CE -2209



**ARANKA**
# USER MANUAL
# AIVFL-24/AIVFG-24

# VORTEX FLOWMETER

## Ver. 1.0

CE

CE -2209

ISO 9001:2015 COMPANY

# AIVFL 24/AIVFG 24 Vortex Flowmeter

# User Manual

# AIVFL 24/AIVFG 24 Vortex Flowmeter

# User Manual

# 1 Overview

## 1.1 Technical Support

AIVFL/G 24 is designed for vortex flowmeters with pressure and temperature compensation function.

Please read this manual carefully before use AIVFL/G 24. Please follow this manual to complete your operation. If you have any questions, please do not hesitate to contact us.

## 1.2 Main Specification

Power supply:            12-32VDC

Operating temperature:  -20°C ~ +70°C(with LCD)

                        -40°C ~ +85°C(without LCD)

## 1.3 Features

**Output:**                4~20mA output.

**Configuration:**          Flow mode, Flow unit, Range (Qmax), Density, Display, etc.

**Alarm:**                 Low alarm will output 3.8mA, high alarm will output 22.0mA.

**K-Factor linearity:**    AIVFL/G 24  provides 2 to 5 points k-Factor correction.

**Local adjust functions:** Setting flow range and unit, Density, Flow mode, damping, alarm, and data recovery etc.

**LCD display:**           The first line shows the instantaneous flow. The second line shows the totalized flow. The third line can display the percentage, loop current, temperature, pressure, density and so on.

**Perfect compensation:**  AIVFL/G 24 supports real-time temperature and pressure compensation for gas, and supports the international standard of steam density table, temperature and pressure compensation for over heat steam, pressure compensation or temperature compensation for saturated steam.

**Restore factory settings:** If the damping value entered is '05678', it will automatically perform 'restore factory settings'. (Manufacturers need to perform 'Data Backup' operation.)

**Temperature trim:**      High trim and low trim easily.

**Pressure trim:**         High trim and low trim easily.

AIVFL/G 24 has a power-down data protection function and a flow accumulation function.

# 2 Hardware

## 2.1 Terminal Board Wiring

The terminal board is used for connects the external power supply, output pulse, the external pressure sensor and temperature sensor.

The following are common wiring.

### 2.1.1 4~20mAoutput+ HART+External Pressure
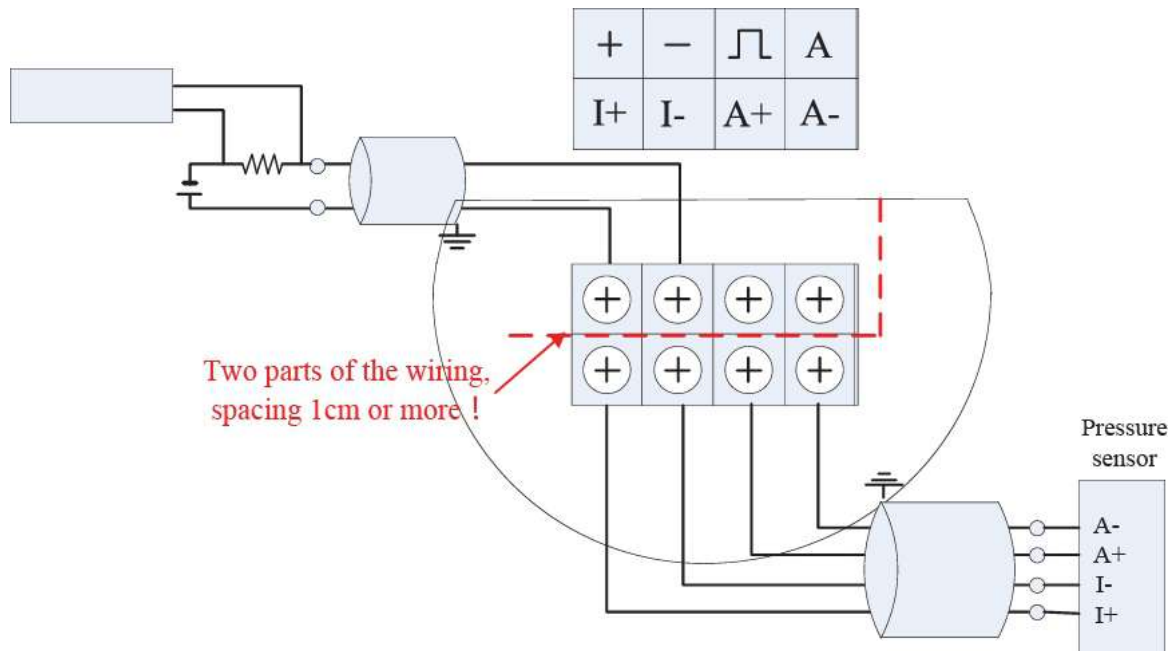


### 2.1.2 Pulse Output+External Pressure and Temperaturesensors
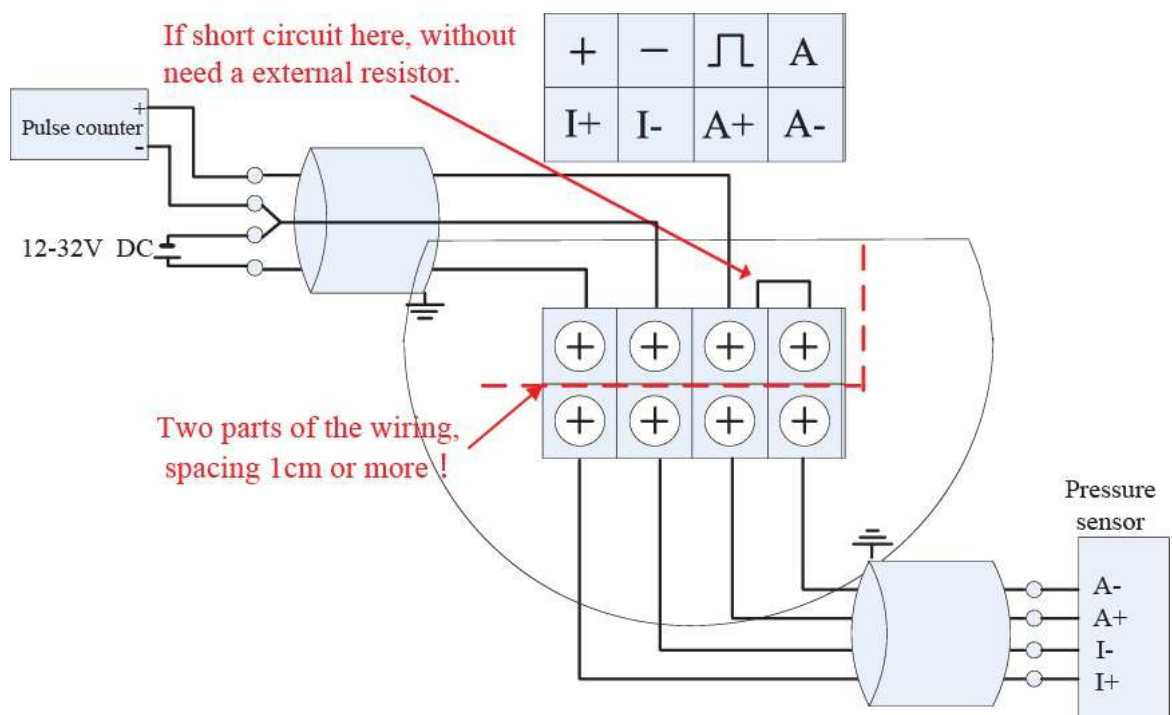
## 2.2  Sensor Interface

### 2.2.1  Vortex Sensor

The 2-Pin green terminal XT is used for connecting the vortex sensor.
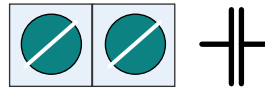
### 2.2.2  Pressure Sensor

Users can use XF3 socket to connect pressure sensor, and the pressure sensor should be bridge type sensors. I+ and I- are power supply, A + and A- are the sensor signal outputs.

The bridge impedance of the pressure sensor is required to be between 3000 and 6000 ohms. The excitation current of the sensor is about 0.3mA, and the output of the sensor is required to not exceed 50mV@0.3mA.

Socket XF3 defined as follows:

I+    I-    A+    A-

XF3

I+: Power Supply +
I-: Power Supply -
A+: Sensor Output +
A-: Sensor Output -
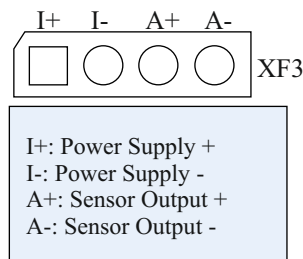
### 2.2.3  Temperature Sensor

Socket XF5 supports Pt1000 and Pt100, two-wire connection.

Pt

Pt1000 or Pt100
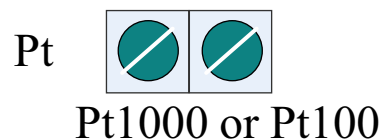
**Installation Notes: To ensure reliable grounding, the board must be securely attached to the housing for testing!**

# 3  LCD Display

LCD with 128 * 64 dot matrix display, support for multi-variable display.
The instrument supports two display modes:

## 3.1  Three-line display mode

123.456 Nm³/h
Σ :        123456.789  Nm³
P= 1234.5  kPa    T=123.4℃
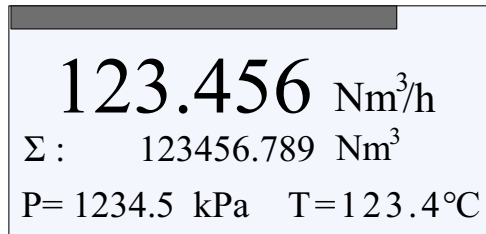
Displays the current percentage in progress bar

First line display Instantaneous flow.

The second line display totalized flow.

The third line display frequency, pressure,

temperature, density, current or the percentage.

Notes:

► If enable automatic measure pressure, and the pressure signal abnormality (sensor fault), the corresponding pressure value will be replaced with the set pressure value and will flash.

► If enable automatic measure temperature, and the temperature signal abnormality (sensor fault), the corresponding temperature value will be replaced with the set temperature value and will flash.

► When the flow mode is Sat_Steam(P), that means saturated steam pressure compensation, the temperature value will display as "----", which means the acquisition of temperature sensor is not activated.

► When the flow mode is Sat_Steam(T), that means saturated steam temperature compensation, the pressure value will display as "----", which means the acquisition of pressure sensor is not activated.

You can press KEY-M to change the third line display variables. Use indicator to distinguish between different display variables shows in the second line.

| Indicator | F: | Den: | P: | T: | Curr: | Per: | P=    T= |
|-----------|-----|------|-----|-----|-------|------|----------|
| variable | Frequency | Density | Pressure | Temperature | Loop current | Percentage | Pressure and temperature |

## 3.2   Two-line display mode

123.456   Nm³/h
Σ : 123.45678

Displays the current percentage in progress bar

First line display instant Instantaneous flow.

The second line display totalized flow.

# 4   Production Process Using HART-Config Tool

Connect the flow meter as shown in Figure 4 - 1.
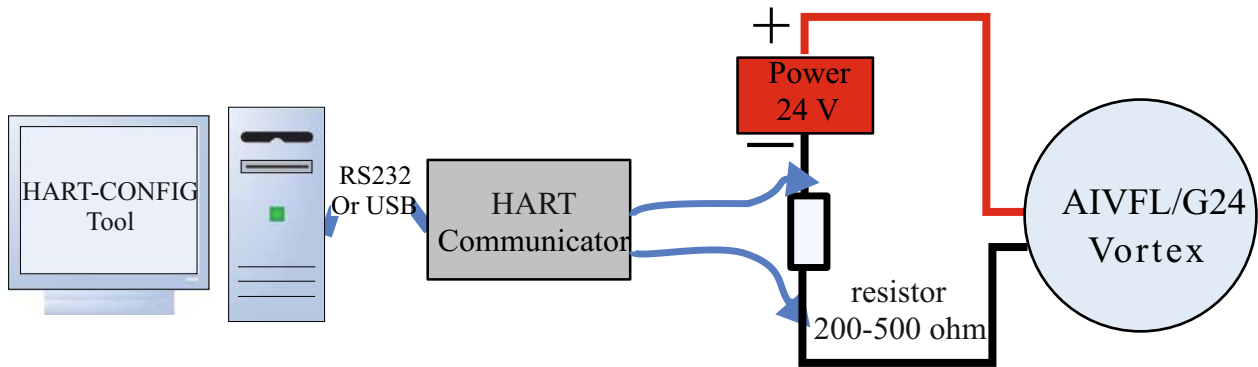


Figure 4-1 HART communication connection diagram

Run the HART-CONFIG TOOL software, and follow these steps to complete the production process of vortex flowmeters.
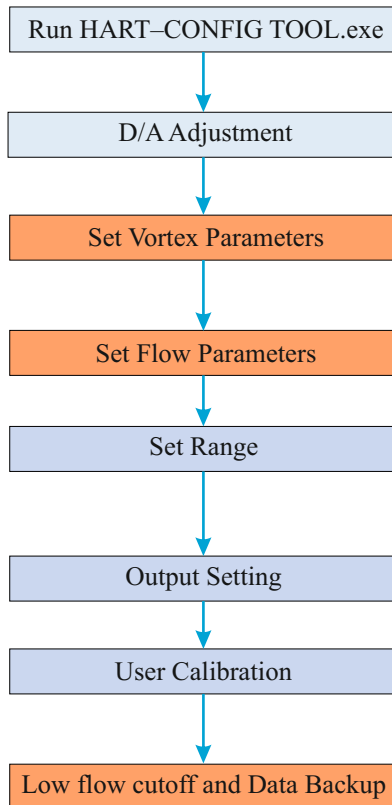
| | |
|---|---|
| Run HART–CONFIG TOOL.exe | Set COM, then click the "Connect" -> "Polling 0". |
| D/A Adjustment | Click on 'Transmitter adjustment' -> 'D/A Adjustment' to enter into operation interface.<br>Note: This operation is factory calibrated done! |
| Set Vortex Parameters | Click on 'Vortex Parameters' -> 'Working Parameter' to enter the interface. You can set meter size, fluid type, upper flow limit, lower flow limit, maximum amplification, k-Factor and pulse factor. |
| Set Flow Parameters | Click on 'Vortex Parameters' -> 'Flow Parameters' to enter the interface. You can set flow mode, medium status such as densi ty, pressure, temperature, etc. And You can also reset the total flow. |
| Set Range | Click on the 'Configuration' -> 'Range' to enter into transmitter range configuration interface. |
| Output Setting | Click on the 'Configuration' -> 'Output' to set the damping value.<br>Click on the 'Configuration' -> 'Fault Protection' to set the write protect mode and alarm limit setting. |
| User Calibration | Five-point k-Factor linearity correction. |
| Low flow cutoff and Data Backup | Enter 'Advanced Functions'-> 'Additional Functions' . You can set the low flow cutoff percent. And you can perform 'Data Backup' here.<br>If the damping value entered is '05678', it will automatically perform 'restore factory settings'. |

Note:  ▢  This color means that these items must be done.  ▢  This color means that these items must be done, and easily forgotten or incorrectly set.

# 5 Production Process via Local Adjustment

We recommend the following steps to set parameters.

| Set Protection ＝ OFF | Please make sure the current write protection is 'OFF', which allows you to change the settings. |

Please input the opcode '00050' , and scroll down the menu to set meter size.

**Set The Opcode '00050'**

**Set Meter Size** — Select the meter size.

**Set Fluid Type** — Select the type 'Gas'or 'Liquid'.

**Set Flow Limit** — According to the meter size and f luid type, set the corresponding 'Low Flow Limit'and 'High Flow Limit'. The actual measurement range i s about 50% of the 'Low Flow Limit' to 200% of 'High Flow Limit'.

**Set Max AMP** — Setting maximum gain, which corresponds to the 'Low Flow Limit'. The gain should between 200 to 600 suggested. Typically about 300.

**Set K - Factor** — Set average calibration k-Factor

**Set Pulse Factor Unit** — Select the unit for pulse output calculation.

**Set Pulse Factor** — Select the unit for pulse output calculation.
And then press Z-Key to return to main menu,

**Set Pulse Factor** — Set low alarm limit and high alarm limit.
Set flow mode：
Liquid Qv：Liquid volume Liquid Qm：Liquid mass
Gas Qv： Gas volume： Gas Qm： Gas mass：
Steam Qv: Steam volume Steam(P/T)：Steam mass
Sat_Steam(T)：Saturated steam mass (temperature compensation)
Sat_Steam(P)：Saturated steam mass(pressure compensation)

**Set Flow Mode** — Set flow unit and upper range value.

**Set Range and Unit** — The lower range value is fixed to 0. The total flow unit is depends on the flow unit.

**Set Density for liquid Set Density , pressure and temperature for gas** — If flow mode is liquid, then set liquid density.
If flow mode is gas, then set the gas density, pressure and temperature.
If flow mode is steam, you may need set the default pressure and temperature depends on the flow mode.

**Set Flow Cutoff** — Set low flow cutoff value.

**Set Damping** — Set damping.
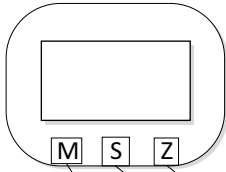
**Total Flow Reset** — Totalizer reset

Note：
This color means that these items must be done. This color means that these items must be done, and easily forgotten or incorrectly set.

# 6   Data Entry

## 6.1  Basic Function of Keys

Data is entered using the 3 keys M, S and Z on the display.

Press Z-Key to enter or exit the menu mode (data entry).
Press S-Key to scroll forward through the menu, or to shift the setting number.
Press the M-Key to scroll backwards through the menu, or to increase the setting number. Long press (over 3 seconds) the M-Key to enter submenu setting, or access the parameter to be changed , or accept the new selected or entered value.

## 6.2  Enter or Exit Menu Mode

### 6.2.1  Enter Menu Mode

In the operating mode, press the "Z" key to enter the menu mode (data entry).

### 6.2.2  Exit Menu Mode

In the menu mode, press the "Z" key to back to the operating mode.

## 6.3  Data Entry Method

Setting parameters include "select" and "data input" methods.

### 6.3.1  Select Method

☐   Long press M-Key to enter setting, and the menu optionswill start flashing.
☐   Short press M-Key or S-Key to scroll backwards or forwards the menu.
☐   Long press M-Key to save (access) the parameter.

### 6.3.2  Data Input Method

☐   Long press the M key, that means press the M button for 3 seconds and then release it to enter the setting. In this state, the underline is on the second line, indicating that the parameters can be modified;

☐   Short press the — Key to switch the sign.
☐   Press the S- Key to shift the setting number. Press — Key to increase the setting number.
☐   Press the S-Key to shift the setting number again. All bits can be set according to the same operation.

☐   Long press M-Key to save (access) the parameter. Or press Z-Key to give up and exit settings.

For example, the original range100% is 200 and the range 100% needs to be changed to 400.

| | |
|---|---|
| Press the Z- key to enter the menu mode. Press - Key or S- Key to scroll backwards or forwards the menu until to set the range limitmenu . | Setting the upper range value menu<br><br>Range 100%<br>200.000 |
| Long press the M key, that means press the M button for 3 seconds and then release it to enter the setting. In this state, the underline is on the second line, indicating that the parameters can be modified; | Enter setting menu<br><br>Range 100%<br>200.000 |
| Press the M-Key to switch the sign between "+" and "-". "-"means data is negative(less than 0, vortex flowmeterupper range value must be apositive number). | Setting sign<br><br>Range 100%<br>+200.000 |
| Press the S-Key to shift the setting number.Then press M-Key to increase the setting number. If the highest bit is set, the number that can be entered is between 0 and 9; if it is other bits, the decimal point can also be selected. | Setting sign<br><br>Range 100%<br>+400.000 |
| Long press M-Key to save (access) the parameter. Press Z-Key to give up and exit settings Return to the previous menu or return to the operating mode. | |

## 6.4  Local Configuration Function

## 6.4.1  Basic Function (No Password)

| Menu | Setting method | Notes |
|---|---|---|
| Contrast | Select | 1~5 |
| Protection | Select | ON / OFF |
| Min Alarm(%) | Data Input | Set low alarm value. Unit: % |
| Max Alarm(%) | Data Input | Set high alarm value. Unit: % |
| MeterSize | Read Only | View meter size setting. |
| Flow mode | Select | Liquid Qv : Liquid volume<br>Liquid Qm : Liquid mass<br>Gas Qv : Gas volume<br>Gas Qm : Gas mass<br>Steam Qv : Steam volume<br>Steam(P/T) : Steam mass<br>Sat_Steam(T) : Saturated steam mass (temperature compensation) |

| | | |
|---|---|---|
| | | Sat_Steam(P) : Saturated steammass(pressure compensation) |
| Unit-Qv<br>Unit-Qm | Select | Volume units supported:<br>Nm$^3$/h   Nm$^3$/m   Nm$^3$/s<br>l/s   l/m   l/h<br>m$^3$/s   m$^3$/m   m$^3$/h   m$^3$/d<br>Scf/s   Scf/m   Scf/h<br>cf/s   cf/m   cf/h<br>USG/s   USG /m   USG /h<br>UKG/s   UKG /m   UKG /h<br>bbl/h   bbl/d<br><br>Mass units supported:<br>g/s     g/m   g/h<br>kg/s   kg/m   kg/h   kg/d<br>t/m   t/h   t/d<br>lb/h   lb/d<br><br>Note: Totalizer flow's unit based on the flow unit. |
| Range 100% | Data Input | Set the Qmax value for selected flow mode (= 20 mA) |
| Density (kg/m$^3$)<br>Density (g/c m$^3$) | Data Input | Set Gas density (unit: Kg/m3)<br>Set Liquid density (unit: g/cm3) |
| Gauge Pre.(Kpa) | Data Input | Use for gas or steam measure. Unit: kpa. |
| Temperature (℃) | Data Input | Use for gas or steam measure. Unit: ℃. |
| PV Cutoff (%) | Data Input | Range: 0% ~ 20% |
| Damping | Data Input | Range: 0 ~ 64S |
| Disp. Point | Select | Set the first line display point, can be 0,1,2, 3. |
| Display Mode | Select | Set display mode. |
| Totalizer reset | Select | When Lcd display 'Yes', long press M-Key to reset the totalizer and overflow counter. |
| Number of totalizer overflows | Read Only | Display of the number of totalizer overflows;<br>1 overflow = 10,000,000 |
| K-Factor | Read Only | View the k-Factor. |

## 6.4.2  Advanced Function (Password Protection)

| Opcode | Data Input | **Input ****50, set 51~ 57 menu。**<br>**Input ****60, set 60 menu。**<br>**Input ****61, set 62 menu。**<br>**Input ****62, set 62 menu。**<br>**Input ****63, set 63 menu。**<br>**Input ****70, set 70~77 menu。**<br>**Input ****40, set 40~ 41 menu。**<br>**Input ****38, set 38~ 39 menu。**<br>**Input ****11, set 11~ 13 menu。** |
|---|---|---|

| | | Input ****111, preset total<br>Input ****721, set temperature sensor trim data.<br>Input ****741, set pressure sensor trim data. |
|---|---|---|
| | | |
| Signal status[51] | Read Only | LCD display<br>    450.00          This is the PGA gain.<br>    CH2 –A       Ch2 is signal channel .<br>    A means 10, it is signal amplitude , it must be greater than 9. |
| Meter size [52] | Select | Options<br>15mm 20mm 25mm 32mm 40mm 50mm 65mm 80mm 100mm 125mm 150mm 200mm 250mm 300mm 350mm 400mm 450mm 500mm 600mm;<br>Note:<br>1) LCD display DN15, means meter size is 15mm.<br>**2) If you change the meter size, you must re-set from 53 to 56.** |
| Fluid Type[53] | Select | Options Gas, or Liquid .<br>**Note: If you change the fluid type, you must re-set from 53 to 56.** |
| Low Flow Limit[54] | Data Input | According to the meter size and measuring media, set the corresponding low limit of the flow.<br>The unit of 'Low Flow Limit' is fixed as $\mathbf{m^3/h.}$<br>The actual measurement of the lower limit of about 50% of 'Low Flow Limit'. |
| High Flow Limit[55] | Data Input | The 'High Flow Limit' defaults to 10 times the 'Low Flow Limit', the actual measurement of the upper limit of 2 times the set value.<br>The unit of 'High Flow Limit' is fixed as $\mathbf{m^3/h.}$<br>When the actual required range ratio exceeds 20: 1, you can manually modify the 'High Flow Limit'. |
| Max AMP. [56] | Data Input | Between 200 and 600 suggested Typically about 300 |
| k-Factor [57] | Data Input | Set average calibration k-Factor |
| Pulse Factor Unit[58] | Select | Options：$m^3$, N $m^3$, t, kg, Scf, cf, USG, UKG, bbl, lb. |
| Pulse factor[59] | Data Input | Set the number of output pulses corresponding to one Pulse Factor Unit'.<br>**Note: If you want to output the original pulse, set 'K-factor [57]' and 'Pulse factor [59]' to the same value, and 'Pulse Factor Unit [58]' must set to m3.** |
| | | |
| [60]<br>K-Factor Trim Fi<br>K- Factor Trim Yi | Data Input | **Five-point K-Factor correction.**<br>**Where Fi is the reference frequency, Yi is the correction coefficient K. i=1,2,3,4,5.** |
| | | |
| [61] | Data Input | The reference frequency value of the five-point correction |

| | | |
|---|---|---|
| Frequency Factor | | is multiplied by the Frequency Factor, and then the new reference frequency value of the correction point is obtained.<br>Normally, this value should be 1.<br>When calibrated with water, for gas measurements, you can set the coefficient so that the five-point correction factor remains in effect. |
| [62]<br>Channel settings | Select | There are CH_1, CH_2, CH_3 three options<br>CH_3 gain maximum<br>CH_1gain minimum<br>Note：<br>CH2 generally used for liquid measurement, which corresponds to the configuration software, select X1 and X2.<br>CH_3 generally used for gas measurement, which corresponds to the configuration software, select X1, X2 and X3. |
| [63]<br>Work  mode settings | Select | There are F_1, F_2, F_3, F_4 four options.<br>F_1: Anti-vibration Mode<br>F_2: Normal Mode<br>F_3:Turbine Mode<br>F_4: Test Mode<br><br>Note :<br>Generally choose F_2. |
| | | |
| [40]<br>Trim 4mA | | Steps<br>1.  Long press M-Key, enter trim;<br>2.  Short press M-key to decrease current. Press S-Key to increase current. Stepping is 16 microamperes.<br>3.  Long press M-Key to save new trim value. Or press Z-Key to exit without saving. |
| [41].<br>Trim 20mA | | |
| | | |
| [70]<br>Temp. Measure | Select | Temperature acquisition mode setting.<br>Options：Manual, or Auto.<br>Manual: Temperature uses the input reference value.<br>Auto: Temperature is automatic acquisition, should be use external Pt1000 or Pt100. |
| [71]<br>Pressure Measure | Select | Pressure acquisition mode setting.<br>Options：Manual, or Auto.<br>Manual: Pressure uses the input reference value.<br>Auto: Pressure is automatic acquisition, should be use external silicon pressure sensor. |
| [72]<br>Temperature low trim | Data Input | Enter the lower calibration resistor value. unit: ohm.<br>Use standard resistance as input. |

| | | For example: 1000 for Pt1000, or100 for Pt100. |
|---|---|---|
| [73]<br>Temperature high trim | Data Input | Enter thehighcalibration resistor value , unit: ohm.<br>Use standard resistance as input<br>For example:2500 for Pt1000, or 250 for Pt100. |
| [74]<br>Pressure low trim | Data Input | Enter the calibration reference pressure value, unit is Kpa<br>Apply the standard pressure to the sensor.<br>For example: 0 Kpa |
| [75]<br>Pressure high trim | Data Input | Enter the calibration reference pressure value, unit is Kpa<br>Apply the standard pressure to the sensor.<br>For example: 1000 Kpa |
| [76]<br>Pre. Cutoff | Data Input | Set the low pressure cutoff value. Unit is Kpa.<br>If the measured pressure value is less than 'Pre. Cutoff',<br>  the pressure will be set to 0kpa. |
| [77]<br>Set Pre. Bias | Data Input | Set the pressure bias value. Unit is Kpa.<br>Enter the current actual pressure value to achieve bias.<br>The pressure will be set to input value. |
| | | |
| [38]<br>Min Pre. (Kpa) | Data Input | This parameter is only used for steam mass measurement.<br>In the steam mass measurement mode, if the  pressure is less than the set 'minimum pressure  value'  when   the pressure compensation   is  activated,  the  flow  will automatically return to zero. |
| [39]<br>Min Temp. (℃) | Data Input | This parameter is only used for steam mass measurement.<br>In the steam mass measurement mode, if the temperature is less than the set 'minimum temperature value' when the temperature compensation is activated, the flow will automatically return to zero. |
| | | |
| [11]<br>Version | Read Only | To view the embedded software version. |
| [12]<br>Max Frequency | Read Only | The internal conversion frequency value corresponds to the 'Low Flow Limit'. |
| [13]<br>Min Frequency | Read Only | The internal conversion frequency value corresponds to the 'Low Flow Limit'. |
| | | |
| [111]<br>Total Preset | | Used to directly set the current total flow value. |
| | | |
| [721]<br>Temp. Data X0;<br>Temp. Data Y0;<br>Temp. Data X1;<br>Temp. Data Y1; | Data Input | You can directly view and modify the temperature sensor calibration values.<br>Temp. Data X0 and Temp. Data X1 are internal ADC measurements.<br>Temp. Data Y0[73] and Temp. Data Y1[74] are the input calibration value. |
| [741] | Data Input | You can directly view and modify the pressure sensor |

| Pre. Data X0; | | calibration values. |
| Pre. Data Y0; | | Pre. Data X0 and Pre. Data X1 are internal ADC measurements. |
| Pre. Data X1; | | |
| Pre. Data Y1; | | Pre. Data Y0[75] and Pre. Data Y1[76] are the input calibration value. |

## Special Note :

Low Flow Limit, High Flow Limit, maximum gain and average calibration K- Factor should be reset, if meter size or fluid type changed. These parameters are very important for vortex flowmeter good working, please carefully set according to the actual application.

## 6.5  Totalizer Flow Unit Table

Totalizer flow's unit is determined according to the flow unit.

| Flow Unit | Totalizer Flow Unit |
|---|---|
| $Nm^3$/h , $Nm^3$/m , $Nm^3$/s | $Nm^3$ |
| $m^3$/d , $m^3$/h , $m^3$/m , $m^3$/s | $m^3$ |
| l/h , l/m , l/s | L |
| Scf/s , Scf/m , Scf/h | Scf |
| cf/s , cf/m , cf/h | cf |
| USG/s , USG /m , USG /h | USG |
| UKG/s , UKG /m , UKG /h | UKG |
| bbl/h , bbl/d | bbl |
| g/h , g/m , g/s | g |
| kg/d , kg/h , kg/m , kg/s | kg |
| t/d , t/h , t/m | t |
| lb/h , lb/d | lb |

# 7    Parameter Description

## 7.1  K-Factor

The average k-Factor value shown in the display must be the same as the value on the primary tag on the flowmeter primary.

## 7.2  Five-point Linearity Correction

The actual k-Factor of vortex flowmeter is different in low flowrates and high flowrates. In order to improve the accuracy of vortex flowmeter, it provides 2 to 5 points k-Factor correction.

For example, for D = 80mm, measuring medium is liquid, the real k-Factor in different flowrates as follows:

| <20 Hz | 40 | 80 | > 100 |
|---|---|---|---|
| 2200 | 2100 | 2100 | 2000 |

Then we can choose 4-points calibrated, set k-Factor 2100. Enter the calibration data as follows:

| Frequency | k-Factor coefficient | formula |
|---|---|---|
| 20 | 0.954545 | 2100/2200=0.954545 |

| 40 | 1 | 2100/2100=1 |
|---|---|---|
| 80 | 1 | 2100/2100=1 |
| 100 | 1.05 | 2100/2000=1.05 |

## 7.3  Pulse  Factor  Description

There are two ways to set the pulse factor via HART - CONFIG Tool.

1.   Set the number of pulses output everyone  unit [58] total flow.

2.   Set a pulse corresponds to how many of one unit [58] total flow.

The output pulses are based on the flow value after five-point K-Factor correction. That will get higher accuracy than using the original pulses.

The local adjustment menu [59] is used to set the output pulse number corresponding to 1 unit [58] total flow.

## 7.4  Output Original Pulses Description

If you need the flowmeter outputs original pulses, follow the following steps:

1.   Set the K- Factor and the Pulse Factor equal. That is the value of local adjustment menu 57 and 59 equal. And set the pulse factor unit to $m_3$.

2.   Cancel the Five-point linearity correction via HART-CONFIG Tool. Or enter the local adjustment menu 60 to set all of correction coefficient K equal 1.0.

Then the flowmeter output pulse frequency equals to the original pulse frequency.

## 7.5  Temperature  and   Pressure Compensation

### 7.5.1  Precondition

The pressure sensor should be bridge type sensors and the temperature sensor should be Pt1000

User input reference pressure should be gauge pressure, and the unit must be kpa. Absolute pressure and gauge pressure relationship: Absolute pressure = gauge pressure + 101.325kPa.

User should input the reference resistor when trim the temperature sensor.

### 7.5.2  Pressure Sensor Trim

If you want trim the pressure sensor, please check the flow mode and pressure acquisition mode setting.

If you want trim the pressure sensor, please check the flow mode and pressure acquisition mode setting.

| Menu | Setting |
|---|---|
| Flow mode | Set one of the following     (Other modes do not use pressure sensor.) <br> Gas Qv :  Gas volume <br> Gas Qm :  Gas mass <br> Steam Qv :  Steam volume <br> Steam(P/T) :  Steam mass <br> Sat_Steam(P) :  Saturated steam mass(pressure compensation) |
| [71] <br> Pressure Measure | Pressure acquisition mode setting <br> Auto: Start automatic measurement of external pressure. <br> External pressure sensor required |

It provides two points calibration for the pressure sensor. If use HART-CONFIG Tool, please enter into 'Advanced Features' -> 'Temperature and Pressure Sensors' to trim the sensor.

You can also trim the sensor via local adjustment menu 'Pressure low trim '[74] and 'Pressure high trim

'[75]:
1. Set flow mode and pressure acquisition mode.
2. Apply zero pressure to the sensor, enter into menu 'Pressure low trim '[74], input the reference pressure(gauge pressure, unit kpa) to trim zero.
3. Apply full pressure to the sensor, enter into menu 'Pressure high trim '[75], input the reference pressure(gauge pressure, unit kpa) to trim full.

**Note: 'Pressure low trim' and 'Pressure full trim' should be calibrated together to ensure that the measured pressure is correct.**

**It should be noted that the pressure measurement cycle is approximately 4 seconds. The calibration should be performed after the input pressure has stabilized for more than 10 seconds.**

## 7.5.3 Low pressure cutoff value

If the pressure measurement is close to 0Kpa, but it is not stable, for example, varied between -0.01 and 0.01kPa. You can set 'Low pressure cutoff value' to adjust the pressure measurement to 0Kpa.

If the measured pressure value is less than 'Low pressure cutoff value', it will set to be 0kpa.

## 7.5.4 **Pressure bias settings**

If there is a fixed pressure deviation, for example, the actual pressure value is 10 Kpa and the measured pressure value is 9.8 Kpa. You can perform 'Set Pre. Bias [77]', and enter 10(Kpa) to remove this error.

Enter the current actual pressure value, to achieve bias.

## 7.5.5 **Temperature Sensor Trim**

If you want trim the temperature sensor, please check the flow mode and temperature acquisition mode setting.

| Menu | Setting |
|------|---------|
| Flow mode | Set one of the following: (Other modes do not use temperature sensor.) |
| | Gas Qv : Gas volume |
| | Gas Qm : Gas mass |
| | Steam Qv : Steam volume |
| | Steam(P/T) : Steam mass |
| | Sat_Steam(T) : Saturated steam mass (Temperature compensation) |
| [70] Temperature Measure | Temperature acquisition mode setting |
| | Auto: Start automatic measurement of external temperature. |
| | External temperature sensor Pt1000 or Pt100 required |

It provides two points calibration for the temperature sensor. We recommend use 1000ohm and 2500ohm, or 100ohm and 2500ohm (for PT100) resistors for trim. If use HART-CONFIG Tool, please enter into 'Advanced Features' -> 'Temperature and Pressure Sensors' to trim the sensor.

You can also trim the sensor via local adjustment menu 'Temperature low trim '[72] and 'Temperature high trim '[73]:
1. Set flow mode and temperature acquisition mode.
2. Apply lower resistor, such as 1000ohm, enter into menu 'Temperature low trim '[72], input the reference resistor value(1000) to trim..
3. Apply higher resistor, such as 2500ohm, enter into menu 'Temperature high trim '[73], input the reference resistor value(2500) to trim.

## 7.6 Measurement Mode Setup Instructions

### 7.6.1 Gas Qv

#### A: Measure Working State Volume

Density:          Set to the density at 20 ℃ (not used for computing)

Gauge Pre.(Kpa):    **0.0KPa 'Change does not affect the measurement'**

Gas Tem (℃):       **20℃ 'Change does not affect the measurement'**

#### B: Measure Standard State Volume(20℃)

Density:          Set to the density at 20 ℃ (not used for computing)

Gauge Pre.(Kpa):   Input working state pressure (Gauge pressure). If the temperature and pressure compensation circuit board is used and set to Pressure automatic acquisition, use real-time pressure

Tem (℃):          Input working state temperature. If the temperature and pressure compensation circuit board is used and set to Temperature automatic acquisition, use real-time temperature

### 7.6.2 Gas Qm

#### A: Current Actual Density is Known (the state transition factor is 1)

Density:          Set to the current actual density.

Gauge Pre.(Kpa):   0.0KPa (Not allowed to change) 'changes affect the measurement'

Temperature (℃):   20℃ (Not allowed to change) 'changes affect the measurement'

#### B: Standard State Density is Known (state transition calculation is required)

Density:          Set to the standard state density. (0 KPa gauge pressure, 20 ° C)

Gauge Pre.(Kpa):   Input working state pressure. If the temperature and pressure compensation circuit board is used and set to Pressure automatic acquisition, use real-time pressure.

Temperature (℃):   Input working state temperature. If the temperature and pressure compensation circuit board is used and set to Temperature automatic acquisition, use real-time temperature.

### 7.6.3 Liquid Qv

Density:          Set to 1.0 or the current actual density. (Not used for computing)

### 7.6.4 Liquid Qm

Density:          Set to the current actual density.

### 7.6.5 Steam Qv

Density:          Set to 1.205 or the current actual density. (Not used for computing)

Gauge Pre.(Kpa):   0.0KPa      'Not used for computing'

Temperature (℃):   20℃      'Not used for computing'

### 7.6.6  Steam Mass

#### A: Steam(P/T): (Temperature and Pressure Compensation)

If the external temperature sensor or pressure sensor fails, calculate the steam density according to the input temperature or pressure

Density:               Not used for computing

Gauge Pre.(Kpa):   Input working state pressure. If the temperature and pressure compensation circuit board is used and set to Pressure automatic acquisition, use real-time pressure,

Temperature (℃):  Input working state temperature. If the temperature and pressure compensation circuit board is used and set to Temperature automatic acquisition, use real-time temperature

#### B: Sat_Steam(T): Saturated Vapor(Temperature Compensation)

If the external temperature sensor fails or the temperature sensor is not connected, the steam density is calculated according to the input temperature.

Density:               Not used for computing.

Gauge Pre.(Kpa):   Not used for computing.

Temperature (℃):  Input working state temperature. If the temperature and pressure compensation circuit board is used and set to Temperature automatic acquisition, use real-time temperature

#### C: Sat_Steam(P): Saturated Vapor(Pressure Compensation)

If the external pressure sensor fails or the pressure sensor is not connected, the steam density is calculated according to the input pressure.

Density:               Not used for computing.

Gauge Pre.(Kpa):   Input working state pressure. If the temperature and pressure compensation circuit board is used and set to Pressure automatic acquisition, use real-time pressure.

Temperature (℃):  Not used for computing.

# STEAM TABLE

| PRESSURE | TEMPERATURE | PRESSURE | TEMPERATURE | PRESSURE | TEMPERATURE |
|---|---|---|---|---|---|
| BAR | 'C | BAR | 'C | BAR | 'C |
| 0 | 100 | 3.6 | 148.84 | 19 | 212.47 |
| 0.1 | 102.66 | 3.8 | 150.44 | 20 | 214.96 |
| 0.2 | 105.1 | 4 | 151.96 | 21 | 217.35 |
| 0.3 | 107.39 | 4.5 | 155.55 | 22 | 219.65 |
| 0.4 | 109.55 | 5 | 158.92 | 23 | 221.85 |
| 0.5 | 111.61 | 5.5 | 162.08 | 24 | 224.02 |
| 0.6 | 113.56 | 6 | 165.04 | 25 | 226.12 |
| 0.7 | 115.4 | 6.5 | 167.83 | 26 | 228.15 |
| 0.8 | 117.14 | 7 | 170.5 | 27 | 230.14 |
| 0.9 | 118.8 | 7.5 | 173.02 | 28 | 232.05 |
| 1 | 120.42 | 8 | 175.43 | 29 | 233.93 |
| 1.1 | 121.96 | 8.5 | 177.75 | 30 | 235.78 |
| 1.2 | 123.46 | 9 | 179.97 | 31 | 237.55 |
| 1.3 | 124.9 | 9.5 | 182.1 | 32 | 239.28 |
| 1.4 | 126.28 | 10 | 184.13 | 33 | 240.97 |
| 1.5 | 127.62 | 10.5 | 186.05 | 34 | 242.63 |
| 1.6 | 128.89 | 11 | 188.02 | 35 | 244.26 |
| 1.7 | 130.13 | 11.5 | 189.82 | 36 | 245.86 |
| 1.8 | 131.37 | 12 | 191.68 | 37 | 247.42 |
| 1.9 | 132.54 | 12.5 | 193.43 | 38 | 248.95 |
| 2 | 133.69 | 13 | 195.1 | 39 | 250.42 |
| 2.2 | 135.88 | 13.5 | 196.62 | 40 | 251.94 |
| 2.4 | 138.01 | 14 | 198.35 | 42 | 254.74 |
| 2.6 | 140 | 14.5 | 199.92 | 44 | 257.5 |
| 2.8 | 141.92 | 15 | 201.45 | 46 | 260.13 |
| 3 | 143.75 | 16 | 204.38 | 48 | 262.73 |
| 3.2 | 145.46 | 17 | 207.17 | 50 | 265.26 |
| 3.4 | 147.2 | 18 | 209.9 | | |