User's
Manual

User Manual

Thank you for purchasing the color/blue widescreen paperless recorder. This manual describes the functions, installation and wiring procedures, operating procedures, and handling precautions of the instrument. To ensure correct use, please read this manual thoroughly and have a clear understanding of the instrument before operation.

Notes

- This manual should be read by the end user.
- We warrant goods of its manufactures being free of defective materials and faulty workmanship. If warranted goods are returned to us or its representatives during the period of coverage of one year, we will repair or replace without charge any defective items. We guarantee all the goods with life maintenance.
- Every effort has been made in the preparation of this manual to ensure the accuracy of its contents. However, should you have any questions or find any errors, please contact your nearest customer service.
- Specifications or other contents of this manual are subject to change without prior notice for improvement. When there is a possibility that the foregoing change may result in serious accident or injury, we will give notice in advance.
- Do not modify this product. We assume no liability for any loss or damage, direct or indirect, caused by the user.
- Copying or reproducing all or any part of the contents of this manual without our permission is strictly prohibited.

Symbol Definitions

	**Danger**
	This symbol indicates a hazardous situation, which, if not avoided, could result in death, serious injury or property damage.
	**Caution**
	This symbol indicates a potentially hazardous situation, which, if not avoided, might result in damage to the instrument, process or surroundings.
	**Attention**
	This symbol indicates a situation, which will be very helpful to operate the instrument.

Danger

- Do not operate the instrument in the presence of flammable liquids or vapors, since operation in such environments constitutes a safety hazard.
- Ensure that the source voltage matches the voltage of the power supply before turning on the power.
- Make sure to connect the protective grounding to prevent electric shock before turning on the power.
- When there is a possibility that the abnormality of the instrument may cause a major accident or damage to other equipments, externally install an adequate emergency stop circuit or protection circuit to prevent accidents.
- The cover should be removed by the qualified personnel only. Opening the cover is dangerous, because some areas inside the instrument have high voltages.
- Never turn on the power before all the mounting and wiring work are finished to prevent electric shock, malfunction or failure of the instrument.
- Never disassemble, remodel, modify, or repair this instrument. Otherwise malfunction, electric shock, or failure may result.
- Never touch the terminal while the instrument is being energized. Otherwise electric shock or malfunction may result.
- Turn off the power before attaching/detaching the module/unit. Otherwise electric shock, malfunction or failure may result.
- Stop using the instrument if it is immersed in water. Otherwise electric leak, electric shock, or fire may result.
- Never use organic solvents such as alcohol or benzene when cleaning this instrument. Do not directly water the main unit. Otherwise deterioration, failure, electric leak, electric shock, or fire may result. When cleaning the main unit, wipe with a dry cloth.
- Check periodically that the terminal screws and mounting screws are securely fastened. Loose screws may cause fire or malfunction.
- Do not block the ventilation holes. Otherwise a failure, malfunction, shortened service life, or fire may result.
- Operating the instrument in a manner not described in this manual may damage its protective structure.

Caution

- Never use the instrument if it is found damaged or deformed when unpacked. Otherwise a fire, malfunction, or failure may result.
- Operate the instrument paying attention to prevent foreign matters such as scraps, electric wire chips, and iron powder from entering the instrument.
- When modifying the settings during the operation or forcibly outputting, starting or stopping the instrument, be sure to check that safety is ensured. Improper operation may result in damage or failure of the instrument.
- Make sure to perform periodic maintenance for the safe and continuous use of this instrument, because consumable parts or those which deteriorate with time are mounted in this instrument.
- Dispose the instrument as an industrial waste.

Chapter Review

Chapter1	**Overview** Functions of the instrument in brief; The general parameters and input/output performance.
Chapter2	**Installation and Wiring** The Installation and wiring for the instruments.
Chapter3	**Key & Menu** Describes the parts on the panel of instruments, the basic key operations, and how to login/logout.
Chapter4	**Basic Configuration** The general setup such as system setup and configuration management to prepare for the further setup.
Chapter5	**Input & Output** Settings and displays related to the analog/pulse input and analog/PWM output.
Chapter6	**PID Control** Settings and operations related to the PID control.
Chapter7	**Mass Flow Compensation** Settings and applications related to the mass flow compensation.
Chapter8	**Totalizer** Settings and operations related to the totalizer function.
Chapter9	**History Data** Settings and operations related to the record function of history data.
Chapter10	**Message Logs** Message logs including alarm log, system log of the instrument.
Chapter11	**USB Disk** How to transfer data between the instrument and PC via USB interface.
Chapter12	**Communication** Serial communication function.
Chapter13	**Print** Settings and operations related to the print function.
Chapter14	**Troubleshooting & Maintenance** Troubleshooting and maintenance.
Appendix1	**Soft Key Guide** Indication of the soft keys appeared in this manual.

Contents

Chapter1 Overview

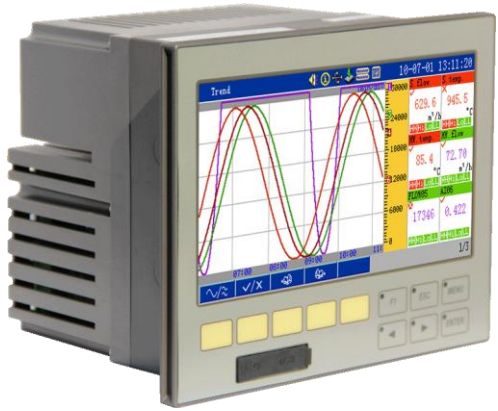


Figure 1-1

Introduction

Color/Blue widescreen paperless recorder offers up to 16 analog inputs, 2 pulse input, 4 analog outputs, 15 alarm outputs, 6 PWM outputs, 4 PID control modules and 100mA transmitter power supply. Meanwhile, it provides the RS-232C/RS-485 communication interface and USB interface to be connected with computer.

With display, alarm, compensation and other functions, the instrument can be acquire, store data from kinds of industrial process.

It can be used in kinds of industry such as Metallurgy, Petroleum, Chemical Industry, Building Materials, Papermaking, Food Industry, Pharmacy, Heat and Water Treatment, etc.

1.1 Main Performance

Table 1-1 Main Performance

Item	Explanation
Display	7" TFT LCD
Boundary dimensions	180mm×144mm×158mm
Panel cut-out dimension	138^{+1}_{0}mm×138^{+1}_{0}mm
Installed panel thickness	(1.5~6.0)mm
weight	1.75kg approx
Power supply	(175~240)VAC, (50~60)Hz
Inbuilt memory	32MB NAND Flash
Removable media	USB interface
Power consumption	20VA max.
Isolation	Between channel and ground: > 500VAC; Between two channels: > 250VAC.
Relative humidity	(10~85)%RH(non-condensing)
Ambient temperature	(0~50)℃
Transport and reserve	Temperature : (-20~60)℃ Humidity: (5~95)%RH (non-condensing) Altitude: <2000m

1.2 Input Signal

Table 1-2 DC Voltage and DC Current Input

Type	Range	Accuracy (%)
DC Voltage	(-1.00~1.00)V	±0.2
	(-10.00~10.00)V	±0.1
	(-100.00~100.00)mV	±0.1
	(-20.00~20.00)mV	±0.2
DC Current	(0.00~20.00)mA	±0.2

Table 1-3 RTD Input

Type	Range (℃)	Accuracy (℃)
Pt100	-200~800	±1.0
JPt100	-100~400	±1.0
Cu50	-50~140	±1.5

Note: Pt1000 can be ordered.

Table 1-4 TC Input

Type	Range (℃)	Accuracy (℃)
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
	-100~380	±1.6
N	-200~1300	±3.0
R	-50~100	±3.7
	100~300	±2.0
	300~1600	±1.5
WRe5-26	0~2300	±4.6
WRe3-25	0~2300	±4.6

Note: The accuracy here excludes cold junction error.

Table 1-5 Pulse Input

Amplitude (V)	Low level (V)	High Level (V)	Range (Hz)	Accuracy (Hz)	Response Period (s)
0~10	0~1	4.5~10	0~10000	±2	1s

1.3 Output Signal

Table 1-6 Analog Output

Analog Output	Accuracy (%)	Load Capacity
(0.00~20.00)mA	±0.2	550Ω

Table 1-7 Alarm Output

Max working voltage	250VAC/50Hz
Max permissible working current for single contact	2A (resistive load, inductive load)
Max permissible working current for each common port	4A (resistive load, inductive load)

Table 1-8 PWM Output

Output Period (s)	Resolution (ms)	Accuracy
1~999	250	Same as the output period

1.4 Others

Table 1-9 Other Performance

Item	Explanation
Fuse specification	1A/250VAC
Distribution specification	100mA, (24±1)VDC. It is forbidden to short the terminals.
Insulating strength	Insulation for power supply to ground is more than 1500VAC, for 1 min, leakage current is 3.5mA. Insulation for power supply to the cover is more than 1500VAC, for 1 min, leakage current is 1mA.
Real-time clock	Hardware real-time clock is adopted, and power is supplied by lithium cell after power off, the error is less than ±1min per month.
Power-off protection	History data and configuration information are saved into inbuilt memory, which assures the data won't be lost when power is off via cell in support.

Item	Explanation
Communication mode	It offers RS-485 and RS-232C which can be used simultaneously.
Communication protocol	Adopt Modbus communication protocol.
Sampling period	1s for no more than 12 input channels and 2s for others.

Chapter2 Installation and Wiring

Overview

Unpack the box and check the contents according to the packing list before operating the instrument. If any of the contents are not correct or missing or if there is any physical damage, contact our customer service.

2.1 Installation

2.1.1 Installation Location

The instrument must be installed inside the room.

- Operation temperature: (0~50)℃.
- Relative humidity: (10~85)% RH (non-condensing).
- Well ventilated to prevent the instrument from temperature-rising.
- Little mechanical vibration.
- No excessive amount of soot, steam, dust, or corrosive gases.
- Minimum induction, static, or magnetic-field and low electrical noise is desired.
- When installing, ensure the instrument put flatly.

Condensation may occur and the measurement precision may be reduced if the instrument is moved to another place where the ambient temperature changes rapidly. In this case, let the instrument adjust to the new environment for at least an hour before using it.

2.1.2 Installation Procedure

The instrument is designed to be installed in an instrumentation panel (panel mount type).

Use a 1.5mm to 6mm thick steel plate for the panel on which the instrument is to be mounted. The panel cutout dimension and the instrument dimension is shown

in Figure 2-1.

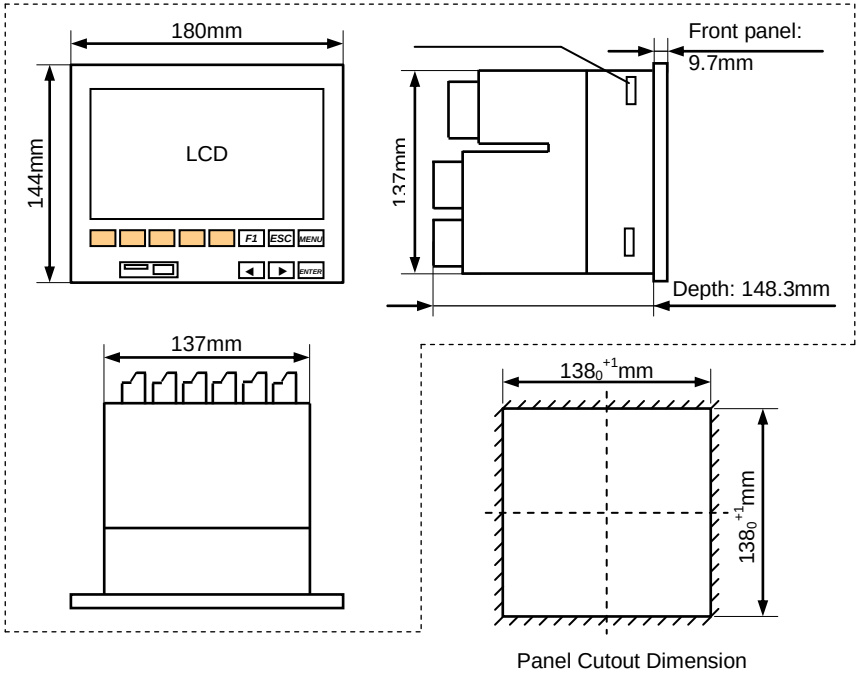


Figure 2-1 Boundary dimension

- Insert the instrument into the panel from the front view.
- Fit 4 fixation clamps into 4 fixed slots which are located beside the instrument. See Figure 2-2.
- Tighten the setscrews of fixation clamp with an adequate torque.

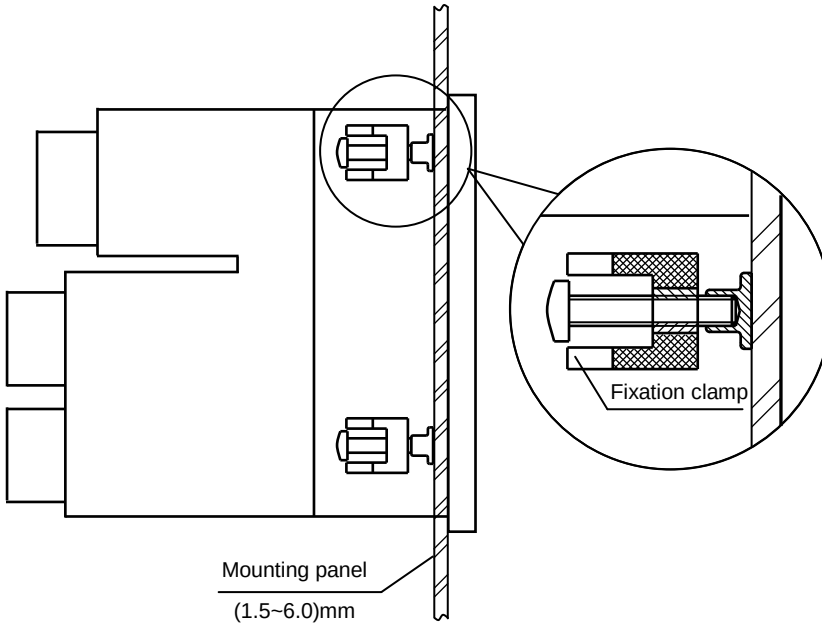


Figure 2-2 Diagram for installation

2.2 Wiring

To improve the stability of connection, cold-pressed terminal as shown in Figure 2-3 is recommended.

Figure 2-3 Cold-pressed terminal

To prevent electric shock when wiring, confirm that the power supply is OFF.

Be sure to keep the attached terminal cover mounted on the terminal block after wiring.

2.2.1 Arrangement of the Terminals

Terminals arrangement of the instrument is shown in Figure 2-4.

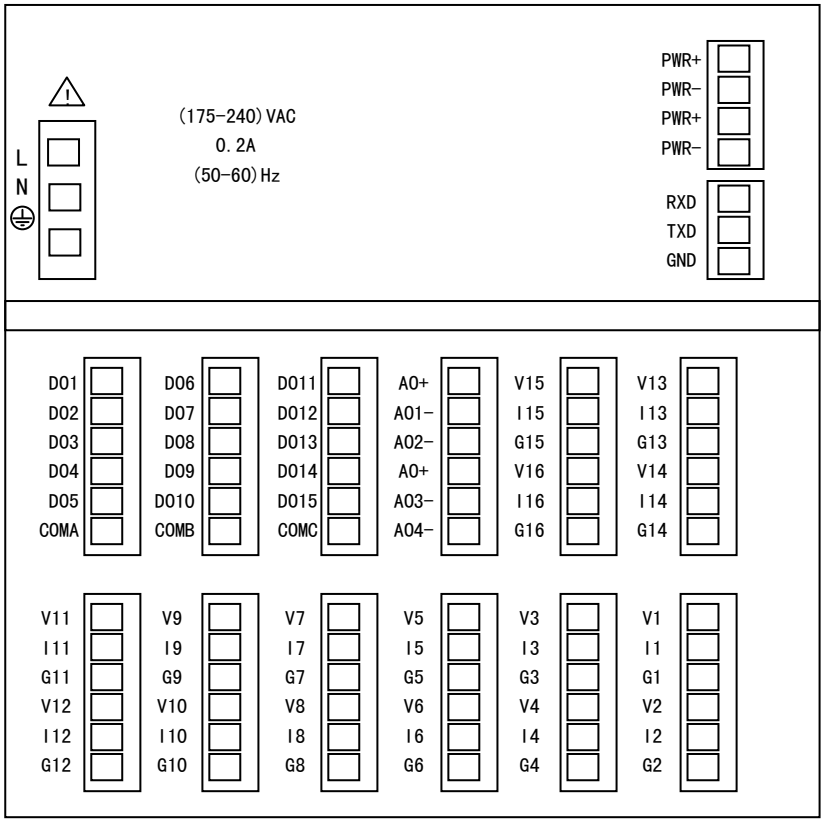


Figure 2-4 Terminal arrangement

Table 2-1 Terminal Definition

Label	Description
AC power supply	
L	Phase line terminal.
N	Zero line terminal.
⏚	Protective earth terminal.
Communication	
RXD, TXD, GND	RS-232C communication interface.
RXD, TXD	RS-485 communication interface.
Signal input/output	
V, I, G	Analog input terminals, up to 16 channels.
AO+, AOI-	Analog output terminals, up to 4 channels.
PWR+, PWR-	Transmitter power supply, (24±1)VDC , 100mA（without AO）
DO, COMA/ COMB/COMC	Alarm output terminals, up to 15 channels. (relay contacts)

Table 2-2 Explanation of Terminal

Label	Explanation
Analog input/output	
V1, I1, G1	Analog input channel 01
V2, I2, G2	Analog input channel 02
V3, I3, G3	Analog input channel 03
V4, I4, G4	Analog input channel 04
V5, I5, G5	Analog input channel 05
V6, I6, G6	Analog input channel 06
V7, I7, G7	Analog input channel 07
V8, I8, G8	Analog input channel 08
V9, I9, G9	Analog input channel 09
V10, I10, G10	Analog input channel 10
V11, I11, G11	Analog input channel 11
V12, I12, G12	Analog input channel 12
V13, I13, G13	Analog input channel 13
V14, I14, G14	Analog input channel 14
V15, I15, G15	Analog input channel 15
V16, I16, G16	Analog input channel 16

Label	Explanation
Pulse input	
V15, G16	Pulse input channel 01
I15, G16	Pulse input channel 02
Analog output	
AO+, AO1-	Analog output channel 01
AO+, AO2-	Analog output channel 02
AO+, AO3-	Analog output channel 03
AO+, AO4-	Analog output channel 04
Communication	
485+, 485-	RS-485communication interface
RXD, TXD, GND	RS-232Ccommunication interface
Transmitter power supply	
PWR+, PWR-	Transmitter power supply
Alarm output	
DO1/DO2/DO3/DO4/DO5, COMA	Alarm output channel 01~05
DO6/DO7/DO8/DO9/DO10, COMB	Alarm output channel 06~10
DO11/DO12/DO13/DO14/DO15, COMC	Alarm output channel 11~15

2.2.2 Power Supply Connection

Connect the power supply as shown in Figure 2-5. To ensure safety, please treat the power cord as shown in Figure 2-5(c).

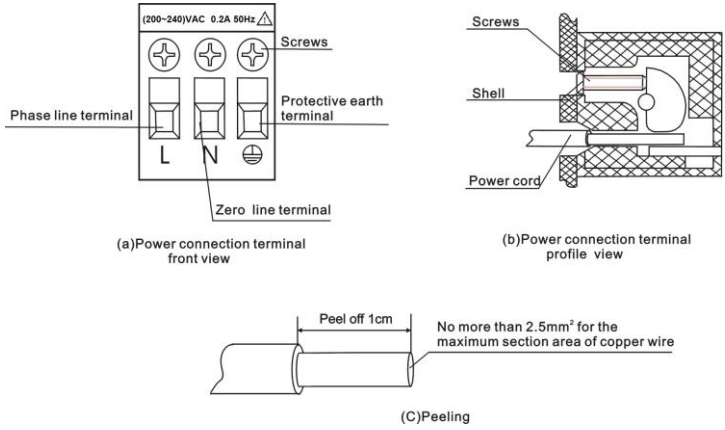


Figure 2-5 Power supply connection

2.2.3 Signal Connection

Connect current, voltage, TC (thermocouple) and RTD (resistance temperature detector) inputs to the terminals as shown in Figure 2-6. Connect pulse input to the terminals as shown in Figure 2-7. Connect analog and alarm outputs to the terminals as shown in Figure 2-8. Connect transmitter power supply to the terminals as shown in Figure 2-9 and Figure 2-10.

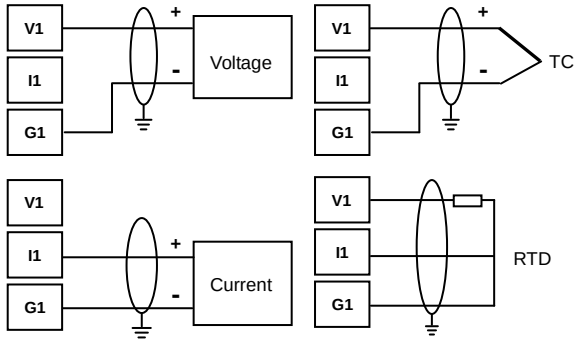


Figure 2-6 Analog input connection

RTD needs three leads. The resistance of the every lead must be equal and 10Ω or less.

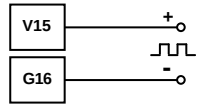


Figure 2-7 Pulse input connection

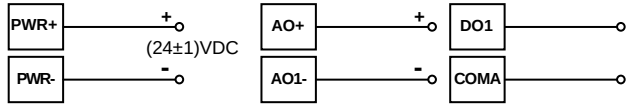


Figure 2-8 Transmitter power supply/Analog output/Alarm output connection

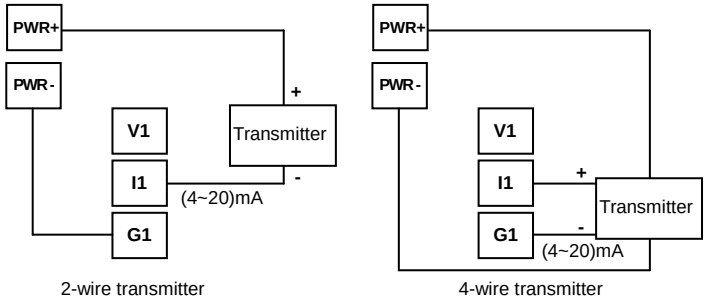


Figure 2-9 Transmitter power supply connection

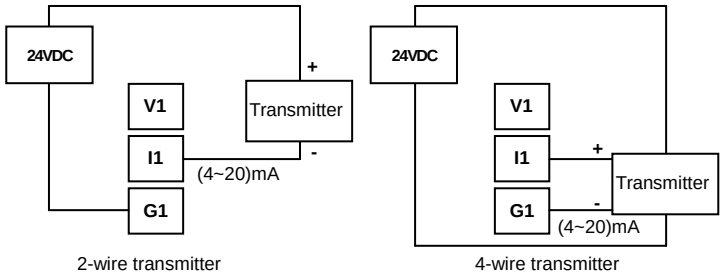


Figure 2-10 Transmitter power supply (External 24VDC) connection

2.2.4 Communication Connection

RS-232C communication

The RS-232C communication interface at the rear of the instrument can be applied to exchange data with computer. The connection is shown in Figure 2-11. Use the Shielded Twisted Pair (STP) cable which is less than 10 meters.

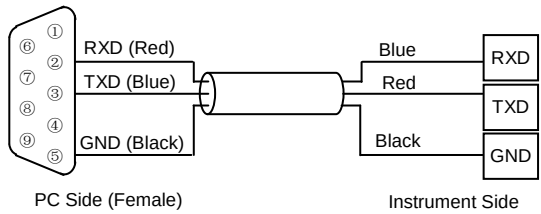


Figure 2-11 RS-232C communication between computer and the instrument

RS-485 communication

When several instruments are connected with one computer, as shown in Figure 2-12, RS232 to RS485 communication converter is necessary. Connection between the instrument and the converter is shown in Figure 2-13. Connection between the converter and computer is shown in Figure 2-14.

The communication cables should be STP. When the baud rate is larger than 19200bps, the cables should be less than 1000 meters. For long transmission cables, two 120Ω termination resistors must be fitted to the last slave in the chain.

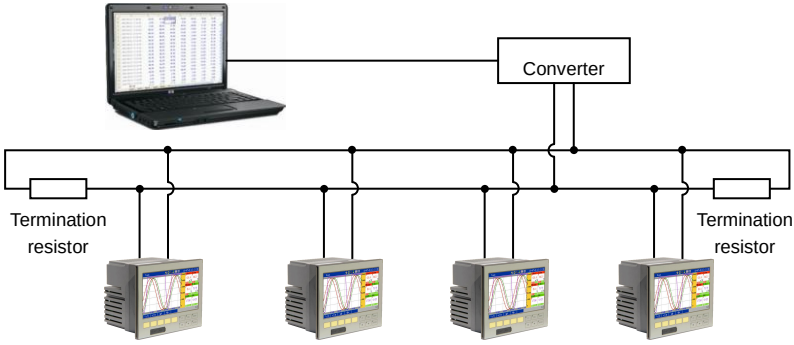


Figure 2-12 RS-485 communication between computer and several instruments

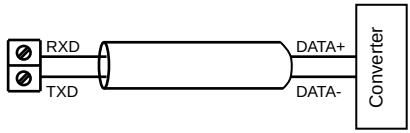


Figure 2-13 Connection between the instrument and the communication converter

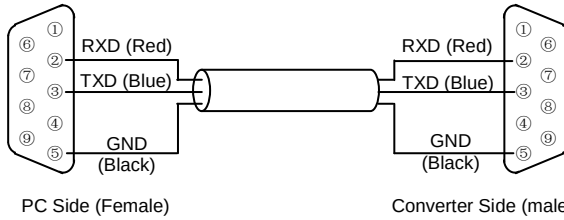


Figure 2-14 Connection between computer and the communication converter

Print communication

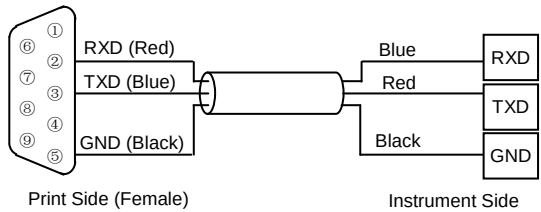


Figure 2-15 Connection between the instrument and the micro printer

Chapter3 Key & Menu

Overview

The instrument panel layout is shown in Figure 3-1.

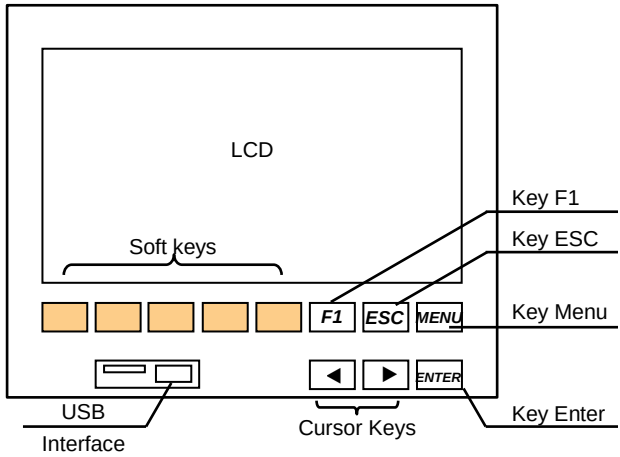


Figure 3-1 Parts on Panel

3.1 Keys

USB Interface: Used to insert USB Disk. The USB Disk should be inserted horizontally, for avoiding unnecessary damage.

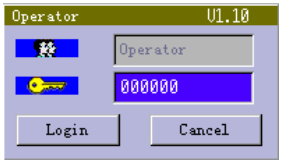
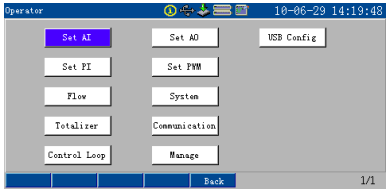
Keys: Including 5 soft keys and 6 function keys.

- **Soft keys:** 5 soft keys execute the corresponding function according to the prompts at the bottom of each display. For soft key guides, please refer to Appendix1.
- **Key F1:** Press it to pop up the shortcut menu in any monitoring displays. Key F1 is also used to copy the monitoring displays into USB Disk.
- **Key ESC:** Press it to exit to previous display or menu.
- **Key Menu:** Used to switch from operation mode to setting mode.
- **Key Enter:** Press it to switch the pages among monitoring displays

automatically. Used to enter in configuration displays or activate the input box.

- **Cursor Keys:** Used to move cursor.

3.2 How to Access Setup Menu

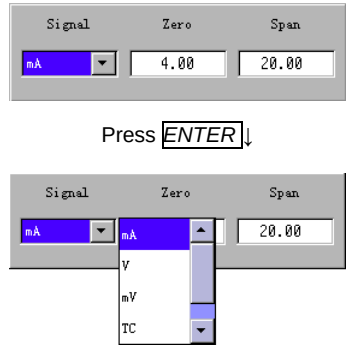
Do This	This is The Display You Should See
1. Press *MENU* to enter the login display from any monitoring displays. 2. Press *ENTER* to activate the input box. 3. Use ◄ or ► to move cursor, then input the password by ▲ or ▼. 4. Press *ENTER* to confirm.	
5. Use ► to move focus frame to Login, then press *ENTER* to enter setup menu.	

Note: Change the password in [system] after enter setup menu.

3.3 Parameters Setup

3.3.1 Enumerated Parameters

Table 3-1 Enumerated Parameters Setup

Do This	This is The Display You Should See
1. Press *ENTER* to pop up drop-down list. 2. Press ◄ or ► select parameters, and press *ENTER* to confirm.	

3.3.2 Numerical Parameters

Table 3-2 Numerical Parameters Setup (1)

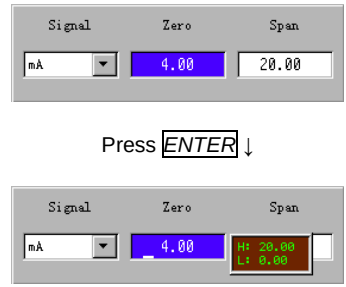
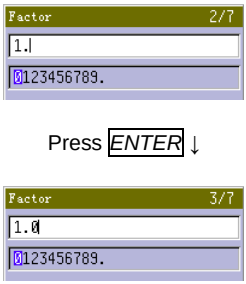
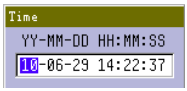
Do This	This is The Display You Should See
1. Press *ENTER* to activate the input box. 2. Press ◄ or ► to move cursor. 3. Press ▲ or ▼ to increase or decrease the numerical parameter; Press +/- to input sign for the parameter. 4. After modifying the value, press *ENTER* to confirm.	

Table 3-3 Numerical Parameters Setup (2)

Do This	This is The Display You Should See
1. Press → to move cursor. 2. Press Del to delete the character. 3. Press ◄ or ► to select characters; Press ENTER to insert the selected character. 4. Press OK to confirm the input and exit.	

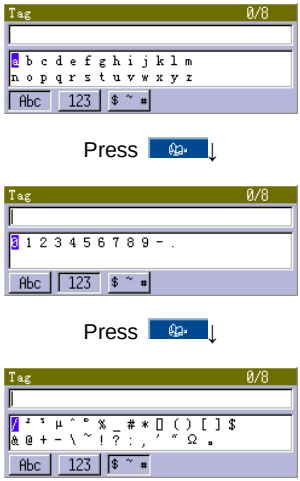
3.3.3 Time Parameters

Table 3-4 Time Parameters Setup

Do This	This is The Display You Should See
1. Press ◄ or ► to move cursor 1. Press ▲ or ▼ to modify date or time. 2. After modifying, press ENTER to confirm and exit. 2. Press Back to exit directly without modifying.	 Press ▲ or ▼ to modify YY-MM-DD: Year-Month-Day HH:MM:SS: Hour-Minute-Second

3.3.4 Mixed Character Parameters

Table 3-5 Mixed Character Parameters Setup

Do This	This is The Display You Should See
1. Letter, numerical and sign input is as seen in Table 3-3. 2. In letter input view, press Caps to switch between upper case and lower case. 3. Press to switch among different character input boxes. 4. After inputting the characters, press *ENTER* to confirm and exit.	

Chapter4 Basic Configuration

Overview

This section describes the universal operation, settings management, brightness adjustment and so on.

4.1 System Setup

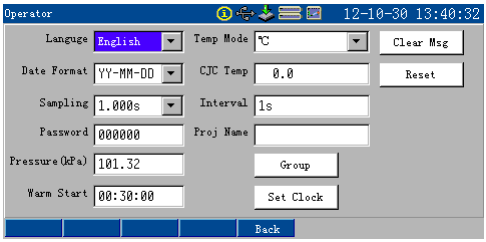


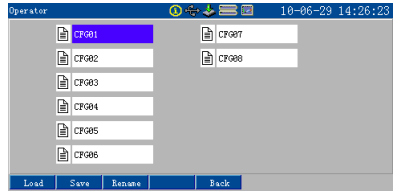
Figure 4-1

Table 4-1 [General] Main Menu Parameters

Name	Description	Selections or Range of Setting	Default
Language	To select the display language.	English/简体/繁體	English
Date Format	To select the date format.	YY-MM-DD/DD-MM-YY/ MM-DD-YY	YY-MM-DD
Sampling	To select sampling period.	According to the ordering code.	/
Password	To set the login password	000000~999999	000000
Pressure (kPa)	To input local standard atmosphere pressure.	0.00~300.00	101.32
Warm Start	To set the warm start time.	00:00:00~24:00:00	00:30:00
Temp Mode	To select temperature units.	°C/°F	°C
CJC Temp	Cold junction compensation，the unit is based on [Temp Mode].	-12.7~12.7	0.0

Name	Description	Selections or Range of Setting	Default
Interval	To select the record interval for the history data.	1s~60h	1s
Proj Name	Project name, which will be shown in real-time displays.		
Group	4 groups, each of which has 6 sources, are provided to show for real-time displays.		
Set Clock	To set the time for the instrument.		
Clear Msg.	To clear the alarm messages and the system messages.		
Reset	To restore the default settings.		

4.2 Settings Management

Do This	This is the Display You Should See
1. In [Manage], press Save to save current settings; Press Load or *ENTER* to load the settings selected; Press Rename to modify the name of the configuration. 2. Press Back to exit.	

4.3 Apply the Settings

Settings compile is provided by the instrument.

Once settings are modified, a 'Save & Apply' dialog box will be pop up before exit, as shown in Figure 4-2. Press Cancel to return the configuration display to setup continually; Press Exit to return the monitoring display without enabling the settings; Press Enable to enable the settings and enter to the compile display, as shown in Figure 4-3.

It will show the error settings or warning settings in the compile display if settings

are not correct. You can modify the settings according to the prompt until it is correct.

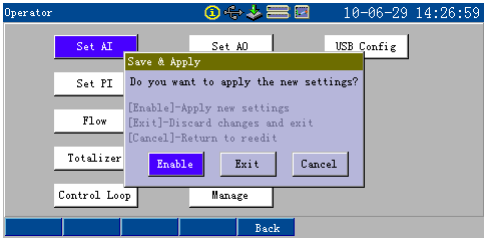


Figure 4-2 Dialog Box of Apply Settings

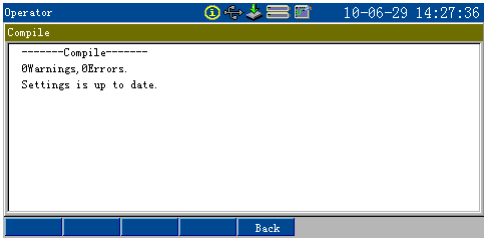


Figure 4-3 Settings Compile Display

4.4 Shortcut Menu Operation

Press *F1* to pop up the shortcut menu in any monitoring display. Adjust the brightness of LCD as shown in Figure 4-4. Open or close the buzzer as shown in Figure 4-5; [USB Disk] please refer to Chapter11; [Print] please refer to Chapter13; [Add Flag] please refer to Chapter9; Display setting is as shown in Figure 4-6, whose parameters are shown in Table 4-2.

Figure 4-4 Brightness Adjustment

Figure 4-5 Buzzer Adjustment

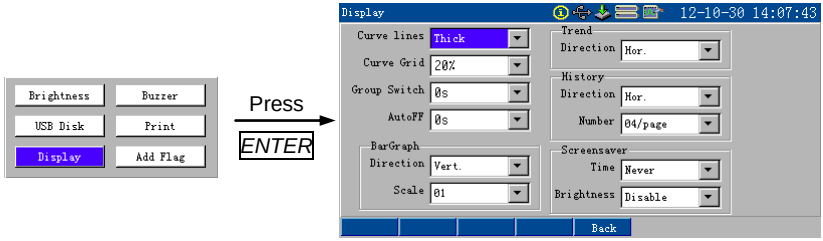


Figure 4-6 Display Setup

Table 4-2 [Display] Shortcut Menu Parameters

Name	Description	Selections or Range of Setting
Curve lines	To select the line for the real-time or history trend.	Thick/Thin
Curve Grid	To select the vertical scale for the real-time trend.	5%/10%/20%/50%
Group Switch	To select the switch interval for the pages in digital, bar graph and trend displays.	0s/5s/10s/20s/30s/60s
AutoFF	To select the switch interval for all monitoring displays.	0s/5s/10s/20s/30s/60s
Direction	To select the display direction for the bar graph, real-time or history trend.	Hor.(Horizontal)/Vert.(Vertical)
Scale	To select the scale for the bar graph.	NULL/01/02/03/04/05 (i.e., No scales / 5/10/15/20/25 equal divisions)
Number	To select the channel number shown in the history display.	01/page, 02/page, 03/page, 04/page, 05/page
Time	To select the time of screensaver.	Never / 01/05/10/30 minute
Brightness	To select the LCD brightness when screensaver available.	Disable/Low/Middle/High

4.5 Basic Information in Status Bar

4.5.1 Status Bar in Monitoring Displays

Figure 4-7 Status Bar in Monitoring Displays

1. Alarm symbol: Appears only when alarm activated.
2. System message symbol: Appears only when there's uncheck system message.
3. USB disk symbol: Appears only when the USB disk is on work.
4. Recording symbol: Flashing means recording is on work. Otherwise, USB disk is in the process of saving screen. will be turned to when stopping recording.
5. Inbuilt memory symbol: Top indicates the record data while bottom indicates the record block. For both two, green means normal status, "not full"; while red means the inbuilt memory is almost full, '>90%', it reminds the user to transfer data via USB disk immediately to avoid data loss.
6. Running symbol: Green curve means normal, while red means excessive use of expressions.

4.5.2 Status Bar in Configuration Displays

As shown in Figure 4-8, the symbols of the status bar in configuration display is the same as what in monitoring display.

Figure 4-8 Status Bar in Configuration Displays

Chapter5 Input & Output

Overview

Summary of signal type that the instrument related is shown in Table 5-1, for details see section 1.2 and section 1.3.

Table 5-1 Input & Output Signal Overview

Channel	Signal	Range/Signal	Description
Analog Input (AI)	mA	(0.00~20.00)mA	The range is customized.
	V	(-10.00~10.00)V	
	mV	(-100.00~100.00)mV	
	Thermocouple (TC)	B, E, J, K, S, T, R, N, WRe5-26, WRe3-25	/
	RTD	Pt100, JPt100, Cu50	/
Pulse Input (PI)	Hz	(0~10000)Hz	Responding time is 1s.
Analog Output (AO)	mA	(0.00~20.00)mA	The range is customized and can be reversed.
Alarm Output (DO)	Digital	0, 1	Output by relay contact.
Pulse Width Modulation (PWM)	Digital	0, 1	Output resolution is 1/32s.

Note: If no specified, the responding time of each type is identical with the sampling period.

5.1 Analog Input (AI) Setup

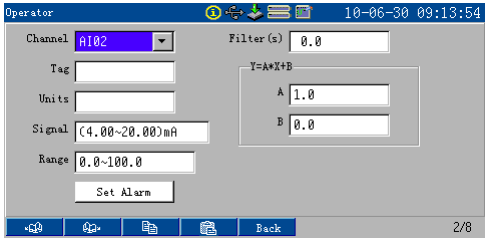


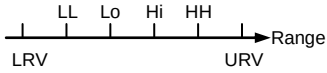
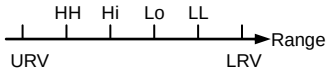
Figure 5-1 [Set AI] Display

Table 5-2 [Set AI] Main Menu Parameters

Name	Description	Selections or Range of Setting	Default
Channel	To select the No. of AI channel.	Up to 16 channels.	AI01
Tag	To describe the channel.	Up to 8 characters	/
Units	To input the units of AI.	Up to 8 characters	/
Signal	To set the signal type and range.	See Table 5-1	(4.00~20.00)mA
Range	To set the decimal point and the LRV/URV.	-30000~30000	0.0~100.0
Filter (s)	To set the first- order filter.	0.0~25.5	0.0
A	To set the coefficient A and the constant B for the modification formula Y=A*X+B.	-999~9999	1.0
B		-999~9999	0
Set Alarm	To set the parameters of alarm related.	See Table 5-3 and following details.	/

Note: LRV—Lower Range Value; URV—Upper Range Value.

Table 5-3 [Set Alarm] Submenu Parameters

Name	Description	Additional Notes
Alarm HH	To set the alarm value, delay time and hysteresis related to high-high limit, high limit, low limit and low-low limit alarm for the selected channel.	The alarm value can not be over LRV or URV. Their relationship is shown in the following figure: When LRV<URV,  When LRV>URV, 
Alarm Hi		
Alarm Lo		
Alarm LL		
Output	To select the output contact for alarm.	Selections: DO01~DO15

Additional Notes

- Signal

When mA, V or mV is selected in [Signal], [Zero] and [Span] should be setup. Press *ENTER* to activate the input box, and the range of the signal will be shown beside the box, as shown in Figure 5-2. (Modify the value as shown in Table 3-2.) If input is over this range, it will be saved as the maximum or the minimum value allowed.

Figure 5-2 Voltage/Current Signal Setup

[Zero] must be less than [Span]; otherwise, compile will be failed when enabling the settings.

When TC or RTD is selected in [Signal], [Sig. Type] and [Burn Out] should be setup, as shown in Figure 5-3. [Burn Out] means the recording data status when TC or RTD burns out.

Down: Record as 'LRV'.

Hold: Keep the one before it burns out.

Up: Record as 'URV'.

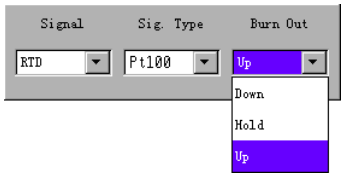


Figure 5-3 TC/RTD Signal Setup

For TC, cold junction temperature should be taken into consideration for accuracy when measuring. Shorten the TC input wires, thus the show value of this channel is just its cold junction temperature. It can be modified as section

4.1, when the cold junction temperature drifted.

The instrument can display either in Celsius or Fahrenheit, pay attention to the temperature mode when using TC or RTD.

For example, one user uses AI05 to measure the temperature of K-type TC. The cold junction temperature is 1°C less than the room temperature. Therefore, the user could setup as shown in Figure 5-4 and Figure 5-5.

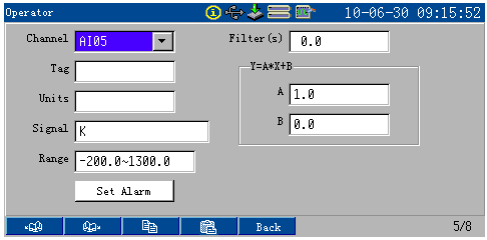


Figure 5-4 Channel Setting for TC Measurement

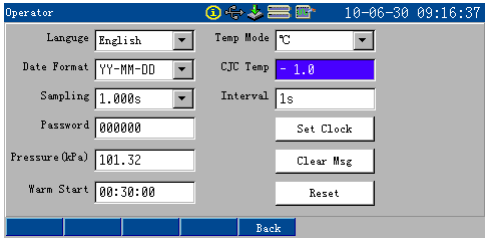


Figure 5-5 Cold Junction Compensation for TC Measurement

- Filter

The instrument adopts first-order inertial digital filter, the equation shows as follows:

$$y(i) = x(i) \bullet \frac{T_S}{T_S + T_F} + y(i-1) \bullet \frac{T_F}{T_S + T_F} \quad \text{.....Equation 5-1}$$

Where, *y(i)*: Current show value

x(i): Current show value which hasn't been treated by filter

y(i -1): Previous measured value

T_S: Sampling period

T_F: Filter time. See Figure 5-6.

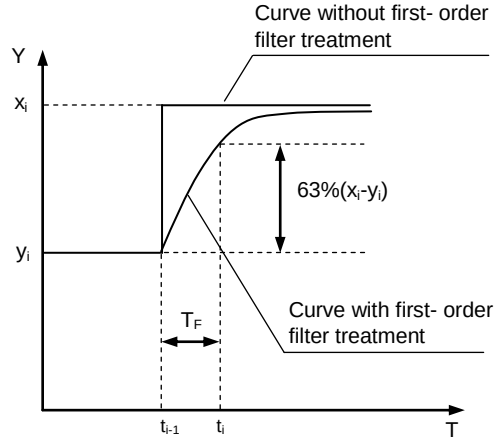


Figure 5-6 First-order Filter

From the equation and Figure 5-6, we can conclude that it is helpful to improve the curve's smoothness and reduce the interferential signal influence on curve to set the filter time constant. The longer the filter time is, the less the influence on show value from sampling period signal is, which makes the curve smooth.

The filter time can be any value between 0.0 and 25.5, and 0.0 is the default value, which means the filter is off.

- Y=A*X+B (Linear Modification)

The formula Y=A*X+B is used for linear modification to the measurement value. Where, A is a linear coefficient, B means zero modification, and X is the engineering value before modification while Y is the modified value. By default, A=1, B=0, which means no modification.

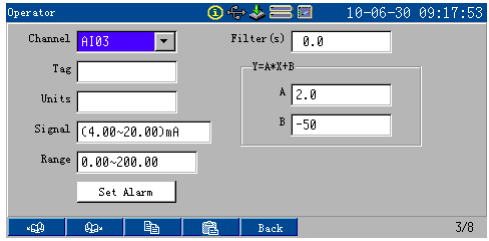


Figure 5-7 Linear Modification

For example, setup as shown in Figure 5-7. The engineering value will be 150.00, when input is 12.00mA.

- Set Alarm

Set alarm as shown in Figure 5-8. High/Low limit alarm are de-activated by default, you can press *ENTER* to activate.

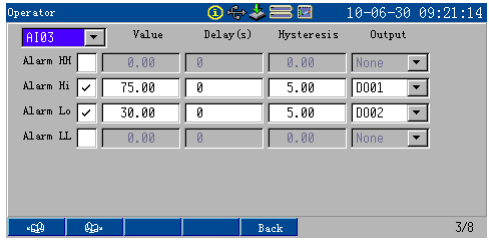


Figure 5-8 Set Alarm

- Alarm HH/Hi/Lo/LL (High/Low Limit Alarm)

When the measured value fluctuates near the alarm value, the instrument will activate and de-activate alarm relays frequently, resulting in alarm contacts malfunction. The instrument provides alarm hysteresis to avoid this case.

Following is the illustration of the high/low limit of alarm.

For high limit alarm, if the alarm value is set as 75.00, hysteresis is 5.00, and delay is 0; when the measured value increases and reaches 75.00, the alarm relay will be activated; If the measured value decreases below 75.00, alarm relay will not be de-activated immediately, unless the measured value reaches 70.00, see Figure 5-9.

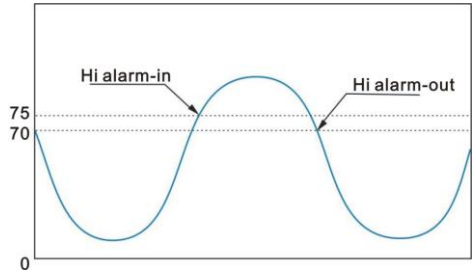


Figure 5-9 High Limit Alarm Hysteresis

Alike, for low limit alarm, if the alarm limit is set as 30.00, hysteresis is 5.00, delay is 0; when the measured value decreases and reaches 30.00, the alarm relay will be activated; If the measured value rises above 30.00, alarm relay will not be de-activated immediately, unless the measured value reaches 35.00, see Figure 5-10.

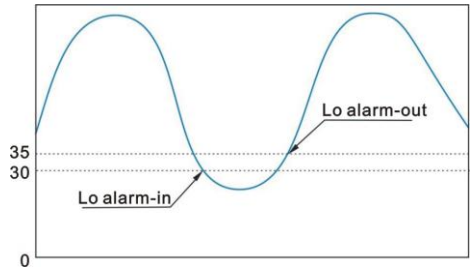


Figure 5-10 Low Limit Alarm Hysteresis

For high-high limit and low-low limit, the alarm hysteresis configuration works same as high limit and low limit alarm.

High/Low limit alarm has the function of alarm-in delay and alarm-out delay. Set the delay time within the range of (0~30)s. When the instrument detects that input meets alarm state, and it maintains for a period of preset delay time, the instrument will produce an alarm. So is alarm-out.

When delay time is set as 0, the instrument will be in alarm and out of alarm immediately.

The alarm can be output by DO01~DO15, if different alarm types select the same output contact, the contact will be activated when either of them happened.

5.2 Pulse Input (PI) Setup

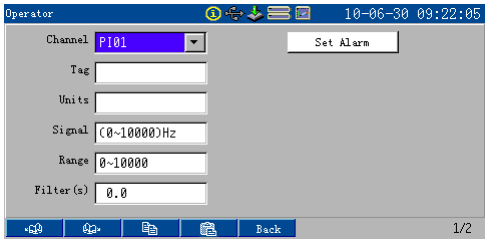


Figure 5-11 [Set PI] Display

Table 5-4 [Set PI] Main Menu Parameters

Name	Description	Selections or Range of Setting	Default
Channel	To select the No. of PI channel.	Up to 2 channels.	PI01
Tag	To describe the channel.	Up to 8 characters	/
Units	To select the units of PI.	Up to 8 characters	/
Signal	To select the signal range.	(0~10000)Hz	(0~10000)Hz
Range	To set the decimal point and the LRV/URV.	-30000~30000	0~10000
Filter (s)	To set the first-order filter.	0.0~25.5	0.0
Set Alarm	To set the parameters of alarm related.	See section 5.1	/

5.3 Analog Output (AO) Setup

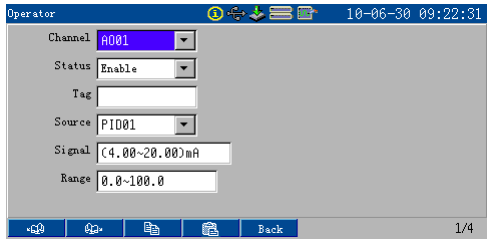


Figure 5-12 [Set AO] Display

Table 5-5 [Set AO] Main Menu Parameters

Name	Description	Selections or Range of Setting	Default
Channel	To select the No. of AO channel.	Up to 4 channels.	AO01
Status	To select the status of channel.	Disable /Enable	Disable
Tag	To describe the channel.	Up to 8 characters	/
Source	To select the signal source.	AI/PI/PID	PID01
Signal	To select the signal range.	(0~20)mA	(4.00~20.00)mA
Range	To set the decimal point and the LRV/URV.	-30000~30000	0.0~100.0

5.4 Pulse Width Modulation (PWM) Output

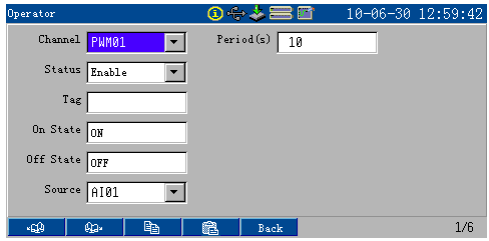


Figure 5-13 [Set PWM] Display

Table 5-6 [Set PWM] Main Menu Parameters

Name	Description	Selections or Range of Setting	Default
Channel	To select the No. of PWM.	Up to 6 channels.	PWM01
Status	To select the status of channel.	Disable/Enable	Disable
Tag	To describe the channel.	Up to 8 characters	/
On State	To describe the ON status of PWM.	Up to 8 characters	ON
Off State	To describe the OFF status of PWM.	Up to 8 characters	OFF
Source	To select the signal source.	AI/PI/PID	AI01
Period	To set the output period.	(1~999)s	10

Display, output and calculation of PWM are all digitals and PWM01~PWM06 occupied DO01~DO06. When PWM channels are enabled, corresponding DO channels must be closed; otherwise, compile will be failed.

5.5 Input & Output Related Displays

5.5.1 Digital Display

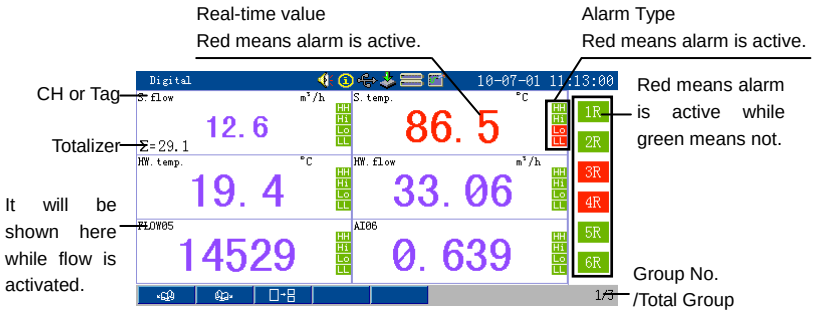
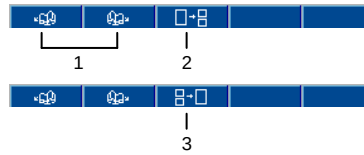


Figure 5-14 Digital Display



1. Page up and page down. Page circularly among max. 2 displays.
2. Switch from one group shown display to two groups shown display.
3. Switch from two groups shown display to one group shown display.

5.5.2 Bar Graph Display

The Bar Graph Display shows the position of channel's current engineering value within the range. The direction and scale of Bar Graph Display can be set in [Display]. See section 4.4. The soft keys in Bar Graph Display are similar to those in Digital Display.

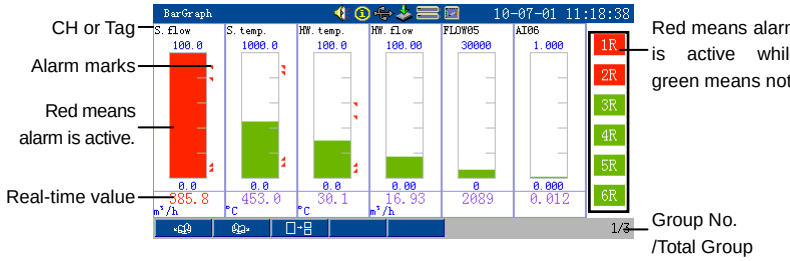


Figure 5-15 Bar Graph Display

5.5.3 Trend Display

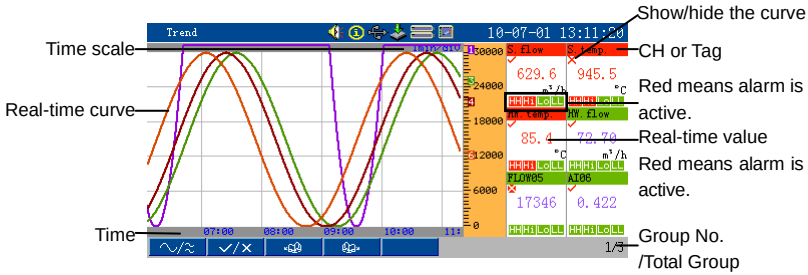
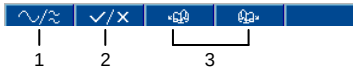


Figure 5-16 Trend Display



1. Press to switch between gathered form and separate form. The former shows all curves in the same zone while the latter shows the curves in independent zones respectively.
2. Press to show or hide the curve. '√' means to show while '×' means to hide.
3. Press to page up and page down. Page circularly among max. 2 displays.

Chapter6 PID Control

6.1 PID Parameters

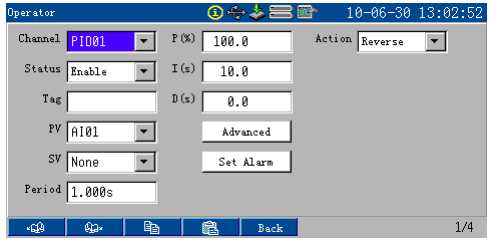


Figure 6-1 [Control Loop] Display

Table 6-1 [Control Loop] Main Menu Parameters

Name	Description	Selections or Range of Setting	Default
Channel	To select the No. of the PID channel.	Up to 4 channels.	PID01
Status	To select the status of the PID channel.	Disable/Enable	Disable
Tag	To describe the PID channel.	Up to 8 characters	/
PV	To select the signal source of PV.	AI/PI/PID	AI01
SV	To select the signal source of SV. The SV will be given as local when 'None' is selected.	None/AI/PI/PID	None
Period	To set the control period.	(1~30)×sampling	1.000s
P (%)	To set the proportional band.	0.1~3000.0	100.0
I (s)	To set the integral time.	0.1~3000.0	10.0
D (s)	To set the derivative time.	0.0~900.0	0.0
Action	To select the control action.	Reverse/Direct	Reverse
Advanced	See Table 6-2.	/	/
Set Alarm	See following details.	/	/

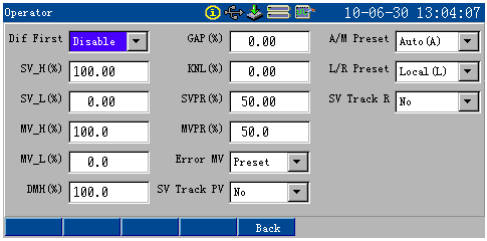


Figure 6-2

Table 6-2 [Advanced] Submenu Parameters of [Control Loop]

Name	Description	Selections or Range of Setting	Default
Dif First	To decide to use differential forward or not.	Disable/Enable	Disable
SV_H (%)	To set the high limit and low limit of SV.	0.00~100.00	100.00
SV_L (%)		0.00~100.00	0.00
MV_H (%)	To set the high limit and low limit of MV.	0.00~100.00	100.00
MV_L (%)		0.00~100.00	0.00
DMH (%)	To set the limit of MV variation rate.	0.1~100.0	10.0
GAP (%)	To set the dead band.	0.00~100.00	0.00
KNL (%)	To set the nonlinear gain.	0.00~300.00	0.00
SVPR (%)	To preset the initial value of SV and MV after cold start.	0.00~100.00	50.00
MVPR (%)		0.0~100.0	50.0
Error MV	To preset the MV output after error occurs.	Preset/Hold	Preset
SV Track PV	To decide to track PV or not in manual.	No/Yes	No
A/M Preset	To preset the Auto/Manual state after cold start or enabled the settings.	Auto (A) /Manual (M)	Auto (A)
L/R Preset	To preset the Local/Remote state after cold start or enabled the settings.	Local (L) Remote (R)	Local (L)
SV Track R	To decide to track the remote value or not when switch from remote to local.	No/Yes	No

Additional notes:

- Alarm DH (Deviation alarm)

When the absolution of difference between SV and PV is more than the preset deviation alarm value, the corresponding alarm is activated.

Deviation alarm information shows on top of monitoring displays as AI alarm information.

- Dif First (Differential Forward)

In practical control system, the tuning from operator to SV is step changed, which may cause a great jump in derivative output. It is forbidden to have controlled variable change a lot and produce a large overshoot in practical use. To avoid a great jump caused by setpoint varying without weakening derivative action, differential forward is provided by the instrument.

The differential forward PID structural figure shows as Figure 6-3:

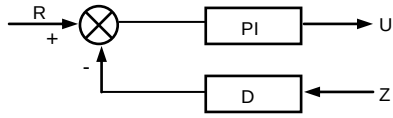


Figure 6-3 Differential Forward Frame

The step response of the PID loop with differential forward and without deferential forward is shown in Figure 6-4 and Figure 6-5.

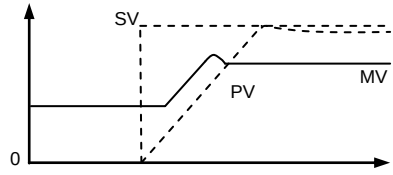


Figure 6-4 PID with Differential Forward

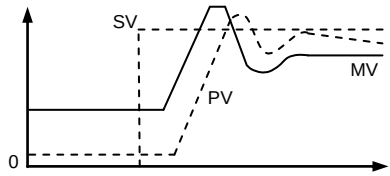


Figure 6-5 PID without Differential Forward

Apparently, the PID algorithm with differential forward, compared with which without differential forward, slows down the MV changing, decreases overshoot, and extends the time to reach stable state.

Differential forward always used on the occasion that MV can't be changed a lot, but not used when the setpoint tracking is needed.

- Gap (Dead Band)

In some industrial manufacture process, the controlled plant may not always be on the setpoint precisely, but may change in a stated range. In order to avoid the actuator damaged by frequent action, the PID algorithm with dead band is always used in practical industry.

Here, GAP is related to the dead band range. If the GAP is too large, the control will be sluggish; if too small, the actuator will work frequently.

- KNL (Nonlinear Gain)

Nonlinear gain: the virtual error within GAP is the product of original error and nonlinear gain 'KNL'.

$$e_{k(KNL)} = e_k \times KNL \quad \text{.....Equation 6-1}$$

The nonlinear gain affects the control result around setpoint and it can be applied in nonlinear control system to solve tough nonlinear problem.

For instance, in process of pH neutralization, the nonlinearity produced by the process of pH titration, typically exhibits a large slope around 7 (pH value). In other words, a small quantity of additive neutralizer will bring a great fluctuate. On the contrary, when the pH is far from 7 and the titration slope turns small, only

a large quantity of additive neutralizer can bring a little bit pH change.

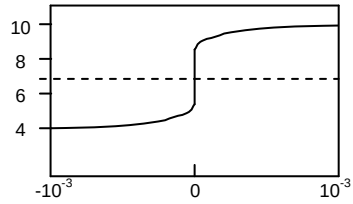


Figure 6-6 Process of pH neutralization

Thus, a fixed-gain linear control system of pH leads to serious overshoot when the setpoint is around 7(pH value) and weak control when the setpoint is on other points. This problem can be alleviated to a large extent by employing dead band and nonlinear gain. When the controlled variable error 'e' is within the dead band, the practical error in operations is the product of 'e' and nonlinear gain 'KNL'. As Equation 6-1, the gain is small if KNL is set small. When the error is out of the dead band, nonlinear gain may increase ten-odd times. It utilizes the nonlinearity of the instrument to compensate the nonlinearity of controlled target, composing an approximately linear control system.

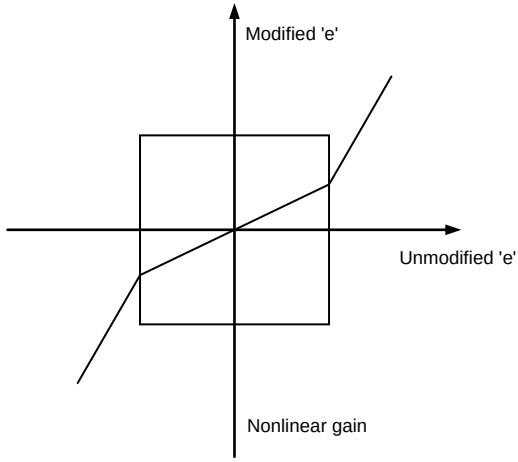


Figure 6-7 Gap and KNL

Set the corresponding parameters in [Advanced] page, GAP related to dead band and KNL related to nonlinear gain. Disable the dead band and nonlinear gain by setting GAP as 0.0% and KNL as 0.0%.

- SV Tracking

SV Track PV: If selected, SV tracks PV in manual mode.

SV Track R: If selected, SV keeps the last remote value when remote state switches to local state; Otherwise, SV keeps the last local value.

If both are selected, SV shows the remote value when in remote and manual mode, and it will track PV from the last remote value when remote state switched to local state.

6.2 PID Related Display

6.2.1 PID Display

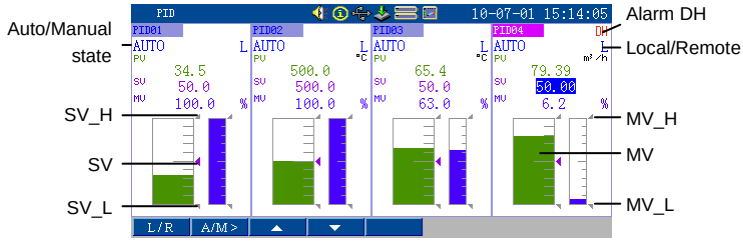
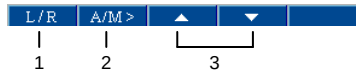


Figure 6-8 PID Display



1. Press to switch between local and remote.
2. Long press to switch between auto and manual.
3. Press to modify SV in auto and local state or modify MV in manual.

6.2.2 Tuning Display

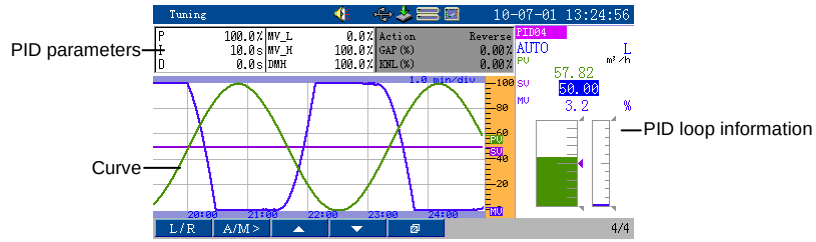
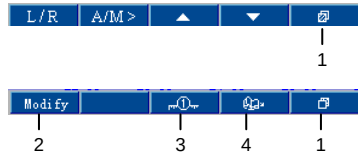


Figure 6-9 Tuning Display



1. Press to switch the function of the soft keys.
2. Press to pop up the PID parameters tuning box, as shown in Figure 6-10. Press Save to save the modification and exit. Press Exit to exit without modification.

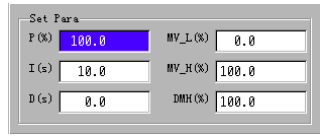


Figure 6-10 PID Parameters Tuning Box

3. Press to modify the time scale.
4. Press to page up and page down. Page circularly among max. 4 channels.

6.3 Example

6.3.1 Example for Single Loop Control

This single-loop control system achieves ordinary temperature control. It measures the temperature in heater, and output the signal to heating coil which is supposed to be able to receive continuous analog signal. For the details of channels connection, please refer to section 2.2. Here, in this section, we mainly introduce the construction and configuration of control loop.

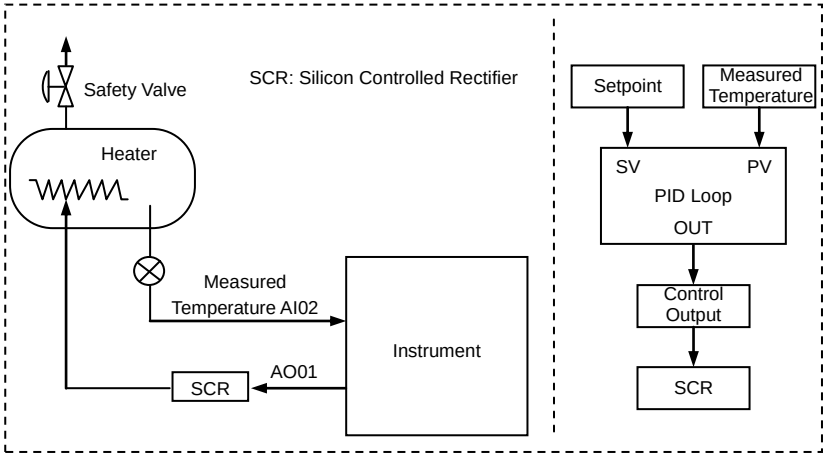
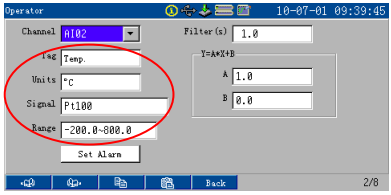
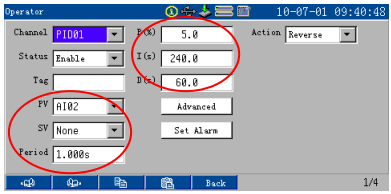
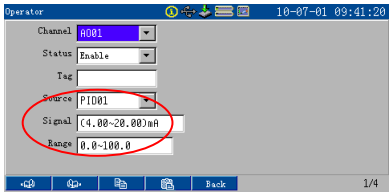


Figure 6-11 Single Loop Control

Do This	This is the Display You Should See
1. Set the parameters of AI02 in [Set AI] page for temperature measurement.	

Do This	This is the Display You Should See
2. Set the parameters of PID01 in [PID] page for control loop.	
3. Set the parameters of AO01 in [Set AO] page for output.	

4. Adjust MV to make PV close to SV in PID display.
5. Set loop into auto state, then observe the PV whether it meets the control requirement.
6. If PID parameters need to be modified, press *ENTER* to enter tuning display, and then adjust.

6.3.2 Example for Cascade Control

Cascade control is a combination of two PID control loops, where the output signal from one (the master) forms the setpoint for the other (the slave). To be effective for cascade control, the slave loop should be more responsive than the master.

This cascade control system achieves temperature control by controlling fuel flow. Because of the slow change of temperature, take the pressure of fuel oil as slave loop. The input amount of fuel oil is controlled by valve. If it is pneumatic valve, the valve will be closed when no gas, thereby, gas open valve is used.

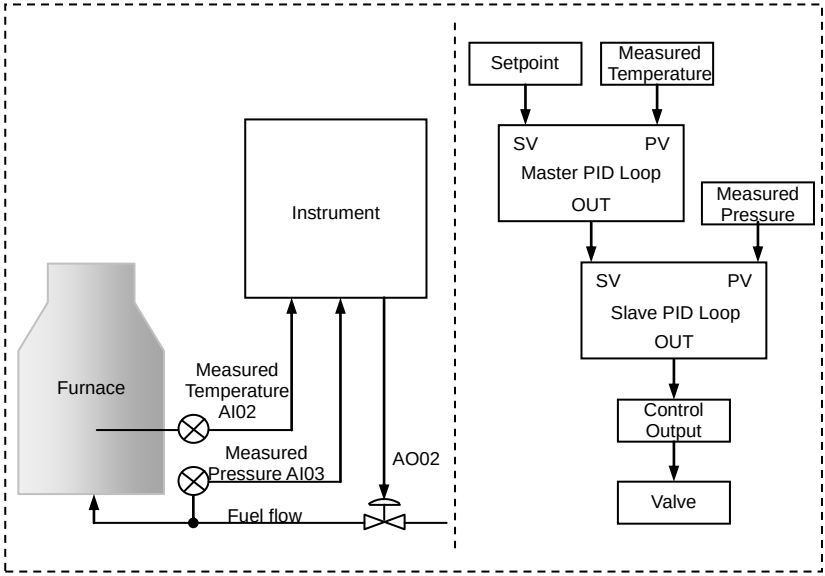
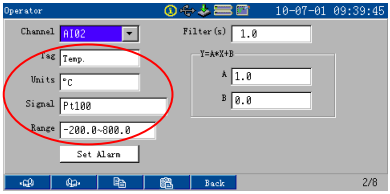
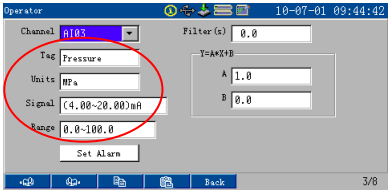
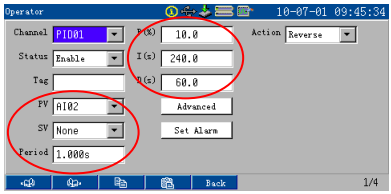
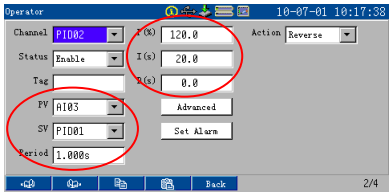
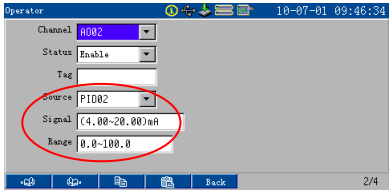


Figure 6-12 Cascade Control

Do This	This is the Display You Should See
1. Set the parameters of AI02 in [Set AI] page for temperature measurement.	
1. Set the parameters of AI03 in [Set AI] page for pressure measurement.	

Do This	This is the Display You Should See
2. Set the parameters of PID01 in [PID] page for master control loop. 3. If the furnace temperature is more than setpoint, then the valve opening for gas should be diminished. Therefore, the act manner for master loop is set as reverse.	
4. Set the parameters of PID02 in [PID] page for slave control loop. 5. If the fuel oil pressure is more than setpoint, then the valve opening for gas should be diminished. Therefore, the act manner for slave loop is set as reverse.	
6. Set the parameters of AO02 in [Set AO] page for output.	

7. Adjust MV for PID02 to make PV close to SV in PID display.
8. Set PID02 into auto state, and then adjust its PID parameters as single loop control to make the loop stable.
9. Adjust MV for PID01 to make PV close to SV in PID display, and then switch PID02 into remote state.
10. Adjust MV for PID01 to a right value, and then adjust PID parameters to make the loop stable.

Chapter7 Mass Flow Compensation

Overview

The term flow means the amount that flows through a certain section of a pipe per unit time, which is also considered as an instantaneous magnitude. Generally speaking, measurement of flow is usually done by means of restriction flowmeter, velocity flowmeter, pulse frequency flowmeter, volumetric flowmeter or mass flowmeter, etc. For most of flowmeter currently in use, mass flow can be expressed with the following 3 equations:

Equation 7-1 works for throttle flowmeter such as a standard orifice or a nozzle while equation 7-2 works for velocity flowmeter and pulse frequency flowmeter such as a vortex flowmeter, a turbine flowmeter or a electromagnetic flowmeter, and equation 1-3 is derived from equation 7-1, working for certain measurement systems where differential pressure signal has already been square-rooted.

$Q = K\sqrt{\Delta P\rho}$ .....Equation 7-1

$Q = I_f \rho / K$ .....Equation 7-2

$Q = K\Delta P'\sqrt{\rho}$ .....Equation 7-3

Where, Q: value of mass flow

K: coefficient of flow

ρ: density of flow

ΔP: value of input differential pressure

I_f: output frequency of a velocity flowmeter

$\Delta P'$: differential pressure extracted value

The above equations show that the mass flow develops proportional to the density of flow or the square-rooted one. Taking into consideration the fact that the density of almost all kinds of flow varies according to variation of temperature and pressure, compensation for temperature and pressure variations must be done to ensure accurate measurements of mass flow. There are different kinds of compensation models serving corresponding flow. 5 kinds of compensation

modes are provided in the instrument including SHS (superheated steam), STS (saturated steam), GAS (ideal gas), LPC (linear pressure compensation) and LTC (linear temperature compensation).

7.1 Parameters

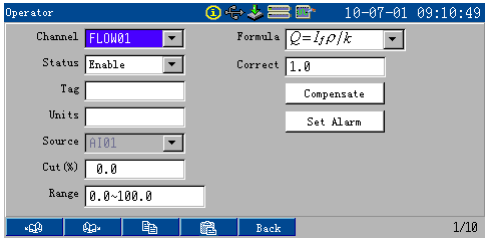


Figure 7-1 [FLOW] Display

Table 7-1 [Flow] Main Menu Parameters

Name	Description	Selections or Range of Setting	Default
Channel	To select the No. of FLOW channel.	Up to 16 channels	FLOW01
Status	To select the status of channel.	Disable/Enable	Disable
Tag	To describe the channel.	Up to 8 characters	/
Units	To select the units of FLOW.	Up to 8 characters	/
Source	To select the channel need to be compensated.	AI/PI	AI01
Cut(%)	If the compensated flow value is less than the preset extraction value, it is recognized as zero; if not, it is recognized as the real flow.	(0.0~25.0)%	0.0
Range	To select the decimal digits, LRV and URV.	-30000~30000	0.0~100.0
Formula	To select the corresponding formula.	$Q=I_f\rho/k$ $Q=K\sqrt{\Delta P\rho}$ $Q=K\Delta P'\sqrt{\rho}$	$Q=I_f\rho/k$
Correct	To set the coefficient for correcting the flow value.	0~9999999	1

Name	Description	Selections or Range of Setting	Default
Compensate	To select compensated type and set the further parameters.	See Table 7-2	/
Set Alarm	To set the parameters of alarm related.	See Table 5-3	/

Table 7-2 [Compensate] Submenu Parameters of [Flow]

Name	Description	Selections or Range of Setting	Default
Type	To select the compensated type.	None/SHS/STS/ GAS/LPC/LTC	None
Density	To set the density of flow.	0~9999999	10
P Source	To set the pressure channel.	None/AI	None
Settled P	To set the value of settled pressure.	-999999~9999999	10
T Source	To set the temperature channel.	None/AI	None
Settled T	To set the value of settled temperature.	-999999~9999999	10
Design ρ	To set when ‘GAS’ is selected.	-999999~9999999	1
A	To set coefficient ‘A’ and ‘B’ for LPC and LTC. See 7.2.5 and 7.2.6.	-999999~9999999	1
B		-999999~9999999	0
Thermal	To decide whether thermal flow accumulation is needed when SHS or STS is selected.	No /Yes	No
Max Flow	To set the parameters when the formula equation 7-1 and equation 7-3 is selected.	-999999~9999999	1000
Max ΔP		-999999~9999999	100
Design P		-999999~9999999	2
Design T		-999999~9999999	100

Be aware of that the pressure displayed in the instrument is the gage pressure, and its unit should be as MPa.

7.2 Compensate

7.2.1 None

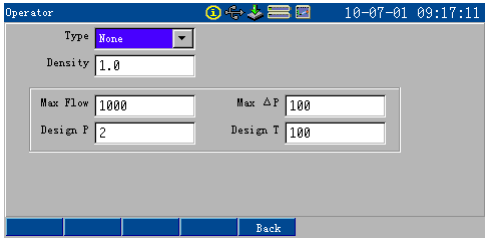


Figure 7-2 Set for [None]

7.2.2 SHS

If no temperature or pressure signal input, set the temperature and pressure value in 'Settled T' and 'Settled P', and select 'None' for both 'T Source' and 'P Source'.

If analog input is selected from AI or VA in 'T Source' and 'P Source', the 'Settled T' and 'Settled P' items disappear. For details, please refer to section 7.4.1.

The scope of applicability: Pressure (0.1~16)MPa (gage pressure), Temperature (140~560)℃. It is necessary to set pressure and temperature.

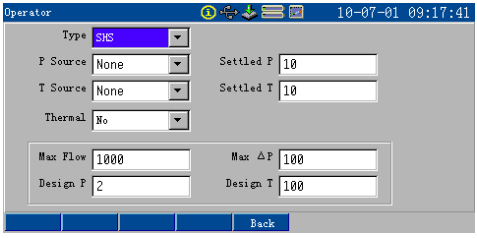


Figure 7-3 Set for [SHS]

7.2.3 STS

If no pressure signal input, set the pressure value in 'Settled P' and select 'None' for 'P Source'.

If analog input is selected from AI or VA in 'P Source', the 'Settled P' disappears.

For details, please refer to section 7.4.2.

The scope of applicability: Pressure (0.1~16)MPa (gage pressure). It is necessary to set pressure which unit is MPa.

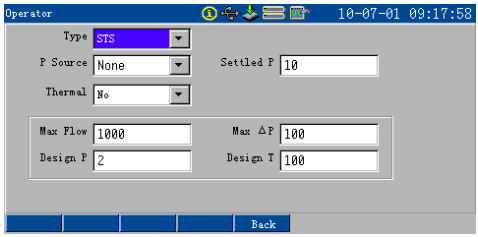


Figure 7-4 Set for [STS]

7.2.4 GAS

If no temperature or pressure signal input, set the temperature and pressure value in ‘Settled T’ and ‘Settled P’, and select ‘None’ for both ‘T Source’ and ‘P Source’.

If analog input is selected from AI or VA in ‘T Source’ and ‘P Source’, the ‘Settled T’ and ‘Settled P’ disappear.

For details, please refer to section 7.4.3.

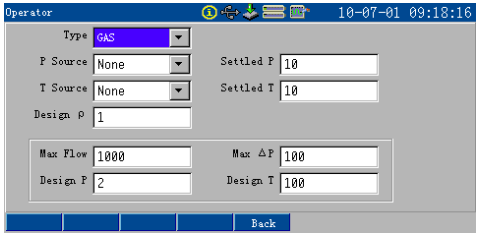


Figure 7-5 Set for [GAS]

7.2.5 LPC

If no pressure signal input, set the pressure value in ‘Settled P’ and select ‘None’ for ‘P Source’.

If analog input is selected from AI or VA in ‘P Source’, the ‘Settled P’ disappears.

Gas constant resulted from formula ρ=A×P+B needs to be set correctly, it is necessary to set correct pressure unit as MPa. Where, P in this formula means the absolute pressure. For details, please refer to section 7.4.4.

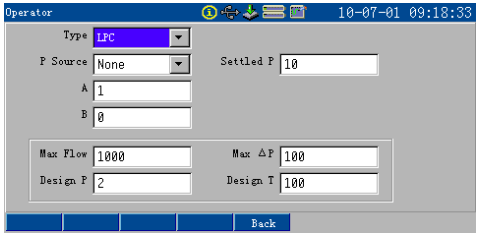


Figure 7-6 Set for [LPC]

7.2.6 LTC

If no temperature signal input, set the temperature value in 'Settled T' and select 'None' for 'T Source'.

If analog input is selected from AI01~AI12 in 'T Source', the 'Settled T' disappears.

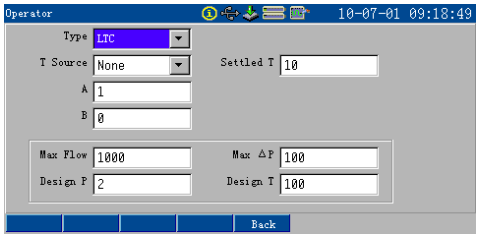


Figure 7-7 Set for [LTC]

7.3 FLOW Related Display

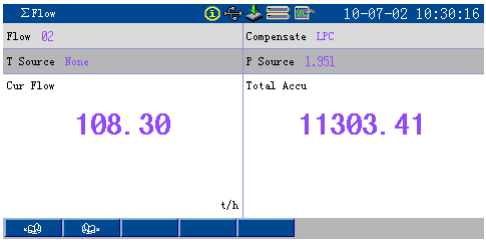


Figure 7-8 Flow display

7.4 Example

7.4.1 Example 1: SHS

If measurement of the mass flow of superheated steam (SHS) is planed to be done, with a standard orifice connected to a smart differential pressure transmitter without the function of square-root extraction. In this case, superheated steam compensation type should be adopted.

Designing condition as follows:

Temperature: 250.0℃;

Pressure: 1.2MPa;

Differential pressure range: (0.000~30.000)kPa;

Flow range: (0.00~50.00)t/h.

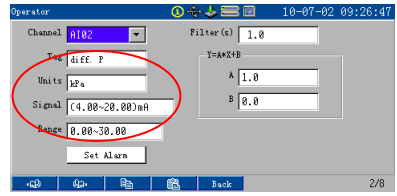
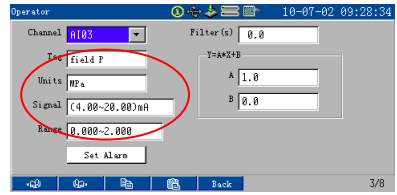
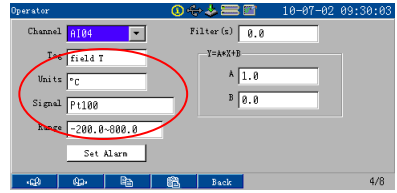
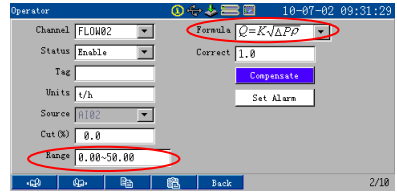
Assume that the actual temperature is 200℃ and the actual pressure is 0.5MPa (gauge pressure), and the output current of the smart DP transmitter is 5.60 mA without square-root extraction.

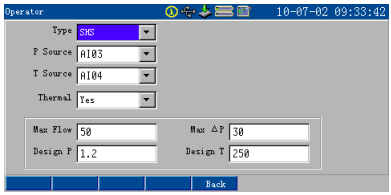
And, differential pressure range of the transmitter is (0.000~30.000)kPa, with signal range of (4.00~20.00)mA; mass flow range is (0.00~50.00)t/h; pressure range of the actual flowing condition is (0.000~2.000)MPa, with signal range of (4.00~20.00)mA; temperature range of the actual flowing condition is

(-200~800)℃, using Pt100 signal.

What is more, the instrument displays the differential pressure signal (kPa) in channel AI02, field pressure (MPa) in channel AI03, field temperature (℃) in channel AI04 and compensated mass flow (t/h) in channel FLOW02.

Procedure of configuration:

Do This	This is the Display You Should See
1. Set AI02 for differential pressure signal. 2. Set the parameters of [Set AI] as shown in figures on right.	
3. Set AI03 for field pressure signal. 4. Set the parameters of [Set AI] as shown in figures on right.	
5. Set AI04 for field temperature signal. 6. Set the parameters of [Set AI] as shown in figures on right.	
7. Set FLOW02 for flow calculation. 8. Set the parameters of [Set FLOW] as shown in figures on right.	 Press ENTER ↓

Do This	This is the Display You Should See
	

7.4.2 Example 2: STS

If measurement of the mass flow of saturated steam (STS) is planed to be done, with a standard nozzle connected to a differential pressure transmitter with the function of square-root extraction. In this case, saturated steam compensation type should be adopted.

Designing flowing conditions:

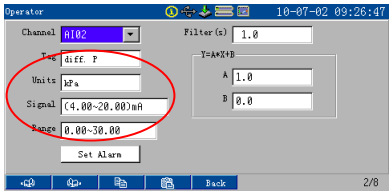
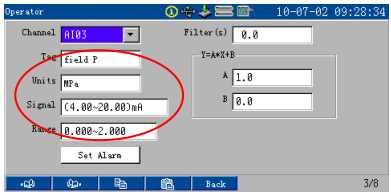
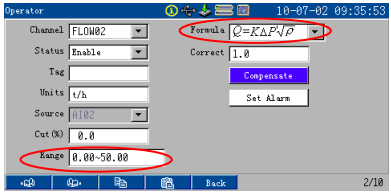
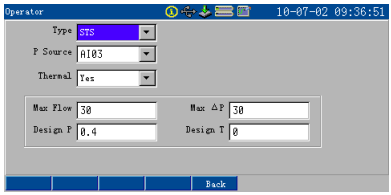
Pressure: 0.4MPa

Assume that the actual pressure is 0.3MPa (gauge). For transmitter, and the output current of the DP transmitter is 5.60 mA with square-root extraction already done.

And, differential pressure range of the transmitter is (0.000~30.000)kPa, with signal range of (4.00~20.00)mA; mass flow range is (0.000~50.000)t/h; pressure range of the actual flowing condition is (0.000~2.000)MPa, with signal range of (4.00~20.00)mA.

What is more, the instrument displays the square-rooted signal of the DP transmitter as a mass flow signal (kPa) in channel AI02, field pressure (MPa) in channel AI03 and compensated mass flow (t/h) in FLOW02.

Procedure of configuration:

Do This	This is the Display You Should See
1. Set AI02 for differential pressure signal. 2. Set the parameters of [Set AI] as shown in figures on right.	
3. Set AI03 for field pressure signal. 4. Set the parameters of [Set AI] as shown in figures on right.	
5. Set FLOW02 for flow calculation. 6. Set the parameters of [Set FLOW] as shown in figures on right.	 Press ENTER ↓ 

7.4.3 Example 3: GAS

If measurement of the mass flow of ideal gas is planed to be done with a vortex flowmeter, ideal gas compensation type should be adopted.

Designing flowing conditions:

Temperature: 0.0℃

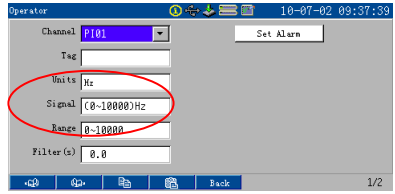
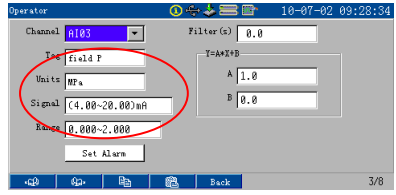
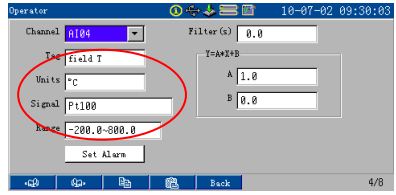
Pressure: 0.0MPa

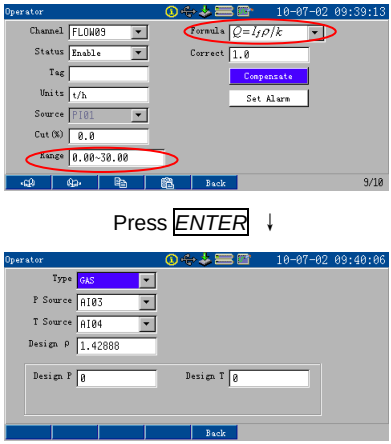
Assume that actual temperature is 30.0℃ and the actual pressure is 0.1 MPa(gauge pressure), and the output frequency of the vortex flowmeter is 1000Hz, with ξ=0.1495.

And, range of volume flow of the vortex flowmeter is (0.000~30.000)m^3/h; field pressure range is (0.000~2.000)MPa, with signal range of (4.00~20.00)mA; field temperature range is (-200~800)℃, using Pt100 signal.

What is more, the instrument displays the frequency signal (Hz) in channel PI01, field pressure (MPa) in channel AI03, field temperature (℃) in channel AI04 and compensated mass flow (t/h) in channel FLOW09.

Procedure of configuration:

Do This	This is the Display You Should See
1. Set PI01 for frequency input signal. 2. Set the parameters of [Set AI] as shown in figures on right.	
3. Set AI03 for field pressure signal. 4. Set the parameters of [Set AI] as shown in figures on right.	
5. Set AI04 for field temperature signal. 6. Set the parameters of [Set AI] as shown in figures on right.	

Do This	This is the Display You Should See
7. Set FLOW09 for flow calculation. 8. Set the parameters of [Set FLOW] as shown in figures on right.	

7.4.4 Example 4: LPC

If measurement of the mass flow of a certain kind of flow is planed to be done, with a standard nozzle connected to a smart differential pressure transmitter without the function of square-root extraction. Density of this kind of flow has little to do with its temperature but develops linear to the pressure. In this case, linear pressure compensation type should be adopted.

Designing flowing conditions:

Pressure: 0.3MPa

Density: 1.68011 kg/m^3

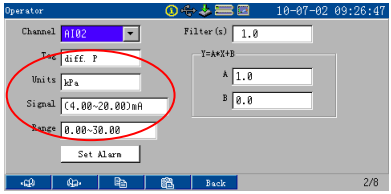
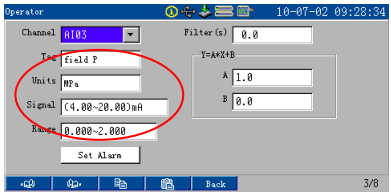
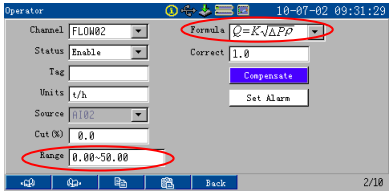
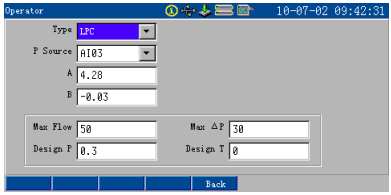
Assume that the actual pressure is 0.2MPa (gauge pressure), and the output current of the smart DP transmitter is 5.60 mA without square-root extraction.

And, range of volume flow of smart DP transmitter is (0.000~30.000) kPa, with signal range of (4.00~20.00)mA; field pressure range is (0.000~2.000)MPa, with signal range of (4.00~20.00)mA.

What is more, the instrument displays the signal of the smart DP transmitter as a volume flow signal (kPa) in channel AI02, field pressure (MPa) in channel AI03

and compensated mass flow (m^3/h) in channel FLOW02.

Procedure of configuration:

Do This	This is the Display You Should See
1. Set AI02 for differential pressure signal. 2. Set the parameters of [Set AI] as shown in figures on right.	
3. Set AI03 for field pressure signal. 4. Set the parameters of [Set AI] as shown in figures on right.	
5. Set FLOW02 for flow calculation. 6. Set the parameters of [Set FLOW] as shown in figures on right.	 Press ENTER ↓ 

Chapter8 Totalizer

Overview

The instrument provides flow totalizer, which supports up to 16 channels totalizer and displays the logs of per month, per day, per hour and also customized. After applying the correct totalizer settings, it will calculate the total flow, which is measured through any selected signal.

8.1 Parameters

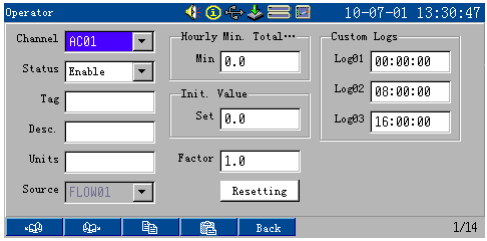


Figure 8-1 [Totalizer] Display

Table 8-1 [Totalizer] Main Menu Parameters

Name	Description	Selections or Range of Setting	Default
Channel	To select the No. of AC channel.	Up to 16 channels	AC01
Status	To select the status of channel.	Disable/Enable	Disable
Tag	To describe the channel.	Up to 8 characters	/
Desc.	To set the description.	Up to 8 characters	/
Units	To select the units of AC.	Up to 8 characters	/
Source	To select the channel need to be totalizer.	FLOW	FLOW01
Hourly Min. Totalizer	To set the hourly Min. totalizer.	0~9999999	0.0
Factor	To set the totalizer factor.	0~9999999	0.0
Init. Value	To set initial value.	0~9999999	1.0

Name	Description	Selections or Range of Setting	Default
Log 01	To set the begin time of Log01, Log02 and Log03.	00:00:00~23:59:59	00:00:00
Log 02			08:00:00
Log 03			16:00:00

8.2 Totalizer Related Displays

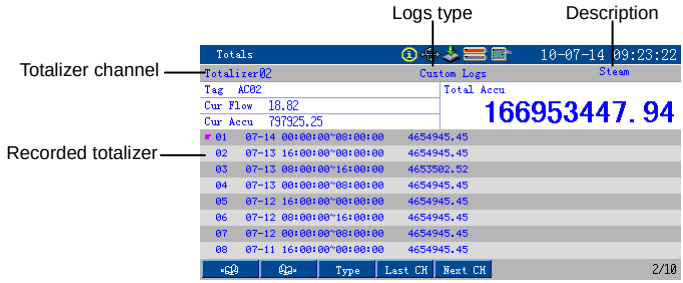
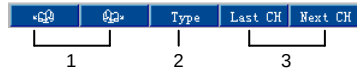


Figure 8-2 Totalizer Display

If [Tag] is null in setup display, the totalizer channel No. will be shown in the logs.

There are up to 12, 45, 1024 and 135 pieces of logs for monthly, daily, hourly and custom respectively.



1. Page up and page down. Page circularly among the logs of one channel.
2. Page circularly among the four kinds of logs.
3. Page circularly among max. 16 channels.

Chapter9 History Data

Overview

For 32MB inbuilt memory, up to 1026 record blocks is provided. The relationship among recording interval, total record channel and recordable capacity is shown as Table 9-1.

Table 9-1 Recordable Capacity

Recording Interval	Channels	Recordable Capacity
1.000s	1	72 days
	2	72 days
	3	48 days
	4	36 days
	5	29 days
	6	24 days
	7	20 days
	8	18 days
	9	16 days
	10	14 days
	11	13 days
	12	12 days
	13	11 days
	14	10 days
	15	9 days
	16	9 days

9.1 Parameters

- Interval

Interval = Period × Factor. The [Period] can be 1s, 1min or 1hour and the [Factor] should be integer type with range 1~60.

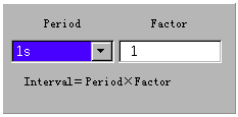


Figure 9-1 Recording Interval Setup

- Preset flag

The flag preset in [Add Flag] page can be added to the history display as a bookmark in any monitoring display via following steps: press *F1* in any monitoring display to pop up the shortcut menu, and then focus on [Add Flag] and press *ENTER* to pop up the flag preset table. Here, press *ENTER* to modify the flag content. Press Apply to add a flag.

Figure 9-2 Add Flag

Add flag in history display, the flag will be added on the time point of cursor while add in other monitoring display, the flag will be adds on the present time.

9.2 REC Related Displays

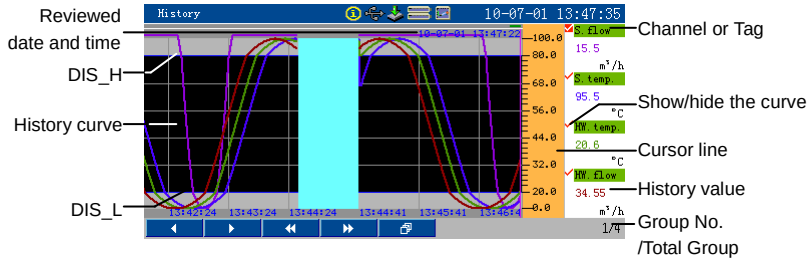
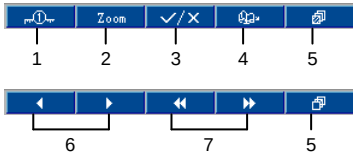
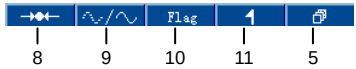


Figure 9-3 History Display





1. Press to modify the range of data displayed on each screen, which can enlarge or reduce the curve spread to make it easy to observe.
2. Press to pop up a dialog box as shown in Figure 9-4. You can zoom part of the curve whose range is between [DIS_L] and [DIS_H].

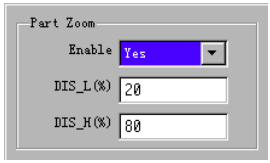


Figure 9-4 Part Zoom

3. Show or hide the curve. '√' means show while '×' means hide.
4. Page among the displays shown different record channels.
5. Press to switch the function of the soft keys.
6. Press to move the cursor line forth or back to review the history curves. The moving distance of the cursor line is determined by the scale and record interval.
7. Press to accelerate the moving speed of the cursor line, the moving distance of the cursor line is one screen.
8. Press to pop up a dialog box to input the recall time. After setting and then press knob, the cursor line will be positioned to the input time automatically. If the input time is earlier than the earliest record time, it will be positioned to the earliest time; If later than the current system time, it will be positioned to the current time.
9. Press to switch between real-time trend and the history curve.
10. Press to pop up the flag logs as shown in Figure 9-5.

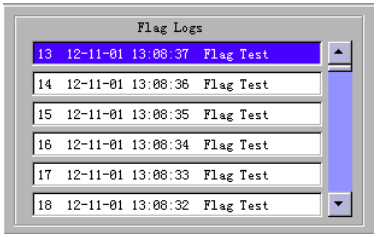


Figure 9-5 Flag Logs

11. Press to show or hide the flags. Up to 6 flags can be shown per 2000 record data.

Chapter10 Message Logs

Overview

Two message logs including alarm logs and system logs are provided. Each type has 512 pieces in total. When it is out of 512, the instrument will delete the earliest one for the latest. Press  to locate the corresponding time in the history display.

10.1 Alarm Log

As shown in Figure 10-1, alarm logs record the information of alarm channel, alarm type, output contact, alarm activated time and alarm de-activated time.

Where, red for alarm type means the alarm activated, while blue means alarm de-activated. Especially, black means that power off may occur in alarming, so the alarm de-activated time is not recorded when power on except warm start.

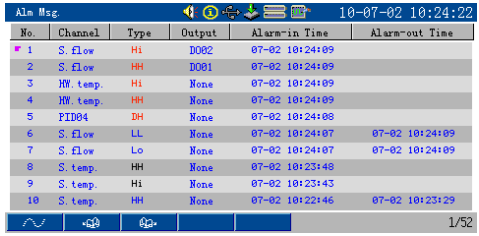


Figure 10-1 Alarm Logs

10.2 System Log

As shown in Figure 10-2, system logs record the information of power ON or power OFF (as cold start and warm start etc.), configuration information (as login, logout, backup etc.) and so on.

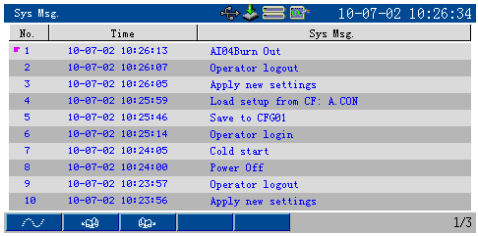
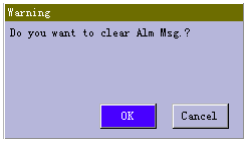
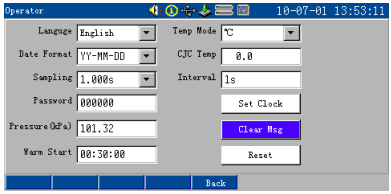
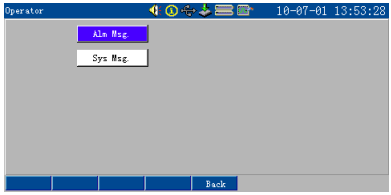


Figure 10-2 System Logs

10.3 Message Logs Clearing

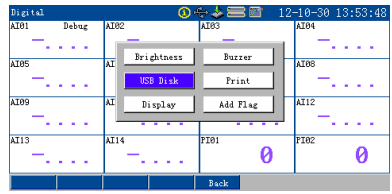
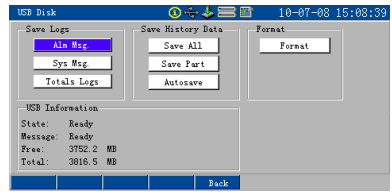
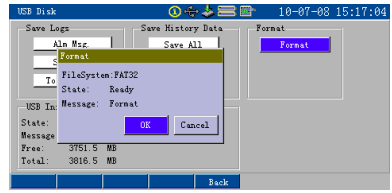
Do This	This is the Display You Should See
1. Login the setup menu as section 3.2. 2. Press *ENTER* to enter the message clearing display following the path [System] → [Clear Msg]. 3. Press ◄ or ► to scroll the logs. 4. Press *ENTER* to pop up the dialog box as following. Press OK to clear while Cancel to exit.  5. Press Back to exit.	 Press *ENTER* ↓ 

Chapter11 USB Disk

Overview

The USB Disk is accepted to transfer the history data, the settings and the logging data from the instrument to computer. For settings, it also can load settings data from USB Disk to the instrument. When inserting USB Disk correctly,  shows on top. The type of USB Disk is specified when ordering.

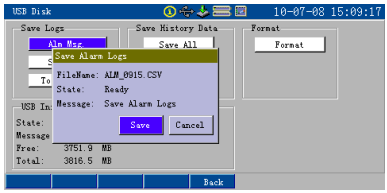
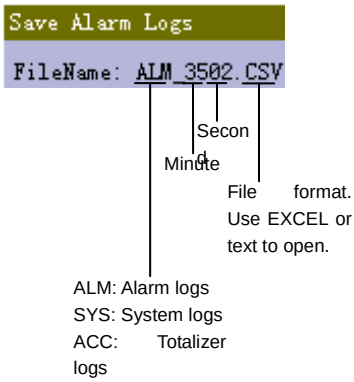
11.1 Format USB Disk

Do This	This is the Display You Should See
1. Press *F1* in any monitoring display to pop up the shortcut menu. 2. Press ◄ or ► to focus on [USB Disk] and press *ENTER* to enter the USB Disk operation display. 3. Press Back to exit. 4. USB Disk information: USB Information State: Ready Message: Ready Free: 3803.8 MB Total: 3816.5 MB	 Digital 12-10-30 13:53:43 Brightness Buzzer USB Disk Print Display Add Flag Back Press *ENTER* ↓  USB Disk 10-07-08 15:08:39 Save Logs: Aln Msg, Sys Msg, Totals Logs Save History Data: Save All, Save Part, Autosave Format: Format USB Information State: Ready Message: Ready Free: 3752.2 MB Total: 3816.5 MB Back
5. Press ◄ or ► to focus on [Format] and press *ENTER*, a dialog box appears. 6. Press OK to format while Cancel to exit.	 USB Disk 10-07-08 15:17:04 Format FileSystem:FAT32 State: Ready Message: Format OK Cancel Free: 3751.5 MB Total: 3816.5 MB Back

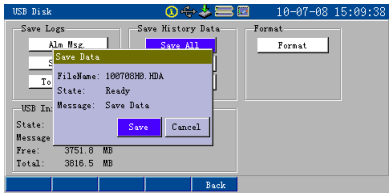
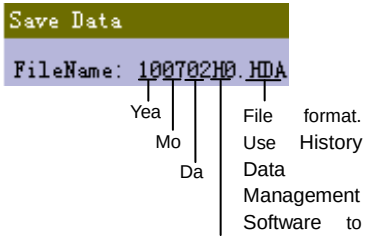
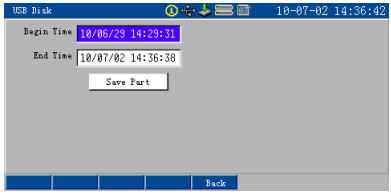
7. Formatting USB Disk is necessary if it is used for the first time.
8. During formatting, the instrument shows the present progress.
9. A directory will be created in USB Disk after formatting which is named as the

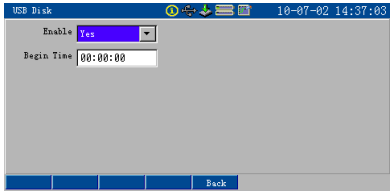
Do This	This is the Display You Should See
form “first 5 codes of the ordering code”+ ‘the address of the instrument’. Six subfolders are contained in the file: ALARM, CONFIG, HISTORY, PICTURES, REPORT, SYSINFO.	

11.2 Save Logs

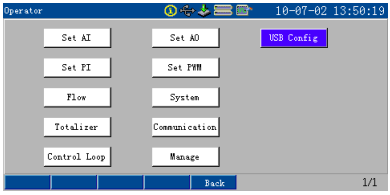
Do This	This is the Display You Should See
1. In [USB Disk], Press ◄ or ► to focus on [Alm Msg.] and Press *ENTER*, a dialog box appears. 2. Press Save to save, while Cancel to exit.	
3. During saving, the instrument shows the present progress, and shutting dialog box will not interrupt it.	
4. The operation method of saving System logs and totalizer logs is the same as saving alarm logs.	
5. Alarm logs are saved in properties of ALARM, while system logs in SYSINFO and totalizer logs in REPORT.	

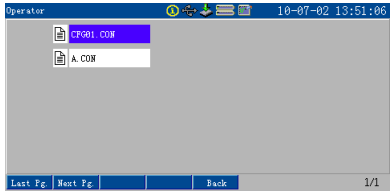
11.3 Save History Data

Do This	This is the Display You Should See
[Save All] 1. In [USB Disk], Press ◄ or ► to focus on [Save All] and press *ENTER*, a dialog box appears. 2. Press Save to save all history data, while Cancel to exit.	
3. During saving, the instrument shows the present progress, and shutting dialog box will not interrupt it.	
[Save Part] 4. In [USB Disk], Press ◄ or ► to [Save Part] and press *ENTER* to enter save part display. 5. Set [Begin Time] and [End Time]. 6. Press [Save Part] to start saving data. 7. Press Back to exit.	

Do This	This is the Display You Should See
8. Data within this preset time will be saved into USB Disk. 9. After saving, [Begin time] will be updated as the latest [End Time] automatically, and the [End Time] will always be the current system time.	
[Autosave] 10. In [USB Disk], Press ◄ or ► to focus on [Autosave] and press *ENTER* to enter autosave display. 11. Select 'Yes' for [Enable] and set the [Begin Time]. 12. Press Back to exit.	
13. The range of [Begin Time] is 00:00:00~23:59:59. 14. History data is saved in properties of HISTORY.	

11.4 Save Configuration

Do This	This is the Display You Should See
1. In [USB Config], press [Save] to save current settings to the USB Disk; Press [Load] to enter into the catalog of the USB Disk. 2. Press ◄ or ► and *ENTER* to load the settings selected.	 Press *ENTER* ↓ 

Do This	This is the Display You Should See
	Press [Load Config]↓ 

11.5 Save Monitoring Display

In monitoring displays, press *F1* for several seconds to copy the screen into USB Disk. It will be saved in properties of PICTURES.

Chapter12 Communication

Overview

Communication with PC, which achieves the real-time monitoring and history data reading, is provided by the instrument.

12.1 Parameters

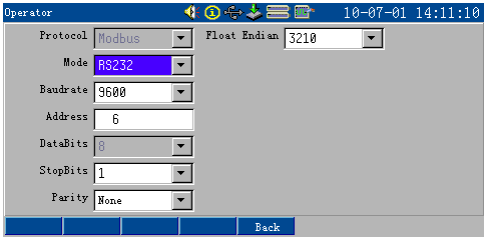


Figure 12-1 [Communication] Display

Table 12-1 [Communication] Main Menu Parameters

Name	Selections or Range of Setting	Default
Protocol	Modbus	Modbus
Mode	RS232/RS485	RS232
Baudrate	1200/9600/19200/57600/115200	9600
Address	6~254	6
DataBits	8	8
StopBits	1/2	1
Parity	None/Odd/Even/Space/Mark	None
Float Endian	0123/1032/2301/3210	3210

Chapter13 Print

Overview

Print function is provided by the instrument via connection with micro printer. The history trend, history data or totalizer logs can be printed with your requirement.

13.1 Parameters

Press *F1* in any monitoring display to pop up the shortcut menu.

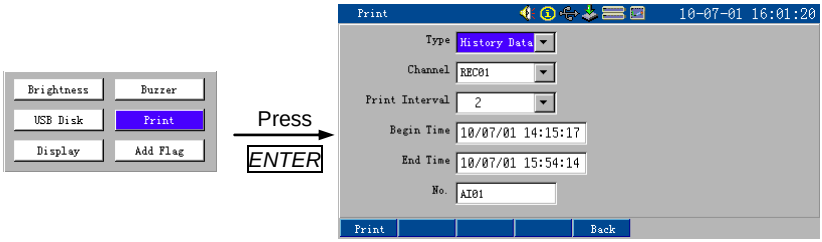


Figure 13-1 [Print] Setup

Table 13-1 [Print] Shortcut Menu Parameters

Name	Description	Selections or Range of Setting	Default
Type	To select the type of the data.	History Trend /History Data/ Monthly Logs / Daily Logs / Hourly Logs / Custom Logs	History Trend
Type	To select the type of the data.	REC01~REC16	REC01
Totalizer	To select the totalizer channel.	AC01~AC16	AC01
Print Interval	To select the print interval for history trend or history data.	1/2/4/8/16	1
Begin Time	To set the print beginning time.	00/01/01 00:00:00 ~99/12/31 23:59:59	The earliest record time
End Time	To set the print end time.	00/01/01 00:00:00 ~99/12/31 23:59:59	The current system time
No.	To set print No.	Up to 8 characters	/

13.2 Print Interval

Actual print interval = [Record Interval]×[Print Interval]. For instance, if [Print Interval] is set as '1', the actual print interval is the same as the [Record Interval]; if [Print Interval] is set as '2' or more, the actual print interval will be enlarged accordingly while the history trend or data will be compressed.

[Begin Time] must be earlier than [End Time], otherwise, print will be failed.

13.3 Operation

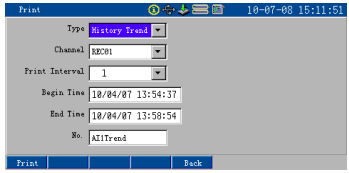
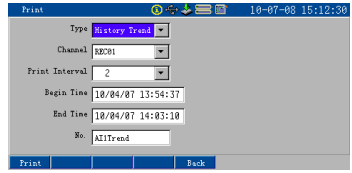
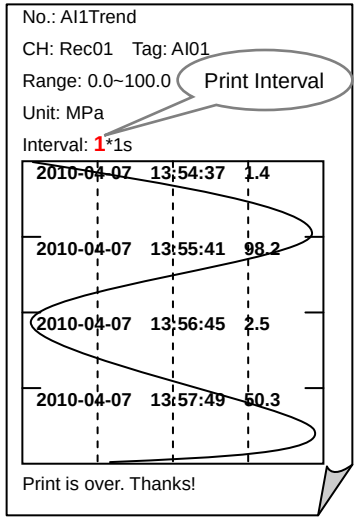
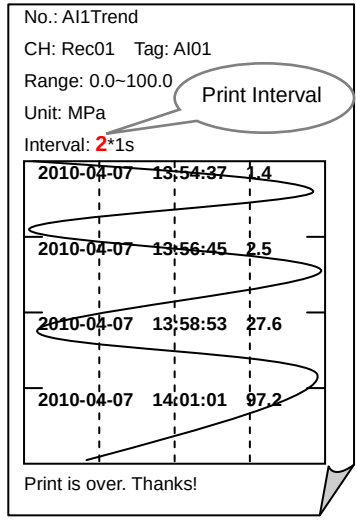
The micro printer should be connected to the instrument with communication cables, as shown in Figure 2-15. Shielded Twisted Pair (STP) less than 10 meter is recommended as communication cables.

After connecting printer to the instrument, press Print to start print. Press Stop to stop print, and Stopping will be shown which means it is stopping print.

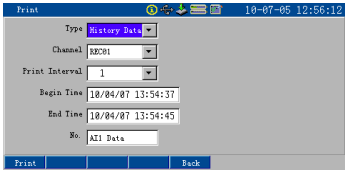
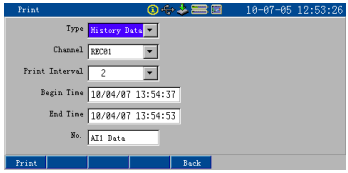
The baudrate must be 9600, otherwise, print will be failed.

13.4 Example

13.4.1 Print History Trend

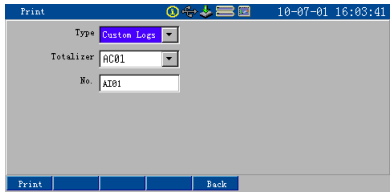
	When [Print Interval] is '1'	When [Print Interval] is '2'
Do This		
Return the Result		

13.4.2 Print History Data

	When [Print Interval] is '1'	When [Print Interval] is '2'
Do This		
Return the Result	No.: AI1 Data CH: Rec01 Tag: AI01 Range: 0.0~100.0 Unit: MPa Interval: **1***1s Print Interval **2010-04-07 13:54:37 28.7** **2010-04-07 13:54:38 27.3** **2010-04-07 13:54:39 25.9** **2010-04-07 13:54:40 24.5** **2010-04-07 13:54:41 23.2** **2010-04-07 13:54:42 21.9** **2010-04-07 13:54:43 20.6** **2010-04-07 13:54:44 19.4** **2010-04-07 13:54:45 18.1** Print is over. Thanks!	No.: AI1 Data CH: Rec01 Tag: AI01 Range: 0.0~100.0 Unit: MPa Interval: **2***1s Print Interval **2010-04-07 13:54:37 28.7** **2010-04-07 13:54:39 25.9** **2010-04-07 13:54:41 23.2** **2010-04-07 13:54:43 20.6** **2010-04-07 13:54:45 18.1** **2010-04-07 13:54:47 15.8** **2010-04-07 13:54:49 13.6** **2010-04-07 13:54:51 11.5** **2010-04-07 13:54:53 9.6** Print is over. Thanks!

13.4.3 Print Totalizer Logs

Take custom logs as an example.

Do This	Return the Result
	Print No: AI01 Channel: AC01 Tag: FQRC-131 Units: m^3/h **2010-04-07 16:00:00~00:00:00 29.5** **2010-04-07 08:00:00~16:00:00 30.2** **2010-04-07 00:00:00~08:00:00 29.1** **2010-04-06 16:00:00~00:00:00 31.7** **2010-04-06 08:00:00~16:00:00 30.8** Print is over. Thanks!

Chapter14 Troubleshooting & Maintenance

Overview

When regular error occurs, settle it with the means introduced by this manual. Check the operation and replace the parts of the instrument periodically to keep it in good working order.

14.1 Periodic Inspection

Check if the parts of the instrument have been damaged or cauterized, and make instrument's surface clear;

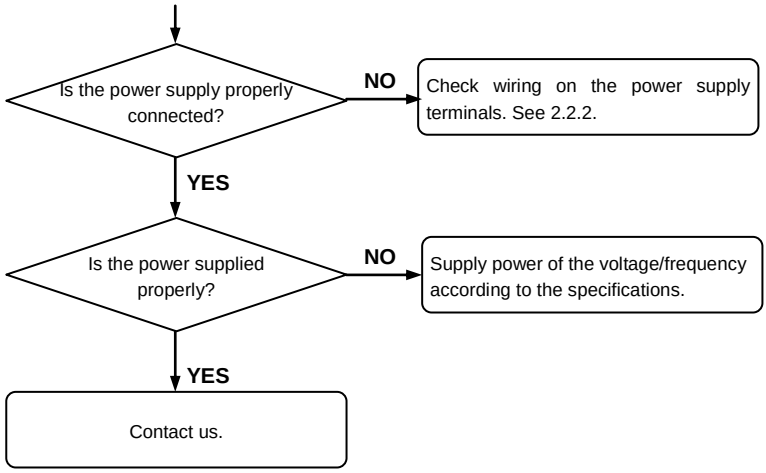
Check if parts become flexible;

Check the grounding protection to make sure the safeguard is perfect;

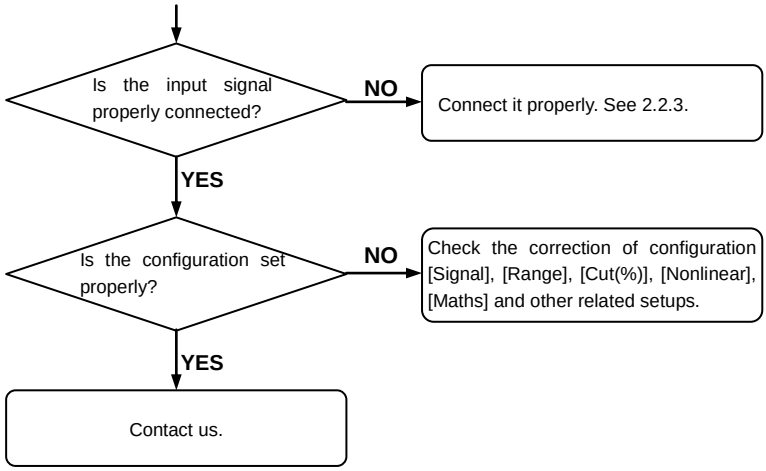
Keep the bores clear and ventilated; high temperature may lead to the breakdown, abnormal performance, short life-span or fire.

14.2 Troubleshooting Flow Chart

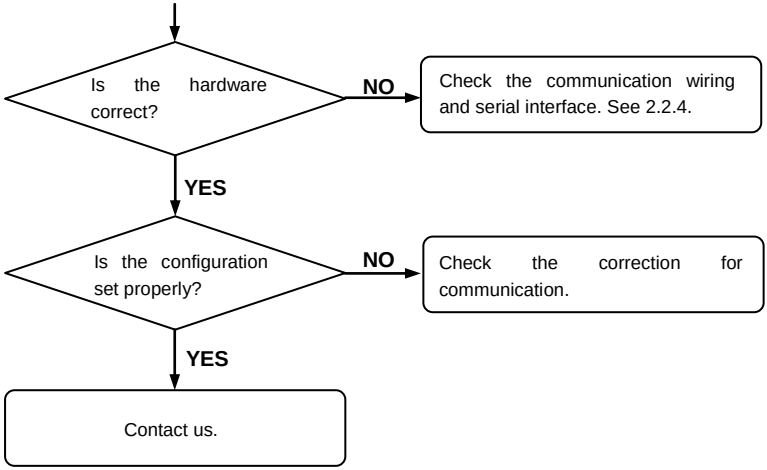
14.2.1 When Nothing Operates (Nothing is displayed)



14.2.2 When Error Signal Data Displays



14.2.3 When Connection Link is Faulty



If you couldn't manage the trouble, please contact our customer service center.

Appendix1 Soft Key Guide

Soft Keys	Description
	Check the version information and system configuration information.
	Rename settings. Refer to section 4.2.
	Load settings. Refer to section 4.2.
	Save settings. Refer to section 4.2. Save modified parameters of PID. Refer to section 6.1.
 	Page up or page down in the USB disk CONFIG fold.
	Page up.
	Page down.
	Switch between upper case and lower case. Refer to 3.3.4.
	Delete characters
	Finish input.
	Exit current setup or operation page.
	Increase the value.
	Decrease the value.
	Select parameters positive or negative.
	Copy parameters.
	Paste parameters.
	Show or hide the curve.
	Move cursor right or Enter next menu.
	Move cursor left.
	Press to switch between gathered form and separate form. Refer to section 5.5.3.
 	Switch between two groups shown display and one group shown display. Refer to section 5.5.1.

Soft Keys	Description
	Locate the corresponding time in the history display. Refer to section Chapter10.
	Backward. Refer to section 9.2.
	Forward. Refer to section 9.2.
	Recall backward speed up. Refer to section 9.2.
	Recall forward speed up. Refer to section 9.2.
	Display switch. Refer to section 9.2.
	Display switch. Refer to section 6.2.2.
	Recalling location. Refer to section 9.2.
	Switchover between real-time and history curve. Refer to section 9.2.
	Time scale. Refer to section 6.2, 9.2.
	Zoom part of the curve. Refer to section 9.2.
	Page among month logs, day logs, hour logs, and custom logs. Refer to section 8.2.
	Page circularly among max. 16 channels. Refer to section 8.2.
	Switch between local and remote. Refer section 6.2.
	Switch between auto and manual. Refer section 6.2.
	Modify the PID parameters. Refer section 6.2.
	Give up modifying parameters of PID. Refer to section 6.2.
	Start printing. Refer to section 13.3.
	Stop printing. Refer to section 13.3.
	Print operation is stopping. Refer to section 13.3.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