# *Electromagnetic Flow meter_GT300*

# *Transmitter: S400*

# Operation & maintenance Manual

Greentech Innovation Co., Ltd.

# Index

# 1. Connection and operation of transmitter (S400)

## 1-1. Keys and display

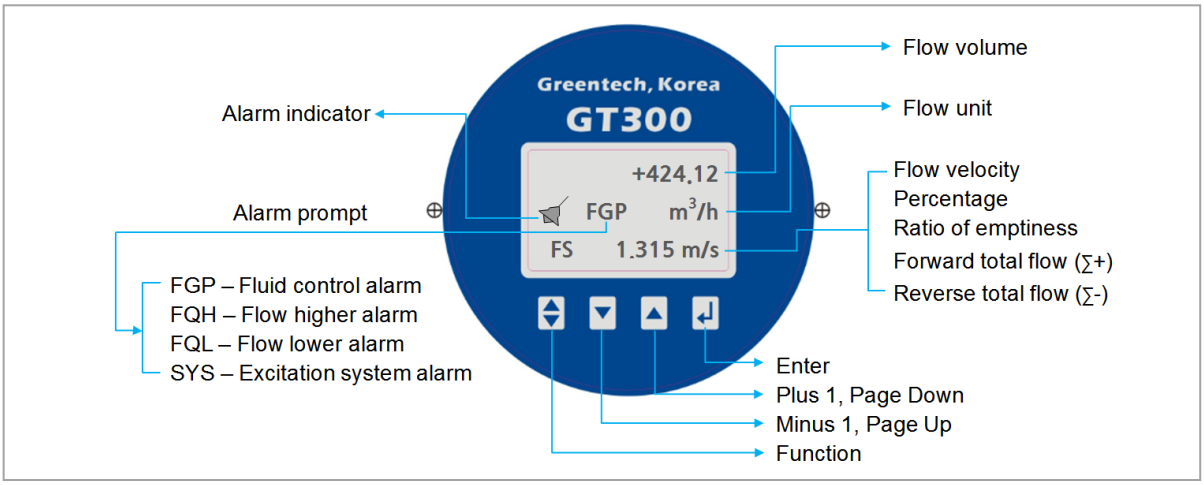


*Fig. 1: Define Keys and LCD screen display (Integral type)*

**Note:** when there are multiple alarms at the same time, the alarms will be displayed circularly. The meaning of alarm code is as follows:

| | |
|---|---|
| FQH – Alarm of upper limit of flow rate; | FQL – Alarm of lower limit of flow rate; |
| FGP – Alarm of empty pipe of fluid; | SYS – Alarm of system excitation; |

The transmitter contains 4 keys – Function, Up, Down, and Enter. In normal display, you can press these keys to perform related functions:

- Press "Down": flow velocity, percentage of flow rate, ratio of empty pipe, forward accumulation, reverse accumulation and difference accumulation are displayed circularly.
- Press "Function + Up": LCD contrast is increased.
- Press "Function + Down": LCD contrast is decreased.
- Press "Function + Enter" to enter "Set Parameters" and be ready for inputting password.

## 1-2. Connection of transmitter

### 1-2-1. Links and labels of connector in model

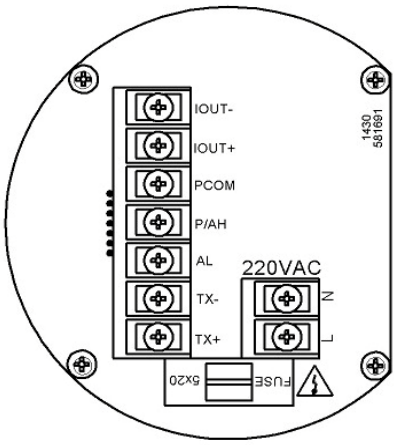


*Fig. 2: Labels of connector in Model*

### 1-2-2. Symbols and Description of Connectors in Model

| | |
|---|---|
| **IOUT -** | : 4~20mA/0~10mA current output (ground) |
| **IOUT +** | : 4~20mA/0~10mA current output (positive) |
| **PCOM** | : Frequency (pulse) output (ground), upper limit and lower limit alarm (ground) |
| **P/AH** | : Frequency (pulse) output/upper limit and lower limit alarm output |
| **AL** | : lower limit alarm output/flow direction output |
| **TX -** | : Line B of communication RS485 |
| **TX +** | : Line A of communication RS485 |
| **N (+)** | : 220V power input N. (24V power supply transmitter, power supply - positive) |
| **L (-)** | : 220V power input L. (24V power supply transmitter, power supply - ground) |

## 1-3. Output of frequency, pulse and upper limit alarm and their calculation

The output of upper limit alarm, frequency and equivalent pulse of the electromagnetic flow meter uses the same terminal P/AH, which is set as follows:

| P/AH options | Description | P/AH output |
|---|---|---|
| **Frequency output** | Frequency | The frequency corresponding to instantaneous flow rate with an upper limit of 5,000Hz. |
| **Pulse output** | Pulse | Equivalent pulse |
| **Upper limit alarm** | Upper limit alarm output | P/AH is at low level: there is an upper limit alarm<br>P/AH is at high level: there is no upper limit alarm |

The frequency output reflects the percentage of flow rate, and is generally used for control. If the user wants to apply the system for measurement, the pulse output should be selected.

### 1-3-1. Frequency output

The frequency output ranges from 0 to 5000Hz, and corresponds to the percentage of flow rate.

F= (Measure value / Full scale value) • the range of frequency

The upper limit of frequency output is adjustable. The user can select a value from 0 to 5000Hz, or a lower frequency, such as from 0 to 2000Hz.

### 1-3-2. Pulse Output:

The pulse output is mainly used for measurement. A pulse output represents an equivalent flow, such as 1L and 1m$^3$.

The equivalent of pulse output includes: 0.001L, 0.01L, 0.1L, 1L, 0.001 m$^3$, 0.01 m$^3$, 0.1 m$^3$ and 1 m$^3$. Remember that the flow meter's flow-rate range should match with the pulse equivalent when you select desired pulse equivalent. The calculation formula of volume flow rate is as follows:

$$QL=0.0007854\times D2\times V \text{ (L/s) or } QM=0.0007854\times D2\times V\times 10\text{-}3 \text{ (m}^3\text{/s)}$$

Where: D - Pipe diameter (mm)
V - Flow velocity (m/s)


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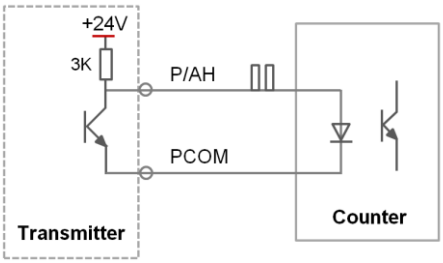
Proper pulse equivalent should be selected according to pipe diameter. The frequency of pulse output should be less than 5000Hz. k
The pulse output is different from the frequency output. If the accumulated pulse output is enough for a pulse equivalent, a pulse is output. Therefore, the pulse output is non-periodic.

### 1-3-3. Connection of P/AH frequency, pulse, upper limit alarm output:

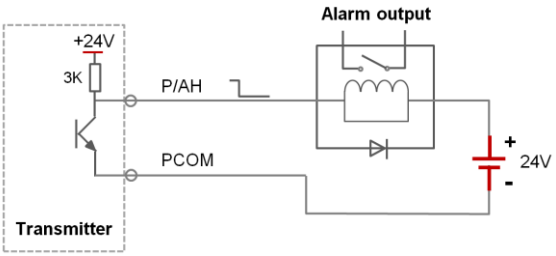
The frequency/pulse digital output has two terminal points: output contact and grounding contact. Their symbols are as follows:

**P/AH** --- Output;
**PCOM** --- Ground

**Wring method of frequency and equivalent pulse output:**
The user's load can be connected between P/AH and PCOM as follows. The working voltage of pulse output is 24V. The 3kΩ current-limiting resistance in the transmitter can provide a drive current of 8mA for user's device.




**Wring method of alarm output:**
An external relay can be connected to output the alarm signal. The load current should not exceed 100mA. Refer to the picture below for the wiring method.




## 1-4. AL lower limit alarm or flow direction output

Lower limit alarm output and flow direction output shares the same terminal AL. You can select relevant parameters from the "AL Function" to confirm the signal to be output.
The parameter setting is as follows:

| AL options | AL output | Representation |
|---|---|---|
| **Low limit alarm** | Low level | There is a low limit alarm |
| | High level | There is no low limit alarm |
| **Flow direction indication** | Low level | The flow is in a negative direction |
| | High level | The flow is in a positive direction |

The wiring method of lower limit alarm output or flow direction output is totally the same with that of P/AH terminal. Please refer to the wiring method of P/AH output above.

# 1-5. Current output and calculation

## 1-5-1. Current output

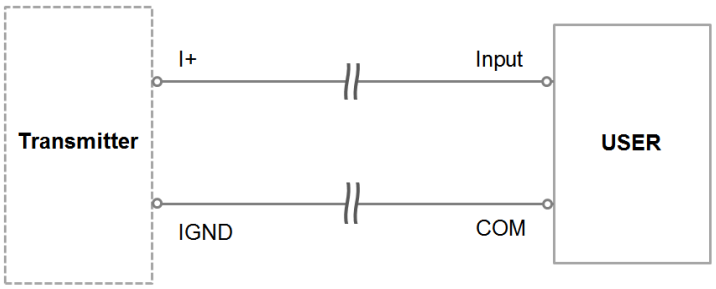
The current output can provide two kinds of signal output range: 4~20mA and 0~10mA. The inside of current output uses the 24V power supply. Within 4~20mA, a 600Ω load resistance can be driven.
The current output corresponds to the percentage of flow rate, i.e.:

$I_0$ = (Measure value / Full scale value) ×the scale of current + the zero point of current

The manufacturer has calibrated the current output before delivery. Generally, the user is not required to adjust it again.

## 1-5-2. Current output wiring

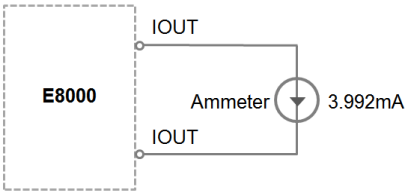
The wiring of current output is as follows:




## 1-5-3. Current output calibration

**1) Preparation for instrument calibration**

Prepare an ammeter with ±0.1% accuracy, and connect it as follows:




**2) 4mA current calibration**

Press relevant keys to enter the editing status of "Zero trim of current". The LCD screen is displayed as follows.
The transmitter's output is 4mA, the user only needs to input the actual current value measured by the ammeter by pressing keys, and press "Enter" to complete the correction of 4mA current.

**Analog zero**

**3) Full-scale current calibration**

Press relevant keys to enter the editing status of "full-scale correction of current".
The LCD screen is displayed as follows.
The transmitter's output is 20mA, the user only needs to input the actual current value measured by the ammeter by pressing keys, and press "Enter" to complete the correction of 20mA current.

**Analog Range**

# 2. Parameter setting and configuration

## 2-1. Total reset

Press “Function + Enter” to access the “Parameter Setting 00000” page. Press “Up” or “Down” to access the “Total Reset 00000” page.
Enter the password for total reset (06108). Press “Enter” to reset positive accumulated flow rate, negative accumulated flow rate, difference accumulated flow rate and overflow counter.

## 2-2. Parameter setting

The S400 transmitter has 59 parameters in total, as shown in Table 2. The user should set relevant parameters as required before using the transmitter so as to confirm its operating condition, data processing algorithm, output mode and working mode.

To prevent the arbitrary modification of parameters, a 6-level password protection function corresponding to 6 privilege levels of user is provided. The level 1-5 is for common users, and the 6th level is for manufacturer. The user with the 5th privilege level can set the password at the level 1-4.
The users with the 1-6 privilege level all can view the instrument parameters. However, if the user wants to modify the parameter, a corresponding privilege must be authorized. The Table 1 lists the privilege range of users at all levels and default passwords.

**Table 1**

| User level | Access right | Password attribute | Default password |
|---|---|---|---|
| 1 | The user is only able to view the instrument parameters | Changeable | 00521 |
| 2 | The user can change the instrument parameters 1-26 | Changeable | 03210 |
| 3 | The user can change the instrument parameters 1-27 | Changeable | 06108 |
| 4 | The user can change the instrument parameters 1-40 | Changeable | 07206 |
| 5 | The user can change the instrument parameters 1-57 | Unchangeable | |
| 6 | Special password for manufacturer. It can be used to change all parameters | Unchangeable | |

It is suggested that the user should assign senior staff to manage the password at the 5th level; the password at the 4th level is mainly used for setting total; the manager of the passwords at the level 1-3 is decided by the user.

**Table 2**

| Parameter No. | Parameter name | Setting mode | Range of parameter value | Default | Privilege level |
|---|---|---|---|---|---|
| 1 | Language | Optional | English, Chinese | English | 2 |
| 2 | Comm Address | Can be set | 0-99 | 1 | 2 |
| 3 | Baud rate | Optional | 600-19200 | 9600 | 2 |
| 4 | Sensor Size | Optional | 3-3000mm | 100 | 2 |
| 5 | Flow Unit | Optional | L/h, L/m, L/s, $m^3/h$, $m^3/m$, $m^3/s$ | $m^3/h$ | 2 |
| 6 | Flow Decpoint | Optional | 0-5 Decpt | 1 decpt | 2 |
| 7 | Flow Range | Can be set | 0-99999 | 424.2 | 2 |
| 8 | Flow Rspns | Can be set | 0.0-50.0S | 2.0 | 2 |
| 9 | Flow Direct | Can be set | Normal, Reverse | Normal | 2 |
| 10 | Flow Zero | Can be set | -9999-+9999 | 0.0 | 2 |
| 11 | Fow Cutoff | Can be set | 0-99% | 1.0 | 2 |
| 12 | Cut Disp Ena | Optional | Enable/ Disable | Enable | 2 |

| | | | | | |
|---|---|---|---|---|---|
| 13 | Total Unit | Optional | 0.001$m^3$-1$m^3$, 0.001L-1L | 1$m^3$ | 2 |
| 14 | Segma_n Ena | Optional | Enable/Disable | Enable | 2 |
| 15 | Analog Type | Optional | 0-10mA / 4-20mA | 4-20mA | 2 |
| 16 | P/AH Fc Sel | Optional | Pulse, Freque, H_Alarm | Freque | 2 |
| 17 | AL Fc Select | Optional | L_Alarm, Direct | L_Alarm | 2 |
| 18 | Pulse unit | Optional | 0.001$m^3$-1$m^3$, 0.001L-1L | 0.1L | 2 |
| 19 | Frequen Max | Can be set | 1-5000 Hz | 5000 | 2 |
| 20 | Mtsensor Ena | Optional | Enable/ Disable | Enable | 2 |
| 21 | Mtsnsr Trip | Can be set | 1-65535 | 50 | 2 |
| 22 | Alm High Ena | Optional | Enable/ Disable | Disable | 2 |
| 23 | Alm High Val | Can be set | -200.0 - +200.0 % | 200.0 | 2 |
| 24 | Alm Low Ena | Optioanl | Enable/ Disable | Enable | 2 |
| 25 | Alm Low Val | Can be set | -200.0 - +200.0 % | -200.0 | 2 |
| 26 | SYS Alm Ena | Optioanl | Enable/ Disable | Enable | 2 |
| 27 | Clr Sum Key | Can be set | 0-65535 | 6108 | 3 |
| 28 | Sensor code1 | Set by Factory | Finished Y M (0-999999) | 0 | 4 |
| 29 | Sensor code1 | Set by Factory | Product Serial (0-999999) | 0 | 4 |
| 30 | Field Type | Optional | Type 1<br>Type 2<br>Type 3 | Type 2 | 4 |
| 31 | Sensor Fact | Can be set | 0.0000-5.9999 | 1.0 | 4 |
| 32 | Line CRC Ena | Optional | Enable / Disable | Disable | 4 |
| 33 | Lineary CRC1 | Set by Factory | 0 | 0.3 | 4 |
| 34 | Lineary Fact1 | Set by Factory | 0.0000-1.9999 | 1.0 | 4 |
| 35 | Lineary CRC2 | Set by Factory | 0 | 0.225 | 4 |
| 36 | Lineary Fact2 | Set by Factory | 0.0000-1.9999 | 1.0 | 4 |
| 37 | Lineary CRC3 | Set by Factory | 0 | 0.15 | 4 |
| 38 | Lineary Fact3 | Set by Factory | 0.0000-1.9999 | 1.0 | 4 |
| 39 | Lineary CRC4 | Set by Factory | 0 | 0.075 | 4 |
| 40 | Lineary Fact4 | Set by Factory | 0.0000-1.9999 | 1.0 | 4 |
| 41 | FWD Total | Can be ste | 000000000-999999999 | 0.0 | 5 |
| 42 | REV Total | Can be ste | 000000000-999999999 | 0.0 | 5 |
| 43 | Plsnt Lmt Ena | Optional | Enable / Disable | Disable | 5 |
| 44 | Plsnt Lmt Val | Can be set | 0.010-0.800m/s | 0.010m/s | 5 |
| 45 | Plsnt Delay | Can be set | 400-2500ms | 400 | 5 |
| 46 | Pass Word 1 | Set by user | 00000-65535 | 00521 | 5 |
| 47 | Pass Word 2 | Set by user | 00000-65535 | 03210 | 5 |
| 48 | Pass Word 3 | Set by user | 00000-65535 | 06108 | 5 |
| 49 | Pass Word 4 | Set by user | 00000-65535 | 07206 | 5 |
| 50 | Analog Zero | Can be set | 3.500-4.500mA | 4.0 | 5 |
| 51 | Analog Range | Can be set | 18.000-22.000mA | 20.0 | 5 |
| 52 | Meter Factor | Can be set | 0.0000-5.9999 | 1.0 | 5 |
| 53 | Sample Mode | Optional | Mode 1-10 | Mode 1 | 5 |
| 54 | Backup Param | Optional | Yes / No | No | 5 |
| 55 | Recover Param | Optional | Yes / No | No | 5 |
| 56 | Output Param | Optional | Yes / No | No | 5 |
| 57 | Import Param | Optional | Yes / No | No | 5 |
| 58 | Meter code 1 | Set by factory | Finished Y M (0- 999999) | 000000 | 6 |
| 59 | Meter code 2 | Set by factory | Product serial (0- 999999) | 000000 | 6 |

# 2-3. Details of instrument parameters

## 2-3-1. Language

The S400 Electromagnetic flow meter Transmitter supports both Chinese and English. Users can choose the right language as required.

## 2-3-2. Communication parameters

The S400 Electromagnetic flow meter Transmitter supports RS-232/RS-485 serial communication of Modbus RTU protocol.

- Correspondence address: the address No. 01-247 is optional, and the default address when delivery is 1.
- Available baud rate in communication: 600, 1200, 2400, 4800, 9600 and 19200bps. The default baud rate when delivery is 9600bps.

## 2-3-3. Optional pipe diameter

Optional diameter range of the sensor equipped in S400 transmitter: 3, 6, 10, 15, 20, 25, 32, 40, 50, 65, 80, 100, 125, 150, 200, 250, 300, 350, 400, 450, 500, 600, 700, 800, 900, 1000, 1200, 1400, 1600, 1800, 2000, 2200, 2400, 2500, 2600, 2800 and 3000 mm.

## 2-3-4. Unit of instantaneous flow rate

There are six units of instantaneous flow rate: L/s, L/m, L/h, $m^3/s$, $m^3/m$ and $m^3/h$.

## 2-3-5. Display accuracy of flow rate

The display accuracy of flow rate is used for setting the digits of the displayed decimal point of instantaneous flow rate. 0-5 digits after the decimal point are optional.

## 2-3-6. Measurement range setting

The measurement range refers to the upper limit of the flow rate measurement of the electromagnetic flow meter. The lower limit is fixed at “0”. The range defines the corresponding relation between the flow rate and its percentage display, frequency output and current output:

- Percentage display of flow rate = (instantaneous flow rate/measurement range) * 100;
- Frequency output of flow rate = (instantaneous flow rate/measurement range) * full scale value of frequency output;
- Current output of flow rate = (instantaneous flow rate/measurement range) * full scale value of current output + zero point value of current output.

**Note: the value of pulse output is not influenced by the measurement range.**

## 2-3-7. Damping time

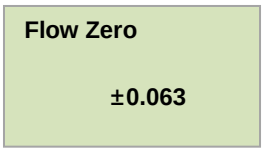
Damping time is used to adjust the stability of the flow rate measurement. The value of damping time ranges from 0 second to 50 seconds. Long damping time can improve the stability of the measurement and output signal, and is applicable for the pulsation flow rate measurement accumulated in total. Short damping time can respond rapidly to the rate of change in external measurement, and is applicable for production process control.

## 2-3-8. Flow direction setting

During debugging, if the user thinks that the measured flow direction is not consistent with the actual flow direction, the user only needs to change the parameter setting of flow direction instead of changing the wiring method of excitation line or electrode signal line.

## 2-3-9. Zero trim of flow rate

When the pipe is full and the actual flow velocity is zero (stationary state), if the measured value is not zero, the user can trim the zero point by the "zero trim" function.
During zero trim of flow rate, the pipe should be full and the fluid should be in the stationary state. The zero point is represented by flow velocity (unit: m/s). The zero trim of flow rate is displayed as follows:




The third row displays the real time flow velocity which has not been corrected/calibrated (unit: m/s);
Correction method: enter the measured real time flow velocity displayed after FS.c into the second row.

**Note: The corrected value of the zero point of flow velocity is a symbolic number, which should be consistent with the symbolic value of the measured real time flow velocity that has not been treated with zero trim.**

## 2-3-10. Small-signal removal

Small-signal removal is used to remove the flow rate value around the zero point. The point of small-signal removal is displayed in the percentage of flow rate range. If the instantaneous flow rate is less than the set removal flow rate, then the instantaneous flow rate is zero, and the corresponding percentage, current output signal and frequency (pulse) output signal are all zero.

**Note: small-signal removal only removes flow rate, and the flow velocity remains unchanged.**

## 2-3-11. Integrating unit of flow rate

The integrating unit of flow rate is the unit of accumulated flow rate. Since the maximum count value of the transmitter's accumulative calculator is 999999999, the user should select appropriate unit according to actual flow rate. When the actual flow rate is large, if the selected integrating unit is too small, the accumulation will overflow rapidly.
Optional unit of accumulation includes 0.001L, 0.010L, 0.100L, 1.000L, 0.001$m^3$, 0.010$m^3$, 0.100$m^3$ and 1.000$m^3$, but it is displayed in L or $m^3$. The decimal places after the value represent its display accuracy. For example: when the current forward accumulation is 1000.12345, if the unit is 0.001 $m^3$, then the accumulation in the third row during automatic measurement is displayed as follows:

**∑+ 1000.123 $m^3$**

## 2-3-12. Inverted output

When inverted output is allowed, if the measured flow rate is "negative", the output frequency (or pulse) and current will be output accordingly.
When inverted output is not allowed, if the measured flow rate is "negative", the frequency (or pulse) is zero and the current output is 4mA (or 0mA).

## 2-3-13. Type of current output

The S400 Electromagnetic Flow meter Transmitter supports 0~10mA or 4~20 mA current output. Users can select the right output range as required.

## 2-3-14. P/AH function

Upper limit alarm output, frequency output and pulse output share the same terminal P/AH. By setting its output mode, the type of output signal at present can be confirmed.
See the third part for details.

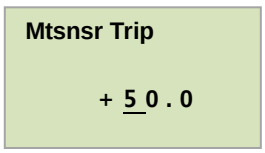
## 2-3-15. AL function

Lower limit alarm output and flow direction output share the same terminal AL. By setting its output mode, the type of output signal at present can be confirmed.
See the third part for details.

## 2-3-16. Empty pipe alarm

**1) Permission of empty pipe alarm**
S400 is capable of empty pipe detection, and no additional pole is required. If empty pipe alarm is permitted, the instrument can detect the empty pipe when the fluid level in the pipe is lower than the measuring electrode. After the empty pipe is detected, the signal of analog output and digital output is set as zero, and the displayed flow rate is zero. Meanwhile, the alarm symbol and the indication message FGP appear.

**2) Threshold of empty pipe alarm**
When the empty alarm is not correct, the user can recalibrate the alarm by resetting the threshold of empty pipe alarm. Ensure the sensor is in the state of full pipe (whether there is flow velocity or not) before calibration. Otherwise, the calibration will be incorrect.
The setting interface of “Threshold of Empty Pipe Alarm” is as shown in the following picture. The third row displays the measured sampling value of empty pipe - FS.c, and the second row displays the threshold of empty pipe alarm entered by the user. Set the threshold of empty pipe alarm until the sampling value FS.c is stabilized. Otherwise, the calibration of empty pipe alarm will be incorrect. The threshold of empty pipe alarm is generally set as the value which is over ten times the sampling value FS.c. The recommended minimum setting value is 100. Users can set the threshold as required. If the threshold is too small, a false alarm may be triggered.




The second row: the threshold of empty pipe alarm entered by the user; The third row: FS.c indicates the sampling value of empty pipe at present.

## 2-3-17. Upper and lower limit alarm

**1) Permission of upper and lower limit alarm**
Users can select whether to permit or forbid the upper and lower limit alarm.

**2) Value of upper and lower limit alarm**
The value of upper and lower limit alarm is calculated in the percentage of range, which allows users to set a value between -200.0% and 200.0%. If the alarm condition is met during operation, the instrument will display the alarm symbol and the indication message **FQH/FQL.**
If P/AH and AL are set as alarm output, then the corresponding alarm status will be output.

## 2-3-18. Excitation alarm

When the transmitter is not connected to the excitation coil or the excitation coil breaks, an excitation alarm will be produced. The instrument will display the alarm symbol and the indication message **SYS**.
The output flow rate is zero.
The excitation alarm function can be opened or closed.

## 2-3-19. Password for total reset

The password for total reset corresponds to the protection password of “Total Reset” in the functional menu, which can be modified by the user with the third privilege level or above.

## 2-3-20. Sensor parameters

**1) Sensor code**
The sensor code 1 and 2 can be used to mark the delivery time and number of the sensor equipped in the transmitter for the convenience of setting sensor parameters.

**2) Sensor coefficient**
Sensor coefficient: the calibration coefficient of the electromagnetic flow meter. The coefficient is based on the actual value and marked on the sensor’s nameplate. The user must place the coefficient in the parameter list of S400 transmitter. The calculation formula of sensor coefficient is as follows:
Sensor coefficient = actual flow velocity / the flow velocity measured by S400

**Note: close the non-linear correction before calibrating the sensor coefficient. Otherwise, the calibration will be incorrect.**

## 2-3-21. Selection of excitation mode

S400 electromagnetic transmitter provides three kinds of excitation frequency for selection: 1/10 power frequency (mode 1), 1/16 power frequency (mode 2), and 1/25 power frequency (mode 3). If the diameter of excitation coil is small, its inductance value is also small, so the 1/10 power frequency is recommended for users. If the diameter of excitation coil is large, its inductance value is also great, so the 1/16 power frequency or 1/25 power frequency is recommended for users.

**Note: select the right excitation frequency before calibration. When the excitation mode is modified, please recalibrate the transmitter.**

## 2-3-22. Forward and reverse total

The value of forward and reserve accumulative total can be changed by total setting, which is mainly used for maintenance and replacement of instrument.
The user can enter the setting with the level 5 password to modify the forward accumulation (Σ+) and the reverse accumulation (Σ-). The setting value of accumulation should not be greater than the maximum displayed by LCD (999999999).

## 2-3-23. Peak inhibition

When the solid particles in serous fluid like pulp and mud rub or impact the measuring electrode, the “peak interference” will be generated. To overcome such interference, the S400 transmitter adopts the algorithm for inhibiting rate of change. Three parameters, including permission of peak inhibition, coefficient of peak inhibition and time of peak inhibition, are designed for selecting the inhibition features of rate of change.

**1) Permission of peak inhibition**
The peak inhibition is started when the parameter is set as “permitted” and closed when the parameter is set as “forbidden”.

**2) Coefficient of peak inhibition**
The coefficient is used to select the rate of change for inhibiting peak interference, and calculated in the percentage of flow velocity. There are ten levels for selection, including 0.010m/s, 0.020m/s, 0.030m/s, 0.050m/s, 0.080m/s, 0.100m/s, 0.200m/s, 0.300m/s, 0.500m/s and 0.800m/s. The smaller the percentage is, the higher the sensitivity for inhibiting peak interference is.

**Note: the user can try many times to find the right value as the case may be in practice. The higher sensitivity is not always better.**

**3) Time of peak inhibition**
The coefficient is used to select the time width for inhibiting peak interference, and calculated in millisecond (ms). The change of flow rate whose duration is smaller than selected time is regarded as peak interference by the S400 transmitter. The change of flow rate whose duration is greater than selected time is regarded as normal by the S400 transmitter. The user can try multiple times to find the right value as the case may be.

## 2-3-24. User password 1~4

The user with the level 5 privilege or above can modify the user password 1~4.

## 2-3-25. Current output correction

The current output of the transmitter has been corrected before delivery. If the user finds any large error during operation, the output can be recalibrated. See the third part for calibration method.

**Note: no independent correction is required for 0-10mA current.**

## 2-3-26. Factory calibration coefficient

The coefficient is the coefficient specially designed for manufacturer. The transmitter's manufacturer uses the coefficient to normalize the measurement circuit system of the S400 electromagnetic transmitter, so as to ensure that the interchangeability between S400 electromagnetic transmitters reaches 0.1%.
The calculation formula of the factory calibration coefficient is as follows:

Factory calibration coefficient = actual flow velocity / the flow velocity measured by S400

**Note: close the non-linear correction before calibrating the factory calibration coefficient. Otherwise, the calibration will be incorrect.**

## 2-3-27. Mode of flow rate collection

There are multiple modes for flow rate collection. Here, the Modes 1-10 are provided for selection. The Mode 1 is suitable for most occasions. Only when the measured liquid containing particulate matter leads to unstable measurement, it is suggested to use the Mode 10.

## 2-3-28. Backup and recovery of instrument parameters

Backup: it is used to back up the parameters of instrument and transmitter in the internal EEPROM. Only the users at level 5 and 6 can use the backup function.
Recovery: it is used to restore the instrument parameters to the previous backup. The users at level 2-6 can use the recovery function. The parameter range that the users at different levels can restore is different. The recovery range corresponds to the range of their access right, as shown in Table 2
Suggestion: the parameter backup of the flow meter has been completed before delivery. If the user modifies the parameter incorrectly, the "Recovery" function can be performed to restore the system to the backup status.

## 2-3-29. Import/export instrument parameters

The S400 transmitter provides the pluggable external EEPROM for importing and exporting instrument parameters. Exporting instrument parameters means exporting the item 1-50 of instrument parameters and the accumulation parameters to the external EEPROM. If any damage is made to the transmitter, the user only needs to replace the damaged transmitter with a new one and import the instrument parameters in the external EEPROM to the new transmitter. In this way, the instrument can restore to the user's original settings and continue its operation. Meanwhile, the forward and reverse accumulation continues to be accumulated.

To plug or remove the external EEPROM, the user only needs to remove the plastic cover of the LCD (the four hooks should be handled carefully).

## 2-3-30. Instrument code 1 and 2

The instrument code is used to record the delivery time and number of the transmitter.

## 2-3-31. Non-linear correction

This function is mainly used for the linear correction of the flow rate below 0.3m/s. It supports the 4-section linear correction. The correction parameters include 4 flow velocity points and the correction coefficient. Non-linear correction is based on the calibration coefficient of the sensor, so **the non-linear correction should be closed before calibrating the sensor coefficient**. If the sensor's linearity is not good in some section, the non-linear correction can be started to fix it, i.e. corresponding correction point and correction coefficient should be set. The calculation formula of the correction coefficient is as follows: Correction

Coefficient = actual flow velocity / the flow velocity measured by S400

If the correction coefficient is greater than 1.0, it is regarded as positive correction (increase). If the correction coefficient is smaller than 1.0, it is regarded as negative correction (decrease). The following relation should be maintained when setting the correction point:

**15.0m/s >= correction point 1 > correction point 2 > correction point 3 > correction point 4 > 0m/s**

The corresponding relation between flow velocity and correction coefficient during non-linear correction is shown as the table below:

| Original flow velocity | Used correction coefficient |
|---|---|
| 15.0m/s ≥ original flow velocity ≥ correction point 1 | Correction coefficient 1 |
| Correction point 1 > original flow velocity ≥ correction point 2 | Correction coefficient 1 and 2, smooth transition |
| Correction point 2 > original flow velocity ≥ correction point 3 | Correction coefficient 2 and 3, smooth transition |
| Correction point 3 > original flow velocity ≥ correction point 4 | Correction coefficient 3 and 4, smooth transition |
| Correction point 4 > original flow velocity ≥ 0.00m/s | Correction coefficient 4 |

**Note: to ensure that the flow rate between the correction point 1 and 15m/s is not influenced by the correction coefficient. The correction coefficient 1 must be 1.000.**

**Example:**

Suppose the flow meter tested four small flow rate points before the non-linear correction is started. The measured flow velocity is shown in the table below. It can be seen from the table that the flow velocity of the four test points is different.

| Actual flow velocity (m/s) | Flow velocity measured by S400 (m/s) |
|---|---|
| 0.225 | 0.221 |
| 0.150 | 0.145 |
| 0.075 | 0.069 |

The flow velocity at the four points can be corrected to implement the non-linear correction of small flow rate in four sections. The correction coefficient is calculated as follows

| No. | Correction point (m/s) | Correction coefficient |
|---|---|---|
| 1 | 0.300 | 1.0 (It must be 1.0) |
| 2 | 0.225 | 1.018 (0.225 / 0.221 = 1.018) |
| 3 | 0.150 | 1.034 (0.150 / 0.145 = 1.034) |
| 4 | 0.075 | 1.087 (0.075 / 0.069 = 1.087) |

# 3. Installation

This section covers the steps required to physically install the flow-tube. Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations.
Please refer to the following safety messages before performing any operation in this section.

| WARNING |
| --- |
| Failure to follow these installation guidelines could result in death or serious injury: Installation and servicing instructions are for use by qualified personnel only. Performing any servicing other than that contained in this manual may result in death or serious injury. Do not perform any servicing other than that contained in the operating instructions, unless qualified. |

| CAUTION |
| --- |
| The flow-tube liner is vulnerable to handling damage. Never place anything through the flow-tube for the purpose of lifting or gaining leverage. Liner damage can render the flow-tube useless. |

| CAUTION |
| --- |
| To avoid possible damage to the flow-tube liner ends; do not use metallic or spiral-wound gaskets. If frequent removal is anticipated, take precautions to protect the liner ends. Short spool pieces attached to the flow-tube ends are often used for protection. |

| CAUTION |
| --- |
| Correct flange bolt tightening is crucial for proper flow-tube operation and life. All bolts must be tightened in the proper sequence to the specified torque limits. Failure to observe these instructions could result in severe damage to the flow-tube lining and possible flow-tube replacement. |

## 3-1. Upstream and Downstream Piping

To ensure specification accuracy over widely varying process conditions, install the flow-tube a minimum of five straight pipe diameters upstream and two pipe diameters downstream from the electrode plane (see Fig. 3).

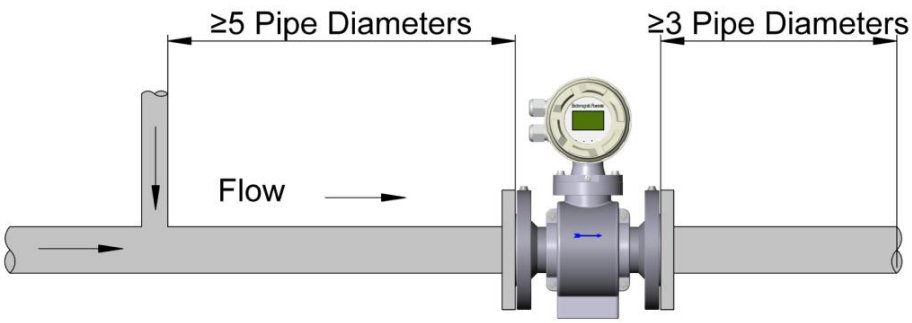



*Fig. 3: Upstream and Downstream Straight Pipe Diameters*

## 3-2. Flow-tube Orientation

The flow-tube should be installed in a position that ensures the flow-tube remains full during operation. Horizontal or inclined positions are preferred. Fig. 4, Fig 5, and Fig. 6 show the proper flow-tube orientation for the most common installations. The following orientations ensure that the electrodes are in the optimum plane to minimize the effects of entrapped gas. As illustrated in Fig. 5B and Fig. 5B, avoid downward flows where back pressure does not ensure that the flow-tube remains full at all times.

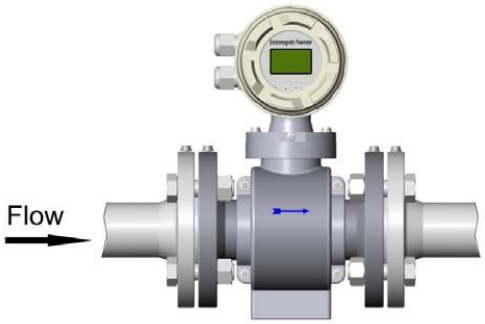



*Fig. 4: Horizontal flow-tube Orientation*

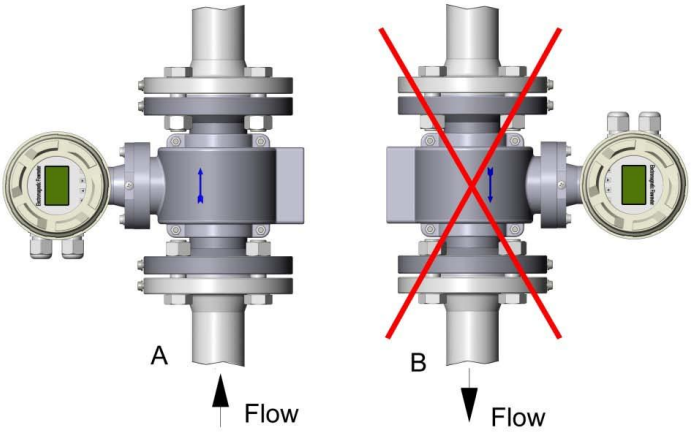



*Fig. 5: Vertical flow-tube Orientation*

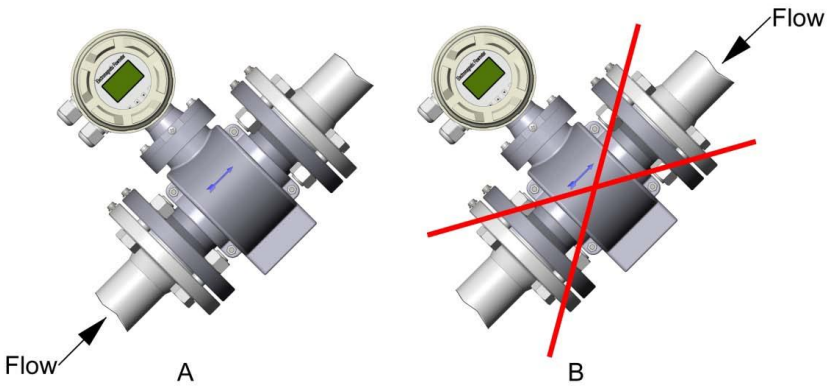



*Fig. 6: Incline or Decline Orientation*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## 3-3. Flow Direction

The flow-tube should be mounted so that the FORWARD end of the flow arrow, shown on the flow-tube identification tag, points in the direction of flow through the tube . In this mounting configuration, the conduit ports point upstream.

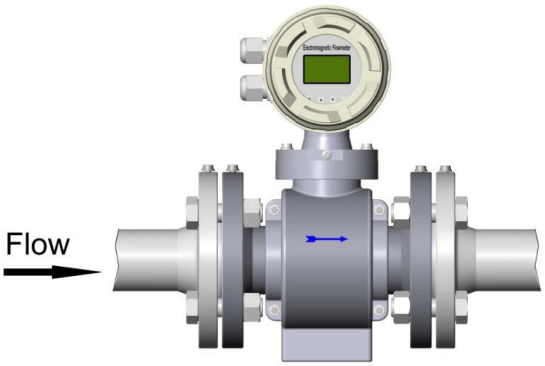


*Fig. 7: Flow Direction*

## 3-4. Grounding

Grounding the flow-tube is one of the most important details of flow-tube installation. Proper grounding ensures that only the voltage induced in the magnetic field of the flow-tube is measured. Following the figure to determine which grounding option to follow for proper installation. Attached grounding rings should be grounded equivalently to non-attached grounding rings.
The flow-tube case should always be grounded in accordance with national and local electrical codes. Failure to do so may impair the protection provided by the equipment. The most effective grounding method is direct connection to earth ground with minimal impedance.

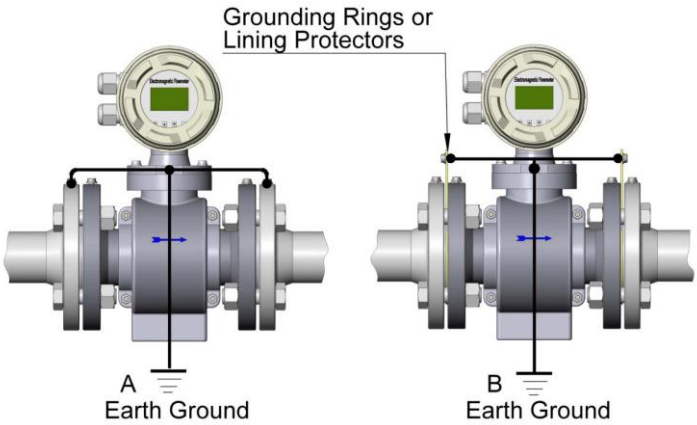


*Fig. 8: Grounding instruction*

# 4. Troubleshooting

## 4-1. Instrument has no display

1) Check whether the powers supply is on;
2) Check whether the fuse is complete;
3) Check whether the supply voltage meets the requirement.

## 4-2. Empty pipe alarm

1) Check whether the connection of electrode signals is correct;
2) Check whether the measuring tube of the sensor is full of fluid;
3) Use the wire to input the converter's signal into the terminal SIG1, SIG2 and SGND for 3-point short circuit. If the "empty pipe" presents "canceled", it indicates the converter is in normal condition.
   The problem may be caused by the low electrical conductivity of measured fluid or the small threshold of empty pipe. Increase the threshold until the empty pipe alarm disappears;
4) When there is a flow, measure the resistance of the terminal SIG1 and SIG2 against the terminal SGND respectively, which should be less than 50kΩ (if the medium is water, it is recommended to use pointer multi meter for measurement. Charging and discharging phenomena can be observed during measurement).
5) Check whether the sensor's electrode is normal: the DC voltage between DS1 and DS2 measured by multi meter should be less than 1V. Otherwise, it indicates that the sensor's electrode is polluted and should be cleaned.

## 4-3. Excitation alarm

1) Check whether the excitation alarm is closed when the converter is connected to the standard signal generator;
2) Check whether the connection of the excitation coils is correct;
3) Check whether the connection of the sensor's electrode is correct;
4) If the three items above are all normal, it indicates the converter fails.

## 4-4. Inaccurate measurement of flow rate

1) Check whether the ground wire is connected correctly;
2) Check whether the signal wire is connected correctly;
3) Check whether the sensor's measuring tube is full of fluid;
4) Check whether the sensor's coefficient and zero point are set according to the nameplate or the inspection list when delivery.

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