Paperless Recorder

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Preface

Thank you for purchasing paperless recorder. Please read this manual carefully before operating and using it correctly to avoid unnecessary losses caused by false operation.

Note

- Modification of this manual's contents will not be notified as a result of some factors, such as function upgrading.
- We try our best to guarantee that the manual content is accurate, if you find something wrong or incorrect, please contact us.
- This product is forbidden to use in explosion-proof occasions.

Version

U-SUP-RN5000/RN6000/RN6500-EN3

Safety Precautions

In order to use this product safely, be sure to follow the safety precautions described.

About this manual

- Please submit this manual to the operator for reading.
- Please read the operation manual carefully before applying the instrument. On the precondition of full understanding.
- This manual only describes the functions of the product. The company does not guarantee that the product will be suitable for a particular use by the user.

Precautions for protection, safety and modification of this product

- To ensure safe use of this product and the systems it controls, Please read carefully the operation manual and understand the correct application methods before putting into operation, to avoid unnecessary losses due to operation mistakes. If the instrument is operated in other ways not described in the manual, the protections that the instrument give may be destroyed, and the failures and accidents incurred due to violation of precautions shall not be borne by our company.
- When installing lightning protection devices for this product and its control system, or designing and installing separate safety protection circuits for this product and its control system, it needs to be implemented by other devices.
- If you need to replace parts of the product, please use the model specifications specified by the company.
- This product is not intended for use in systems that are directly related to personal safety.Such as nuclear power equipment, equipment using radioactivity, railway systems, aviation equipment, marine equipment, aviation equipment and medical equipment.If applied, it is the responsibility of the user to use additional equipment or systems to ensure personal safety.
- Do not modify this product.

- The following safety signs are used in this manual:

Hazard, if not taken with appropriate precautions, will result in serious personal injury, product damage or major property damage.

Warning:Pay special attention to the important information linked to product or particular part in the operation manual.

- Confirm if the supply voltage is in consistent with the rated voltage before operation.
- Don’t use the instrument in a flammable and combustible or steam area.
- To prevent from electric shock, operation mistake, a good grounding protection must be made.
- Thunder prevention engineering facilities must be well managed: the shared grounding network shall be grounded at is-electric level, shielded, wires shall be located rationally, SPD surge protector shall be applied properly.
- Some inner parts may carry high voltage. Do not open the square panel in the front except our company personnel or maintenance personnel acknowledged by our company, to avoid electric shock.
- Cut off electric powers before making any checks, to avoid electric shock.
- Check the condition of the terminal screws regularly. If it is loose, please tighten it before use.
- It is not allowed to disassemble, process, modify or repair the product without authorization, otherwise it may cause abnormal operation, electric shock or fire accident.
- Wipe the product with a dry cotton cloth. Do not use alcohol, benzine or other organic solvents. Prevent all kinds of liquid from splashing on the product. If the product falls into the water, please cut off the power immediately, otherwise there will be leakage, electric shock or even a fire accident.

- Please check the grounding protection State regularly. Do not operate if you think that the protection measures such as grounding protection and fuses are not perfect.
- Ventilation holes on the product housing must be kept clear to avoid malfunctions due to high temperatures, abnormal operation, shortened life and fire.
- Please strictly follow the instructions in this manual, otherwise the product's protective device may be damaged.

- Don’t use the instrument if it is found damaged or deformed at opening of package.
- Prevent dust, wire end, iron fines or other objects from entering the instrument during installation, otherwise, it will cause abnormal movement or failure.
- During operation, to modify configuration, signal output, startup, stop, operation safety shall be fully considered. Operation mistakes may lead to failure and even destruction of the instrument and controlled equipment.
- Each part of the instrument has a certain lifetime, which must be maintained and repaired on a regular basis for long-time use.
- The product shall be scrapped as industrial wastes, to prevent environment pollution.
- When not using this product, be sure to turn off the power switch.
- If you find smoke from the product, smell odor, abnormal noise, etc., please turn off the power switch immediately and contact the company in time.

Disclaimer

- The company does not make any guarantees for the terms outside the scope of this product warranty.
- This company is not responsible for damage to the instrument or loss of parts or unpredictable damage caused directly or indirectly by improper operation of the user.

No.	Name	Quantity	Note
1	Paperless recorder	1	
2	Manual	1	
3	Standard accessory package	1	
4	Certificate	1	
5	U disk	1	

After opening the box, please confirm the package contents before starting the operation.If you find that the model and quantity are incorrect or there is physical damage in appearance, please contact us.

Contents

1 Introduction

1.1 Introduction

This industrial paperless recorder is equipped with a 7-inch TFT full-color high-contrast liquid crystal display, featuring a resolution of 1024*600. It seamlessly integrates various industrial standard signals, such as current, voltage, thermocouples, thermistors, resistors, and frequency (customizable), enabling real-time display, recording, limit monitoring, report generation, data communication, signal transmission, and functions like flow accumulation, as well as flow temperature and pressure compensation. It is widely applicable in industries such as metallurgy, petrochemicals, construction materials, papermaking, power, food, pharmaceuticals, and industrial water treatment.

This product supports up to 48 analog universal input channels, 6 frequency inputs (customizable), 22 relay alarm outputs, and 6 transmitter outputs (supporting (0~10) mA, (4~20) mA, (0~20) mA, (0~5) V, (1~5) V, (0~10) V outputs). It also provides a 250mA power supply output, 2 RS485 communication interfaces, 1 Ethernet communication interface, 1 USB data transfer interface, and 128M of internal super-large storage. The product supports functions such as Ethernet communication and remote online upgrading.

Table 1 Comparison of function

Model / Function	RN5000	RN6000	RN6500
Analog input	1-12 channels	1-48 channels (Channels not isolated)	1-48 channels (Channels isolated)
Analog output	6 channels	6 channels	6 channels
Relay output	22 channels	22 channels	22 channels
RS485 output	Yes	Yes	Yes
RS485 input	No	Customized	Customized
Frequency input	No	Customized	Customized
Ethernet	Customized	Yes	Yes
Feed output	Yes	Yes	Yes

Model / Function	RN5000	RN6000	RN6500
Flow (temperature and pressure compensation)	No	Yes	Yes
Accumulation and report	Customized	Yes	Yes
Internal storage	128M	128M	128M
Customizable display	Yes	Yes	Yes

1.2 Principle

The principle of the paperless recorder is to capture and record data or computed data with time as the primary axis within the internal storage system of the instrument. This method eliminates the consumption of traditional recording tools such as paper and ink. The collected information is stored in the internal memory of the instrument, processed through calculations and simulations, and then displayed on a liquid crystal screen. The screen offers a rich array of display options, including values, curve graphs, bar charts, and alarm states.

1.3 Main parameters

1.3.1 Input

Table 2 DC voltage/current input

Type	Maximum permitted error (%F.S)
（0~5）V	±0.1
（1~5）V	
（-5~5）V (Only RN6500 supports)	
（0~10）V	
（2~10）V	
（-10~10）V (Only RN6500 supports)	
（0~100）mV	

Type	Maximum permitted error (%F.S)
（0~20）mV	±0.2
（-20~20）mV	
（-100~100）mV	
（4~20）mA	±0.1
（0~20）mA	
（0~10）mA	

Table 3 Thermocouple input (excluding cold-side error)

Type	Measurement range (℃)	Maximum permitted error (%F.S)
B	600 ~ 1800	±2.4
E	-200 ~ 1000	±2.4
J	-200 ~ 1200	±2.4
K	-200 ~ -100	±3.3
	-100 ~ 1300	±2.0
S	-50 ~ 100	±3.7
	100 ~ 300	±2.0
	300 ~ 1600	±1.5
T	-200 ~ -100	±1.9
	-100 ~ 400	±1.6
R	-50 ~ 100	±3.7
	100 ~ 300	±2.0
	300 ~ 1600	±1.5
N	-200 ~ 1300	±3.0
WRe5-26	0~ 2310	±4.0
WRe3-25	0~ 2315	±4.0

Table 4 Thermoresistive input

Type	Measurement range (℃)	Maximum permitted error (℃)
PT100	-200 ~ 650	±1.0
JPT100	-200 ~ 510	±1.0

Type	Measurement range (℃)	Maximum permitted error (℃)
PT1000	-200 ~ 200	±0.3
Cu50	-50 ~ 150	±1.0
Cu53	-50 ~ 150	±1.0
Cu100	-50 ~ 150	±1.0
Note: Special-purpose resistance temperature detectors (RTDs) can be customized.		

Table 5 Resistance input

Type	Measurement range (Ω)	Maximum permitted error (Ω)
（0~400）Ω	0~400	±0.3
（0~4000）Ω	0~4000	±3

Table 6 Frequency input (customized)

Type	Amplitude	Response period	Measurement range (Hz)	Maximum permitted error (Hz)
Fr	（0~15）V	1s	1~1000	±1
			1001~10000	±10
Note: When the voltage is less than 1V, it is considered a low level; when the voltage is between 4.5V and 15V, it is considered a high level.				

1.3.2 Output

Table 7 Alarm output

Type	Measurement range	Contact type	Contact capacity	Response period
Alarm output	0/1	SPST Normally open contact	2A，250VAC (resistive load)	1s

Table 8 Current output

Type	Measurement range	Accuracy	Load resistance
Active current output	(4~20)mA	±0.025mA	≤750Ω
	(0~20)mA	±0.025mA	≤750Ω
	(0~10)mA	±0.025mA	≤1500Ω

Table 9 Feed output

Feed type	250mA, 24 VDC

Table 10 Communication output

Communication interface and communication protocol	1-channel RS485 communication output interface, Modbus_RTU communication protocol
	1-channel Ethernet communication output interface, Modbus_TCP communication protocol
Note: 1-channel RS485 communication input can be customized.	

1.3.3 Power supply

Table 11 Power supply

Power supply	AC:（85~264）VAC ,50/60Hz DC: 24VDC±10%
Power consumption	≤20W

1.3.4 Environmental condition

Table 12 Environmental condition

Working environment	Temperature: 0℃-50℃ Relative humidity: 10%-85% (No condensation); Avoid corrosive gases. Note: In case of poor working environment, it is necessary to specify it when ordering.
Storage environment	Temperature: -20℃-60℃; Relative humidity: 5%-95% (No condensation)

1.3.5 Other parameters

Table 13 Other parameters

Internal storage	128M Byte
External storage	Supports USB flash drive (standard USB 2.0 communication interface).
Sampling period	1s
Recording interval	Adjustable at 1s, 2s, 5s, 10s, 15s, 30s, 1min, 2min, 5min, 10min, 15min, 30min, and 1h.

2 Structure and dimensions

Dimensions: 193mm (W) x 162mm (H) x 138mm (D)

Enclosure material: ABS (Acrylonitrile Butadiene Styrene)

Panel material: PMMA (Polymethyl Methacrylate)

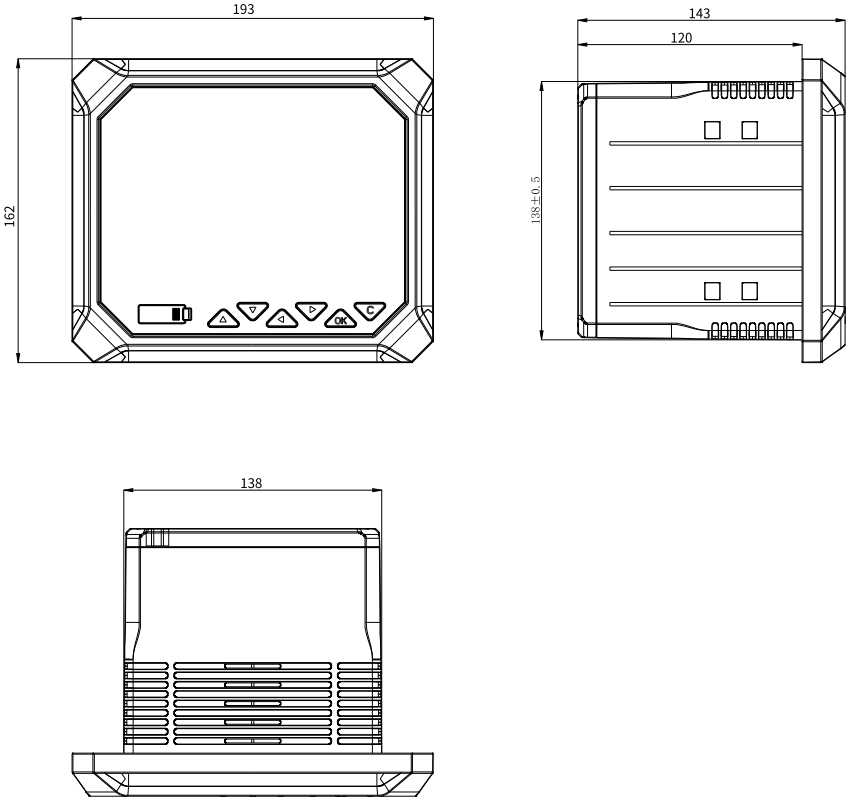


Fig.1 Product dimensions (unit: mm)

3 Installation

This chapter describes the installation and wiring methods of this instrument. It is necessary for technicians to learn when they use the instrument for the first time. This is a procedure which enables the instrument to normal operation，as the table

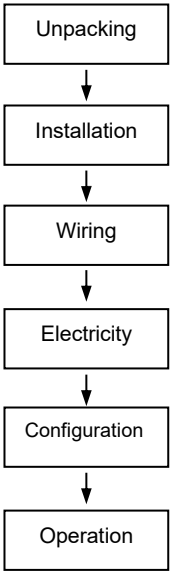


Fig.2 Flow diagram from unpacking to operation

3.1 Arrival inspection

Upon receiving the product, the user should first inspect the quality of the packaging. The packaging box should be intact and undamaged with clear labels. If there is obvious damage to the packaging, the user should promptly contact the storage and transportation department to clarify the issue and responsibility, and inform our company. If there are no issues such as damage to the packaging, the user can then open the box, remove the product, and check its completeness.

3.2 Installation condition

This instrument is a panel-mounted type and should be installed indoors or within a control cabinet, ensuring it is shielded from wind, rain, and direct sunlight.

Please install at the following location(s):

- Well-ventilated locations: To prevent the internal temperature of the instrument from rising, please install in a well-ventilated area.
- Locations with minimal mechanical vibration: Please choose a location with minimal mechanical vibration for installation.

Please avoid installing at the following locations:

- Direct sunlight or near heat sources: Choose a location with minimal temperature fluctuations, preferably around 23°C (73.4°F). Exposure to direct sunlight or heat sources may negatively affect the instrument's internal components.
- Locations with high concentrations of oil, steam, moisture, dust, or corrosive gases: These elements can negatively affect the instrument's performance.
- Close proximity to electromagnetic radiation sources: Keep magnetic components or magnets away from the instrument. Exposure to strong electromagnetic radiation sources can cause display errors due to the influence of the magnetic field.
- Maintain a distance of at least 20 cm (7.87 inches) between the instrument and any radiofrequency generators during operation to prevent abnormal instrument behavior.

Note:

- When moving the instrument from a location with low temperature and humidity to one with high temperature and humidity, a significant temperature change may cause condensation, leading to measurement errors when using thermocouple inputs. In such cases, please allow the instrument to acclimate to the surrounding environment for at least one hour before use.
- Prolonged use in high-temperature conditions may shorten the lifespan of the LCD (resulting in reduced image quality, etc.). Please avoid using the instrument in high-temperature conditions (above 40°C/104°F) whenever possible.

3.3 Installation method

This recorder is designed for indoor panel mounting. The installation procedure is as follows:

(1) Cut an opening in the panel (with dimensions of 138mm x 138mm). Ensure that the area around the cut-out is clean, smooth, and free of burrs.

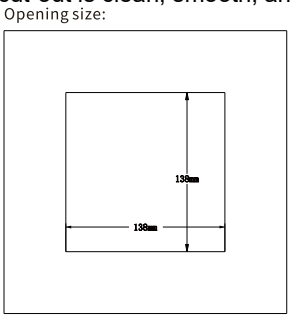


Fig.3 Cutout dimensions

(2) Insert the recorder into the cutout, and make sure that the recorder is tightly secured against the panel.

(3) Place the four mounting brackets that come with the recorder on both sides of the instrument, and then use a Phillips screwdriver to tighten the screws on the control cabinet.

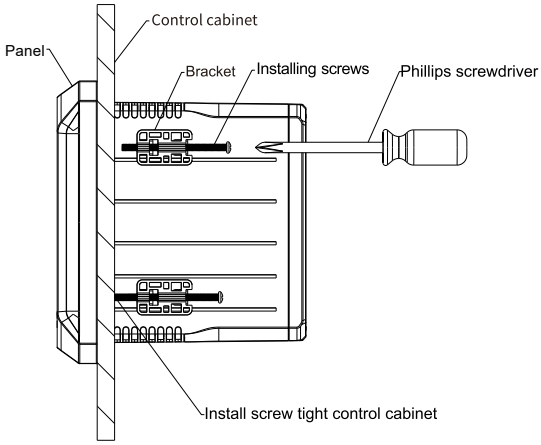


Fig.4 Installation

4 Electrical connection

4.1 Ground connection

Please operate with the recorder powered off. Ensure that the ground wire is connected before wiring.

4.2 Terminal blocks

The paperless recorder features a total of five slots, with different specifications accommodating different board configurations (refer to Figure 5):

(1) Regular configuration: Slots 1 to 4 are equipped for universal inputs (up to 48 channels); Slot 5 is designated for a power interface, one feed power output, four relay outputs, two RS485 interfaces, and one Ethernet interface.

(2) The universal inputs can have a maximum of 48 channels, occupying slots 1 to 4, which leaves no room for frequency input and transmitter output configurations.

(3) When configuring transmitter outputs, frequency outputs, or increasing the number of relay output channels, Slot 4 will be occupied, which results in a reduction of the corresponding input channels.

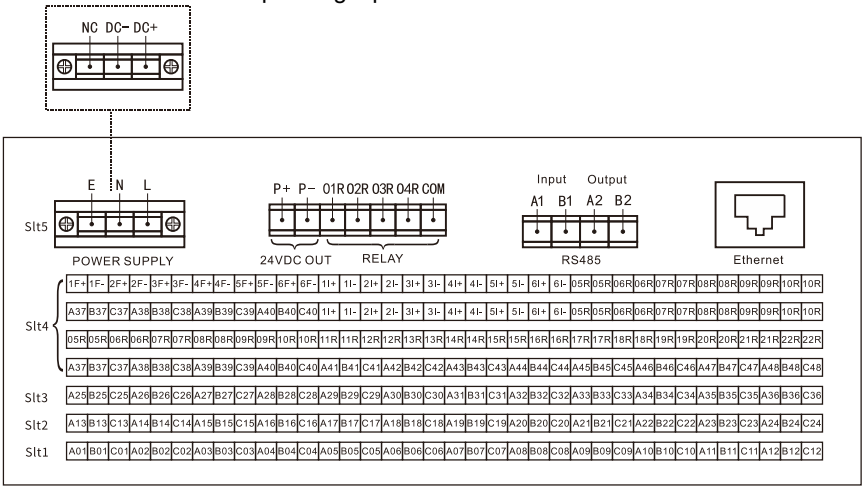


Fig.5 Terminal schematic diagram

4.3 Terminal instructions

Table 14 Regular configuration terminal instructions

Terminal No.	Signal type	Description
Power		
E、N、L	220VAC	L: Phase line terminal N: Zero line terminal E: Ground terminal
NC、DC-、DC+	24VDC	DC+: 24VDC+ DC-: 24VDC- NC: Undefined
Signal input		
A1，B1，C1	Universal input	Analog input channel 1
A2，B2，C2	Universal input	Analog input channel 2
A3，B3，C3	Universal input	Analog input channel 3
A4，B4，C4	Universal input	Analog input channel 4
A5，B5，C5	Universal input	Analog input channel 5
A6，B6，C6	Universal input	Analog input channel 6
A7，B7，C7	Universal input	Analog input channel 7
A8，B8，C8	Universal input	Analog input channel 8
A9，B9，C9	Universal input	Analog input channel 9
A10，B10，C10	Universal input	Analog input channel 10
A11，B11，C11	Universal input	Analog input channel 11
A12，B12，C12	Universal input	Analog input channel 12
A13，B13，C13	Universal input	Analog input channel 13
A14，B14，C14	Universal input	Analog input channel 14
A15，B15，C15	Universal input	Analog input channel 15
A16，B16，C16	Universal input	Analog input channel 16
A17，B17，C17	Universal input	Analog input channel 17
A18，B18，C18	Universal input	Analog input channel 18
A19，B19，C19	Universal input	Analog input channel 19
A20，B20，C20	Universal input	Analog input channel 20
A21，B21，C21	Universal input	Analog input channel 21

Terminal No.	Signal type	Description
A22，B22，C22	Universal input	Analog input channel 22
A23，B23，C23	Universal input	Analog input channel 23
A24，B24，C24	Universal input	Analog input channel 24
A25，B25，C25	Universal input	Analog input channel 25
A26，B26，C26	Universal input	Analog input channel 26
A27，B27，C27	Universal input	Analog input channel 27
A28，B28，C28	Universal input	Analog input channel 28
A29，B29，C29	Universal input	Analog input channel 29
A30，B30，C30	Universal input	Analog input channel 30
A31，B31，C31	Universal input	Analog input channel 31
A32，B32，C32	Universal input	Analog input channel 32
A33，B33，C33	Universal input	Analog input channel 33
A34，B34，C34	Universal input	Analog input channel 34
A35，B35，C35	Universal input	Analog input channel 35
A36，B36，C36	Universal input	Analog input channel 36
A37，B37，C37	Universal input	Analog input channel 37
A38，B38，C38	Universal input	Analog input channel 38
A39，B39，C39	Universal input	Analog input channel 39
A40，B40，C40	Universal input	Analog input channel 40
A41，B41，C41	Universal input	Analog input channel 41
A42，B42，C42	Universal input	Analog input channel 42
A43，B43，C43	Universal input	Analog input channel 43
A44，B44，C44	Universal input	Analog input channel 44
A45，B45，C45	Universal input	Analog input channel 45
A46，B46，C46	Universal input	Analog input channel 46
A47，B47，C47	Universal input	Analog input channel 47
A48，B48，C48	Universal input	Analog input channel 48
Ethernet		
Ethernet	LAN	Ethernet
RS485		
A1	485+	RS485 input

Terminal No.	Signal type	Description
B1	485-	RS485 input
A2	485+	RS485 output
B2	485-	RS485output
Feed output		
P+	/	24V+
P-	/	24V-
Alarm output		
DO1	Relay	Alarm output channel 1
DO2	Relay	Alarm output channel 2
DO3	Relay	Alarm output channel 3
DO4	Relay	Alarm output channel 4
COM	/	Alarm commons

Table 15 Enhanced output terminal instructions

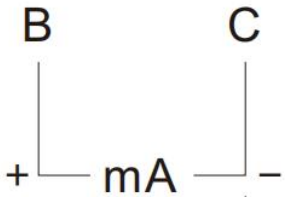
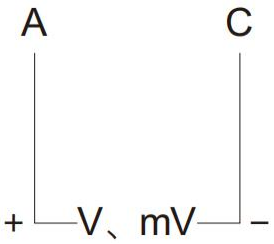
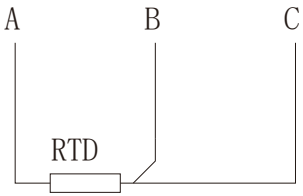
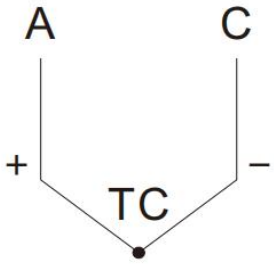
Terminal No.	Signal type	Description
Multifunctional frequency input		
1F+，1F-	Frequency input	Frequency input channel 1
2F+，2F-	Frequency input	Frequency input channel 2
3F+，3F-	Frequency input	Frequency input channel 3
4F+，4F-	Frequency input	Frequency input channel 4
5F+，5F-	Frequency input	Frequency input channel 5
6F+，6F-	Frequency input	Frequency input channel 6
1I+，1I-	Current/voltage output	Analog output channel 1
2I+，2I-	Current/voltage output	Analog output channel 2
3I+，3I-	Current/voltage output	Analog output channel 3
4I+，4I-	Current/voltage output	Analog output channel 4
5I+，5I-	Current/voltage output	Analog output channel 5
6I+，6I-	Current/voltage output	Analog output channel 6
05R，05R	Relay	Alarm output channel 5
06R，06R	Relay	Alarm output channel 6
07R，07R	Relay	Alarm output channel 7
08R，08R	Relay	Alarm output channel 8

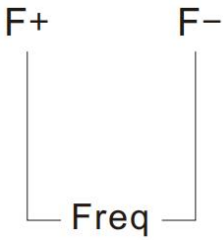
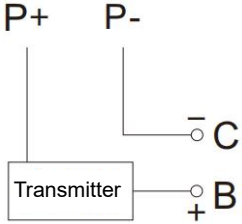
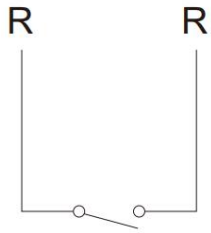
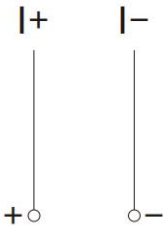
Terminal No.	Signal type	Description
09R，09R	Relay	Alarm output channel 9
10R，10R	Relay	Alarm output channel 10
Multi functional AI input		
A37，B37，C37	Universal input	Analog input channel 37
A38，B38，C38	Universal input	Analog input channel 38
A39，B39，C39	Universal input	Analog input channel 39
A40，B40，C40	Universal input	Analog input channel 40
1I+，1I-	Current/voltage output	Analog output channel 1
2I+，2I-	Current/voltage output	Analog output channel 2
3I+，3I-	Current/voltage output	Analog output channel 3
4I+，4I-	Current/voltage output	Analog output channel 4
5I+，5I-	Current/voltage output	Analog output channel 5
6I+，6I-	Current/voltage output	Analog output channel 6
05R，05R	Relay	Alarm output channel 5
06R，06R	Relay	Alarm output channel 6
07R，07R	Relay	Alarm output channel 7
08R，08R	Relay	Alarm output channel 8
09R，09R	Relay	Alarm output channel 9
10R，10R	Relay	Alarm output channel 10
Alarm output		
05R，05R	Relay	Alarm output channel 5
06R，06R	Relay	Alarm output channel 6
07R，07R	Relay	Alarm output channel 7
08R，08R	Relay	Alarm output channel 8
09R，09R	Relay	Alarm output channel 9
10R，10R	Relay	Alarm output channel 10
11R，11R	Relay	Alarm output channel 11
12R，12R	Relay	Alarm output channel 12
13R，13R	Relay	Alarm output channel 13
14R，14R	Relay	Alarm output channel 14
15R，15R	Relay	Alarm output channel 15
16R，16R	Relay	Alarm output channel 16

Terminal No.	Signal type	Description
17R，17R	Relay	Alarm output channel 17
18R，18R	Relay	Alarm output channel 18
19R，19R	Relay	Alarm output channel 19
20R，20R	Relay	Alarm output channel 20
21R，21R	Relay	Alarm output channel 21
22R，22R	Relay	Alarm output channel 22

4.4 Wiring instructions

Table 16 Wiring instructions

Current signal input	Voltage signal input
	
RDT input	TC input
	

Frequency input (customized)	Passive transmitter 24VC output
	
Relay output	**Current output**
	 Note: The voltage output is consistent with the current output. When wiring, connect the two resistors in the accessory package in parallel and connect them to I+ Between I -.

5 Basic operation

5.1 key display

Panel component distribution of paperless recorder is shown in figure 6.

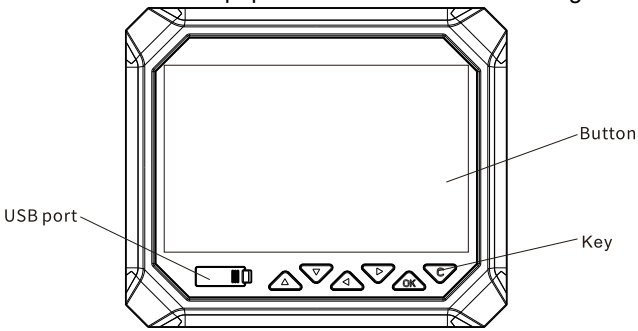
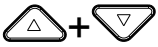


Fig.6 Panel component distribution

Table 17 Key Definition

Label	Key Name	Function
△	UP	● In the main page, switch to the previous cyclic display. ● In the menu interface, select a menu item. ● In the settings mode, select the settings parameters.
▽	Down	● In the main page, switch to the next cyclic display. ● In the real-time curve, select a channel. ● In the menu interface, select a menu. ● In the settings mode, select the settings parameters.
◁	Left	● In the main page, switch display screens: overview, group, single, bar, real-time curve, flow, accrue, and accrue list. ● In the settings mode, modify the parameter values.

Label	Key Name	Function
	Right	● In the main page, switch display screens: overview, group, single, bar, real-time curve, flow, accrue, and accrue list. ● In the settings mode, modify the relevant values.
	Confirm	● On the main page, long press for 3 seconds to enter the first-level menu. ● In the menu interface, confirm the modification.
	Cancel	● On the main page, long press for 3 seconds to enter the first-level menu; ● Confirm the modification on the menu interface. ● On the menu interface, return to the upper level between related upper and lower interfaces. ● In the settings mode, cancel the settings.
	Up + Down	● Long press the key combination for 3 seconds to capture a screenshot.

5.2 Interface description

The user interface mainly consists of the main page, the first-level menu, and the second-level menu.

Main page: overview, group, single, bar, real-time curve,flow, accrue, and accrue list., among which the flow, accrue, and accrue list. are optional features.

First-level menu: historical curves, alarm logs, powerdown logs, operation logs, export data, instrument about, and settings.

Second-level menu: system settings, input settings, output settings, function settings, flow settings, and accumulation settings, among which flow settings and accumulation settings are optional features.

5.2.1 Main page

On the main page, press ***Left / Right key*** to switch display screens: overview, group, single, bar, real-time curve, flow, accrue, and accrue list.

(1) Navigation bar

Fig.7 Navigation bar

① : Running screen name.

② : File recording identifier, indicating that the file is being recorded.

③ : Loop display identifier, indicating the open state of the loop display mode on the patrol display screen.

④ : Alarm reminder, displayed when an over-limit alarm occurs.

⑤ : USB flash disk reminder, prompted when a USB flash disk is inserted.

⑥ : key battery (for internal clock power supply) level indicator, displaying the remaining battery level of the internal key battery in real-time.

⑦ : System time, displaying the date and time of the instrument's operation.

(2) Overview / Group screen

The overview screen displays the state of all channels, including tag names, units, and instantaneous values. Fig.8 shows the overview screen for a 44-channel product screen.

The group screen display screen differs from the overview screen in that it allows for the setting of the number of channels displayed on a single screen (with options for 4, 6, 12, 16, and 24 channels), and can switch between displayed channel groups using the ***UP/Down key.***

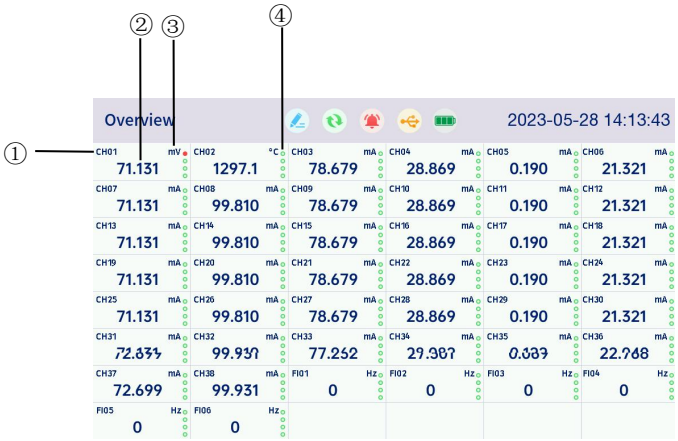


Fig.8 Overview screen (44-channel product screen)

① : Channel tap, configurable.

② : Instantaneous value of engineering quantity. Calculated formula: Instantaneous value of engineering quantity = (Original signal value - Lower limit of signal range)/Full scale of signal * Input range set in the settings.

(Note: The full scale of the signal refers to the difference between the upper and lower limits, e.g., for a 4-20 mA signal, the full scale is 20mA - 4mA = 16mA. The input range set refers to the difference between the upper and lower limits in the second-level menu settings.)

③ : Signal unit, configurable.

④ : Alarm state indicator: green indicates no alarm, red indicates alarm. The four lights from top to bottom represent: high-high alarm, high alarm, low alarm, and low-low alarm.

(3) Single screen

The single-channel display screen can be configured to cycle through displays at fixed intervals or switch between channels manually by pressing the ***Up/Down key.***

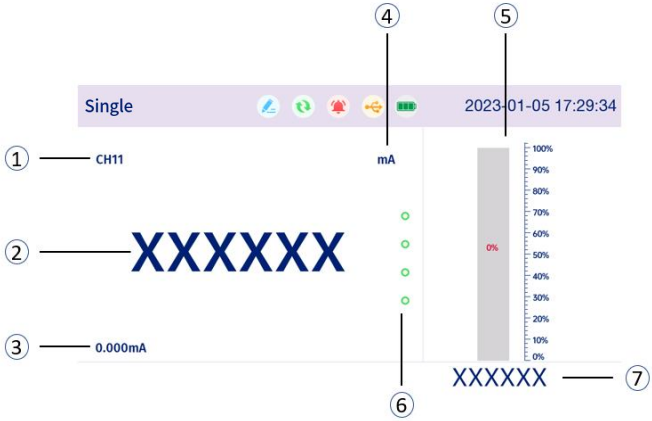


Fig.9 Single screen

① :Channel tap, configurable.

② :Instantaneous value of engineering quantity.

③ :Instantaneous raw signal value and unit.

④ :Engineering quantity unit, configurable.

⑤ :Percentage bar graph of engineering quantity, where the percentage displayed = instantaneous value of engineering quantity/full scale of input setting.

⑥ :Alarm state indicator lights: green indicates no alarm and red indicates alarm; the four lights from top to bottom represent high-high alarm, high alarm, low alarm, and low-low alarm respectively.

⑦ :Instantaneous value of engineering quantity.

⑧ :When the channel input signal is a thermocouple signal, the display shows the cold junction temperature, as shown in the figure below.

Fig.10 Thermocouple signal single screen

(4) Bar graph screen

The bar graph screen defaults to displaying six channels of signals as a group. Pressing the ***Up/Down key*** switches between the current and previous/next group. The orientation of the bar graph can be set to vertical or horizontal in the configuration.

Fig.11 Bar graph screen

① : Channel tap, configurable.

② : Engineering quantity percentage bar graph, displaying percentage = instantaneous value of engineering quantity/input set full scale, bar graph color is configurable.

③ : Engineering quantity unit, configurable.

④ : Instantaneous value of engineering quantity, configurable.

⑤ : Alarm State indicator lights: green indicates no alarm, and red indicates alarm; the four lights from top to bottom represent high-high alarm, high alarm, low alarm, and low-low alarm, respectively.

(5) Real-time curve screen

The real-time curve screen displays 6 channels of signals as a group by default. The group can be switched by ***UP key,*** and the channel can be selected by ***Down key***. The current channel curve can be selected to display or hide by pressing the ***Confirm key.***

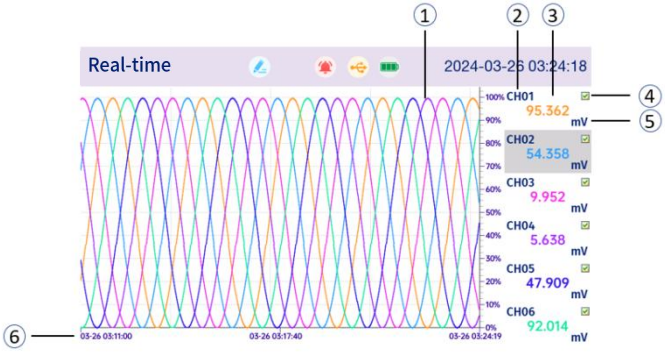


Fig.12 Real-time curve screen

① : Real-time curve, color configurable.

② : Channel tap, configurable.

③ : Instantaneous value of engineering quantity.

④ : Real-time curve display State box. When a green "√" appears within the box, the channel displays real-time curves; when the green "√" is removed, the real-time curve for that channel is hidden. Press the Minus key to select a channel, and the Confirm key to switch between the display/hide of the current channel's curve.

⑤ : Unit of engineering quantity, configurable.

⑥ : Time scale on the coordinate axis dynamically adjusts based on the storage interval, allowing for a full-screen display of up to 800 data points.

(6) Flow screen

The flow screen defaults to displaying a group of four channel signals. Press the ***Up/Down key*** to switch between displaying the previous or next group.

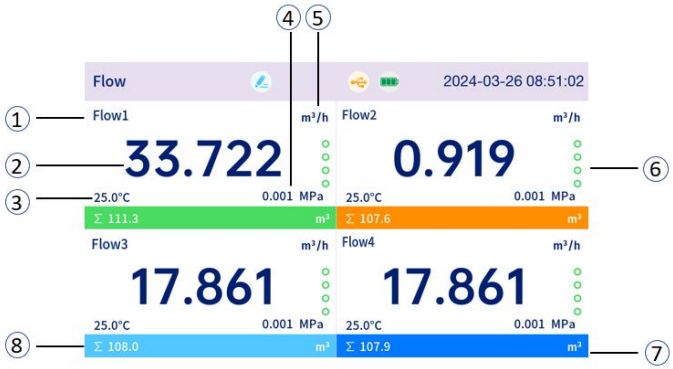


Fig.13 Flow screen

① : Channel tap.

② : Instantaneous value of flow engineering quantity.

③ : Compensation temperature, used for calculation compensation.

④ : Compensation pressure, used for calculation compensation.

⑤ : Flow unit, configurable.

⑥ : Alarm state indicator lights: green indicates no alarm, red indicates alarm; the four lights from top to bottom represent high-high alarm, high alarm, low alarm, and low-low alarm.

⑦ : Accumulated value unit.

⑧ : Total accumulated value of the channel.

(7) Accrue screen

The accrue screen defaults to showing four channels of signals as a group. Press the ***Up/Down key*** to switch between displaying the previous or next group.

Fig.14 Accrue screen

① : Channel tap.

② : Total accrue value.

③ : Instantaneous value.

④ : Accrue value unit.

⑤ : Instantaneous value unit.

(8) Accrue list screen

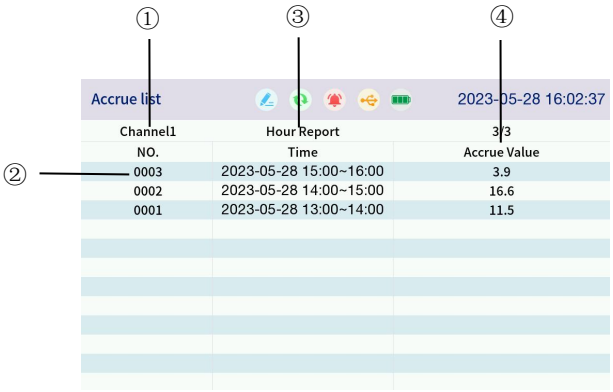


Fig.15 Accrue list screen

① : Channel tagp press the ***Up key*** to enter the selected state, press the ***Left / Right key*** to switch channels.

② : Report sequence number.

③ : Report type, including hour report, daily report, and monthly report.

④ : Accrue value represents the accumulated value under the current report type, and the real-time report represents the accumulated value in one hour.

5.2.2 First-level Menu

In the main page, long press the ***OK key*** to enter the first-level menu, where you can view history curves, alarm records, powerdown records, operation logs, data export, instrument about, and enter the setting mode (second-level menu).

Fig.16 Entering the first-level menu

(1) History curves

The history curve screen defaults to displaying a group of six channel signals.

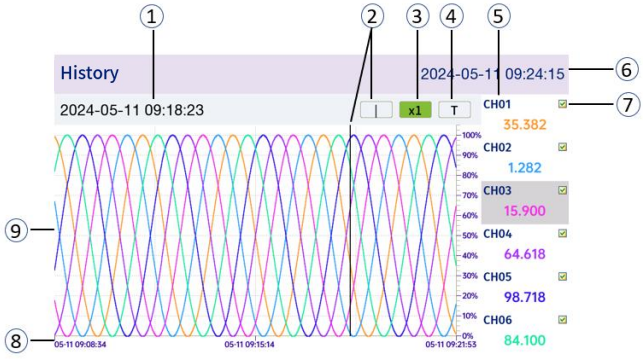


Fig.17 History curves screen

Move the cursor using the *UP key* to browse data, set time axis interval multiples, and select historical data time.

① : Historical time: Real-time display ②the time corresponding to the historical data time scale line at this moment on the time axis, or ④the time set for historical data time.

② : Historical data time scale line. Move the cursor to ② by pressing the "Plus" key, and then move the cursor horizontally by pressing the **Left/Right key** to select the corresponding historical data of that moment.

③ : Time axis interval multiplier. Move the cursor to ③ by pressing the **Up key**, and then set the time axis multiplier by pressing the **Left/Right key**, which can be set to four intervals: x1, x2, x4, x8. As shown in the figure above, the time axis interval is x1, and the figure below shows the x4 time axis interval.

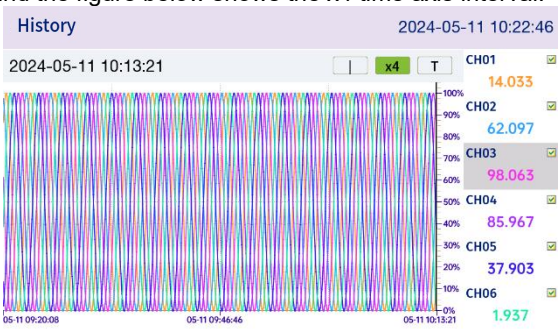


Fig.18 Time axis interval set to 4 times

④ : Historical data time setting. Move the cursor to ④ using the Up key and then press the OK key to enter the historical data time setting.

When exiting the settings for ②, ③, and ④ by moving the cursor with the Up key (i.e. no cursor displayed for ②, ③, and ④), press the *Left/Right key* to switch between displaying the previous/next group of channels. Press the *Down key* to select a channel, and at this moment, pressing the confirm key will enable you to configure whether the curve for the current channel is shown.

⑤ : Channel tap

⑥ : System time.

⑦ : Historical curve display State box. When a green "√" appears within the box, the channel displays historical curves; when the green "√" is removed, the channel's history curve is hidden. Press the Minus key to select a channel, and the Confirm key to switch between the display/hide of the current channel's curve.

⑧ : Time scale axis.

⑨ : Historical curve, color can be customized.

(2) Alarm records

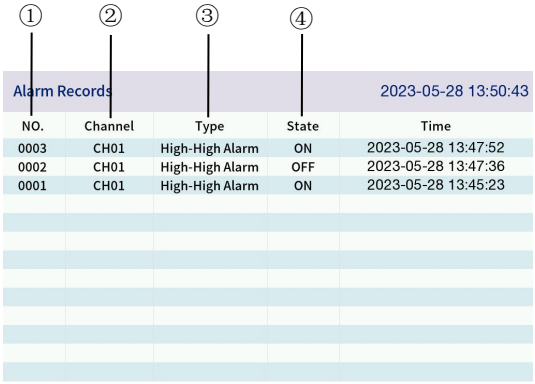


Fig.19 Alarm records screen

① : Alarm record sequence number, with the top entry representing the most recent one.

② : Channel, alarm channel tag number.

③ : Alarm type: high-high alarm, high alarm, low alarm, low-low alarm.

④ : Alarm State: alarmed and cleared.

⑤ : Alarm time, displayed as "Year-Month-Day-Hour-Minute-Second".

(3) Powerdown records

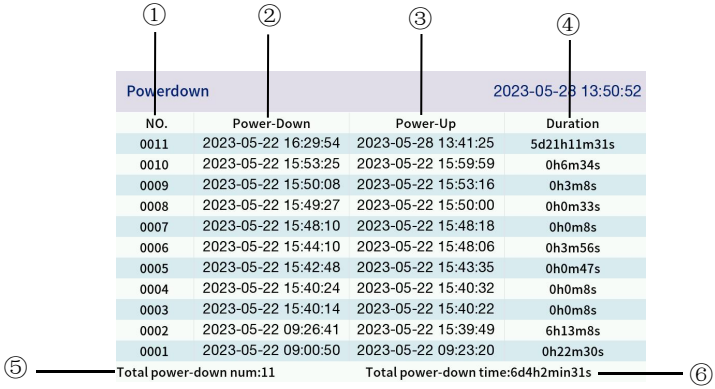


Fig.20 Powerdown records screen

① : Powerdown record sequence number, with the top entry representing the most recent one.

② :Power-down time, displayed as “Year-Month-Day-Hour-Minute-Second”.

③ :Power-on time, shown as “Year-Month-Day-Hour-Minute-Second”.

④ : Duration of powerdown, indicating the length of power failure.

⑤ : Total number of powerdown occurrences.

⑥ : Accumulated duration of powerdown.

(4) Operation logs

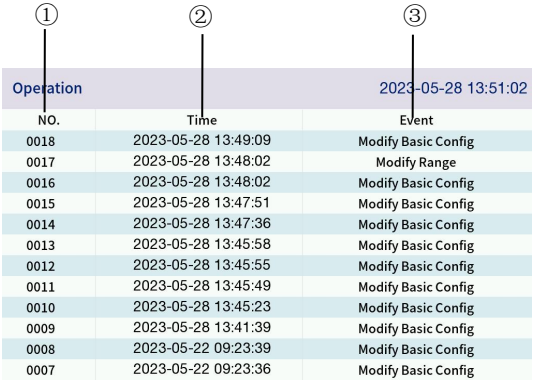


Fig.21 Operation log screen

① : Operation log sequence number, with the most recent record at the top.

② :Operation log time, displayed as “Year-Month-Day-Hour-Minute-Second”.

③ : Operation items: modify base configuration, modify record interval, modify signal range, modify safety password, restore factory settings, export data file, modify system time, firmware upgrade, clear alarm information, clear power failure records, clear operation logs, and clear alarm logs.

(5) Export data

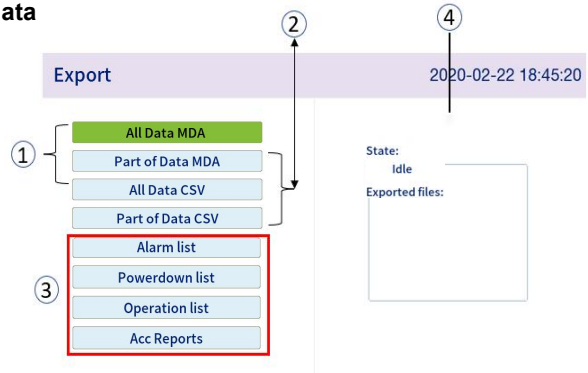


Fig.22 Export data screen

① : Export all data in MDA/CSV formats. MDA and CSV are file formats, with MDA requiring a dedicated PC from our company for opening.

② : Export partial data in MDA/CSV format. Users can select to export data within a specific time range. Choose the desired start and end time, then click the ***OK key*** to proceed to the time setting interface.

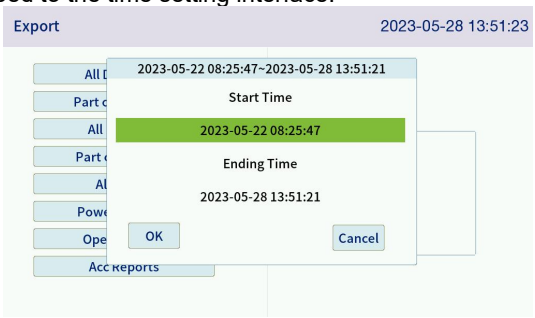


Fig.23 Select start time

Fig.24 Start time setting

③ : Export alarm records, power-off records, operation records, and accumulated reports.

④ : USB flash disk State, which includes a total of 11 USB flash disk Statees: No USB, Idle, File opening failed, Exporting, File creation failed, File read failed, File verification failed, File does not exist, File write failed, File opening failed, and Failed to obtain file

(6) Instrument about

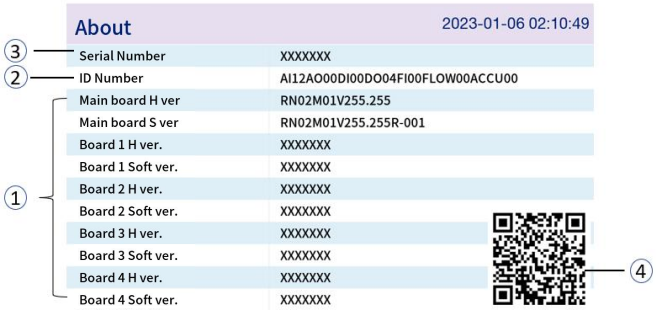


Fig.25 Instrument about

① : Mainboard and sub-board software and hardware version information.

② : Selection ID, composed of Channel Type (abbreviated in English) + Channel Number (2-digit number). The English abbreviations for channel types are as follows: AI: Analog Input; AO: Analog Output; DI: Digital Input; DO: Relay Output; FI: Frequency Signal Input; FLOW: Flow Channel; ACCU: Accumulation Channel.

③ : Product serial number, SN code.

④ : User manual QR code: Scanning the QR code with a mobile phone can retrieve an electronic version of the product manual.

(7) Settings

Configuration setup requires input of a security password to enter the second ary menu, default password is “0000”. Users can navigate to **[Settings]→ [System]→[Password]** to modify the custom password, please keep the modified password securely. Should you inadvertently forget your password, please contact our company.

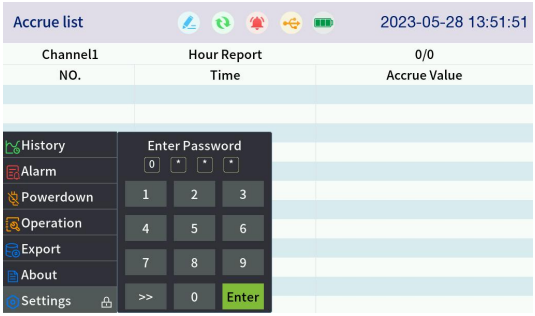


Fig.26 Input password

5.2.3 Second-level menu

After selecting the **[Settings]** and inputting the password, proceed to the second-level menu. Detailed configuration parameters can be found in Chapter 6 Settings.

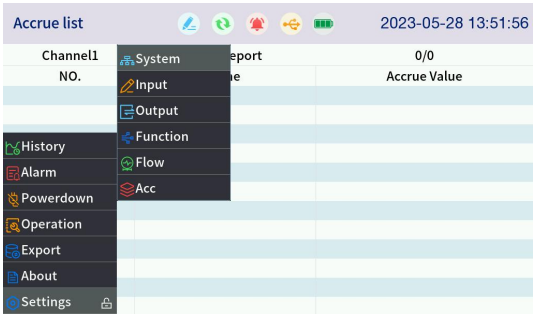


Fig.27 Second-level menu

6 Settings

This chapter introduces the individual configuration parameters of instrument.

6.1 System settings

Setting the basic parameters of the recorder; correct configuration of the parameters ensures the normal operation of the recorder.

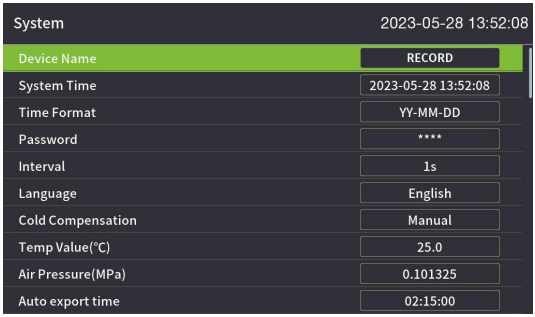


Fig.28 System settings

Table 18 Description of System configuration items

Parameter	Function	Parameter range
Device Name	Set device name	16-character (numeric or alphabetic) or 5-character Chinese
System Time	Set instrument time	2000-2099 (When the set time is earlier than the current system time, data within the specified time range will be cleared)
Time Format	Set time display format	YY-MM-DD, DD-MM-YY,MM-DD-YY
Password	Set password	0000~9999
Interval	Set recording interval	1s, 2s, 5s, 10s, 15s, 30s, 1 min, 2 min, 5 min, 10 min, 15 min, 15 min, 1h. ***[Note 1]***
Language	Select system language	Chinese, English, Korean, Spanish

Parameter	Function	Parameter range
Cold Compensation	Set cold compensation mode	Auto / Manual
Temp Value (℃)	Compensation temperature	When the cold junction compensation is set to manual, a fixed compensation temperature (ranging from -50℃ to 110℃) can be set here. If set to automatic mode, no operation is required for this item.
Air Pressure (MPa)	Environmental air pressure setting	0 ~ 999999. The default setting is standard atmospheric pressure, which is 0.101325 MPa.
Auto export time	Set daily automatic transfer time	00：00：00 ~ 23：59：59
Reset Config	Reset all setting parameters and data of the recorder	Confirm or cancel. **Please be cautious when operating!**

Note 1:

The recorder records sampled data in real-time at preset intervals, with the recording interval selectable from: 1 second, 2 seconds, 5 seconds, 10 seconds, 15 seconds, 30 seconds, 1 minute, 2 minutes, 5 minutes, 10 minutes, 30 minutes, and 1 hour. The default is 1 second.

When the storage space for data recording is full, it will cycle and overwrite. The duration of recording can be dynamically adjusted based on the number of channels and the recording interval. For example, the calculation of recording duration is as follows: Assuming a base interval of 1 second and a maximum of 48 channels, it can record for 13 days. The continuous storage duration varies with the number of channels, as detailed below:

Table 19 Continuous storage duration

Recording Interval	Number of Channel						
	1	2	3-4	5~8	9~12	13~16	17~20
1s	631d	315d	158d	79d	52d	39d	31d
2s	1262d	630d	316d	158d	104d	78d	62d
5s	3155d	1575d	790d	395d	260d	195d	155d
	21~24	25~28	29~32	33~36	37~40	41~44	45~48
1s	26d	22d	20d	17d	16d	14d	13d
2ss	52d	44d	40d	34d	32d	28d	26d
5s	130d	110d	100d	85d	80d	70d	65d
...	...	...	...	...	...	...	...

(Note: The number of days stored at different time intervals is calculated by multiplying the recording interval in seconds based on a 1-second time interval.

6.2 Input settings

The recorder has a 3-terminal versatile input design for its input channels, capable of accepting inputs of current in mA, voltage in V, voltage in mV, thermocouples, thermistors, resistors, and analog signals (for demonstration purposes). Different signal types can be achieved simply by setting the input channel parameters.

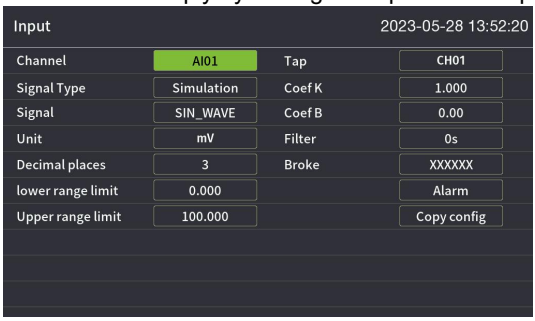


Fig.29 Input settings

Table 20 Description of Input configuration items

Parameter	Function	Parameter range
Channel	Select the channel for settings	AI01-AI48 (as shown in actual display)
Signal Type	Set the channel signal type	Current (mA), Voltage (V), Millivolts (mV), Thermocouple, Thermistor, Resistance, and Analog Signals, ***[Note 2]***
Signal	Configure signal	***[Note 2]***
Unit	Set the unit	
Decimal Places	Set decimal places	Set range: 0 to 3, switch between options using Left/Right keys.
Lower range limit	Set range lower limit	-999999~999999
Upper range limit	Set range upper limit	-999999~999999
Tag	Set rag number of the channel	16-digit (numeric or alphabetic) or 5-character Chinese
Coef K	K value for the equation Y=K_X+B	-999.999~999.999
Coef B	B value for the equation Y=K_X+B	-9999.99~9999.99
Filter	Parameters for filter; the larger the data, the smoother the value change.	0s~30s
Broke	When the channel signal is disconnected (for types like thermocouple, thermistor, resistor, or voltage mv), the channel display configuration.	XXXXX,Upper range limit, lower range limit, HOLD
Alarm Setup	Access the Alarm Setup Screen	Four types of alarm settings: High-high alarm (HH), high alarm

Parameter	Function	Parameter range
		(Hi), low alarm (Lo), and low-low alarm (LL). ***[Note 3]***
Copy config	Copy the current channel configuration to other channels for quick setup	***[Note 4]***

Note 2:

Table 21 Signal Types and Signal settings

Signal Type	Signal
Current (mA)	(4~20)mA, (0~20)mA(0~10)mA
Voltage (V)	(0~5)V, (1~5)V, (-5~5)V, (0~10)V, (2~10)V, (0~10)V,
Voltage (V)	(0~20)mV, (-20~20)mV, (0~100)mV, (-100~100)mV,
Thermocouple	K, S, B, E, J, T, R, N, WRe5-26, WRe3-25
Thermistor	PT100, JPT100, PT1000, Cu50, Cu53, Cu100
Resistance	(0~400)Ω, (0~4000)Ω,
Analog signal	SIN_WAVE, COS_WAVE, TRI_WAVE, SQR_WAVE
Frequency (customizable)	(0~10000)Hz

Note 3:

Table 22 Alarm configuration description

Alarm Type	Parameter	Function	Parameter range
High-high Alarm	High-High Alarm values	Set High-high alarm value	-999999~999999
	State	Set alarm state	Enable, disable
	High-High Alarm Output	Set High-high alarm output terminal	Disable, Relay 1-Relay 22 (as actually displayed)
	Delay delay	Set Alarm delay time	0s~120s
	Hysteresis	Set Alarm hysteresis	0~999999
High Alarm	High Alarm values	Set High alarm value	-999999~999999
	State	Set alarm state	Enable, disable

Alarm Type	Parameter	Function	Parameter range
	High Alarm Output	Set High alarm output terminal	Disable, Relay 1-Relay 22 (as actually displayed)
	Delay delay	Set Alarm delay time	0s~120s
	Hysteresis	Set Alarm hysteresis	0~999999
Low Alarm	Low Alarm values	Set Low alarm value	-999999~999999
	State	Set alarm state	Enable, disable
	Low Alarm Output	Set Low alarm output terminal	Disable, Relay 1-Relay 22 (as actually displayed)
	Delay delay	Set Alarm delay time	0s~120s
	Hysteresis	Set Alarm hysteresis	0~999999
Low-low Alarm	Low-low Alarm values	Set Low-low alarm value	-999999~999999
	State	Set alarm state	Enable, disable
	Low-low Alarm Output	Set Low-low alarm output terminal	Disable, Relay 1-Relay 22 (as actually displayed))
	Delay delay	Set Alarm delay time	0s~120s
	Hysteresis	Set Alarm hysteresis	0~999999

The relay delay and hysteresis of different alarm types are independently set.

Hysteresis prevents repeated alarm when the measures date fluctuates from the alarm point. The high- or low-level alarm and Hysteresis figure is showed in Figure 30. At high level alarm, when the actual engineering value is larger than or equal to the alarm value, the recorder enters into the alarm state. When the input is reduced, the actual engineering value is less than the alarm value, but the recorder will not exit the alarm state immediately. Until the actual engineering value is less than the alarm value and Hysteresis value, will the recorder exit the alarm state. The same is for low level alarm.

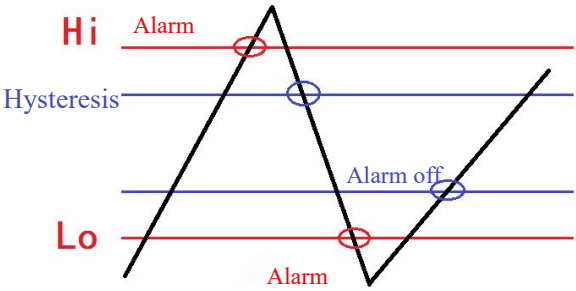


Fig.30 High and Low alarm and Hysteresis

[Note 4]

Copy configuration : Please select the copy channel first, then set the paste channel (all the channels from the start channel to the end channel will be pasted with the same configuration as the copy channel). As shown in the figure, this means that all channels from channel 3 to channel 20 (including channels 3 and 20 themselves) will be copied with the same configuration as channel 1.

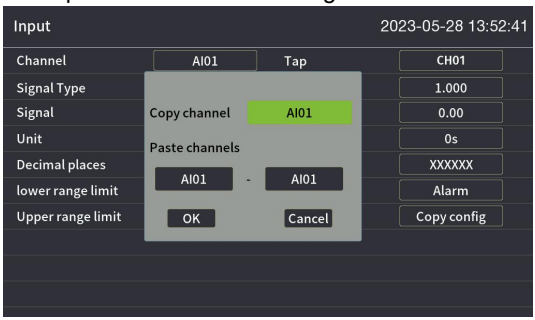


Fig.31 Copy configuration

6.3 Output settings

The current output module provides 6 independent analog outputs. It can convert and output analog input channels and flow channels.

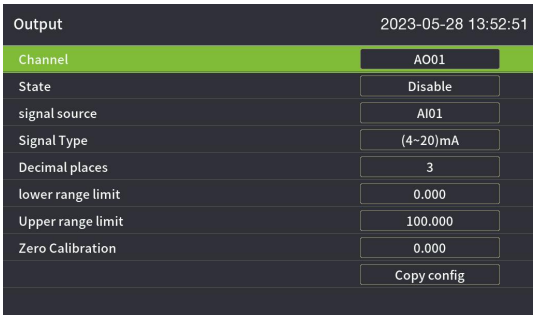


Fig.32 Output settings

Table 23 Description of output configuration parameter

Parameter	Function	Parameter Range
Channel	Select the configured AO (Analog Output) channel	AO01~AO06
State	Enable or disable the channel	Enable, disable
Signal Source	The channel to output	AI01~AI48, flow 1 ~ flow 6 (as actually displayed)
Signal Type	Type of analog output	(4~20)mA,(0~20)mA,(0~10)mA, (0~5)V, (1~5)V, (0~10)V
Decimal Places	Set the number of decimal places	0~3
Lower range limit	The lower limit of the channel	-999999~999999
Upper range lLimit	The upper limit of the channel	-999999~999999
Zero Calibration	Adjustable zero, unit: mA	-999.999~999.999
Copy config.	Copy the current channel configuration information	

[Note 5]

$$\text{Current output} = \frac{\text{Signal source} * (\text{Output high limit} - \text{Output low limit})}{\text{Signal source high limit} - \text{Low limit}} + \text{Output low limit} + \text{Zero calibration}$$

6.4 Function settings

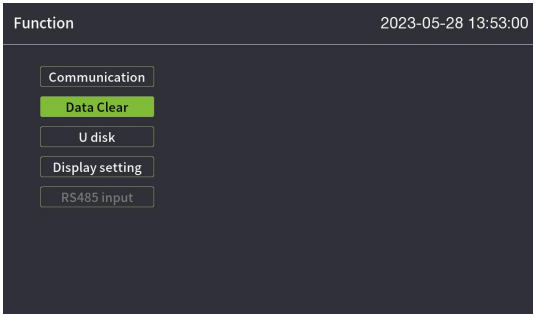


Fig.33 Function setting

6.4.1 Communication setting

This product supports both RS485 communication interface and Ethernet communication interface, which can be configured simultaneously. RS485 communication adopts the Modbus RTU communication protocol, while Ethernet communication adopts the Modbus TCP communication protocol.

Table 24 Description of Communication configuration

Communication Interface	Parameter	Function	Parameter range
RS485	Address	Device address	1~247 (default 1)
	Baud rate	Communication rate	1200, 4800, 9600 (default), 19200, 57600, 115200
	Parity	Communication check	None(default), Odd, Even
	Float Format	Floating-point format	0123, 1032 (default), 2301, 3210
Ethernet	IP Address	IP address	Default 192.168.10.245
	Subnet mask	Subnet mask	Default 255.255.255.0
	Gateway	Default gateway	Default 192.168.10.2
	TPC Port	TPC port	502
	Firmware Update	Firmware update	

Communication Interface	Parameter	Function	Parameter range
	Note: After setting the Ethernet parameters, the instrument must be powered off and then powered on once for the settings to take effect.		

6.4.2 Data Clear

Table 25 Description of Data clear configuration

Item	Function Description
Clear Alarm list	Clear all alarm lists
Clear Operation list	Clear all operation lists
Clear Powerdown list	Clear all powerdowan lists
Clear Acc report	Clear all accumulate reports

6.4.3 U disk

The instrument supports saving the current configuration to a U disk, as well as reading the configuration file from the U disk.

Table 26 Description of U disk operation configuration

Item	Description	File Format
Export Config	Export current instrument configuration	CFG (.cfg)
Import Config	Read instrument configuration from USB	
Firmware Update	Perform firmware update	
Format USB	Perform USB flash disk formatting	FAT16/32

(1) When transferring data to a USB, please use a dedicated USB for reading and writing to avoid potential failure in data export.

(2) File storage path: All files of this instrument are stored in the corresponding folders under the root directory of the USB flash disk labeled [RNX]. The [Bmp] folder contains recorded screenshots, the [Config] folder holds configuration files, the [History] folder stores historical records, and the [Information] folder includes various types of information, such as alarm messages.

Table 27 Example of USB file names

File	Subdirectory	File Name
Historical records	/History	H220905091650.csv/ H220905091650.mda
Accrue list	/Information	R20240511085609.csv
Alarm records	/Information	A20240511085602.csv
Powerdown Records	/Information	P20240511085606.csv
Operation Records	/Information	O20240511085608.csv

6.4.4 Display setting

Table 28 Description of Display configuration

Parameter	Function	Parameter range
Backlight	Adjust screen brightness	1~5 levels of brightness adjustable, with 1 being the lowest brightness and 5 the highest.
Backlight Off	Set screen to automatically turn off after a period of inactivity	Always on, 5 min, 10 min, 15 min, 30 min, 1h.
Cycle Time	Set the single display time for the cyclic display channel	Disable, 5s, 15s and 30s.
Startup screen	Set the startup screen	Overview screen, single display screen, group display screen, bar graph screen, real-time curve screen, flow screen,flow, accrue, and accrue list.
Bar chart direction	Set the bar graph direction	Vertical, horizontal.
Number of grouped channels	Set the number of channels displayed on a single digital screen	4, 6, 12, 16, 24

Parameter	Function	Parameter range
Channel combination	Set the default group channel bar graph and curve colors, and customize signal groups	

- **Description of channel combination settings**

Fig.34 Channel combination setting

① Groups: 1~8 are the default groups, corresponding to 6 channels of signals. Custom group1, Custom group2 are custom groups, where you can select the signal source from the channels, and each group can select up to 6 channels at most.

Fig.35 Groups

② Channels: with a default configuration of six channels per group (CH01~CH06).

③ Signal source. When the group is selected as 1 to 8, channels correspond to signal sources in sequence, unmodifiable, as shown in the figure. For example, Channel CH01’s source is AI01, Channel CH02’s is AI02, and so on. When the group is set to Custom Combination 1 and Custom Combination 2, Channels CH01 to CH06 can be customized for signal sources, as shown below, where Channel CH01’ s source can be set to AI06.

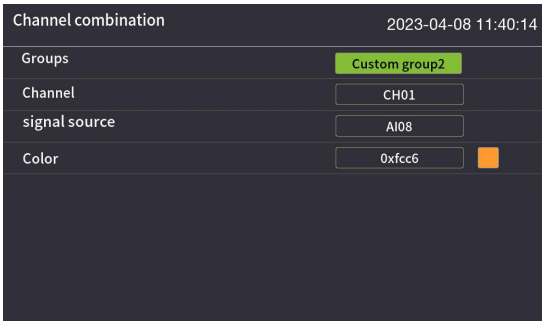


Fig.36 Custom signal source

When a user set a custom signal source for a group, the main page of the recorder displays not only the default group’ s screens (digital screen, bar chart screen, and real-time curve screen) but also the custom group’ s screens, as shown in Figures 37 ~ 39.

Fig.37 Custom Group - group display Screen

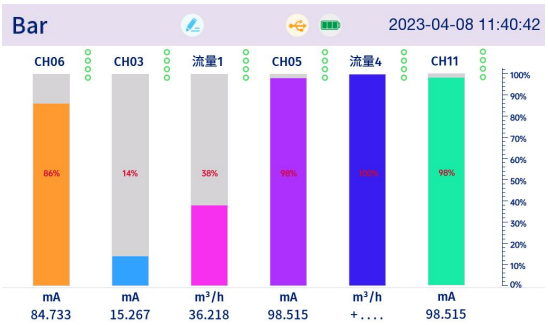


Fig.38 Custom group – bar chart screen

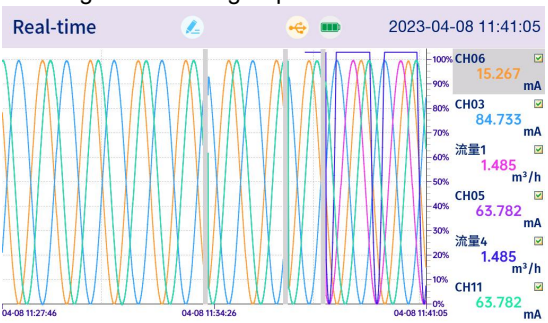


Fig.39 Custom group – real-time curve screen

④ Color: Users can set the color of the bar chart and curve for the corresponding signal, and generate the required color by setting the corresponding three primary colors.

Fig.40 Color setting interface

6.5 Flow settings

Flow function can be used to measure media such as superheated steam, saturated steam, general gas, mixed gas, natural gas, gas, water, hot water, chemical liquid, and chemical liquid. It is suitable for the matching use of flow products such as vortex flowmeters, turbine flowmeters, V-cone flowmeters, bend flowmeters, electromagnetic flowmeters, mass flowmeters, orifice flowmeters, nozzle flowmeters, and classic Venturi tubes.

Fig.41 Flow setting

Table 29 Description of flow setting configuration

Parameter	Description	Parameter range
Channel	Select the flow channel for settings	01~08
Stat	Enable or disable this channel	Enable, disable
Unit	Units displayed in the flow screen	Customized string, with the default unit being m^3/h.
Signal source	Channel of the flow signal	AI01~AI48 (as actually displayed)
Decimal places	Set the decimal places for flow	0~3
Lower range Limit	Lower range limit after flow compensation	-999999~999999
Upper range Limit	Upper range limit after flow compensation	-999999~999999
Flow model	Select a formula suitable for	No SQRT, HAVE UNSQRT,

Parameter	Description	Parameter range
	the throttling device	HAVE SQRT ***[Note 6]***
Flow cut	Small flow cutoff	-999999~999999
Flow K	[Note 1] K in the formula	-999999~999999
Compensation	Select the algorithm for density compensation	No Compensation, Temp Compensation, Pre Compensation, Manual Density, Superheated Steam, Saturated Steam P, Saturated Steam T, General Gases. ***[Note 7]***
Pressure source	P in density compensation, unit kPa	None, AI01~AI48
Design Pressure (kPa)	Can be set manually	
Temp source	T in density compensation, unit °C	None, AI01~AI48
Design Temp (°C)	Can be set manually	
Manual Density	Set the density value of the substance	-999999~999999
Compensation Coef A	Compensate flow with coefficient A	-999999~999999
Compensation Coef B	Compensate flow with coefficient B	-999999~999999
Alarm	Enter the alarm setting screen	Please refer to the “Alarm Setting” in the Input Setting.
Copy Config.	Copy the current channel configuration information	Please refer to the “Copy Configuration” in the Input Setting.

[Note 6]

There are many ways to measure flow, including volumetric, speed, pulse frequency, and mass-based methods, among others. This instrument categorizes these into three types:

Table 30 Flow Models and Formulas

Flow Model	Formula
No SQRT,	$Q = \frac{I_f \rho}{K}$
HAVE UNSQRT	$Q = K * \sqrt{\Delta P * \rho}$
HAVE SQRT	$Q = K * \Delta P * \sqrt{\rho}$

Where:

Q: Mass flow rate

K: Mass flow rate

ρ ： Fluid density

ΔP : Differential pressure signal

If : Flow value for non-orifice plate type restriction devices, which can be an electrical current signal or a frequency signal

[Note 7]

From the flow model, it can be observed that the calculation of mass flow rate is directly related to the fluid density. Since the density of gases varies significantly with different operating conditions, it is necessary to calculate the density under specific operating conditions. The table below outlines the methods for calculating different gas densities.

Table 31 Methods for Calculating Different Gas Densities

Compensation Mode	Calculation Method	Applicable Fluids
Manual Density	ρ: Calculate based on [Manual Density	Liquids
Superheated Steam	ρ: Calculate based on IAPWS-IF97	Superheated steam

Compensation Mode	Calculation Method	Applicable Fluids
Saturated Steam P	ρ: Calculate through pressure, based on IAPWS-IF97	Saturated steam
Saturated Steam t	ρ: Calculate through temperature, based on IAPWS-IF97	Saturated steam
General Gases	ρ: Calculate based on ideal gas equation, require setting of [reference density]	Gases such as oxygen, nitrogen, and hydrogen
No Compensation	ρ: Calculate based on Constant 1	Measure volume flow
Temp Compensation	ρ=A+B/t, A B are linear compensation coefficients	
Pre Compensation	ρ= A+B*P, A B are linear compensation coefficients	

6.6 Accumulation settings

The accumulation function accumulates the selected signal source based on hours, days, and months, forming hourly reports, daily reports, and monthly reports.

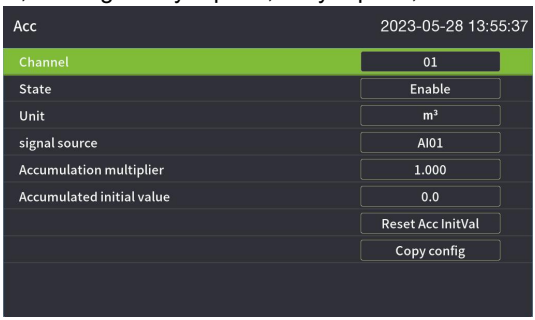


Fig.42 Accumulation setting

Table 32 Description of accumulated Setting Configuration Items

Parameter	Description	Parameter Range
Channel	Select the channel for setting	01~08
State	Enable or disable this channel	Enable, Enable
Unit	Unit displayed in the accumulation screen	Custom string
Signal Source	Channel to be accumulated	AI01~AI48, Flow 1~Flow 8
Accumulation Multiplier	Accumulate by multiplying with the accumulation	-999999~999999

Parameter	Description	Parameter Range
	multiplier	
Accumulated initial value	Initial value at the time of reset	-999999~999999
Reset Acc InitVal	Reset this channel with the accumulation initial value	*[Note 8]*
Copy Config	Copy the configuration information of the current channel	Please refer to "Copy Configuration" in Input Setting

[Note 8]

The modified accumulation initial value will only take effect after re-enabling the configuration.

7 Fault analysis and troubleshooting

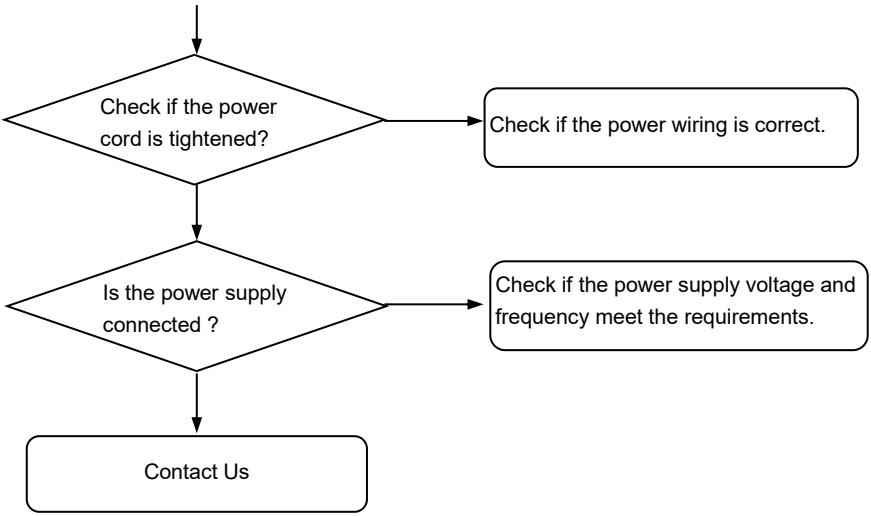
In order to maintain the reliability of the instrument and maintain its good working condition for a longer period of time, please regularly inspect and maintain it to ensure that the installation and usage environment of the instrument meet the requirements, and conduct wiring and other operations according to normal procedures. When the instrument malfunctions, it should be resolved according to the methods described in this manual.

7.1 Regular inspection and maintenance

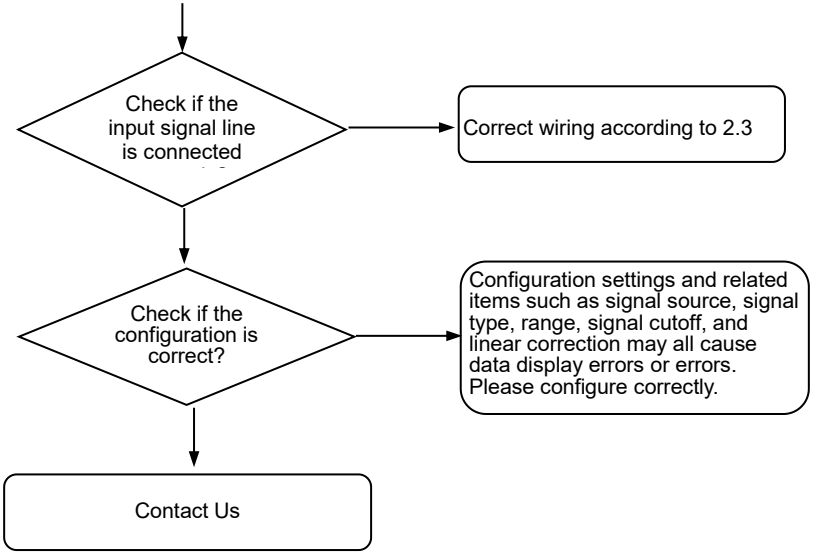
- Inspect all components of the instrument for damage, corrosion, and remove surface attachments;
- Check if all components are loose;
- Check the grounding protection to ensure that the protection measures are complete;
- Ensure that the ventilation holes of the instrument casing are unobstructed to prevent high-temperature faults, abnormal actions, reduced lifespan, and fires.

7.2 Fault handling

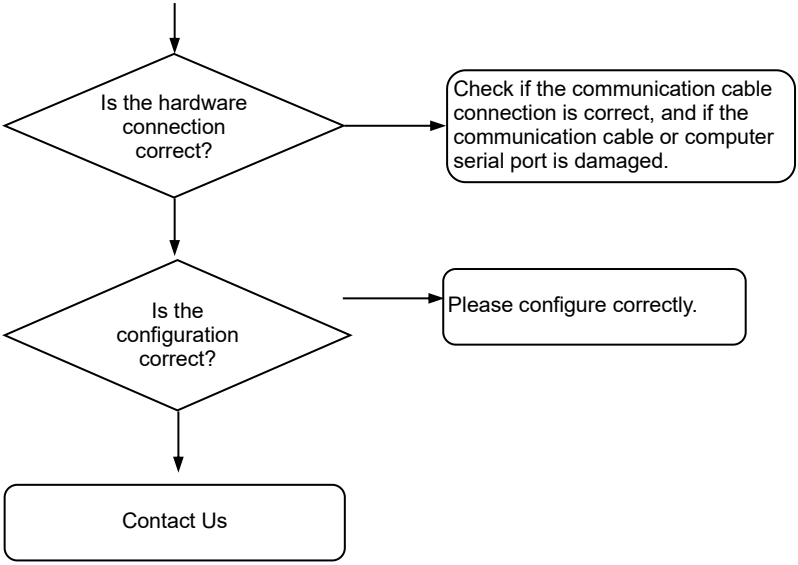
7.2.1 LCD screen without display



7.2.2 Signal data display error



7.2.3 Unable to communicate correctly



8 Communication

The paperless recorder is equipped with three types of communication interfaces: 485 input, 485 output, and Ethernet. When functioning as a 485 output or Ethernet communication device, the recorder operates as a slave (server), allowing a master (client) to retrieve the data monitored by the device via the communication protocol. Conversely, when acting as a 485 input, the recorder assumes the role of a master and can configure the interface to read data from the monitoring equipment.

8.1 Protocol overview

8.1.1 Modbus Serial

The Modbus protocol over serial port can operate on RS-232, RS-422, or RS-485 bus lines. The character format for serial Modbus is as follows:

- 1 start bit.
- 8 data bits, with the least significant bit sent first.
- 1 parity bit, which is omitted if no parity checking is required.
- 1 stop bit.

The detailed character format is as follows:

Parity:

Start bit	1	2	3	4	5	6	7	8	Parity bit	Stop bit

No parity:

Start bit	1	2	3	4	5	6	7	8	Stop bit	Stop bit

Note: The above represents the standard recommended method. However, in practice, when the R series meters communicate without parity, they use a 1-bit stop bit method, as shown below.

Start bit	1	2	3	4	5	6	7	8	Stop bit

Frame Format:

For Modbus over serial lines, the additional address field uses a 1-byte slave address, and the data integrity field uses a 2-byte CRC (Cyclic Redundancy Check) for error detection. Therefore, the ADU (Application Data Unit) frame format for serial line Modbus is as follows:

Slave address	Function code	Command data	CRC check
（1 bit）	（1 bit）	（0~252 bits）	（2 bits）

Slave Address:

The address field in the message frame consists of 8 bits, and the address range for a single device is from 1 to 254. The master device activates the slave device by placing the address of the slave device it wishes to communicate with in the address field of the message. When the slave device sends a response message, it places its own address in the address field of the response message, so that the master device knows which device is responding. Address 0 is used as a broadcast address to enable all slave devices to recognize it.

CRC Check:

When using the RTU mode for character frames, the error detection field contains a 16-bit value (realized using two 8-bit characters). The content of the error detection field is obtained through a cyclic redundancy check method applied to the message content. The CRC field is appended at the end of the message, with the low byte added first, followed by the high byte. Therefore, the high byte of the CRC is the last byte sent in the message.

8.1.2 Modbus TCP

Modbus TCP operates over TCP/IP networks. This section mainly discusses the format, composition, and significance of the Modbus frames carried over Modbus/TCP networks. All Modbus TCP frames are sent over TCP register port 502.

Frame Format:

For Modbus over TCP/IP, an additional address field of 7 bytes is used in the MBAP header, and the Modbus frame itself does not have a data checksum field. The accuracy of transmitted data is verified by the mechanisms of TCP/IP and link layer (Ethernet) checksums. Therefore, the ADU frame format of Modbus TCP is as follows.

MBAP header	Function code	Command data
（7 bits）	（1 bit）	（0~252 bits）

MBAP header MODBUS Application Protocol header.

The format of the MBAP prefix is as follows:

Unit	length byte	description
Transaction process identifier	2	initialized by the client and copied by the server. typically 0.
Protocol identifier	2	0 denotes modbus protocol. initiated by the client, copied by the server.
Length of subsequent data	2	for modbus, the high byte is always 0.
Unit identifier	1	generally the slave address in serial mode

8.2 Register address

Table 33 Data information address list

Name	Starting Address	Register Count	Attributes	Data Type	Function Code
AI Engineering Quantity	0x2000	N	Read only	float	0x03
AI Channel Quality Code	0x2080	N	Read only	short	0x03
Flow Channel Value	0x2100	M	Read only	float	0x03
Flow Channel State	0x2150	M	Read only	short	0x03
Integer part of flow channel total accumulated value	0x22C0	M	Read only	int	0x03
accumulated Value of Flow Channel Over Time	0x2310	M	Read only	float	0x03
Daily accumulated Value of Flow Channel	0x2360	M	Read only	float	0x03
Monthly accumulated Value of Flow Channel and Accumulated Channel	0x23B0	M	Read only	float	0x03
Real-time Value of Operational Channel	0x2410	M	Read only	float	0x03

Name	Starting Address	Register Count	Attributes	Data Type	Function Code
Fractional Part of Flow Channel Total accumulated Value	0x2440	M	Read only	float	0x03
Total accumulated Value of Flow Channel Double-Precision Floating-Point Value	0x2470	M	Read only	double	0x03
AO Engineering Quantity Output Value	0x24B0	P	Read only	float	0x03
DO Output State Value	0x24E0	Q	Read only	Boolean	0x01
FI Frequency Input Value	0x2510	L	Read only	float	0x03
FI Channel State Value	0x2530	L	Read only	short	0x03

Table 34 Register address

Name	Register Address	Function Code	Data Type	Description
AI Engineering Quantity				
Engineering Quantity of Channel 1	0x2000	0x03	float	Note endianness, with a default value of 1032
Engineering Quantity of Channel 2	0x2002	0x03	float	
…	…	…	…	…
Engineering Quantity of Channel N	0x2000+(N-1)*2	0x03	float	Hexadecimal: 0x2000, Decimal: (N-1) * 2. For example, if N=48, the register address is 0x205E.
AI Quality Code				
Quality Code of Channel 1	0x2080	0x03	short	BIT0: 0 - Normal, 1 - HH alarm BIT1: 0 - Normal, 1 - HH alarm BIT2: 0 - Normal, 1 - L alarm

Name	Register Address	Function Code	Data Type	Description
				BIT3: 0 - Normal, 1 - LL alarm BIT4: 0 - Normal, 1 - Disconnection BIT5: 0 - Normal, 1 - Lower- limit alarm BIT6: 0 - Normal, 1 - Upper -limit alarm
Quality Code of Channel 2	0x2081	0x03	short	
…	…	…	…	…
Quality Code of Channel N	0x2080+(N-1)	0x03	short	Hexadecimal: 0x2080 Decimal: N - 1 Example: N = 48, Register address = 0x20AF
Real-time Value of Flow Channel				
Flow Value of Channel 1	0x2100	0x03	float	Flow rate real-time value
Flow Value of Channel 2	0x2102	0x03	float	Flow rate real-time value
…	…	…	…	…
Flow Value of Channel N	0x2100+(N-1)*2	0x03	float	Hexadecimal: 0x2100 Decimal: (N - 1) * 2 Example: N = 8, Register address = 0x210E
State Value of Flow Channel				
State of Flow Channel 1	0x2150	0x03	short	BIT0: 0 - Normal, 1 - HH alarm BIT1: 0 - Normal, 1 - HH alarm BIT2: 0 - Normal, 1 - L alarm BIT3: 0 - Normal, 1 - LL alarm BIT4: 0 - Normal,

Name	Register Address	Function Code	Data Type	Description
				1 - Disconnection BIT5: 0 - Normal, 1 - Lower- limit alarm BIT6: 0 - Normal, 1 - Upper -limit alarm
State of Flow Channel 2	0x2151	0x03	short	
…	…	…	…	…
State of Flow Channel N	0x2150+(N-1)	0x03	short	Hexadecimal: 0x2150 Decimal: N-1 Example: N=8, Register address = 0x2157
Integer Part of Flow Channel Total accumulated Value				
Integer part of flow channel 1 total accumulated value	0x22C0	0x03	int	
Integer part of flow channel 2 total accumulated value	0x22C2	0x03	int	
…	…	…	…	…
Integer part of flow channel n total accumulated value	0x22C0+(N-1)*2	0x03	float	Hexadecimal:0x22C0 Decimal: (N-1) *2 Example: N=8, Register address = 0x22CE

Name	Register Address	Function Code	Data Type	Description
Accumulated Value of Flow Channel Over Time				
Accumulated Value of Flow Channel 1 Over Time	0x2310	0x03	float	
Accumulated Value of Flow Channel 2 Over Time	0x2312	0x03	float	
…	…	…	…	…
Accumulated Value of Flow Channel N Over Time	0x2310+(N-1)*2	0x03	float	Hexadecimal: 0x2310 Decimal: (N-1) *2 Example: N=8, Register address =0x231E
Daily Accumulated Value of Flow Channel				
Daily accumulated Value of Flow Channel 1	0x2360	0x03	float	
Daily accumulated Value of Flow Channel 2	0x2362	0x03	float	
…	…	…	…	…
Daily accumulated Value of Flow Channel N	0x2360+(N-1)*2	0x03	float	Hexadecimal: 0x2360 Decimal: (N-1) *2 Example: N=8, Register address =0x236E

Name	Register Address	Function Code	Data Type	Description
Monthly Accumulated Value of Flow Channel				
Monthly accumulated Value of Flow Channel 1	0x23B0	0x03	float	
Monthly accumulated Value of Flow Channel 2	0x23B2	0x03	float	
…	…	…	…	…
Monthly accumulated Value of Flow Channel N	0x23B0+(N-1)*2	0x03	float	Hexadecimal: 0x23B0 Decimal: (N-1) *2 Example: N=8, Register address =0x23BE
Real-Time Value of Calculation Channel				
Real-Time Value of Calculation Channel 1	0x2410	0x03	float	
Real-Time Value of Calculation Channel 2	0x2412	0x03	float	
…	…	…	…	…
Real-Time Value of Calculation Channel N	0x2410+(N-1)*2	0x03	float	Hexadecimal: 0x2410 Decimal: (N-1) *2 Example: N=8, Register address =0x241E

Name	Register Address	Function Code	Data Type	Description
Fractional Part of Flow Channel Total Acaccumulated Value				
Fractional Part of Flow Channel 1 Total Accumulated Value	0x2440	0x03	float	
Fractional Part of Flow Channel 2 Total Accumulated Value	0x2442	0x03	float	
...	...	...	...	...
Fractional Part of Flow Channel N Total Accumulated Value	0x2440+(N-1)*2	0x03	float	Hexadecimal: 0x2440 Decimal: (N-1) *2 Example: N=8, Register address =0x244E
Total Accumulated Value of Flow Channel (Double-Precision)				
Total Accumulated Value of Flow Channel 1 (Double-Precision)	0x2470	0x03	double	
Total Accumulated	0x2474	0x03	double	

Name	Register Address	Function Code	Data Type	Description
Value of Flow Channel 2 (Double-Precision)				
...	...	...	...	...
Total Accumulated Value of Flow Channel N (Double-Precision)	0x2470+(N-1)*4	0x03	double	Hexadecimal: 0x2470 Decimal: (N-1) *4 Example: N=8, Register address =0x248C
AO Engineering Quantity Value				
Engineering Quantity of AO Channel 1	0x24B0	0x03	float	
Engineering Quantity of AO Channel 2	0x24B2	0x03	float	
...	...	...	...	...
Engineering Quantity of AO Channel N	0x24B0+(N-1)*2	0x03	float	Hexadecimal: 0x24B0 Decimal: (N-1) *2 Example: N=6, Register address =0x24BA
DO Output State Value				
DO Channel 1 State	0x24E0	0x01	Boolean	DO Relay Value 0: Open 1: Closed
DO Channel 2 State	0x24E1	0x01	Boolean	

Name	Register Address	Function Code	Data Type	Description
…	…	…	…	…
DO Channel N State	0x24E0+(N-1)	0x01	Boolean	Hexadecimal: 0x24E0 Decimal: N-1 Example: N=22, Register address =0x24F5
Frequency Input Value				
Input Value of Frequency Channel 1	0x2510	0x03	float	FI frequency input value, number of pulses detected per second. Unit: Hz
Input Value of Frequency Channel 2	0x2512	0x03	float	
…	…	…	…	…
Input Value of Frequency Channel N	0x2510+(N-1)*2	0x03	float	Hexadecimal: 0x2510 Decimal: (N-1) *2 Example: N=6, Register address =0x251A
State Value of FI Channel				
State Value of FI Channel 1	0x2530	0x03	short	The State of bits 0-6 in the register value is as follows: BIT0: 0 - Normal, 1 - High-high alarm BIT1: 0 - Normal, 1 - High alarm BIT2: 0 - Normal, 1 - Low alarm BIT3: 0 - Normal, 1 - Low-low alarm BIT4: 0 - Normal, 1 - Disconnection BIT5: 0 - Normal, 1 – Lower-limit

Name	Register Address	Function Code	Data Type	Description
				alarm BIT6: 0 - Normal, 1 – Upper-limit alarm
State Value of FI Channel 2	0x2531	0x03	short	
...	...	...	...	...
State Value of FI Channel N	0x2530+(N-1)	0x03	short	Hexadecimal: 0x2530 Decimal: N-1 Example: N=6, Register address =0x2535

8.3 Communication example

8.3.1 485 Communication

Example: Reading the engineering quantity of channel 1

Transmit data:

01 03 20 00 00 02 CF CB

Description:

01: Instrument address (configurable)

03: Modbus command 03

20 00: Register address 0x2000

00 02: Number of register 2

CF CB: CRC check

Return data:

01 03 04 00 00 3F 80 EA 63

Description:

01: Instrument address

03: Modbus command for data retrieval

04: Four bytes of returned data

00 00 3F 80: Floating-point number (F 1-0-3-2, configurable), representing 1.00

EA 63: CRC check

8.3.2 Ethernet Communication

Modbus TCP operates on a TCP/IP network. For Modbus based on TCP/IP, the additional address field uses a 7-byte MBAP (Modbus Application Protocol) header. The Modbus frame itself does not have a data validation field, and the accuracy of the transmitted data is ensured using the TCP/IP and link layer (Ethernet) validation mechanisms. Consequently, the ADU (Application Data Unit) frame format for Modbus TCP is as follows:

MBAP header	Function code	Command data
（7 bits）	（1 bit）	（0~252 bits）

Example: Reading the engineering quantity of channel 1

Transmit data: 00 00 00 00 00 06 01 03 20 00 00 02

Description:

00 00 00 00 00 06: MBAP header

01: Instrument address

03: Modbus Function Code 03

20 00: Register address 0x2000

00 02: Number of register 2

Return data:

00 00 00 00 00 07 01 03 04 00 00 42 BE

Description: 00 00 00 00 00 07: MBAP Prefix

01: Instrument address

03: Modbus function code 03

04: Four bytes of returned data

00 00 42 BE: Floating-point number (F 1-0-3-2, configurable) representing 95.00

Appendix : Calculation of flow coefficient K

Case 1: Orifice (no extraction of a root for differential pressure), measure the flow of oxygen in Nm3/h.

Table 35 Calculation sheet

Process data:	Design	Max	Norm	Min	Unit
absolute pressure	950.000				kPa
temperature	20.0				℃
Flow	40000.00000	36000.00000	21500.00000	10800.00000	Nm3/h
expansion coefficient	0.9994	1.0000	0.9998	0.9995	-
reynolds	278E+04	25,009E+02	14,936E+02	75,026E+01	-
fluid velocity	12.3963	11.1567	6.6630	3.3470	m/s
pressure loss	0.1066	0.0863	0.0308	0.0078	kPa
differential pressure	1.8400	1.4901	0.5312	0.1340	kPa

Obtain the following information based on the calculation sheet:

parameter	Value
Design pressure	0.95MPa
Design temperature	20℃
Design flow	40000Nm3/h
Design differential pressure	1.84kPa

Calculation method:

The oxygen density under standard conditions and design temperature pressure are calculated.

According to the ideal state equation:

$$PV = (mRT / M) = nRT$$
$$PV = mRT / M$$
$$PM / RT = m / V = \rho$$
$$\rho = PM / RT$$

The density under standard conditions is 1.429Kg/m3.

The density under design temperature pressure is 12.485Kg/m3.

Calculate according to the formula $Q = K * \sqrt{\Delta P * \rho}$, which is substituted by design parameters.

$$40000 * 1.429 = K * \sqrt{1.84 * 12.485}$$

K=11926.1

Note:

Since the designed flow unit is Nm3/h, first, convert the designed flow unit into standard unit. The flow unit obtained at this time is kg/h. If you want to acquire t/h, you need to reduce K by 1000 times to 11.9261. If you want to acquire Nm3/h, you need to use K to divide by the density under standard conditions 1.429 to obtain 8345.7.