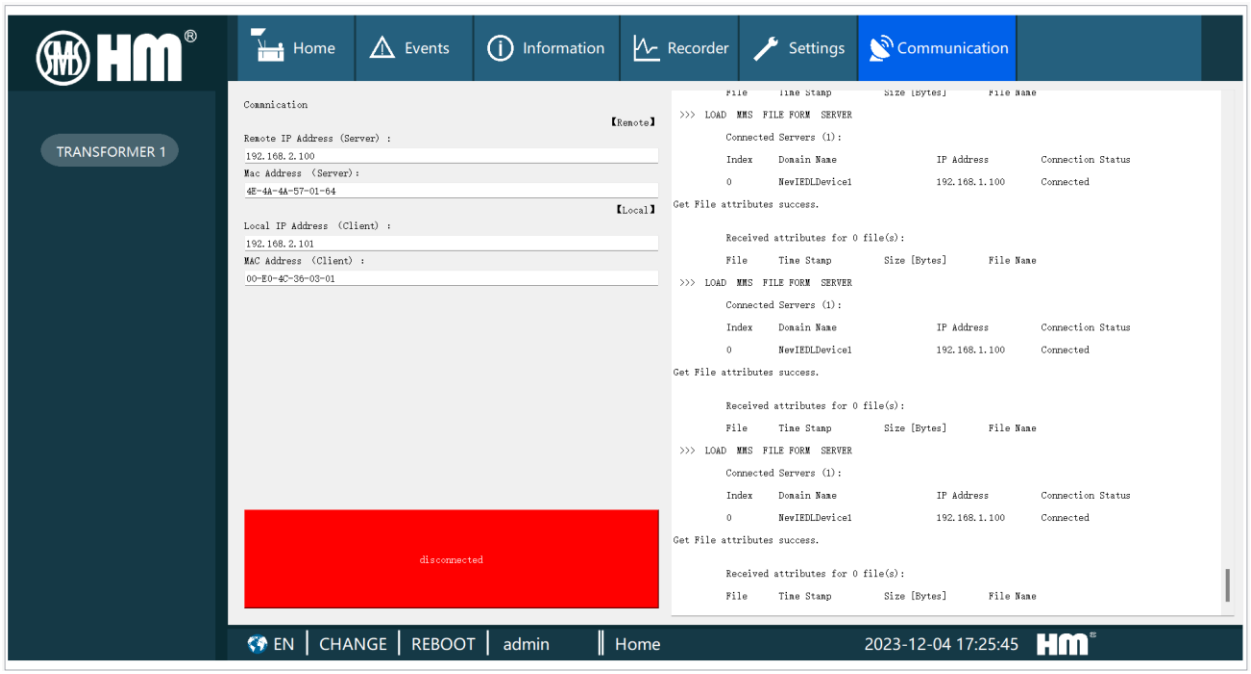
	DA Name	DA Desc	DA fc	DA Type	DAID r1	DAID r2	DA Value(L)	DA Value(R)
1	Ind1	Single point status	ST	SPS_0	2-5-1-1-1	12-5-1-1-1		
2	Ind2	Single point status	ST	SPS_0	2-5-1-2-1	12-5-1-2-1		
3	Ind3	Single point status	ST	SPS_0	2-5-1-3-1	12-5-1-3-1		
4	Ind4	Single point status	ST	SPS_0	2-5-1-4-1	12-5-1-4-1		
5	Ind5	Single point status	ST	SPS_0	2-5-1-5-1	12-5-1-5-1		
6	Ind6	Single point status	ST	SPS_0	2-5-1-6-1	12-5-1-6-1		
7	Ind7	Single point status	ST	SPS_0	2-5-1-7-1	12-5-1-7-1		
8	Ind8	Single point status	ST	SPS_0	2-5-1-8-1	12-5-1-8-1		
9	Ind9	Single point status	ST	SPS_0	2-5-1-9-1	12-5-1-9-1		
10	Ind10	Single point status	ST	SPS_0	2-5-1-10-1	12-5-1-10-1		
11	Ind11	Single point status	ST	SPS_0	2-5-1-11-1	12-5-1-11-1		
12	Ind12	Single point status	ST	SPS_0	2-5-1-12-1	12-5-1-12-1		
13	Ind13	Single point status	ST	SPS_0	2-5-1-13-1	12-5-1-13-1		
14	Outd1	Single point status	ST	SPS_0	2-5-1-23-1	12-5-1-23-1		
15	Outd2	Single point status	ST	SPS_0	2-5-1-24-1	12-5-1-24-1		
16	Outd3	Single point status	ST	SPS_0	2-5-1-25-1	12-5-1-25-1		
17	Outd4	Single point status	ST	SPS_0	2-5-1-26-1	12-5-1-26-1		
18	Outd5	Single point status	ST	SPS_0	2-5-1-27-1	12-5-1-27-1		
19	Outd6	Single point status	ST	SPS_0	2-5-1-28-1	12-5-1-28-1		
20	Outd7	Single point status	ST	SPS_0	2-5-1-29-1	12-5-1-29-1		

The information page will display the status and changes of input, output, and other data in the IEC61850 communication point table.



On the waveform display page, the vibration waveform and motor current waveform corresponding to gear switching will be displayed. The upper part is the vibration waveform, and the lower part is the motor current waveform. On the right navigation bar, you can choose to view the switching of historical gears and their corresponding waveform curves, and colleagues can analyze and diagnose the waveforms.

The vibration waveform diagnosis algorithm adopts coincidence degree algorithm, high and low frequency capability ratio analysis, and automatic identification algorithm. By comparing the correspondence between different sequence elements of standard waveform and fault waveform through coincidence degree algorithm, similarity is evaluated, and warning signals are proposed for those with coincidence degree less than 70%; Using high and low frequency capability ratio analysis, the actual switching process of the tap changer is taken as the energy analysis period, divided into two analysis areas: 0-10kHz and 10-20kHz. The energy percentage of these two areas in the entire analysis period is calculated, and the proportion of energy percentage is used as the fault diagnosis characteristic quantity; Utilize automatic identification algorithms to learn and train more fault samples to achieve optimal diagnostic accuracy.



In the communication page, the IP address of the device and the IP address of the backend system will be displayed, which can be modified according to the on-site situation. The lower section will display whether the current communication status is normal, with green indicating normal communication and red indicating abnormal. The message on the right displays the interaction between the currently transmitted data, files, and event information.

7. Delivery Accessories

When the equipment is shipped, it will be accompanied by the following attachments

Type	Count	describe
HMJK-Ⅱ instructions	1	Device manual
Equipment Configuration Table	1	Provide a detailed description of the device's parameter configuration
Factory debugging report	1	Equipment debugging report in the factory
Equipment drawings	2	Wiring diagram
Certificate of conformity	1	
232 connection attack	1	Debugging equipment and upgrading programs

8. Appendix (Point Table)

8.1 IEC61850

IED	LD	LN	DO	DA	CDC	FC	Description
HMJK001	LD0	ATCC1	CtlV	mag.f	MV	MX	Control Voltage
HMJK001	LD0	ATCC1	LodA	mag.f	MV	MX	Load Current (total transformer secondary current)
HMJK001	LD0	ATCC1	PhaDiff	mag.f	MV	MX	Phase Difference
HMJK001	LD0	ATCC1	SecIa	mag.f	MV	MX	Secondary active current
HMJK001	LD0	ATCC1	SecIr	mag.f	MV	MX	Secondary reactive current
HMJK001	LD0	ATCC1	Freq	mag.f	MV	MX	Frequency
HMJK001	LD0	ATCC1	PriValV	mag.f	MV	MX	Primary Voltage Value
HMJK001	LD0	ATCC1	PriValA	mag.f	MV	MX	Primary Current Value
HMJK001	LD0	ATCC1	PriIa	mag.f	MV	MX	Primary active current
HMJK001	LD0	ATCC1	PriIr	mag.f	MV	MX	Primary reactive current
HMJK001	LD0	ATCC1	TapPos	stVal	INS	ST	Tap Position
HMJK001	LD0	ATCC1	LastTapPos	stVal	INS	ST	Last Tap Position
HMJK001	LD0	ATCC1	RunMode	stVal	DPC	ST	Debug/Run Mode
HMJK001	LD0	ATCC1	PriVoltage	setMag.f	ASG	SG	Primary Voltage
HMJK001	LD0	ATCC1	SecVoltage	setMag.f	ASG	SG	Secondary Voltage
HMJK001	LD0	ATCC1	PriCurrent	setMag.f	ASG	SG	Primary Current
HMJK001	LD0	ATCC1	SecCurrent	setMag.f	ASG	SG	Secondary Current
HMJK001	LD0	ATCC1	PhaseAngle	setVal	ING	SG	Phase Angle
HMJK001	LD0	ATCC1	DevCommFault	stVal	SPS	ST	Device communicate status
HMJK001	LD0	ATCC1	SetOpCnt	setVal	ING	SG	Set the operation counter value
HMJK001	LD0	ATCC1	DevFaulty	stVal	SPS	ST	Device fault
HMJK001	LD0	YLTC1	AbrasionPct	setMag.f	MV	MX	Abrasion use condition
HMJK001	LD0	YLTC1	DiverterPct	setMag.f	MV	MX	Diverter use condition
HMJK001	LD0	YLTC1	SelectorPct	setMag.f	MV	MX	Selector use condition
HMJK001	LD0	YLTC1	OilExchangePct	setMag.f	MV	MX	OilExchange use condition
HMJK001	LD0	YLTC1	OilSamplingPct	setMag.f	MV	MX	OilSampling use condition
HMJK001	LD0	YLTC1	OperationPct	setMag.f	MV	MX	Operation use condition
HMJK001	LD0	YLTC1	OilFilterPct	setMag.f	MV	MX	OilFilter use condition
HMJK001	LD0	YLTC1	ElecPct	setMag.f	MV	MX	Elec Lifetime
HMJK001	LD0	YLTC1	AbrasionAlm	stVal	SPS	ST	Abrasion Parts Alarm
HMJK001	LD0	YLTC1	DiverterAlm	stVal	SPS	ST	Diverter Switch Insert Alarm
HMJK001	LD0	YLTC1	SelectorAlm	stVal	SPS	ST	Tap Selector Inspect Alarm
HMJK001	LD0	YLTC1	OilExchangeAlm	stVal	SPS	ST	Oil Exchange Clean Alarm

HMJK001	LD0	YLTC1	OilSamplingAlm	stVal	SPS	ST	Oil Sampling Alarm
HMJK001	LD0	YLTC1	OperationAlm	stVal	SPS	ST	Operation Time Number Alarm
HMJK001	LD0	YLTC1	OilFilterAlm	stVal	SPS	ST	Oil Filter Maintenance Alarm
HMJK001	LD0	YLTC1	AbrasionWrn	stVal	SPS	ST	Abrasion Parts Warning
HMJK001	LD0	YLTC1	DiverterWrn	stVal	SPS	ST	Diverter Switch Insert Warning
HMJK001	LD0	YLTC1	SelectorWrn	stVal	SPS	ST	Tap Selector Inspect Warning
HMJK001	LD0	YLTC1	OilExchangeWrn	stVal	SPS	ST	Oil Exchange Clean Warning
HMJK001	LD0	YLTC1	OilSamplingWrn	stVal	SPS	ST	Oil Sampling Warning
HMJK001	LD0	YLTC1	OperationWrn	stVal	SPS	ST	Operation Time Number Warning
HMJK001	LD0	YLTC1	ElecWrn	stVal	SPS	ST	Tap Life Warning
HMJK001	LD0	YLTC1	ResetAbrasion	stVal	SPS	ST	Reset Abrasion Parts
HMJK001	LD0	YLTC1	ResetDSI	stVal	SPS	ST	Reset Diverter Switch Insert
HMJK001	LD0	YLTC1	ResetTapSel	stVal	SPS	ST	Reset Tap Selector Inspect
HMJK001	LD0	YLTC1	ResetOilClean	stVal	SPS	ST	Reset Oil Exchange and Clean
HMJK001	LD0	YLTC1	ResetOilSamp	stVal	SPS	ST	Reset Oil Sampling
HMJK001	LD0	YLTC1	ResetOperation	stVal	SPS	ST	Reset Operation Time and Number
HMJK001	LD0	YLTC1	ResetOilFilter	stVal	SPS	ST	Reset Oil Filter Maintenance
HMJK001	LD0	YLTC1	ResetTapLife	stVal	SPS	ST	Reset Tap Life
HMJK001	LD0	YLTC1	ResetSwitch	stVal	SPS	ST	Reset Switch Operation Statis
HMJK001	LD0	YLTC1	EndPosR	stVal	SPS	ST	End position raise reached
HMJK001	LD0	YLTC1	EndPosL	stVal	SPS	ST	End position lower reached
HMJK001	LD0	YLTC1	OpCnt	stVal	INS	ST	Operation counter
HMJK001	LD0	YLTC1	LTCTmp	setMag.f	MV	MX	OLTC oil temperature
HMJK001	LD0	YLTC1	LTCVol	setMag.f	MV	MX	OLTC motor voltage
HMJK001	LD0	YLTC1	LTCCur	setMag.f	MV	MX	OLTC motor current
HMJK001	LD0	YLTC1	LTCTorMean	setMag.f	MV	MX	OLTC motor torque mean
HMJK001	LD0	YLTC1	LTCVolPeak	setMag.f	MV	MX	OLTC motor voltage peak
HMJK001	LD0	YLTC1	LTCCurPeak	setMag.f	MV	MX	OLTC motor current peak
HMJK001	LD0	YLTC1	LTCTorPeak	setMag.f	MV	MX	OLTC motor torque peak
HMJK001	LD0	YLTC1	LTCMCI	setMag.f	MV	MX	OLTC motor current index
HMJK001	LD0	YLTC1	LTCTime	setMag.f	MV	MX	OLTC switching delay time
HMJK001	LD0	YLTC1	LTCCurPeakAlm	stVal	SPS	ST	OLTC motor current peak over/lower limit exceeded alarm
HMJK001	LD0	YLTC1	LTCMCIAlm	stVal	SPS	ST	OLTC motor current index over/lower limit exceeded alarm
HMJK001	LD0	YLTC1	LTCTimeAlm	stVal	SPS	ST	OLTC switching delay time over/lower limit exceeded alarm
HMJK001	LD0	YLTC1	LTCTorAlm	stVal	SPS	ST	OLTC motor torque over limit exceeded alarm
HMJK001	LD0	YLTC1	LTCCurAlm	stVal	SPS	ST	OLTC motor abnormal current alarm
HMJK001	LD0	YLTC1	LTCVolAlm	stVal	SPS	ST	OLTC motor abnormal voltage alarm
HMJK001	LD0	YLTC1	LTCTmpAlm	stVal	SPS	ST	OLTC oil temperature over limit exceeded alarm

8.2 Modbus Rtu

DI	0x02	0	DevCommFault	Device communicate status	
		1	DevFaulty	Device fault	
		2	AbrasionAlm	Abrasion Parts Alarm	
		3	DiverterAlm	Diverter Switch Insert Alarm	
		4	SelectorAlm	Tap Selector Inspect Alarm	
		5	OilExchangeAlm	Oil Exchange Clean Alarm	
		6	OilSamplingAlm	Oil Sampling Alarm	
		7	OperationAlm	Operation Time Number Alarm	
		8	OilFilterAlm	Oil Filter Maintenance Alarm	
		9	AbrasionWrn	Abrasion Parts Warning	
		10	DiverterWrn	Diverter Switch Insert Warning	
		11	SelectorWrn	Tap Selector Inspect Warning	

		12	OilExchangeWrn	Oil Exchange Clean Warning	
		13	OilSamplingWrn	Oil Sampling Warning	
		14	OperationWrn	Operation Time Number Warning	
		15	ElecWrn	Tap Life Warning	
		16	EndPosR	End position raise reached	
		17	EndPosL	End position lower reached	
		18	LTCCurPeakAlm	OLTC motor current peak over/lower limit exceeded alarm	
		19	LTCMCIAlm	OLTC motor current index over/lower limit exceeded alarm	
		20	LTCTimeAlm	OLTC switching delay time over/lower limit exceeded alarm	
		21	LTCTorAlm	OLTC motor torque over limit exceeded alarm	
		22	LTCCurAlm	OLTC motor abnormal current alarm	
		23	LTCVolAlm	OLTC motor abnormal voltage alarm	
		24	LTCTmpAlm	OLTC oil temperature over limit exceeded alarm	
DO	0x01 /0x05	0	RunMode	Debug/Run Mode	0:Debug 1:Run
		1	ResetAbrasion	Reset Abrasion Parts	
		2	ResetDSI	Reset Diverter Switch Insert	
		3	ResetTapSel	Reset Tap Selector Inspect	
		4	ResetOilClean	Reset Oil Exchange and Clean	
		5	ResetOilSamp	Reset Oil Sampling	
		6	ResetOperation	Reset Operation Time and Number	
		7	ResetOilFilter	Reset Oil Filter Maintenance	
		8	ResetTapLife	Reset Tap Life	
		9	ResetSwitch	Reset Switch Operation Statis	
AI	0x04	0	TapPos	Tap Position	Float HH HL LH LL
		2	LastTapPos	Last Tap Position	
		4	CtlV	Control Voltage	
		6	LodA	Load Current (total transformer secondary current)	
		8	PriValV	Primary Voltage Value	
		10	PriValA	Primary Current Value	
		12	AbrasionPct	Abrasion use condition	
		14	DiverterPct	Diverter use condition	
		16	SelectorPct	Selector use condition	
		18	OilExchangePct	OilExchange use condition	
		20	OilSamplingPct	OilSampling use condition	
		22	OperationPct	Operation use condition	
		24	OilFilterPct	OilFilter use condition	
		26	ElecPct	Elec Lifetime	
		28	OpCnt	Operation counter	
		30	LTCTmp	OLTC oil temperature	
		32	LTCVol	OLTC motor voltage	
		34	LTCCur	OLTC motor current	
		36	LTCTorMean	OLTC motor torque mean	
		38	LTCVolPeak	OLTC motor voltage peak	
		40	LTCCurPeak	OLTC motor current peak	
		42	LTCTorPeak	OLTC motor torque peak	
		44	LTCMCI	OLTC motor current index	
		46	LTCTime	OLTC switching delay time	
		48	PhaDiff	Phase Difference	
		50	SecIa	Secondary active current	
		52	SecIr	Secondary reactive current	
		54	Freq	Frequency	
		56	PriIa	Primary active current	
		58	PriIr	Primary reactive current	
		...	Space	Space	
		100	OilTmp	Oil temperature(℃)	
		102	Pressure	Pressure(Kpa)	
		104	Mst	Moisture(ppm)	

AO	0x03 /0x10	0	PriVoltage	Primary Voltage	Float HH HL LH LL Must be modified in debug mode.
		2	SecVoltage	Secondary Voltage	
		4	PriCurrent	Primary Current	
		6	SecCurrent	Secondary Current	
		8	PhaseAngle	Phase Angle	
		9-99	Space	Space	
		100	Year	Year	int32 HH HL LH LL Can be modified at any time.
		102	Month	Month	
		104	Day	Day	
		106	Hour	Hour	
		108	Min	Min	
		110	Sec	Sec	