G610/G610R Series LCD Thermal (Cold) Volume Intergral Regulator/ Recorder
Instruction for Use

I. Product Introduction

G610/G610R Series LCD Thermal (Cold) Volume Intergral Regulator/Recorder is specifically designed for boiler self-control, air-conditioning measurement, improvement of flow rate measurement accuracy. It is based on a 32-bit ARM micro-processor and equipped with the secondary meter with high-speed AD and high-capacity storage unit. The device has empowered by the surface mounting technology, featuring the design of multiple-layered protection and isolation, with a strong anti-interference capability and high reliability. It has used the embedded operating system with USB data dump function. The data storage time could reach up to 720 days. The enthalpy could be calculated according to the incoming and outgoing air temperatures in a real-time manner. Thus, the device is suitable to perform the process monitoring over the thermal/cold amount of the air conditioning and manage the accumulated total. By using U disk and host computer analysis software, one could call and view the historic curve of process variants and relevant historic data from time to time. It also could match with various flow-rate sensors, such as V-core flow-meter. The device has sound anti-theft and anti-power-down and other features.

II. Technical Parameters

Measurement Input	
Input Signal	Current: 0~20mA, 0~10mA, 4~20mA, 0~10mA rooting, 4~20mA rooting Input impedance: ≤ 100Ω Maximum input current limit: ≤ 30mA
	Voltage: 0~5V, 1~5V, 0~10V (customized), 0~5V rooting, 1~5V rooting, 0~20mV, 0~100mV Input impedance: ≥ 500KΩ
	Thermal resistance: Pt100, Cu50, Cu53, Cu100, BA1, BA2
	Linear resistance: 0~400Ω
	Thermocouple: B, S, K, E, T, J, R, N, F2, Wre3-25, Wre5-26
	Frequency signal: range: 0-10kHz; Wave shape: rectangle, sine wave, square wave
Output	
Output Signal	Analog output: 4~20mA (load resistance ≤ 480Ω), 0~20mA (load resistance ≤ 480Ω), 0~10mA (load resistance ≤ 960Ω), 1~5V (load resistance ≥ 250KΩ), 0~5V (load resistance ≥250KΩ), 0~10 V (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 communication interface, configurable baud rate of 1200~9600bps, standard MODBUS RTU communication protocol, RS-485 communication distance of up to 1km, and RS-232 communication distance of up to 15m.
General Parameters	
Measuring Accuracy	0.2%FS±1d
Setting Mode	Touch-panel-based key setting; password locking of parameter settings; permanent preservation of settings upon power failure.
Display	Backlit 3.5-inch 128*64 high-resolution dot-matrix FSTN LCD Support the display of Chinese characters, figures, curves and bar graphs, as well as screen page turning, historical data search and timescale changes of curves etc. through the panel keys

Recording Interval	1, 2, 4, 6, 15, 30, 60, 120, or 240 seconds, nine options available
Storage Length	3 days (with 1-sec interval) – 720 days (with 240-sec interval)
Printing Control	RS-232C printer interface, supporting SP-A40SH series serial printers
Operating Environment	Ambient temperature: 0~50℃; relative humidity: ≤ 85%RH; avoid strongly corrosive gas
Working Power Supply	AC 100~240V (switching power supply), 50/60HZ; DC 20~29V (switching power supply)
Power	≤5W
Structure	-Standard snap-in type

III. Ordering Instruction

Model Selection

G610 thermal integral regulator □ □ □ □

(1) (2) (3) (4)

G610R thermal integral regulator □ □ □ □

(1) (2) (3) (4)

①Dimensions		**②Alarm Output (Note 1)**	
Code	W*H*D	Code	Alarm channel (relay contact output)
A	160*80*110mm (horizontal)	X	No output
B	80*160*110mm (vertical)	1	Limit-1 alarm
C	96*96*110mm (square)	2	Limit-2 alarm
③Power Supply		3	Limit-3 alarm
Code	Voltage range	4	Limit-4 alarm
A	AC/DC 100~240V(50/60Hz)	5	Limit-5 alarm
D	DC 20~29V	6	Limit-6 alarm

④ Additional Functions

(all of the following functions can be selected and separated by "/"; functions not selected can be omitted)

Transmission Output (Note 1)		**Communication Output**	
Code	Output channel	Code	Communication interface(communication protocol)
1	Channel-1 transmission output	D1	RS-485 communication interface (Modbus RTU)
2	Channel-2 transmission output	D2	RS232 communication interface (Modbus RTU)
3	Channel-3 transmission output	D3	RS232C printer interface
4	Channel-4 transmission output		

Feed Output	
Code	Feed output (output voltage)
1P	Channel-1 feed output
2P	Channel-2 feed output
	E.g.: "2P (12/24)" refers to channel-1 and channel-2 feed outputs of 12V and 24V respectively

For Recording Instrument

USB Transfer		**Expansion**	
Code	Transfer	Code	Expansion
U	USB card transfer (with 1GB U disk)	SD	SD card expansion (8GB)

Note 1: the transmission output can be combined with alarm output, i.e. transmission output + alarm output ≤ 6; when the meter has chosen frequency input, to the greatest extent, channel-2 is the only option, transmission output transmission output + alarm output ≤ 4.

★: Input signal type (please indicate the signal type following the model selection at the time of goods ordering)

Signal Type	Span Range	Signal Type	Span Range
B	400~1800℃	0-400Ω Liner resistance	-9999~99999
S	-50~1600℃	0-350Ω (Internally reserved parameter)	-9999~99999
K	-100~1300℃	30-350Ω (Internally reserved parameter)	-9999~99999
E	-100~1000℃	0~20mA	-9999~99999
T	-100.0~400.0℃	0~100mA	-9999~99999
J	-100~1200℃	0~20mA	-9999~99999
R	-50~1600℃	0~10mA	-9999~99999
N	-100~1300℃	4~20mA	-9999~99999
F2	700~2000℃	0~5V	Customized
Wre3-25	0~2300℃	1~5V	-9999~99999
Wre5-26	0~2300℃	0~10V (customized)	-9999~99999
Cu50	-50.0 ~ 150.0℃	0~10mA Rooting	-9999~99999
Cu53	-50.0 ~ 150.0℃	4~20mA Rooting	-9999~99999
Cu100	-50.0 ~ 150.0℃	0~5V Rooting	-9999~99999
Pt100	-200.0 ~ 650.0℃	1~5V Rooting	-9999~99999
BA1	-200.0 ~ 600.0℃	Frequency F	1~10KHz
BA2	-200.0 ~ 600.0℃		

★Output signal type (please indicate the signal type following the model selection)

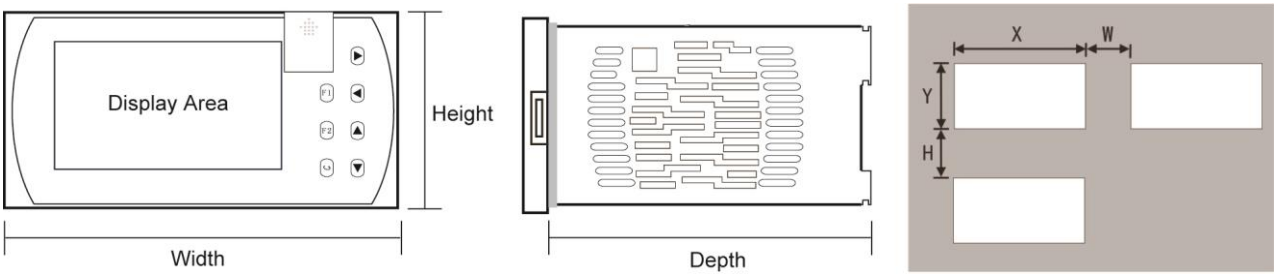
Signal Type	4~20mA	1~5V	0~10mA	0~5V	0~20mA	0~10V (customized)
RL	RL≤480Ω	RL≥250KΩ	RL≤960Ω	RL≥250KΩ	RL≤480Ω	RL≥4KΩ

IV. Installation

1. Position and climatic conditions

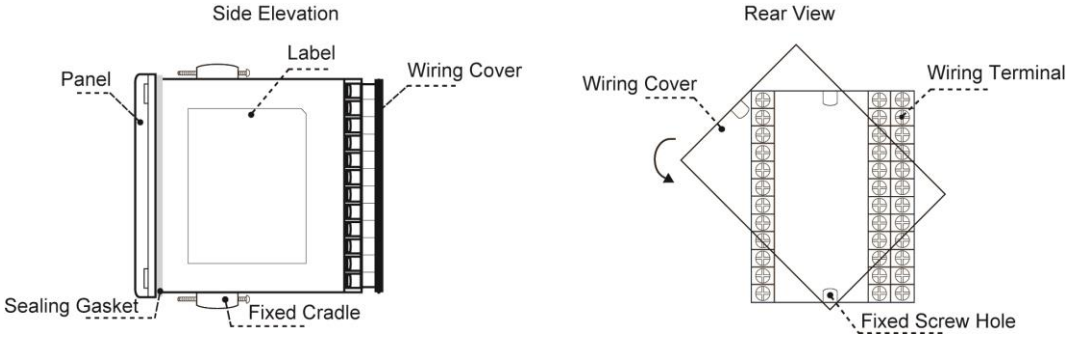
The instrument should be installed and kept as far away as possible from motors, transformers or other areas with shock, vibration and electromagnetic interferences. The instrument should remain horizontal with no tilt in installation. The installation position requires an ambient temperature of 0~50℃ and a relative humidity of no more than 85%, and should produce no condensate or corrosive or flammable gases.

2. Installation Dimension (Unit: mm)



	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. Instrument Installation

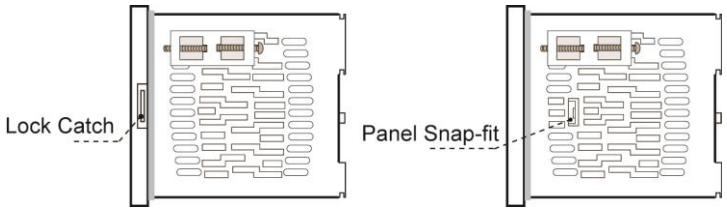


(1) Method for instrument installation on dial plates

Open the installing holes with the corresponding dimensions on the disk surface in accordance with the opening dimensions required by different instruments firstly to insert the instruments, and then install fixed cradles on both sides of the instruments with the screws tightened to make the instruments fixed on the disk surface and finally strip the protective membranes on the display screen. (In case more than one instrument shall be installed on a same dial plate, the minimum spacing between instruments listed on the above picture shall be referred to ensure the necessary heat dissipation and handling space.)

(2) Method for instrument core extraction from outer coverings

Move the lock catch on the body side of the instrument to the external side, push the snap-fit between the panel and the body on the other side of the instrument to the inner side, catch and push the front panel to the external side and finally the instrument core and shell can be separated (See the right picture).During the reinstallation, the instrument core must be pushed after inserted into the instrument shell and the lock catch shall be locked to ensure the reliability of the installation.



（3）Notes for installation

★The cable selection, instrument installation and electric connection must comply with the VD0100 “provisions for installation with circuits of 1000V or below” or relevant local regulations

★The electric connections must be conducted by specialized persons

★The load circuit should use fuse to ensure that the relay contact cut off the circuit automatically in case of short circuit or current exceeding the maximum capacity of the relay

★The input, output and power supply should be wired separately while avoiding parallel wiring

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

★The sensor and communication wire should use the shielded twisted cable

(1) Notes for standard wiring

★DC signal input (process input)

1. In order to reduce electrical interference, the cables for low-voltage DC signal and sensor input should be laid away from the strong current wiring. If not applicable, the shielded wire should be adopted and grounded at one point

2. Any device connected between the sensor and the terminal may have an impact on the measurement accuracy due to resistance or leakage current

★Thermocouple or pyrometer input

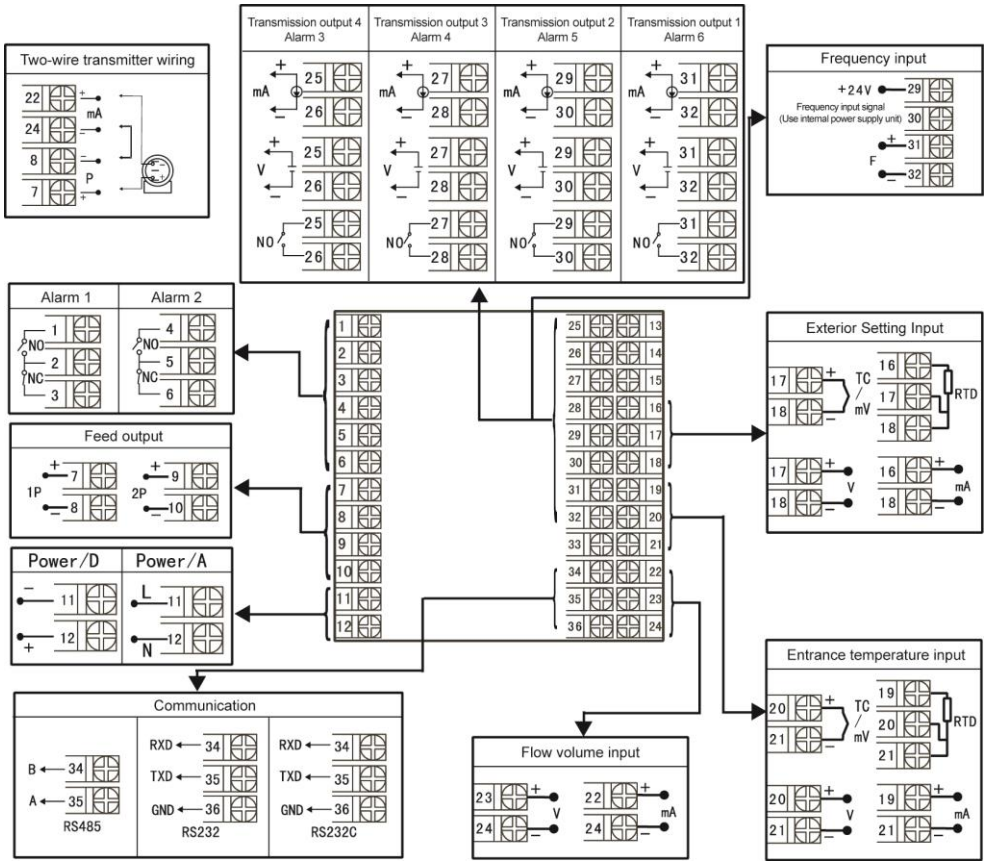
A compensation wire corresponding with the thermocouple should be used as extension and should

be shielded

★RTD input

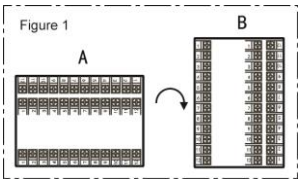
The three wires should have the same resistance value of no more than 15Ω

(5) Wiring diagram



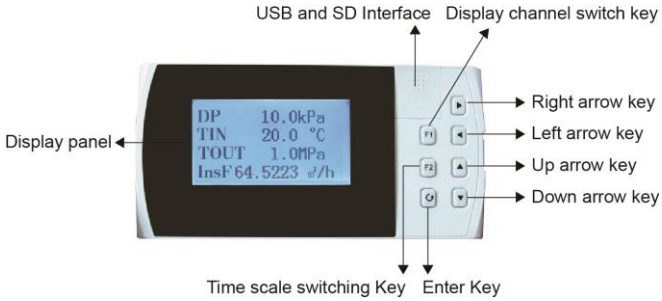
Note 1: regarding the different functions for the same terminal set as shown in the above diagram, the user can select only one of them. E.g., RS485 and RS232 are marked for the same set of terminals, and only one of them can be applied.

Note 2: The terminals on the back covers of horizontal and vertical instruments are arranged in different directions (see Figure 1)



V. Meter operation

1. Meter panel configuration



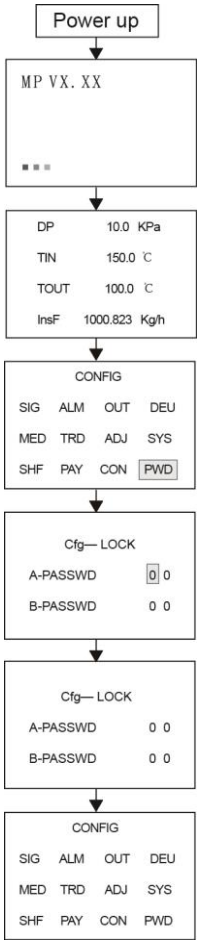
Name		Contents
Operation keys	Confirmation key	Confirm the options in the menu while choosing the menu. Confirm the newly designated parameters while revising parameters. Get access to SYS CONFIG menu by using "▲"key while the screen being displayed. Confirm the retracing time to be revised in the next step while historic data being displayed. Match with "◀ "key to clear the accumulative volume and power-down accumulative time to zero Move the position of decimal point by using "◀ " key while setting parameters
	▼ Key to move the cursor downward	Choose the menu to move the cursor upward and downward. Reduce the value of designated cursor location while revising parameters. Turn the displayed screen of the same channel up or down while measuring the displayed values. Reduce the time value of designated cursor location while revising the retracing time.
	▲ Key to move the cursor upward	Move the cursor upward while choosing the menu. Increase the value of designated cursor position while revising the parameters. Increase the time value of designated cursor location while revising the retracing time.
	◀ Key to move the cursor to the left	Move the cursor leftward while choosing the menu. Move the cursor leftward while setting the parameters. Move the cursor leftward while revising the retracing timeframe. Search retracing time backward from current time while displaying historic data. Stop the search while searching retracing timeframe forward.
	▶ Key to move the cursor to the right	Move the cursor rightward while choosing the menu. Move the cursor rightward while setting the parameters. Move the cursor rightward while revising the retracing timeframe. Search retracing time forward from current time while retracing historic data.
	F1	Switch among displayed screens of different channels while displaying measurement data. Get access to measurement display screen upon the completion of configuration setting.
	F2	Under real-time or historic curve screen, one could revise the time stamp of curve screen.

2. Operation method

1) Power-on the meter

After the wirings of the meter have been confirmed as correctly connected, the system will use several seconds or minutes to initialize the system. Please wait patiently.

2) Instrument unlocking



Power-on self-inspection

Main measurement display

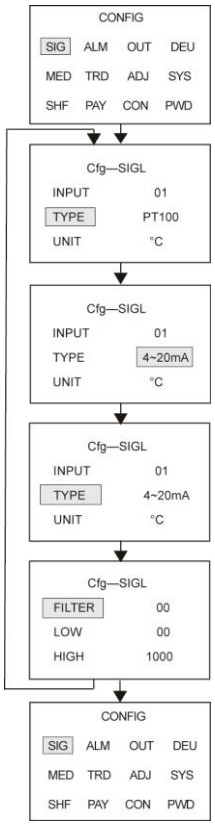
Press and ▲keys to enter the configuration screen
Move the cursor to “UNL” item

Press “ ” to enter Use “▲”, “▼”, “►”, and “◄” to enter the unlock code (default is 0)
Note: Only if the password of supplier and that of demand party both are set, the unlocking operation could be performed. a “√” symbol will appear when the code is entered correctly.

Press “ ” key to confirm the code, and then press “F1” key to return to the menu

When the unlocking operation is completed, the user may proceed with the setting of configuration parameters.
Note: if it returns to the measurement screen during setting, another unlocking operation would be required.

3) Parameter setting (unlocked)



Move the cursor to the target item (take “channel” for example)
Press “ ” to enter channel parameters setting

Move the cursor to the parameter to be changed
For example, “Input type PT100”
Press “ ” to confirm the parameter to be changed

Press “▲” and “▼” to change the target parameter
For example, “Input type 4-20mA”

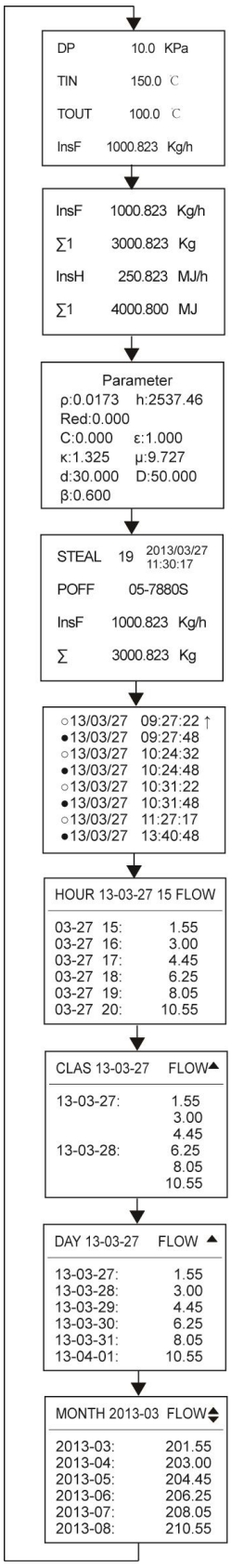
Press “ ” to save the new parameter

Press “▼” to enter filter coefficient setting and go through the above process. Setting of other parameters is the same as above.

Upon completion, press “F1” to return to configuration page.
Press “▲”, “▼”, “►”, and “◄” to set parameters of next item.

4) Display operation

a. Flow chart



Main measurement display

Press “F1” to switch to instantaneous cumulation display

Press “F1” to switch to intermediate parameters display

Press “F1” to switch to power-failure memory display

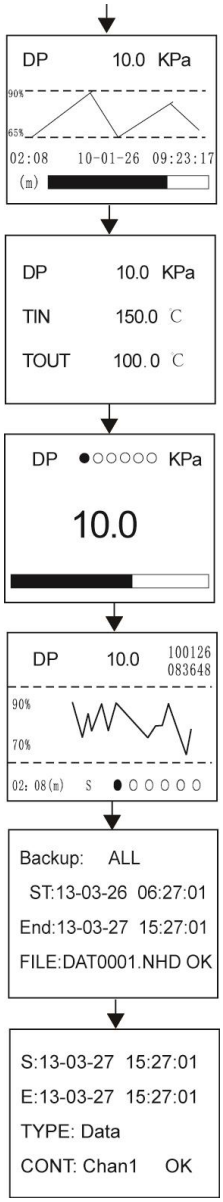
Press “F1” to switch to power-failure time display

Press “F1” to switch to hourly report display

Press “F1” to switch to shift report display

Press “F1” to switch to daily report display

Press “F1” to switch to monthly report display



Press "▼" to switch to real-time curve display
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
Press "F1" to switch to retrospective display of each channel

Press "▼" to switch to data backup page
(provided that the recording function is activated).

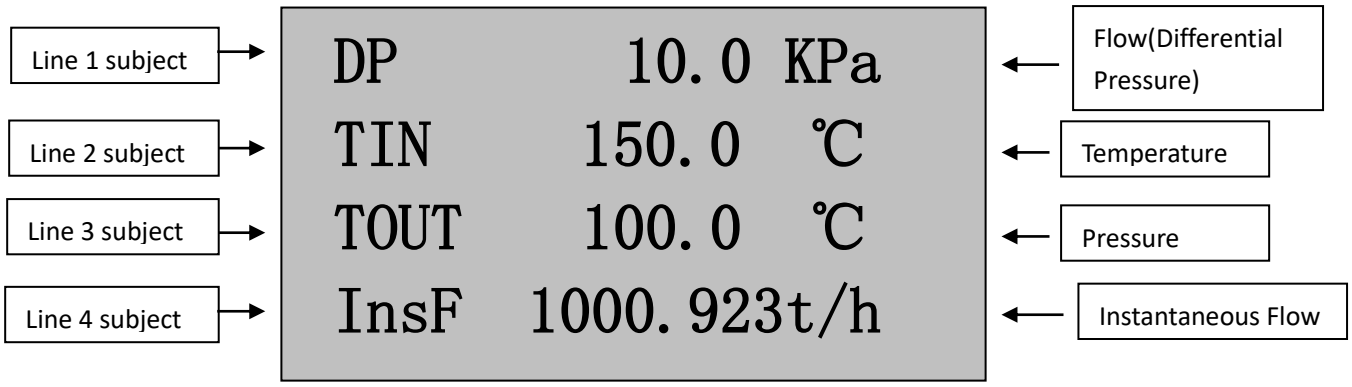
Press "▼" to switch to data printing page
(provided that the printing function is activated)

b. Explanations of relevant display screens

① Parameter display screen:

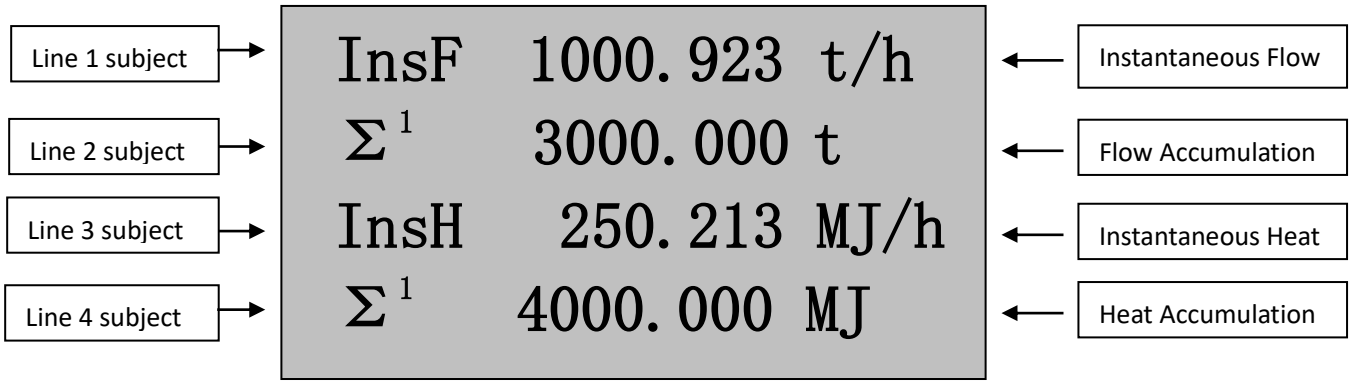
There are two screens in relation to flow rate and other related parameters, which could demonstrate entrance temperature value, exit temperature value, pressure difference, flow rate, channel measurements, instantaneous flow rate, and instantaneous thermal amount, accumulative flow rate value of each channel, accumulative thermal energy value, balance value, and margin value. Users may configure Display Screen 1 and Display Screen 2 through SYSTEM menu and define the displayed items and their sequence of each screen

Display Screen 1.



Press F1 to enter into the instantaneous accumulation screen.

Display Screen 2.



②Press “F1” key to access the intermediate parameter screen:

ρ:1.2045———— working status density ， Kg/m^3

C:0.605————discharge coefficient

Red:88346.393————Renault coefficient

ε：1.000————Expansion coefficient of measured medium

h：238.93———— Enthalpy of measured medium

(notes: this is usable when heat integral function is available)

μ：19.550———— Dynamic viscosity of measured medium, 10 Pa.s

κ： 1.402———— Isentropic coefficient of measured medium

β：0.600———— Diameter ratio of throttling device

d：30.000————Inner diameter of throttling device，mm

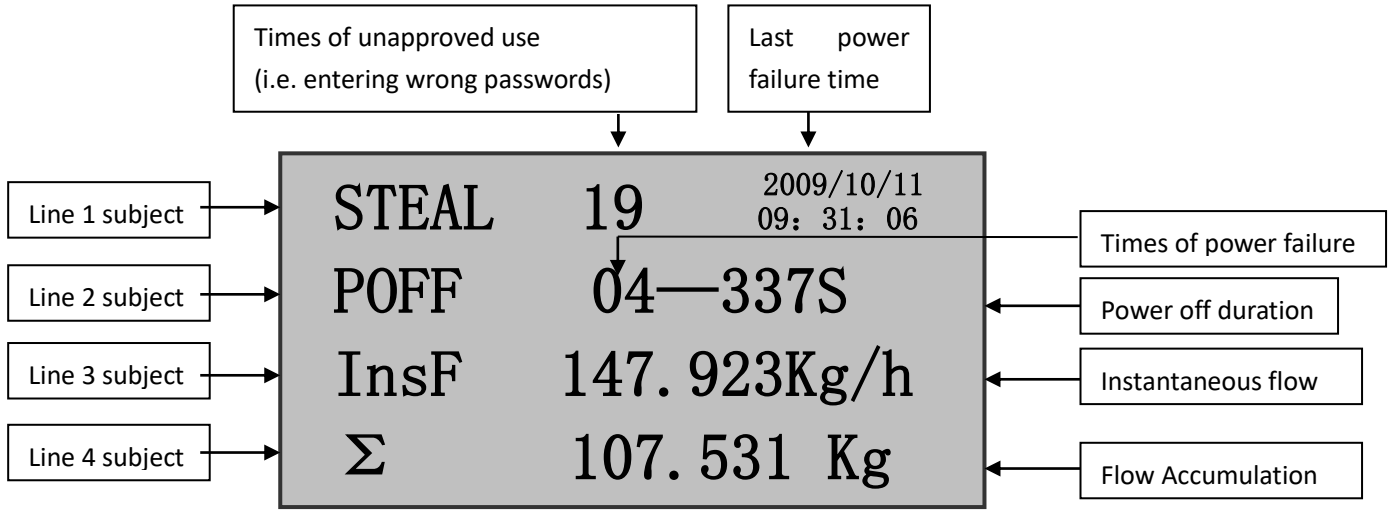
D：50.000————Pipeline diameter of throttling device, mm

Z：0.999———— Organic or inorganic gas compression coefficient

K：1.000———— Instrument coefficient

③ Press “F1” key again to access power-down memory display screen:

The chart below has shown the following: second, minute, hour, day, month, and year of the previous power-down event; total amount and duration of meter power-down (with second as its unit), instantaneous and accumulative flow rate values of previous power-down event.

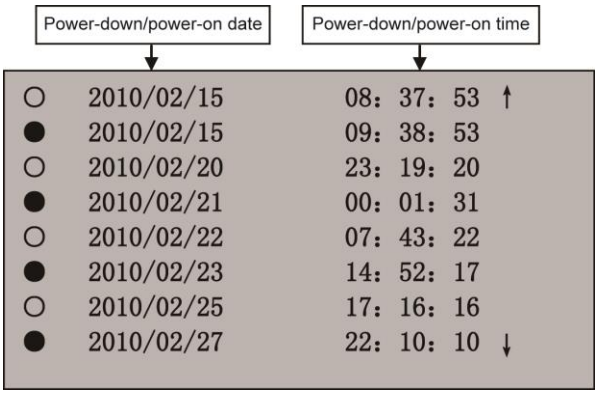


④ Press K1 key again to access power-down time display screen:

Only if the power down item in the system configuration above is set as “ON”, this screen will appear.

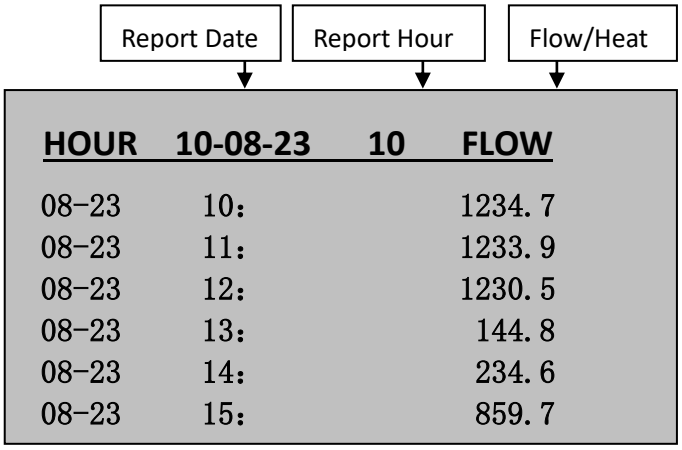
Power-down time display screen records the actual times of power-down and power-on during the course of meter operation. This screen could record eight moments of most recent power-down and power-on events.

As the chart below shown, the line with “○” refers to power-down record and that with “●” to power-on record. Rightward and leftward keys could be used to roll over the screen to view other records.



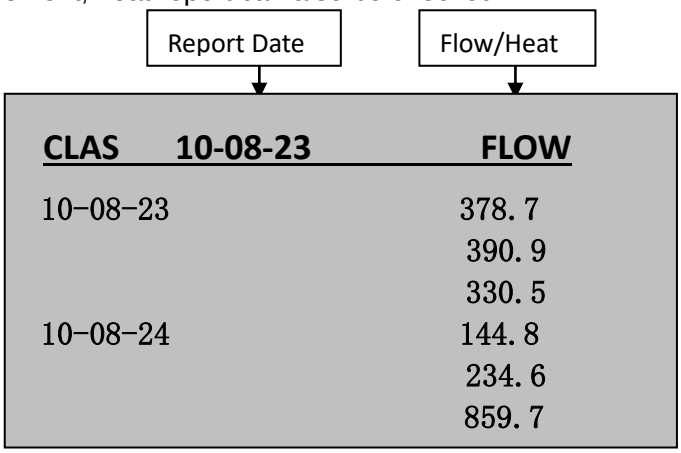
⑤ Press “F1” again to switch to hourly report display:

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.



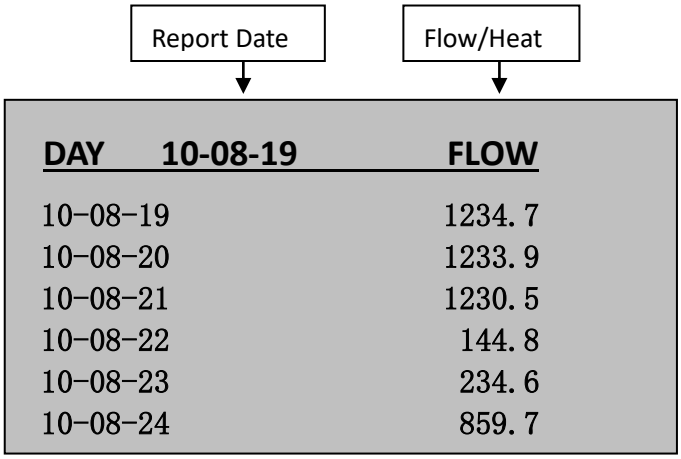
⑥ Press “F1” again to switch to shift report display:

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.



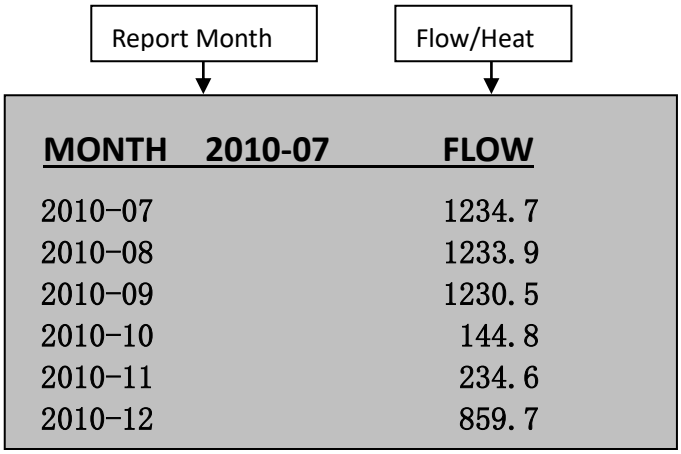
⑦ Press “F1” again to switch to daily report display:

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.



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

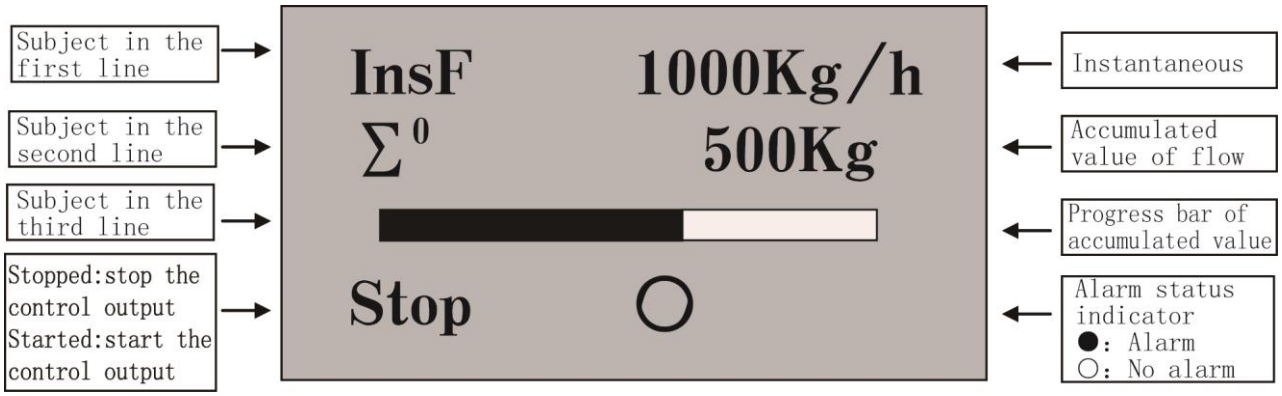
Monthly report is used to compile statistics of cumulative flow of current month, and reports may be checked by setting certain date. In case of steam or water measurement, heat report can also be checked.



c. Explanation of Dynamic measurement process screen

1) Quantitative Control Image

Press the ▼ button at the lower part of screen to turn to quantitative control image (As for the control parameters, this image is available when the quantitative control function is turned on).

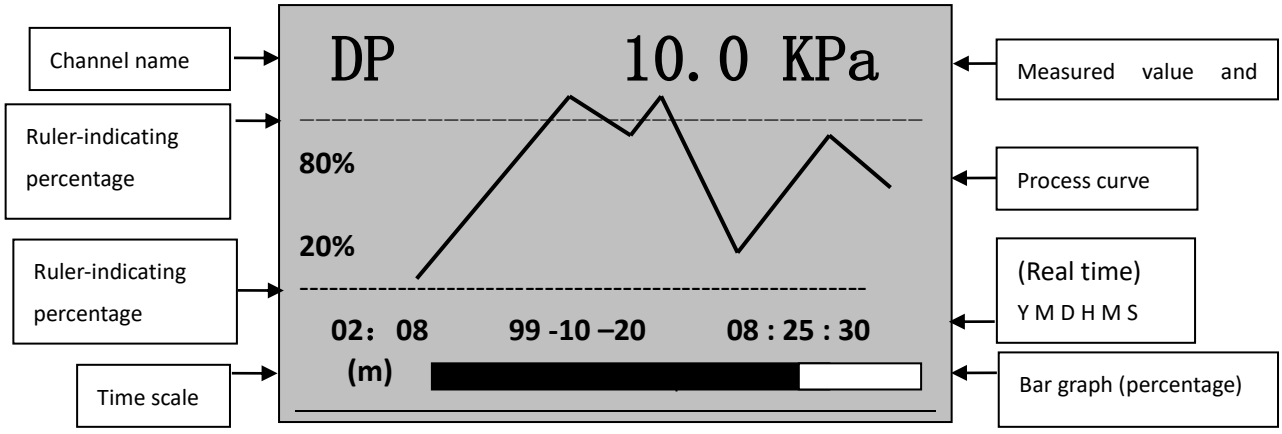


1. When in the automatic starting mode and instantaneous flow rate is input, the instrument will automatically activate the quantitative control function; when in the manual mode, press F1 to switch between the stopped and started function.

2. When the output settings are closed and accumulated value of flow reaches the controlling value, the instrument will exhibit alarm status, otherwise, it will not.

3. When the automatic resetting function is turned on, the instrument will reset automatically when the accumulated value of flow reaches the controlling value. If the instantaneous flow rate is still being input, the instrument will keep on accumulating.

2) Real-time curve screen



1. Screen time stamp 02:08 (m) means that the time length of the entire display screen is 2 minutes and 8 seconds.

Screen time stamp 02:08 (h) means that the time length of the entire display screen is 2 hours and 8 minutes

If the record time interval is above 15 seconds, the unit of screen time stamp will automatically change from (m) to (h).

2. Press "F2" key to change the screen time stamp in turn so as to expand or narrow down the historic data curve scope to be observed.

3. In the screen, the ruler ratio will be adjusted in line with the fluctuation magnitude of the process

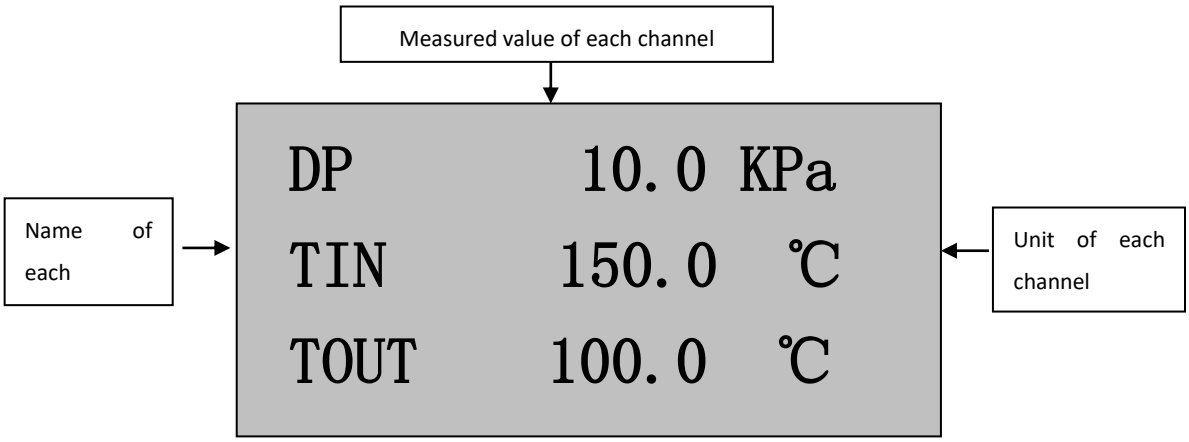
curve so that the meter might reach its maximum display accuracy as possible under the limited resolution.

4. The measured entities and channel name in the screen are the characters, whose display traits are defined by the values of “Name of Channel 1” and “Name of Channel 2” in the SYS CONF.

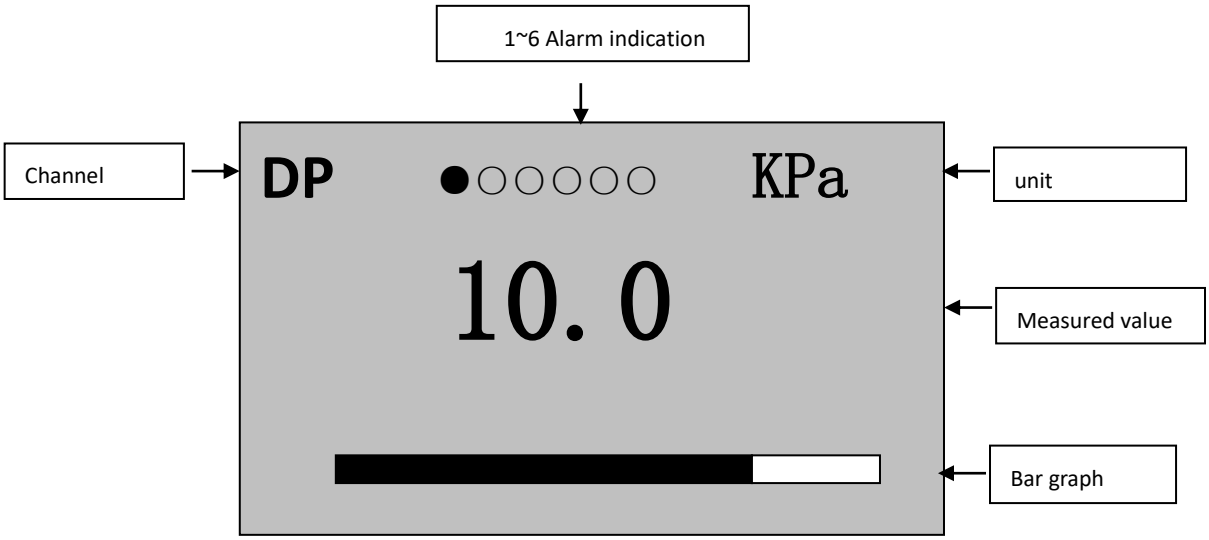
5. In the real-time curve screen, the real-time curves of given value and valve level could be switched with “F1”key

3) Real-time data measurement screen

Press “▼” key to switch from real-time curve screen to real-time data measurement screen.



Press F1 key again and then the alarm bar chart screen will appear.



1. Upon client demand, one could define any of the six input channels and set the upper limit or lower limit alarms.

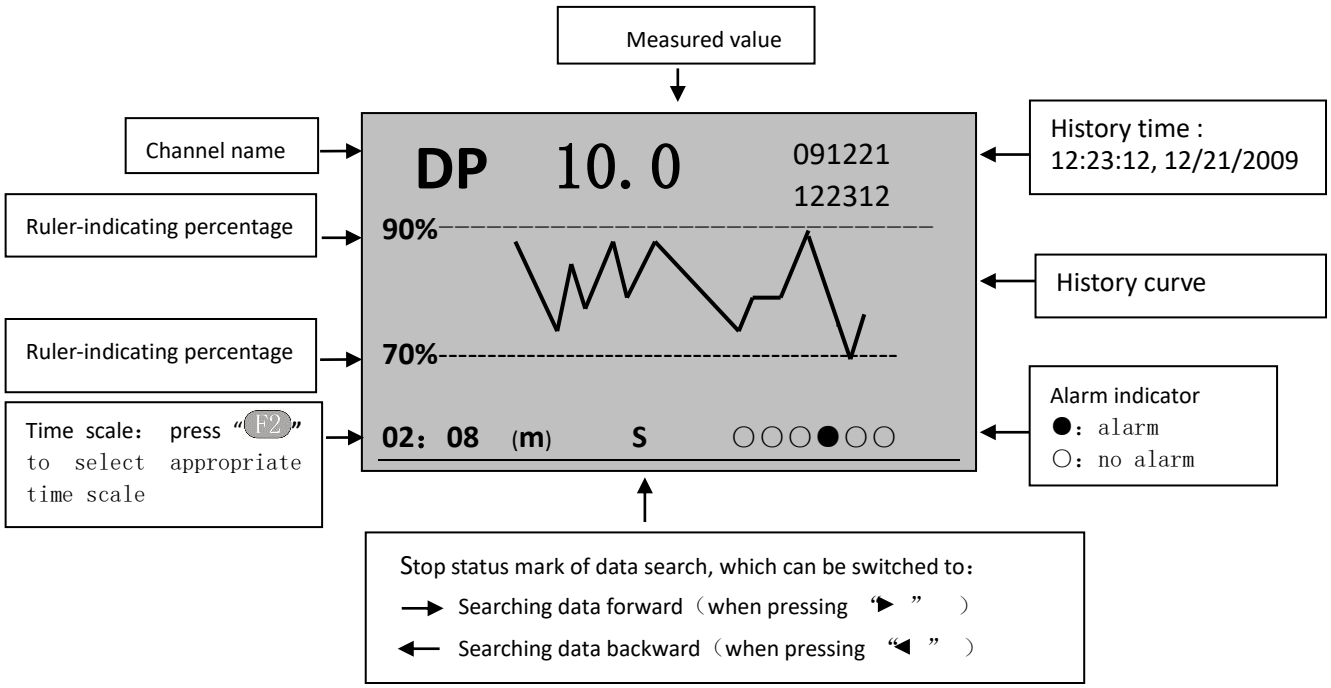
2. ● represents electrical relay action (alarming);

○ represents no electrical relay action (no alarming).

3. Under the alarm bar chart screen, one could press “F1” key to switch to the alarm bar chart screen of flow rate (pressure gap), temperature, and pressure.

4) Historic record screen

Press “▼” key to switch from real-time data measurement screen to historic record data screen.



Notes: Instructions on historic data retracing operations: (when the screen above is shown)

(1) When "►"key is pressed, one could search forward for the recorded data from existing screen; when "►"key is pressed, the search is halted.

When "◄"key is pressed, one could search backward for the recorded data from existing screen; when "◄"key is pressed, the search is halted.

(2)When "F2"key is pressed, the time stamp of the screen could changed in turn to expand or narrow down the historic data curve range to be observed.

(3) Press "↺" key to move the cursor to the time display zone on the upper right corner; press "►" and "◄" keys to move the cursor; press "▲" and "▼" keys to increase or decrease the value of "Second/minute/hour/day/month/year" at the cursor; press "↺" key to call the historic curve of the dates you input so as to retrace the required historic data curve screen.

(4) The matching relation between historic curve and data is as follows: the intersection point of historic curve and right frame of the screen.

(5) Under the historic record data retracing screen, one could press "F1" to switch the historic screens of flow rate (pressure gap), incoming air temperature, outgoing air temperature.

Notes: Flow rate clearing-to-zero function

A: Press"↺" key and "▲" Key to access the unlocking password setting of system configuration screen.

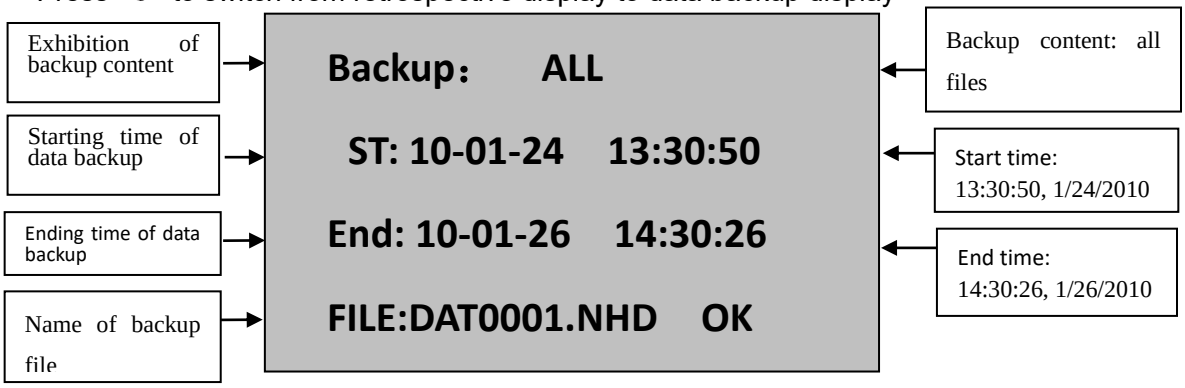
B: The password shall be set as follows:

The user sets the system password	******	Ex-factory default:00
Supplier and receiver passwords =******+1	Allow the clearing of accumulative flow rate value, accumulative heat energy value, amount of power-down events and time	After setting the password (for example: if initial code is 100132, clearing could be performance as the code is 100133)
Supplier and receiver passwords =******+2	Allow the clearing of the amount of power-down events and time	The operation method is the same with the item above
Supplier and receiver passwords	Allow the clearing of accumulative flow	The operation method is the same with

=******+3	rate value and accumulative heat energy value of Channel 1	the item above
Supplier and receiver passwords =******+4	Allow the clearing of accumulative flow rate value of Channel 2	The operation method is the same with the item above
Supplier and receiver passwords =******+5	Allow the clearing of accumulative flow rate value of Channel 3	The operation method is the same with the item above
Supplier and receiver passwords =******+6	Allow the clearing of accumulative flow rate value of Channel 4	The operation method is the same with the item above

5) Data backup screen

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



Notes: Instructions on data backup operation

Insert U Disk into the USB interface of the meter. Move the cursor with "►" and "◄" keys and revise the value of "Second/minute/hour/day/month/year" with "▲"and "▼" keys besides the cursor. After the revision, one could move the cursor to "data backup" option and press "" for confirmation. Then the meter will show the word "transferring" and then start to backup data (data copy time is related to data volume and U Disk performance). After the word "transferring" disappears, the data back operation is completed. Then, U Disk may be pulled out.

A file in *.NHD format copied to U Disk must be read by the machine position management software of the company. The software could view and print historic data and curve, export required data to an Excel file for further treatment.

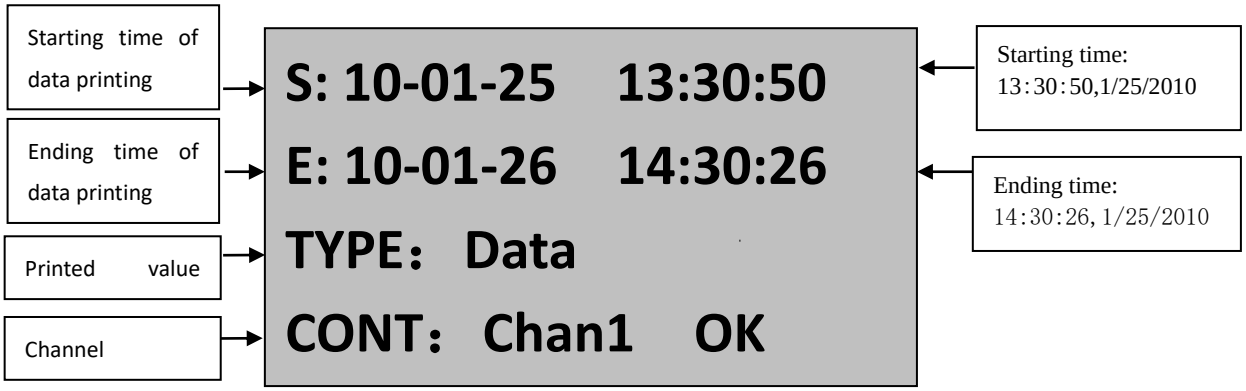
Insert the SD card into the SD card interface of the meter. As the meter time jumps to 00:00:00, the meter will automatically store the data of the day into SD card. When storing data, the meter will automatically change the starting time to 00:00:00 and the ending time to 23:59:59. The word "SD" will appear in the meter. As the progress bar disappears, the word "SD" will disappear as well, data storage operation will end, and the file name will become the date of the day.

Notes: U Disk and SD card must be in FAT or FAT32 format.

We suggest using U Disks and SD cards produced by the brands below: Kingston, Tsinghua UNIS, and SONY.

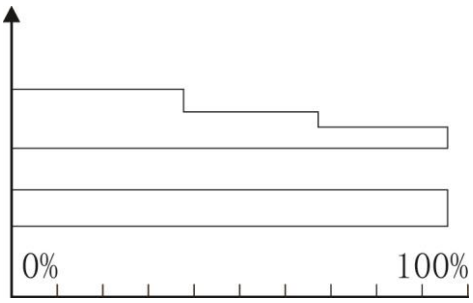
6) Data printing screen (this screen appears as the printer function is activated)

Press key to switch from data backup screen to data printing screen.



1. Manual printing

①After the printer type option of SYS CONFIG is set as “AS”, the printing channel will set the data and curve within the set time scope. Press “►” and “◄” keys and “▲”and “▼” keys to revise the values of “Second/minute/hour/day/month/year”, “type” and “channel”. After data revision, move the cursor to “Printing” option and press “ ” key for confirmation. Then the word “printing” will be displayed on the meter screen, representing that the meter has started to print the data or curve. The curve printing format is as follows:Curve printing format:



Pressure difference: KPa
End: 10-07-25 10-00-00
Start: 10-07-25 09-58-00
Data printing format:
100724142610： 625 ----------Measurement value at ending time
100724142609： 625
100724142608： 625
100724142607： 656
100724142606： 687
100724142605： 750
100724142604： 750
100724142603： 812
100724142602： 812
100724142601： 875 ---------- Measurement value at starting time

②As the printer type option of SYS CONFIG is set as “TS”, the data of all the channels of the moment will be printed. Press “►” and “◄” keys and “▲”and “▼” keys to revise the values of “Second/minute/hour/day/month/year”, “type” and “channel”. After data revision, change the printer type into “Data” and move the cursor to “Printing” option and press “ ” key for confirmation. Then the word “printing” will be displayed on the meter screen, representing that the meter has started to print the data or

curve. The printing format is as follows:

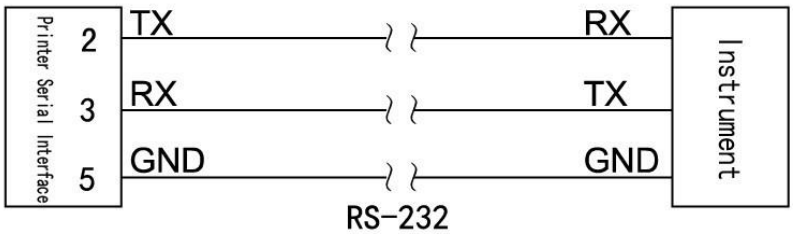
```
-------------------------------------------------
Alarm: ● ○ ○ ○ ○ ○          ----------Alarm status      ○: no alarm; ●: with alarm
Σ=                  0.053MJ  ----------Accumulative heat energy value
Instantaneous heat：  0.0000MJ/h ----------Instantaneous heat value
Σ=                  0.021Kg  ----------Accumulative flow rate value
Instantaneous：      15.0056Kg/h ----------Instantaneous flow rate value
Exit air temperature:    100.0℃  ----------Exit air temperature measurement
Entrance air temperature：  180.0℃ ----------Entrance air temperature measurement
Pressure gap:          10.0Kpa   ----------Pressure gap measurement
Time:          10-07-12 15-00-02  ----------Date/Time
-------------------------------------------------
```

2. Timing printing

Set the timing printing time interval within SYS CONFIG. As the measured time is equal to the pre-set time interval, the meter will automatically control the printer for timing printing, whose format is indicated above.

3. Alarming printing

As the alarming configuration function of SYS CONFIG is initiated and the alarm action triggered, the meter will automatically control the printer for alarming printing, whose format is indicated above. The schematic diagram on the connection means of the meter and the serial printer is as follows:



Notes: The baud rates of the meter and the printer must be equal (For details on setting the meter's baud rate, please refer to the section on the setting of the meter's level-2 parameters; for details on setting the printer's baud rate, please refer to the instruction manual of the printer).

6. Adjustment of frequency input voltage scope

1): At the time of configuring OC gate, the instrument input end has a voltage of 10V and OE gate is configured as no voltage:

	OC gate for frequency input	OE gate for frequency input
JP2 status		

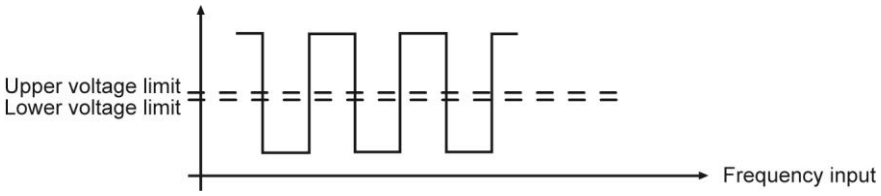
The scope of frequency and frequency scope is adjusted as follows:

1. Adjust the upper limit of input voltage: adjust the potentiometer W1 (forward spinning for decreasing and backward spinning for increase) and make the voltage of LM339's 7 pins against frequency input negative-end is less than the upper limit of input voltage.

2. Adjust the upper limit of input voltage: adjust the potentiometer W2 (forward spinning for

decreasing and backward spinning for increase) and make the voltage of LM339's 8 pins against frequency input negative-end is greater than the lower limit of input voltage.

★ Adjust potentiometers W1 and W2 and make their upper and lower voltage limits within the wave scope. At the time of exiting the factory, the lower voltage limit has been defaulted as about 2.5V, and the upper voltage limit as about 4.5V.



2) The chart below shows the switching method of amplifying the frequency:

	Enlarged voltage input (CP)	Normal voltage input (PP)
JP1 status		

★ Example: Because the frequency scope value of electromagnetic sensor is low, the instrument can't directly collect the data. Thus an amplifying circuit could be embedded in the instrument.

VII. 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.

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 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: 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
INPUT	04	The fourth input channel (unchangeable)	04
TYPE	See table of input types	Input signal type (see table of input signal types)	NO
UNIT	See table of units	Engineering unit of input channel (see Note 1)	MPa
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: 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.)

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

Name	Range	Description	Default Value
ALM-CHAN	01	The first alarm channel(unchangeable)	01
INPUT	1 – the 1st input channel 2 – the 2nd input channel 3 – the 3rd input channel 4 – the 4th input channel 5 –flow 6 –heat	Input channel (1 – 6) corresponding to the alarm channel	05
ALM-TYPE	NO: no alarm AL: Low alarm AH: High alarm SAL: reserved SAH: reserved LAL: Low cumulation alarm LAH: High cumulation alarm LALC: Low cumulation alarm and clear cumulation LAHC: High cumulation alarm and clear cumulation	Alarm type 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
ALM-TYPE	Same as above	Alarm type 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

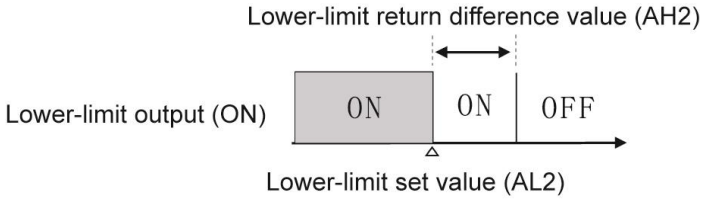
HYSTERES	0 ~ 99999	Set the alarm threshold hysteresis, which can prevent signal oscillation near the alarm threshold.	00
ALM-CHAN	03	The 3rd alarm channel(unchangeable)	03
INPUT	Same as above	Input channel (1 – 6) corresponding to the alarm channel	05
ALM-TYPE	Same as above	Alarm type Note: when the 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	04	The 4th alarm channel(unchangeable)	04
INPUT	Same as above	Input channel (1 – 6) corresponding to the alarm channel	05
ALM-TYPE	Same as above	Alarm type 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	05	The 5th alarm channel(unchangeable)	05
INPUT	Same as above	Input channel (1 – 6) corresponding to the alarm channel	05
ALM-TYPE	Same as above	Alarm type 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	06	The 6th alarm channel(unchangeable)	06
INPUT	Same as above	Input channel (1 – 6) corresponding to the alarm channel	05
ALM-TYPE	Same as above	Alarm type 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

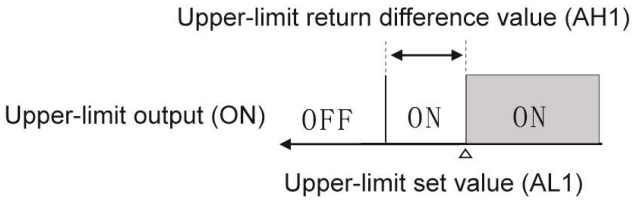
Note 4: Alarm mode: (Alarm threshold hysteresis can prevent signal oscillation near the alarm threshold, frequent alarms and cancellation of report)

Output status:

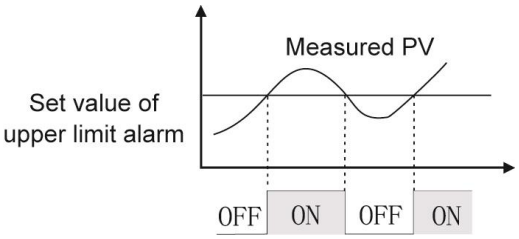
★ Signal value increases from a low value:



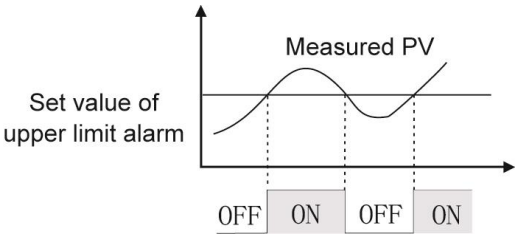
★ Signal value decreases from a high value:



★ High alarm output:



★ Low alarm output:



3) “OUTt” parameters

Name	Range	Description	Default Value
OUT-CHAN	01	The 1st output channel(unchangeable)	01
INPUT	1 – the 1st input channel 2 – the 2nd input channel 3 – the 3rd input channel 4 – the 4th input channel 5 –flow 6 –heat	Input channel (1 – 6) corresponding to the analog output channel	05
OUT-TYPE	No: no output Current: 0~20mA, 0~10mA, 4~20mA Voltage: 0~5V, 1~5V, 0~10V	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
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
OUT-CHAN	03	The 3rd output channel(unchangeable)	03
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
OUT-CHAN	04	The 4th output channel(unchangeable)	04
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.

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 λ_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 λ_d (Note 2)	actual condition
D20	0 – 999999	The pipe diameter D20 at 20℃ (in mm)	actual condition
d20	0 – 999999	Throttling piece diameter d20 at 20℃ (in mm)	actual condition
λD	0 – 999999	Linear expansion coefficient of tube material – λ_D (in 10^{-6}mm/(mm.℃))	actual condition
λ_d	0 – 999999	Linear expansion coefficient of throttling piece material – λ_d (in 10^{-6}mm/(mm.℃))	actual condition
SQRT	YES/NO	YES: When differential pressure transmitter has	YES

		no square root computation, and the instrument needs to do this for differential pressure signal. NO: When differential pressure transmitter has square root computation	
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 ≤ differential pressure or frequency ≤ RANGE5	100
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 iron
10CrMo910	User-defined

5) “MED” parameters

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

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℃
ρ 0	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 compensation; see liquid density formula.	1
A2	-9999.9 ~ 999999	Quadratic coefficient of quadratic polynomial of liquid temperature compensation; see liquid density formula.	1
H0	0~ 999999	Liquid thermal enthalpy value in the standard condition ,KJ/Kg Note: medium for liquid need to set the parameters	actual condition
B1	-9999.9 ~ 999999	Thermal enthalpy of liquid temperature compensation in a quadratic polynomial coefficients, see liquid enthalpy equation	1

B2	-9999.9 ~ 999999	Thermal enthalpy of liquid temperature compensation in a quadratic polynomial coefficients, see liquid enthalpy equation	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 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

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 signal cut off	1
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, m^3/h, m^3/m, m^3/s, Nm^3/h, Nm^3/m, Nm^3/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

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
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

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;	AS

		TS: when manual printing data, it will print measured value of all channels at current time	
PRT-INTR	1- 2000 minutes	The interval time of equal-interval print	1 (minute)
PRT-STRT	H-M	Start time of equal-interval print	00:00
ALM-PRT	ON/OFF	ON: print when new alarm occur 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 01: TEMP, Temperature 02: PRES, Pressure 03: FLOW 04: DP, Differential Pressure 05: TIN, Inlet Temperature 06: TOUT, Outlet Temperature 07: blank	Channel name of the 1st input channel	4
CH2-NAME	Same as above	Channel name of the 2nd input channel	5
CH3-NAME	Same as above	Channel name of the 3rd input channel	6
CH4-NAME	Same as above	Channel name of the 4th input channel	4
AUT-PAGE	ON: automatic page switch (interval of about 10s) 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: 1 0 X1 X2 X3 X4: X1: 1st line content X2: 2nd line content X3: 3rd line content X4: 4th line content	Line content: Xi Content 0 – blank 1 – measured value of signal channel 1 2 – measured value of signal channel 2 3 – measured value of signal channel 3 4 – measured value of signal channel 4 5 – instantaneous flow 6 – instantaneous heat 7 – instantaneous cold 8 – cumulative flow 9 – cumulative heat A – cumulative flow of channel 2 B – cumulative flow of channel 3 C – cumulative flow of channel 4 D – user balance E – residual flow subscribed	User-defined
PAGE2	Page 1 has 4 lines, its content is defined by the following 4 bits: 2 0 X1 X2 X3 X4: X1: 1st line content X2: 2nd line content	Same as above	User-defined

	X3: 3rd line content X4: 4th line content		
PWR-PAGE	ON: Display of Power On/Down page is ON; 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; 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; No: not to clear all reports;	Press "U", 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 "U" for confirmation.	

9) "SHF" parameters

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

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 4th alarm contact will be used. The 4th contact will be ON when there is no remain quantitative, or it is OFF.	OFF
CHARGE	-99999 ~ 999999	The flow purchased by user (RMB Yuan)	0

		If it's a positive value, the "BALANCE" will increase; if it's a negative value, the "BALANCE" will decrease.	
BALANCE	0 ~ 9999999	The balance of flow charge (RMB Yuan)	0

11) "CON" parameters

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. "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. "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

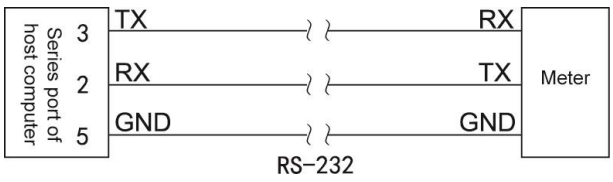
Ⅷ. Communication devices

This device has the communication function of host computer, which could perform various functions against subordinate computer, such as parameter setting, data collection, and monitoring. By matching with industrial control software, under Chinese-version Windows, the host computer could accomplish dynamic screen display, meter data setting, chart generation, disk storage record, statement printing and others. Meanwhile, by using the company's host computer management software, the host computer could collect required data and curve, record historic data and curve in a real-time manner. The historic data and curve could be exported to Excel for further treatment.

Communication means: Series communication RS-485, RS-232 and others; baud rate 1200- 9600 bps available.

Data format: one digit for initiation bit, eight for data bits, one for stop bit. See communication CD for parameter details.

Wiring connection means:



Ⅸ. Calculation function

1. Mass flow rate equation

1.1 The mass flow rate equation of standard throttling element is:

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

Therein:

q_m-------Mass flow rate, kg/h;

C-------Discharge coefficient, without dimension;

β------Pipe diameter ratio, without dimension;

ε-------Expansion coefficient of measured medium, without dimension;

d-------Orifice plate opening diameter, m;

△P---------Pressure gap, Pa;

ρ---------Medium density under working conditions, kg/ m^3;

Therein, βshall be calculated according to the equation below:

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

Therein:

D------Inner pipeline diameter, m.

d and D shall be calculated as follows:

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

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

d_{20}-------Orifice plate opening diameter at 20℃, m;

D_{20}-------Inner pipeline diameter at 20℃, m;

λ_d-------Expansion coefficient of orifice plate material, 10^{-6} /℃;

λ_D------- Expansion coefficient of pipeline material, 10^{-6} /℃;

t------Working temperature, ℃;

In Formula (1), ε and C shall be calculated pursuant to GT/T 2624-2006 Measurement of Fluid Flow Rate of Full Tube with Pressure Gap Measuring Device mounted inside the Pipe with Round Section. Formula (1) is applicable to the following mass flow rate measuring devices: flange tapping orifice plate, corner joint tapping orifice plate, D and/2 tapping orifice plate, ISA1932 nozzle, long diameter nozzle, Venturi nozzle, Venturi nozzle of casting type, classic Venturi nozzle of mechanic processing type, classic Venturi nozzle of rough iron plate section.

1.2 Mass flow rate equation of V-coned flow meter

$$q_m = K \times \varepsilon \sqrt{\Delta P \times \rho} \quad \cdots\cdots(5)$$

Therein:

q_m-------Mass flow rate, kg/h;

K-----Instrument coefficient;

ε-------Expansion coefficient of measured medium, without dimension;

△P---------Pressure gap, Pa;

ρ---------Medium density under working conditions, kg/ m^3;

In Formula (5), εshall be calculated as follows:

$$\varepsilon = 1 - \left(0.649 + 0.696 \times \beta^4\right) \times \frac{\Delta P}{\kappa \times P} \quad \cdots\cdots(6)$$

In Formula (6),

β-----Equivalent diameter ratio, without dimension;

κ----Isentropic coefficient of measured medium (compressible liquid);

△P---------Pressure gap, Pa;

P------Absolute static pressure of compressible liquid of upper stream tapping opening of throttling element (inner cone) under working conditions

△P shall have the same unit with P.

Therein, β shall be calculated as follows:

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

In Formula (7):

D------Inner diameter of measuring tube under working conditions, m;

d------Diameter of the circle at the maximum section of sharp-coned body under working conditions, m;

D and d shall be calculated pursuant to Formula (3) and Formula (4).

Formula (5) is applicable to V-coned flow meter. Because the instrument index K is not a constant, we divide K into 8 sections so that K could be calculated by section, gaining a higher accuracy.

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

Therein:

q_m-------Mass flow rate, kg/h;

△P---------Pressure gap, Pa;

ρ---------Medium density under working conditions, kg/ m^3;

K-----Instrument coefficient;

Formula (8) is a simplified equation assuming that all the coefficients are constants, applicable to V11 flow meter of pressure gap type. Because the instrument index K is not a constant, we divide K into 8 sections so that K could be calculated by section, gaining a higher accuracy.

1.4 Mass flow rate equation of turbine flow meter of constant frequency type:

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

Therein:

q_m-------Mass flow rate, kg/h;

K-----Flow rate coefficient of turbine flow meter, pulse/L;

ρ---------Medium density under working conditions, kg/ m^3;

f-------Signal frequency sent forth by turbine flow meter, Hz.

Because the instrument index K is not a constant, we divide K into 8 sections so that K could be calculated by section, gaining a higher accuracy. Formula (9) is applicable to the turbine flow meter of constant frequency type:

1.5 Mass flow rate expression of linear volume flow meter

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

In Formula (10):

q_m-------Mass flow rate, kg/h;

q-------volumetric flow rate measured by linear flow meter, m^3 /h;

ρ--------Medium density under working conditions, kg/ m^3.

Formula (10) is only applicable to linear flow meter.

2. Formula of volume flow rate

Volume under working conditions

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

Volume flow rate under standard conditions:

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

In Formula (12):

q_v------Volume flow rate under working conditions, m^3 /h;

q_{vN}-------Volume flow rate under standard conditions, Nm^3/h;

q_m-------Mass flow rate, kg/h;

ρ-------Medium density under working conditions, kg/m^3;

ρ_n-------- Medium density under standard conditions, kg/m^3.

Standard conditions represent that the users may choose an environment of 20℃，0.10133MPa or 0℃，0.10133MPa.

3. Density compensation calculation formula

3.1 Gas density compensation formula

Dry air density compensation formula:

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

Density compensation formula of dry parts of wet air:

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

Therein:

ρ---- Medium under working conditions；

ρ_N-----Liquid density under standard conditions, Kg/m^3；

P------Absolute pressure under working conditions, MPa;

T------ Absolute temperature under working conditions, T;

P_N-----Absolute pressure under standard conditions, 0.10133Mpa;

T_N-----Absolute temperature under standard conditions, 273.15K or 293.15K;

Z------Compression coefficient under working conditions, without dimension;

Z_N----- Compression coefficient under working conditions, without dimension;

φ---Absolute humidity under working conditions, %;

$P_{s\,max}$ --------Saturated pressure of water vapor under working conditions, MPa

Compression coefficient Z shall be calculated based on the Redlich-Kwong Equation:

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

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

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

3.2 Calculation of water and vapor density

The density of vapor shall be calculated according to measured pressures, temperatures, IAPS-IF97 formula on a real-time basis:

Dryness compensation formula of saturated vapor:

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

In formula (16):

V--------Specific volume of wet saturated vapor, m^3 /Kg;

V_g-------Specific volume of saturated vapor, m^3 /Kg;

V_f-------Specific volume of water, m^3 /Kg;

X--------Dryness, %

The water density could be calculated with measured temperatures, input atmospheric pressure, IAPWS-IF97 on a real-time basis.

3.3 Liquid density formula

The density formula of liquid (like gasoline, diesel, and liquid ammonia) could be based on quadratic polynomial algorithm:

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

In Formula (17):

ρ---- Liquid density under working conditions, Kg/m^3;

ρ_N-----Liquid density under standard conditions, Kg/m^3;

t_N-----Temperature under working conditions, ℃;

t-----Temperature under standard conditions, ℃;

A_1---First-order coefficient of quadratic polynomial equation, without dimension;

A_2--- Second-order coefficient of quadratic polynomial equation, without dimension;

3.4 Calculation of physical feature parameters of natural gas

This is executed pursuant to SY/T6143-2004 Standard Orifice Plate Measurement Method of Natural Gas Flow Rate.

The calculation of compression factors complies with GB/T17747-1999 Norms.

$$Z = 1 + B\rho_m - \rho_\tau \sum_{n=13}^{18} C_n^* + \sum_{n=13}^{58} C_n^* \left(b_n - c_n k_n \rho_\tau^{k_n}\right) \rho_\tau^{b_n} \exp\left(-c_n \rho_\tau^{k_n}\right) \quad \cdots\cdots(18)$$

In Formula (18):

Z ------Compression factor;

3.5 Expression of heat energy

Heat energy formula of vapor:

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

In Formula (19):

Q------Instantaneous heat energy, KJ/h;

q_m------Mass flow rate, Kg/h;

h------ Caloric content, KJ/Kg

$$Q = q_m \times \left(h_{入温} - h_{出温}\right) \quad \cdots\cdots(20)$$

In Formula (20):

Q--------Instantaneous heat energy, KJ/h;

Qm------Mass flow rate, Kg/h;

$h_{入温}$------ Caloric content of pipe joint of incoming hot water, KJ/Kg;

$h_{出温}$------ Caloric content of pipe joint of outgoing hot water, KJ/Kg;

The caloric content of hot water or h shall be calculated according to IAPWS-IF97 Formula on a real-time basis.

$$Q = q_{vn} \times h \quad \cdots\cdots(21)$$

In Formula (21):

Q----Energy flow rate of natural gas, MJ/h;

q_{vn}----Volumetric flow rate of natural gas under standard comparison conditions, m^3/h;

h----Volumetric caloric value of natural gas under standard comparison conditions, following SY6143—1999 Norms.

Ⅹ. Application examples

Example 1: Use the flange tapping orifice plate to measure the heat quantity of hot water

- Known parameters:

  Pipeline material: 20 Steel

  Throttling element material: 1Cr18Ni9Ti

  Pipeline diameter: 100mm

  Throttling element diameter: 50.47mm

  Atmospheric pressure: 0.10133Mpa

  Pressure gap sensor: Two-wired System 4-20mA pressure gap transducer, two-lined power distribution, measurement scope: 0.00-100.00 Kpa, no root extraction

  Temperature sensor: PT100

- Parameter setting:

Item	Content
Measuring device under “Equipment” menu	V01: flange tapping orifice plate
Pipeline material under “Equipment” menu	C04: 20 Steel
Throttling element material under “Equipment” menu	C12: 1Cr18NiTi
Pipeline diameter under “Equipment” menu	100mm

Throttling diameter under “Equipment” menu		50.47mm
Measured medium under “Medium” menu		F04:0.6Mpa
Atmospheric pressure under “Medium” menu		0.10133Mpa
Pressure gap signal	Input channel	01
	Input type	4-20mA
	Input unit	Kpa
	Upper and lower limits of measuring scopes	0.0-100.00
Incoming air temperature	Input channel	02
	Input type	PT100
	Input unit	℃
	Upper and lower limits of measuring scopes	0.0-650.0
Outgoing air temperature	Input channel	03
	Input type	PT100
	Input unit	℃
	Upper and lower limits of measuring scopes	0.0-650.0

- Calculation formula

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

- Displayed outcome: