# LCD flow integrating control instrument

Supmea

**Headquarters**

5th floor,Building 4,Singapore Hangzhou Science Technology Park,No. 6 street,
Hangzhou Economic Development Area,Hangzhou 310018,China

**Singapore**

2 Venture Drive #11-30 Vision Exchange Singapore

info@supmea.com
www.supmea.com
Supmea Automation Co.,Ltd.

## Preface

Thank you for purchasing LCD flow integrating control instrument. Please read this manual carefully before operating and using it correctly to avoid unnecessary losses caused by false operation.

**Note**

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

**Version**

U-SUP-7610-EN1

## Safety Precautions

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

**About this manual**

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

**Precautions for protection, safety and modification of this product**

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

- The following safety signs are used in this manual:

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

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

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

accident.

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

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

## Disclaimer

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

| No. | Name | Quantity | Note |
|---|---|---|---|
| 1 | LCD Flow Integrating Control Instrument | 1 | |
| 2 | Manual | 1 | |
| 3 | Certificate | 1 | |

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

# Contents

Chapter Ⅰ Introduction ..... 1
Chapter II Technical Parameters ..... 2
Chapter III Installation ..... 4
3.1 Installation Position and Environment ..... 4
3.2 Dimension (mm) ..... 4
3.3 Installation ..... 4
Chapter IV Parameters Setting ..... 8
4.1 Panel Configuration ..... 8
4.2 Operation ..... 9
Chapter V Voltage Range Regulation in Frequency Input ..... 25
Chapter VI Parameters Description ..... 27
Chapter VII Communication Setting ..... 46
Chapter VIII Calculation ..... 47
8.1 Mass Flow Expression ..... 47
8.2 Volumetric Flow Expression ..... 49
8.3 Density Compensation Formula ..... 50
Chapter IX Example ..... 53

# Chapter Ⅰ Introduction

LCD flow totalizer is mainly designed for trading discipline between supplier and customer in regional central heating, and calculating steam, and high precision flow measurement. It's a full-functional secondary instrument based on 32-bit ARM micro-processor, high-speed AD and large-capacity storage. The instrument has fully adopted surface-mount technology. It has good EMC ability and high reliability because of heavy protection and isolation in design. It is embedded RTOS, USB Host, and high-density FLASH memory, which can record 720-day length sampling data. It can automatically identify saturated steam and superheated steam. It can also be used for process monitoring and volume control of steam heat. History data recorded in instrument can be copied to USB disk at any time and analyzed by DTM software on PC. The instrument may be used together with vary flow sensors such as Orifice Plate, V-cone, vortex, and so on. Besides, it also features good performance in anti-theft and power failure protection.

# Chapter II Technical Parameters

Table 1

| Measurement input | |
|---|---|
| Input signal | Current: 0-20mA, 0-10mA, 4-20mA, √0-10mA,√4-20mA<br>Input impedance: ≤100Ω<br>Maximum limit of input current: ≤ 30mA |
| | Voltage: 0-5V, 1-5V, 0-10V (customized), √0-5V, √1-5V, 0-20mV, 0-100mV<br>Input impedance: ≥ 500KΩ |
| | Thermal resistance: Pt100, Cu50, Cu53,<br>Cu100, BA1, BA2 |
| | Linear resistance: 0-400Ω |
| | Thermocouple: B, S, K, E, T, J, R, N, F2,<br>Wre3-25, Wre5-26 |
| | Frequency signal: range: 0-10KHz; wave shape: rectangular, sine wave, square wave |
| Output | |
| Output signal | Analog output: 4-20mA (load resistance ≤ 480Ω), 0-20mA (load resistance ≤ 480Ω)<br>0-10mA (load resistance ≤ 960Ω), 1-5V (load resistance ≥ 250KΩ)<br>0-5V (load resistance ≥ 250KΩ), 0-10V (load resistance ≥ 4KΩ) (customized) |
| | Alarm output: relay control output: AC220V/2A, DC24V/2A (resistive load) |
| | Feed output: DC24V±1, load current ≤ 50mA |
| | Communication output: RS485/RS232, 1200-9600bps, Protocol: MODBUS RTU. Communication distance: 1Km for RS-485 and 15m for RS-232. |
| Comprehensive parameters | |
| Measurement precision | 0.2%FS±1d |
| Setting mode | Light touch control panel for setting parameter, which will be stored permanently even in case of power failure, and can be locked & protected with password. |
| Display mode | 3.5” matrix 128*64 LCD screen with backlight (black characters on white screen).<br>Display pages include Digits, Curves, Bar graphs, and so on. Pages switch conveniently on the panel. History data can be searched, and time scale of curves is changed by operating proper keys on the panel. |

| | |
|---|---|
| Record interval | 9 options for your choice: 1s, 2s, 4s, 6s, 15s, 30s, 60s, 120s, and 240s |
| Storage time | 3 days (record interval of 1s) – 720 days (record interval of 240s) |
| Print | Printer interface: RS-232C; Serial-interface printer: SP-A40SH |
| Operating environment | Ambient temperature: 0-50℃; relative humidity: ≤ 85RH; isolated from strongly corrosive gas |
| Power supply | AC 100-240V (switch power), 50/60HZ; DC 12-36V (switch power) |
| Power consumption | ≤ 5W |
| Structure | - Standard panel mounted instrument structure |

# Chapter III Installation

## 3.1 Installation Position and Environment

The instrument shall be installed away from motors and transformers to avoid impact, shock, and electromagnetic interference. Keep it horizontal during installation. The ambient temperature of the installation site shall be between 0℃ and 50℃, and the relative humidity shall not exceed 85%RH, where there're no condensate, corrosive gas, and combustible gas.

## 3.2 Dimension (mm)

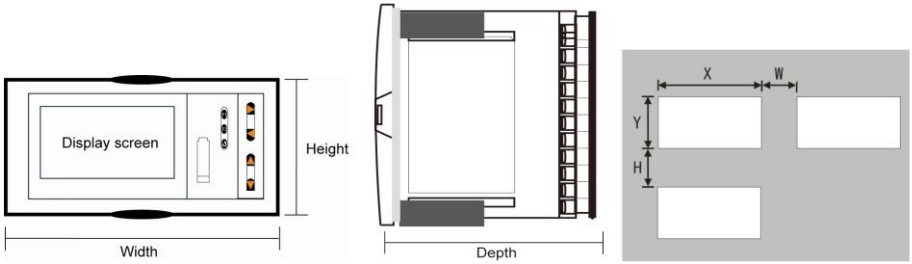



Fig. 1

Table 2

| | Dimension | | | Hole Size | | Minimum Distance Between Instruments | |
|---|---|---|---|---|---|---|---|
| Type | Width | Height | Depth | X | Y | W | H |
| A | 160 | 80 | 110 | 152+0.5 | 76+0.5 | 38 | 34 |
| B | 80 | 160 | 110 | 76+0.5 | 152+0.5 | 34 | 38 |
| C | 96 | 96 | 110 | 92+0.5 | 92+0.5 | 38 | 38 |

## 3.3 Installation

(1) Installing the instrument on mounting panel

Drill installation holes of proper size according to the instrument requirements and put the seal ring on the back of instrument. Then insert the instrument right to the installation hole and install the attaching clamps to back of the board to fix top and bottom surface of the instrument and push two clamps forward so that the instrument could be fixed on the board. Take the protective film off the screen. (If multiple instruments would be installed on one board, minimum distance between

instruments as specified in table above shall be considered to ensure adequate heat dissipation and space for installation.)

(2) How to take the core out of enclosure

Core of the instrument may be taken out of the enclosure. Push aside two buckles on each side of the front panel, and pull front panel outward to separate the core and enclosure. When reassembly, insert core into the enclosure tightly and fasten them with buckles for reliability.

(3) Installation instructions

★ Cable selection, instrument installation, and electrical wiring must comply with VD0100 “Relevant Rules on Circuit Installation under 1,000V” or relevant local rules;

★ Electrical wiring must be completed by professionals;

★ Fuse shall be used in load circuit to protect the circuit and ensure that the relay contact will be open in the case of short circuit or load exceeding the maximum capacity of relay;

★ Separate wiring shall be made for input, output, and power supply respectively and parallelism shall be avoided;

★ No other load shall be connected to the power terminal of the instrument;

★ Shielded twisted wires shall be used for sensor and communication.

(4) Standard wiring instructions

★ DC signal input (process input)

1. In order to reduce electrical interference, wires carrying low-voltage DC signals and sensors input shall be far away from high-voltage-bearing wires. If not, shielded wires shall be used and grounded at the same point;

2. Any device connected between sensors and terminals may influence measurement accuracy due to resistance or current leakage.

★ Thermocouple or pyrometer input

Compensating lead wires appropriate to the thermocouple shall be used as extension wires, which must be shielded.

★ RTD (thermal resistance) input

The resistance of three wires must be the same and shall not exceed 15Ω each.

(5) Wiring diagram

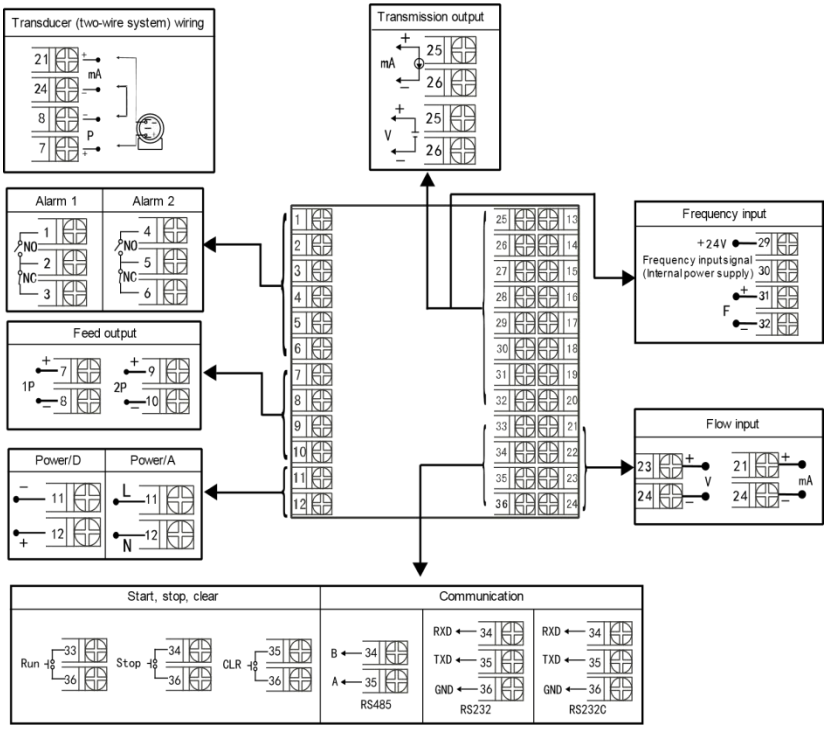



Fig. 2

Note: in the above diagram, if one group of terminals has different functions, only one of them may be available.

For example, RS485 and RS232 are on the same group of terminals, so only one of them may be selected.

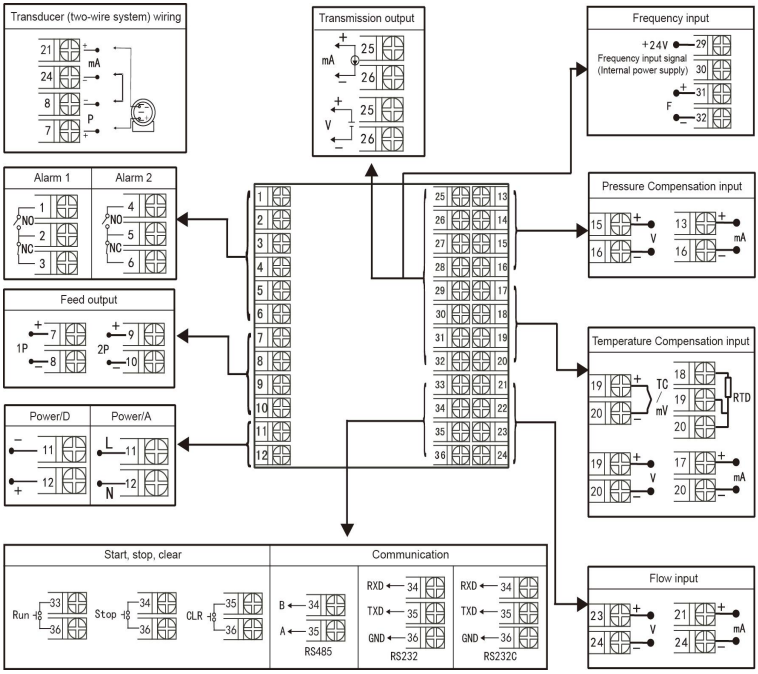



Fig. 3

Note: in the above diagram, if one group of terminals has different functions, only one of them may be available.

For example, RS485 and RS232 are on the same group of terminals, so only one of them may be selected.

The wiring terminal directions at rear cover of horizontal and vertical instruments are different; see Figure 4.

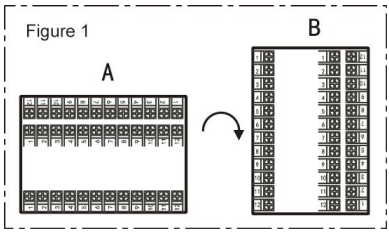



Fig. 4

# Chapter IV Parameters Setting

## 4.1 Panel Configuration

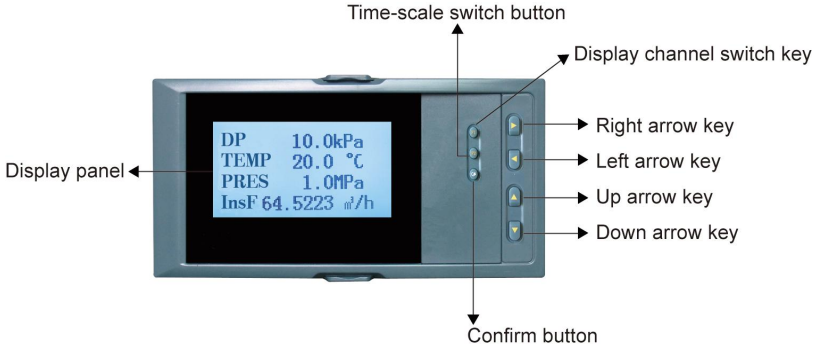



Fig. 5

Table 3

| Name | | Description |
|---|---|---|
| Operation keys | Enter | Menu page: to confirm item selection on the menu<br>Parameter change: to confirm new set parameter<br>Curve display: to enter configuration page combined with "▲" key<br>Historical data display: to confirm the retrospective time to be modified in the next step; to clear cumulant and cumulative power-failure duration combined with "◀" key<br>Parameter setting: to move position of decimal point combined with "◀" key |
| | ▼ Down | Menu page: to move the cursor down<br>Parameter change: to decrease the number before the cursor<br>Measured value display: to turn display pages of the same channel<br>Retrospective time change: to decrease time value before the cursor |
| | ▲ Up | Menu page: to move the cursor up<br>Parameter change: to increase the number before the cursor<br>Retrospective time change: to increase time value before the cursor |

| | | |
|---|---|---|
| | ◀ Left | Menu page: to move the cursor left<br>Parameter change: to move the cursor left<br>Retrospective time change: to move the cursor left<br>Historical data display: to search historical data backward from current time, or to stop the forward search of historical data |
| | ▶ Right | Menu page: to move the cursor right<br>Parameter change: to move the cursor right<br>Retrospective time change: to move the cursor right<br>Historical data display: to search historical data forward from current time, or to stop the backward search of historical data |
| | F1 | Measured value display: to switch display between different channels<br>End of setting: to enter measured value display |
| | F2 | Real-time curve or historical curve display: to change time scale of curve display |

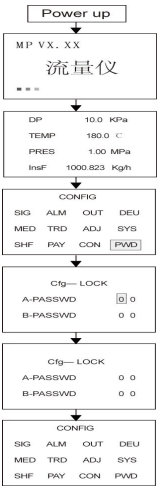
**4.2 Operation**

1) Power-on

Turn on the instrument while ensuring it's properly wired. The system would take several seconds or minutes for initialization. Please wait a moment.

2) Unlocking

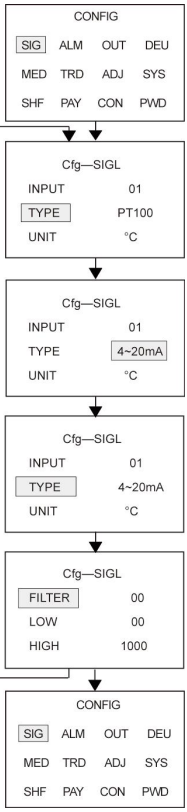
Table 4

| | |
|---|---|
|  | Power-on self test |
| | Main measurement display |

| | |
|---|---|
| | Press [U] and ▲to enter configuration page.<br>Move the cursor to “Unlocking”. |
| | Press “[U]” to enter “Unlocking” setting.<br>Enter password with “▲”, “▼”, “▶”, and “◀” for unlocking (preset as 0)<br>Note: Only if both supplier password and customer password are input correctly, the instrument will be unlocked, when it will display the mark “√”. |
| | Press “[U]” to enter the password, and press “[F1]” to return to the menu. |
| | Start configuration parameters setting upon unlocking.<br>Note: If it returns to the display screen during setting, the passwords shall be entered again for unlocking. |

3) Parameters setting (unlocked)

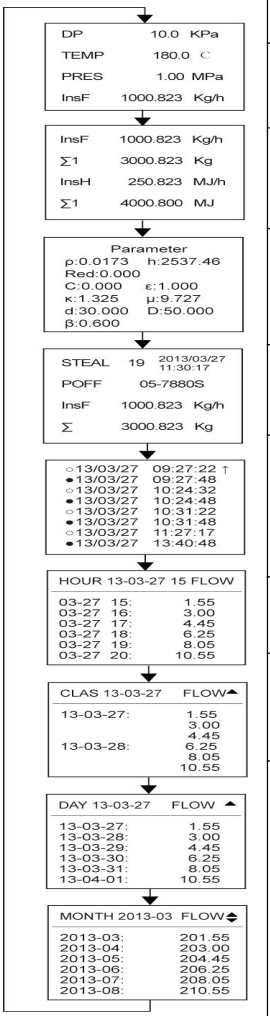
Table 5

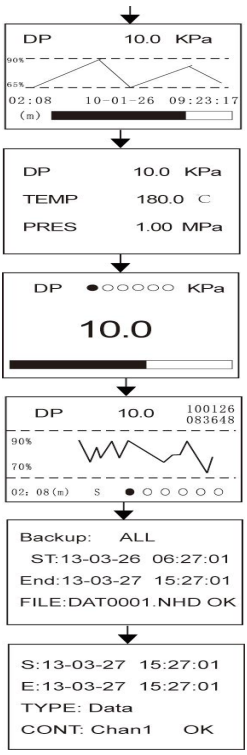
| | |
|---|---|
|  | Move the cursor to the target item<br>(take “channel” for example)<br>Press “ ” to enter channel parameters setting |
| | Move the cursor to the parameter to be changed<br>For example, “Input type PT100”<br>Press “ ” to confirm the parameter to be changed |
| | Press “ ” and “ ” to change the target parameter<br>For example, “Input type 4-20mA” |
| | Press “ ” to save the new parameter |
| | Press “ ” to enter filter coefficient setting and go through the above process. Setting of other parameters is the same as above. |
| | Upon completion, press “ ” to return to configuration page.<br>Press “ ”, “ ”, “ ”, and “ ” to set parameters of next item. |

4) Display operation

a. Flow chart

Table 6

| | |
|---|---|
|  | Main measurement display<br>Press “Fl” to switch to instantaneous cumulation display<br>Press “Fl” to switch to intermediate parameters display<br>Press “Fl” to switch to power-failure memory display<br>Press “Fl” to switch to power-failure time display<br>Press “Fl” to switch to hourly report display<br>Press “Fl” to switch to shift report display<br>Press “Fl” to switch to daily report display<br>Press “Fl” to switch to monthly report display |




| |
|---|
| Press “▼” to switch to real-time curve display<br>Press “F1” to switch to real-time curve of each channel |
| Press “▼” to switch to measurement display |
| Press “F1” to switch to bar graph display of each channel |
| Press “▼” to switch to retrospective display<br>Press “F1” to switch to retrospective display of each channel |
| Press “▼” to switch to data backup page (provided that the recording function is activated). |
| Press “▼” to switch to data printing page (provided that the printing function is activated) |

b. Instructions for each display:

① Parameters display:

There are 2 pages for flow and relevant parameters, including temperature compensation value, pressure compensation value, differential pressure or flow channel measured value, instantaneous flow, instantaneous heat, cumulative flow of each channel, totalized heat, balance, and residue.

User may use “System” configuration to set items displayed in "Page 1” and “Page 2” and define their orders.

Page 1

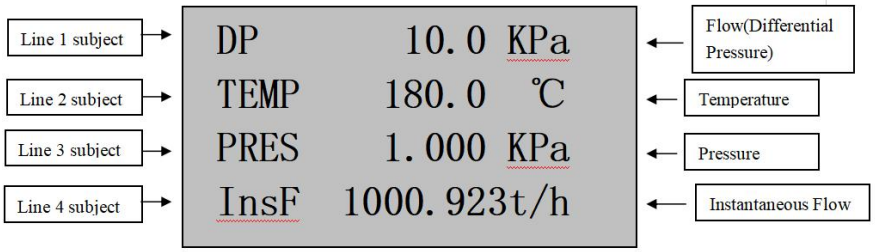



Fig. 6

Press “F1” to switch to instantaneous cumulation display

Page 2

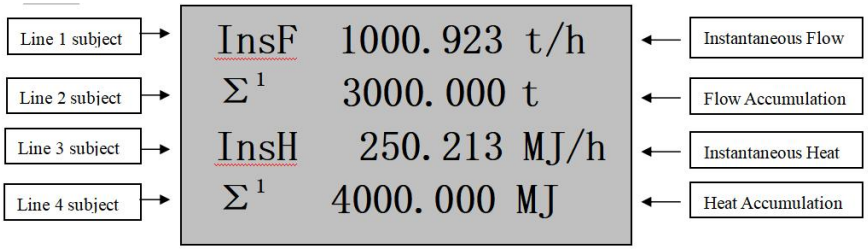



Fig. 7

② Press “F1” again to switch to intermediate parameters display:

ρ: 1.2045 – density in operating condition (Kg/m3)

C: 0.605 – discharge coefficient

Red: 88346.393 - Reynolds number

ε: 1.000 – expansion coefficient of measured medium

h: 238.93 – enthalpy of measured medium (note: appearing if heat totalizing function is activated)

μ: 19.550 – dynamic viscosity of measured medium (10-6 Pa.s)

κ: 1.402 – isentropic exponent of measured medium

β: 0.600 – diameter ratio of throttling device

d: 30.000 – interior diameter of open hole of throttling device (mm)

D: 50.000 – diameter of tube of throttling device (mm)

Z: 0.999 - compressibility factor of inorganic or organic gas

K: 1.000 – instrument factor

③ Press “F1” again to switch to power-failure memory display:

It will display time (year, month, date, hour, minute, and second) of last power failure, times of power failure and total failure duration (in seconds), and instantaneous flow and cumulative flow at the time of last power failure.

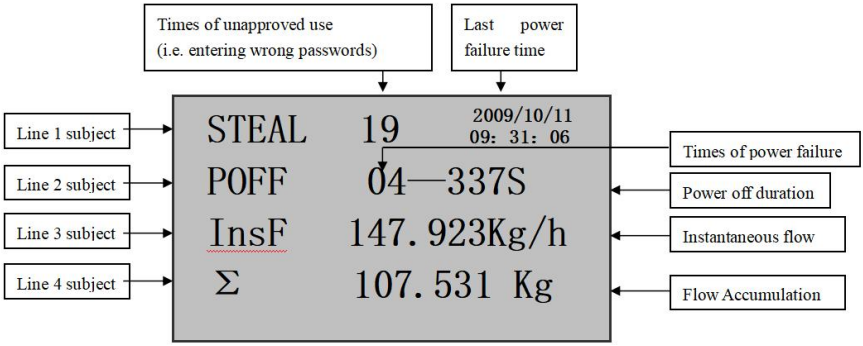



Fig. 8

④ Press “F1” again to switch to power failure time display:

The following will be displayed only when “Power-failure Time” in “System” configuration is set as “ON”. It will display the actual time of power failure and power-on during operation, and can display 8 moments of recent power-failure/on in one page.

As seen below, line started with “○” means power failure record, while line started with “●” means power-on record. Other records may be checked by using left and right key for page turning.

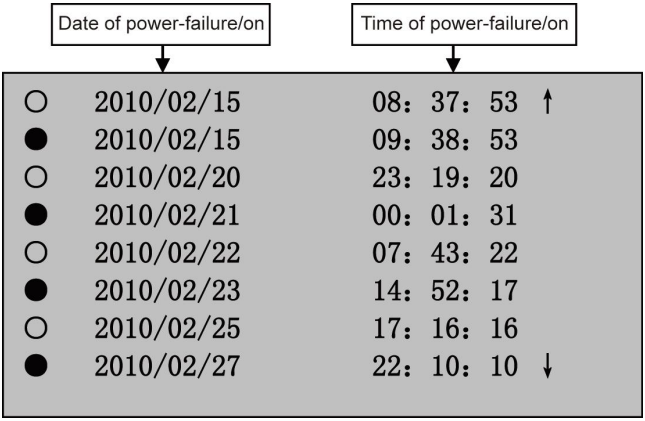



Fig. 9

⑤ Press “F1” again to switch to hourly report display:

Hourly report is used to compile statistics of cumulative flow in every hour within one day, and reports may be checked by setting certain date and time. In case of steam or water measurement, heat report can also be checked.

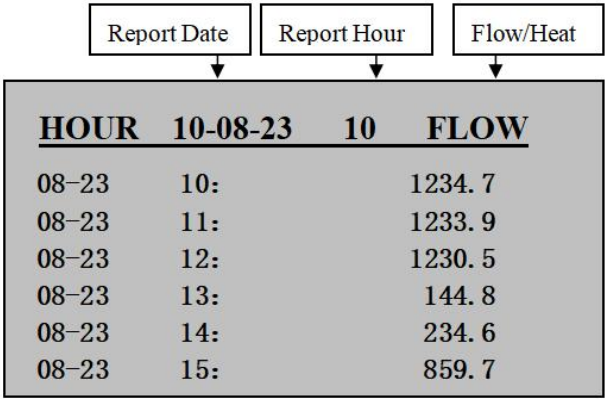



Fig. 10

⑥ Press “F1” again to switch to shift report display:

Shift report is used to compile statistics of cumulative flow of some shift within one day, and 3 shift reports at maximum may be made in one day. Reports may be

checked by setting certain date. In case of steam or water measurement, heat report can also be checked.

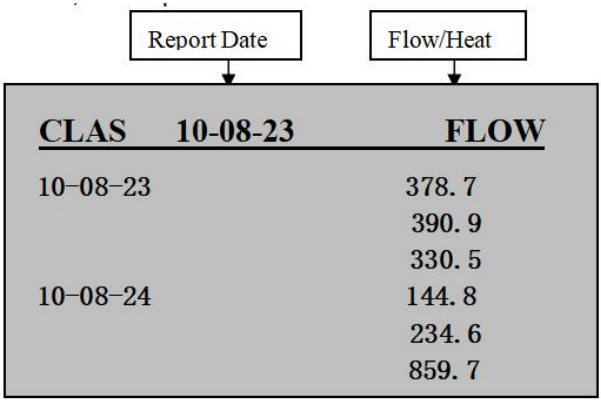



Fig. 11

⑦ Press “F1” again to switch to daily report display:

Daily report is used to compile statistics of cumulative flow of current day, and reports may be checked by setting certain date. In case of steam or water measurement, heat report can also be checked.

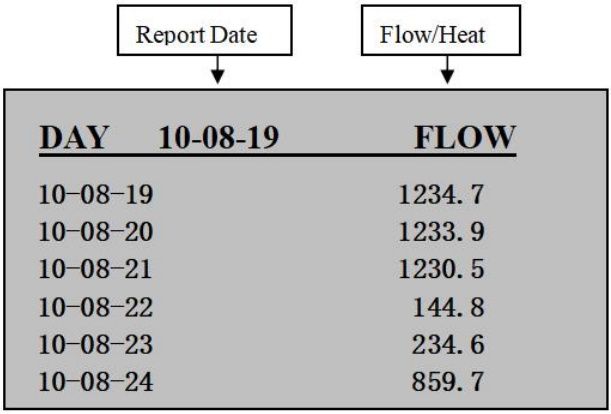



Fig. 12

⑧ Press “F1” again to switch to monthly report display:

Monthly report is used to compile statistics of cumulative flow of current month, and reports may be checked by setting certain date. In case of steam or water measurement, heat report can also be checked.

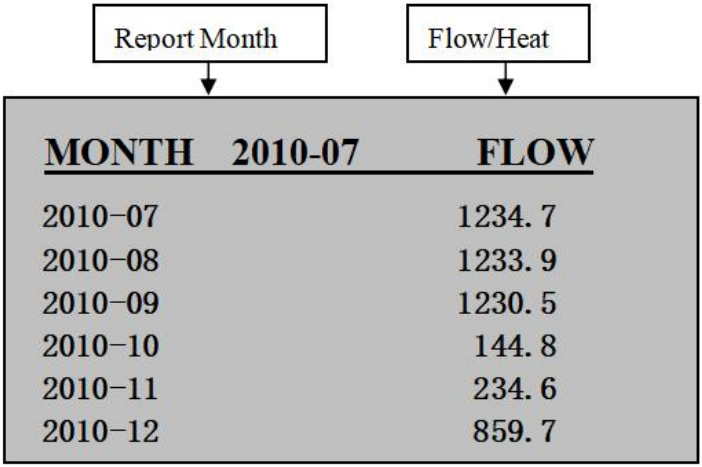



Fig. 13

c. Instructions for display of dynamic measurement process:

1) Real-time curve display

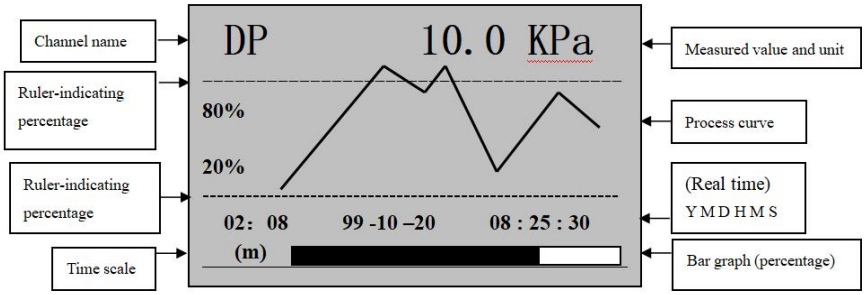



Fig. 14

1: Time scale 02:08 (m) indicates that the screen shows the curve for a length of 2 minutes and 8 seconds.

If it shows 02:08 (h), then it indicates that the screen shows the curve for a length of 2 hours and 8 minutes.

If the recording interval is higher than 15 seconds, the unit of time scale will automatically switch from (m) to (h).

2: Press " F2 " to alternate time scale units to expand or shorten the length of historical data curve.

3: Rule-indicating percentage will change with fluctuation of process curve to give the best display performance under limited resolution.

4: Measurement subject and channel name is defined with value of "Channel 1 name", "Channel 2 name", "Channel 3 name", and "Channel 4" name in "System" configuration.

5: Press " F1 " in real-time curve display to switch to real-time curve display of flow (differential pressure), temperature, and pressure.

2) Real-time data measurement display

Press " ▼ " to switch from real-time curve display to measurement display

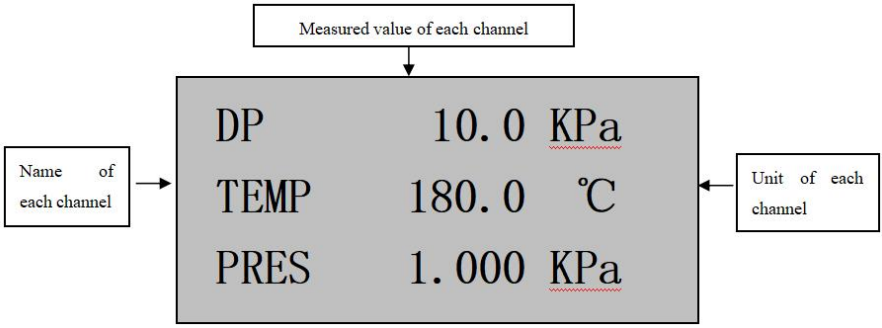



Fig. 15

Press F1 again to show the alarm bar graph below:

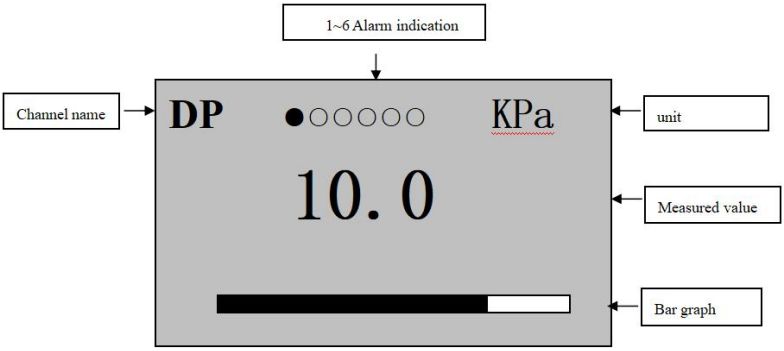



Fig. 16

1: Alarm 1, 2, 3, 4, 5, or 6 above may be defined to correspond to any input channel (channel 1, 2, 3, or 4) based on user's needs, and alarm at upper limit or lower limit may be set.

2: ● means the relay operates (alarm)

○ means the relay does not operate (no alarm)

3: Press "F1" in the alarm bar graph to switch to alarm bar graph of flow (differential pressure), temperature, and pressure.

3) Retrospective display

Press "▼" to switch from real-time data measurement to historical data retrospective display

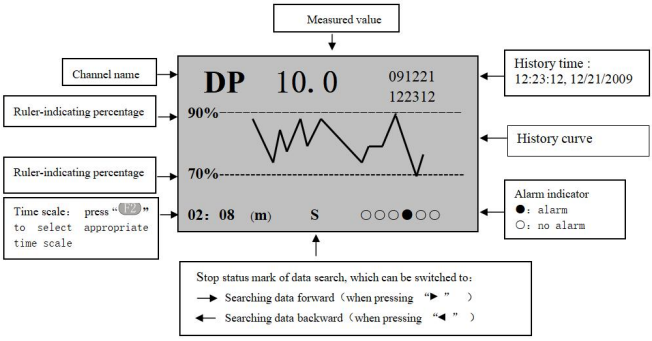



Fig. 17

Note: instructions on historical data retrospective operation: (when the image above is displayed)

(1) Press " ▶ " to search historical data forward from current display and press " ◀ " to stop the search.

Press " ◀ " to search historical data backward from current display and press " ▶ " to stop the search.

(2) Press " F2 " to change time scale to expand or shorten the length of historical data curve.

(3) Press " ↺ " to return the cursor to time display area on the right above corner, and press " ◀ " and " ▶ " to move the cursor and press " ▲ " and " ▼ " to increase/decrease value of year, month, date, hour, minute, and second. Press " ↺ " again for confirmation, and historical data curve of selected time will be shown on the screen.

(4) Relation between historical curve and historical data: the historical data will be at the intersection of historical curve and right frame of screen.

(5) Press " F1 " in the historical data retrospective display image to alternate between flow (differential pressure), temperature, and pressure.

Note: flow clearing

a. Press " ↺ " and " ▲ " to enter unlocking password setting in configuration page.

b. Passwords may be set as follows:

Table 7

| User sets system passwords | ****** | Preset as 00 |
|---|---|---|
| Supplier and customer password = ****** + 1 | Cumulative flow, cumulative heat, and times and time of power failure clearing allowed | Upon setting of passwords (for example, when the initial password is 100132, values will be cleared when entering password 100133), press " F1 " to return to measurement display, and press " ↺ " and " ◀ " for clearing. |
| Supplier and customer password = ****** + 2 | Power failure times and time clearing allowed | |
| Supplier and customer password = ****** + 3 | Cumulative flow and cumulative heat in channel 1 clearing allowed | |
| Supplier and customer password = ****** + 4 | Cumulative flow in channel 2 clearing allowed | |

| | | |
|---|---|---|
| Supplier and customer password = ****** + 5 | Cumulative flow in channel 3 clearing allowed | |
| Supplier and customer password = ****** + 6 | Cumulative flow in channel 4 clearing allowed | |

4) Data printing display (available when printer function is activated)

Press "▼" to switch from data backup display to data printing

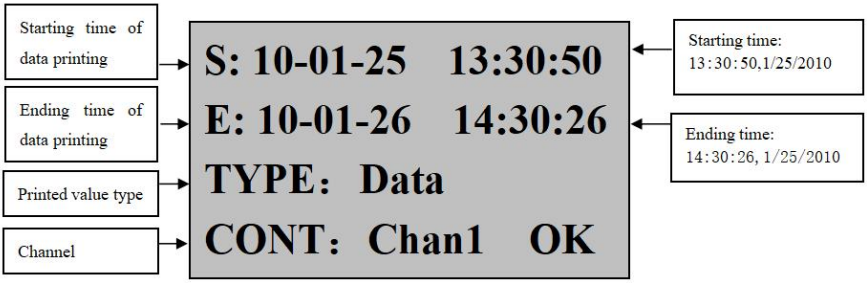



Fig. 18

1. Manual printing

1) When the printer in system configuration is set as "AS", it will print the data or curve of current channel within the set time length; use "◀" and "▶", "▲" and "▼" to change value of time, type, and channel; after that, move the cursor to "Print" and press "↵" for confirmation, and the screen will display "printing", indicating that it starts to print data or curves.

Format of curve printing:

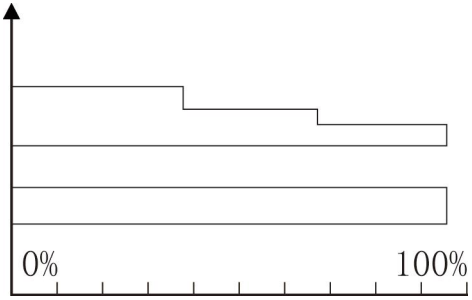



Fig. 19

Differential pressure: Kpa
Start: 10-07-25 10-00-00
End: 10-07-25 09-58-00
Format of data printing:
100724142610: 625 ---------- measured value at the time of ending
100724142609: 625
100724142608: 625
100724142607: 656
100724142606: 687
100724142605: 750
100724142604: 750
100724142603: 812
100724142602: 812
100724142601: 875 ---------- measured value at the time of starting

2) When the printer in system configuration is set as “TS”, it will print data of all channels at current time; use “◀” and “▶”, “▲” and “▼” to change value of time, type, and channel, and set the type as “Data”; after that, move the cursor to “Print” and press “↺” for confirmation, and the screen will display "printing”, indicating that it starts to print data. Format of printing:

---
Alarm: ● ○ ○ ○ ○ ○ ----------Alarm status: ○: no alarm ●: alarm
∑= 0.053MJ ----------Cumulative heat
Instantaneous heat: 0.0000MJ/h ----------Instantaneous heat
∑= 0.021Kg ----------Cumulative flow
Instantaneous: 15.0056Kg/h ----------Instantaneous flow
Pressure: 1.000Mpa----------Measured pressure
Temperature: 50.0℃----------Measured temperature
Differential pressure: 10.0Kpa----------Measured differential pressure
Time: 10-07-12 15-00-02 ----------Date and time
---

2. Timed printing

Set interval of timed printing in system configuration; when the interval of

measurement equals to interval of time printing, it will automatically control the printer for timed printing (see format of printing above).

3. Alarm printing

When the alarm function is actuated in system configuration, in case of any alarm, it will automatically control the printer for alarm printing (see format of printing above).

Connection between instrument and serial-interface printer:

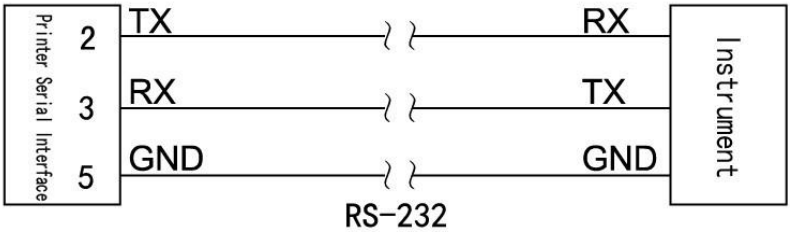



Fig. 20

Note: baud rate of the instrument and printer must be the same (baud rate setting of the instrument could be referred to in Level 2 Parameters Setting and that of the printer could be referred to in printer instructions).

## Chapter V Voltage Range Regulation in Frequency Input

1) : With open collector, the input end has a voltage of 10V; with open emitter, there's no voltage;

Table 8

| | Frequency input: OC | Frequency input: OE |
|---|---|---|
| JP2 status |  |  |

Voltage regulation:

1. Regulate upper limit of input voltage: regulate potentiometer W1 (clockwise rotation for decrease and counterclockwise rotation for increase) so that voltage at negative end of frequency input of pin pair 7 of LM339 is not more than upper limit of input voltage.

2. Regulate lower limit of input voltage: regulate potentiometer W2 (clockwise rotation for decrease and counterclockwise rotation for increase) so that voltage at negative end of frequency input of pin pair 8 of LM339 is not less than lower limit of input voltage.

★ Regulate W1 and W2 to keep the amplitude of upper limit / lower limit of voltage is within the range of wave shape. The voltage is preset as about 2.5V and 4.5V for lower limit and upper limit amplitude.

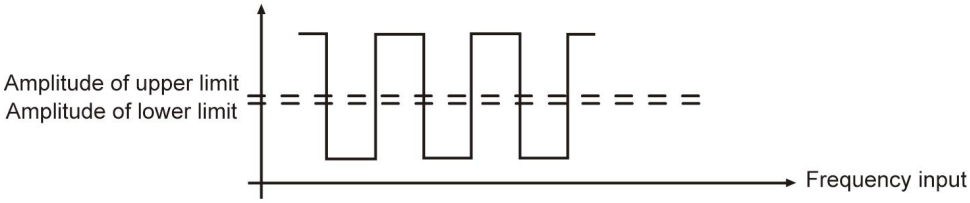



Fig. 21

2) : Frequency amplification (see figure below):

Table 9

| | Amplified voltage input (CP) | Normal voltage input (PP) |
|---|---|---|
| JP1 status |  |  |

★ For example, the frequency amplitude of magnetoelectric transducer is relatively low, which cannot be directly collected by the instrument, so amplification circuit is required in the instrument.

## Chapter VI Parameters Description

1) “SIG” parameters – when flow with temperature/pressure compensation is calculated, input channel 01 means flow (differential pressure) signal, 02 means temperature signal, and 03 means pressure signal.

Table 10

| Name | Range | Description | Default Value |
|---|---|---|---|
| INPUT | 01 | The first input channel (unchangeable) | 01 |
| TYPE | See table of input types | Input signal type (see table of input signal types) | 4-20mA |
| UNIT | See table of units | Engineering unit of input channel (see Note 1) | KPa |
| FILTER | 0-19 | Set the input signal filter coefficient | 0 |
| LOW | -9999 ~ 99999 | Lower limit of measuring range (see Note 2 for decimal digit setting) | 0 |
| HIGH | -9999 ~ 99999 | Higher limit of measuring range (see Note 2 for decimal digit setting) | 1000 |
| BAR-LOW | -9999 ~ 99999 | Lower limit of bar graph | 0 |
| BAR-HIGH | -9999 ~ 99999 | Higher limit of bar graph | 1000 |
| CUT-OFF | -25.0 ~ 100.0 | Percentage of small signal cutoff (see Note 3) | -25.0 |
| CUMULATE | ON | Flow value is cumulated | ON |
| INPUT | 02 | The second input channel (unchangeable) | 02 |
| TYPE | See table of input types | Input signal type (see table of input signal types) | PT100 |
| UNIT | See table of units | Engineering unit of input channel (see Note 1) | ℃ |
| FILTER | 0-19 | Set the input signal filter coefficient | 0 |
| LOW | -9999 ~ 99999 | Lower limit of measuring range (see Note 2 for decimal digit | 0 |

| Name | Range | Description | Default Value |
|---|---|---|---|
| | | setting) | |
| HIGH | -9999 ~ 99999 | Higher limit of measuring range (see Note 2 for decimal digit setting) | 1000 |
| BAR-LOW | -9999 ~ 99999 | Lower limit of bar graph | 0 |
| BAR-HIGH | -9999 ~ 99999 | Higher limit of bar graph | 1000 |
| CUT-OFF | -25.0 ~ 100.0 | Percentage of small signal cutoff (see Note 3) | -25.0 |
| CUMULATE | ON: cumulation OFF: no cumulation | If the channel is used for flow signal, CUMULATE can be set ON, and flow value will be cumulated. If set OFF, will not be cumulated. | OFF |
| INPUT | 03 | The third input channel (unchangeable) | 03 |
| TYPE | See table of input types | Input signal type (see table of input signal types) | 4-20mA |
| UNIT | See table of units | Engineering unit of input channel (see Note 1) | KPa |
| FILTER | 0-19 | Set the input signal filter coefficient | 0 |
| LOW | -9999 ~ 99999 | Lower limit of measuring range (see Note 2 for decimal digit setting) | 0.000 |
| HIGH | -9999 ~ 99999 | Higher limit of measuring range (see Note 2 for decimal digit setting) | 1.000 |
| BAR-LOW | -9999 ~ 99999 | Lower limit of bar graph | 0.000 |
| BAR-HIGH | -9999 ~ 99999 | Higher limit of bar graph | 1.000 |
| CUT-OFF | -25.0 ~ 100.0 | Percentage of small signal cutoff (see Note 3) | -25.0 |
| CUMULATE | ON: cumulation OFF: no cumulation | If the channel is used for flow signal, CUMULATE can be set ON, and flow value will be cumulated. If set OFF, will not be cumulated. | OFF |

Note 1: Table of Unit (if special unit is required, it should be specified in the order.)

Table 11

| No. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Unit | ℃ | Kgf | Pa | KPa | MPa | mmHg | mmH2O | bar | Kg/h | Kg/m | Kg/s | t/h | t/m |
| No. | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| Unit | t/s | l/h | l/m | l/s | $m^3/h$ | $m^3/m$ | $m^3/s$ | $Nm^3/h$ | $Nm^3/m$ | $Nm^3/s$ | KJ/h | KJ/m | KJ/s |
| No. | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 |
| Unit | MJ/h | MJ/m | MJ/s | GJ/h | GJ/m | GJ/s | kg | t | L | $m^3$ | $Nm^3$ | KJ | MJ |
| No. | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | |
| Unit | GJ | m | m/s | V | KV | A | KA | KW | HZ | % | PH | mm | |

Note 2: decimal digit setting: if it's required to display value with decimal places in the setting of measuring range, press "↺" and "◀" to move the decimal place from right to left.

When the point moves to the first decimal place in the right, it will display value with one decimal place, and when the point moves to the second, it will display value with two decimal places.

For example, if upper limit of measuring range is set as "1.0", the instrument will display "1.0", and if it's set as "1.00", the instrument will display "1.00". Number of decimal places of upper limit of measuring range shall be set first, and that of lower limit will follow the same rule as upper limit.

Negative range setting: move the cursor to the first place in the left, and press "▼" so that the instrument will display "0", and then press "▼" again – the negative mark "-"will be displayed.

Note 3: Small signal cutoff: if the measured value < (upper limit of measuring range – lower limit of measuring range)* small signal cutoff percentage + lower limit of measuring range, the measured value will be displayed as lower limit of measuring range. (This function only serves voltage and current signals; for frequency signal,

its engineering value will be cut off.)

2) “ALM” parameters

Table 12

| Name | Range | Description | Default Value |
|---|---|---|---|
| ALM-CHAN | 01 | The first alarm channel(unchangeable) | 01 |
| INPUT | 1 – the 1st input channel<br>2 – the 2nd input channel<br>3 – the 3rd input channel<br>4 – the 4th input channel<br>5 –flow<br>6 –heat | Input channel (1 – 6) corresponding to the alarm channel | 05 |
| ALM-TYPE | NO: no alarm<br>AL: Low alarm<br>AH: High alarm<br>SAL: reserved<br>SAH: reserved<br>LAL: Low cumulation alarm<br>LAH: High cumulation alarm<br>LALC: Low cumulation alarm and clear cumulation<br>LAHC: High cumulation alarm and clear cumulation | Alarm type<br>Note: when the alarm type is set as LAL, LAH, LALC or LAHC, the input channel must be set flow or heat | AH |
| THRESHLD | -9999 ~ 99999 | Set the alarm threshold value (see Note 4) | 50 |
| HYSTERES | 0 ~ 99999 | Set the alarm threshold hysteresis, which can prevent signal oscillation near the alarm threshold. | 00 |
| ALM-CHAN | 02 | The 2nd alarm channel (unchangeable) | 02 |
| INPUT | Same as above | Input channel (1 – 6) corresponding to the alarm channel | 05 |

| Name | Range | Description | Default Value |
|---|---|---|---|
| ALM-TYPE | Same as above | Alarm type<br>Note: when the alarm type is set as LAL, LAH, LALC or LAHC, the input channel must be set flow or heat | AH |
| THRESHLD | -9999 ~ 99999 | Set the alarm threshold value (see Note 4) | 50 |
| HYSTERES | 0 ~ 99999 | Set the alarm threshold hysteresis, which can prevent signal oscillation near the alarm threshold. | 00 |

Note 4: Alarm mode: (Alarm threshold hysteresis can prevent signal oscillation near the alarm threshold, frequent alarms and cancellation of report)

Output status:

★ Signal value increases from a low value:

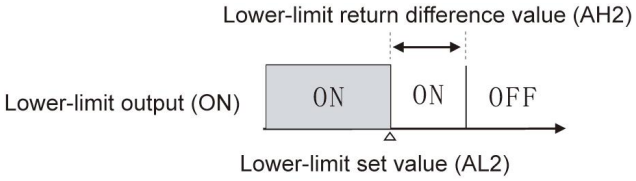



Fig. 22

★ Signal value decreases from a high value:

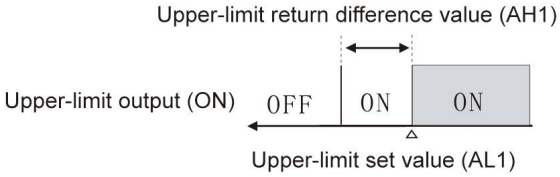



Fig. 23

★ High alarm output:

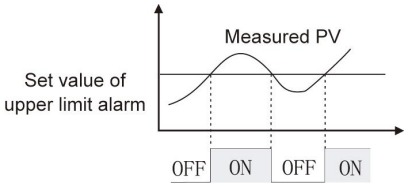



Fig. 24

★ Low alarm output:

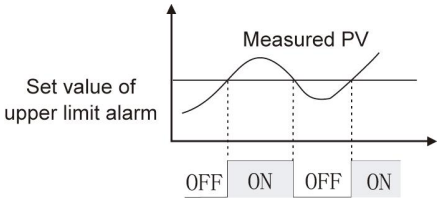



Fig. 25

3) “OUTt” parameters

Table 13

| Name | Range | Description | Default Value |
|---|---|---|---|
| OUT-CHAN | 01 | The 1st output channel (unchangeable) | 01 |
| INPUT | 1 – the 1st input channel<br>2 – the 2nd input channel<br>3 – the 3rd input channel<br>4 – the 4th input channel<br>5 –flow<br>6 –heat | Input channel (1 – 6) corresponding to the analog output channel | 05 |
| OUT-TYPE | No: no output<br>Current: 0~20mA, 0~10mA, 4~20mA<br>Voltage: 0~5V, 1~5V, 0~10V | Signal output type of transmission (any special requirement shall be specified) | 4~20mA |

| Name | Range | Description | Default Value |
|---|---|---|---|
| OUT-LOW | -9999 ~ 99999 | The lowest signal value of transmission | 0 |
| OUT-HIGH | -9999 ~ 99999 | The highest signal value of transmission | 1000 |
| OUT-CHAN | 02 | The 2nd output channel(unchangeable) | 02 |
| INPUT | Same as above | Input channel (1 – 6) corresponding to the analog output channel | 05 |
| OUT-TYPE | Same as above | Signal output type of transmission (any special requirement shall be specified) | 4~20mA |
| OUT-LOW | -9999 ~ 99999 | The lowest signal value of transmission | 0 |
| OUT-HIGH | -9999 ~ 99999 | The highest signal value of transmission | 1000 |

4) “DEV” parameters

When some of following parameters marked with “*”, it means no setting is required.

Table 14

| Name | Range | Description | Default Value |
|---|---|---|---|
| DEVICE | Flange pressure plate, linear flow meter, etc. | Primary measuring devices such as orifice plate and vortex street are used (Note 1) | actual condition |
| C | 0~ 999999 | Discharge coefficient | actual condition |
| ε | 0~ 999999 | Expansion factor | actual condition |
| TUBE | A3 steel, Cr6SiMo, etc. | The material used to manufacture pipes, and different materials have different expansion coeffieient $\lambda_D$ (Note 2) | actual condition |
| THROTTLE | A3 steel, Cr6SiMo, etc. | The material used to manufacture throttling parts(orifice plate, etc.), and different materials have different expansion coeffieient $\lambda_d$ (Note 2) | actual condition |
| D20 | 0 – 999999 | The pipe diameter D20 at | actual |

| Name | Range | Description | Default Value |
|---|---|---|---|
| | | 20℃ (in mm) | condition |
| d20 | 0 – 999999 | Throttling piece diameter d20 at 20℃ (in mm) | actual condition |
| λD | 0 – 999999 | Linear expansion coefficient of tube material –$\lambda_D$ (in $10^{-6}$mm/(mm.℃)) | actual condition |
| $\lambda_d$ | 0 – 999999 | Linear expansion coefficient of throttling piece material –$\lambda_d$ (in $10^{-6}$mm/(mm.℃)) | actual condition |
| SQRT | YES/NO | YES: When differential pressure transmitter has no square root computation, and the instrument needs to do this for differential pressure signal.<br>NO: When differential pressure transmitter has square root computation | YES |
| SEGMENTS | 1 – 8 | For measuring devices of other flow meters of differential pressure type or frequency-type vortex street flow meter, K coefficient may be divided into several segments (at maximum of 8 segments) | 8 |
| RANGE1 | 0 – 999999 | K=K1, when : 0 ≤ differential pressure or frequency ≤ RANGE1 | 100 |
| K1 | 0 – 999999 | K1 coefficient | 1 |
| RANGE2 | 0 – 999999 | K=K2, when : RANGE1 ≤ differential pressure or frequency ≤ RANGE2 | 100 |
| K2 | 0 – 999999 | K2 coefficient | 1 |
| RANGE3 | 0 – 999999 | K=K3, when : RANGE2 ≤ differential pressure or frequency ≤ RANGE3 | 100 |
| K3 | 0 – 999999 | K3 coefficient | 1 |
| RANGE4 | 0 – 999999 | K=K4, when : RANGE3 ≤ differential pressure or frequency ≤ RANGE4 | 100 |
| K4 | 0 – 999999 | K4 coefficient | 1 |
| RANGE5 | 0 – 999999 | K=K5, when : RANGE4 ≤ | 100 |

| Name | Range | Description | Default Value |
|---|---|---|---|
| | | differential pressure or frequency ≤ RANGE5 | |
| K5 | 0 – 999999 | K5 coefficient | 1 |
| RANGE6 | 0 – 999999 | K=K6, when : RANGE5 ≤ differential pressure or frequency ≤ RANGE6 | 100 |
| K6 | 0 – 999999 | K6 coefficient | 1 |
| RANGE7 | 0 – 999999 | K=K7, when : RANGE6 ≤ differential pressure or frequency ≤ RANGE7 | 100 |
| K7 | 0 – 999999 | K7 coefficient | 1 |
| RANGE8 | 0 – 999999 | K=K8, when : RANGE7 ≤ differential pressure or frequency ≤ RANGE8 | 100 |
| K8 | 0 – 999999 | K8 coefficient | 1 |

Note 1: Primary instrument devices

| | |
|---|---|
| Flange pressure plate | Machined classical Venturi tube |
| Angle pressure plate | Thick iron wielding section of Venturi tube |
| D and D/2 pressure plate | V-cone flow meter |
| ISA932 nozzle | Other differential pressure flow meter |
| Long diameter nozzle | Frequency-type vortex flow meter |
| Venturi nozzle | Linear flow meter |
| Casting-type Venturi tube | |

Note 2: Tube or Throttle materials

| | |
|---|---|
| 15 steel, A3 steel | Cr6SiMo |
| A3F, B3 steel | X20CrMoWV121 |
| 10 steel | 1Cr18Ni9Ti |
| 20 steel | Ordinary carbon steel |
| 45 steel | Industrial copper |
| 1Cr13, 2Cr13 | Copper |
| 1Cr17 | brass |
| 12CrlMoV | Grey cast iron10CrMo910 |

**User-defined**

5) “MED” parameters

When some of following parameters marked with “*”, it means no setting is

required.

Table 15

| Name | Range | Description | Preset Value |
|---|---|---|---|
| MEDIUM | Steam, water, etc. | Flow medium to be measured, such as steam, water, and gas (Note 1) | actual condition |
| PRESSURE | -9999.9 ~ 999999 | Local atmospheric pressure PA (in MPa). If the pressure compensation channel is absolute pressure, the atmospheric pressure should be set 0. | 0.10133 |
| T0 | 0℃ or 20℃ | Standard conditions temperature, T0 = 0℃ or 20℃; Standard conditions Pressure, P0 = 0.10133Mpa. | 20℃ |
| ρ0 | 0 ~ 999999 | Density of medium in standard condition (in Kg/m3). It needs to be set if the medium is other gas or liquid. | actual condition |
| HUMID | 0 – 100 | Relative humidity of humid gas (in %) | 0 |
| HUMID0 | 0 – 100 | Under standard condition of humid gas (in %) | 0 |
| DRYNESS | 0 – 100 | Dryness of saturated steam (in %) | 100 |
| Z | 0 ~ 999999 | Compressibility factor of gas in operating condition (dimensionless); This parameter needs to be set if the measured medium is other gas. | actual condition |
| κ | 0 ~ 999999 | Isentropic exponent of medium κ (dimensionless); this parameter needs to be set if the measuring device is throttling device of varied flow meters of differential pressure type (except V-cone flow meter) and the medium is other gas or liquid. | actual condition |
| μ | 0 ~ 999999 | Dynamic viscosity of medium μ (in Pa.s); this parameter needs to be set if the measuring device is throttling device of varied flow meters of differential pressure type (except V-cone flow meter) and the medium is other gas or liquid. | actual condition |
| A1 | -9999.9 ~ 999999 | Monomial coefficient of quadratic polynomial of liquid temperature | 1 |

| Name | Range | Description | Preset Value |
|---|---|---|---|
| | | compensation; see liquid density formula. | |
| A2 | -9999.9 ~ 999999 | Quadratic coefficient of quadratic polynomial of liquid temperature compensation; see liquid density formula. | 1 |
| The following parameters will be applicable only when the medium is manufactured gas. | | | |
| Air | 0 ~ 100.00 | Air percent by volume (%) | actual condition |
| $N_2$ | 0 ~ 100.00 | Nitrogen percent by volume (%) | actual condition |
| $O_2$ | 0 ~ 100.00 | Oxygen percent by volume (%) | actual condition |
| He | 0 ~ 100.00 | Helium percent by volume (%) | actual condition |
| $H_2$ | 0 ~ 100.00 | Hydrogen percent by volume (%) | actual condition |
| Ar | 0 ~ 100.00 | Argon percent by volume (%) | actual condition |
| CO | 0 ~ 100.00 | Carbon monoxide percent by volume (%) | actual condition |
| $CO_2$ | 0 ~ 100.00 | Carbon dioxide percent by volume (%) | actual condition |
| $H_2S$ | 0 ~ 100.00 | Sulfureted hydrogen percent by volume (%) | actual condition |
| $NH_3$ | 0 ~ 100.00 | Ammonia percent by volume (%) | actual condition |
| $CH_4$ | 0 ~ 100.00 | Methane percent by volume (%) | actual condition |
| $C_2H_6$ | 0 ~ 100.00 | Ethane percent by volume (%) | actual condition |
| $C_3H_8$ | 0 ~ 100.00 | Propane percent by volume (%) | actual condition |
| $C_4H_{10}$ | 0 ~ 100.00 | Butane percent by volume (%) | actual condition |
| $C_2H_4$ | 0 ~ 100.00 | Ethylene percent by volume (%) | actual condition |
| $C_3H_6$ | 0 ~ 100.00 | Propylene percent by volume (%) | actual condition |
| $C_4H_8$ | 0 ~ 100.00 | Butylene percent by volume (%) | actual condition |
| $C_2H_2$ | 0 ~ 100.00 | Ethyne percent by volume (%) | actual |

| Name | Range | Description | Preset Value |
|---|---|---|---|
| | | | condition |
| SUM | 0 ~ 100.00 | Sum of percent by volume of above 18 components, which would be calculated automatically by the instrument and unchangeable. The sum of percent by volume shall be: 100±0.01% | actual condition |

Note 1: Flow medium:

| | | |
|---|---|---|
| Saturated steam temperature compensation | H2 | C4H10 |
| Saturated steam pressure compensation | Ar | C2H4 |
| Steam | CO | C3H6 |
| 0.6Mpa water | CO2 | C4H8 |
| 1.6Mpa water | H2S | C2H2 |
| Air | NH3 | Other gas |
| N2 | CH4 | Liquid |
| O2 | C2H6 | Manufactured gas |
| He | C3H8 | |

6) “TRD” parameters

Table 16

| Name | Range | Description | Preset Value |
|---|---|---|---|
| F-UNIT | Kg/h, Kg/m, etc. | Select flow unit (Note 1) | Kg/h |
| H-UNIT | KJ/h, KJ/m, etc. | Select heat unit (Note 2) | MJ/h |
| LOW-THR | 0 ~ 999999 | Low Threshold Value, See Note 3 | 0 |
| LOW-VAL | 0 ~ 999999 | Small Flow Value, See Note 3 | 0 |
| OVER-THR | 0 ~ 999999 | Over Threshold Value, See Note 3 | 100 |
| OVER-MUL | 0 ~ 999999 | Over coefficient(dimensionless), See Note 3 | 0 |
| ACCU-MUL | 0 ~ 999999 | Accumulation multiple rate(dimensionless), See Note 3 | 1 |
| F-COMP | 0 ~ 999999 | Flow compensation during power down(see Note 5) | 0 |
| H-COMP | 0 ~ 999999 | Heat compensation during power down(see Note 5) | 0 |
| CONST-P | 0 ~ 999999 | Constant Pressure when pressure | 1 |

| Name | Range | Description | Preset Value |
|---|---|---|---|
| | | signal cut off | |
| CONST-T | 0 ~ 999999 | Constant Temperature when temperature signal cut off | 20 |
| F-DIGIT | 0 ~ 5 | Maximum decimal digit of instantaneous flow (0 – 5 decimal digit) | 3 |
| H-DIGIT | 0 ~ 5 | Maximum decimal digit of instantaneous heat (0 – 5 decimal digit) | 3 |
| K | 0 ~ 999999 | Adjustment of instantaneous flow Kx+b, where K means proportional factor | 1.00000 |
| B | 0 ~ 999999 | Adjustment of instantaneous flow Kx+b, where B means constant factor | 0.0 |
| F-RANGE | 0 ~ 999999 | Measuring range of instantaneous flow, which is only used for display on computer and transmission. | 2000.0 |
| H-RANGE | 0 ~ 999999 | Measuring range of instantaneous heat, which is only used for display on computer and transmission. | 2000.0 |

Note 1: the following units of instantaneous flow are available:

Kg/h, kg/m, kg/s, t/h, t/m, t/s, l/h, l/m, l/s, m3/h, m3/m, m3/s, Nm3/h, Nm3/m, Nm3/s

Note 2: the following units of instantaneous heat are available:

KJ/h, KJ/m, KJ/s, MJ/h, MJ/m, MJ/s, GJ/h, GJ/m, GJ/s

Note 3: calculation of cumulative flow:

If instantaneous flow < Low Threshold Value, Cumulative flow = Previous cumulative flow + Small Flow Value;

If Low Threshold Value ≤ instantaneous flow ≤ Over Threshold Value, Cumulative flow = Previous cumulative flow + instantaneous flow;

If instantaneous flow > Over Threshold Value, Cumulative flow = Previous cumulative flow + Over coefficient * (instantaneous flow – Over Threshold Value) + Over Threshold Value.

Note 4: Cumulative flow = Previous cumulative flow + Accumulation multiple rate * instantaneous flow.

Cumulative heat = Previous cumulative heat + Accumulation multiple rate * instantaneous heat.

Note 5: Complementary Cumulative Flow = Flow compensation during power down * duration of power down; Complementary Cumulative Heat = Heat compensation during power down * duration of power down;

7) “ADJ” parameters

Table 17

| Name | Range | Description | Default Value |
|---|---|---|---|
| INPUT | 01 | The 1st input channel (unchangeable) | 01 |
| B | -9999 ~ 99999 | Adjustment of signal value Kx+B, where B is constant factor | 0 |
| K | -9999 ~ 9999 | Adjustment of signal value Kx+B, where K is proportional factor | 1 |
| INPUT | 02 | The 2nd input channel (unchangeable) | 02 |
| B | -9999 ~ 99999 | Adjustment of signal value Kx+B, where B is constant factor | 0 |
| K | -9999 ~ 9999 | Adjustment of signal value Kx+B, where K is proportional factor | 1 |
| INPUT | 03 | The 3rd input channel (unchangeable) | 03 |
| B | -9999 ~ 99999 | Adjustment of signal value Kx+B, where B is constant factor | 0 |
| K | -9999 ~ 9999 | Adjustment of signal value Kx+B, where K is proportional factor | 1 |
| INPUT | 04 | The 4th input channel (unchangeable) | 04 |
| B | -9999 ~ 99999 | Adjustment of signal value Kx+B, where B is constant factor | 0 |
| K | -9999 ~ 9999 | Adjustment of signal value Kx+B, where K is proportional factor | 1 |
| OUT-CHAN | 01 | The 1st output channel (unchangeable) | 01 |
| B | -9999 ~ 99999 | Adjustment of signal value Kx+B, where B is constant factor | 0 |
| K | -9999 ~ 9999 | Adjustment of signal value Kx+B, where K is proportional factor | 1 |
| OUT-CHAN | 02 | The 2nd output channel (unchangeable) | 02 |
| B | -9999 ~ 99999 | Adjustment of signal value Kx+B, where B is constant factor | 0 |
| K | -9999 ~ 9999 | Adjustment of signal value Kx+B, where K is proportional factor | 1 |
| OUT-CHAN | 03 | The 3rd output channel (unchangeable) | 03 |
| B | -9999 ~ 99999 | Adjustment of signal value Kx+B, where B is constant factor | 0 |
| K | -9999 ~ 9999 | Adjustment of signal value Kx+B, where K is proportional factor | 1 |

| Name | Range | Description | Default Value |
|---|---|---|---|
| OUT-CHAN | 04 | The 4th output channel (unchangeable) | 04 |
| B | -9999 ~ 99999 | Adjustment of signal value Kx+B, where B is constant factor | 0 |
| K | -9999 ~ 9999 | Adjustment of signal value Kx+B, where K is proportional factor | 1 |

8) “SYS" parameters

Table 18

| Name | Range | Description | Default Value |
|---|---|---|---|
| DATE | Y-M-D | Current date, year-month-day | Current date |
| TIME | H-M-S | Current time, hour-minute-second | Current time |
| CJC-B | -99999 ~ 999999 | Cold junction compensation KX+B, where B is constant factor | 0 |
| CJC-K | -99999 ~ 999999 | Cold junction compensation KX+B, where K is proportional factor | 1 |
| ADDRESS | 1 ~ 255 | Instrument address of communication | 1 |
| BAUD | 1200/2400/4800/9600 bps | Baud rate of the serial communication | 9600 |
| PRINTER | NO, AS, TS | Printing mode: NO: no printing function AS: when manual printing data, it will print measured value of selected channel within the set time; TS: when manual printing data, it will print measured value of all channels at current time | AS |
| PRT-INTR | 1- 2000 minutes | The interval time of equal-interval print | 1 (minute) |
| PRT-STR T | H-M | Start time of equal-interval print | 00:00 |

| Name | Range | Description | Default Value |
|---|---|---|---|
| ALM-PRT | ON/OFF | ON: print when new alarm occur<br>OFF: no print when new alarm occur | OFF |
| REC-INTR | 1/2/4/6/15/30/60/120/240s | Record interval time | 1 second |
| CH1-NAME | 00: CH01, Channel 1<br>01: TEMP, Temperature<br>02: PRES, Pressure<br>03: FLOW<br>04: DP, Differential Pressure<br>05: TIN, Inlet Temperature<br>06: TOUT, Outlet Temperature<br>07: blank | Channel name of the 1st input channel | 4 |
| CH2-NAME | Same as above | Channel name of the 2nd input channel | 1 |
| CH3-NAME | Same as above | Channel name of the 3rd input channel | 2 |
| CH4-NAME | Same as above | Channel name of the 4th input channel | 4 |
| AUT-PAGE | ON: automatic page switch (interval of about 10s)<br>OFF: manual page switch (press F1) | Page switch option: automatic/manual page switch | OFF |
| PAGE1 | Page 1 has 4 lines, its content is defined by the following 4 bits:<br>1 0 X1 X2 X3 X4:<br>X1: 1st line content<br>X2: 2nd line content<br>X3: 3rd line content<br>X4: 4th line content | Line content:<br>Xi Content<br>0 – blank<br>1 – measured value of signal channel 1<br>2 – measured value of signal channel 2<br>3 – measured value of signal channel 3<br>4 – measured value of signal channel 4<br>5 – instantaneous flow<br>6 – instantaneous heat<br>7 – instantaneous cold<br>8 – cumulative flow<br>9 – cumulative heat<br>A – cumulative flow of | User-defined |

| Name | Range | Description | Default Value |
|---|---|---|---|
| | | channel 2<br>B – cumulative flow of channel 3<br>C – cumulative flow of channel 4<br>D – user balance<br>E – residual flow subscribed | |
| PAGE2 | Page 1 has 4 lines, its content is defined by the following 4 bits:<br>2 0 X1 X2 X3 X4:<br>X1: 1st line content<br>X2: 2nd line content<br>X3: 3rd line content<br>X4: 4th line content | Same as above | User-defined |
| PWR-PAGE | ON: Display of Power On/Down page is ON;<br>OFF: Display of Power On/Down page is OFF | The last 8 power on/off time will be recorded in flow meter. | OFF |
| REPORT | ON: Display of hourly report, shift report, daily report, and monthly report pages are ON;<br>OFF: the above pages are OFF | The instrument is capable of compiling hourly report, shift report, daily report, and monthly report. All reports can be inquired by turning on the “REPORT” | OFF |
| PASSWORD | To set supplier password and customer password | | |
| CLEAR | Yes: to clear all reports;<br>No: not to clear all reports; | Press “ ”, and a window for choosing to or not to clear reports will pop up. Use “ ◀ ” and “ ▶ ” to move the cursor on proper option, and press “ ” for confirmation. | |

9) “SHF” parameters

Table 19

| Name | Range | Description | Default Value |
|---|---|---|---|
| SHIFTS | 1 ~ 3 | Number of shifts counted in one day, reports of 3 shifts may be made at maximum for one day. | 3 |
| SHF1-ST | 00:00 ~ 23:30 | Start time of shift 1 (H:M), which may be H:00 or H:30 | 00:00 |
| SHF1-END | 00:00 ~ 23:30 | End time of shift 1 (H:M), which may be H:00 or H:30 | 08:00 |
| SHF2-ST | 00:00 ~ 23:30 | Start time of shift 2 (H:M), which may be H:00 or H:30 | 08:00 |
| SHF2-END | 00:00 ~ 23:30 | End time of shift 2 (H:M), which may be H:00 or H:30 | 16:00 |
| SHF3-ST | 00:00 ~ 23:30 | Start time of shift 3 (H:M), which may be H:00 or H:30 | 16:00 |
| SHF3-END | 00:00 ~ 23:30 | End time of shift 3 (H:M), which may be H:00 or H:30 | 00:00 |

10) “PAY” parameters

Table 20

| Name | Range | Description | Default Value |
|---|---|---|---|
| CHRG-DIV | ON/OFF | Time-division charge, which can be divided to peak period, valley period, and normal period. | ON |
| PEAK-ST | 00:00 ~ 23:30 | Start time of peak period | 00:00 |
| PEAK-END | 00:00 ~ 23:30 | End time of peak period | 00:00 |
| VALL-ST | 00:00 ~ 23:30 | Start time of valley period | 00:00 |
| VALL-END | 00:00 ~ 23:30 | End time of valley period | 00:00 |
| PEAK-FEE | 0 – 999999 | Flow unit price in peak period (RMB) | 0 |
| VALL-FEE | 0 – 999999 | Flow unit price in valley period (RMB) | 0 |
| NORM-FEE | 0 – 999999 | Flow unit price in normal period (RMB) | 0 |
| REM-CTRL | ON/OFF | Remain quantitative control, if activated, the 4$^{th}$ alarm contact | OFF |

| Name | Range | Description | Default Value |
|---|---|---|---|
| | | will be used. The 4th contact will be ON when there is no remain quantitative, or it is OFF. | |
| CHARGE | -99999 ~ 999999 | The flow purchased by user (RMB Yuan)<br>If it's a positive value, the "BALANCE" will increase; if it's a negative value, the "BALANCE" will decrease. | 0 |
| BALANCE | 0 ~ 9999999 | The balance of flow charge (RMB Yuan) | 0 |

11) "CON" parameters

Table 21

| Name | Range | Description | Default Value |
|---|---|---|---|
| CONTROL | ON/OFF | The 4th alarm contact will be used when CONTROL is ON. | OFF |
| TRIGGER | MAN/AUTO | "MAN": Before triggered, the 4th alarm contact remain its status. When triggered, alarm contact's status depends on GOT-OUT.<br>"AUTO": The 4th Alarm contact's status depends on GOT-OUT. | MAN |
| GOT-OUT | OFF/ON | "OFF": When this accumulation got CTRL-VAL, the 4th alarm contact will be OFF, otherwise it is ON.<br>"ON": When this accumulation got CTRL-VAL, the 4th alarm contact will be ON, otherwise it is OFF. | ON |
| AUTO-CLR | ON/OFF | ON: When this accumulation got CTRL-VAL, this accumulation will be cleared automatically. AUTO-CLR works only if TRIGGER is AUTO. | OFF |
| CTRL-VAL | 0—— 999999 | Control Value | 100 |
| ADVANCE | 0—— 999999 | Actually control will work if (this accumulation >= CTRL-VAL – ADVANCE). | 0 |

## Chapter VII Communication Setting

The instrument is capable of communication with master computer which may complete parameters setting, data collection, and monitoring of slave computer. Combined with industrial computer software, dynamic display, instrument data setting, graph generation, data storage, and printing can be realized in Chinese Windows system. Real-time data and curves collection as well as historical data and curves recording can also be achieved with our master computer management software, where historical data and curves can be exported to be Excel files for processing.

Communication: RS-485/RS-232 serial interface communication, baud rate between 1200 and 9600bps for choice;

Data format: 1 start bit, 8 data bits, 1 stop bit (see details in CD)

Wiring method:

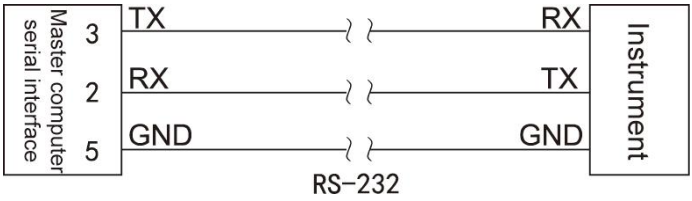



Fig. 26

# Chapter VIII Calculation

## 8.1 Mass Flow Expression

### 8.1.1 Mass Flow Expression for Standard Throttling Device

$$q_m = \frac{C}{\sqrt{1-\beta^4}} \varepsilon \frac{\pi}{4} d^2 \sqrt{2\Delta P \times \rho} \times 3600 \quad \cdots\cdots(1)$$

Fig. 27

Where: qm: mass flow (Kg/h)

C: Discharge coefficient (dimensionless)

B: diameter ratio (dimensionless)

ε: expansion coefficient (dimensionless)

d: Throttling piece diameter (m)

△P: differential pressure (Pa)

ρ : medium density in operating condition (Kg/m3)

In formula (1) above, β will be calculated below:

$$\beta = \frac{d}{D} \quad \cdots\cdots(2)$$

Fig. 28

D: The pipe diameter (m)

In formula (2) above, d and D will be calculated below:

$$d = d_{20}\left[1 + \lambda_d (t-20)\right] \quad \cdots\cdots(3)$$

$$D = D_{20}\left[1 + \lambda_D (t-20)\right] \quad \cdots\cdots(4)$$

Fig. 29

Where: d20 : throttling piece diameter at 20℃ (m)

d20 : the pipe diameter at 20℃ (m)

λ d: linear expansion coefficient of orifice plate material (10-6/℃)

λ D: linear expansion coefficient of tube material (10-6/℃)

t: operating temperature (℃)

In formula (1) above, ε and C will be calculated according to GB/T2624-2006 "Measurement of Fluid Flow by means of pressure differential devices inserted in circular cross-section conduits running full". Formula (1) applies to mass flow of the following measuring devices: Flange pressure plate, Machined classical Venturi tube, Angle pressure plate, Thick iron wielding section of Venturi tube, D and D/2 pressure plate, V-cone flow meter, ISA932 nozzle, Long diameter nozzle, Venturi nozzle, Casting-type Venturi tube.

**8.1.2 Mass Flow Expression for V-cone Flow Meter**

In formula (1) above, β will be calculated below:

$$\beta = \frac{\sqrt{D^2 - d^2}}{D} \quad \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots(7)$$

Fig. 30

**8.1.3 Simplified Mass Flow Expression for Throttling Device**

$$q_m = K\sqrt{\Delta P \times \rho} \quad \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots(8)$$

Fig. 31

Where: qm: mass flow (Kg/h)

△P: differential pressure (Pa)

ρ: medium density in operating condition (Kg/m3)

K: instrument coefficient

Formula (8) is a simplified expression derived from formula (1) where all coefficients are taken as constants, which applies to ther flow meter of differential pressure type. As instrument coefficient K is possibly not an invariable constant, K may be divided into 8 segments for segmented calculation to higher precision.

**8.1.4 Mass Flow Expression for Frequency-type Flow Meter such as Vortex**

$$q_m = \frac{3.6}{K} \times \rho \times f \quad \cdots\cdots (9)$$

Where: qm: mass flow (Kg/h)

K: flow coefficient of vortex flow meter (pulse/L)

ρ: medium density in operating condition (Kg/m3);

f: frequency of signal sent by vortex flow meter (Hz)

As flow coefficient K is possibly not an invariable constant, K may be divided into 8 segments for segmented calculation to higher precision.

Formula (9) applies to frequency-type flow meter such as vortex.

**8.1.5 Mass Flow Expression for Linear Volumetric Flow Meter**

$$q_m = \rho \times q \quad \cdots\cdots (10)$$

Fig. 32

Where: qm : mass flow (Kg/h);

q : volumetric flow measured by linear flow meter (m3/h);

ρ: medium density in operating condition (Kg/m3);

Formula (10) applies to measuring device of linear flow meter.

**8.2 Volumetric Flow Expression**

Volumetric flow in operating conditions:

$$q_v = \frac{q_m}{\rho} \quad \cdots\cdots (11)$$

Fig. 33

Volumetric flow in standard condition:

$$q_{vN} = \frac{q_m}{\rho_N} \quad \cdots\cdots (12)$$

Fig. 34

Where: qv : volumetric flow in operating condition (m3/h)

qvN : volumetric flow in standard condition (Nm3/h);

qm : mass flow (Kg/h);

ρ : medium density in operating condition (Kg/m3);

ρN : medium density in standard condition (Kg/m3);

Standard condition means temperature of 20℃ or 0℃ (subject to user's choice) and atmospheric pressure of 0.10133MPa.

**8.3 Density Compensation Formula**

**8.3.1 Gas Density Compensation Formula**

Dry gas density compensation formula:

$$\rho = \rho_N \times \frac{P \times T_N \times Z_N}{P_N \times T \times Z} \quad \cdots\cdots (13)$$

Fig. 35

Density compensation formula for dry part of humid gas:

$$\rho = \rho_N \times \frac{(P - \phi \times P_{s\max}) \times T_N \times Z_N}{P_N \times T \times Z} \quad \cdots\cdots (14)$$

Fig. 36

Where: ρ : medium density in operating condition

ρN : medium density in standard condition (Kg/m3);

P : absolute pressure in operating condition (MPa);

T : absolute temperature in operating condition (T);

PN : absolute pressure in standard condition (0.10133MPa);

TN : absolute temperature in standard condition (273.15K or 293.15K);

Z : compressibility factor in operating condition (dimensionless);

ZN : compressibility factor in standard condition (dimensionless);

φ : relative humidity in operating condition (%);

Ps max : saturated steam pressure in operating condition (MPa)

Compressibility factor Z could be solved by Redlich-Kwong equation:

$$Z^3 - Z^2 - (B^2 + B - A)Z - AB = 0 \quad \cdots\cdots (15)$$

$$A = \frac{0.4274802 P_r}{T_r^{2.5}} \qquad B = \frac{0.0866404 P_r}{T_r}$$

$$P_r = \frac{P}{P_c} \qquad T_r = \frac{T}{T_c}$$

Fig. 37

Where: Pc means critical pressure of gas (MPa);

Tc means critical temperature of gas (K)

**8.3.2 Water and Steam Density Formula**

Steam density may be solved by IAPWS-IF97 formula based on measured pressure and temperature.

Saturated steam dryness compensation formula:

$$v = x v_g + (1 - x) v_f \quad \cdots\cdots (16)$$

Fig. 38

Where: v : specific volume of humid saturated steam (m3/Kg);

vg : specific volume of saturated steam (m3/Kg);

vf : specific volume of water (m3/Kg);

x : dryness (%);

Water density may be solved in real time IAPWS-IF97 formula based on measured temperature and input atmospheric pressure.

**8.3.3 Liquid Density Formula**

Liquid (e.g. petroleum and diesel oil) density will be solved by formula below:

$$\rho = \rho_N \times \left(1 + A_1 \times (t - t_N) \times 10^{-2} + A_2 \times (t - t_N)^2 \times 10^{-6}\right) \quad \cdots\cdots (17)$$

Fig. 39

Where: ρ : liquid density in operating condition (Kg/m3);

ρN : liquid density in standard condition (Kg/m3);

tN : temperature in standard condition (℃);

t : temperature in operating condition (℃);

A1 : monomial coefficient of quadratic polynomial (dimensionless);

A2 : quadratic coefficient of quadratic polynomial (dimensionless);

**8.3.4 Heat Expression**

Steam heat expression:

$$Q = q_m \times h \quad \cdots\cdots (19)$$

Fig. 40

Where: Q : instantaneous heat (KJ/h);

qm : mass flow (Kg/h);

h : enthalpy (KJ/Kg);

Steam enthalpy h will be calculated in real time by IAPWS-IF97 formula.

**8.3.5 Heat Expression for Hot Water**

Heat expression for hot water:

$$Q = q_m \times \left(h_{\text{inlet temperature}} - h_{\text{outlet temperature}}\right) \quad \cdots\cdots (20)$$

Fig. 41

Where: Q means instantaneous heat (KJ/h);

qm means mass flow (Kg/h);

$h_{\text{inlet temperature}}$ : enthalpy of hot water at the inlet (KJ/Kg);

$h_{\text{outlet temperature}}$ : enthalpy of hot water at the outlet (KJ/Kg);

Hot water enthalpy h may be calculated in real time by IAPWS-IF97 Formula

## Chapter IX Example

Example 1: measuring mass flow of superheated steam with orifice plate with corner taps

- It's known that:

Tube material: #45 steel

Throttling element material: 1Cr18Ni9Ti

Tube caliber: 441.20mm

Throttling element caliber: 313.71mm

Atmospheric pressure: 0.10133Mpa

Differential pressure sensor: 4~20mA differential pressure transducer (two-wire system), measuring range: 0.00 ~ 60.00Kpa (no extraction);

Pressure sensor: 4~20mA pressure transducer (two-wire system), measuring range: 0.00 ~ 3.00Mpa;

Temperature sensor: PT100

- Validation parameters

Differential pressure sensor: 14mA

Pressure sensor: 12mA

Temperature sensor: 200Ω

- Parameters setting:

Table 22

| Item | | Content |
|---|---|---|
| Measuring device in "Device" configuration | | V02: orifice plate with corner taps |
| Tube material in "Device" configuration | | C05: #45 steel |
| Throttling element material in "Device" configuration | | C12: 1Cr18Ni9Ti |
| Tube caliber in "Device" configuration | | 441.20mm |
| Throttling element caliber in "Device" configuration | | 313.71mm |
| Measured medium in "Medium" configuration | | F03: steam |
| Atmospheric pressure in "Medium" configuration | | 0.10133Mpa |
| Differential pressure signal | Input channel | 01 |
| | Input type | 4 ~ 20mA |
| | Input unit | Kpa |
| | Upper/lower limit of measuring range | 0.00 ~ 60.00 |
| Temperature signal | Input channel | 02 |

| | | |
|---|---|---|
| | Input type | PT100 |
| | Input unit | ℃ |
| | Upper/lower limit of measuring range | 0.0 ~ 650.0 |
| Pressure signal | Input channel | 03 |
| | Input type | 4 ~ 20mA |
| | Input unit | Mpa |
| | Upper/lower limit of measuring range | 0.00 ~ 3.00 |

- Formula:

$$q_m = \frac{C}{\sqrt{1-\beta^4}} \varepsilon \frac{\pi}{4} d^2 \sqrt{2\Delta P \times \rho} \times 3600$$

Fig. 42

- Displayed result:

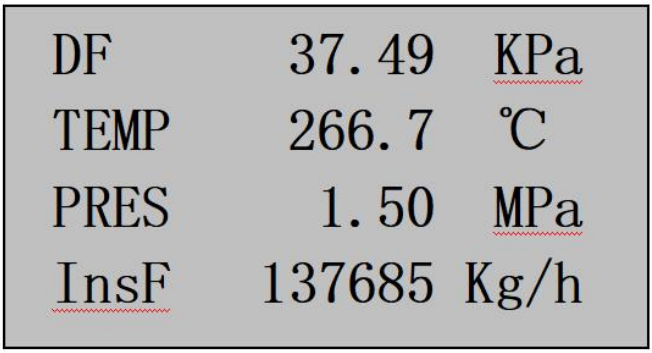



Fig. 43

Example 2: measuring mass flow of superheated steam by vortex street (frequency) flow meter with pressure and temperature.

- It's known that:

Atmospheric pressure: 0.10133Mpa

Vortex street sensor: 12V distributed power;

frequency 0 ~ 2000Hz;

coefficient K =500times/L

Pressure sensor: 4~20mA pressure transducer (two-wire system) for power distribution;

Measuring range: 0.00 ~ 1.00Mpa.

Temperature sensor: PT100

- Validation parameters

Vortex street sensor: 2000Hz

Pressure sensor: 16mA

Temperature sensor: 175.84Ω

- Parameters setting:

Table 23

| Item | | Content |
|---|---|---|
| Measuring device in “Device” configuration | | V12: frequency-type vortex street flow meter |
| Coefficient segment in “Device” configuration | | 1 |
| Segment 1 end point in “Device” configuration | | 1000 |
| Coefficient K1 in “Device” configuration | | 500 |
| Measured medium in “Medium” configuration | | F03: steam |
| Atmospheric pressure in “Medium” configuration | | 0.10133Mpa |
| Differential pressure signal | Input channel | 01 |
| | Input type | 4 ~ 20mA |
| | Input unit | Kpa |
| | Upper/lower limit of measuring range | 0 ~ 2000 |
| Temperature signal | Input channel | 02 |
| | Input type | PT100 |
| | Input unit | ℃ |
| | Upper/lower limit of measuring range | 0.0 ~ 6500.0 |
| Pressure signal | Input channel | 03 |
| | Input type | 4 ~ 20mA |
| | Input unit | Mpa |
| | Upper/lower limit of measuring range | 0.00 ~ 1.00 |

- Formula:

$$q_m = \frac{3.6}{K} \times \rho \times f$$

Fig. 44

- Displayed result:

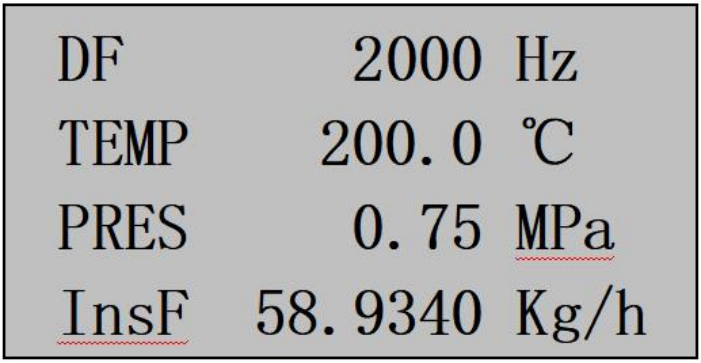



Fig. 45