# TGF600 Series
# Thermal Mass Flowmeter

## User's Manual

Dear Customer:

Thanks for choosing our flowmeter products. Please read this manual carefully to know how to install and use this product to ensure its best performance. If you should encounter a problem when using the product, please do not hesitate to let us know. We are going to take no responsibility if the flowmeter is damaged because of anyone repair or replace any parts of it with our permission.

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# 1 General

Every TGF600 thermal mass flowmeter will be carefully inspected before delivered to users.

Please carefully check if there is any damage on the package and product when you received them

Please check if the package contains all the accessories according to 1.2 or your purchase order.

Please make sure the person in charge of this device has carefully read this manual and understand its descriptions.

## 1.1 Model Number and General Specification

Please check if the model number and specifications on the name plate match your requirement on the purchase order.

Please kindly record the model number and instrument ID code, which will be required if you need and service or support from us.

## 1.2 Packing List

When you recived the package, please check if it contains the items as below:

TGF600 thermal mass flowmeter x1

User's manual x1

Calibration certificate x1

Quality certificate x1

Cable (For remote type only, length according to customer's requirement)

Counter flanges (For wafer type, or for flanged type when customer requied so)

Screws and bolt (For wafer type, or for flanged type when customer requied so)

## 1.3 Storage

If the product needs to be stored for a long period before use, please be awared of below:

(1) The product should be kept in the origin package and same as it was when received.

(2) Please store the product in a proper location according to the requirements below:

Not in a uncovered field.

Not in a location where could have great vibration.

Please keep the enclosure of the meter closed.

The ambient temperature, atmospheric pressure and humidity should be:

Temperature: -20~+60℃； RH： 5%~99%； Pressure： 86~106Kpa

## 1.4 Ex-proof

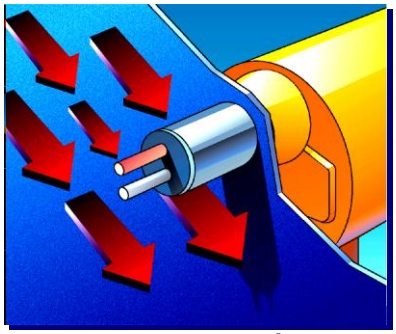
TGF600 thermal mass flow meter ex-proof version has the following certification

Exd II C T3 (NEPSI Gb)

## 1.5 Measuring principle

TGF600 Series Thermal Mass Flowmeter measures gas mass flow base on thermal diffusion theory and thermal principle of Newton , It have two RTD sensor (ref to picture 1.2) located in the flow. One RTD is heated to T1 by a heating power rate of P, the other is not heated but to measure the medium temperature T2. So there is a temperature difference $T^D$=T1-T2 . $T^D$ reach max when mass flow is 0. When the mass flow Q increases, the heat on T1 is taken away so the T1 decline and the $T^D$ become smaller. So there is a certain relationship between heating power rate P, difference of temperature $T^D$ and mass flow Q as below:

$$P/ T^D = K1 + K2\ F(Q)^{K3}$$



Picture 1.2 Principle

The K1,K2 and K3 in above equation is constant related to the character of medium . So the mass flow Q can be get through measuring the heating power rate P and difference of temperature $T^D$ . In actual application, there are two different method, one is consistent current method (keep the P unchanged) and the other is consistent temperature method (keep $T^D$ unchanged)

# 2 Install

# 2.1 Find Most Suitable Location

### 2.1.1 Ambient temperature

Please avoid installing the flowmeter at a location where temperature could dramaticly changes. If the meter is under heavy heat radiation, please implement effective heat insulation and venting method.

### 2.1.2 Atomosphere

Please do not install the meter at a locaition where the atomosphere contains a high level of corrosive substance. If can not install the meter at a better location, please make sure there is enough venting.

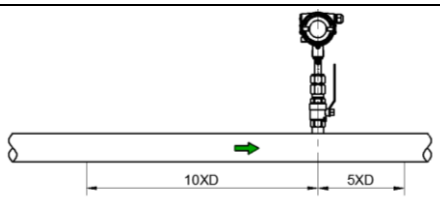
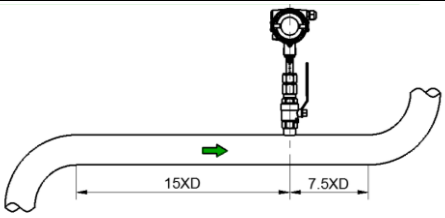
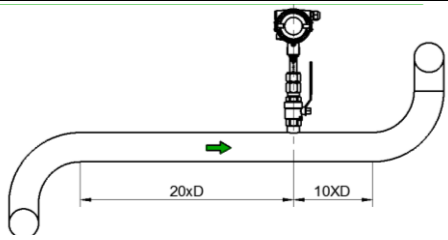
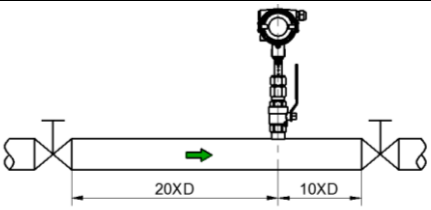
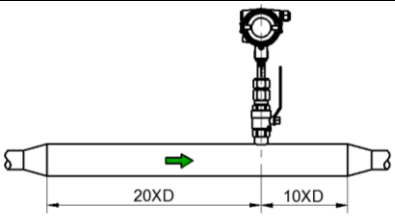
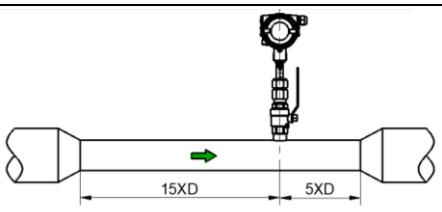
### 2.1.3 Vibration

The meter should not be installed at a location where could have strong vibration. If the mounting pipeline could have heavy vibration, the pipe line should be holden steady by some supporting racks.

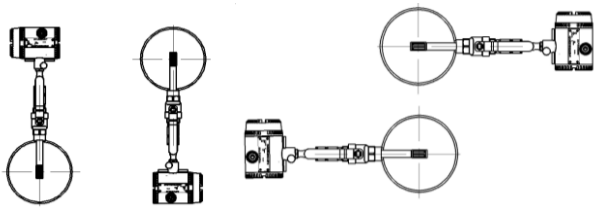
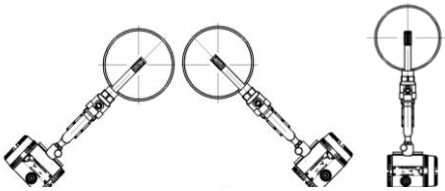
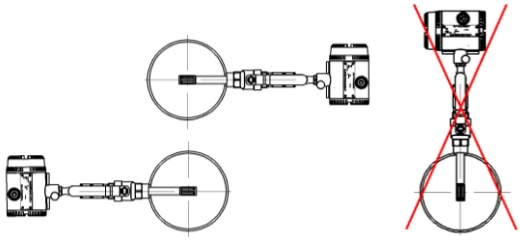
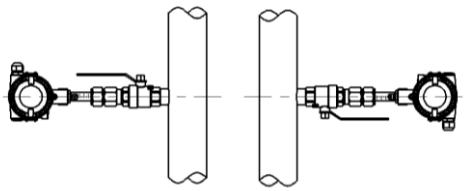
### 2.1.4 Caution

(a) All screws and bolts should be tighen.
(b) Make sure there is not leakage point on the connection.
(c) The process pressure should not be higher than the meter's rated pressure.
(d) Once the meter is under pressure, please do not screw the bolts and screws.
(e) When measuring harzad gas, do not breath the gas in
(f) If the meter is insertion mounted, please the outer of the connection part should be sealed with proper sealant.
(g) If the meter is insertion mounted,

## 2.2 Requirement on straight pipe line

| | |
|---|---|
| Standard |  |
| Curved pipe line in the upstream or downstream |  |
| Curved pipe line that may creat turbulence in the upstream or downstream |  |
| There are valves or pressure controller or any other device may cause turbulence in upstream or down stream of the flowmeter |  |
| If the pipeline of the flowmeter is upsized |  |
| If the pipeline of the flowmeter is downsized |  |

## 2.3 Requirement on insertion direction

| | |
|---|---|
| On a horizontal pipe line, normal air or gas |  <br>Above or under the pipeline Side of the pipe line |
| On a horizontal pipe line, high humidity air or wet natural gas. |  <br>45 degree under the pipe line or just under the pipelien<br>  <br>On the side of the pipe. Do not recommend to install the meter above the pipeline |
| On a vertical pipeline, when the density of the gas is higher than air |  |

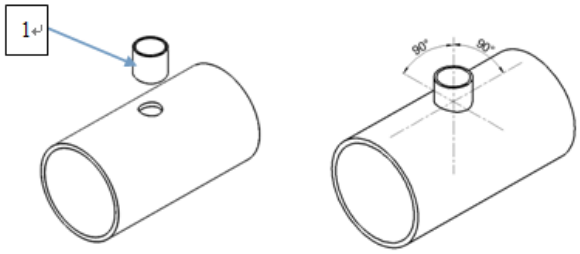
# 2.4 Procedure of installation

## 2.4.1 Nut sleeve insertion (No flow in pipeline)

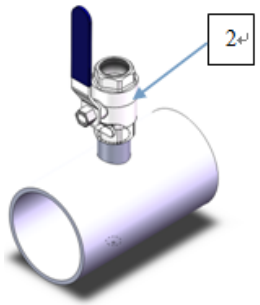
1) Drill a hole on the position where the meter will be installed, Ø 22mm （±0.5 mm）

2) Clean the burrs and sharps on where will be welded

3) Weld the MNPT 1” socket (Part No.1) on the open hole vertically. The socket and the open hole should be concentric, and vertical to the center line of the pipe line




4) Connect the 1” ball valve (Part No.2) with FNPT threads on both ends to the socket. Seal the thread connection with thread sealant. Please note the lever on the ball valve should be point to up when the valve is open



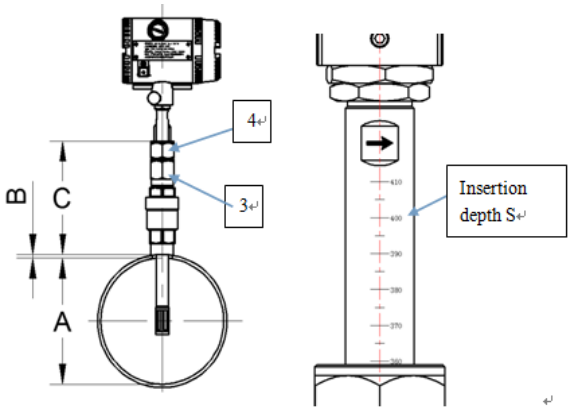

5) Insert the flowmeter into the ball valve and the socket, connect the sleeve (Part No.3) on the meter and the ball valve, seal the thread conection part with thread sealant. Tighten the nut (Part No.4) with hand.

6) Calculate the insertion depth. The sensor should be in the middle of the pipe area, insertion depth S=A/2+B+C. Please reference to the picture below

A: Inner diameter of the pipeline

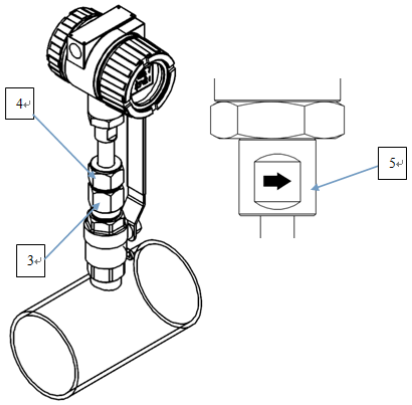
B: Thickness of the pipe line

C: The distance between the top of the pipeline and the upper end of the nut when the nut is fixed



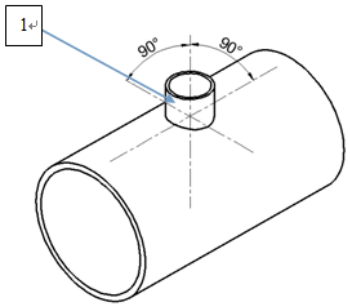
7) Adjust the direction of the flowmeter: Make sure the derection mark on the probe (Part No.5) is pointing to the direction as the flow goes. Please reference to the picture below.

8) Insert the flowmeter to the depth S as calculated previous, now hold the sleeve (Part No.3) with a wrench and tighen the nut (Part No.4) with another wrench. Make sure the nut sleeve is holding the meter tightenly.

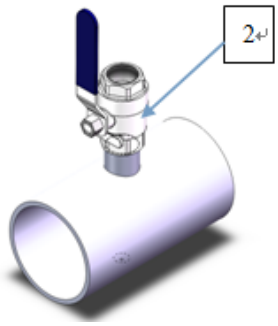



### 2.4.2 Nut sleeve insertion (flow and pressure in pipeline)

1) Weld the MNPT 1" socket (Part No.1) on the pipeline vertically. The socket should be vertical to the center line of the pipe line




2) Connect the 1" ball valve (Part No.2) with FNPT threads on both ends to the socket. Seal the thread connection with thread sealant. Please note the lever on the ball valve should be point to up when the valve is open.



3) Drill a hole with the hot tap hole opener, Ø 22mm (± 0.5 mm). (Please reference to the manual of hot tap mounting for details)

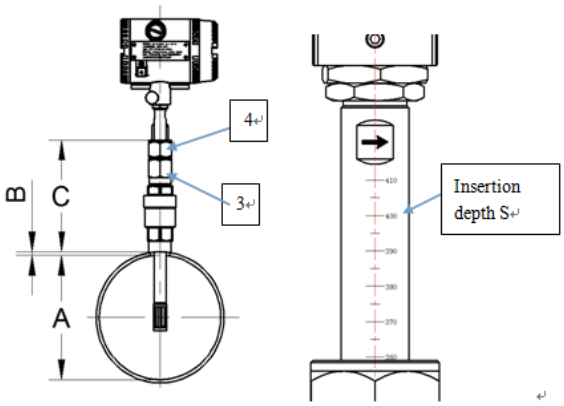
4) Make sure the senor of the meter is with in the sleeve on the flowmeter, so the sleeve can protect the sensor.. Connect the sleeve with the ball valve with the thread, please seal the 1" NPT thread connection with thread sealant, (the ball valve should be closed)

5) Calculate the insertion depth. The sensor should be in the middle of the pipe area, insertion depth S=A/2+B+C. Please reference to the picture below

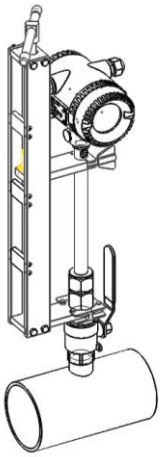
A: Inner diameter of the pipeline

B: Thickness of the pipe line

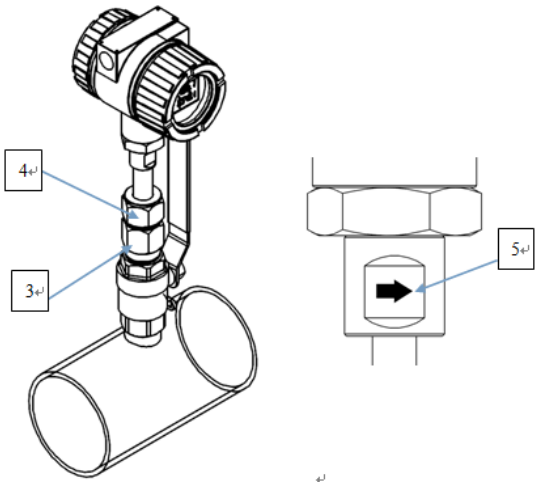
C: The distance between the top of the pipeline and the upper end of the nut when the nut is fixed




6) Use the hot tapping insertion tool to hold the flow meter



7) Adjust the direction of the flowmeter: Make sure the derection mark on the probe (Part No.5) is pointing to the direction as the flow goes. Please reference to the picture below.



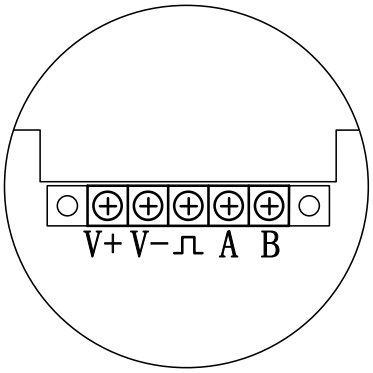

8) Open the ball valve, please make sure that procedure 1~7 is operated properly before opening the ball valve. The sleeve should be connected to the ball valve tightenly that the meter can not be ejected out.

9) Insert the meter to the depth S as calculated with the hot tap mounting tool. (Please reference to the manual of hot tap mounting for details). Now hold the sleeve (Part No.3) with a wrench and tighen the nut (Part No.4) with another wrench. Make sure the nut sleeve is holding the meter tightenly.

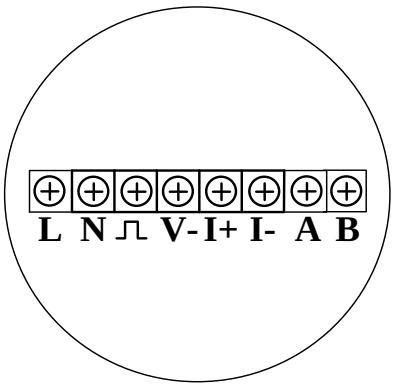
10) Remove the hot tapping insertion tool

# 3 Wiring

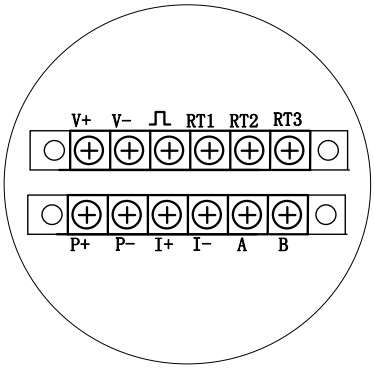
There are four types of terminal boards of TGF600, the 5 terminals board, AC terminal board, 12 terminals board and remote version terminal board as picture 3.1, picture 3.2, picture 3.3 and picture 3.4 below



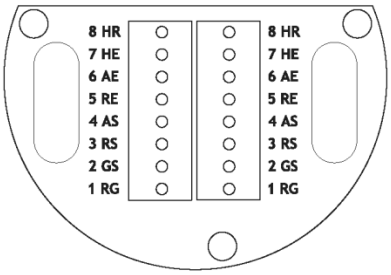

Picture 3.1 TGF600 5 terminals board




Picture 3.2 TGF600 AC terminals board




Picture 3.3 TGF600 12 terminals board




Picture 3.4 TGF600 remote version terminal board

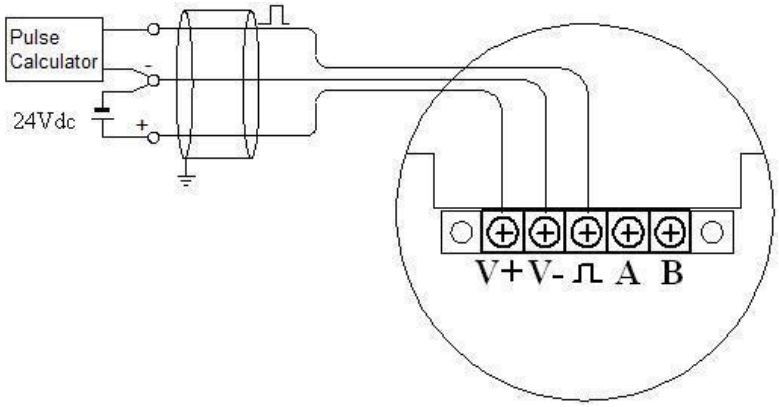
On above board, V+ and V- are for power, the DC power should be within 16VDC~32VDC. Terminal L and N are AC power input terminal, the AC power should be within 65~264VAC. ⎍ is pulse output terminal. A, B are "+" and "-" for RS485Modbus communication, I+ and I- are + and – for 3-wire or 4-wire 4~20 mA. P+,P- are for pressure transmitter .

# 3.1 Wiring for 5 terminals board

Please power the flowmeter with 16~32VDC

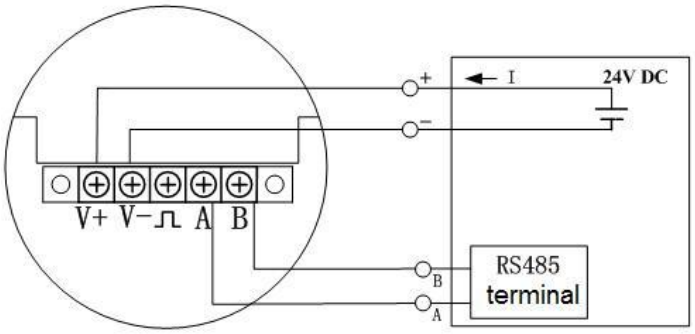
### 3.1.1 Wiringfor 3-wire pulse output

TGF600 use a current pulse output with 50% duty ratio. If the pulse reciving instrument require voltate pulse, please add a resistor between "⎍" and "V-", the resistance should be within 500ohms~1000ohms, and power consumption should be no less than 0.5W.




Picture 3.5 3-wire pulse output wiring on 5 terminals board

### 3.1.2 Wiring for RS485



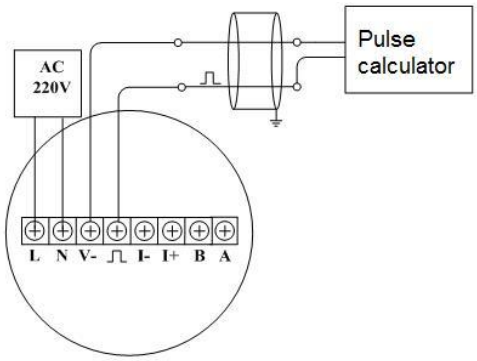

Picture 3.6 RS485 wiring on 5 terminals board

## 3.2 Wiring for AC terminals board

Please power the flowmeter with 85~264VAC 50/60Hz

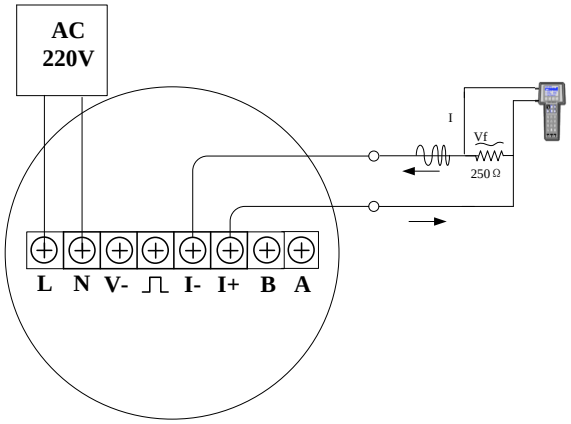
### 3.2.1 Wiring for pulse output

TGF600 use a current pulse output with 50% duty ratio. If the pulse reciving instrument require voltate pulse, please add a resistor between "⎍" and "V-", the resistance should be within 500ohms ~ 1000ohms.



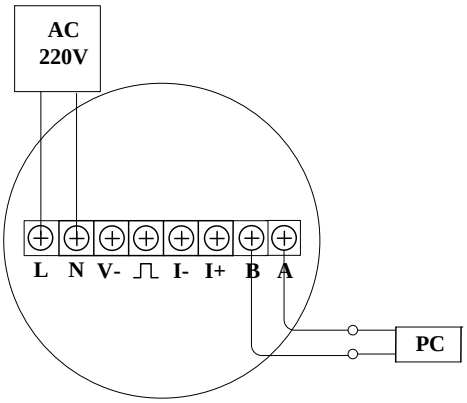

Picture 3.7 Pulse output wiring on AC terminals board

### 3.2.2 Wiring for 4~20mA@HART




Picture 3.8 4~20mA@HART wiring on AC terminals board

### 3.2.3 Wiring for RS485

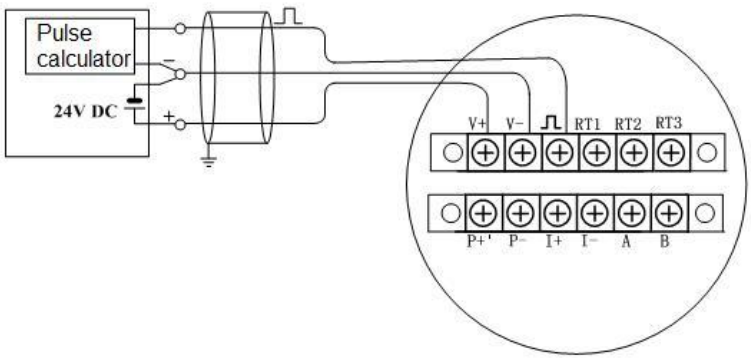



Picture 3.9 RS485 wiring on AC terminals board

## 3.3 Wiring for 12 terminals board

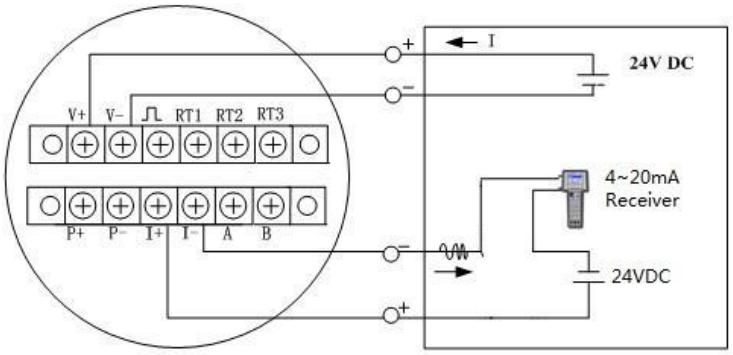
Please power the flowmeter with 16~32VDC

### 3.3.1 Wiring for pulse output



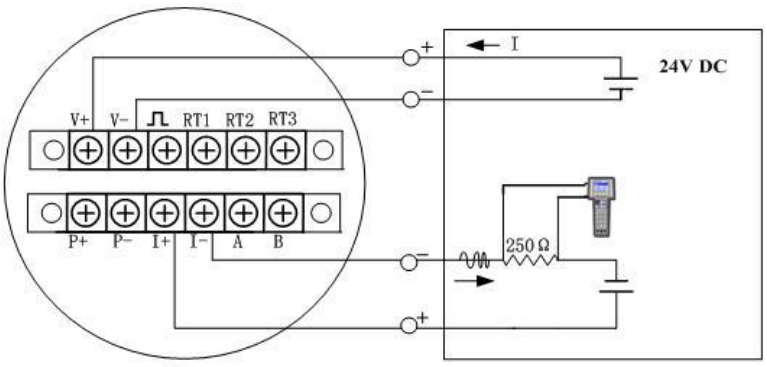

Picture 3.10 pulse output wiring on 12 terminals board

### 3.3.2 Wiring for 4-wire 4~20mA@HART



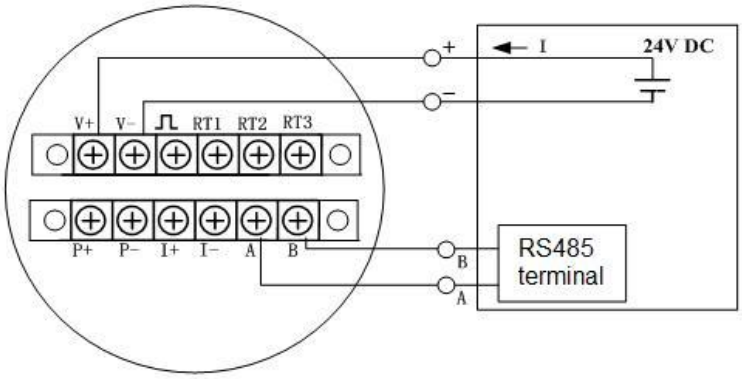

Picture 3.11 4-wire 4~20mA wiring on 12 terminals board

### 3.3.3 Wiring for 4-wire 4~20mA@HART




Picture 3.12 4-wire 4~20mA@HART wiring on 12 terminals board

### 3.3.4 Wiring for RS485




Picture 3.13 RS485 wiring on 12 terminals board

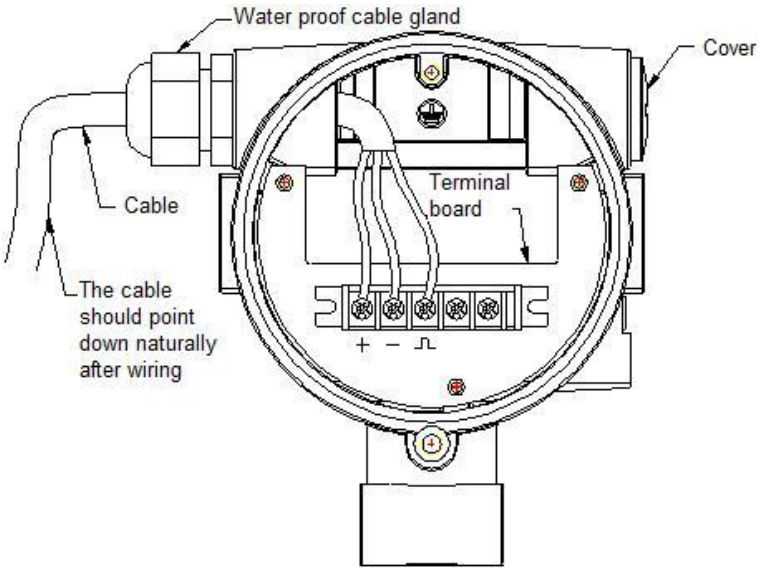
## 3.4 Shell grounding and elimination of interference

In TGF600 thermal mass flowmeter the power supply of signal processing circuit is transferred from outside power supply by a isolation type DC-DC transmitter with advanced grounding technology . The field frequency interference can be isolated well.

When using this product , the "V-" of power supplier should not be connected with the ground .When this product is used in a environment with strong interference , the shell should be clean connected with earth through cable , so the interference can be eliminated .

## 3.5 Requirement on wiring

1) Please do not conduct wiring when the power is on in a explosive environment.
2) Please open the rear cover first, then inert the cable into back zone of housing thourgh the water-proof cable gland.
3) Conduct wiring according to 3.2.
4) If possible, please conduct the wiring according to picture 3.6 to avoid the water get into the housing through the cable.




Picture 3.14 Wiring instruction

# 4 Display

TGF600 thermal mass flow meter provide with local display and setting. Users can display several variables on the local multi-funcational LCD display. The transmitter also has 3 buttons so users can do setting on it.

## 4.1 Intruction of multi-functional LCD display

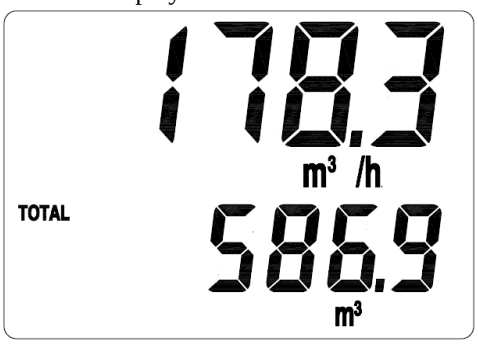
TGF600 thermal mass flow meter has a display to indicate “Temperature” “Flow rate” “Total flow” and more parameters. Please reference to picture 4.1 below.


Pitcure 4.1 TGF600 display

The LCD display has 2 areas to display the content, the upper row, the lower row. The upper row displays the flow rate/mass flow/standard flow rate. Below the upper row shows the unit of the variable displayed in upper row.

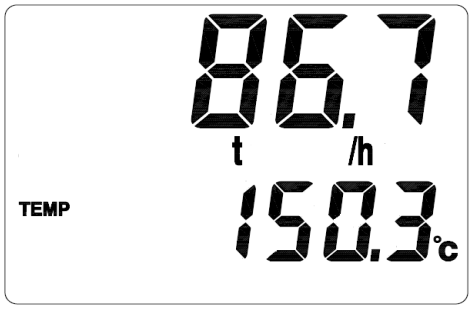
The lower row display indicates other variables, such as temperature/ pressure/ total flow/ density. And below the lower row shows the unit of the variable displayed in lower row.

Please reference to picture 4.2 for display




Picture 4.2 Flow rate and total flow display

TGF600 multi-varibale version can also display temperature. Users can switch the parameter displayed by using the buttons and the parameter will be displayed for 30 seconds. Please reference to picture 4.3 for mass flow and temperature displaying. Users can also fix the lower row to display a parameter consistently.



Picture 4.3 Mass flow and temperature display

You can also set the lower row to display several variables in circular turn.

## 4.2 Unit of the variable displayed

The variables that can be displayed in lower row and their units that can be displayed are as the chart 4.4 below.

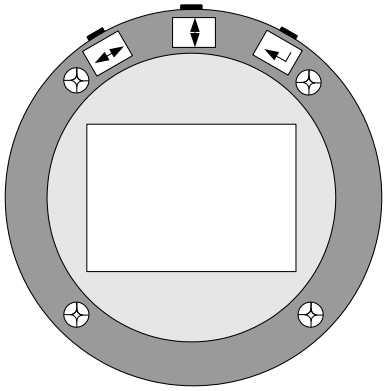
| Subject | Variable | Unit | Circular display code |
|---|---|---|---|
| TOTAL | Total flow | N$m^3$, $m^3$,L,kg or t | 01 |
| TEMP | Temperature | ℃，K，℉ | 02 |
| PRES | Pressure | MPa or kPa | 03 |
| DENS | Density | kg/$m^3$ | 05 |

Chart 4.4 The displayed units

Remark: Clients can select the unit, pressure need separate pressure sensor

## 4.3 Three button setting

TGF600 series thermal mass flowmeter has three buttons on the top of the displayer, which are: ↔ (will be mentioned as "L-R button" below), ↕ (will be mentioned as "U-D button" below), ↵ (will be mentioned as "Enter button" below). Please reference to below picture

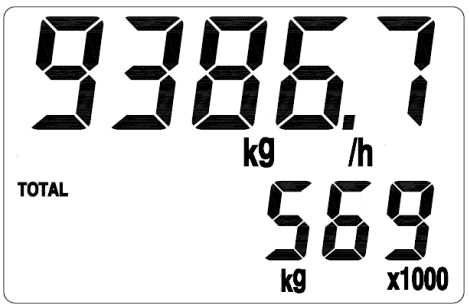

Picture 4.5 buttons

When under working, use “U-D button” to switch the displaying content, use “L-R button” can switch to the left and right digits of total flow. “Enter button” is to dispay the entire digits of total flow directly.

When the flowmeter is under setting mold, the “L-R button” means move to left and right to select the digit, the “U-D button” means to set the digit to a number, the “Enter button” means “confirm”. All the “Digital setting” and “Code setting” of VFM series vortex flowmeter is made through these 3 buttons. Please reference to related article for details.

## 4.4 Total flow displaying

TGF600 can display the total flow with 9 digits left to decimal point and 3 digits right to it.When there is more than six digits, the total flow reading will be displayed in two times. One time displays the right digits and the other displays the left digits. You can use the “L-R button” to switch between the right digits and left digits. The left digits will be displayed with a mark of “x1000”. Please reference to picture 4.6




Picture 4.6 Displaying the left digits, a “x1000” mark is displayed

If you want to check the right digits now, please pressure the “L-R button”, the display will be as picture 4.7 below.


Picture 4.7 Displaying the right digits

According to picture 4.6 and 4.7, the total flow is 569864.581 kg.

## 4.5 Status

TGF600 series thermal mass flowmeter have three different statuses as below

- **Working status**
- **Setting status**
- **Calibration status**

When under working status,please follow the instruction in 4.1 to switch the parameter displayed.

When under setting status, you can set the flowmeter, while the flowmeter is still processing, so setting will not have effect on the measuring. In next chapter, there will be instruction of how to do setting.

The calibration of the flowmeter have been finished in manufacture's lab before delivery, including temperature and pressure calibration if required and the setting of high-limit and low-limit of 4~20mA stimulation output. Thus customers do not to set any more.

# 5 Setting

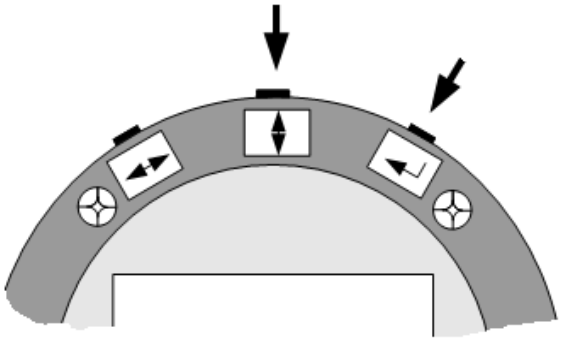
**Note: Every TGF600 thermal mass flowmeters has been set according to requirement before delivery, please do not change setting unless it is necessary and under correct instruction!**

TGF600 thermal mass flowmeter have digital setting and code setting. Use code setting to set parameters such as damping and output signal. Use digital setting to set parameters related to a number, such as pipe size, flow range, factor.

## 5.1 How to set

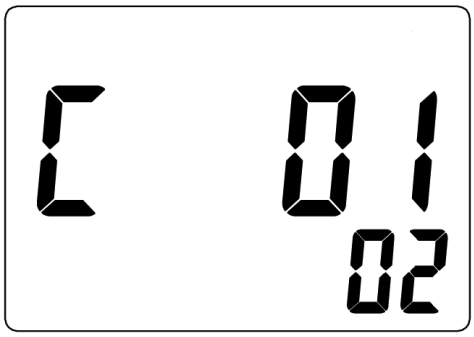
### 5.1.1 Code setting

Under working status, to enter code setting, please hold "Enter button" then press "U-D button" at the same time. Please reference to picture 5.1.



Picture 5.1 enter and quit code setting

When in code setting, the first row will display the reference number of the code setting, and the lower row will display the contents of this parameter. The digit that is flashing is the digit under setting. Please reference to picture 5.2, which means C01=02, that is set the pre-heating time to 2 seconds.



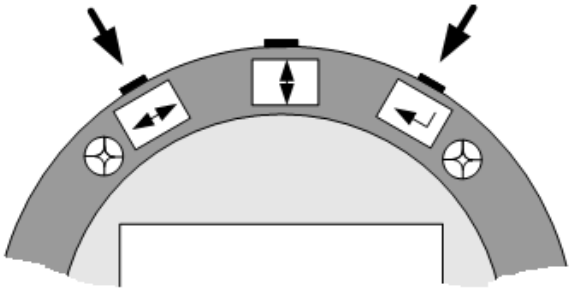

Picture 5.2 code setting

When under code setting, Now ,user can use “L-R button” to choose which digit on the displayer are to be set , and use “R-D button” to switch the digit to 0~9 . The first time of pressing “Enter button” means to set the lower row, when under this situation, users can still use “L-R button” or “U-D button” to set. Press “Enter button” again to check if the setting is available. If setting is available, the display will not flash, when user can still press “L-R button” or “U-D button” to set again. When display is not flashing, pressure “Enter button” to save and go to next setting.

If want to quit code setting, same as entering, please hold “Enter button” then press “U-D button” at the same time.

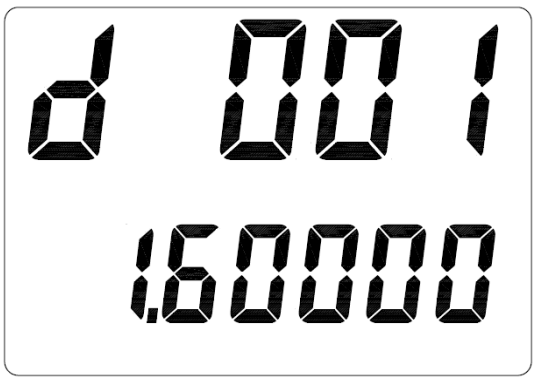
## 5.1.2 Digital setting

Under working status, to enter code setting, please hold “Enter button” then press “L-R button” at the same time. Please reference to picture 5.3.



Picture 5.3 Picture Enter or quit digital setting

When in digital setting, the first row will display the reference number of the digital setting, and the lower row will display the contents of this parameter. The digit that is flashing is the digit under setting. Please reference to picture 5.4., which means D001=1.60000, Max flow is 1.6 (unit according to other setting.)




Picture 5.4 digital setting

When under digital setting,, user can use “L-R button” to choose which digit on the displayer are to be set , and use “R-D button” to switch the digit to 0~9. The first time of pressing “Enter button” means to set the lower row, when under this situation, users can still use “L-R button” or “U-D button” to set. Press “Enter button” again to check if the setting is available. If setting is available, the display will not flash, when user can still press “L-R button” or “U-D button” to set again. When display is not flashing, pressure “Enter button” to save and go to next setting.

If want to quit code setting, same as entering, please hold “Enter button” then press “U-D button” at the same time.

## 5.2 Setting list

Please check chart 5.1 and 5.2 for code and digital setting address list.

# Chart 5.1 Code setting address

| Code setting address | Item | Code | Description of code |
|---|---|---|---|
| C01 | Start up time | 01~99 | Set the start up time within 1~99 seconds |
| C02 | Density type | 00 | Display standard volume flow rate |
| | | 01 | Density preset, display mass flow |
| | | 02 | Display actual flow rate |
| C03 | Pulse output type | 00 | pulse output off |
| | | 01 | Frequency output |
| | | 02 | Pulse equivalent output |
| C06 | Pulse output parameter | 00 | Flow rate |
| | | 01 | Temperature |
| | | 02 | Pressure |
| | | 03 | Total flow |
| C07 | Damping | 01~16 | 1~16 seconds |
| C08 | Instrument number | 00~99 | For Modbus |
| | | 00~15 | For HART communication |
| C09 | Baud rate | 1 | 1200 no parity 1 stop bit |
| | | 2 | 1200 even parity 1 stop bit |
| | | 3 | 2400 no parity 1 stop bit |
| | | 4 | 2400 even parity 1 stop bit |
| | | 5 | 4800 no parity 1 stop bit |
| | | 6 | 4800 even parity 1 stop bit |
| | | 7 | 9600 no parity 1 stop bit |
| | | 8 | 9600 even parity 1 stop bit |
| | | 9 | 19200 no parity 1 stop bit |
| | | 10 | 19200 even parity 1 stop bit |
| | | 11 | 1200 odd parity 1 stop bit |
| | | 12 | 2400 odd parity 1 stop bit |
| | | 13 | 4800 odd parity 1 stop bit |
| | | 14 | 9600 odd parity 1 stop bit |
| | | 15 | 19200 odd parity 1 stop bit |
| | | 16 | 38400 no parity 1 stop bit |
| | | 17 | 38400 even parity 1 stop bit |
| | | 18 | 38400 odd parity 1 stop bit |
| | | 19 | 57600 no parity 1 stop bit |
| | | 20 | 57600 even parity 1 stop bit |
| | | 21 | 57600 odd parity 1 stop bit |
| | | 22 | 115200 no parity 1 stop bit |
| | | 23 | 115200 even parity 1 stop bit |
| | | 24 | 115200 odd parity 1 stop bit |
| | | | |
| | | | |

| Code setting address | Item | Code | Description of code |
|---|---|---|---|
| C10 | Time unit for flow rate | 00 | /s |
| | | 01 | /min |
| | | 02 | /h |
| C11 | Mass unit | 00 | kg |
| | | 01 | ton |
| | | 02 | lb |
| C12 | Volume unit for flow rate | 00 | Standard cubic meter |
| | | 01 | Cubic meter |
| | | 02 | Standard litre |
| | | 03 | Litre |
| | | 04 | Standard Cubic feet |
| | | 05 | Gallon |
| | | 06 | Imperial gallon |
| C13 | Pressure unit | 00 | Kpa (Absolute pressure) |
| | | 01 | Kpa (Gauge pressure,minus sign for negative pressure ) |
| | | 02 | Kpa (Gauge pressure) |
| | | 03 | Mpa (Absolute pressure) |
| | | 04 | Mpa (Gauge pressure,minus sign for negative pressure ) |
| | | 05 | Mpa (Gauge pressure) |
| | | 06 | PSI (Absolute pressure) |
| | | 07 | PSI (Gauge pressure,minus sign for negative pressure ) |
| | | 08 | PSI (Gauge pressure) |
| | | 09 | Bar (Absolute pressure) |
| | | 10 | Bar (Gauge pressure,minus sign for negative pressure ) |
| | | 11 | Bar (Gauge pressure) |
| C14 | Temperature unit | 00 | ℃ |
| | | 01 | ℉ |
| | | 02 | K |
| C15 | Right digits number for total flow | 00~05 | 00：No right digits for total flow |
| | | | 01~05：1~5 right digits for total flow |
| C25 | Password for setting | 00 | Password protection off |
| | | 01 | Password protection on |
| C26 | Fixed max flow | 00 | Fixed max flow off |
| | | 011 | Fixed max flow on. (If the flow rate measured is over the setting of D039, the display will show the reading as D039) |
| C31 | Time space for circle display | 00~30 | 00：circle display off |
| | | | 1~30：1~30 seconds between the display of different parameter |
| C32 | First paratmeter displayed in circle display | 00~05 | 00：circle display off |
| | | | 01~05：see chart 4.4 |
| C33 | Second paratmeter displayed in circle display | 00~05 | 00：circle display off |
| | | | 01~05：see chart 4.4 |

| Code setting address | Item | Code | Description of code |
|---|---|---|---|
| C36 | Last paratmeter displayed in circle display | 00~05 | Same as above |
| C40 | The date sequence of IEEE formate float of Modbus | 01 | Lower 16bits address in front, the lower 8bits in the 16bits address in front |
| | | 02 | Higher 16bits address in front, the Higher 8bits in the 16bits address in front |
| | | 03 | Lower 16bits address in front, the higher 8bits in the 16bits address in front |
| | | 04 | Higher 16bits address in front, the lower 8bits in the 16bits address in front |
| C41 | Shape of pipeline | 00 | Round pipeline(D:D010) |
| | | 01 | Rectangel pipeline(L:D018 W:D019) |
| C47 | Set password | 00 | Keep the password |
| | | 01 | Change the pass word |
| C49 | Status | 00 | Working status |
| | | 01 | 4~20mA output calibration statues |
| | | 02 | Flow rate calibration statues |
| | | 03 | Temperature calibration statues |
| | | 04 | Pressure calibration statues |
| C50 | Total flow reset | 00 | Reset total flow to 0 |
| | | 01 | Default |
| C60 | Restore to backup date | 06 | Restore to backup date |
| C61 | Save setting backup | 16 | Save current setting for backup |

Note:

1) If the unit of flow rate is changed or measurement changed from flow rate to mass flow, users can reset the total flow to 0 or record the current total flow, as the number of total flow will not change according to unit.

2) Total flow can only be output by pulse, temperature and pressure can only be output by frequency

# Chart 5.2 Digits settingaddress

| Code setting address | Item | Code | Description of code |
|---|---|---|---|
| D001 | Max flow rate | [-99999，999999] | Unit is same as flow rate,Max/min flow rate of 4~20mA and 200~1000Hz output |
| D002 | Min flow rate | [-99999，999999] | |
| D003 | Max frequency output | 0.5~10000 | The frequency output of max flow, unit is Hz |
| D004 | Min frequency output | 0.5~10000 | The frequency output of min flow, unit is Hz |
| D005 | Cut off small signal | [-99999，999999] | Unit is same as flow rate |
| D008 | K factor | 0~999999 | |
| D009 | Density | 0~999999 | Unit is Kg/m ³ |
| D010 | Pipe size | 0~9999999 | Unit is mm |
| D011 | Max temperature (Unit as set in C14） | -99999~999999 | The max frequency when temperature is output by frequency, 1000Hz for instance. The max current when temperature is output by current, 20mA for instance. |
| D012 | Min temperature (Unit as set in C14） | -99999~999999 | The min frequency when temperature is output by frequency, 200Hz for instance. The min current when temperature is output by current, 4mA for instance. |
| D013 | Max pressure (Unit as set in C13） | -99999~999999 | The max frequency when temperature is output by frequency, 1000Hz for instance. The max current when temperature is output by current, 20mA for instance. |
| D014 | Min pressure (Unit as set in C13） | -99999~999999 | The min frequency when temperature is output by frequency, 200Hz for instance. The min current when temperature is output by current, 4mA for instance. |
| D015 | Ambiant pressure | 0~999999 | Unit according to setting |
| D017 | Equivalent of pulse output | 0~999999 | Set the equivalent that one pulse output stands for.Unit as C06 |
| D018 | Length of rectangle pipeline | 0~999999 | Unit is mm |
| D019 | Width of rectangle pipeline | 0~999999 | Unit is mm |
| D030 | Temperature of standard condition | 0~20 | Default temperature of standard condition is 20 degree C |
| D033 | Reference flow rate | 0~999999 | When measured flow rate is over calibrated max flow, will display/output the reference flow rate |

Note:

1) When setting the max or min of pressure, please take consideration of gauge pressure or absolute pressure, if the pressure sensor is outputting gauge pressure, please set D015 the ambient pressure to get correct pressure reading.

## 5.3 Example of setting

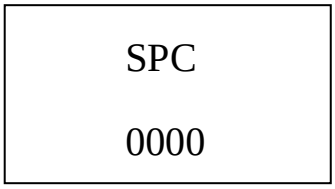
Sample: For insertiong connecting, measure air in DN150 pipe, density preset, unit displayed in kg/hr, flow range of 0~4000kg/hr, 200~1000Hz output

| | Address | Code | Description |
|---|---|---|---|
| Code setting | C02 | 01 | Density preset |
| | C03 | 01 | Frequency output |
| | C06 | 00 | Output parameter is flow rate |
| Digital setting | D009 | 1.2930 | Density=1.293 ,air |
| | D008 | 1.000 | Factor =1 |
| | D001 | 5000 | The flow rate for 1000Hz output |
| | D002 | 0 | The flow rate for 200Hz output |
| | D010 | 150 | Pipe size=150mm |
| | D003 | 1000 | Max output frequency |
| | D004 | 200 | Min output frequency |

## 5.4 Password setting instruction

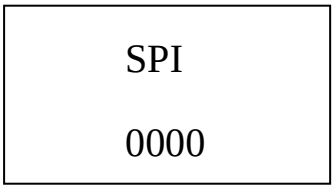
There is no password set in default in a new TGF600 thermal mass flowmeter ,users can set a password following instruction below.

Enter code setting, set C47=01, confirm and quit then enter the password setting ineterface as picture 5.5




Picture 5.5 Password setting interface

To set a new password, users have to input the correct password twice, the password will become effective only if the both inputs are the same; or users have to input again. If the power is off during a password setting process, the password will be 0000 as default. When a password becomes effective, users have to input the correct password before he can set the flowmeter, please reference to picture 5.6. If users input incorrect password 3 times consistently, the display will come back to normal display




Picture 5.6 Password input

If a password has been set to a TGF600 thermal mass flowmeter, users can enter code setting C47=01 to set a new password.

# 6 Instruction of RS485 Modbus Communication

## 6.1 Interface regulation

The communication interface should be RS485, the range of Baud rate should be 1200~115200.

The wiring terminal is “A” and “B”.

The communication should comply with MODBUS-RTU statute.

The combination of a communication signal: Address code - function code – date segment – CRC calibration code. The distance between two characters should not be longer than one character, or it will be considered as the beginning of a new message or the end of a old message. The message is combined with hexadecimal arrays.

Defination of the dates: Please reference to the chart 6.1 below.

Chart 6.1 Address of the displayed date

| Register address | Usage | Nature | Date type |
|---|---|---|---|
| 0~1 | Flow rate | Read only | Float |
| 2~3 | Frequency | Read only | Float |
| 4~5 | Pressure | Read only | Float |
| 6~7 | Total Flow | Read only | Float |

The displayable dates including flow rate, pressure, temperature and total flow, if the meter is not multi-variable version, then the reading of pressure and temperature will both be 0. The date of the parameters in above chart can be read by using function code 03 according to the address above and shifting.

The addresses of code setting are as below.

Chart 6.2 Address of code setting

| Register | Usage | Range | Nature | Date type |
|---|---|---|---|---|
| 1000 | Pre-heating time (warm up) C01 | 1~99 | Read only | Short |
| 1001 | Density compensation C02 | 0~2 | Read/Write | Short |
| 1002 | Method of pulse output | 0~2 | Read/Write | Short |
| 1004 | Output C05 | 0~2 | Read/Write | Short |
| 1005 | Pulse output parameter | 0~3 | Read/Write | Short |
| 1006 | Damping C07 | 1~16 | Read/Write | Short |
| 1007 | Instrument number C08 | Hart(0~15)<br>MB(1~99) | Read | Short |
| 1008 | Baud rate C09 | 1~24 | Read | Short |
| 1009 | Unit of time C10 | 0~2 | Read/Write | Short |
| 1010 | Mass unit C11 | 0~2 | Read/Write | Short |
| 1011 | Volume unit C12 | 0~6 | Read/Write | Short |
| 1012 | Pressure unit C13 | 0~11 | Read/Write | Short |
| 1013 | Temperature unit C14 | 0~2 | Read/Write | Short |
| 1014 | Right digits number for total flow C15 | 0~5 | Read/Write | Short |
| 1030 | Time of circle display C31 | 0~30 | Read/Write | Short |
| 1031 | First paratmeter displayed in circle display C32 | 1~5 | Read/Write | Short |
| 1032 | Second paratmeter displayed in circle display C33 | 0~5 | Read/Write | Short |
| 1033 | Third paratmeter displayed in circle display C34 | 0~5 | Read/Write | Short |
| 1034 | Fourth paratmeter displayed in circle display C35 | 0~5 | Read/Write | Short |
| 1035 | fifth paratmeter displayed in circle display C36 | 0~5 | Read/Write | Short |
| 1039 | Sequence of float C40 | 1~4 | Read/Write | Short |
| 1040 | Shape of pipeline C41 | 0~1 | Read/Write | Short |
| 1042 | The array length of moist control C43 | 5~50 | Read/Write | Short |
| 1048 | Status C49 | 0~10 | Read/Write | Short |
| 1049 | Total flow reset to 0 C50 | 0~1 | Read/Write | Short |

Users can use function code 04 and 06 to access to the address for code setting above.

Digital setting address is as below.

Chart 6.3 Address of digital setting

| Register | Usage | Restriction of modification | Nature | Date type |
|---|---|---|---|---|
| 2000~2001 | D001 Max flow | -1e5~1e6 | Read/Write | Float |
| 2002~2003 | D002 Min flow | -1e5~1e6 | Read/Write | Float |
| 2004~2005 | D003 Max frequency output | 0~1e6 | Read/Write | Float |
| 2006~2007 | D004 Min frequency output | -1e5~1e6 | Read/Write | Float |
| 2008~2009 | D005 Small signal cut off | 0~1e6 | Read/Write | Float |
| 2014~2015 | D008 K factor | 0~1e6 | Read/Write | Float |
| 2016~2017 | D009 Density setting | 0~1e6 | Read/Write | Float |
| 2018~2019 | D010 Pipe inner diameter | 0~1e6 | Read/Write | Float |
| 2020~2021 | D011 Max temperature | -1e5~1e6 | Read/Write | Float |
| 2022~2023 | D012 Min temperature | -1e5~1e6 | Read/Write | Float |
| 2024~2025 | D013 Max pressure | -1e5~1e6 | Read/Write | Float |
| 2026~2027 | D014 Min pressure | -1e5~1e6 | Read/Write | Float |
| 2028~2029 | D015 Ambient pressure | 0~1e6 | Read/Write | Float |
| 2030~2031 | D016 Temperature for standard condition | -1e5~1e6 | Read/Write | Float |
| 2032~2033 | D017 Equivalent of pulse output | 0~1e6 | Read/Write | Float |
| 2034~2035 | D018 Length of rectangle pipeline | 0~1e6 | Read/Write | Float |
| 2036~2037 | D019 Width of rectangle pipeline | 0~1e6 | Read/Write | Float |
| 2058~2059 | D030 Temperature for standard condition | 0~20 | Read/Write | Float |
| 2064~2065 | D033 Reference flow rate | 0~1e6 | Read/Write | Float |

The chart above indicates the register address, usage of the register, restriction of modification, read/write nature and date type. The register above are all holding register, the supporting function code is 03,04,06,16 function code.

# 6.2 Commends

Function code 03 and 04 are the codes supported for reading the registers. Function code 06 is for writing one register. Function code 16 is for wrting multi registers. Function code 06 is only supported for writing short date. Function code 16 is supported for writing both short date and float date.

**Function code 03 – Read register**

| Request | Response |
|---|---|
| 01 : Address | 01: Address |
| 03 : Function code | 03 : Function code |
| 00 : Register address higher | 04 : Quantity of bit |
| 00 : Register address lower (display the address) | 80 : Date 1 |
| 00 : Register number higher | 04 : Date 2 |
| 02 : Register number lower | 80 : Date 3 |
| CRCL : CRC Parity code lower | 80 : Date 4 |
| CRCH ： CRC parity code higher | CRCL : CRC Parity code lower |
| | CRCH ： CRC parity code higher |

**Note:** To read a float date, the quantity of the register addresses and their values have to be even, or reponse will be error.

**Function code 04 – Same as function code 03**

**Function code 06** – write one register

| Request | Response |
|---|---|
| 01 : Address | 01: Address |
| 06 : Function code | 06 : Function code |
| 00 : Register address higher | 00 : Register address higher |
| 01 : Register address lower (code setting address) | 01 : Register address lower |
| 00 : Value higher | 00 : Value higher |
| 04 : Value lower | 04 : Value lower |
| CRCH ： CRC parity code higher | CRCH ： CRC parity code higher |
| CRCL : CRC Parity code lower | CRCL : CRC Parity code lower |

**Note:** Function code is only supported for writing short dater.

**Function code 16**- write multi registers.

| Request | Response |
|---|---|
| 01 : Address | 01: Address |
| 10H : Function code | 10H : Function code |
| 00 : Register address higher | 00 : Register address higher |
| 01 : Register address lower (digital setting address) | 01 : Register address lower |
| 00 : Quantity of register higher | 00 : Quantity of register higher |
| 02 : Quantity of register lower | 02 : Quantity of register lower |
| 04 : Quantity of values | CRCH ： CRC parity code higher |
| 86h : Value 1 | CRCL : CRC Parity code lower |
| 00 : Value 2 | |
| 00 : Value 3 | |
| 48H: Value 4 | |
| CRCH ： CRC parity code higher | |
| CRCL : CRC Parity code lower | |

| | |
|---|---|
| Request<br>01 : Address<br>10 : Function code<br><br><br><br><br>04 : Date quantity<br>80 : Date 1<br>04 : Date 2<br>80 : Date 3<br>80 : Date 4 | N11 if move out is 0 , CRC=CRC |
| CRCL : CRC Parity code lower | Move right for 8 times to finish the N11 calculation |
| CRCH ： CRC Parity code higher | Get the CRC calibration value |

# 6.4 The float date format of the instrument

The storage sequence of 4 bits float formate is as below:

| Address: | 0 | 1 | 2 | 3 |
|---|---|---|---|---|
| Content: | MMMMMMMM | MMMMMMMM | EMMMMMMM | SEEEEEEEE |

Use IEEE standard method, do not store 1 on top digit, if top digit is 1, means negative; if top digit is 0, means positive. So the 23 mantissas and a 1 on top digit, which is concealed, constitute a 24 bits fixed point true form decimal, which is a decimal have mantissas less than 1 and more than or equal to 0.5. The lowest 8 bits are exponent-marker using shift code method. The exponent marker equals to the actual value minus 127. For example: 7=86H-7FH, -10=75H-7FH

e.g.: 100=0x00,0x00,0x42,0xc8

-100=0x00,0x00, 0xc2,0xc8

0=0x00.0x00.0x00.0x00 (exponent-marker is 0, the number is 0)

## 6.5 The sequence of the float date bytes of instrument

Code setting C40 is used for setting the sequence of the float date bytes of instrument.

1: LL_LH_HL_HH the lower 16 bytes registers come first, the lower 8 bytes within the 16 bytes registers come first.

eg: 100=0x00,0x00, 0xc8, 0x42

-100=0x00, 0x00, 0xc8, 0xc2

2: HH_HL_LH_LL the higher 16 bytes registers come first, the higher 8 bytes within the 16 bytes registers come first.

eg: 100=0x42,0xc8,0x00,0x00

-100=0xc2,0xc8 ,0x00,0x00

3: LH_LL_HH_HL the lower 16 bytes registers come first, the higher 8 bytes within the 16 bytes registers come first.

eg: 100=0x00,0x00,0x42,0xc8

-100=0x00,0x00,0xc2,0xc8

4: HL_HH_LL_LH the higher 16 bytes registers come first, the lower 8 bytes within the 16 bytes registers come first.

eg: 100=0xc8,0x42,0x00,0x00

-100=0xc8,0xc2,0x00,0x00

## 6.6 Modbus error reponse

When the host sends a command and asks for a correct reponse, one of below four is going to happen:

1) If the command from the host is correct and processable, the flow meter will give a correct reponse.

2) If the flowmeter failed to receive the command due to a communication failure, the flowmeter will not response. . The host will process an overtime commend.

3) If the flowmeter received a command, but detected parity, the error of LRC and CRC will cause no reponse. The host will process an overtime commend.

4) If the flowmeter recived a correct command, but can not process it (read or write a none-existing register etc.), the flowmeter will send a error reponse

A error reponse has two byte sections to show its difference from a correct reponse.

Function code section: In a correct reponse, the flowmeter will copy the origin function code sent from the host, and the highest bytes of them are all 0(all function codes are smaller than 0x80). In a error reponse, the flowmeter will set the highest bytes to 1. The host can detect the error code and know the content of the error when it detect that the highest bytes of function codes are 1.

Value section: In a error reponse, the flowmeter will reply a byte as the error code to definite the content of the error. Pleaes reference to the chart below for the error codes and its definition:

| Code | Name | Meaning |
|---|---|---|
| 01 | Illegal function code | Flowmeter can not process the function code in a command. Maybe this function code can only be used on a new device, or it can also indicate that the flowmeter is under error statues. |
| 02 | Illegal address | The flowmeter can not process with the address in the command. The initiate address plus address diversion are higher than the highest address. |
| 03 | Illegal contents of value | The content of the value in the command is not acceptable for the flowmeter. |
| 04 | Flow meter function failed | An unrecoverable failure happened when the flowmeter is trying to reponse. |
| 05 | Reponse | The flow meter will take a long while to process the command. So reponse this error code to prevent the host from processing a overtime command. |
| 06 | Flowmeter is busy | To advise the host that the flowmeter is processing a command which will takes a long time. So the host should resend the command when the flowmeter is free. |

## 6.7 Examples of communication

The flowmeter's instrument Modbus address is 01, baud rate=4800 (C08=01, C09=05, C40=02).

**Example 1:** Read flow rate F,F=916.49 (4 bytes float)

Host command: 01 03 00 00 00 02 C4 0B

Flowmeter reponse: 01 03 04 **44 65 1F CE** 77 78

**Example 2:** Read total flow

Host command: 01 03 00 06 00 02 24 0A

Flowmeter reponse: 01 03 04 **44 9D 1E 3F** 36 9D

**Example 3:** Read all the value displayed on the flowmeter, including flow rate, temperature, pressure, total flow ….. all together 4 value (16 bytes)

Host command: 01 03 00 00 00 08 44 0C

Flowmeter reponse: 01 03 10

**44 65 1F CE**（flow rate＝916.49）

**00 00 00 00**（temperature＝0）

**00 00 00 00**（pressure＝0）

**44 9D 1E 3F**（total flow in float＝1256.94）

B7 (CRCL)

BF (CRCH)

# 7 Introduction of HART communication protocol

## 7.1 HART commands

## 7.1.1 Command 0:Read transmitter unique identifier

**Command formate**

Return to the expension device type code, version number and identification number

Request: None

Response:

| | |
|---|---|
| Byte 0: | 254 |
| Byte 1: | Manufacture's ID |
| Byte 2: | Manufacture's device type |
| Byte 3: | Number of request preambles |
| Byte 4: | Revision level of universal command |
| Byte 5: | Revision level of transmitter document |
| Byte 6: | Software revision level |
| Byte 7: | Hardware revision level |
| Byte 8: | Flags, none defined at this time |
| Byte 9-11: | Device Indentification Number |

**Test of command**

Send 0 command:FF FF FF FF FF 02 80 00 00 82; to request information of the instrument

Receive 0 command:FF FF FF FF FF 06 80 00 0E 00 00 FE 1A 1A 05 05 00 00 00 00 AD 18 8C 4F

## 7.1.2 Command 1: Read primary variable value (PV)

**Command formate:**

Return to primary variable value in float.

Request:None

Response:

| | |
|---|---|
| Byte 0: | Primary variable unit code |
| Byte 1-4: | Primary variable |

**Remark: Set primary command to flow rate.**

**Test of command:**

Send command 1: FF FF FF FF FF 82 9A 1A AD 18 8C 01 00 3A ;to read the IEEE754 float value of primary variable.

Receive command 1:FF FF FF FF FF 86 9A 1A AD 18 8C 01 07 00 00 13 00 00 00 00 2A

## 7.1.3 Command 2:Read primary variable's current and percentage value

**Command formate:**

Read the current and percent of the primary variable, the current of primary variable always match the AO current output of the instrument. Percent is not restricted within 0~100%, if it is beyond the limit of primary variable, it will find the limit of the transmitter.

Request: None

Reponse:

| | |
|---|---|
| Byte 0-3: | Analog output current mA, |
| Byte 4-7: | Percent of range |

**Test of command:**

Send command 2: FF FF FF FF FF 82 9A 1A AD 18 8C 02 00 39; to read the current and primary variable percent of range.

Receive command 2: FF FF FF FF FF 86 9A 1A AD 18 8C 02 0A 00 00 40 80 00 00 00 00 00 00 F7

## 7.1.4 Command 3: Read primary variable current and dynamic variables

**Command formate:**

Read the current of primary variable and 4 preset dynamic variables at maximum. The current of primary variable always match the AO output current of the instrument. Every type of device has a definition on a relative dynamic variable, for example the secondary variable is temperature sensor.

Request: None

Response:

Byte 0-3: Analog output current mA, IEEE 754
Byte 4: Primary variable unit code
Byte 5-8: Primary variable, IEEE 754
Byte 9: Secondary variable unit code
Byte 10-13: Secondary variable, IEEE 754
Byte 14: Tertiary variable unit code
Byte 15-18: Tertiary variable, IEEE 754
Byte 19: Quaternary variable unit code
Byte 20-23: Quaternary variable, IEEE 754

Remark: Primary variable is flow rate. The unit code is 75:kg/hour, 19:m3/hour;
Secondary variable is total flow. The unit code is 61:kg, 43:m3;
Tertiary variable is temperature. The unit is 32: ℃;
Quaternary variable is pressure. The unit is 12: Mpa;

**Test of command:**

Send command 3: FF FF FF FF FF 82 9A 1A AD 18 8C 03 00 38; to read dynamic variables

Receive command 3: FF FF FF FF FF 86 9A 1A AD 18 8C 03 1A 00 00 40 80 00 00 13 00 00 00 00 2B 48 33 5A 4B 26 00 00 00 00 20 00 00 00 00 B2

## 7.1.5 Command 6: Write polling address

**Command formate:**

It is a date link manangment command. This command writes a polling address to the device. This address is used to control the AO of primary variable and providing of device ID.

Only when the polling address of the instrument is 0, that the AO output of primary variable is available. If the address is 1~15, AO will be not activated and will not reponse, AO will be minimum value; transmission status will be the 3rd statue------primary variable AO fixed; max and min alarm not implemented. If polling address is write back to 0, AO will be activated again and will reponse.

Request:

Byte 0: Device polling address

Response:

Byte 0: Device polling address

**Test of command:**

Send command 6: FF FF FF FF FF 82 9A 1A AD 18 8C 06 01 00 3C: to write POLLING ADDRESS

Receive command 6: FF FF FF FF FF 86 9A 1A AD 18 8C 06 03 00 00 00 3A

## 7.1.6 Command 11: Read unique identifier associated with tag

**Command formate:**

It is a date link manangment command. This command will return the device type, revision level and divice indentification number of the device which matches to the tag. Process the command upon receipt of the expension address or broadcast address. The expension addresses in command and reponse are the same.

Request:

Byte 0-5: Tag,Packed ASCI

Response:

Byte 0: Device type code for expansion
Byte 1: Manufacture Indentification code
Byte 2: Manufacture device type
Byte 3: Number of request preambles
Byte 4: Revision level of universal command
Byte 5: Revision level of transmitter document
Byte 6: Software revision level
Byte 7: Hardware revision level
Byte 8: Flags, none defined at this time.
Byte 9-11: Device identification number

**Test of command:**

Send command 11: FF FF FF FF FF 82 9A 1A AD 18 8C 0B 00 30; Read relevant info of the device such as unique identifier associated with tag

Receive command 11: FF FF FF FF FF 86 9A 1A AD 18 8C 0B 0E 00 00 FE 1A 1A 05 05 00 00 00 00 AD 18 8C FD

## 7.1.7 Command 12:Read message

**Command formate:**

To read message

Request: None

Response:

Byte 0-23: Message

**Test of command:**

Send command 12:FF FF FF FF FF 82 9A 1A AD 18 8C 0C 00 37 ; read message

Receive command 12:FF FF FF FF FF 86 9A 1A AD 18 8C 0C 1A 00 00 59 00 74 D6 05 8F 49 41 58 80 42 47 25 40 4C 81 04 8F 0C 54 D3 3D 28 20 10

## 7.1.8 Command 13: Read tag, descriptor, date

**Command formate:**

Read device tag,description and date.

Request: None

Response:

Byte 0-5: Tag,ASCII
Byte 6-17: Descriptor,ASCII
Byte 18-20: Date: day,month,year

**Test of command:**

Send command 13:FF FF FF FF FF 82 9A 1A AD 18 8C 0D 00 36 ;read device tag, descriptor and date

Receive command 13:FF FF FF FF FF 86 9A 1A AD 18 8C 0D 17 00 00 50 11 E0 82 08 20 58 F4 94 15 88 06 30 F5 CD 15 41 52 0F 01 6F E2

## 7.1.9 Command 14: Read primary variable sensor information: device serial number and limits

**Command formate:**

Read device information

Request: None

Response:

Byte 0-2: Sensor serial number MSB, 24-BIT unsigned integer

Byte 3: Flow rate unit

Byte 4-7: Upper sensor limit of flow rate

Byte 8-11: Lower sensor limit of flow rate

Byte 12-15: Minimum span of flow rate

**Test of command:**

Send command 14: FF FF FF FF FF 82 9A 1A AD 18 8C 0E 00 35; to read primary sensor serial number and limits.

Receive command 14: FF FF FF FF FF 86 9A 1A AD 18 8C 0E 12 00 00 00 00 00 13 43 96 00 00 00 00 00 00 38 D1 B7 17 AC

## 7.1.10 Command 15: Read primary variable output information

**Command formate:**

Read Primary variable alarm select code, primary variable transfer code,primary variable range values units code, primary variable upper and lower range value, primary variable damping value, write protect code and private label distributor code VIII

Request: None

Response:

Byte0: Alarm select code

Byte1: Primary variable transfer function code

Byte2: Primary variable range values unit code

Byte3-6: Primary variable upper range value, IEEE754

Byte7-10: Primary variable lower range value, IEEE754

Byte11-14: Primary variable damping value, IEEE754,units of seconds

Byte15: Write protect code

Byte16: Private Label Distributor Code

**Test of command:**

Send command 15:FF FF FF FF FF 82 9A 1A AD 18 8C 0F 00 34; Read primary variable output information

Receive command 15:FF FF FF FF FF 86 9A 1A AD 18 8C 0F 13 00 00 00 00 13 43 96 00 00 00 00 00 00 42 20 00 00 FB 12 6E

## 7.1.11 Command 16: Read final assembly number

**Command formate:**

Read final assembly number.

Request: None

Response:

Byte 0-2: Final assembly number

**Test of command:**

Send command 16:FF FF FF FF FF 82 9A 1A AD 18 8C 10 00 2B; Read final assembly number

Receive command 16: FF FF FF FF FF 86 9A 1A AD 18 8C 10 05 00 00 A8 36 81 35

## 7.1.12 Command 17: Write message

**Command formate:**

Write message

Request:

Byte 0-23: Message

Responee:

Byte 0-23: Message

**Test of command:**

Send command 17:FF FF FF FF FF 82 9A 1A AD 18 8C 11 18 00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F 10 11 12 13 14 15 16 17 32 ;message

Receive command 17:FF FF FF FF FF 86 9A 1A AD 18 8C 11 1A 00 00 00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F 10 11 12 13 14 15 16 17 34

## 7.1.13 Command 18: Write tag, descriptor, date

**Command formate:**

Write tag, descriptor, date.

Request:

Byte 0-5: Tag,ASCII

Byte 6-17: Descriptor,ASCII

Byte 18-20: Date: day, month, year

Response:

Byte 0-5: Tag,ASCII

Byte 6-17: Descriptor,ASCII

Byte 18-20: Date: day, month, year

**Test of command:**

Send command 18: FF FF FF FF FF 82 9A 1A AD 18 8C 12 15 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 3C

Receive command 18:FF FF FF FF FF FF 86 9A 1A AD 18 8C 12 17 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 3A

## 7.1.14 Command 19: Write final assembly number

**Command formate:**

Write final assembly number

Request:

Byte 0-2: Final assembly number

Response:

Byte 0-2: Final assembly number

**Test of command:**

Send command 19: FF FF FF FF FF 82 9A 1A AD 18 8C 13 03 01 02 03 2B ;

Receive command 19: FF FF FF FF FF 86 9A 1A AD 18 8C 13 05 00 00 01 02 03 29

## 7.1.15 Command 34: Write primary variable damping value

**Command formate:**

Write primary variable damping value. If the value is not acceptable, will revert with alarm

Request:

Byte 0-3: Damping value, IEEE754

Response:

Byte 0-3: Actual damping value, IEEE754

**Test of command:**

Send command 34: FF FF FF FF FF 82 9A 1A AD 18 8C 22 04 40 00 00 00 5D; Write primary variable damping value

Receive command 34: FF FF FF FF FF 86 9A 1A AD 18 8C 22 06 00 00 40 00 00 00 5B

## 7.1.16 Command 35: Write primary variable range values

**Command formate:**

The upper and lower limits of primary variable are independent. The primary variable range unit value that this command received has no effect on the primary variable unit value. The primary value range value will be returned in the unit received.

Most device allows that the measurement range upper limit lower than lower limit ,to support the device to reverse output.

Request:

Byte 0: Primary variable upper and lower range value unit code

Byte 1-4: Primary variable upper range limit, IEEE 754

Byte 5-8: Primary variable lower range limit, IEEE 754

Response:

Byte 0: Primary variable upper and lower range value unit code

Byte 1-4: Primary variable upper range limit, IEEE 754

Byte 5-8: Primary variable lower range limit, IEEE 754

**Test of command:**

Send command 35: FF FF FF FF FF 82 9A 1A AD 18 8C 23 09 13 40 00 00 00 40 00 00 00 02; Write primary variable range values

Receive command 35: FF FF FF FF FF 86 9A 1A AD 18 8C 23 0B 00 00 13 00 00 00 00 00 00 00 00 04

## 7.1.17 Command 36: Write primary variable upper limit value

**Command formate:**

Write the primary variable upper limit to current primary variable value. The change of primary variable upper limit value has no effect on the primary variable lower limit.

Request:

NONE

Response:

NONE

**Test of command:**

Send command 36: FF FF FF FF FF 82 9A 1A AD 18 8C 24 00 1F; Write the primary variable upper limit to current primary variable value.

Receive command 36: FF FF FF FF FF 86 9A 1A AD 18 8C 24 02 00 00 19

## 7.1.18 Command 37: Write primary variable lower limit value

**Command formate:**

Write the primary variable lower limit to current primary variable value. The change of primary variable lower limit value has no effect on the primary variable higher limit.

Request:

NONE

Response:

NONE

**Test of command:**

Send command 37: FF FF FF FF FF 82 9A 1A AD 18 8C 25 00 1E; Write the primary variable lower limit to current primary variable value.

Receive command 37: FF FF FF FF FF 86 9A 1A AD 18 8C 25 02 00 00 18

## 7.1.19 Command 40: Enter/Exit primary variable current mode

**Command formate:**

Device is set to fixed primary variable current, when primary variable is 0, means to exit primary variable current mode.

Request:

Byte 0-3: Fixed primary variable current level IEEE 754, mA

Response:

Byte 0-3: Actual fixed primary variable current level IEEE 754, mA

**Test of command:**

Send command 40: FF FF FF FF FF 82 9A 1A AD 18 8C 28 04 40 80 00 00 D7

Receive command 40: FF FF FF FF FF 86 9A 1A AD 18 8C 28 06 00 00 40 80 00 00 D1

## 7.1.20 Command 45: Trim primary variable current DAC zero

**Command formate:**

Trim the primary variable current AO zero, so the current current value is accurate set to its min value.

Before implementing this command, use command 40 to set current to accurate primary variable AO min value. If device is not under fixed primary variable current mode or current has not been set to accurate min value, need to return response code 9---not under correct current mode.

Request:

Byte 0-3: Externally measured primary variable current level IEEE754, units of mA

Response:

Byte 0-3: Actual measured primary variable current level IEE 754

**Test of command:**

Send command 45: FF FF FF FF FF 82 9A 1A AD 18 8C 2 D 04 40 80 00 00 D2

Receive command 45: FF FF FF FF FF 86 9A 1A AD 18 8C 2D 06 09 00 40 80 00 00 DD : response code is 09, device is not under correct current mode.

## 7.1.21 Command 46: Trim primary variable current DAC gain

**Command formate:**

Trim primary variable AO gain,so the current current value is accurate set to its max value.

Before implementing this command, use command 40 to set current to accurate primary variable AO max value. If device is not under fixed primary variable current mode or current has not been set to accurate max value, need to return response code 9---not under correct current mode.

Request:

Byte 0-3: Externally measured primary variable current level IEEE754, units of mA

Response:

Byte 0-3: Actual measured primary variable current level IEE 754

**Test of command:**

Send command 46: FF FF FF FF FF 82 9A 1A AD 18 8C 2 E 04 40 80 00 00 D1

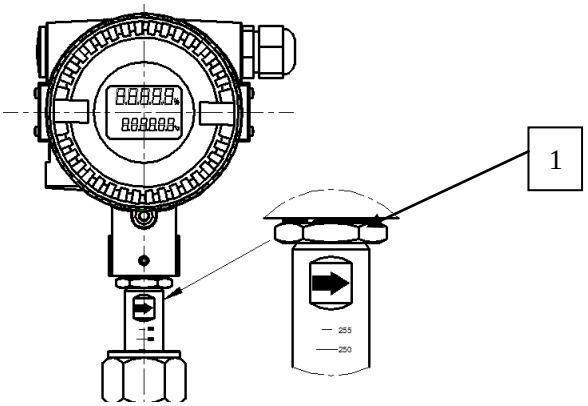
Receive command 46: FF FF FF FF FF 86 9A 1A AD 18 8C 2E 06 09 00 40 80 00 00 DE : response code is 09, device is not under correct current mode.

# 8 Maintaining

# 8.1 How to change the transmitter's direction

1) The transmitter can be reversed to any direction.
2) Before reverse the transmitter, please loose the nut (Part No.1) under the transmitter.
3) Reverse the transmitter to the direction required, then screw and tighten the fixing nut.

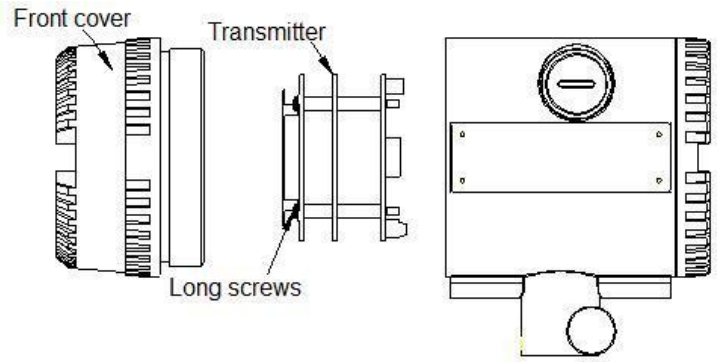
Please reference to picture 8.1




Picture 8.1 Change the transmitter's direction

## 8.2 Replace a transmitter circuit boards

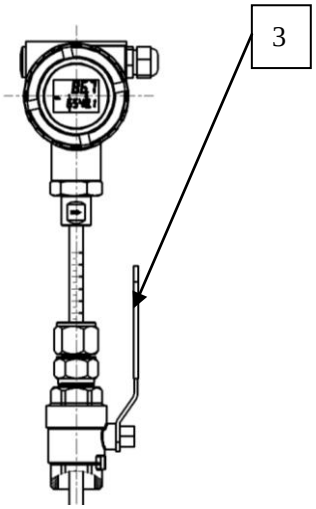
1) Please make sure the power is off before replacing the transmitter.
2) Remove the front cover.
3) Loose the 4 screws on the circuit boards, than can take the boards out a little.
4) Remove all the plugs on the circuit board.then remove the circuit board away
5) Put the new circuit board in and put the plug on
6) Tighten the 4 screws on the board, tighten the front cover
Please reference to picture 8.2



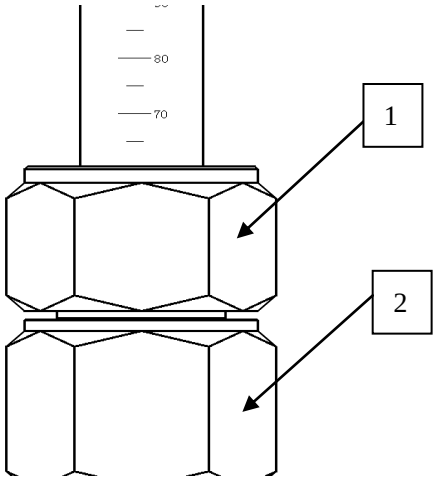

Picture 8.2 Replace the transmitter

## 8.3 Remove the flow meter

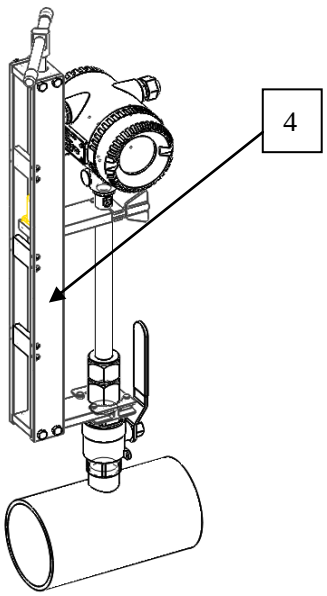
1) Please make if the meter is under pressure from pipeline, if it is, please hold it before loosing the nut sleeve to prevent it from ejecting out by hand or using hot tapping insertion tool (Part 4)
2) Loose the nut (Part No.1) with a wrench (loose it for 2 or 3 circle will be enough)
3) Pull out the meter as you can, relock the nut (Part No.1), please note the sleeve is still connected to the ball valve so far
4) Close the ball valve (Part No.3) to hold the pressure inside the pipeline
5) Loose the sleeve (Part No.2) and take out the flow meter




Picture 8.3

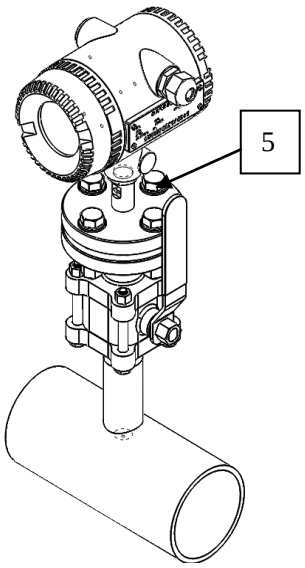



Picture 8.4




Picture 8.5

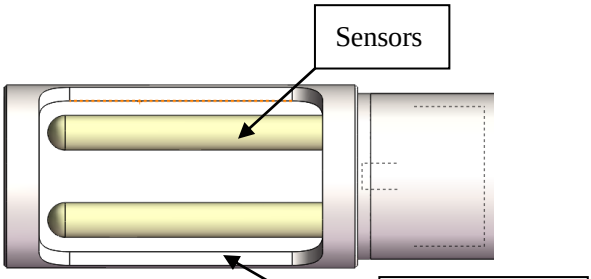
6) To remove a flanged insertion TGF600 thermal mass flow meter, please make sure that there is not pressure inide the pipe, then loose the the bolts(part 5). After removed the flow meter, and it can not be installed before flow on, please use a side pipe, or close the ball valve if there is, or block the insertion hole with a DN20 blind flange (GB/T 9133-2010 PN40).




Picture 8.6

## 8.4 How to clean the sensors

The sensor itself can be dirt caused by the oil, dust, impurity and dirt in the fluid, which may cause effect on the measurement result. When it is necessary to clean the sensor, please remove the meter according to 8.3. Then dip the sensor into alcohol or acetone (according to the contents of the dirty) for 10~30 minutes, then wipe the sensors with clean cloth or paper. Please make sure the sensor is well protected during the whole process, do not hit or scratch it.




Picture 8.7

# 9 Troubleshooting and repair

## 9.1 Safty introduction

Please do not open the cover on the flame proof enclosure if in an explosive environment.
When trying to wire to HART or RS485 device, please make sure that the process of wiring the device into the loop complys with the intrinsic safty requirement. Or please process the wiring in a none-explosive environment.
Please make sure the environment the flowmeter in can meet the requirement of the certificate.
When power is wired, please make sure the front and rear cover is closed properly.

## 9.2 Troubleshooting and repair

Please check out below issues before the troubleshooting
1) Please make sure the power source and its wiring is correct
2) Please process all wiring according to Chapter 3
3) Please make sure the straight pipeline length apply to the requirement in Chapter 2
4) Please make sure the meter's flow direction mark is point at the direction where the flow goes

After checking out above issues, please process trouble shooting according to following description.

| Problem | Possible Cause | Solution |
|---|---|---|
| Velocity measurement is erractic or fluctuating | Very erractic or non-uniform flwo | Follow installation requirements shown in Chapter 2 |
| | Flow meter installed with less than required minimum pip diameters upstream and dlown stream of the sensor | Follow installation requirements shown in Chapter 2 |
| | Insertiong sensor probe not mounted securely | Sensor probe must be mounted securely without vibration |
| | Earthing circuit loop | Wire the meter according to the introduction in Chapter 3 |
| | Liquid contains in fluid | Install a water filter in upstream of the meter |
| | Sensor failure | Return to factory for evaluation |
| | Transmitter failure | Return to factory for evaluation |
| The measuring flow is too high or too low | Sensor is not inserted to the middle of the pipe line | Please fix the sensor in the middle of the pipeline |
| | The flowmeter is not vertical to the center line of the pipe line | Re-install the meter and make the probe vertical to the center line of the pipe line |
| No flow measured | The limit of small signal cut off is set too high | Set the small signal cut off limit to a lower and proper value |
| | The flow rate in pipeline is smaller than the lower limit of the meter | Contact the supplier |
| | The flow rate in pipeline is larger than the higher limit of the meter | Contact the supplier |
| | Flow profile distortion | Try to find another location for the meter |
| | Sensor failure | Return to factory for evaluation |
| | Transmitter failure | Return to factory for evaluation |
| | Extremely turbulent flow | Do not place the emter near a ventilator static mixer or valve |

## 9.3 Self-diagnose function

TGF600 thermal mass flowmeter display can also indicate the self-diagnose code as below：

| Error code | Problem | Repair |
|---|---|---|
| Err-003 | Temperature sensor disconnected | Check Temperature sensor |
| Err-004 | Pressure sensor disconnected | Check pressure sensor |
| Err-005 | About to over total flow | This is a reminding message |
| Err-006 | Display value over limit | The value is over the physical limit of the display |
| Err-013 | Button is pressed and hold for too long time | Check the button circuit |
| Err-014 | Reset code setting failed | Check EEPROM |
| Err-015 | Reset digital setting failed | Check EEPROM |
| Err-016 | Read total flow error | Check EEPROM |
| Err-017 | Temperature calibration setting is wrong | Check the record of temperature calibration |
| Err-018 | Pressure calibration setting is wrong | Check the record of pressure calibration |
| Err-020 | Flow rate limit setting is incorrect | Check the flow rate limit setting |
| Err-023 | Communication connection error | Check the communication link |
| Err-026 | Pulse equivalent is set too high | Reset D017 |
| Err-027 | Pulse equivalent is set too low | Reset D017 |

# 10 Remark

# Appendix

## Specification

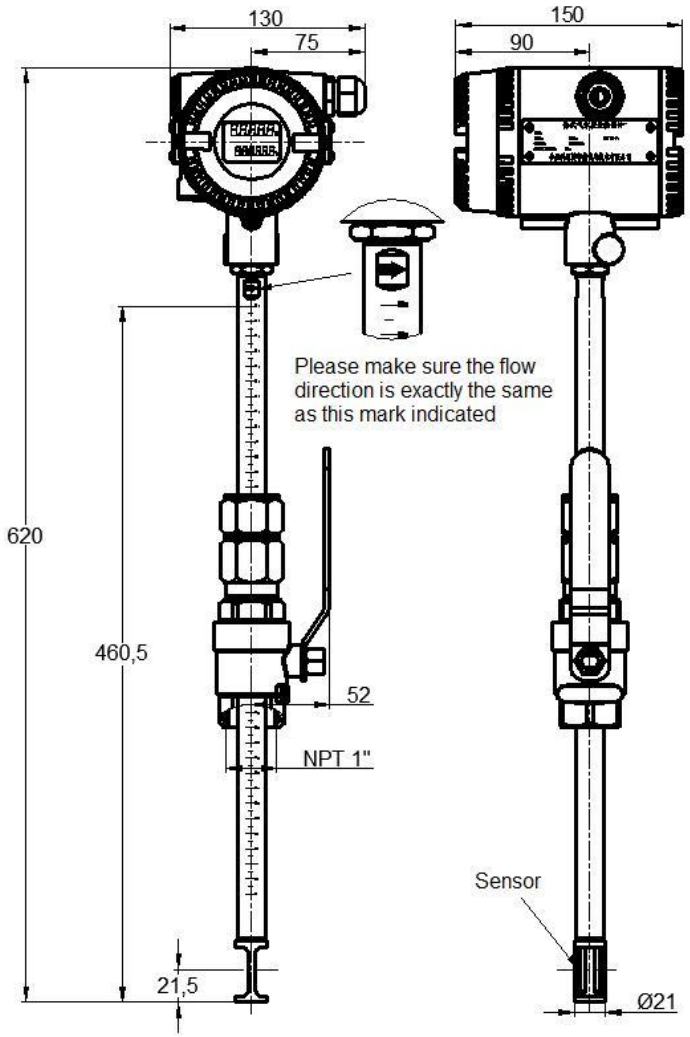
| | Insertion type | In-line type |
|---|---|---|
| **Media Compatibility** | Air, Nitrogen,biogas,natual gas,flue gas and many other gas | |
| Pipe diameter | DN25~1200mm | DN25~300mm |
| Flow velocity range | 0.3~30Nm/s 0.6~60Nm/s or 0.9~90Nm/s or 1.2~120Nm/s or 1.5~150Nm/s | |
| Accuracy | 1.5% RD+ ±0.5% FS | |
| Temperature of medium | －40~+150°c | |
| Pressure of medium | 1.6MPa | 4.0Mpa |
| Power supply | AC85～264V or DC16～32V | |
| Response time | 1 second | |
| Output | Frequency and 4~20mA as standard | |
| Communication | RS~485 as standard , 4~20mA@HART as optional | |
| Date displayed | Mass flow, Volume flow in normal condition<br>Total flow , Temperature of medium. Velocity | |
| Ingress protection grade | IP65 (GB China) | |

## Size and dimension

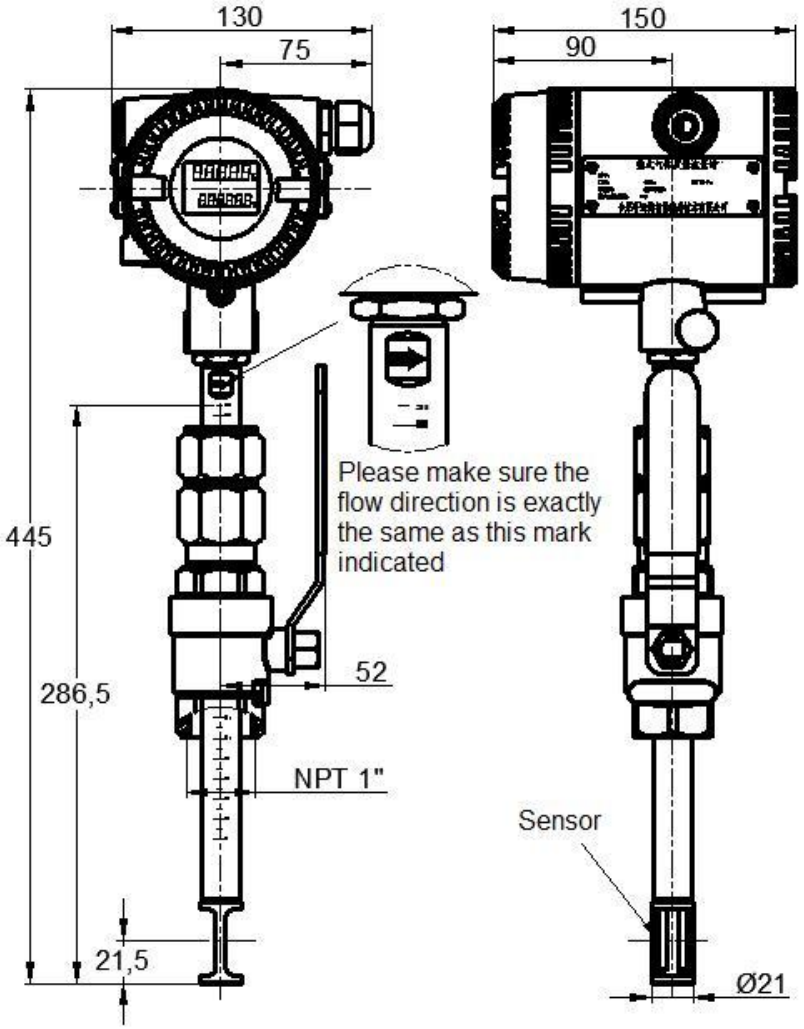
### Nut sleeve insertion with ball valve

DN50~DN500 (Please contact us if need to customized probe length).

For pipe smaller than DN50 or larger than DN500, please check with us for dimension as they are customized products

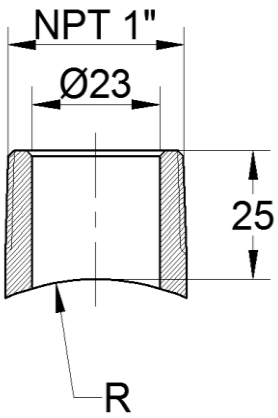



DN150~DN500




DN50~DN150

**1” NPT socket base for nut sleeve insertion**




Remark: R is the outer shape of the pipeline. The material can be same as the pipeling if required so. If customer’s chosen model require 1” NPT, than will need 1” socket base