Flow Totalizer

Installation and Operation Guide

CONTENTS

Safety Information

- Always comply with the safety information to prevent accidents and the occurrence of potential danger.
- This manual classifies important grade of safety attentions by Caution and Warning.

Caution

These tips guide further explanations or related instructions.

Warning

Error operation in case of ignoring the tips might cause the personal injury or major accident.

- In order to use this manual conveniently, please pass this manual to technical department of end user to keep.
- When installing and debugging the module, please take protections before touching the PCB (Electrostatic discharge).
- When doing debugging, it needs to take down the enclosure of instrument. Please take care to avoid electric shock during the process.
- Disposal: This instrument contains a large number of electronic components and a small amount of Ni-MH batteries, please disposal these wastes according to the electronic industry waste treatment. Environmental protection is everyone's responsibility!

Part 1 Instruction

1.1 Features

- Suitable for flow (heat) displaying, calculating and controlling of all kinds of liquids, single or mixed gases and vapor.
- Input multiple flow sensor signals (Such as VSF, Turbine, Electromagnetic, Roots, Elliptical gear, Duplex rotor, Orifice plate, V-cone, Annubar, and Thermal flowmeter, etc.).
- Flow input channel: Receive frequency and multiple current signals.
- Pressure and temperature input channel: Receive multiple current signals.
- Provide 24VDC and 12VDC power supply with short circuit protection, simplify the system and save investment.
- Fault-tolerance: When the compensation measurement signals of temperature, pressure or density are abnormal, compensate with the manual setting of the corresponding operation.
- Circular display: Provide convenience to monitor multiple process variables.
- The update cycle of output current signal is 1 second, which can meet the requirements of the automatic control.
- Configure with Instrument clock, automatic meter reading and print function, provide convenience for metering management.
- Self-test and self diagnosis make the instrument more easy to use and maintain.
- 3 -level password to prevent unauthorized personnel to modify parameters.
- There are no potentiometer, code switch and other adjustable devices, that can improve the vibration resistance, stability and reliability of the instrument;
- Communication
  - ✧ RS485
  - ✧ RS232
  - ✧ GPRS/CDMA
  - ✧ Ethernet
- Configure with temperature, pressure, and density compensations, and it also has compressibility coefficient compensation for general gas and flow nonlinear compensation.

- Perfect function of vapor's density compensation, automatic recognition of saturated vapor and superheated vapor and moisture content calculation of wet vapor.
- Special function for trade settlement.
  - ✧ Power down record
  - ✧ Timing meter reading
  - ✧ Query function on some illegal operations.
  - ✧ Printing
- Display unit can be modified according to different requirements.
- Large storage function.
  - ✧ Day record can be stored in 5 years
  - ✧ Month record can be stored in 5 years
  - ✧ Year record can be stored in 16 years

1.2 Specifications

<table>
<tr><th>Description</th><th colspan="4">Specifications</th></tr>
<tr><td rowspan="4">Input Signal</td><td colspan="2">Analog Input</td><td colspan="2">Pulse Input</td></tr>
<tr><td colspan="2">Thermocouple: K, E, B, J, N, T, S</td><td colspan="2">Waveform: Rectangular, Sine and Triangle wave</td></tr>
<tr><td colspan="2">Pt100</td><td colspan="2">Amplitude: more than 4V</td></tr>
<tr><td colspan="2">Current: 0-10mA, 4～20mA
Input impedance≤250Ω</td><td colspan="2">Frequency: 0～10KHz
Special requirements please contact us</td></tr>
<tr><td rowspan="3">Output Signal</td><td>Analog Output</td><td>Communication Output</td><td>Switch Output</td><td>Feed Output</td></tr>
<tr><td>DC 0～10mA（load resistance≤750Ω）</td><td>RS232, RS485, Ethernet</td><td>Relay with hysteresis</td><td>DC24V (load current≤100mA)</td></tr>
<tr><td>DC 4～20mA (load resistance≤500Ω)</td><td>Baud rate: 600, 1200, 2400, 4800, 9600bps,8 data bits, 1 stop bit, and 1 start bit</td><td>AC220V/3A;
DC24V/6A（Resistive load)</td><td>DC12V (load current≤200mA)</td></tr>
</table>

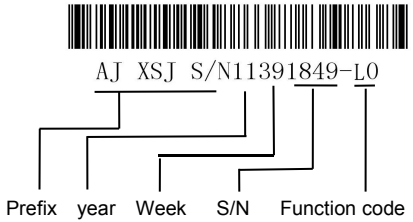
Accuracy	0.2%FS±1d or 0.5%FS±1d Accuracy for frequency conversion: ±1 pulse (LMS), better than 0.2%
Measuring Range	-999999～999999 for flow rate and compensation value 0～99999999.9999 for totalizer
Display	Backlit 128*64 lattice LCD Display flow totalizer, flow rate, energy, power, medium temperature, medium pressure, medium density, medium heat enthalpy, differential pressure, current, frequency, date, time, Alarm status
Control/Alarm	Optional relay upper limit and lower limit control (Alarm) output, LCD and LED output indication; Control (Alarm) with hysteresis (The number of alarm relay is up to 2) Alarm type: flow upper and lower limit, temperature upper and lower limit, pressure upper and lower limit;
Print	Through RS232 interface to Serial thermal printer Real-time print or timing print, Up to 8 times timing print in one day.
Protection	Totalizer will be remained for more than 20 years after power off Reset automatically when Power supply is low Reset automatically when abnormal working (Watch Dog) Self-healing fuse Short circuit protection
	Password protection for important data
Operating environment	Ambient temperature : -20～60℃; Relative humidity: ≤85%RH, Far from strong corrosive gas
Power supply	Normal Type: AC 220V % (50Hz±2Hz) Special Type: AC 80～265V (Switch power) DC 24V±1V (Switch power) (AC 36V 50Hz±2Hz) Back-up power: +12V, 20AH, it will last 72 hours
Power consumption	≤10W

1.3 Ordering Code

Ordering Code											
	□□□□	□	□□	□	□	□	□	□	□	□	
Type											Meter type
Dimension		8									160×80mm (horizontal)
Communication			00								No communication function
			01								RS-485 communication
			02								RS-232 communication
			03								Ethernet
Alarm 1				1 NO							Switching signal of relay output
				2 NC							
Alarm 2					1 NO						
					2 NC						
output						1					Current output
						2					Pulse Output
Input							1				Thermocouple
							2				Pt100
							3				Pt1000
							4				Current: 0-10mA
							5				Current: 4-20mA
Feed Output								1			DC ＋5V
								2			DC ＋12V
								3			DC ＋24V
Power Supply									1		AC 220V
									2		AC36V
									3		DC24V

Extended Function		1	USB interface, using to download the data in meter
		2	Current: 4-20mA
		3	16 Bit A/D convertor module
		4	Wireless remote control function. Mainly used in dangerous occasion and condition of no opening the meter.

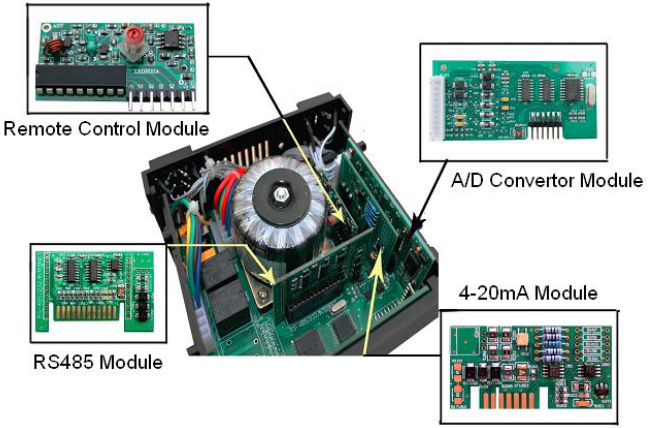
The bar code definition:



Extended Function
L0: No function L1: RS485 L2: RS232
L3: Internet L4: USB interface L5: RS485 and RS232
L6: RS485 and USB L7: RS232 and USB
L8: 4-20mA L9: RS485 and 4-20mA

Part 2 Installation and Dimension

2.1 Instrument Hardware



2.2 Fuse Replacement

Figure 1 Unscrew the two nuts

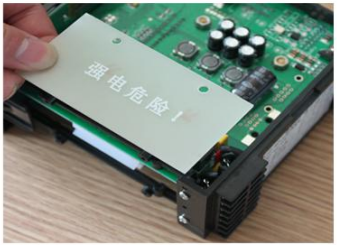


Figure 2 Remove the high voltage protection board

Figure 3 The black rectangular component is fuse

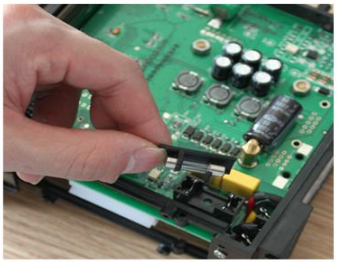
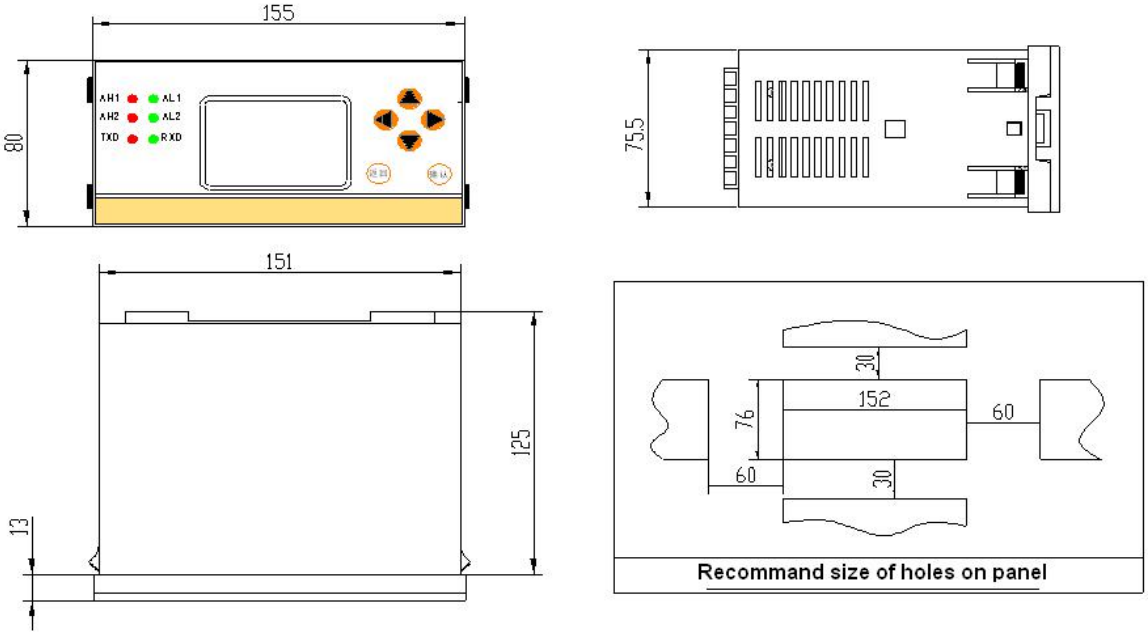


Figure 4 Remove the cover of fuse,
replace the fuse,
and then complete the assembly

Danger Power off before replacing fuse

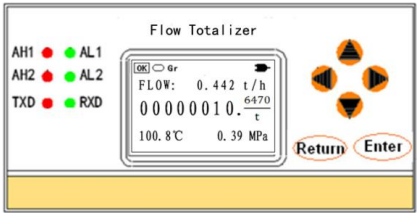
2.3 Dimensions



Part 3 Menu Operation

3.1 Menu instruction

3.1.1 Operation Interface



AH1: No alarm indicator of Alarm 1 AL1: Alarm indicator of Alarm 1

AH2: No alarm indicator of Alarm 2 AL2: Alarm indicator of Alarm 2

TXD: Indicator of data sending RXD: Indicator of data receiving

Return key: Return to previous menu, switch normal and recycling display in measuring screen.

Enter key: Enter to next menu, enter main menu in measuring screen, and switch to next parameter in setup menu.

 : Up key, move the cursor upward, and increase the value in setup menu.

 : Down key, move the cursor downward, and reduce the value in setup menu.

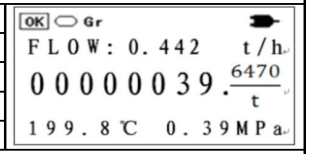
 : Left key, move the cursor leftward, and Shift the flashing digit position to left in setup menu.

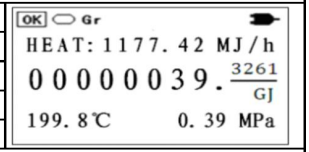
 : Right key, move the cursor rightward, and Shift the flashing digit position to right in setup menu.

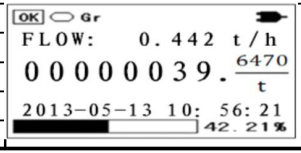
Prompt line

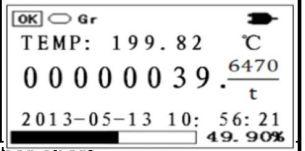
OK	Err			BH	Gr	ST	SP	STP	
Working well	Abnormal working	Normal display	recycling display	Saturated steam	Superheated steam	Temperature compensation	Pressure compensation	temperature and pressure compensation	
008: Meter address		AP: Absolute pressure		GP: gauge pressure					
Relay on	Relay off	Battery power supply, Full battery		Battery power supply, 90%		Battery power supply, 60%	Battery power supply, 30%	Battery is low, please charge timely	220VAC power supply

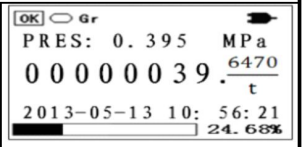
3.1.2 Display Screen

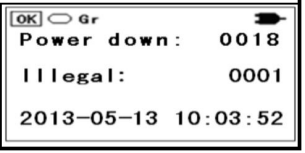
Flow rate	
1.Prompt information	
2.Flow rate	
3.Flow totalizer	
4.Medium temperture	
5.Medium pressure	

Power	
1.Prompt information	
2.Pow er	
3.Energy	
4.Medium temperture	
5.Medium pressure	

Flow rate bar chart	
1.Prompt information	
2.Flow rate	
3.Current date and time	
4.Flow rate bar chart	
5.Flow rate percentage	

Temperature bar chart	
1.Prompt information	
2.Medium temperture	
3.Current date and time	
4.Temperature bar chart	
5.Temperature percentage	

pressure bar chart	
1.Prompt information	
2.Medium pressure	
3.Current date and time	
4.Pressure bar chart	
5.Pressure percentage	

Power down and Illegal operation	
1.Prompt information	
2.Pow er dow n count	
3.Illegal operation count	
4.Current date and time	

In debug screen, according to different instrument type, the frequency (QF) and pressure differential (ΔP) are switched automatically.

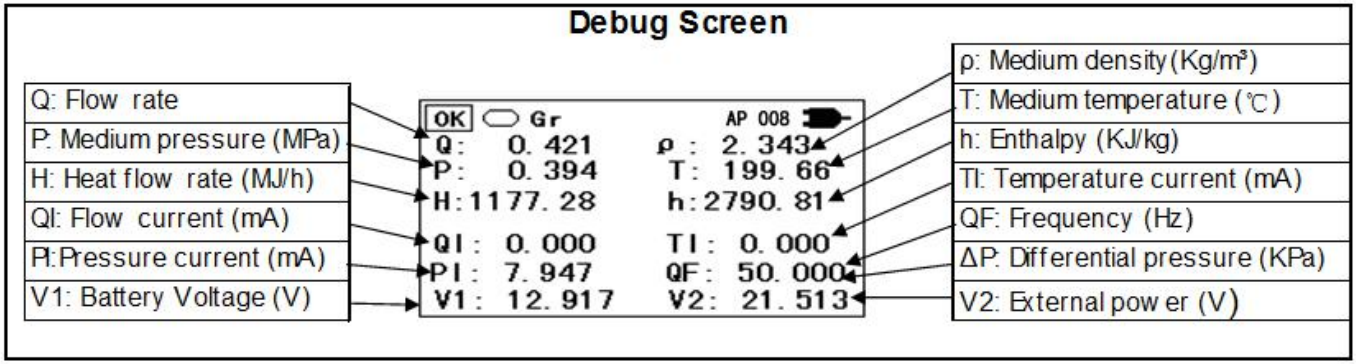
3.2 Main Menu

In display screen, press ENTER key to enter main menu.

Main Menu
1. Query
2. Print
3. self-test

Main Menu
4. Calibrate
5. Setup
6. Total Reset

Main Menu
7. Save
8. Password
9. Display option



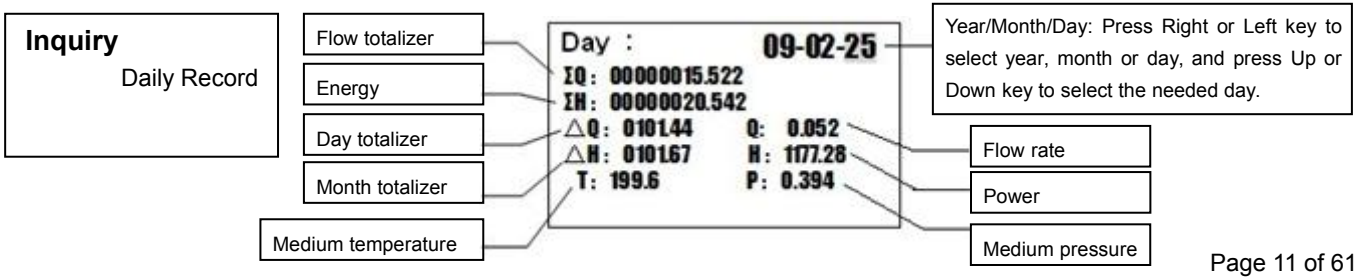
3.3 Query

3.3.1 Query Submenu

In main menu, press Up or Down key to select Query submenu, and then press ENTER key to enter.
In Query submenu, there are records of Daily, Monthly, Power down, illegal action and Timing meter read.
Press Up or Down key to select the inquiry record, and then press ENTER key to query.

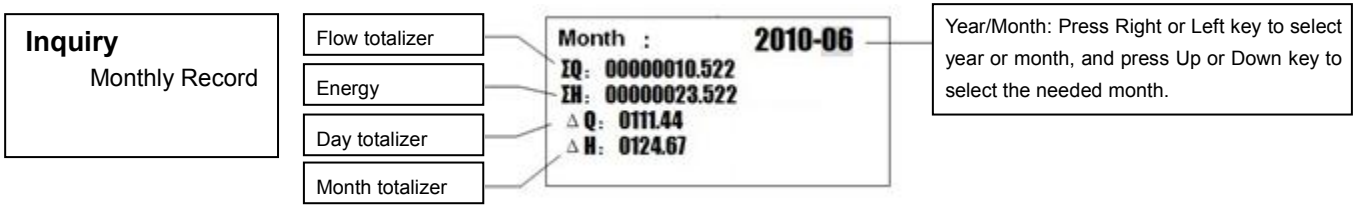
3.3.2 Daily Record

Press Up or Down key to select Daily Record, and then press ENTER key to enter, shown as below.



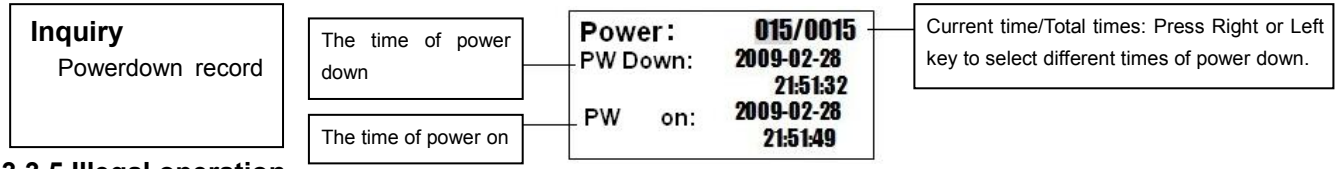
3.3.3 Monthly Record

Press Up or Down key to select Monthly Record, and then press ENTER key to enter, shown as below.



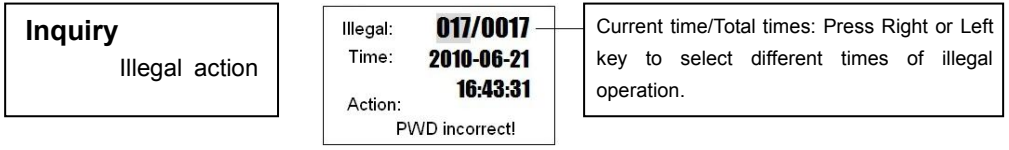
3.3.4 Power Down

Press Up or Down key to select Power Down, and then press ENTER key to enter, shown as below.



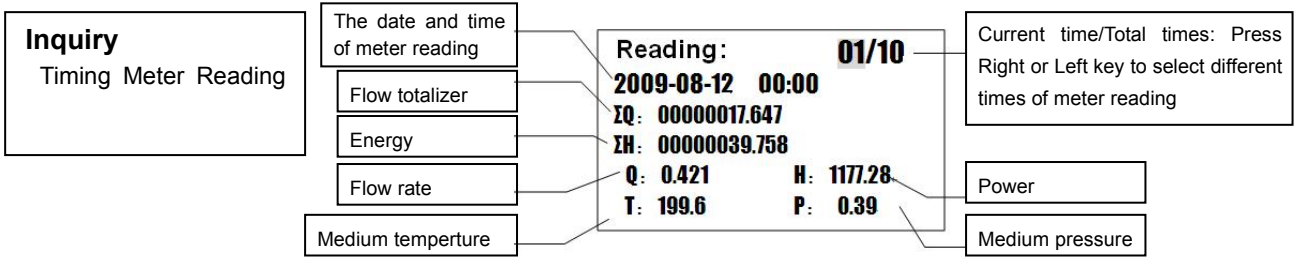
3.3.5 Illegal operation

Press Up or Down key to select Illegal Operation, and then press ENTER key to enter, shown as below.



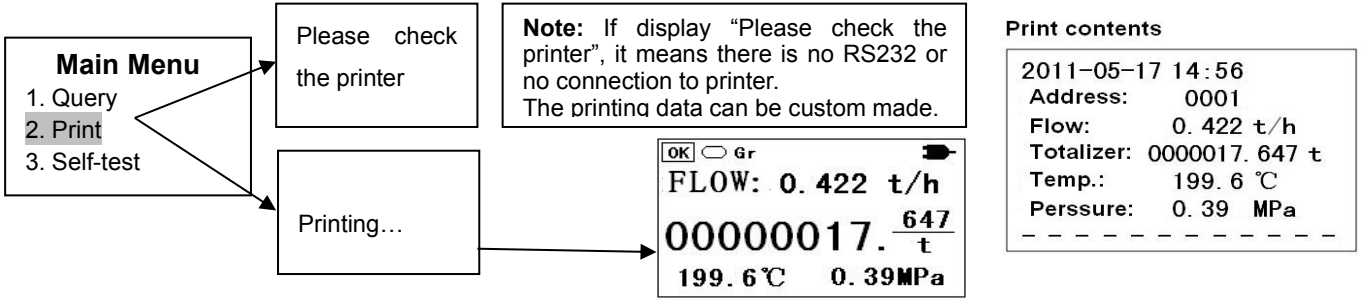
3.3.6 Timing Meter Reading

Press Up or Down key to select Timing Meter Reading, and then press ENTER key to enter, shown as below.



3.4 Print

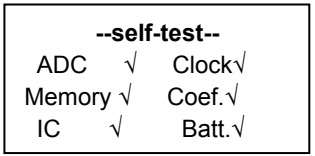
In main menu, press Up or Down key to select Print submenu, and then press ENTER key to enter.



3.5 Self-test

In main menu, press Up or Down key to select Self-test submenu, and then press ENTER key to enter.

This submenu to check the details of running status, √ is ok, and × means this option is abnormal. After self-test, the display will turn to main menu.



3.6 Calibrate

3.6.1 Calibrate Submenu

This submenu is used to calibrate the internal analog signal, and it affects the accuracy of instrument. If there are no resistance box, standard current source, multimeter and other calibration equipments, please do not use this submenu!

In main menu, press Up or Down key to select Calibrate submenu, and then press ENTER key to enter.

Main Menu
2. Print
3. self-test
4. Calibrate

Password:
*****0

1. Current Input
2. Temperature
3. Current Output

⚠ Note: The calibrate submenu has password protection. When inputting password, press Left or Right key to shift the cursor, and press Up or Down key to increase or decrease the number. The default password is 000000, users can modify the password according to 3.10 Password.

3.6.2 Current Input

In calibrate submenu, press Up or Down key to select Current Input, and then press ENTER key to enter.

When calibrating, it needs standard current source to input current to instrument according to “Input” prompt.

For example of calibrating Flow (DP), select Flow (DP), and press ENTER key to calibrate. Input 4mA for zero-scale, the instrument will display a measuring value PV approximating 4mA, and then press ENTER key to enter full-scale. Input 20mA for full-scale, the instrument will display a PV approximating 20mA, and then press ENTER key to finish calibration. After calibration, the instrument will display “Successful”, and then return to calibrate submenu.

1. Current Input
2. Temperature
3. Current Output

Current Input
1. Flow (DP)
2. Pressure
3. Temperature

Current: Flow (DP)
Zero-scale:
Input: 4.000mA
PV: 3.980mA

Flow (DP)
Full-scale:
Input: 20.000mA
PV: 19.998mA

Successful !

The calibration method of temperature and pressure is the same as that of Flow (DP).

3.6.3 Temperature Input

In calibrate submenu, press Up or Down key to select Temperature, and then press ENTER key to enter.

When calibrating, it needs standard resistance box to input resistance to instrument according to R value.

1. Current Input 2. Temperature 3. Current Output	Temp. sensor: Pt100	Sensor: Pt100 RV: 100.00ohm SV: 0.00℃ PV: 0.41℃	Input: Pt100 RV: 247.09ohm SV: 400.00℃ PV: 399.41℃	Successful !

After calibration, the instrument will display “Successful”, and then return to calibrate submenu.

3.6.4 Current Output

In calibrate submenu, press Up or Down key to select Current Output, and then press ENTER key to enter.

When calibrating, it needs multimeter to measuring the output current, and then input this current value into “PV”.

1. Current Input 2. Temperature 3. Current Output	Current output OV: 4.000mA PV: 03.976mA	Current output OV: 20.000mA PV: 19.887mA	Successful !

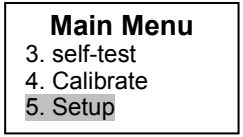
After calibration, the instrument will display “Successful”, and then return to calibrate submenu.

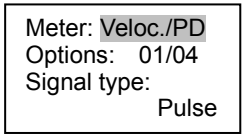
3.7 Setup

3.7.1 Setup Submenu

This submenu affects the performance and accuracy of instrument, please be careful when operating.

In main menu, press Up or Down key to select Setup submenu, and then press ENTER key to enter.





Notes:
1. The setup submenu also has password protection. The default password is 000000, users can modify the password according to 3.10 Password.
2. In setup submenu, press Up/Down keys to select different options or increase/decrease numbers which is on the cursor position, press Right/Left key to shift the cursor position or move options, and press ENTER key to enter the next menu.

Before setting, please confirm the meter type. The meter types are shown as below.

1. Veloc./PD: Velocity/Volume	3. DP scale: DP flow	5. V cone DP	7. Elbow DP
2. Mass Flow	4. Orifice DP: Orifice plate DP	6. Annubar DP	8. Linear: Linear current

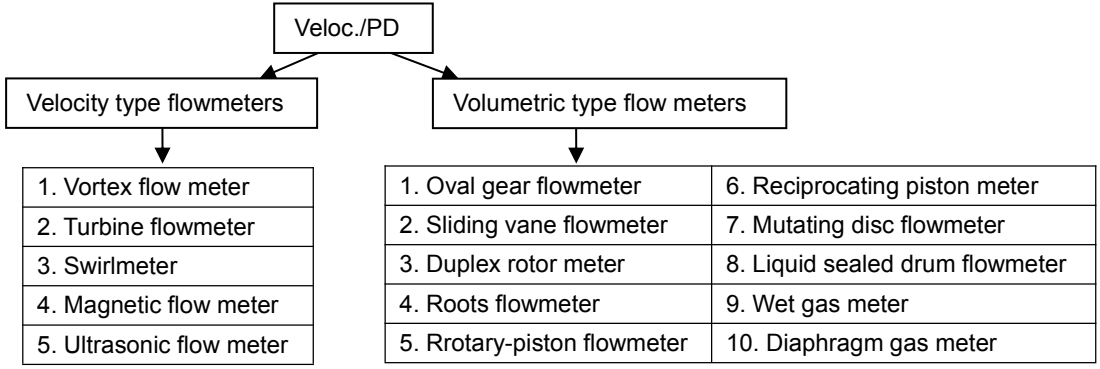
(DP: Differential Pressure)

After setting the meter type, the options display the related parameter numbers of this meter type. For example of 01/04, 01 indicates the follow is the first parameter, 04 indicates that there are 4 parameters needed to set in total.

3.7.2 Velocity (Volume)

3.7.2.1 Veloc/PD

The meter type “Veloc./PD” includes Volumetric flowmeters and Velocity type flow meters, shown as below.



After setting meter type, press Right key to shift cursor on Pulse, press Up or Down key to select different signal type. There are three parameters in Veloc./PD: Pulse (Volume), 4-20mA (Volume) and 0-10mA (Volume).

When choosing different signal type, the related parameters will vary, shown as below.

Pulse		4-20mA		0-10mA	
1. Signal type	3. Coefficient linearity	1. Signal type	3. Flow F.S.	1. Signal type	3. Flow F.S.
2. Cut-off frequency	4. Flow coefficient	2. Flow F.S. unit	4. Cut-off current	2. Flow F.S. unit	4. Cut-off current

3.7.2.2 Pulse

After setting meter type, press Right key to shift cursor on Pulse (Select pulse signal type), and then press Right key to shift cursor on Signal type, press Up key to change Signal type to Cut-off freq. (Cut-off frequency is set according to different flowmeters on site. Generally do not need to set this parameter.). When setting Cut-off freq. value, press right key to shift the cursor position, and press Up or Down key to change the value.

After setting Cut-off frequency, press Left key to shift cursor on Cut-off freq., and then press Up key to change Cut-off freq. to Coefficient linearize (Coefficient linearize is used for linearity correction, default setup is “OFF”).

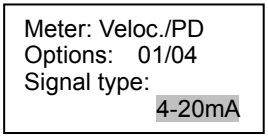
Note: If coefficient linearity is set ON, there are up to 24 parameters needed to set in total. Options 5-24 are used to set section coefficients. In each option, input related section frequency and section coefficient, and then the instrument calculates flow with section coefficient.

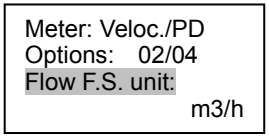
Set Coefficient linearize OFF, press Left key to shift cursor on Coefficient linearize, and then press Down key to change Coefficient linearize to Flow coefficient. Press Right key to shift cursor on coefficient value, and then press Up/Down key to change the value. After setting, press ENTER key to enter next menu.

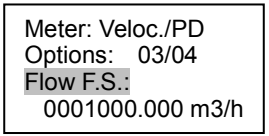
3.7.2.3 4-20mA

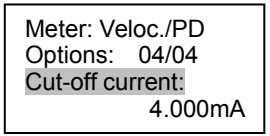
According to 3.7.2.1, select “4-20mA” in signal type.
Press Left key shift cursor on Signal type, and then press Up key to change Signal type to Flow F.S. unit. In Flow F.S. unit, there

are two options: m3/h and l/h (The Flow F.S. unit should be the same as that of flowmeters).









After setting unit, press Left key to shift cursor on Flow F.S. unit, and then press Up key to change Flow F.S. unit to Flow F.S. (The Flow full scale should be the same as that of flowmeters).

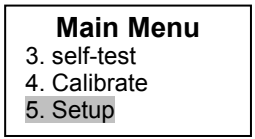
After setting F.S. value, press Left key to shift cursor on Flow F.S., and then press Up key to change Flow F.S. to Cut-off current (Cut-off current is set according to different flowmeters on site. Generally do not need to set this parameter.).

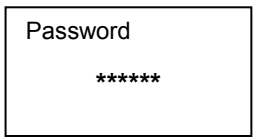
3.7.2.4 0-10mA

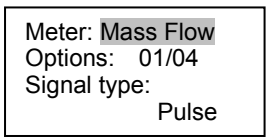
According to 3.7.2.1, select “0-10mA” in signal type, and the method of parameters setup is the same as that of “4-20mA” signal type.

3.7.3 Mass Flow

In main menu, press Up or Down key to select Setup submenu, press ENTER key to enter, and then press Up/Down key to select “Mass Flow”.







There are three parameters in Mass Flow: Pulse (Mass), 4-20mA (Mass) and 0-10mA (Mass).
The setup method of mass flow is the same as that of Veloc./PD.

3.7.4 DP Flow

In main menu, press Up or Down key to select Setup submenu, press ENTER key to enter, and then press Up/Down key to select "DP Scale".

Main Menu	Password	Meter: DP Scale	Note: Orifice plate, V-Cone, Annubar, venturi tube and Elbow are all belong to differential pressure flowmeter, and the output signal is scale mass flow.
3. self-test 4. Calibrate 5. Setup	******	Options: 01/08 Signal type: 4-20mA No √	

There are four signal types: 4-20mA No √, 4-20mA √, 0-10mA No √ and 0-10mA √. In this manual, it only introduce 4-20mA No √, the others refer to 4-20mA No √.

- No √ means that the output signal of differential pressure transmitter is no square root signal, this kind signal should be extracted the square root and then can take part in computation.
- √ means that the output signal of differential pressure transmitter is linear signal, this kind signal do not need to be extracted the square root.

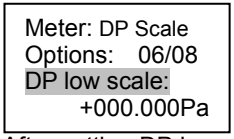
After setting meter type, press Right key to shift cursor on 4-20mA No √ signal type, and then press Right key to shift cursor on Signal type. Press Up key to change Signal type to Scale flow unit, press Right key to shift cursor on unit t/h, and then press Up key to select different units (t/h and Kg/h).

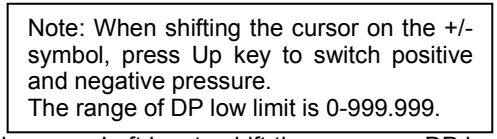
Meter: DP Scale Options: 02/08 Scaled flow unit: t/h	Meter: DP Scale Options: 03/08 Scaled range: 0000010.000t/h	Meter: DP Scale Options: 04/08 Design density: 0001.2800kg/m3	Meter: DP Scale Options: 05/08 DP unit: Pa

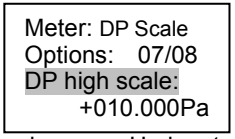
After setting scaled flow unit, press Left key to shift the cursor on Scale flow unit, press Up key to change Scale flow unit to Scaled range, press Right key to shift cursor on flow value, and then press Up/Down key to change this value (The range of F.S. flow is 0-9999999.999).

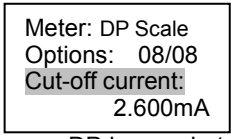
After setting scaled range, press Left key to shift the cursor on Scaled range, press Up key to change Scaled range to Design Density, press Right key to shift cursor on density value, and then press Up/Down key to change this value.
After setting design density, press Left key to shift the cursor on Design density, press Up key to change Design density to DP unit (Differential pressure unit), press Right key to shift cursor on unit, and then press Up/Down key to select different units (Pa, KPa and MPa).

After setting DP unit, press Left key to shift the cursor on DP unit, press Up key to change DP unit to DP low scale (Differential pressure low scale), press Right key to shift cursor on low scale value, and then press Up/Down key to change this value.









After setting DP low scale, press Left key to shift the cursor on DP low scale, press Up key to change DP low scale to DP high scale (Differential pressure high scale), press Right key to shift cursor on high scale value, and then press Up/Down key to change this value.

After setting DP high scale, press Left key to shift the cursor on DP high scale, press Up key to change DP high scale to Cut-off current, press Right key to shift cursor on current value, and then press Up/Down key to change this value.

3.7.5 Orifice DP

In main menu, press Up or Down key to select Setup submenu, press ENTER key to enter, and then press Up/Down key to select "Orifice DP".

There are nine parameters in Orifice DP: Signal type, Pipe inside diameter D, Hole diameter d, Expansibility factor ε, Discharge coefficient c, DP unit, DP low scale, DP high scale and Cut-off current.

Main Menu 3. self-test 4. Calibrate 5. Setup	Password ******	Meter: Orifice DP Options: 01/09 Signal type: 4-20mA No √	Meter: Orifice DP Options: 02/09 Pipe diameter D: 0400.00mm	Meter: Orifice DP Options: 03/09 Hole diameter d: 0200.00mm

After selecting Orifice DP, and then press Right key to shift cursor on 4-20mA No √. There are four signal types: 4-20mA No √, 4-20mA √, 0-10mA No √ and 0-10mA √. In this manual, it only introduce 4-20mA No √, the others refer to 4-20mA No √. Press Up key to select different signal types.

After setting Signal type "4-20mA No √", press Left key to Signal type, press Up key to change Signal type to Pipe diameter D, press Right key to shift cursor on D value, and then press Up/Down key to change this value.
After setting Pipe diameter D, press Left key to shift the cursor on Pipe diameter D, press Up key to change Pipe diameter D to Hole diameter d, press Right key to shift cursor on d value, and then press Up/Down key to change this value.

Meter: Orifice DP Options: 04/09 Expansibility ε: 1.00000	Meter: Orifice DP Options: 05/09 Discharge coe. c: 0.80000	Meter: Orifice DP Options: 06/09 DP unit: KPa	Meter: Orifice DP Options: 07/09 DP low scale: +000.000KPa
Meter: Orifice DP Options: 08/09 DP high scale: +250.000KPa	Meter: Orifice DP Options: 09/09 Cut-off current: 4.000mA	Note: When shifting the cursor on the +/- symbol, press Up key to switch positive and negative pressure. The range of DP low limit is 0-999.999.	

After setting Hole diameter d, press Left key to shift the cursor on Hole diameter d, press Up key to change Hole diameter d to Expansibility ε , press Right key to shift cursor on ε value, and then press Up/Down key to change this value.

After setting Expansibility ε , press Left key to shift the cursor on Expansibility ε , press Up key to change Expansibility ε to Discharge coe. c, press Right key to shift cursor on c value, and then press Up/Down key to change this value.

After setting Discharge coe. c, press Left key to shift the cursor on Discharge coe. c, press Up key to change Discharge coe. c to DP unit, press Right key to shift cursor on unit, and then press Up/Down key to select different units (Pa, KPa and MPa).

After setting DP unit, press Left key to shift the cursor on DP unit, press Up key to change DP unit to DP low scale, press Right key to shift cursor on low scale value, and then press Up/Down key to change this value.

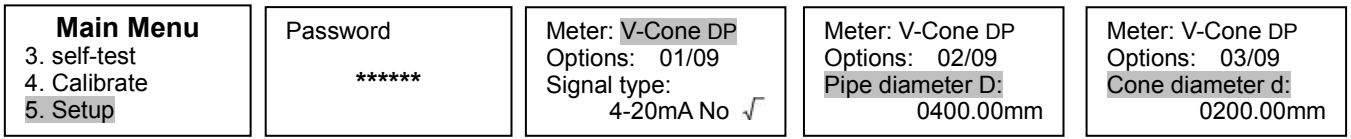
After setting low scale value, press Left key to shift the cursor on DP low scale, press Up key to change DP low scale to DP high scale, press Right key to shift cursor on high scale value, and then press Up/Down key to change this value.

After setting DP high scale, press Left key to shift the cursor on DP high scale, press Up key to change DP high scale to Cut-off current, press Right key to shift cursor on current value, and then press Up/Down key to change this value.

3.7.6 V-Cone DP

In main menu, press Up or Down key to select Setup submenu, press ENTER key to enter, and then press Up/Down key to select "V-Cone DP".

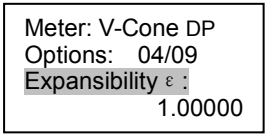
There are nine parameters in V-Cone DP: Signal type, Pipe inside diameter D, Cone diameter d, Expansibility factor ε , Discharge coefficient c, DP unit, DP low scale, DP high scale and Cut-off current.

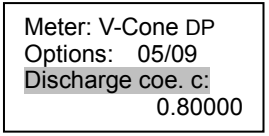


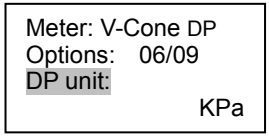
After setting V-Cone DP, and then press Right key to shift cursor on 4-20mA No √. There are four signal types: 4-20mA No √, 4-20mA √, 0-10mA No √ and 0-10mA √. In this manual, it only introduce 4-20mA No √, the others refer to 4-20mA No √. Press Up key to select different signal types.

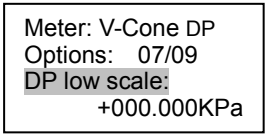
After setting Signal type "4-20mA No √", press Left key to Signal type, press Up key to change Signal type to Pipe diameter D, press Right key to shift cursor on D value, and then press Up/Down key to change this value.

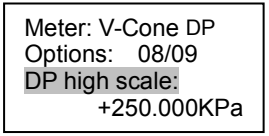
After setting Pipe diameter D, press Left key to shift the cursor on Pipe diameter D, press Up key to change Pipe diameter D to Cone diameter d, press Right key to shift cursor on d value, and then press Up/Down key to change this value.

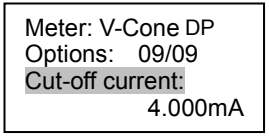












Note: When shifting the cursor on the +/- symbol, press Up key to switch positive and negative pressure.
The range of DP low limit is 0-999.999.

After setting Cone diameter d, press Left key to shift the cursor on Cone diameter d, press Up key to change Cone diameter d to Expansibility ε, press Right key to shift cursor on ε value, and then press Up/Down key to change this value.

After setting Expansibility ε, press Left key to shift the cursor on Expansibility ε, press Up key to change Expansibility ε to Discharge coe. c, press Right key to shift cursor on c value, and then press Up/Down key to change this value.

After setting Discharge coe. c, press Left key to shift the cursor on Discharge coe. c, press Up key to change Discharge coe. c to DP unit, press Right key to shift cursor on unit, and then press Up/Down key to select different units (Pa, KPa and MPa).

After setting DP unit, press Left key to shift the cursor on DP unit, press Up key to change DP unit to DP low scale, press Right key to shift cursor on low scale value, and then press Up/Down key to change this value.

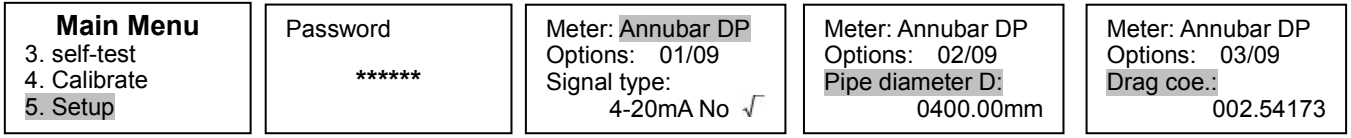
After setting low scale value, press Left key to shift the cursor on DP low scale, press Up key to change DP low scale to DP high scale, press Right key to shift cursor on high scale value, and then press Up/Down key to change this value.

After setting DP high scale, press Left key to shift the cursor on DP high scale, press Up key to change DP high scale to Cut-off current, press Right key to shift cursor on current value, and then press Up/Down key to change this value.

3.7.7 Annubar DP

In main menu, press Up or Down key to select Setup submenu, press ENTER key to enter, and then press Up/Down key to select "Annubar DP".

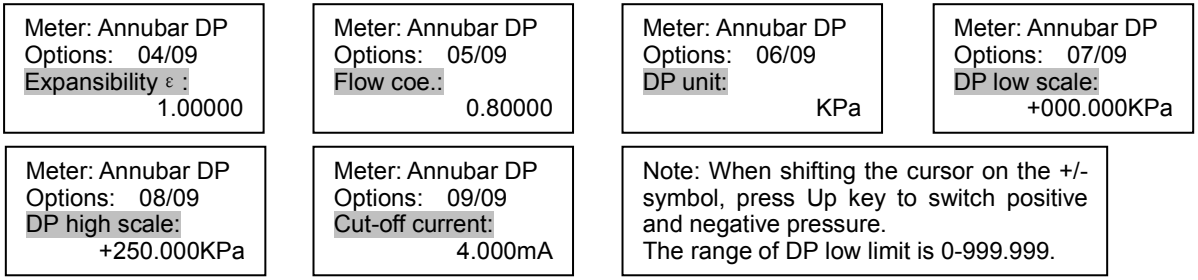
There are nine parameters in Annubar DP: Signal type, Pipe inside diameter D, Drag coefficient, Expansibility factor ε, Flow coefficient, DP unit, DP low scale, DP high scale and Cut-off current.



After setting Annubar DP, and then press Right key to shift cursor on 4-20mA No √. There are four signal types: 4-20mA No √, 4-20mA √, 0-10mA No √ and 0-10mA √. In this manual, it only introduce 4-20mA No √, the others refer to 4-20mA No √. Press Up key to select different signal types.

After setting Signal type "4-20mA No √", press Left key to Signal type, press Up key to change Signal type to Pipe diameter D, press Right key to shift cursor on D value, and then press Up/Down key to change this value.

After setting Pipe diameter D, press Left key to shift the cursor on Pipe diameter D, press Up key to change Pipe diameter D to Resistance coe., press Right key to shift cursor on coe. value, and then press Up/Down key to change this value.



After setting Resistance coe. value, press Left key to shift the cursor on Resistance coe., press Up key to change Resistance coe. to Expansibility ε , press Right key to shift cursor on ε value, and then press Up/Down key to change this value.

After setting Expansibility ε , press Left key to shift the cursor on Expansibility ε , press Up key to change Expansibility ε to Flow coe., press Right key to shift cursor on coefficient value, and then press Up/Down key to change this value.

After setting coefficient value, press Left key to shift the cursor on Flow coe., press Up key to change Flow coe. to DP unit, press Right key to shift cursor on unit, and then press Up/Down key to select different units (Pa, KPa and MPa).

After setting DP unit, press Left key to shift the cursor on DP unit, press Up key to change DP unit to DP low scale, press Right key to shift cursor on low scale value, and then press Up/Down key to change this value.

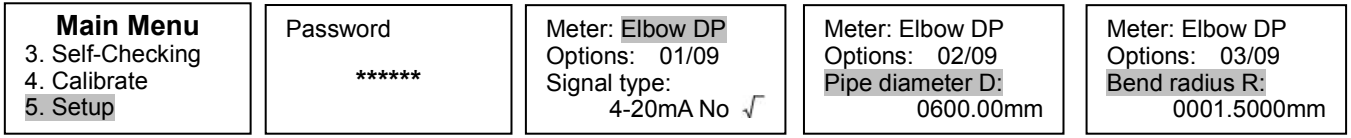
After setting low scale value, press Left key to shift the cursor on DP low scale, press Up key to change DP low scale to DP high scale, press Right key to shift cursor on high scale value, and then press Up/Down key to change this value.

After setting high scale value, press Left key to shift the cursor on DP high scale, press Up key to change DP high scale to Cut-off current, press Right key to shift cursor on current value, and then press Up/Down key to change this value.

3.7.8 Elbow DP

In main menu, press Up or Down key to select Setup submenu, press ENTER key to enter, and then press Up/Down key to select "Elbow DP".

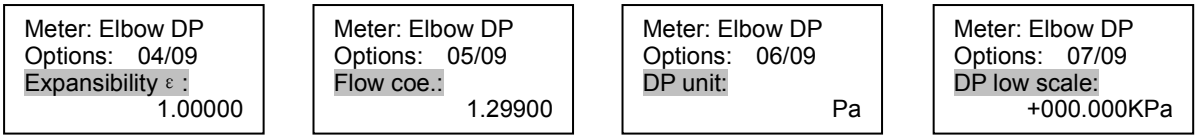
There are nine parameters in Elbow DP: Signal type, Pipe inside diameter D, Bend radius R, Expansibility factor ε , Flow coefficient, DP unit, DP low scale, DP high scale and Cut-off current.



After setting Elbow DP, and then press Right key to shift cursor on 4-20mA No √. There are four signal types: 4-20mA No √, 4-20mA √, 0-10mA No √ and 0-10mA √. In this manual, it only introduce 4-20mA No √, the others refer to 4-20mA No √. Press Up key to select different signal types.

After setting Signal type "4-20mA No √", press Left key to Signal type, press Up key to change Signal type to Pipe diameter D, press Right key to shift cursor on D value, and then press Up/Down key to change this value.

After setting Pipe diameter D, press Left key to shift the cursor on Pipe diameter D, press Up key to change Pipe diameter D to Bend radius R, press Right key to shift cursor on Bend radius R value, and then press Up/Down key to change this value.



Note: When shifting the cursor on the +/- symbol, press Up key to switch positive and negative pressure.
The range of DP low limit is 0-999.999.

After setting Bend radius R, press Left key to shift the cursor on Bend radius R, press Up key to change Bend radius R to Expansibility ε , press Right key to shift cursor on ε value, and then press Up/Down key to change this value.

After setting Expansibility ε value, press Left key to shift the cursor on Expansibility ε , press Up key to change Expansibility ε to Flow coe., press Right key to shift cursor on coefficient value, and then press Up/Down key to change this value.

After setting Flow coefficient value, press Left key to shift the cursor on Flow coe., press Up key to change Flow coe. to DP unit, press Right key to shift cursor on unit, and then press Up/Down key to select different units (Pa, KPa and MPa).

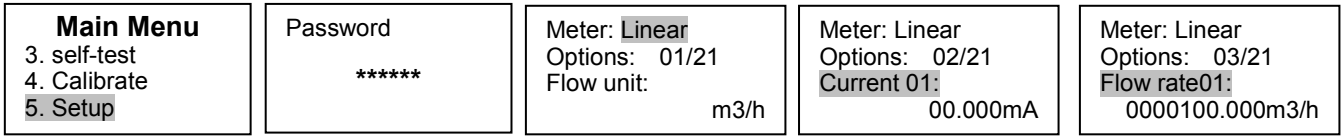
After setting DP unit, press Left key to shift the cursor on DP unit, press Up key to change DP unit to DP low scale, press Right key to shift cursor on low scale value, and then press Up/Down key to change this value.

After setting low scale value, press Left key to shift the cursor on DP low scale, press Up key to change DP low scale to DP high scale, press Right key to shift cursor on high scale value, and then press Up/Down key to change this value.

After setting high scale value, press Left key to shift the cursor on DP high scale, press Up key to change DP high scale to Cut-off current, press Right key to shift cursor on current value, and then press Up/Down key to change this value.

3.7.9 Linear

The Linear current is used to divide output current of instrument into 10 sections, and then set flow value for each current section. In main menu, press Up or Down key to select Setup submenu, press ENTER key to enter, and then press Up/Down key to select “Linear”.



There are four units in Flow unit: m3/h, l/h, t/h and kg/h, press Right key on unit, and press Up/Down key to select different units.

After setting flow unit, press Left key to shift cursor on Flow unit, press Up key to change Flow unit to Current 01, press Right key to shift cursor on current 01 value, and then press Up/Down key to change this value.

After setting Current 01, press Left key to shift cursor on Current 01, press Up key to change Current 01 to Flow rate 01, press Right key to shift cursor on flow 01 value, and then press Up/Down key to change this value.

The setup method of current 02-10 and flow rate 02-10 is the same as that of current 01 and flow rate 01.

3.7.10 Medium

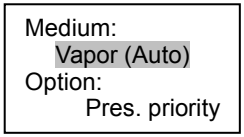
3.7.10.1 Medium Options

After setting related parameters of flowmeter, press ENTER key to enter “Medium” menu.

Medium Options
1. Vapor (Auto): Vapor Automatic Compensation
2. S vapor temp.: Saturated vapor temperature compensation
3. S vapor pres.: Saturated vapor pressure compensation
4. S vapor TP: Superheated vapor pressure and temperature compensation
5. Gas (Std. volume)
6. Gas (Mass)
7. Liquid (Volume)
8. Liquid (Mass)
9. Constant Density

3.7.10.2 Vapor (Auto)

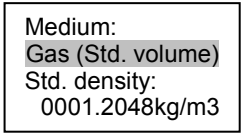
In medium menu, Press Up key to select Vapor (Auto), press Right key to shift cursor to option content, and then press Down key to select Pres. priority or Temp. priority.



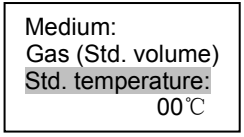
Pres. priority: Include high temperature condensate water, pressure compensation priority.
Temp. priority: Only measure dry saturated vapor, temperature compensation priority.

When measuring vapor, there are another three selections: Saturated vapor temperature compensation, Saturated vapor pressure compensation and Superheated vapor pressure and temperature compensation.

3.7.10.2 Gas (Std. Volume)

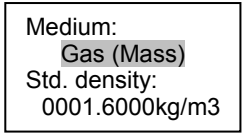


In medium menu, press Left key to shift cursor on Vapor (Auto), and then press Up key to select Gas (Std. volume). Compensation is the temperature and pressure compensation of common gas, and the unit of flow rate is Nm3/h.
Press Right key to shift cursor on density value, and then press Up/Down key to change this value.

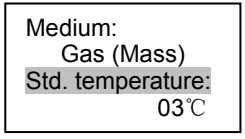


After setting standard density, it needs to input the standard temperature related to standard density. Press Left key to shift cursor on Std. density, press Up key to change Std. density to Std. temperature, press Right key to shift cursor on temperature value, and then press Up/Down key to change this value.

3.7.10.3 Gas (Mass)



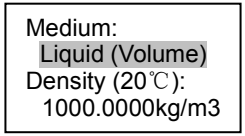
In medium menu, press Left key to shift cursor on Gas (Std. volume), and then press Up key to select Gas (Mass). Compensation is the temperature and pressure compensation of common gas, and the unit of flow rate is t/h.
Press Right key to shift cursor on density value, and then press Up/Down key to change this value.



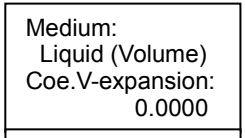
After setting standard density, it needs to input the standard temperature related to standard density. Press Left key to shift cursor on Std. density, press Up key to change Std. density to Std. temperature, press Right key to shift cursor on temperature value, and then press Up/Down key to change this value.

3.7.10.4 Liquid (Volume)

In medium menu, press Left key to shift cursor on Gas (Mass), and then press Up key to select Liquid (Volume).
Press Right key to shift cursor on density value, and then press Up/Down key to change this value.

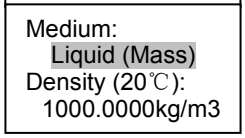


After setting Density (20℃), press Left key to shift cursor on Density (20℃), press Up key to change Density (20℃) to Coe.V-expansion (Expansibility factor), press Right key to shift cursor on factor value, and then press Up/Down key to change this value.

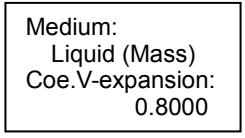


3.7.10.5 Liquid (Mass)

In medium menu, press Left key to shift cursor on Liquid (Volume), and then press Up key to select Liquid (Mass).
Press Right key to shift cursor on density value, and then press Up/Down key to change this value.

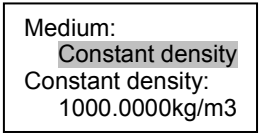


After setting Density (20℃), press Left key to shift cursor on Density (20℃), press Up key to change20℃ density to Coe.V-expansion (Expansibility factor), press Right key to shift cursor on factor value, and then press Up/Down key to change this value.



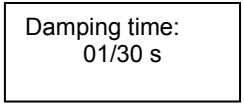
3.7.10.6 Density Compensation

In medium menu, press Left key to shift cursor on Liquid (Mass), and then press Up key to select Constant density (Density compensation).
Press Right key to shift cursor on density value, and then press Up/Down key to change this value.



3.7.11 Damping Time

After setting medium parameters, press ENTER key to enter Damping time menu. The damping time is set according to different flowmeters on site.
Press Right key to shift cursor, and press Up/Down key to change time value, damping time range is 0-30s.



3.7.12 Low Flow Cutoff

After setting damping time, press ENTER key to enter Low Flow Cutoff menu. The cutoff value is set according to different flowmeters on site.
Press Right key to shift cursor, and press Up/Down key to change this value.

Low flow cutoff
00000.000

3.7.13 Temperature Sensor

After setting low flow cutoff, press ENTER key to enter temperature sensor menu, and press Up key to select different temperature sensor type. There are five temperature sensor types: Pt100, 4-20mA, 0-10mA, Constant (Setting temperature) and Thermocouple (S/R/B/K/N/E/J/T).

T Sensor: Pt100
Constant: +180.00

T Sensor: 4-20mA
Const..: +180.00
L scale: +000.0
H scale: +400.0

The setting temperature is used to compensate and display with manual setting temperature when the external temperature sensor is abnormal (Beyond the lower or upper scale of temperature).

When the T sensor is selected 4-2mA or 0-10mA signal, it needs to set the L scale (Lower scale) and H scale (Upper scale) of temperature. Press Right key to shift the cursor on scale values, and then press Up/Down key to change these values.

3.7.14 Pressure Sensor

After setting temperature sensor, press ENTER key to enter pressure sensor menu, press Up key to select different temperature sensor type, and set the L scale (Lower scale) and H scale (Upper scale) of temperature

P Sensor: 4-20mA G
Const.: +00.000
L scale: +00.000
H scale: +01.600

The setting pressure is used to compensate and display with manual setting pressure when the external pressure sensor is abnormal (Beyond the lower or upper scale of pressure).

There are six pressure sensor types: 4-20mA G (4-20mA gauge pressure), 4-20mA A (4-20mA absolute pressure), 0-10mA G (0-10mA gauge pressure), 0-10mA A (4-20mA absolute pressure), Const. G (Setting gauge pressure) and Const. A (Setting absolute pressure).
Note: The unit of setting pressure, L scale and H scale pressure is MPa.3.7.15 Temperature/Pressure Upper and Lower scales

After setting pressure sensor, press ENTER key to enter T/P upper and lower scales menu, press Right key to shift cursor, and then press Up/Down key to set the lower and upper scale of temperature and pressure.

T lower: -040.0
T upper: +300.0
P lower: -00.01
P upper: +02.00

If the temperature or pressure is out of the range, it will use setting temperature or pressure to compensate and alarm. This alarm can be used relay to output switching signal.

3.7.16 External Sensor Parameter Correction

F factor: 000.000
T zero: +00.000
P zero: +01.000

After setting T/P upper and lower scales, press ENTER key to enter external sensor parameter correction menu, press Right key to shift cursor, and then press Up/Down key to set the values.

3.7.17 Local Atmospheric Pressure

Atmospheric P:
101.3 kPa

After setting external sensor parameter correction, press ENTER key to enter local atmospheric pressure menu, press Right key to shift cursor, and then press Up/Down key to set the values.

3.7.18 Timing Meter Reading

Read: Open
Times: 08
No.: 01
Time: 08:00

After setting local atmospheric pressure, press ENTER key to enter timing meter reading menu.
The times of timing meter reading can be set to up to eight, and the records can be queried in 3.3 Query.
Press Right key to shift cursor, and then press Up/Down key to set the values.

3.7.19 Timing Print

Print: Open
Times: 08
No.: 01
Time: 10:00

After setting timing meter reading, press ENTER key to enter timing print menu.
The times of timing print can be set to up to eight, and the time if print can be set by users. This function can be used normally after connecting and setting printer correctly.
Press Right key to shift cursor, and then press Up/Down key to set the values.

3.7.20 Clock Setup

After setting timing meter reading, press ENTER key to enter clock setup menu. Press Right key to shift cursor, and then press Up/Down key to set the values.

Real-time Clock:
Date: 2010-07-20
Time: 17:00:39

3.7.21 Communication

After setting clock, press ENTER key to enter communication menu. Press key to shift cursor, and then press Up/Down key to select options or set the values.

Com type: RS485
Device ID: 0001
Baud rate: 9600

Communication type	
1. RS485	3. Ethernet
2. RS232	4. None

The range of device ID: 01-254.
Baud rate: Optional 600, 1200, 2400, 4800 and 9600.
For communication, it needs to order corresponding interface, please state when ordering.

3.7.22 Current Output

After setting communication, press ENTER key to enter current output menu. Press Right key to shift cursor on 4-20mA, and then press Up key to select different current output types.

Current output:
Options: 01/04
Output type:
4-20mA

Current output type
1. 4-20mA
2. 0-10mA
3. 0-20mA

Current output:
Options: 02/04
Output variable:
Flow rate

Current output variable
1. Flow rate
2. Temperature
3. Gauge pressure (MPa)
4. DP (differential pressure, kPa)
5. Density (Kg/m3)
6. Thermal enthalpy (KJ/kg)
7. Power (MJ/h)

Current output:
Options: 03/04
Lower scale:
+0000000.00

Current output:
Options: 04/04
Upper scale:
+0000100.00

Note: When shifting the cursor on the +/- symbol, press Up key to switch positive and negative value.

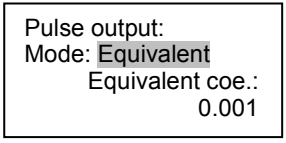
After selecting output type, press Left key to shift cursor on Output type, press Up key to change output type to output variable. Press Right key to shift cursor on variable option, and then press Up key to select different output variables.

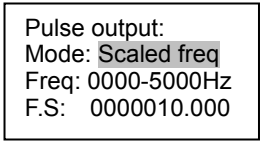
After selecting output variable, press Left key to shift cursor on Output variable, press Up key to change output variable to Lower scale. Press Right key to shift cursor on lower scale value, and then press Up/Down key to change the value.

After setting lower scale, press Left key to shift cursor on Lower scale, press Up key to change lower scale to upper scale. Press Right key to shift cursor on upper scale value, and then press Up/Down key to change the value.

3.7.23 Pulse Output

After setting current output, press ENTER key to enter pulse output menu. Press Right key to shift cursor on Mode option, and then press Up key to select Scale freq or Equivalent (Scaled freq.: Pulse frequency for flow rate; Equivalent: equivalent pulse for totalizer). For equivalent pulse, the equivalent coefficient can be selected 0.001, 0.01, 0.1, 10, 100 or 1000.





3.7.24 Alarm 1

After setting pulse output, press ENTER key to enter alarm 1 menu. Press Right key to shift cursor on alarm variables value, and then press Up key to select different alarm types.
After setting alarm variable type, press Left key to shift cursor on Alarm variable, press Up key to change Alarm variable to Alarm value, press Right key to shift cursor on value, and then press Up/Down key to change the value.
After setting alarm value, press Left key to shift cursor on Alarm value, press Up key to change Alarm value to Alarm hysteresis, press Right key to shift cursor on value, and then press Up/Down key to change the value.

Alarm 1 variable type	
1. None	4. Temperature upper scale
2. Flow rate upper scale	5. Temperature lower scale

Alarm 1: Options: 1/3 Alarm variable: Flow upper scale	Alarm 1: Options: 2/3 Alarm value: +0000000.000	Alarm 1: Options: 3/3 Alarm hysteresis: 0000.00

3. Flow rate lower scale	6. Pressure upper scale
7. Pressure lower scale	

3.7.25 Alarm 2

After setting alarm 1, press ENTER key to enter alarm 2 menu. Press Right key to shift cursor on alarm variable value, and then press Up key to select different alarm types.
After setting alarm variable type, press Left key to shift cursor on Alarm variable, press Up key to change Alarm variable to Alarm value, press Right key to shift cursor on value, and then press Up/Down key to change the value.
After setting alarm value, press Left key to shift cursor on Alarm value, press Up key to change Alarm value to Alarm hysteresis, press Right key to shift cursor on value, and then press Up/Down key to change the value.

Alarm 3: Options: 1/3 Alarm variable: Flow upper limit	Alarm 2: Options: 2/3 Alarm value: +0000000.000	Alarm 2: Options: 3/3 Alarm hysteresis: 0000.00

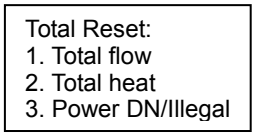
Alarm 2 type	
1. None	4. Temperature upper scale
2. Flow rate upper scale	5. Temperature lower scale
3. Flow rate lower scale	6. Pressure upper scale
7. Pressure lower scale	

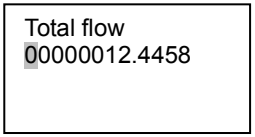
3.8 Total Reset

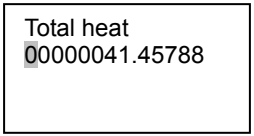
In main menu, press Up or Down key to select Total Reset submenu, and then press ENTER key to enter.

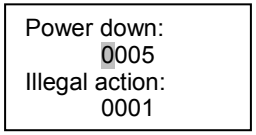
Main Menu 4. Calibrate 5. Setup 6. Total Reset	Password ******	The Reset submenu also has password protection. The default password is 000000, customers can modify the password according to 3.10 Password.

After input correct password, press ENTER key, it will be shown as below.









Press Right key to shift cursor on Total flow and then press ENTER key to enter. In Total flow reset menu, press Right key to shift cursor, and then press Up/Down key to change the value. After setting, press ENTER key to return Total Reset submenu.

Press Right key to shift cursor on Total heat and then press ENTER key to enter. In Total heat reset menu, press Right key to shift cursor, and then press Up/Down key to change the value. After setting, press ENTER key to return Total Reset menu.

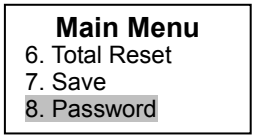
Press Right key to shift cursor on Power DN/Illegal, and then press ENTER key to enter. In Power DN/Illegal menu, press Right key to shift cursor, and press Up/Down key to change the times values of power down and illegal action.

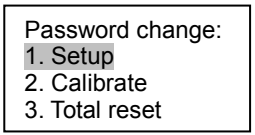
3.9 Save

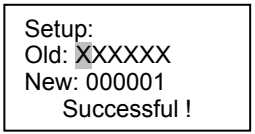
This submenu is used to download operating data from instrument. If customers need this function, please order USB interface.

3.10 Password

In main menu, press Up or Down key to select Password submenu, and then press ENTER key to enter.







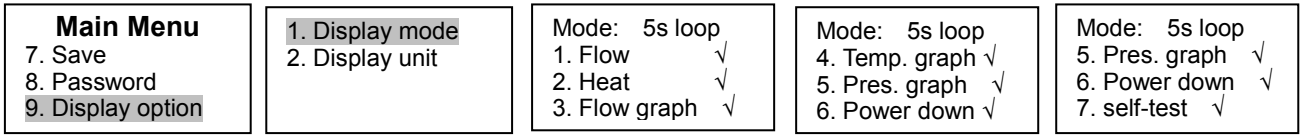
Press Right key to shift cursor on Setup, press ENTER key to enter setup password menu, input old and new passwords, and then press ENTER key, it will display “Successful !”.

The setup method of calibrate and total reset password is the same as that of setup password.

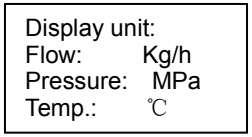
3.11 Display

In main menu, press Up or Down key to select Display submenu, and then press ENTER key to enter.

Press Right key to select display mode, and press ENTER key to enter. Press Right key to shift cursor on display options, and press Down key to switch the options displaying or not (√ means options displaying, else no displaying). After setting, press ENTER key to return display submenu.



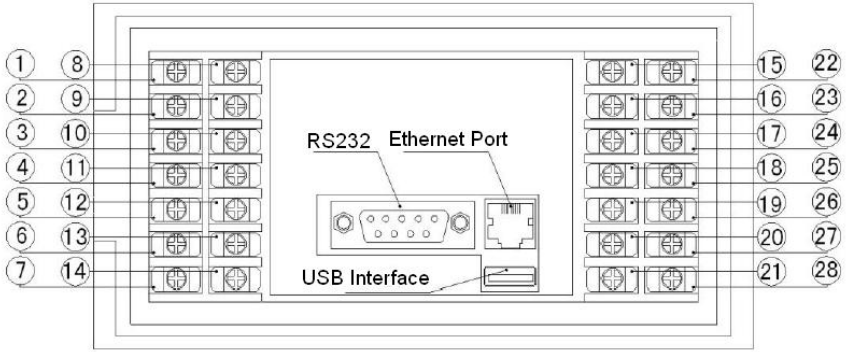
Press Right key to select display unit, and press ENTER key to enter.



Display Unit
Flow: Nm3/h, Nl/h, Nl/m, t/h, kg/h, m3/h, l/h and l/m
Pressure: MPa and KPa
Temperature: ℃ and ℉

Part 4 Wirings

4.1 Wiring Terminals



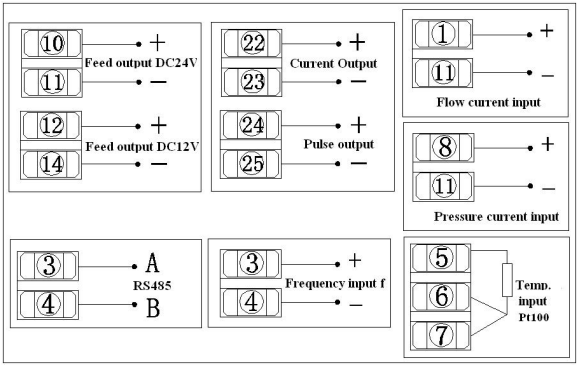
Warning! The left figure only be used as an example, All wirings of instrument should be refer to the marks on instrument.

Terminals Definition

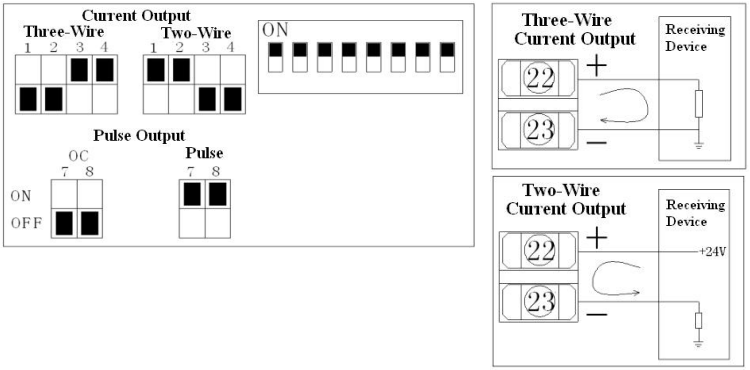
No.	Definition	No.	Definition	No.	Definition	No.	Definition
1	Flow current input	8	Pressure current input	15	Temp. current input	22	Current output +
2	Blank	9	Blank	16	Blank	23	Current output -
3	RS-485 (A)	10	24V (+) output	17	Battery +	24	Pulse output +
4	RS-485 (B)	11	Public GND	18	Battery -	25	Pulse output -
5	Pt100, A	12	12V (+) Output	19	GND	26	Alarm 1 normally-closed contact
6	Pt100, B	13	Flow pulse input	20	**220V N**	27	Alarm 1 normally-open contact
7	Pt100, B	14	Public GND	21	**220V L**	28	Alarm 1 common contact

4.2 Wiring Diagrams

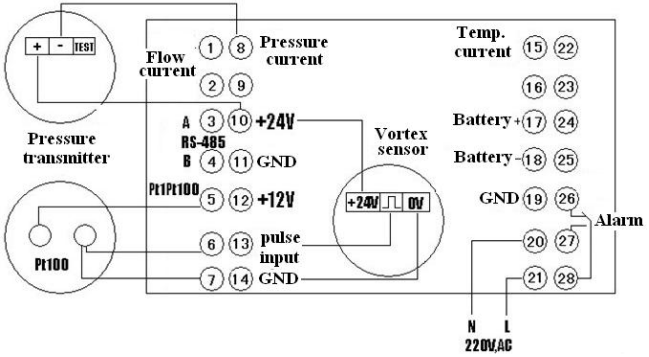
Output Wirings



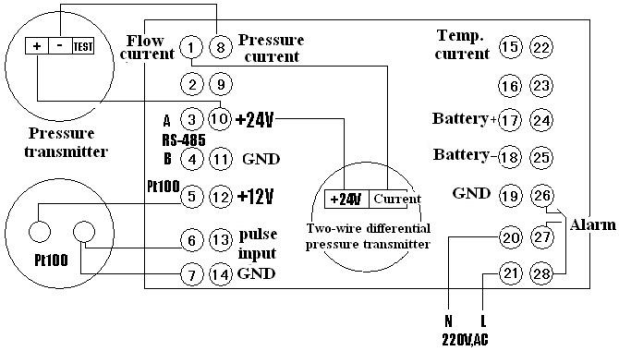
Toggle switch: Output board is shown as below.



Wirings of flow (Pulse), Temperature (Pt100), pressure transmitter and power supply



Wirings of two-wire flow transmitter or differential pressure transmitter

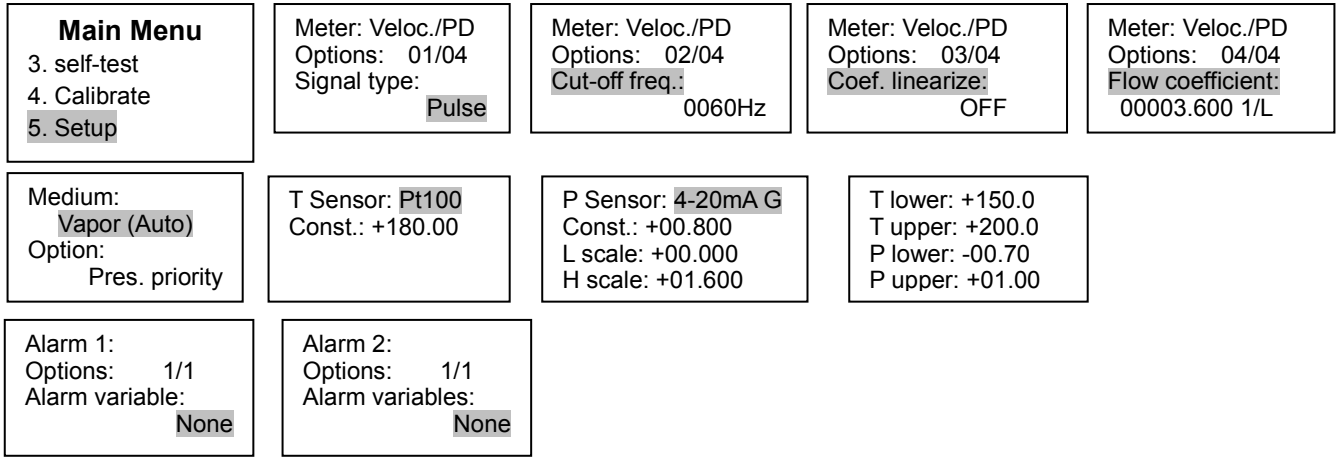


Appendix 1 Application Examples

A.1 Example 1

DN50 Vortex flow sensor, measure vapor; average flow coefficient is 9.4132/l; temperature and pressure compensation; temperature sensor Pt100; pressure transmitter 0-1,6MPa; 4-20mA output; No alarm; low frequency cut-off is 60Hz; temperature range +150～200℃ (If temperature is out if the range, use 180℃ setting temperature); pressure range 0.7～1.0MPa (If pressure is out if the range, use 0.8MPa setting pressure).

Parameters Setup



A.2 Example 2

DN100 vortex flow transmitter, measure compressed air in standard condition; output 4-20mA; flow range is 0-2000m3/h; temperature and pressure compensation; average working temperature: +20℃; the average working pressure: +0.3MPa; Low

flow cut-off 50m3/h; damping time 5s.

Parameters Setup

Main Menu 3. self-test 4. Calibrate 5. Setup	Meter: Veloc./PD Options: 01/04 Signal type: 4-20mA	Meter: Veloc./PD Options: 02/04 Flow F.S. unit: m3/h	Meter: Veloc./PD Options: 04/04 Cut-off current: 4.000mA	Medium: Gas (Std. volume) Std. density: 0001.2048kg/m3
Damping time: 05/30 s	Low flow cutoff 00050.000	T Sensor: Set Const.: +020.00	P Sensor: Set Const.: +00.300	

A.3 Example 3

Annubar flow meter, Rosemount 3095 transmitter and Pt100; measure vapor; output 4-20mA for vapor mass; range 0-10t.
Flow totalizer configuring with Pt100 temperature sensor and 0-1.6MPa pressure transmitter; display temperature, pressure, flow rate, power, flow totalizer and energy of vapor; temperature range +130～200℃; common temperature: +180℃; pressure range 0.6～1.0MPa; common pressure: +0.8MPa.

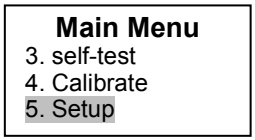
Parameters Setup

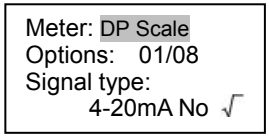
Meter: Mass Flow Options: 01/04 Signal type: 4-20mA	Meter: Mass Flow Options: 02/04 Flow F.S. unit: t/h	Meter: Mass Flow Options: 03/04 Flow F.S.: 00010.000 m3/h	Meter: Mass Flow Options: 04/04 Cut-off current: 4.000mA	Medium: Vapor (Auto) Option: Pres. priority
T Sensor: Pt100 Const.: +180.00	P Sensor: 4-20mA G Const.: +00.800 L scale: +00.000 H scale: +01.600	T lower: +130.0 T upper: +200.0 P lower: -00.60 P upper: +01.00	Mode: 5s loop 1. Flow √ 2. Heat √ 3. Flow graph	Mode: 5s loop 5. Pres. graph 6. Power down 7. self-test √

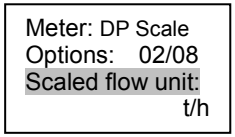
A.4 Example 4

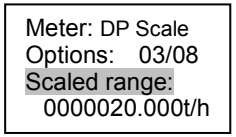
V-cone flowmeter, measure vapor mass; Rosemount 3051 differential pressure transmitter, Pt100 and pressure transmitter; differential pressure transmitter range 0 ~ +300Pa; output 4-20mA No √; flow range 20t/h; design density 3.3342kg/m3; pressure transmitter range 0 ~ 1.6MPa; temperature range +170～+260℃; common temperature: +200℃; pressure range 0.6～1.0MPa; common pressure: +0.7MPa; low current cut-off 4.005mA.

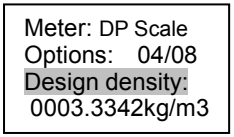
Parameters Setup

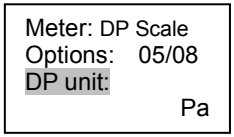


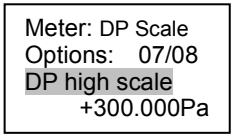


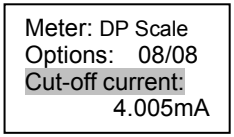


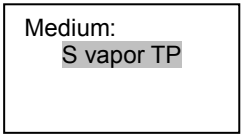


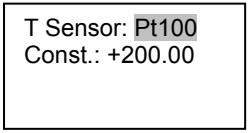


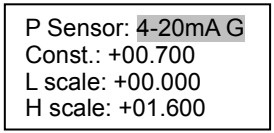


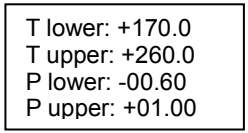












A.5 Example 5

Magnetic flowmeter, measure liquid; output 4-20mA; range 0-60m3/h.

Parameters Setup

Meter: Veloc./PD Options: 01/04 Signal type: 4-20mA	Meter: Veloc./PD Options: 02/04 Flow F.S. unit: m3/h	Meter: Veloc./PD Options: 03/04 Flow F.S.: 00060.000 m3/h	Meter: Veloc./PD Options: 04/04 Cut-off current: 4.000mA	Medium: Liquid (Volume) Density (20℃): 1000.0000kg/m3

A.6 Example 6

Ultrasonic flowmeter, measure liquid; output 4-20mA; range 0-300m3/h.

Parameters Setup

Meter: Veloc./PD Options: 01/04 Signal type: 4-20mA	Meter: Veloc./PD Options: 02/04 Flow F.S. unit: m3/h	Meter: Veloc./PD Options: 03/04 Flow F.S.: 00300.000 m3/h	Meter: Veloc./PD Options: 04/04 Cut-off current: 4.000mA	Medium: Liquid (Volume) Density (20℃): 1000.0000kg/m3

A.7 Example 7

Orifice plate flowmeter, measure vapor; Rosemount 3051 differential pressure transmitter, Pt100 and pressure transmitter; flow range 0-20t; design density 5.17kg/m3; output of differential pressure transmitter is 4-20mA No √; pressure transmitter range 0 ~ 1.6MPa; temperature range +130～+200℃; common temperature: +180℃; pressure range 0.6～1.0MPa; common pressure: +0.8MPa.

Parameters Setup

Meter: DP Scale Options: 01/08 Signal type: 4-20mA No √	Meter: DP Scale Options: 02/08 Scaled flow unit: t/h	Meter: DP Scale Options: 03/08 Scaled range: 0000020.000t/h	Meter: DP Scale Options: 04/08 Design density: 0005.1700kg/m3	Meter: DP Scale Options: 08/08 Cut-off current: 4.000mA	Medium: Vapor (Auto) Option: Pres. priority

The setup of temperature and pressure refers to example 3.

A.8 Example 8

V-Cone flowmeter, measure natural gas in standard condition; Rosemount 3051 differential pressure transmitter, Pt100 and pressure transmitter, differential pressure transmitter range 0 ~ +300Pa, output 4-20mA No √; pressure transmitter range 0 ~ 1.6MPa; temperature range -40～+60℃; common temperature: +25℃; pressure range 0.4～0.8MPa; common pressure: +0.5MPa; local atmospheric pressure 98.4KPa; low current cut-off 4.005mA.

Parameters Setup

Meter: V-Cone DP Options: 01/09 Signal type: 4-20mA No √	Meter: V-cone DP Options: 06/09 DP unit: Pa	Meter: V-Cone DP Options: 07/09 DP low scale: +000.000Pa	Meter: V-Cone DP Options: 08/09 DP high scale: +300.000Pa	Meter:V-Cone DP Options: 09/09 Cut-off current: 4.005mA

Medium: Gas (Std. volume) Std. density: 0000.6660kg/m3	Atmospheric P: 98.4 kPa	V-cone calculation sheet provides: Pipe inside diameter D 400mm, Cone diameter d 275.13mm; Expansibility factor ε 0.9982; Discharge coefficient c 0.85. The setup of temperature and pressure refers to example 3.

A.9 Example 9

DN50 Vortex flow sensor, measure hot-water; flow coefficient is 9.2187/l; damping time 5s; low flow cut-off 2t; temperature range +50～+90℃.

Parameters Setup

Meter: Veloc./PD Options: 01/04 Signal type: Pulse	Meter: Veloc./PD Options: 02/04 Cut-off freq.: 0000Hz	Meter: Veloc./PD Options: 03/04 Coef. linearize: OFF	Meter: Veloc./PD Options: 04/04 Flow coefficient: 0009.2187 1/L	Medium: Liquid (Mass) Density (20℃): 0998.0000kg/m3

Medium: Liquid (Mass) Coe.V-expansion: 0.000251	Damping time: 05/30 s	Low flow cutoff 00002.000

The setup of temperature refers to example 3.

A.10 Example 10

Elbow flowmeter, measure vapor (mass); Rosemount 3051 differential pressure transmitter, Pt100 and pressure transmitter, differential pressure transmitter range 0 ~ +300Pa, output 4-20mA No √; pressure transmitter range 0 ~ 4.0MPa; expansibility factor 0.9876; flow coefficient 1.299; temperature range +300～+350℃; common temperature: +325℃; pressure range 1.4～1.8MPa; common pressure: +1.6MPa; low current cut-off 4.005mA.

Parameters Setup

Meter: Elbow DP Options: 01/09 Signal type: 4-20mA No √	Meter: Elbow DP Options: 02/09 Pipe diameter D: 0400.00mm	Meter: Elbow DP Options: 03/09 Band radius R: 0001.5000mm	Meter: Elbow DP Options: 04/09 Expansibility ε : 0.98760	Meter: Elbow DP Options: 05/09 Flow coe.: 1.29900
Meter: Elbow DP Options: 06/09 DP unit: Pa	Meter: Elbow DP Options: 07/09 DP low scale: +000.000Pa	Meter: Elbow DP Options: 08/09 DP high scale: +300.000Pa	Meter: Elbow DP Options: 09/09 Cut-off current: 4.005mA	Medium: Vapor (Auto) Option: Pres. priority

The setup of temperature refers to example 3.

Appendix 2 Modbus-RTU Communication Protocol

B.1 Communication Instruction

Interface: RS485; Baud rate: Optional 1200, 2400, 4800 or 9600; Start bit: 1, Data bit: 8, Stop bit: 1, Parity bit: none.

B.2 Command Format

Sending Command from PC (Express in Hex)

Meter Address	Function code	High byte of start register	Low byte of start register	High byte of register length	Low byte of register length	CRC high byte	CRC low byte

Answer Command from Instrument (Express in Hex)

Address	Function code	Return Byte number	Return data from register	CRC high byte	CRC high byte

Notes: 1. When debugging, it can use the universal CRC “AA AA”.

2. Register length should be less than 32 (20 in Hex).

3. When the baud rate is low, and the register length is long, the waiting time of PC should be extended.

B.3 Register Map

Register Address	**Parameters**	**Register Address**	**Parameters**
0x0000	Flow rate	0x0010	In spare
0x0001		0x0011	
0x0002	Frequency (Hz)	0x0012	In spare

0x0003		0x0013	
0x0004	Differential pressure (KPa)	0x0014	Flow totalizer (t)
0x0005		0x0015	
0x0006	Pressure (MPa)	0x0016	Energy (GJ)
0x0007		0x0017	
0x0008	Temperature (℃)	0x0018	Battery voltage (V)
0x0009		0x0019	
0x000A	Density (kg/m3)	0x001A	External power voltage (V)
0x000B		0x001B	
0x000C	Power (MJ/h)	0x001C	Times of power down (Two bytes in Hex)
0x000D		0x001D	
0x000E	Status code 1 and 2	0x001E	In spare
0x000F		0x001F	Times of illegal operation (Two bytes in Hex)

Status Code 1		**Status Code 2**	
Bits	**Description**	**Bits**	**Description**
15	In spare	15	In spare
14	In spare	14	In spare
13	LCD status, 0: ok, 1: Fault	13	In spare
12	Clock status, 0: ok, 1: Fault	12	In spare
11	AD convertor status, 0: ok, 1: Fault	11	In spare
10	Memory status, 0: ok, 1: Fault	10	In spare
9	Battery status, 0: ok, 1: Low voltage	9	In spare
8	Parameter status, 0: ok, 1: Overflow	8	Power supply, 0: External power, 1: Battery
7	In spare	7	Frequency/current cut-off, 0: cut-off, 1: no cut-off
6	In spare	6	In spare

5	In spare	5	In spare
4	In spare	4	In spare
3	In spare	3	In spare
2	Stream status, 0: superheated vapor, 1: saturated vapor	2	In spare
1	Temperature compensation range, 0: ok, 1: Overflow	1	In spare
0	Pressure compensation range, 0: ok, 1: Overflow	0	In spare

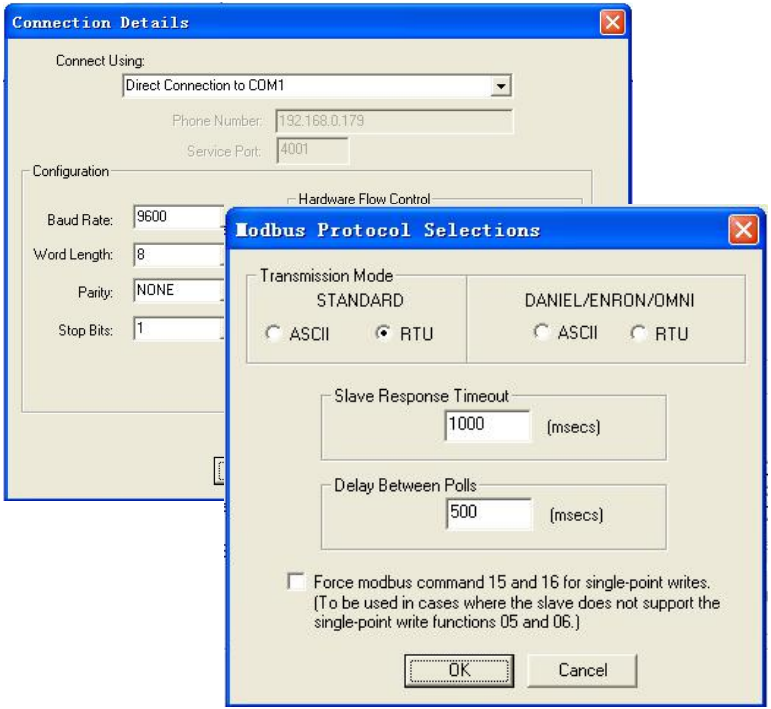
B.4 Examples

Sending command: 01 03 00 00 00 18 45 C0	Answer: 01 03 30 0D 44 41 04 00 00 42 48 00 00 00 00 CC 26 3F 4C 00 01 43 34 B9 68 40 92 0B FF 46 B3 00 00 00 00 00 00 00 00 00 00 00 00 39 09 46 45 48 F4 46 18 78 38
01: Instrument address 03: function code 00 00: Start register address 00 18: Register length 45 C0: CRC check	01: Instrument address 03: function code 30: Return Byte number (Return Byte number=register number * 2) 0D 44 41 04: Flow rate, 8.2532 0 00 42 48: Frequency, 50Hz 00 00 00 00: Differential pressure, 0KPa CC 26 3F 4C: Pressure, 0.8000MPa 00 01 43 34: Temperature, 180.0000℃ B9 68 40 92: Density, 4.5851kg/m3 0B FF 46 B3: Power, 22917.9980MJ/h 00 00 00 00: self-test/Alarm 1, 2, 3, 4 00 00 00 00: In spare 00 00 00 00: In spare 39 09 46 45: Flow totalizer, 12622.1533t 48 F4 46 18: Energy, 9745.9453GJ 78 38: CRC check

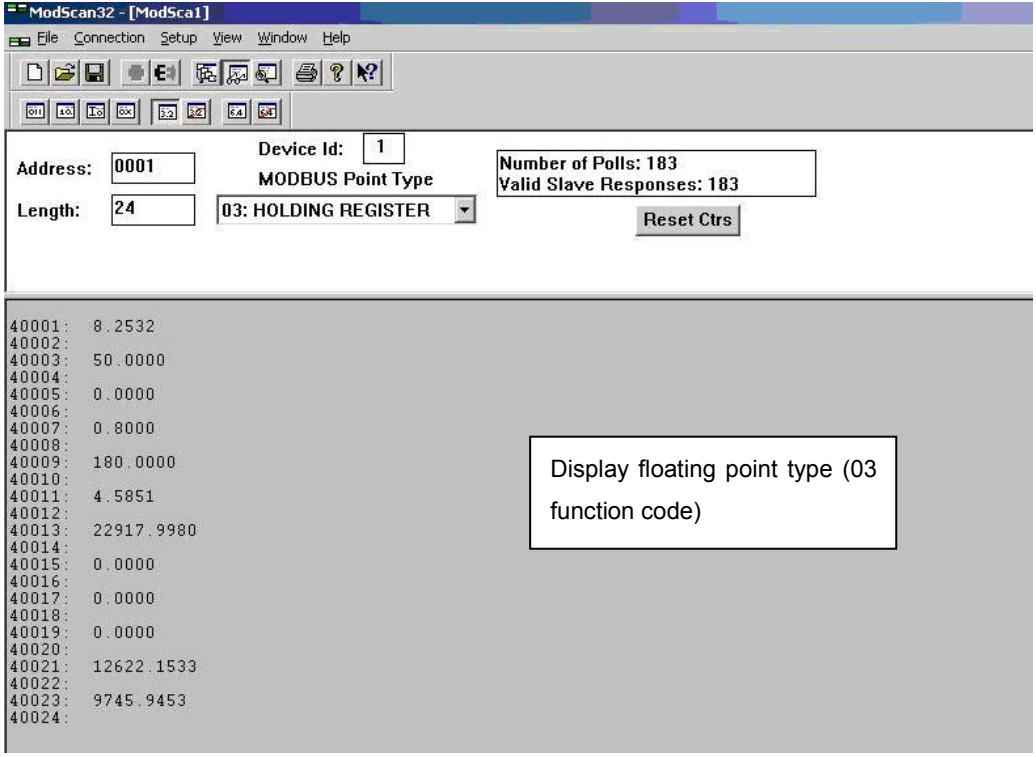
Appendix 3 Modscan32 Software

C.1 Parameter Setup

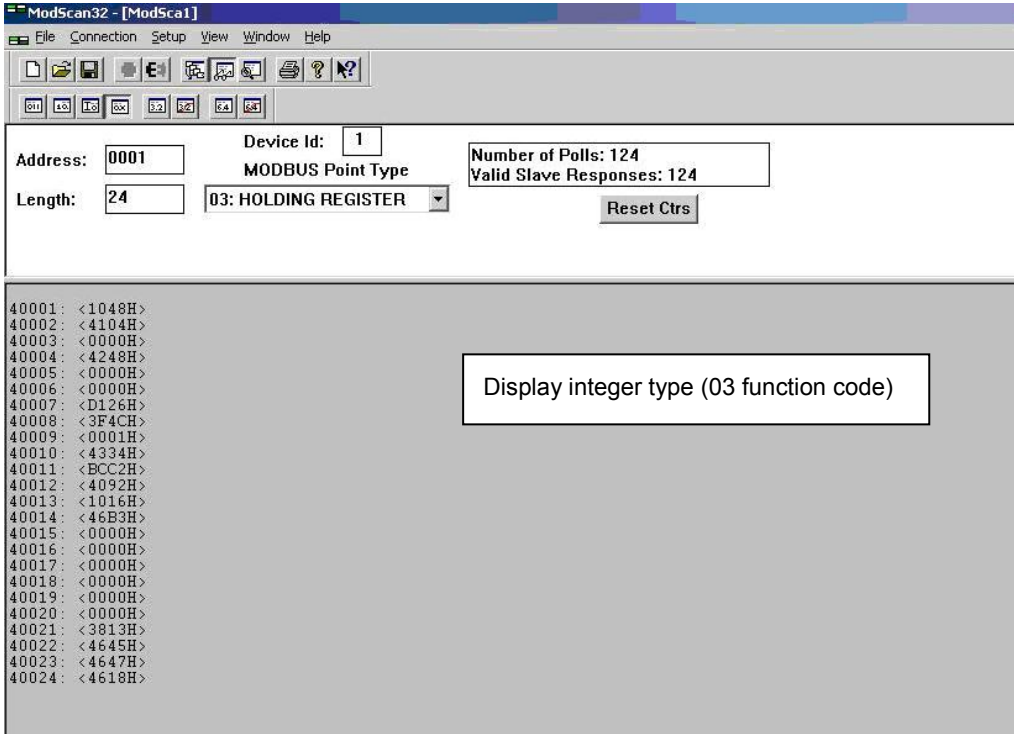
- Display Option: Floating Pt
- Modbus function code: 03 HOLD REGISTER
- Device Id: Slave Device Address
- Address: Point address within the device
- Length: Number of points to scan/display
- Connection: Select serial port
- Baud rate: Communication baud rate
- Word bit: 8 bit
- Parity: None
- Stop bit: 1

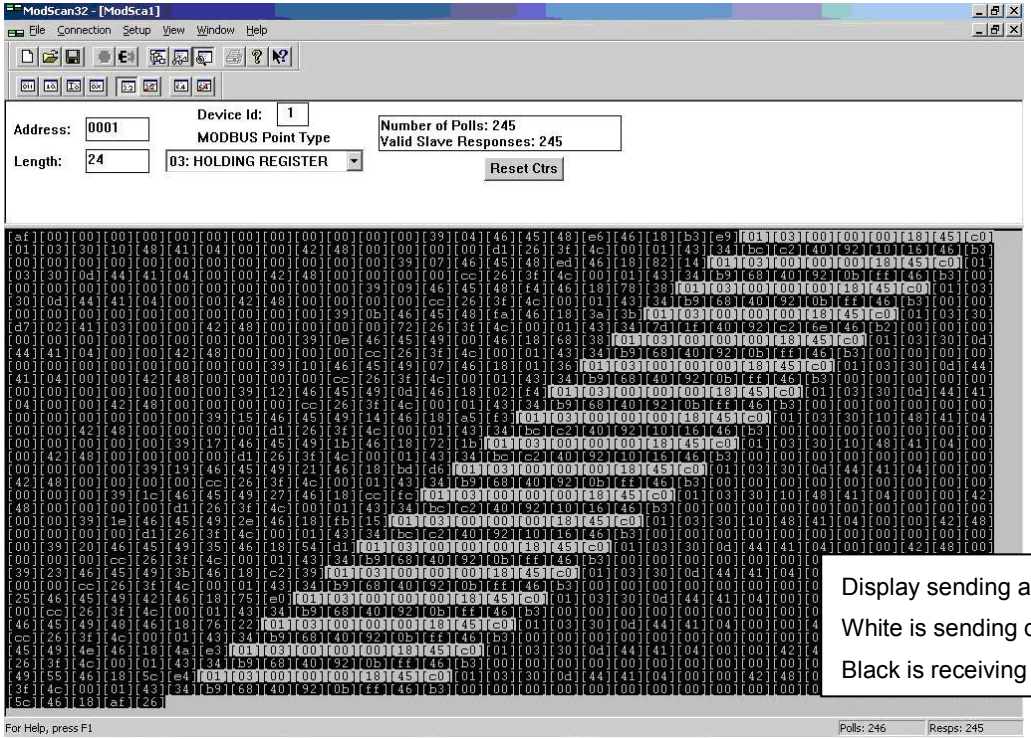


C.2 Display Screen



Display floating point type (03 function code)


ModScan32 - [ModSca1]
File Connection Setup View Window Help
Address: 0001
Length: 24
Device Id: 1
MODBUS Point Type
03: HOLDING REGISTER
Number of Polls: 124
Valid Slave Responses: 124
Reset Ctrs
40001: <1048H>
40002: <4104H>
40003: <0000H>
40004: <4248H>
40005: <0000H>
40006: <0000H>
40007: <D126H>
40008: <3F4CH>
40009: <0001H>
40010: <4334H>
40011: <BCC2H>
40012: <4092H>
40013: <1016H>
40014: <46B3H>
40015: <0000H>
40016: <0000H>
40017: <0000H>
40018: <0000H>
40019: <0000H>
40020: <0000H>
40021: <3813H>
40022: <4645H>
40023: <4647H>
40024: <4618H>
Display integer type (03 function code)



Display sending and receiving data

White is sending data

Black is receiving data

Note:
In MODBUS communication, the data is expressed in Hex, and the floating point data adopts IEEE754 standard.

The data format is shown as below.

- One bit: symbol bit
- Eight bits: exponent bits
- Twenty-three bits: mantissa bits

The symbol bit is the highest bit, and the mantissa bits are the lowest bits.
It can be described as follow according to bytes:

Address	+0	+1	+2	+3
Content	SEEE EEEE	EMMM MMMM	MMMM MMMM	MMMM MMMM

Among above table:

S is symbol bit, 1 indicates negative, and 0 indicates positive.

E is exponent bit (Between two bytes), and has a shift with 127.

M is mantissa bit, the high bit of mantissa is still “1”.

Appendix 4 Computational Formula

D.1 Velocity/Volume

1. Mass flow expression

Applicable Medium Type
1. Vapor Automatic Compensation
2. Saturated vapor temperature compensation
3. Saturated vapor pressure compensation
4. Superheated vapor pressure and temperature compensation
5. Gas (Mass) 6. Liquid (Mass)
7. Constant Density

1.1 Signal type: pulse (Volume)

$$Q_m = 3.6 * \rho * F/K$$

Q_m: Flow rate, t/h; ρ: Medium density, kg/m3; F: Output frequency of flow sensor, Hz; K: Flow coefficient, 1/l.

1.2 Signal type: 4-20mA (Volume)

$$Q_m = \rho * \frac{I-4}{16} * FS$$

Q_m: Flow rate, t/h; ρ: Medium density, kg/m3; I: Output current of flow transmitter, mA; FS: Flow transmitter range, m3/h.

1.3 Signal type: 0-10mA (Volume)

$$Q_m = \rho * \frac{I}{10} * FS$$

Q_m: Flow rate, t/h; ρ: Medium density, kg/m3; I: Output current of flow transmitter, mA; FS: Flow transmitter range, m3/h.

2. Volume flow in working condition expression

Applicable Medium Type: Liquid volume

2.1 Signal type: pulse (Volume)

$$Q_v = 3.6 * F/K$$

Q_v: Flow rate, m3/h; F: Output frequency of flow sensor, Hz; K: Flow coefficient, 1/l.

2.2 Signal type: 4-20mA (Volume)

$$Q_v = \frac{I-4}{16} * FS$$

Q_v: Flow rate, m3/h; F: Output current of flow sensor, Hz; FS: Flow transmitter range, m3/h.

2.3 Signal type: 0-10mA (Volume)

$$Q_v = \frac{I}{10} * FS$$

Q_v: Flow rate, m3/h; F: Output current of flow sensor, Hz; FS: Flow transmitter range, m3/h.

3. Volume flow in standard condition expression

Applicable Medium Type: Gas volume (Std. condition)

3.1 Signal type: pulse (Volume)

$$Q_v = 3.6 * F/K * \frac{(P+101.325) * (273.15+T_0)}{101.325 * (273.15+T)}$$

Q_v: Flow rate, Nm3/h; F: Output frequency of flow sensor, Hz; K: Flow coefficient, 1/l; P: Medium gauge pressure, MPa; T: Medium temperature, ℃; T0: Temperature in std. condition, ℃.

3.2 Signal type: 4-20mA (Volume)

$$Q_v = \frac{I-4}{16} * FS * \frac{(P+101.325) * (273.15+T_0)}{101.325 * (273.15+T)}$$

Q_v: Flow rate, Nm3/h; I: Output current of flow transmitter, mA; FS: Flow transmitter range, m3/h.

3.3 Signal type: 0-10mA (Volume)

$$Q_v = \frac{I}{10} * FS * \frac{(P+101.325) * (273.15+T_0)}{101.325 * (273.15+T)}$$

Q_v: Flow rate, Nm3/h; I: Output current of flow transmitter, mA; FS: Flow transmitter range, m3/h.

D.2 Mass Flow

1. Mass flow expression

Applicable Medium Type
1. Vapor Automatic Compensation
2. Saturated vapor temperature compensation
3. Saturated vapor pressure compensation
4. Superheated vapor pressure and temperature compensation 5. Gas (Mass) 6. Liquid (Mass)

1.1 Signal type: pulse (Mass)

$$Q_m = 3.6 * F/K$$

Q_m: Flow rate, t/h; F: Output frequency of flow sensor, Hz; K: Flow coefficient, 1/kg..

1.2 Signal type: 4-20mA (Mass)

$$Q_m = \frac{I-4}{16} * FS$$

Q_m: Flow rate, t/h; I: Output current of flow transmitter, mA; FS: Flow transmitter range, t/h.

1.3 Signal type: 0-10mA (Mass)

$$Q_m = \frac{I}{10} * FS$$

Q_m: Flow rate, t/h; I: Output current of flow transmitter, mA; FS: Flow transmitter range, t/h.

2. Volume flow in working condition expression

Applicable Medium Type:
1. Gas (Std. condition volume); 2. Liquid (Volume)

2.1 Signal type: pulse (Mass)

$$Q_v = 3.6 * F/K/\rho$$

Q_v: Flow rate, m3/h; ρ: Medium density, kg/m3; F: Output frequency of flow sensor, Hz; K: Flow coefficient, 1/kg.

2.2 Signal type: 4-20mA (Mass)

$$Q_v = \frac{I-4}{16} * FS/\rho$$

Q_v: Flow rate, m3/h; ρ: Medium density, kg/m3; I: Output current of flow transmitter, mA; FS: Flow transmitter range, t/h.

2.3 Signal type: 0-10mA (Mass)

$$Q_v = \frac{I}{10} * FS/\rho$$

Q_v: Flow rate, m3/h; ρ: Medium density, kg/m3; I: Output current of flow transmitter, mA; FS: Flow transmitter range, t/h.

D.3 DP Flow

1. Mass flow expression

Applicable Medium Type
1. Vapor Automatic Compensation
2. Saturated vapor temperature compensation
3. Saturated vapor pressure compensation
4. Superheated vapor pressure and temperature compensation 5. Gas (Mass) 6. Liquid (Mass)

1.1 Signal type: 4-20mA No √

$$Q_m = Q_s * \sqrt{\frac{\rho_w}{\rho_d}} * \sqrt{\frac{I-4}{16}}$$

1.2 Signal type: 0-10mA No √

$$Q_m = Q_s * \sqrt{\frac{\rho_w}{\rho_d}} * \sqrt{\frac{I}{10}}$$

1.3 Signal type: 4-20mA √

$$Q_m = Q_s * \sqrt{\frac{\rho_w}{\rho_d}} * \frac{I-4}{16}$$

1.4 Signal type: 0-10mA √

$$Q_m = Q_s * \sqrt{\frac{\rho_w}{\rho_d}} * \frac{I}{10}$$

Q_m: Flow rate, t/h; Q_s: Flow transmitter range, t/h;.ρ_d: Medium design density, kg/m3; ρ_w: Medium density in working condition, kg/m3;

2. Volume flow expression

Applicable Medium Type
1. Gas (Std. condition volume); 2. Liquid (Volume)

2.1 Gas (Std. volume): $Q_V = Q_m / \rho_s$
Q_v: Flow rate, Nm3/h; Q_m: Flow rate, t/h; ρ_s: Medium density in std. condition, kg/m3;

2.2 Liquid (Volume): $Q_V = Q_m / \rho$
Q_v: Flow rate, m3/h; Q_m: Flow rate, t/h; ρ: Medium density, kg/m3;

D.4 Orifice DP

1. Mass flow expression

Applicable Medium Type
1. Vapor Automatic Compensation
2. Saturated vapor temperature compensation
3. Saturated vapor pressure compensation
4. Superheated vapor pressure and temperature compensation 5. Gas (Mass) 6. Liquid (Mass)

1.1 Flow rate: $$Q_m = 3.6 * \frac{C}{\sqrt{1-(\frac{d}{D})^4}} * \varepsilon * \frac{\pi}{4} d^2 * \sqrt{2 * \Delta P * \rho}$$

Q_m: Flow rate, t/h; c: Discharge coefficient; d: Hole diameter, m; D: Pipe inside diameter, m; ε : Expansibility factor; △P: DP value, Pa; ρ: Medium density, kg/m3;

1.2 DP value:

4-20mA No √: $$\Delta P = \frac{I-4}{16} * (DP_{max} - DP_{min}) + DP_{min}$$

0-10mA No √: $$\Delta P = \frac{I}{10} * (DP_{max} - DP_{min}) + DP_{min}$$

4-20mA √: $$\Delta P = (\frac{I-4}{16})^2 * (DP_{max} - DP_{min}) + DP_{min}$$

0-10mA √: $$\Delta P = (\frac{I}{10})^2 * (DP_{max} - DP_{min}) + DP_{min}$$

△ P: DP value, Pa; DP_{max}: Upper limit of pressure transmitter, Pa; DP_{min}: Lower limit of pressure transmitter, Pa;

2. Volume flow expression

Applicable Medium Type
1. Gas (Std. condition volume); 2. Liquid (Volume)

2.1 Gas (Std. volume): $Q_V = Q_m / \rho_s$

Q_v: Flow rate, Nm3/h; Q_m: Flow rate, t/h; ρ_s: Medium density in std. condition, kg/m3;

2.2 Liquid (Volume): $Q_V = Q_m / \rho$

Q_v: Flow rate, m3/h; Q_m: Flow rate, t/h; ρ: Medium density, kg/m3;

D.5 V-Cone DP

1. Mass flow expression

Applicable Medium Type
1. Vapor Automatic Compensation
2. Saturated vapor temperature compensation
3. Saturated vapor pressure compensation
4. Superheated vapor pressure and temperature compensation 5. Gas (Mass) 6. Liquid (Mass)

1.1 Flow rate: $$Q_m = 3.6 * \frac{C}{\sqrt{1 - B_v^4}} * \varepsilon * \frac{\pi}{4} * (D^2 - d_v^2) * \sqrt{2 * \Delta P * \rho}$$

Q_m: Flow rate, t/h; c: Discharge coefficient; d_v: Max. cone cross-section diameter in working condition, m; D: Pipe inside diameter, m; ε : Expansibility factor; △ P: DP value, Pa; ρ: Medium density, kg/m3.

Bv: equivalent diameter ratio, $B_v = \frac{\sqrt{(D^2 - d_v^2)}}{D}$.

The formula of DP value of mass flow refers to that of DP value of orifice DP.

The formula of gas and liquid of volume flow refers to that of gas and liquid of orifice DP.

D.6 Annubar

1. Mass flow expression

Applicable Medium Type
1. Vapor Automatic Compensation
2. Saturated vapor temperature compensation
3. Saturated vapor pressure compensation
4. Superheated vapor pressure and temperature compensation 5. Gas (Mass) 6. Liquid (Mass)

1.1 Flow rate: $$Q_m = 3.6 * \alpha * \varepsilon * \frac{\pi}{4} * D^2 * \sqrt{2 * \Delta P * \rho}$$

Q_m: Flow rate, t/h; α : Flow coefficient; D: Pipe inside diameter, m; ε : Expansibility factor; △P: DP value, Pa; ρ: Medium density, kg/m3.

The formula of DP value of mass flow refers to that of DP value of orifice DP.

The formula of gas and liquid of volume flow refers to that of gas and liquid of orifice DP.

D.7 Elbow DP

1. Mass flow expression

Applicable Medium Type
1. Vapor Automatic Compensation
2. Saturated vapor temperature compensation
3. Saturated vapor pressure compensation
4. Superheated vapor pressure and temperature compensation 5. Gas (Mass) 6. Liquid (Mass)

1.1 Flow rate: $Q_m = 3.6 * \alpha * \varepsilon * \sqrt{\frac{R}{D}} * \frac{\pi}{4} * D^2 * \sqrt{2 * \Delta P * \rho}$

Q_m: Flow rate, t/h; α : Flow coefficient; D: Pipe inside diameter, m; ε : Expansibility factor; R/D: Bend radius R; △P: DP value, Pa; ρ: Medium density, kg/m3.

The formula of DP value of mass flow refers to that of DP value of orifice DP.

The formula of gas and liquid of volume flow refers to that of gas and liquid of orifice DP.

D.8 Formula of Liquid Density

$$\rho = \rho_{20} * [1 - \mu(t - 20)]$$

ρ: Medium density, kg/m3; ρ_{20}: Medium density at 20 ℃, kg/m3; u: Liquid coefficient of cubic expansion; t: Liquid temperature, ℃.