TCP Display device
Instruction Manual

Qingdao Hesheng Sizhuang Measurement and Control Technology Co., Ltd

Preface

Thank you very much for using our company's exquisite flow calculator!

This manual provides methods for performance indicators, installation and wiring, operation, parameter settings, fault diagnosis, and other aspects when using the delicate flow integrator. Before using the delicate flow integrator, please carefully read this manual and correctly master the usage methods before proceeding with specific operations to avoid unnecessary losses caused by incorrect operations.

After you have finished reading, please keep it in a convenient location for easy reference during operation.

Statement

The content of this manual may be modified without prior notice due to functional and performance upgrades.

The content of this manual is strictly prohibited from being reproduced or copied in whole or in part.

Our company's capital preservation manual is accurate and correct. If you find any inappropriate or incorrect content, please contact us.

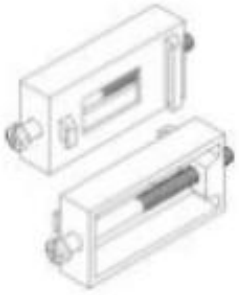
Version

HSSZJSY-6

Packing items

Please confirm the following before use after opening the packaging box. If you receive incorrect products, quantities, or physical damage on the appearance, please contact the supplier or our company.

Exquisite flow integrator



Mounting bracket

Instruction Manual

ProductQualification Certificate

	Name	Unit	Quantity	Remarks
1	Exquisite flow integrator	a	1	
2	Installation bracket (including screws)	a	2	Used for disc installation and fixation
3	Instruction Manual	a	1	
4	Product Qualification Certificate/Warranty Card	a	1	
5	USB dust plug	a	1	
6	RS-232C/485 conversion module	a		Optional accessories
7	RS-232C communication cable	a		Optional accessories
8	USB drive	a		Optional accessories

Precautions

If any damage to the instrument is found during unpacking due to transportation, please contact the supplier or our company

This series of instruments is suitable for general industrial applications. If there are special usage requirements, please set up protective devices separately

For the safety of you and the instrument, please do not install it with electricity. Please use a power supply with rated voltage, wire it correctly, and ground it properly. After connecting the power supply, please do not touch the wiring terminals at the back of the instrument to prevent electric shock

Please install the instrument indoors and ensure smooth ventilation (to prevent excessive temperature inside the instrument). Avoid wind, rain, and direct sunlight. Do not install it in the following situations:

In situations where the temperature and humidity exceed the usage conditions

In environments with corrosive, flammable, or explosive gases

In situations where there is a large amount of dust, salt, and metal powder

In situations where water, oil, and chemical liquids are prone to splashing

In situations where there is direct vibration or impact

Occasions of electromagnetic generation sources

Instruments should take corresponding shielding measures in situations where they are close to power lines, strong electric fields, strong magnetic fields, generate static electricity, noise, or AC contactors, etc

To avoid measurement errors, when the sensor is a thermal resistor, three copper wires with the same specifications and a resistance value less than 10 Ω should be used, otherwise it will cause measurement errors

To extend the service life of the instrument, please perform regular maintenance and upkeep. Please do not repair or disassemble the instrument by yourself. When wiping the instrument, please use a clean soft cloth and do not dip it in organic solvents such as alcohol or gasoline to clean, as it may cause discoloration or deformation

If the instrument has water ingress, smoke, odor, abnormal noise, etc., please immediately cut off the power, stop using it, and contact the supplier or our company in a timely manner

Catalogue

Chapter 1 Overview

Overview

The delicate flow integrator is an instrument based on ARM microprocessor, combined with various flow transmitters and sensors, to accurately measure and calculate flow for different fluid media through multiple flow mathematical models.

It collects, displays, controls, transmits remotely, communicates, prints and processes various signals such as temperature, pressure, flow rate on site, forming a digital acquisition system and control monitoring system. It is widely used in trade settlement and factory measurement management networks in industries such as petrochemicals, chemicals, metallurgy, power, light industry, pharmaceuticals and urban gas.

Feature

1.Suitable for a wide range of flow meters and fluid media.

2.Automatic conversion of flow units, automatic calculation of flow coefficient for differential pressure flow meters

3.The steam density is calculated according to the IAPWS-IF97 formula, and the superheated and saturated states of steam are automatically identified.

4.Emergency fault tolerance function: When temperature and pressure signals are abnormal, use emergency parameter values for compensation calculations.

5.Debugging calculation function: supports viewing the raw values of various transmitter/sensor signals; Support viewing intermediate parameters such as density in traffic calculation.

6.Audit records: Power outage recording function.

7.Alarm List: Supports recording instantaneous or cumulative alarm information such as flow rate, temperature, pressure, differential pressure/frequency/volume/mass.

8.Cumulative report: supports cumulative traffic class report, daily report, monthly report, and annual report.

9.Communication function: Standard Modbus RTU protocol, supporting RS485 and RS232C communication interfaces.

10.Transmission function: Supports standard current transmission output, with optional signal source channels.

11.Report backup function: Supports the backup function of various cumulative reports.

12.Import and export function: Supports the import and export of instrument configuration parameters.

13.Timer printing function: supports timed printing of data such as flow rate, temperature, pressure, and accumulation.

Chapter 2 Technical Indicators

Display

Screen：128 * 64 dot matrix monochrome liquid crystal display (LCD)

Precision： Display and measurement accuracy: ± 0.2% F.S

Rocessor

Adopting high-performance ARM Cortex-M3 32-bit RISC core

Input function

Flow channel: Analog signal: **4-20mA, 0-10mA** and other signals;

Frequency signal: **Fr** (range: **0.0-5000.0HZ**, low level ≤ **1V**, high level **≥ 5V**)

Temperature channel: **0-10mA, 4-20mA, Pt100** and other signals

Pressure channel: **0-10mA, 4-20mA** and other signals

Attention

Other input signals (such as switch input (DI)) need to be specified when ordering

Output Function

Distribution output：Provide 1 set of (**F12**) **12VDC** and 2 sets of (**Q24, P24**) **24VDC** sensor power supplies, with a maximum output current of **30mA** per circuit. The flow current is **24V** and the distribution **Q24** and the pressure **24V** distribution **P24** share the same ground

Transmission output: supports 1 standard current transmission output (source optional), load capacity 500 Ω (maximum)

Relay output: supports up to 3 relay outputs, contact capacity **3A@250VAC / 3A@30VDC** , configurable upper limit, upper limit, lower limit, and lower limit alarms

Communication function

Communication Interface: Provides two communication interfaces, RS232C and RS485, for users to choose from, supports Modbus RTU protocol, baud rate - (1200, 2400, 4800, 9600)

Printing interface: RS232C directly connected to micro printer, baud rate 1200

Report backup

Report backup and transfer: Supports **USB 1.1** and **2.0** protocols, supports cumulative report transfer from **1GB** to **32GB** USB drives, has strong compatibility, and is compatible with the vast majority of USB drives on the market

Power supply

AC power supply: 220VAC/50HZ AC power supply

DC power supply: Supports **24VDC** (**18VDC-36VDC**) DC power supply; Supports **12VDC** (**9VDC-18VDC**) DC power supply, which needs to be specified when ordering

Error accuracy

Clock error: ± 2 seconds/day

Working environment

Ambient temperature: 0-50 ℃ (avoid direct sunlight)

Environmental humidity: 0-85% R.H (no condensation)

Altitude:<2000 meters

Attention

Do not work in flammable or corrosive environments

Net weight of the instrument

Net weight: ≤ 1.0Kg

Technical Indicator Description

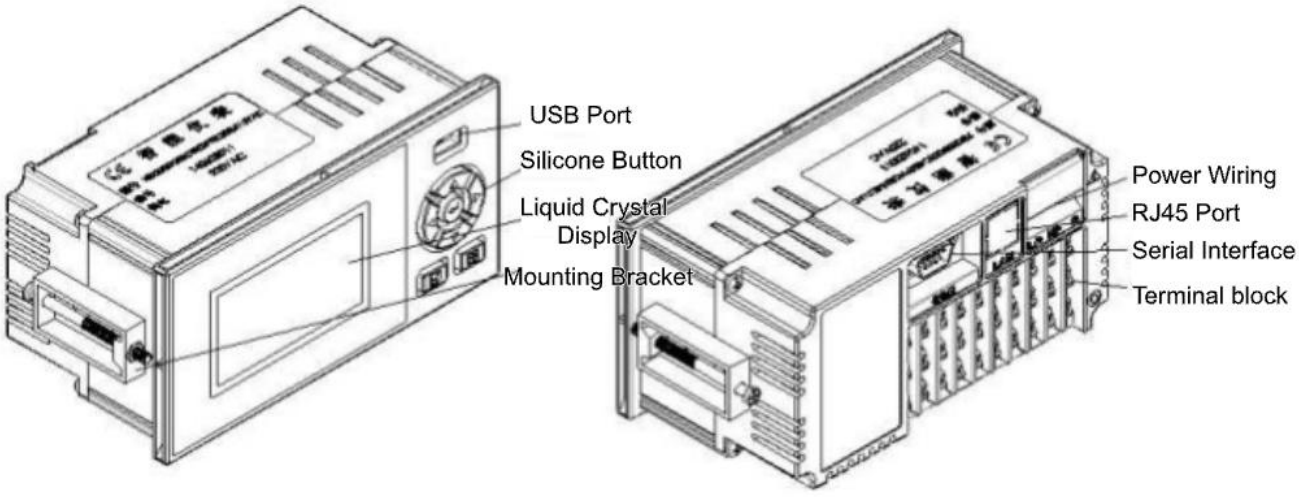
Attention

The technical specifications are universal indicators for this series of instruments, and the functional configuration should be based on the actual product.

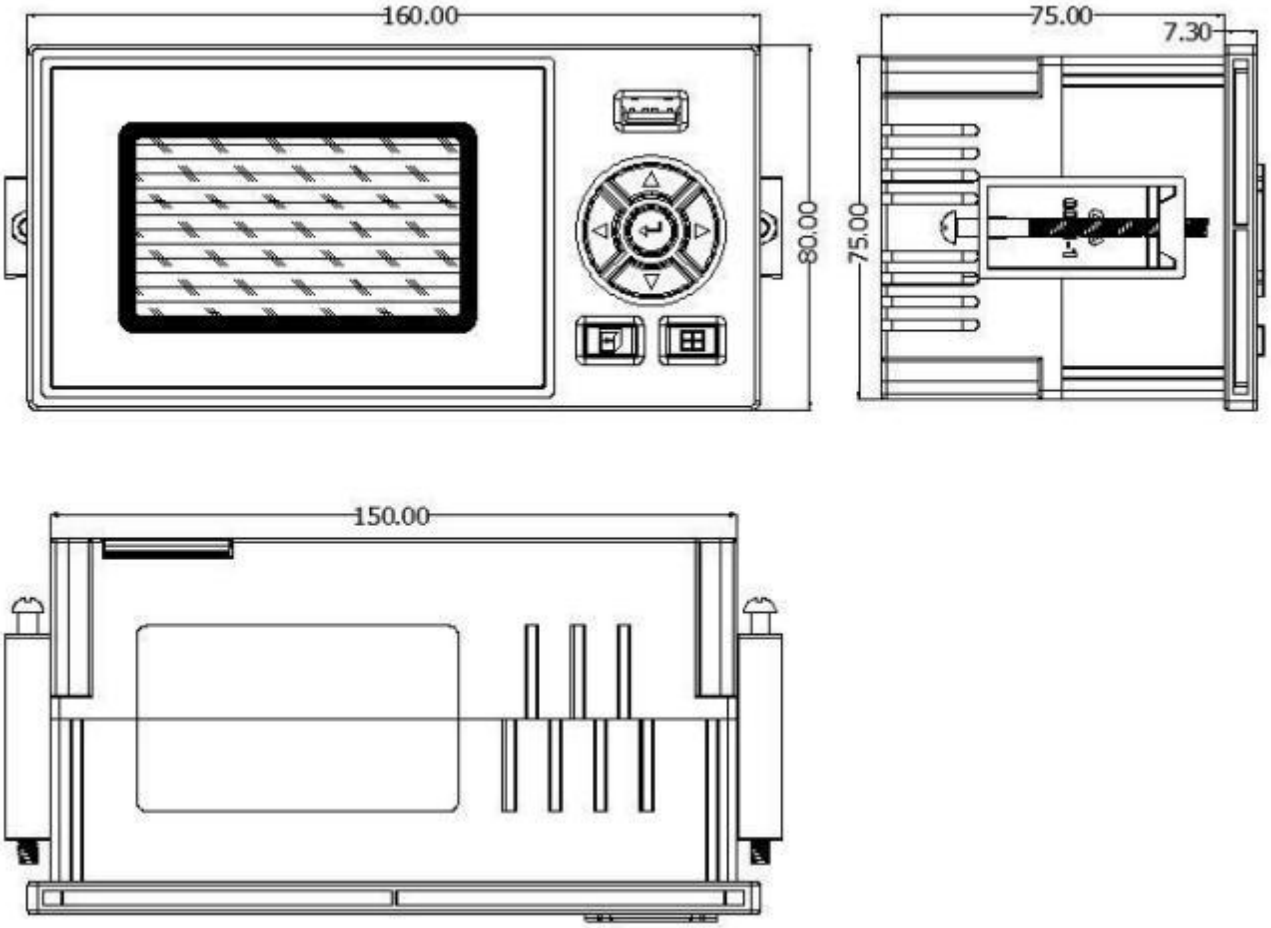
If there is any inconsistency between the technical indicators and the physical instrument, please refer to the physical object.

Chapter 3 Installation and Wiring

3.1 Instrument structure



3.2 Instrument size



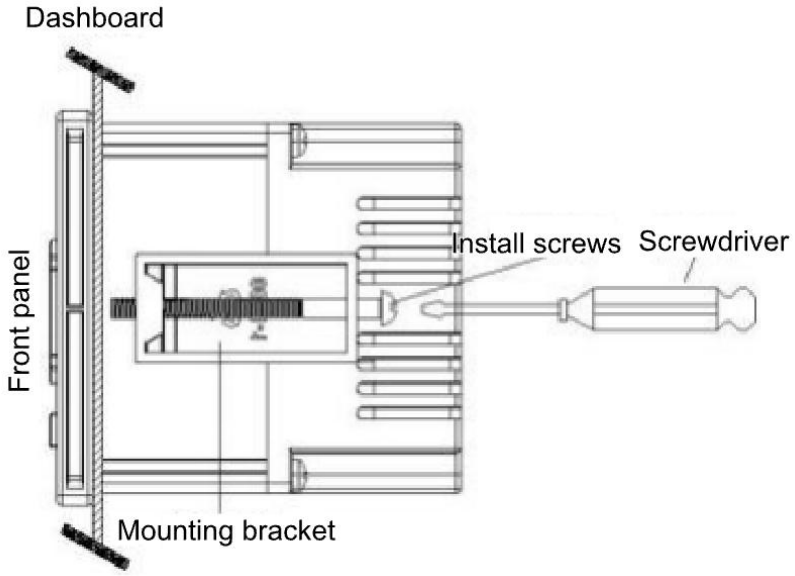
The unit shown in the above diagram is **mm**.

3.3 Cutout Size

Single table opening size　　Hole size of container table

When installing the container meter, the recommended minimum spacing between instruments in the above diagram should be referred to to ensure necessary heat dissipation and loading and unloading space. The unit in the above diagram is mm.

3.4 Instrument installation



Installation method:

3.5 Instrument wiring

Wiring method

It is recommended to use U-shaped crimping terminals with insulation sleeves (M3.5 screws for power terminals and M3 screws for signal terminals).

To improve the safety of the instrument, please follow the following warnings when wiring:

Attention

1.To prevent electric shock, please confirm with the wiring fee that the power supply has been cut off.

2.To prevent fires, please use double insulated wires (it is recommended to use power cords with a cross-sectional area of ≥ 1mm ², insulated)600V wire; The output wiring of the relay should have strong voltage resistance and a wire with a cross-sectional area of ≥ 0.5 mm ².

3.Please install an air switch in the power circuit to separate this meter from the main power supply.

4.Tighten the terminal screws firmly. Tightening torque: 0.5N. m (5kgf. cm).

5.After connecting the power cord, check if the instrument is functioning properly. Do not connect the signal line until the instrument is confirmed to be working properly, then disconnect the power and connect the signal line.

6.The measurement circuit and power circuit need to be laid separately, and it is best that the measurement object is not an interference source. If it cannot be avoided, please isolate the measurement object and the measurement circuit, and ground the measurement object.

7.It is better to use shielded wires for interference caused by static electricity.

8.For interference caused by electromagnetic induction, it is better to densely connect the measurement circuit wiring at equal distances.

9.If the input wiring is connected in parallel with other instruments, it will affect the measured values. When parallel connection is necessary, please be careful not to turn on or off the power supply of one instrument during operation, as this will have adverse effects on other instruments. Thermistors cannot be parallel in principle, and current signals cannot be parallel in principle.

10.When inputting platinum resistance, the resistance of each lead should be less than 10 Ω (with the same lead resistance)

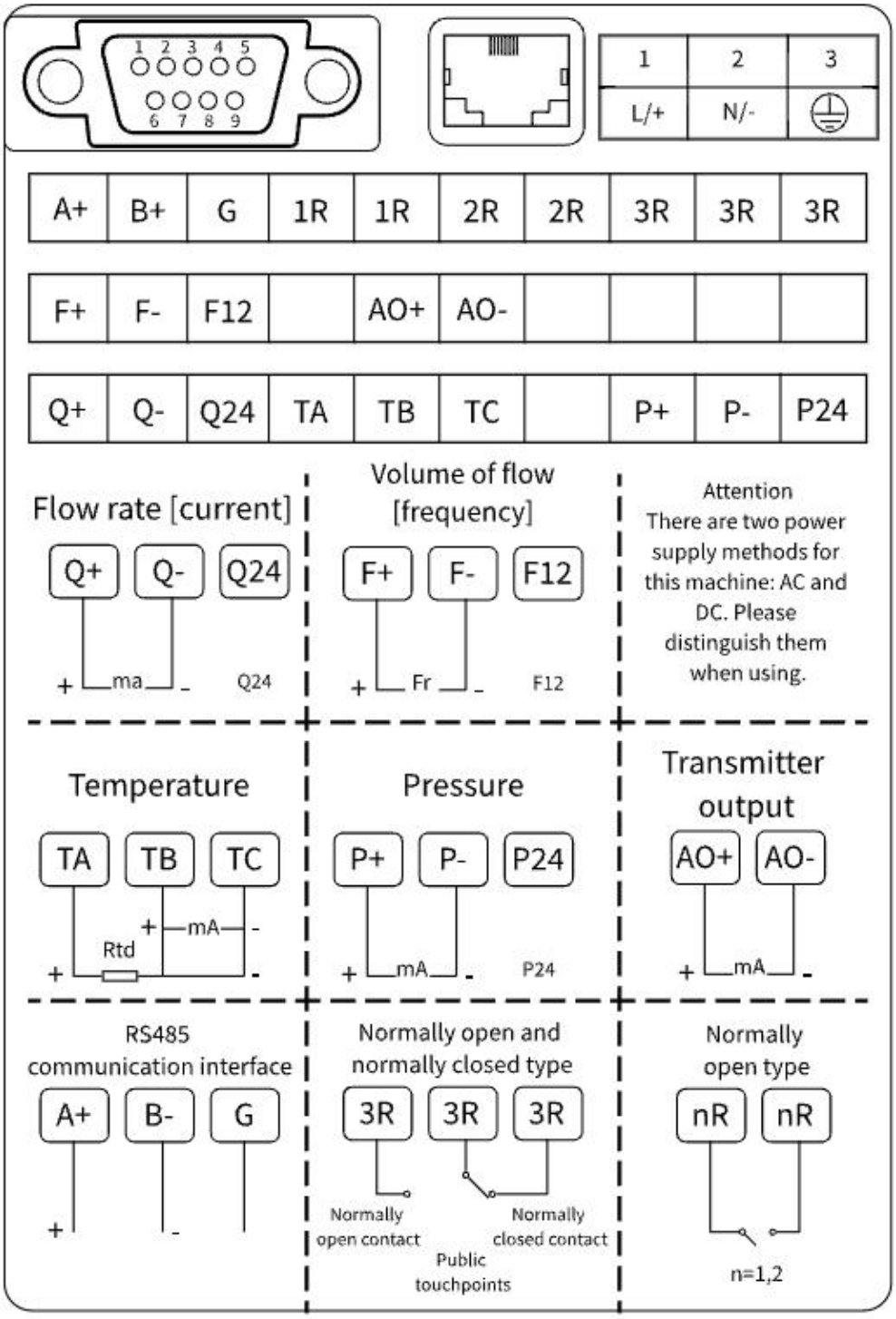
Erminal description

Terminal name	Instructions
L/+、N/-、 Or for+、-、NC	**L** is the phase terminal of the AC power supply, **N** is the neutral terminal of the AC power supply, is the grounding terminal,+is the positive terminal of the DC power supply, and - is the negative terminal of the DC power supply
A+、B-、G	Signal transmitter, receiver, and communication ground of **RS485** communication interface
R1、R2、R3	Relay output interface, specification 250VAC/ 3A@30VDC /3A
F+、F-、F12	Signal terminal, signal ground terminal, and 12VDC feed input terminal of frequency flowmeter
AO+、AO-	Positive and negative terminals of current output
Q+、Q-、Q24	Signal terminal, signal ground terminal, and 24VDC feed input terminal of differential pressure flowmeter (current)
TA、TB、TC	Temperature channel analog input terminals (**TA, TB, TC**); Signal terminal (**TB**) and signal ground terminal (**TC**) of temperature transmitter (current)
P+、P-、P24	Signal terminal (**P+**), signal ground terminal (P -), **24VDC** feed input terminal (**P24**) of pressure transmitter (current)
COM	RS232C communication interface/serial port printing interface (with pin 2 as RXD instrument signal receiver, pin 3 as TXD instrument signal transmitter, and pin 5 as signal ground)
LAN	Ethernet RJ45 interface

Attention

It is strictly prohibited to touch the wiring terminals when they are live.

Wiring diagram



Attention

1.The power supply voltage at the construction site must be limited to the voltage range that the instrument can withstand.

2.When the power consumption of the transmitter exceeds the local feeding load capacity, please use an external voltage regulator to supply power.

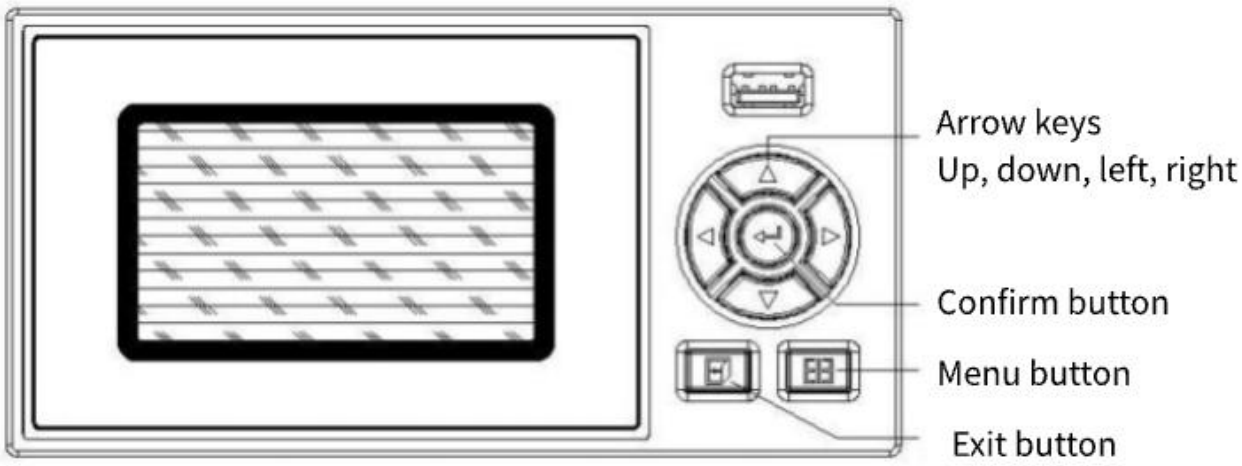
3.The default relay of this instrument is normally open when it leaves the factory. Please specify other methods when ordering.

4.Please do not plug or unplug communication cables with power on.

5.This instruction provides a basic wiring diagram. In case of any conflict between the instrument function and the basic wiring diagram, please refer to the actual product.

Chapter 4 Basic Operations and Operation Screen

4.1 Instrument buttons



Keyboard function

1.Up key: Move the cursor up, switch selections, increase the data value where the cursor is located, etc.

2.Down arrow: Move the cursor down, switch selections, decrease the data value where the cursor is located, etc.

3.Left button: Move the cursor left/forward, switch between main/secondary screens, etc.

4.Right arrow key: Move the cursor to the right/back, switch between main/secondary screens, etc.

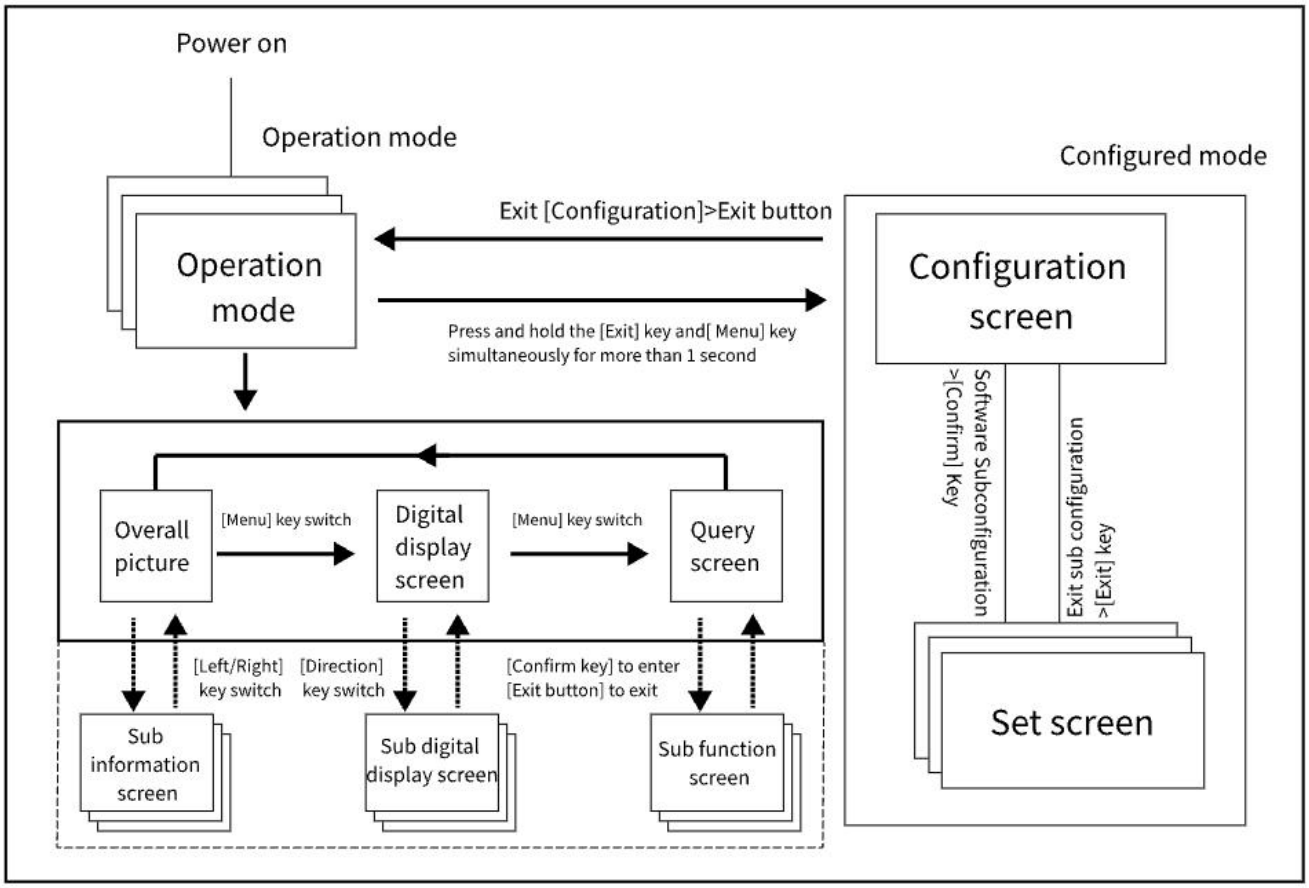
5.Confirm key: Execute the function where the cursor is located or edit the data where the cursor is located, etc.

6.Exit button: Exit the current screen.

7.Menu key: Switch the main display screen (overview, bar chart display, function query screen), switch the decimal point at the cursor location (instrument coefficient, density and other parameters), etc.

8.Exit key+menu key: Configuration composite key, hold down for 1 second or more at the same time to enter the configuration screen.

4.2 Usage pattern



Attention

The operation screen includes an overview screen, a digital display screen, and a query screen. The operation screen can be switched by pressing the [Menu] button.

When in the overall screen, you can press the left or right arrow key to switch to the sub information screen.

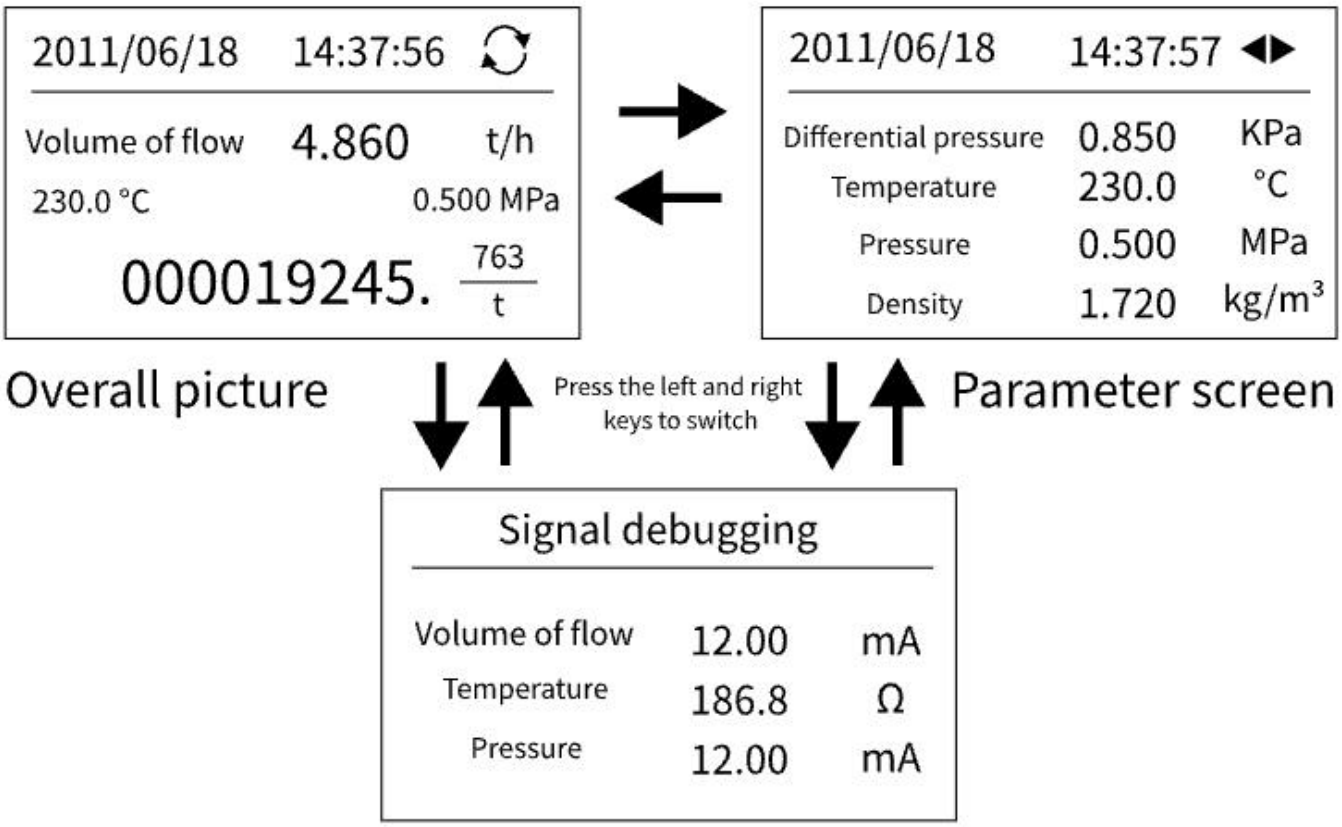
When in the digital display screen, you can press the [direction key] to switch between sub digital display screens.

When in the query screen, you can press the [confirm] key to enter the sub function screen, and press the [exit] key to return to the query screen.

To log in to the configuration parameter settings screen, hold down the [Exit] and [Menu] keys simultaneously for at least one second.

4.3 Runtime Screen

Overall picture



The default power on of this device is the overall display screen. When in the overall display screen, press the [Left] or [Right] key to switch between sub information screens, press the [Confirm] key to switch between automatic/manual display functions, and press the [Menu] key to switch to the digital display screen.

Status bar:： Display the current system time and automatic/manual patrol indicators (where is the automatic patrol indicator and is the manual patrol indicator).

The overall display screen shows the instantaneous flow rate, temperature/pressure/total cumulative flow rate, while the signal debugging screen displays the raw data of the flow channel and temperature/pressure channel signals.

When the temperature input is disconnected or exceeds the physical measurement limit of the instrument, the instrument displays the word "----" at the corresponding position; When the pressure input is less than 2mA, the word "----" will be displayed at the corresponding position. The internal calculation adopts the set value of temperature and pressure disconnection.

When the temperature or pressure is given, the relevant screen displays the given value of temperature or pressure.

Attention

The flow rate displayed in the overall picture is the value under standard conditions, and the density displayed is the value under fluid working conditions.

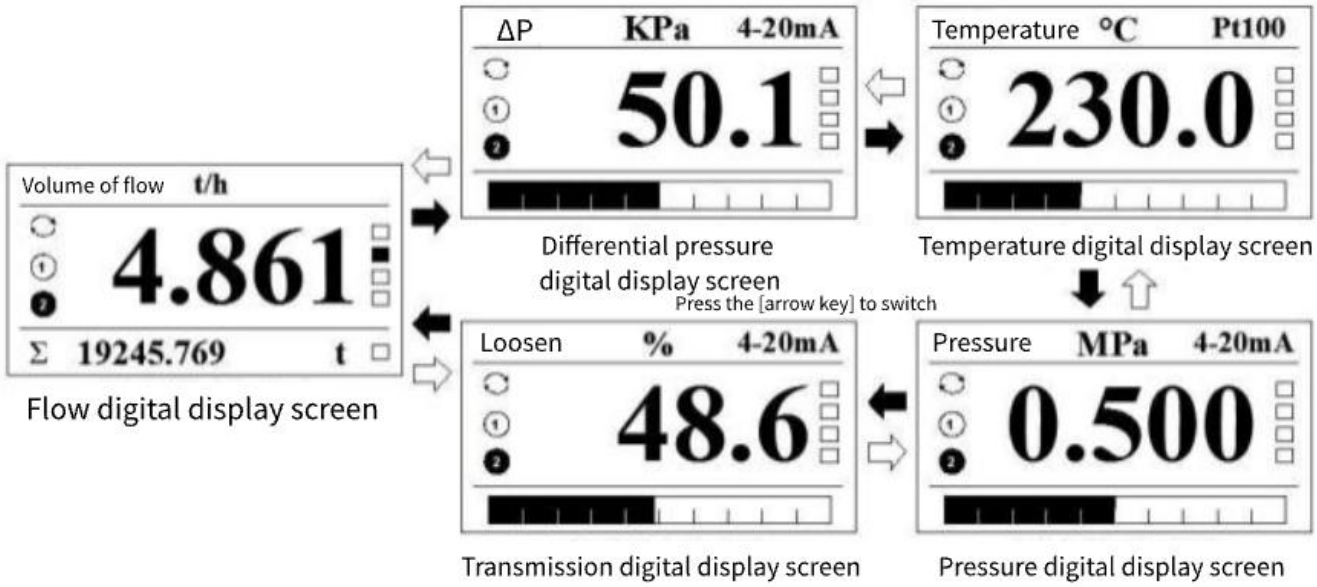
After executing the traffic accumulation reset, the accumulated value in the traffic overview screen will be reset to zero.

The total accumulated traffic is displayed to a fixed 3 decimal places and returns to zero after overflow.

When the system does not compensate or saturates the steam medium, the relevant interfaces or parameters are automatically hidden or adjusted

After setting the [Patrol Display] parameter, automatic patrol display can be performed between the traffic overview and the intermediate parameter screen. When the patrol display time is set to 0 seconds, the patrol display flag in the status bar is fixed as the manual patrol display flag.

Digital Display Screen



When in the digital display screen, press the direction key to manually switch between sub digital display screens, and press the [menu key] to switch to the function query screen.

Status bar: Display channel name, unit, signal type/given (when temperature or pressure is given, [given] is displayed here).

When different flow models are selected, the relevant parameters in the differential pressure (frequency/volume/mass) digital display screen shown in the above figure also change accordingly. [Differential pressure], [frequency], and [volume/mass] correspond to [Differential pressure formula], [frequency type], and [linear] models, respectively.

When the temperature input is disconnected or exceeds the physical measurement limit of the instrument, the instrument displays the word "----" at the corresponding position; When the pressure input is less than 2mA, the word "----" will be displayed at the corresponding position. The internal calculation adopts the set value of temperature and pressure disconnection.

When the relay is activated, its status symbol changes from a hollow circle to a solid circle, and when the system alarms, its status symbol changes from a hollow box to a solid box.

Bar chart: The filled area of the bar chart represents the percentage of the current data in the total range (when the temperature or pressure is given, the upper and lower limits of the bar chart are the range upper and lower limits under the external mode of the temperature or pressure channel, which can achieve the best display effect since configuring the range upper and lower limits).

When the temperature or pressure is given, the relevant screen displays the given value of temperature or pressure.

Σ：Total cumulative traffic volume.

When in the digital display screen, press the direction key to manually switch between sub digital display screens, and press the [menu key] to switch to the function query screen.

Status bar: Display channel name, unit, signal type/given (when temperature or pressure is given, [given] is displayed here).

When different flow models are selected, the relevant parameters in the differential pressure (frequency/volume/mass) digital display screen shown in the above figure also change accordingly. [Differential pressure], [frequency], and [volume/mass] correspond to [Differential pressure formula], [frequency type], and [linear] models, respectively.

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When the relay is activated, its status symbol changes from a hollow circle to a solid circle, and when the system alarms, its status symbol changes from a hollow box to a solid box.

Bar chart: The filled area of the bar chart represents the percentage of the current data in the total range (when the temperature or pressure is given, the upper and lower limits of the bar chart are the range upper and lower limits under the external mode of the temperature or pressure channel, which can achieve the best display effect since configuring the range upper and lower limits).

When the temperature or pressure is given, the relevant screen displays the given value of temperature or pressure.

Σ：Total cumulative traffic volume.

Attention

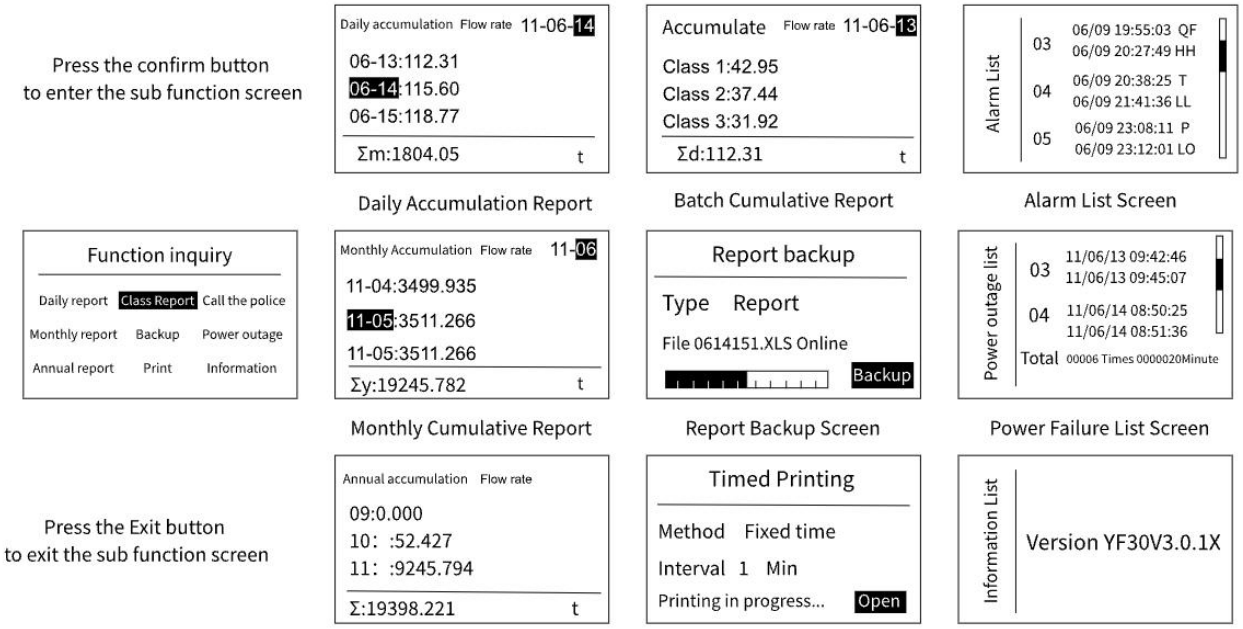
The flow displayed on the digital display screen is the value under standard conditions.

When the system does not compensate, does not enable transmission output, or does not enable alarm functions, the relevant interfaces and signs will not be displayed.

After executing the traffic accumulation reset, the accumulated value in the traffic digital display screen will be reset to zero.

When the [Patrol Display] is not set to 0S, the automatic patrol display can be switched between each digital display screen according to the set time. When the patrol display time is set to 0S, the automatic patrol display flag will not be displayed.

Query Screen



When in the function query screen, press the [confirm] key to enter the sub function screen where the cursor is located, and press the [menu] key to switch to the overall screen; When in each sub function screen, press the 'Exit' button to exit to the function query screen.

Accumulated report screen：

The cumulative shift report displays the accumulated flow details and daily cumulative values of each shift in the instrument system for the past three months.

The cumulative daily report displays the daily flow accumulation details and monthly accumulation values of the instrument system in the past three months.

The cumulative monthly report displays the details of monthly traffic accumulation and annual cumulative value of the instrument system in the past three years.

The cumulative annual report displays the details and total cumulative value of annual flow in the instrument system over the past three years.

The maximum accumulated value for class and day can be displayed to 7 digits 9999999 (including decimal places), and it will be reset to zero after overflow. The maximum cumulative values for month, year, and total can be displayed as 999999999.999, and will be reset to zero after overflow.

The monthly report can display up to 36 months of cumulative records, the shift report and daily report can display up to 3 months of cumulative records, and the annual report can display up to 3 years of cumulative records. The settlement time for the class report is the shift time point, while the settlement time for the daily report is 0:00 on the same day. The accumulated records of this system follow the first in, first out principle. Please backup the report data records within the relevant time period in a timely manner.

Σd： Daily cumulative value；Σm：Monthly cumulative value；

Σy：Annual cumulative value；Σ：Total cumulative value；

Report backup screen: Backup type: Cumulative report.

File Name: The name of the backup file, which can be viewed in XLS format using spreadsheet software such as EXCEL. The fixed name cannot be changed.

Device status: Display the status of the USB flash drive, divided into online, offline, and error states. If the USB flash drive cannot be detected, it will display 'offline'. If an error occurs during the backup process, it will display 'error'.

Backup Progress: Real time display of the current backup process progress, with the filled area representing the currently backed up portion, and the backup progress percentage value in the upper right corner of the progress bar.

Timed printing screen: Printing method: timed.

Printing interval: The interval time for timed printing, with a minimum interval of 1 minute.

Printing status: Real time display of the current printing status.

Switch status: The timed printing is valid when turned on, and invalid when turned off.

Alarm List Screen: Alarm/Cancellation Time: In each group of alarm information in the alarm list, the upper row is the alarm time and the lower row is the cancellation time. When there is no cancellation, it displays --/--: --.

Alarm number: Up to 24 sets of alarm information can be saved, and a single screen can display up to 3 sets of information.

Alarm channels:
QF: instantaneous flow rate,
∑ F: cumulative flow rate alarm,
QC: differential pressure/frequency/volume/mass alarm,
T: temperature alarm, P: pressure alarm.
Alarm types: HH for upper limit alarm, HI for upper limit alarm, LO for lower limit alarm, LL for lower limit alarm.
Scroll bar: Indicates the proportion of the current page in the total number of pages.

Power failure list screen:

Power off/power on time: In the power off list, the top row represents the power off time and the bottom row represents the power on time for each group of power off information.

Power failure serial number: Up to 24 sets of power failure information can be saved, and a single screen can display up to 2 sets of information.

Total number of shutdowns: Refers to the total number of power outages.

Total downtime: Refers to the total accumulated time of power failure, measured in minutes.

Scroll bar: Indicates the proportion of the current page in the total number of pages.

Information List Screen:

Version: Display the current software version.

Attention

After clearing the alarm list and power failure list, the data in the corresponding list screen will be cleared. The alarm list and power failure list records will follow the first in first out principle. Please make timely records of the corresponding list data.

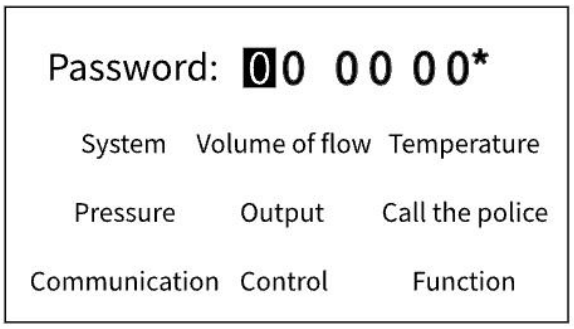
After executing the cumulative reset, the data in the corresponding cumulative report screen is cleared. The cumulative report adopts the first in, first out principle. Please backup the report data records within the relevant time period in a timely manner.

Changing the cumulative initial value will permanently erase the original report data, please proceed with caution.

The printing function needs to be configured with this feature and must be valid under the [Printer] communication mode status. If the printer is not powered on or offline, the instrument panel will not respond when executing the printing function. At this point, the user should check the printer power supply, status indicator lights, and ensure that all statuses are correct and the printing paper is installed properly. If you still cannot print normally, please check the printer settings (baud rate, data format, serial/parallel port settings, etc.).

Chapter 5 Parameter Setting and Auxiliary Screen

5.1 Configuration and system configuration



Configuration Screen

System Configuration

Configuration

Press and hold the [Exit] and [Menu] keys simultaneously for more than one second to enter the [Configuration] entrance. Press the [Exit] key to return to the overall screen, and press the [Direction] key to switch the cursor between sub configurations.

The initial password for <Configuration> is 000000. After entering the correct password, press the 'Confirm' button to enter the hierarchical menu, and then select the corresponding sub configuration entry for configuration settings. If the '*' does not disappear, it means that the password is incorrect or has not been confirmed. If the password is incorrect, you cannot enter the configuration screen.

The <Configuration> adopts a hierarchical menu structure, with functions such as configuration login password input, system configuration, flow configuration, temperature configuration, pressure configuration, output configuration, alarm configuration, communication configuration, control configuration, and function configuration.

Operation: Press the [arrow key] to move the cursor, press the [confirm key] to execute the function where the cursor is located, and press the [exit key] to quickly exit the configuration screen.

System Configuration

Move the cursor to the [System] entrance in the [Configuration] screen, press the [Confirm] key to enter [System Configuration], and the screen description is as follows:

Time setting: Set the system date and time of the instrument.

User password: Set the user management configuration permission password.

Patrol interval: used for switching between primary and secondary screens in digital display and other screens. 0S represents no patrol. Press the [confirm] button to enter the <auxiliary interface> for quick parameter changes.

Local atmospheric pressure: local environmental pressure, user-defined configuration, fixed unit in kPa, initial default value is 101.325KPa (namely 0.101325MPa).

System maintenance: [Clear Power Failure List], [Clear Alarm List], or [Restore Default Settings] and other system maintenance functions. Once the system maintenance operation is confirmed, the relevant data will be cleared or the factory settings will be restored. The process is irreversible, please operate with caution.

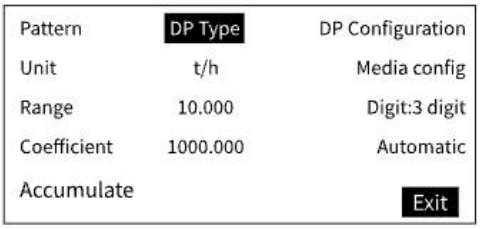
Operation: Press the left or right arrow key to move the cursor, press the up or down arrow key to switch between selecting or adjusting values, press the confirm key to execute the function or edit the data where the cursor is located, and press the exit key to quickly exit the system.

Attention

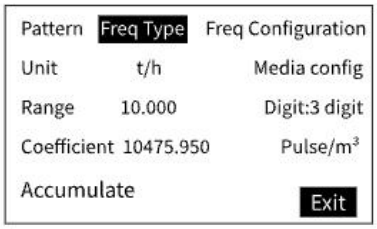
The user password is the only password to enter the configuration and modify parameters. If lost, it cannot be accessed. Users should change their password as soon as possible after purchasing the instrument and keep it properly. If unfortunately lost, please contact the supplier or our company in a timely manner.

Restoring factory settings will initialize all configuration information and clear all stored data in the instrument, including cumulative report data, power failure list information, alarm list information, etc. Please operate with caution.

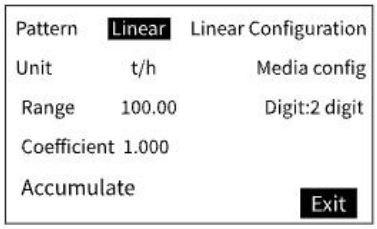
5.2 Traffic configuration



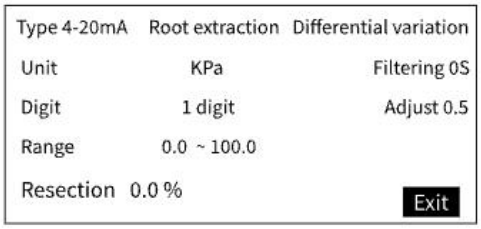
Differential Pressure Model



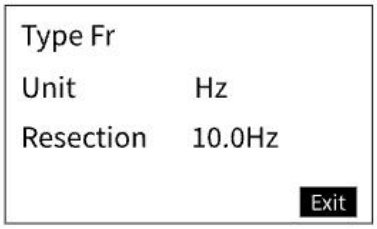
Frequency Based Model



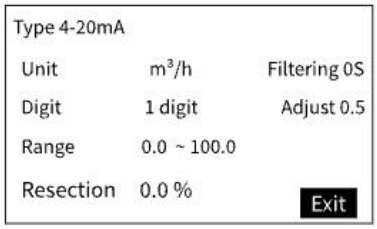
Linear Model



Differential Pressure Configuration



Frequency Configuration



Linear Configuration

Model

The differential pressure model is applicable to differential pressure flow meters, including various standard and non-standard throttling components, V-cones, bends, averaging tubes (xx bar), speed measuring tubes, probes, etc.

The [frequency type] model is applicable to various fixed frequency signals, pulse signal flow meters such as vortex street and turbine flow meters. When the cursor is in the [Frequency Type] setting box, press the [Confirm] key to enter the [Frequency Details] to set the desired frequency value or pulse value.

The [linear] model is applicable to linear signal flow meters such as current output vortex street, electromagnetic, rotary, ultrasonic, target, float, thermal mass, Coriolis mass flow meters, etc.

Mass flow calculation formula (Q is mass flow)

Differential pressure flowmeter : $Q= K \times \sqrt{\Delta P \times \rho}$ … … … ……Equation 5.1

K: Instrument coefficient

ΔP: Input differential pressure value

ρ: Medium density

Frequency type flowmeter (K coefficient unit: Pulse/m³: (times per cubic meter)):

$Q= 3600 \times If \times \rho / K$ … …… …… …… …… ….. … …… …… …Equation 5.2

K： Instrument coefficient If： Vortex frequency ρ： medium density

Linear flowmeter：$Q= K \times \rho \times \Delta P$ … …… …… …… …. Equation 5.3

K： Instrument coefficient ΔP： Linear signal (volume value)

ρ： Medium density

Differential pressure/frequency/volume configuration

When the model is selected as [differential pressure type], the differential pressure configuration can be entered to set the signal type, square root type, engineering unit, filtering time, decimal places, signal cutoff, range upper and lower limits, etc. of the differential pressure transmitter.

Local square root: When the differential pressure transmitter has not been square root and the instrument needs to square root the differential pressure signal, select this setting.

Differential pressure to square root: When the differential pressure signal of the differential pressure transmitter has passed square root, select this setting.

When the model is selected as [frequency type], it can enter the frequency configuration setting to cut off the frequency value.

When the model is selected as [linear], it can enter the linear configuration to set the linear signal type, linear range upper and lower limits, linear signal engineering units, etc.

Small signal cutoff (frequency directly cutoff value, all other signals cutoff range percentage):

When the measured value is less than (range upper limit value - range lower limit value) x small signal percentage value + range lower limit value, the measured value is displayed as the range lower limit value.

Traffic unit

kNm^3 / h， Nm^3 / h， km^3 / h， m^3 / h， m^3 / min， m^3 / s， L/h，L/min，L/s， mL/h， mL/min， mL/s， t/h， t/min， t/s， kg/h， kg/min， kg/s ,etc.Traffic units participate in calculations.

Media configuration

From the commonly used flow calculation formulas, it can be seen that the flow rate of a fluid is directly proportional or square root proportional to its density. In order to accurately measure the flow rate of a fluid, it is necessary to compensate for the density of the fluid. However, most fluid densities vary with changes in pressure and temperature under working conditions. Therefore, compensating for fluid density can be converted into compensating for temperature and pressure of the fluid. According to different fluid media, medium compensation methods can be divided into: no compensation, general gas, saturated steam, superheated steam, and natural gas.

Not compensated

When the system does not have compensation, only [no compensation] can be selected in the [medium] configuration, and the working density of the fluid, ρ 0, needs to be set in the medium configuration. When selecting other compensation methods, this density defaults to a fixed value of 1.000Kg/m3.

General gas

The compensation purpose of general gases is to convert the operating volume into the volumetric flow rate under standard conditions. The state equation of a general gas conforms to the ideal gas state equation, and the relationship between the operating density ρ f and the standard density ρ n follows the following equation:

$$\rho_f = \rho_n * \frac{(273.15 + T_n)(0.10136 + P_f)}{(273.15 + T_f)(0.10136 + P_n)} \quad \text{……Equation5.4}$$

Among them, the standard temperature Tn is 20.00 ℃, the standard pressure (gauge pressure) Pn is 0.000Mpa, Tf is the operating temperature, and Pf is the operating pressure (gauge pressure).

Saturated steam

The purpose of compensating saturated steam is to obtain mass flow rate.

The steam density of this instrument is calculated based on the IAPWS-IF97 formula.

Superheated steam

The purpose of compensating for superheated steam is to obtain mass flow rate.

The steam density of this instrument is calculated based on the IAPWS-IF97 formula.

Natural gas

The purpose of natural gas compensation is to convert the operating volume into the volumetric flow rate under standard conditions.

The state equation of natural gas conforms to the ideal gas state equation, and the relationship between the operating density ρf and the standard density ρn follows the following equation:

$$\rho_f = \rho_n * \frac{(273.15 + T_n)(0.10136 + P_f)}{(273.15 + T_f)(0.10136 + P_n)} * \frac{Z_n}{Z_f} \quad \text{……Equation5.5}$$

Among them, the standard temperature Tn is 20.00 ℃, the standard pressure (gauge pressure) Pn is 0.000Mpa, Tf is the operating temperature, Pf is the operating pressure (gauge pressure), Zn is the compression coefficient of natural gas under standard conditions, and Zf is the compression coefficient of natural gas under flowing conditions

Standard temperature Tn: refers to the temperature corresponding to the compensated volumetric flow rate. When the calculation result is volumetric flow rate, the rated temperature should be set, and its parameters should be determined by the user. The instrument defaults to 20.00 ℃. The calculation result of mass flow rate is independent of standard temperature.

Standard condition pressure Pn: refers to the pressure corresponding to the compensated volumetric flow rate. When the calculation result is volumetric flow rate, the rated pressure should be set, and its parameters should be determined by the user. The instrument defaults to 0.000Mpa. The calculation result of mass flow rate is independent of standard pressure.

Standard condition density ρn: The gas density under standard conditions (such as 20.00 ℃, 0.000Mpa (gauge pressure)), measured in Kg/m3.

Range

User defined flow range, freely configurable, with a maximum support of 99999. Press the confirm button to enter the auxiliary screen for parameter change operations.

Number of decimal places

The decimal places of the flow range can be grouped from 0 to 3.

Automatic calculation of flow K coefficient/K coefficient unit/K coefficient

When the model is selected as [differential pressure type], the calculation formula for the flow meter coefficient is:

$$K=\frac{Q_{max}}{\sqrt{\Delta P_{max}\times\rho}} \quad \cdots\cdots \text{Equation 5.6}$$

Qmax ： Maximum mass flow rate，

ΔPmax ： Maximum differential pressure value，

ρ ： Work density

When using the differential pressure model, the K coefficient can also be automatically calculated. The relevant parameters such as local atmospheric pressure, differential pressure configuration, medium compensation type, and standard temperature must be set first. Move the cursor to [Auto] and press the [Confirm] button to enter and set the corresponding parameters according to the flowmeter book. The maximum scale flow unit can be selected, and the design temperature and pressure are set according to the differential pressure flowmeter design parameters. After setting the parameters correctly, move the cursor to the [Update] button and press the [Confirm] button to update the K coefficient. The decimal place for automatically calculating the K coefficient needs to be changed by pressing the [Menu] key at the [Coefficient] position in the ‘Flow Configuratio’.

When the model is selected as [frequency type], the coefficient K value of this instrument is the same as the average coefficient of the flow meter, and the units 次/m³ (times per cubic meter) and 次/L (times per liter) corresponding to the flow meter are selected.

When the model is selected as [linear] and the medium is not compensated, the flow coefficient K is set to 1.000. The upper limit in the linear configuration is set to the flow value corresponding to the upper limit of the linear (volume or mass) signal, and the lower limit is set to 0. If the flowmeter output is volume flow and the instrument needs to calculate the mass flow rate, both the medium density and the unit in the flow/linear configuration are involved in the calculation. When compensating for the medium, both density and flow/linear configuration units are involved in the calculation. At this time,

the flow coefficient K should be calculated based on the mass flow calculation formula of the linear flowmeter.

Accumulated configuration

Accumulated units: Nm3, m3, L, mL, t, kg, etc. Accumulated units participate in calculations.

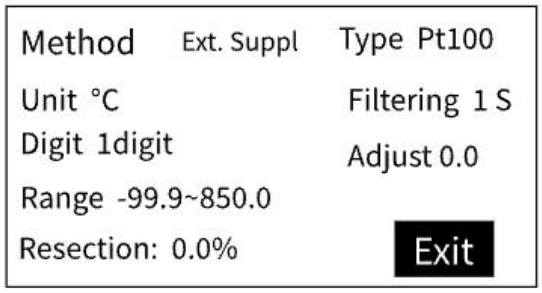
Accumulated initial value: Set the flow accumulation initial value, with a maximum of 999999999 (when the cursor is at this parameter, press the [Menu] key to switch decimal places). After executing the traffic accumulation [reset] function, use this value to start accumulating. Changing the initial accumulation value will permanently clear the original report data. Please operate with caution.

Shift Time: The start time of the first shift can be arranged from 0 to 11 o'clock.

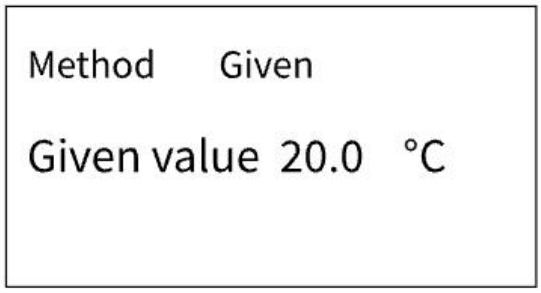
Shift reporting duration: The duration of each shift, which can be grouped at 8:00 (3 shifts) and 12:00 (2 shifts).

Accumulated reset: Clear all previous accumulated data, including accumulated values in the overall/digital display screen, shift accumulation, daily accumulation, monthly accumulation, and annual accumulation reports in the query screen. Please operate with caution.

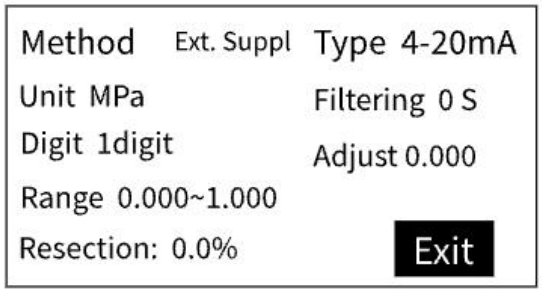
5.3 Temperature and pressure configuration



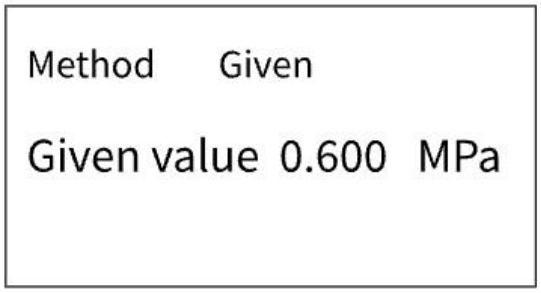
Temperature External Compensation Configuration



Specified Temperature Configuration



External Pressure Compensation Configuration



Pressure Given Configuration

Method

When temperature/pressure compensation is input from an external sensor, select [External Compensation] as the mode. When given internally, set the given temperature/pressure value at [Given Value] using the [Up] or [Down] keys to select the mode.

Attention

When the temperature/pressure breaks, the system automatically calls the set value [non-zero value] as the break compensation value. If the set value is zero, the system automatically defaults to the last collected value before the break as the break compensation value.

The unit cannot be changed under the [Given] method. If you need to change the unit, you need to do so under the [Additional] input method.

When using the [given] mode, the default range upper and lower limits of the digital display screen are the range upper and lower limits under the external mode. Users can set these range upper and lower limits themselves to constrain the proportion of the given value in the bar chart of the upper computer or instrument digital display screen to achieve the best display effect.

Type

The input signal type should be consistent with the signal of the primary instrument or detection component when setting the signal type.

Unit

The temperature engineering unit currently only supports ℃, and can be customized and added according to user needs.

Filtering

The setting of filtering time helps to improve the smoothness of the signal, with a range of 0-99 seconds. The longer the filtering time, the smoother the signal but the slower the response.

Display value=（Last measured value x Filter time constant+Current measured value）/（Filter time constant+1）

Number of decimal places

Scale decimal places, 0-3 can be grouped.

Adjust

Allow users to adjust the deviation value of the displayed value, which is equal to the measured value plus the adjusted value. Generally, the adjusted value should be set to 0.

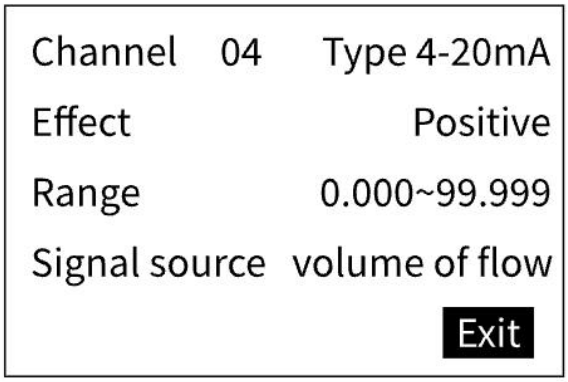
Range

User defined temperature/pressure range, freely configurable. Press the confirm button to enter the auxiliary screen for parameter change operations.

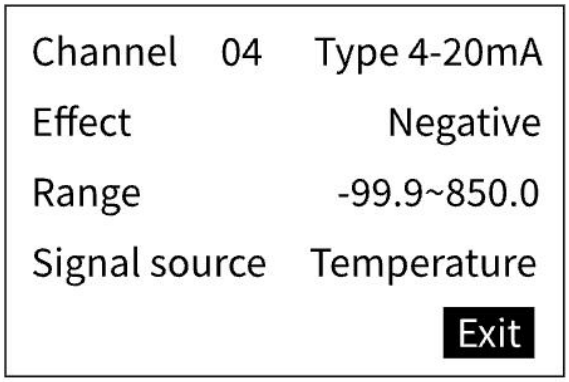
Resection

When the measured value is less than (range upper limit value - range lower limit value) x small signal percentage value+range lower limit value, the measured value is displayed as the range lower limit value.

5.4 Output Configuration



Output Configuration



Output Configuration

Type

Select the type of transmission output signal.

Effect

When the transmission output range (range) is not changed by default, AO acts positively, and the upper limit of the transmission range corresponds to the upper limit of the transmission output current, while the lower limit of the transmission range corresponds to the lower limit of the transmission output current; Under the reaction of AO, the upper limit of the transmission range corresponds to the lower limit of the transmission output current, and the lower limit of the transmission range corresponds to the upper limit of the transmission output current.

Transmission range [range]

Lower limit of transmission range: the source channel sampling measurement/operation value corresponding to the lower limit of transmission current;

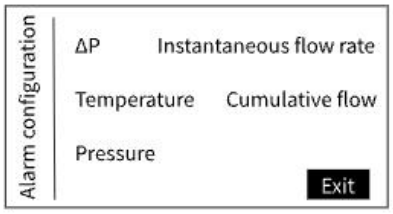
Upper limit of transmission range: the source channel sampling measurement/operation value corresponding to the upper limit of transmission current; The upper and lower limits of the transmission range can be freely configured, and the calculation formula for transmission current is as follows:

$$\text{Output current} = \frac{\text{Source channel sampling measurement value - Lower limit of transmission range}}{\text{Upper limit of transmission range - Lower limit of transmission range}} * (\text{Current upper limit - Current lower limit}) + \text{Current lower limit}$$

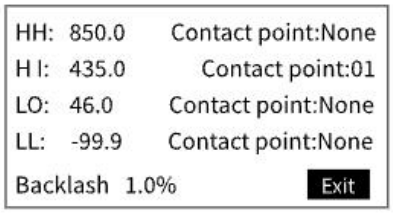
Signal source

Set the transmission output signal source channel, optional: flow rate, temperature, pressure, none. Automatically hide the transmission range when there is no signal source.

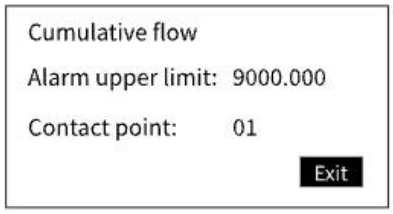
5.5 Alarm configuration



Alarm configuration



Alarm configuration
Instantaneous value category



Alarm configuration
Cumulative quantity category

This series of instruments contains two types of alarm modes, among which instantaneous flow,temperature, pressure,differential pressure/frequency/volume/mass alarms belong to the upper and lower limits of instantaneous values, and cumulative flow alarms belong to the upper limit of cumulative quantities.

Instantaneous value upper and lower limit class

Alarm threshold: HH, HI, LO, LL are the upper limit, upper limit, lower limit, and lower limit alarms, respectively. The subsequent values are the corresponding alarm thresholds. The actual data will only generate or eliminate the alarm signal when it exceeds the corresponding limit and the sum or difference of the return difference.

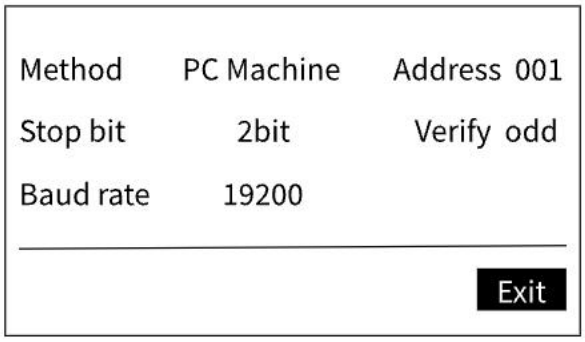
Alarm contact: Relay number, for example, contact 01 represents relay 01. When the signal value exceeds the alarm set value, the relay corresponding to the contact number will activate and the contact will close. If 'none' is selected, it means that the relay will not operate regardless of whether the signal exceeds the limit, but there will still be alarm records in the alarm list.

Alarm hysteresis: Alarm hysteresis is used to prevent the instrument from repeatedly alarming near the alarm point. For example, if the range is set to 0-100, the high alarm point is 80, the low alarm point is 20, and the alarm hysteresis is set to 5.0%, the instrument will only cancel the alarm when the measured value/calculated value is less than 80-100 * 5%=75 after a high alarm occurs. Similarly, when a low alarm occurs, the instrument will only cancel the alarm when the measured value/calculated value is greater than 20+100 * 5%=25.

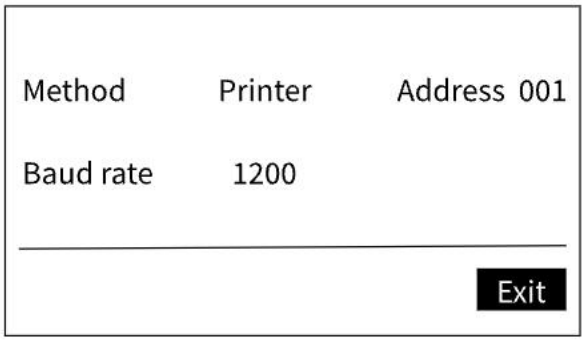
Cumulative upper limit category

The alarm upper limit threshold and alarm contact function are the same as the upper and lower limits of instantaneous values. The upper limit threshold for cumulative traffic is fixed to 3 decimal places.

5.6 Communication configuration



Communication Configuration PC



Communication Configuration Printer

Communication configuration

The instrument supports communication operations with the upper computer, enabling real-time monitoring of the instrument.

Online mode: includes two modes: PC and printer. To enter the printing configuration, the online mode must be set to printer before it can take effect.

Online address: The communication online address is used to distinguish between instruments when forming a network, and is the identifier of the instrument in the network. The upper computer software uses this to access the instrument; The local address in the same communication network can be set between 001 and 255 and cannot be duplicated.

Baud rate: When the communication method is [printer] mode, the baud rate cannot be changed. When [PC machine] mode is used, the baud rate can be selected (1200, 2400, 4800, 9600).

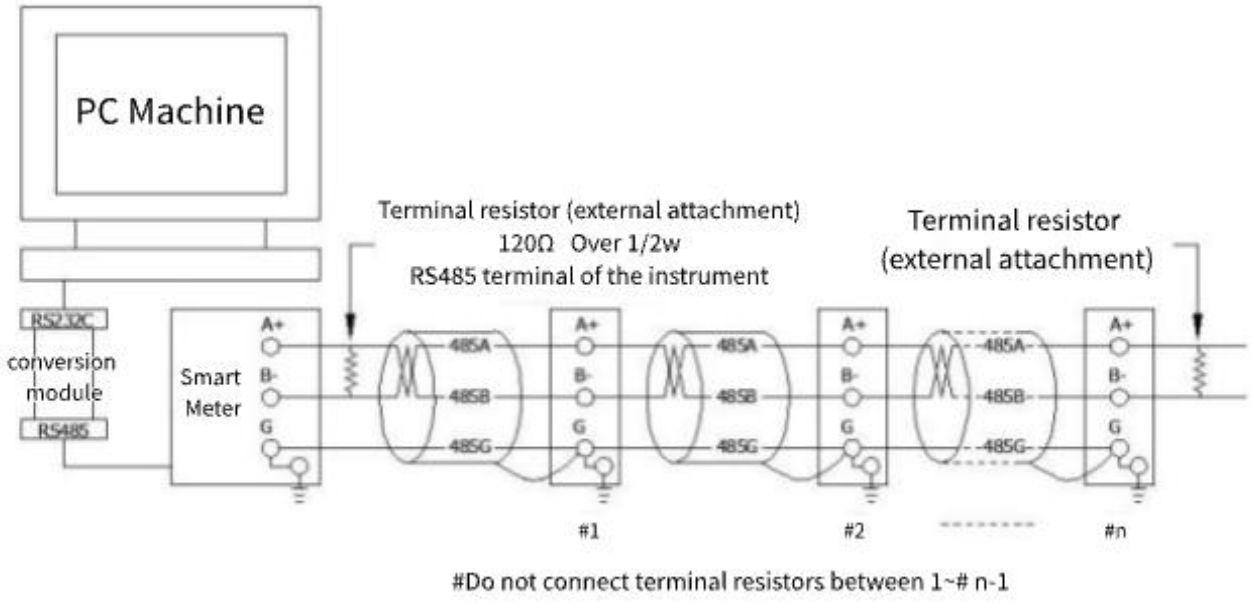
Verification method: no verification/odd verification/evenverification, default odd verification, cannot be changed when using the [printer] method.

Stop bit: 2 bits/1 bit, default 2 bits, cannot be changed when using [printer] mode.

Communication wiring

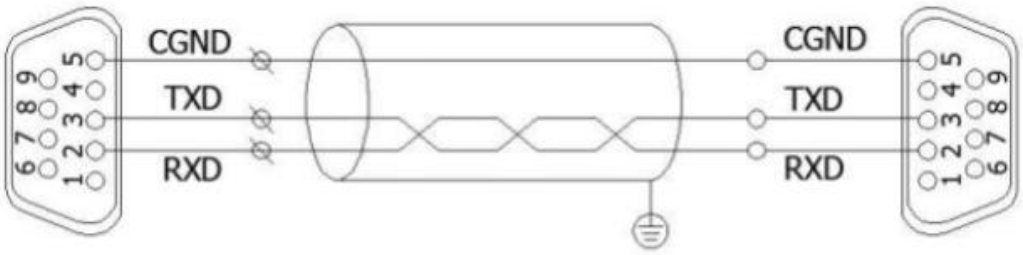
RS-485 connection method

The communication cable should use shielded twisted pair (communication length not exceeding 1000 meters), with one end connected to the serial communication port of the computer through an RS-232/485 conversion module and the other end connected to the 485 communication terminal of the instrument. The connection method is shown in the following diagram.

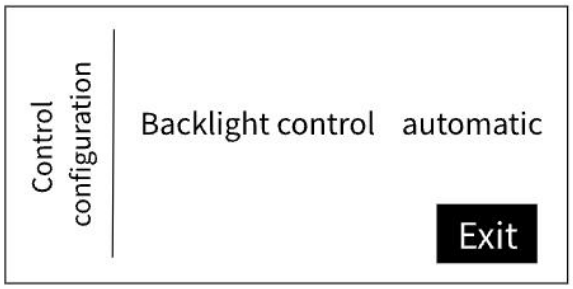


RS-232C connection method

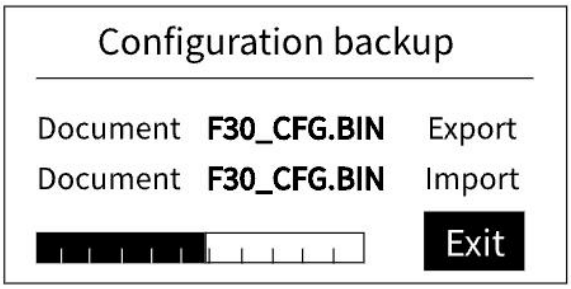
Users only need to connect one end of the equipped RS-232C communication cable to the instrument RS-232C interface and the other end to the serial port of the portable computer (or PDA) to achieve RS-232C communication connection. The communication cable should be made of shielded twisted pair and the length of the communication cable should not exceed 10 meters.



5.7 Control and functional configuration



Control Configuration



Functional Configuration

Control configuration

Backlight control: There are three control modes: constant on, constant off, and automatic. The LCD screen controls the backlight based on these parameters.

1.Always on: The backlight of the LCD screen is always on.

2.Constant off: The backlight of the LCD screen is constantly off.

3.Automatic: If there is no button operation within 30 seconds, the backlight will automatically turn off. Once there is a button operation, the backlight will automatically turn on.

Functional configuration

Configuration export: Backup the configuration to the root directory of the USB drive. The format and name of the exported file are fixed and cannot be changed. Only one configuration backup file can be stored in the same root directory of the USB drive. Please store the configuration backup files for each instrument with different parameters separately to avoid being overwritten by the newly exported configuration backup files.

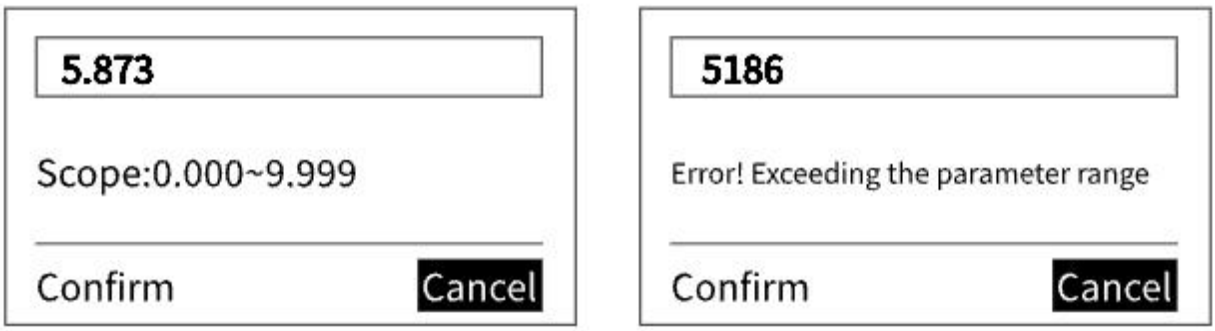
Configuration import: Automatically retrieve the corresponding configuration backup files from the root directory of the USB drive after inserting it.

Attention

The configuration import and export function cannot be performed between different system software versions.

Do not tamper with the file format and content to cause file damage. Configuration import is invalid when the file is damaged.

5.8 Auxiliary interface



Auxiliary Interface

The auxiliary interface is mainly used for setting alarm/range upper and lower limits, adjusting multi digit parameters such as K coefficient values. Entering the auxiliary interface allows for quick adjustment of multi digit values. Once the set value exceeds the adjustable range, the system will prompt that it is outside the parameter adjustable range. At this time, press the [direction key] to reset the parameters. Please refer to section 4.1- Instrument buttons for key operations.

Chapter 6 Fault Analysis and Troubleshooting

This exquisite flow integrator adopts advanced production technology and undergoes strict testing before leaving the factory, greatly improving the reliability of the instrument. Common faults are usually caused by improper operation or parameter settings. If any unresolved faults are found, please record the fault symptoms and promptly notify the local agent or contact us.

The following table shows several common faults of the refined flow integrator in daily applications:

Fault phenomenon	Root cause analysis	Treatment measures
The instrument does not work when powered on	1.Poor contact of power cordThe 2.power switch is not closed	Check the power supply
The signal display does not match the actual situation	1.Incorrect signal parameter settings in configuration 2.wrong connection 3.The sensor is not working properly	1. Check the configuration settings 2. Check the signal line 3. Check the sensor
The accumulated flow display does not match the actual situation (with correct wiring and normal sensor operation)	1. Local atmospheric pressure setting error 2. Fluid medium setting error 3. Incorrect instrument coefficient setting 4. Range decimal point setting error 5. Unit setting error 6. Other parameter settings are incorrect	Correctly set up
Alarm output is abnormal	1. Alarm limit setting error 2. The alarm point is shared by other channels	1.Reset the limit value 2.Cancel other alarm points
Distribution output encountered problems	1.Sensor and instrument wiring error 2.Multiple transmitters are powered beyond the standard distribution of this instrument (especially flow meters with display heads have higher power consumption)	1.Correct wiring 2.Use external power supply or customize the maximum load upon returning to the factory
Communication is not available	1.Communication cable not connected properly 2.Communication parameter setting error 3.Communication serial port setting error	1.Connect the communication cable correctly 2. The communication parameter settings between the integrator and the PC are consistent 3. Set the correct communication COM port (confirm that it is not occupied by other programs)
here is a problem with the transmission output	1. The transmission output is not coming 2. Inconsistent transmission output ratio	1. Check if the signal source is turned on or if the transmission output wiring is correct 2. Set the correct source range or adjust the output range

Report backup or configuration export failed	1.The format of the USB flash drive is incorrect 2.USB drive is not compatible 3.Insufficient remaining space on the USB drive 4.Incorrect operation during backup process	1.Format the USB drive to FET32 2. Use genuine and compatible USB drives 3.Use a larger capacity USB drive or clean up excess files on the USB drive 4.Correct operation
Configuration import failed	1. File damage 2. Different versions of system software	1. Export file format (such as renaming) or file content cannot be tampered with 2. Operations between software versions of the same system

Chapter 7 Service Guide

Dear user: Hello! Thank you for choosing our instrument series. Our company will thank you for your trust in our company with high-quality service. When using this series of instruments for the first time, first check whether the actual configuration of the product is consistent with the instrument configuration sheet, and whether the packing items such as random materials and accessories are complete. If you have any objections, please contact us first.

Precautions

Read random materials: Please carefully read the random materials and warranty principles, and store them in their entirety.

After purchasing the machine, keep the purchase invoice properly.

Warranty principle：

Repair cycle

Five working days from the date of receiving the product.

Repair cost

The free warranty period for this series of exquisite flow calculators is one year (due to product quality issues).

The warranty period is calculated from the date of purchase by the user, and is supported by the user's purchase invoice (indicating the product model and host serial number) or a copy. If an invoice cannot be provided, it will be calculated from the date of production by our company.

During the warranty period, if the product is damaged due to improper use by the customer, or if the customer has opened the qualified seal of the product, a certain fee will be charged. After the product is repaired, it can be guaranteed for another six months for free.

Customer Notice

Please make sure to send the product back with a description of the product malfunction to assist the engineer in repairing it as soon as possible.

Please accurately provide your phone/fax number, mailing address, and contact person for the purpose of returning the repaired product.

If you wish for engineers to go to the site for repairs, you must bear the resulting costs.

The company usually sends it back by express delivery (without insurance). If it needs to be transported by another party, please indicate it in the form and pay the relevant fees.

Appendix 1 Usage Examples

Example 1: Measuring the mass flow rate of superheated steam using a standard orifice plate

Known: Differential pressure sensor: two-wire 4-20mA differential pressure transmitter, requiring instrument opening, range 0.000~4.000KPa, working temperature 230.0 ℃, working pressure 0.30MPa (gauge pressure), scale flow rate 500.0m3/h

Pressure sensor: two-wire 4-20mA pressure transmitter, range 0.00-0.50M Temperature sensor: Pt100

Setting: In the flow configuration, set the ‘Model' column to ‘Differential Pressure'

Differential pressure configuration：

Type	Square root	Digits	Range
4-20mA	local	3	0.000~4.000

Default‘Unit', other parameters can be customized by the user

In the medium configuration:

Set the‘medium' column to‘superheated steam'

Default‘standard temperature'

In traffic configuration:

Unit	digit	Range	Coefficient
Kg/h	1	900.0	331.386

Other parameters can be customized by the user

In temperature configuration:

Method	Type	digit
Supplementary	Pt100	1

‘Unit' and ‘Range' are default, while other parameters can be customized by the use

In pressure configuration:

Method	Type	Digits	Range
Supplementary	4-20mA	2	0.00~0.50

Default'Unit', other parameters can be customized by the user

The calculation process of K coefficient value and maximum mass flow rate value:

According to the IAPWS-IF97 formula, the density of superheated steam at 230.0 ℃ and 0.30MPa is 1.757Kg/m3. The maximum flow rate is Q=500.0 * 1.757=878.5Kg/h. Press the [Confirm] button at the [Auto] button to enter the K coefficient automatic calculation interface (necessary parameters such as local atmospheric pressure, differential pressure configuration, and medium configuration need to be set first). Fill in the design scale flow rate of 500.0m ³/h, design temperature of 230.0 ℃, and design pressure of 0.30MPa, and update the coefficient to obtain K=331.386. The upper limit of the mass flow range is slightly larger than the actual mass flow rate.

Example 2: Electromagnetic flowmeter measures the volumetric flow rate of water

Known: Electromagnetic sensor: Two wire 4-20mA transmitter with a calibrated flow rate of 25.00 m3/h

Settings：In traffic configuration:

Set the‘Model' column to ‘Linear'

In linear configuration：

Type	Unit	Range
4-20mA	m3/h	0.00~25.00

In the medium configuration:

Set the‘medium' column to‘no compensation'

Default‘density' (density is not included in the calculation when the flow unit is volume flow unit)

Intraffic Configuration:

Unit	Digits	Range	Coefficient
m3/h	2	25.00	1.000

Other parameters can be customized by the user

Example 3: Using a standard orifice plate with temperature and pressure to measure the volumetric flow rate of coke oven gas (general gas)

Known：Differential pressure sensor:

Two wire 4-20mA differential pressure transmitter, requiring instrument opening, range 0.000-1.600KPa, working temperature 250.0 ℃, working pressure 0.10MPa (gauge pressure), operating density 0.501kg/m3, scale flow rate 2500Nm3/h

Pressure sensor: two-wire 4-20mA pressure transmitter with a range of 0.00-0.50MPa

Temperature sensor: Pt100

Settings:In traffic configuration:

Set the‘Model' column to‘Differential Pressure'

Differential pressure configuration：

type	root extraction	digit	range
4～20mA	this machine	3	0.000~1.600

Default‘Unit', other parameters can be customized by the user

In the medium configuration:

Set the‘medium' column to‘general gas' and‘standard density 'Default‘standard temperature'

In traffic configuration:

unit	digit	range	coefficient
m^3/h	0	3000	1256.476

Other parameters can be customized by the userIn.

Temperature configuration:

method	type	digit
External supplementation	Pt100	1

‘Unit' and ‘Range' are default, while other parameters can be customized by the user

In pressure configuration:

method	type	digit	range
External supplementation	4-20mA	2	0.00~0.50

Default ‘Unit', other parameters can be customized by the user

The calculation process of K coefficient value and maximum mass flow rate value:

Press the confirm button at the [Auto] button to enter the K coefficient automatic calculation interface (necessary parameters such as local atmospheric pressure, differential pressure configuration, and medium configuration need to be set first). Fill in the design flow rate of 2500Nm³/h, design temperature of 250.0 ℃, design pressure of 0.10MPa (gauge pressure), and design density of 0.501kg/m3 in sequence, and then update the coefficient to obtain K=1256.476. The standard density in the media configuration is automatically updated to 0.450Kg/m3.

Example 4: Vortex (frequency) flowmeter with pressure measurement for saturated steam mass flow rate

Known: Vortex sensor: frequency 0-500Hz, K=5000 times/m3, working pressure 0.75MPa (gauge pressure), scale flow rate 360 m3/h

Pressure sensor: two-wire 4-20mA pressure transmitter with a range of 0.00-1.00MPa

Settings：

In traffic configuration: Set the‘Model' column to‘Frequency Type'

In frequency configuration: ‘Type' and ‘Unit' are default, while other parameters can be customized by the user

In the media configuration: Set the‘medium' column to‘saturated steam' and the‘compensation' column to‘pressure'

In traffic configuration:

unit	digit	range	coefficient
Kg/h	Users set based on on-site traffic values	Users set based on on -site traffic values	5000

In pressure configuration:

method	type	digit	range
External supplementation	4-20mA	2	0.00~1.00

Calculation process of maximum mass flow rate value:

According to the IAPWS-IF97 formula, the density of saturated steam at 0.75MPa is 4.414Kg/m3. Then the mass flow rate Q=360 * 4.414=1589.04 Kg/h.

Example 5: Vortex (current) flowmeter with temperature and pressure measurement for superheated steam mass flow rate

Known: Vortex sensor: two-wire 4-20mA transmitter, working temperature 250.0 ℃, working pressure 0.40MPa (gauge pressure), scale flow rate 1500 m3/h

Pressure sensor: two-wire 4-20mA pressure transmitter with a range of 0.00-1.00MPa

Temperature sensor: Pt100

Settings：

In traffic configuration: Set the ‘Model' column to ‘Linear'

In linear configuration：

type	Unit	digit	rang
4～20mA	m^3/h	0	0~1500

Other parameters can be customized by the user

In traffic configuration:

unit	digit	range	coefficient
t/h	3	3.200	1.000

Other parameters can be customized by the user

In the media configuration: The ‘medium' column is set to ‘superheated steam', ‘standard temperature', and ‘standard pressure' by default

In temperature configuration:

method	type	digit	coefficient
External supplementation	Pt100	1	1.000

Default for‘Unit' and‘Range'

Other parameters can be customized by the user

In pressure configuration:

method	type	digit	range
External supplementation	4-20mA	2	0.00~1.00

Default for‘Unit' and‘Range'

Other parameters can be customized by the user

Calculation process of maximum mass flow rate value:

According to the IAPWS-IF97 formula, the density of superheated steam at 250 ℃ and 0.40MPa is 2.113Kg/m3. Then the mass flow rate Q=1500 * 2.113=3169.5 Kg/h ≈ 3.170 t/h.

Example 6: Vortex (frequency) flowmeter with temperature and pressure measurement for superheated steam mass flow rate

Known: Vortex sensor: frequency 0-5000Hz, K=5000 times/m3, working temperature 300.0 ℃, working pressure 0.75MPa (gauge pressure), scale flow rate 3600 m3/h

Pressure sensor: two-wire 4-20mA pressure transmitter with a range of 0.00-1.00MPa

Temperature sensor: Pt100

Setting:

In the traffic configuration:set the‘Model' column to‘Frequency Type'

In frequency configuration:‘Type' and ‘Unit' are default, while other parameters can be customized by the user

In the medium configuration: the‘medium' column is set to ‘superheated steam'

Default for‘standard temperature' and‘standard pressure'

In traffic configuration:

the‘Unit' column is set to‘t/h '

Users can set the ‘digits' and‘range 'columns based on the on-site flow value

The‘coefficient' column is set to‘5000', and other parameters can be customized by the user

In temperature configuration:

method	type	digit
External supplementation	Pt100	1

‘Unit' and‘Range' are default, while other parameters can be customized by the user

In pressure configuration:

method	type	digit	range
External supplementation	4-20mA	2	0.00~1.00

Default ‘Unit', other parameters can be customized by the user

Calculation process of maximum mass flow rate value：

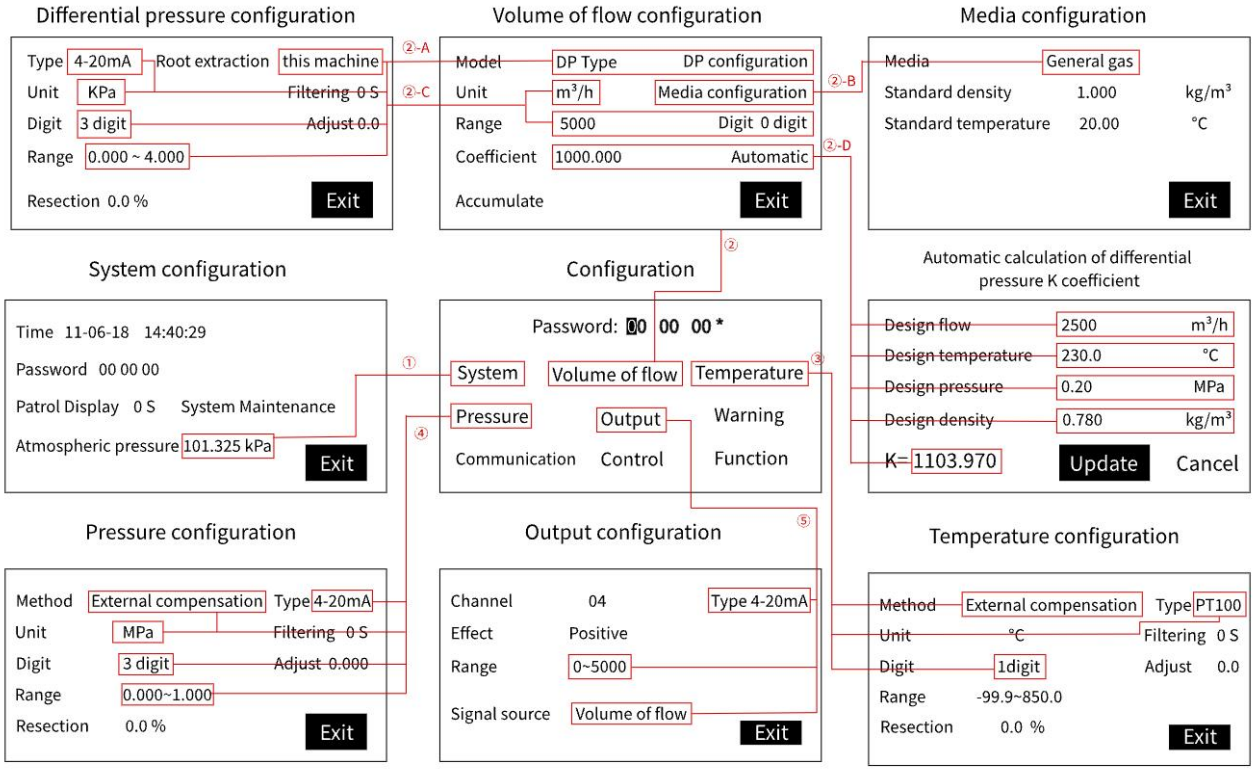
According to the IAPWS-IF97 formula, the density of superheated steam at 300 ℃ and 0.75MPa is calculated to be 3.287Kg/m3. Then the mass flow rate Q=3600 * 3.287=11833.2 Kg/h ≈ 11.833 t/h.

Appendix 2 Example of Parameter Setting

Example settings for parameters such as flow rate, temperature, pressure, and transmission

Set project	Instructions	Label
Local atmospheric pressure	0.101325MPa	①
Model/Differential Pressure Configuration	Differential pressure model, differential pressure transmitter output signal is 4-20mA, measurement range is 0.000-4.000KPa, instrument square root is required	②-A
Media configuration	Measure general gases	②-B
Flow range	Maximum scale flow rate (i.e. design flow rate) 2500 m3/h	②-C
Instrument coefficient	Differential design condition temperature of 230 ℃, design condition pressure of 0.2MPa (gauge pressure), operating density (i.e. design density) of 0.780kg/m^3	②-D
Temperature range	External supplement, Pt100 thermistor, temperature range 0~350 ℃	③
Pressure range	External supplement, the output signal of the pressure transmitter is 4~20mA, and the measurement range is 0.00~1.00MPa	④
Analog output	4~20mA，Source traffic channel	⑤

Log in to the configuration and decrypt it, enter the traffic configuration, set it in the order shown in the diagram, and then exit:



When the model is [frequency type], the instrument coefficient and coefficient unit are the same as the average coefficient and coefficient unit of the flowmeter.

Appendix 3 Customization/Additional Function Description