BROIL

Inline Digital
Thermal Mass Flow Meter Manual



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BROIL SENSOTEK INDUSTRIES

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Safety Information

Thank you for Purchasing our quality thermal Gas Mass Flowmeter With independent Research and development.

We have written this guide to provide the persons responsible for the installation, operation and maintenance of your flow meter with the product specific information they will need.

In order to prevent damage to instrument and make the instrument in the best Performance and stable operation, please read this manual thoroughly before installation.

Please Have a Safekeeping of this Manual and together with the instrument after reading.Please pass this manual to technical department of end user to keep.

This Manual classifies important grade of safety attentions by Caution and Warning.



Caution

Error operation in case of ignoring the tips might cause the personal injury, Or damage to the instrument and property.



Warning

Error Operation in case of ignoring the tips might cause thepersonal injury or major accident.

This manual contents the following icons:

Indicates safety attentions which are dangerous.

Indicates Safety attentions which are needed to pay attention to.

Indicates safety attentions which are forbidden.

Select explosion-proof instrument for explosive environment application.

Confirm whether the nameplate of instrument has the identifies of explosion- Proof certification and temperature class, the instrument can't be used in explosive environment without those identifiers.

The explosion -proof temperature class of instrument must meet the Explosion - proof and temperature of environmental requirements on site

When the instrument is in used explosion -proof environment, make sure that the explosion -proof certification and temperature class of instrument meet the requirements on site.

No Operating while working in explosive environment

Before Wirings, please power instrument off.

The Protection class of instrument must meet the working condition Requirement on site.

The requirement of protection class on site should be under, or the same as the protection class of instrument to ensure that the instrument is working fine.

⚠ Confirm the power type

Customers can select the power type: 220VAC or 24VDC (Please state it when ordering). Please confirm the power type before installation.

⚠ Confirm the working environment of instrument and medium temperature

The environment on site and the maximum medium tempreture should be under the nominal value of instrument. (The details of nominal value are shown in part 2 specifications.)

⊘ No hot tapped installation and maintenance while the medium temperature is too high

When temperature of measuring medium is higher than the temperature that human can bear, or higher than the temperature of possible danger, should shut down or to do cooling process to reach a safety temperature, and then do hot-tapped operation. If there are no conditions to do hot-tapped operation. If there are no conditions to do hot-tapped operation, should shut down to avoid dangers.

⚠ Confirm the ambient pressure of instrument and medium pressure

The ambient pressure on site and the maximum medium pressure should be under the nominal value of instrument. (The details of nominal value are shown in part 2 specifications.)

⚠ No hot-tapped installation and maintenance while the medium pressure is too high

When absolute pressure of measuring medium is higher than 5 time Standard atmospheric pressure, or higher than the pressure of possible Danger, should shut down or to do reducing pressure to reach a safety Pressure, and then do hot -tapped operation. If there are no conditions To do hot -tapped operation, should shut down to avoid dangers.

⚠ Extra requirement of special medium

The Properties of some gas are special, it is needed to order special product, please check the manual of special product thoroughly to make sure whether it meets the requirements on site before installation.

⊘ No hot-tapped installation and maintenance while the medium is dangerous gas

When the medium may cause injury to humans, no hot -tapped installation and maintenance, should shut down or do security processing to reach a Safety condition, and then do hot-tapped operation. If there are no Conditions to do hot-tapped operation, should shut down to avoid dangers. The dangerous gases are such gas and chlorine, etc.

⚠ If doubting that the instrument in the event of failure, please do not operate it

If there are something wrong with the instrument or it had been damaged, please contact us.

1. Introduction

Thermal gas flow meter is designed on the basis of thermal dispersion, and Adopts method of constant differential temperature to measuring gas flow. It has advantage of small size, easy installation, high reliability and high accuracy, etc.

The meter contains two platinum resistance temperature sensors. The thermal Principle operates by monitoring the cooling effect of a gas stream as it passes Over a heated sensor. Gas flowing through the sensing section passes over Two sensors one of which is used conventionally as a temperature sensor, Whilst the other is used as a heater. The temperature sensor monitors the Actual process values whilst the heater is maintained at a constant differential Temperature above this by varying the power consumed by the sensor. The Greater the gas velocity, the greater the cooling effect and power required to maintain the differential temperature. The ensured heater is therefore a measure of the gas mass flow rate.

The format of gas velocity and power is shown as below:

$$V = \frac{K\left[\frac{Q}{\Delta T}\right]^{1.87}}{\rho_g} \ldots\ldots (1)$$

Where,

ρ_g : specific gravity of medium

V : velocity

K : balance coefficient

Q : heater power

ΔT : differential temperature

The medium temperature range of meter is -40°C ~ 220°C.

In the formula (1), the specific gravity of medium is related to the density:

$$\rho_g = \rho_n \times \frac{101.325+P}{101.325} \times \frac{273.15+20}{273.15+T} \ldots\ldots (2)$$

Where

ρ_g : medium density in working condition (kg/m^3)

ρ_n : medium density in standard condition, 101.325kpa and 20°C(kg/m3)

P : pressure in working condition (kpa)

T : temperature in working condition (°C)

In the formats (1) and (2), there is a certain functional relationship between the velocity and pressure in working condition, medium density, the temperature in working condition.

Due to the sensor temperature is always 30°C higher than the medium Temperature (environment temperature), and the meter adopts method of Constant differential temperature. Therefore, the

meter does not need to do Temperature and pressure compensation in principal.

2. Specifications

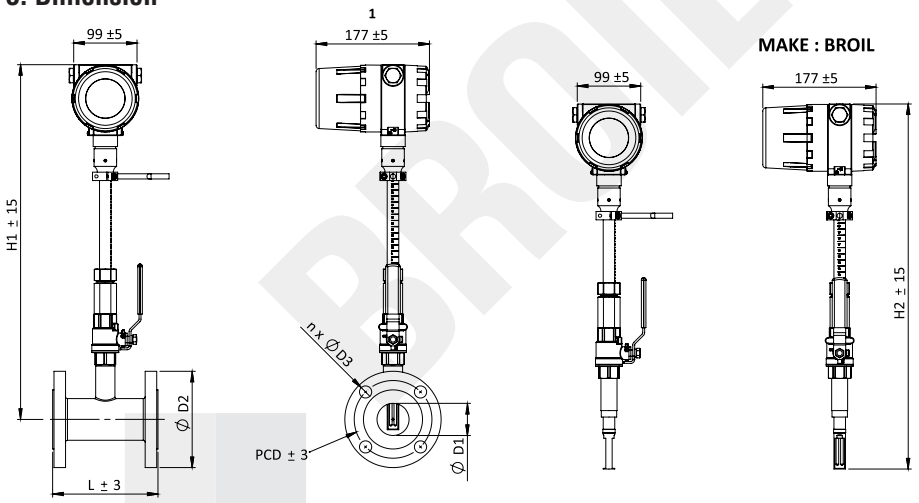
Features

- Measuring the mass flow or volume flow of gas
- Do not need to do temperature and pressure compensation in principal with accurate measurement and easy operation.
- Wide range: 0.5Nm/s～ 100Nm/s for gas. The meter also can be used for gas leak detection
- Good vibration resistance and long service life. No moving parts and pressure sensor in transducer, no vibration influence on the measurement accuracy.
- Easy installation and maintenance. If the conditions on site are permissible, the meter can achieve a hot-tapped installation and maintenance. (Special order of custom-made)
- Digital design, high accuracy and stability
- Digital design, high accuracy and stability
- Configuring with RS485 or HART interface to realize factory automation and integration

Description	Description
Measuring Medium	Various gases (Except the acetylene)
Pipe Size	DN10～DN40000mm
Velocity	0.1～ 100 Nm/s
Accuracy	±1～2.5%
Working Temperature	Sensor: -40℃ ～+220℃ Transmitter: -20℃ ～+45℃
Working Pressure	Insertion sensor: medium pressure≤ 1.6MPa Flanged sensor: medium pressure≤ 1.6MPa Special pressure please contact us
Power supply	Compact type: 24VDC, Power consumption ≤18W Remote type: 220VAC, Power consumption ≤19 W
Response Time	1s
Output	4-20mA (optoelectronic isolation, maximum load 500Ω), Pulse, RS485 (optoelectronic isolation) and HART
Alarm Output	1-2 line Relay, Normally Open state, 10A/220V/AC or 5A/30V/DC
Sensor Type	Standard insertion, Hot- tapped Insertion and Flanged

Construction	Compact and Remote
Pipe Material	Carbon steel, stainless steel, plastic, etc
Display	4 lines LCD Mass flow, Volume flow in standard condition, Flow totalizer, Date and Time, Working time, and velocity, etc.
Protection class	IP65
Sensor Housing Material	Stainless steel (316)

3. Dimension



Model Number	L	H1	H2	D1	D2	n X D3	PCD
BT-TMFM-025	130	437	440	24	110	4 x 16	79.4
BT-TMFM-040	170	434	440	38	125	4 x 16	98.4
BT-TMFM-050	170	435	440	50	150	4 x 19	120.7
BT-TMFM-065	200	443	400	65	180	4 x 19	139.7
BT-TMFM-080	200	568	570	78	190	4 x 19	152.4
BT-TMFM-100	200	570	570	100	230	8 x 19	190.5
BT-TMFM-125	220	583	570	125	255	8 x 22.3	215.9

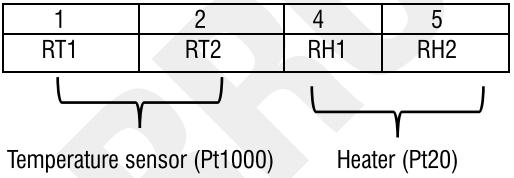
Model Number	L	H1	H2	D1	D2	n X D3	PCD
BT-TMFM-150	270	595	570	150	280	8 x 22.3	241.3
BT-TMFM-200	310	620	570	200	345	8 x 22.3	298.5
BT-TMFM-250	370	645	570	250	405	12 x 25.4	362
BT-TMFM-300	400	670	570	300	485	12 x 25.4	431.8

4. Wiring

⃠ No operation when meter is working

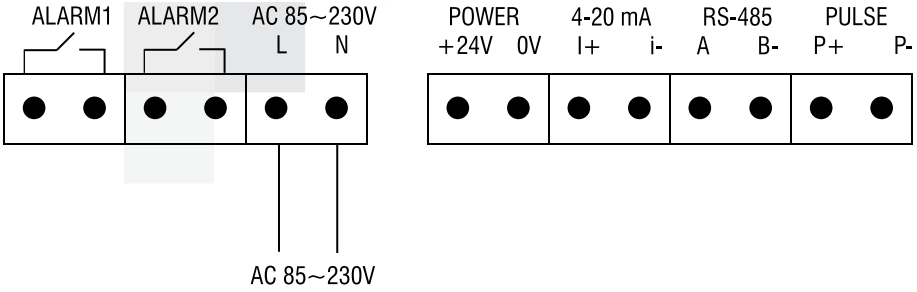
⚠ Confirm the Power supply type

4.1 Instruction of Sensor Wirings

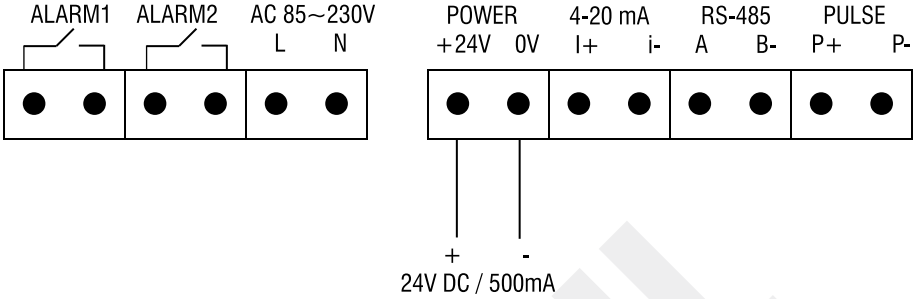


4.2 The Wirings of Power Supply

1. AC power supply

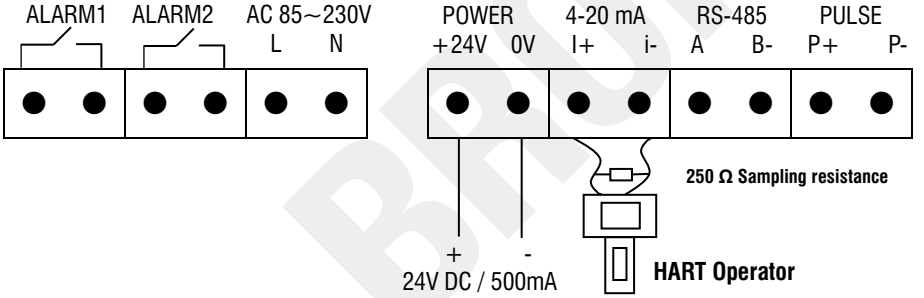


2. DC power supply

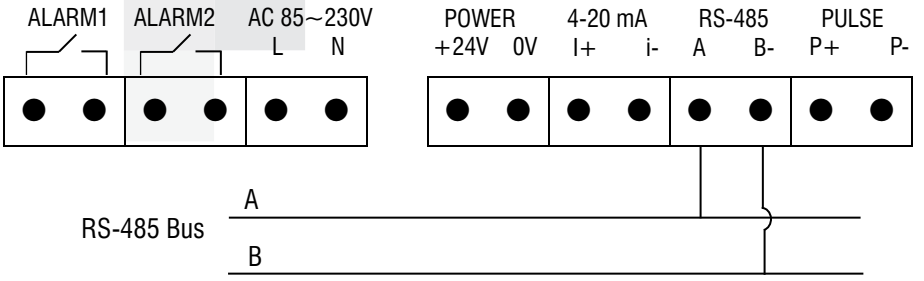


4.3 The Wirings of Outputs

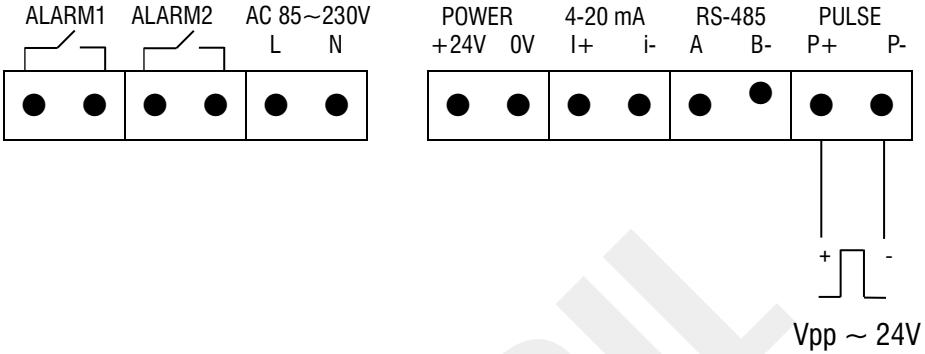
1. The wiring of four-wire 4-20mA output and HART operator



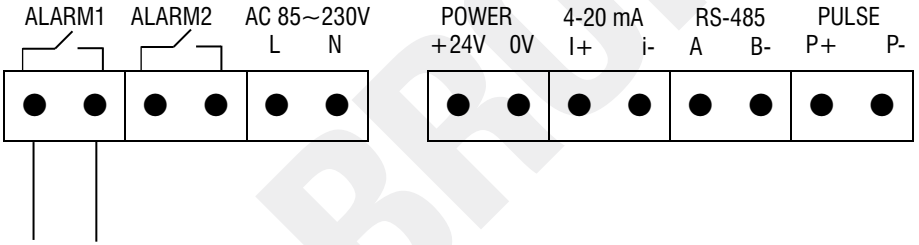
2. The wiring of RS-485 output



3. The wiring of Pulse output



4. The wiring of alarm output



Relay, normal open

250V AC, 10A

30VDC, 5A

5. Installation

5.1 Installation Position

Thermal meters require a fully developed flow profile as a prerequisite for correct flow measurement. For this reason, please note the following points

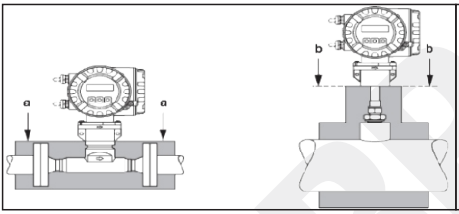
when installing the device.

- Observe the recommended inlet and outlet requirements.
- Good engineering practice is necessary for the associated pipe work and installation.
- Ensure correct alignment end orientation of the sensor.
- Take measures to reduce or avoid condensation (e.g. install a condensation trap, thermal insulation, etc.).
- The maximum permitted ambient temperature and the medium temperature range must be observed.

- Install the transmitter in a shaded location or use a protective sun shield.
- For mechanical reasons, and in order to protect the pipe, it is advisable to support heavy sensors.
- No installation in where large vibration exists
- No exposure in the environment containing a lot of corrosive gas
- No sharing power supply with frequency converter, electric welding machine and other machines which can make power-line interference. If necessary, please add power conditioner for transmitter power supply.

Thermal insulation

When the gas is very humid or saturated with water (e.g. Bio Gas), the piping and Flowmeter body should be insulated to prevent water droplets condensing on the measuring sensor.



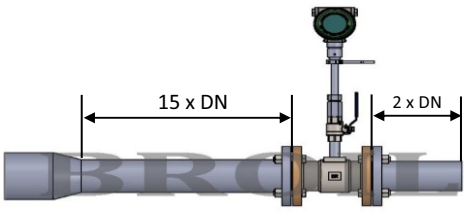
a. Maximum insulation height for the flanged sensor

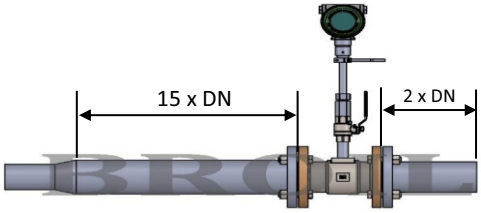
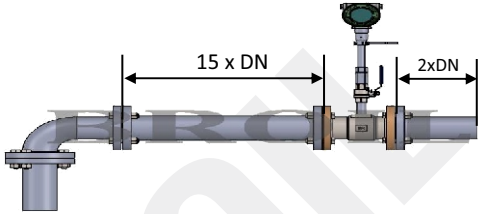
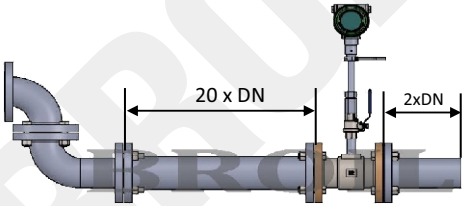
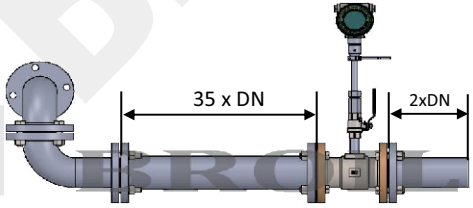
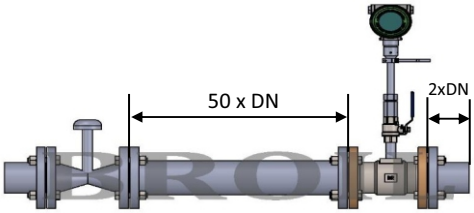
b. Maximum insulation height for the insertion sensor

The thermal dispersion principle is sensitive to disturbed flow conditions.

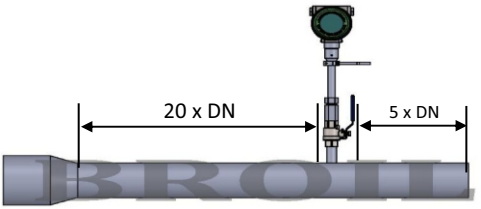
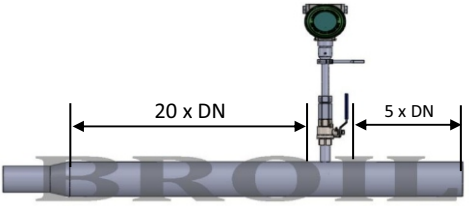
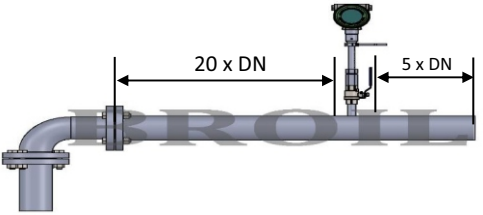
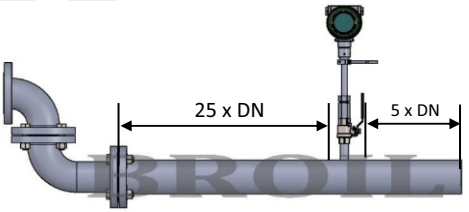
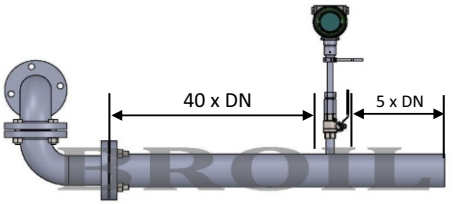
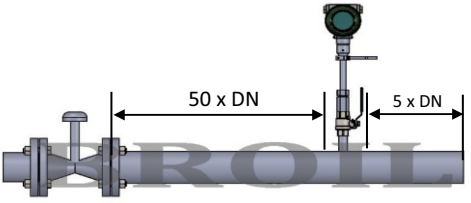
- As a general rule, the thermal flowmeter should always be installed as far away as possible from any flow disturbance. For further information please refer to ISO 14511.
- Where two or more flow disturbance are located upstream of the meter, the recommended inlet length for the flow disturbance causing strongest disturbance must be used. E.g. where a valve is mounted before a bend, upstream of the flowmeter, 50×DN of pipe Work is required from the valve to the flowmeter.
- For very light gases such as Helium and hydrogen all upstream distances should be doubled.

The minimum recommendations for inlet and outlet run (without flow conditioner) are:
Flanged sensor

Reduction	

Expansion	
90° elbow or T-piece	
2 × 90° elbow	
2 × 90° elbow (3-dimensional)	
Control Valve	

Insertion sensor

Reduction	
Expansion	
90° elbow or T-piece	
2 × 90° elbow	
2 × 90° elbow (3-dimensional)	
Control Valve	

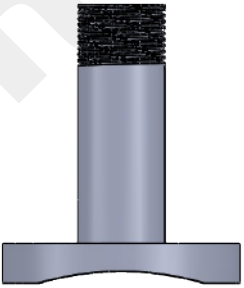
5.2 Pipework requirement

- Good engineering practice should be followed at all times:
- Correct preparation, welding and finishing techniques
- Correctly sized gaskets
- Correctly aligned flanges and gaskets
- Connecting pipe work should match the internal diameter of the flowmeter.
- Maximum pipe diameter mismatch should not exceed:
- -1 mm (0.04 inch) for diameters < DN 200(8")
- -3 mm (0.12 inch) for diameters ≥DN 200(8")
- New installations should be free of metallic and abrasive particles to prevent damage to the sensing elements on start-up For further information please refer to ISO 14511.

5.3 Installation Step
The base of thermal flowmeter



the base of standard insertion type

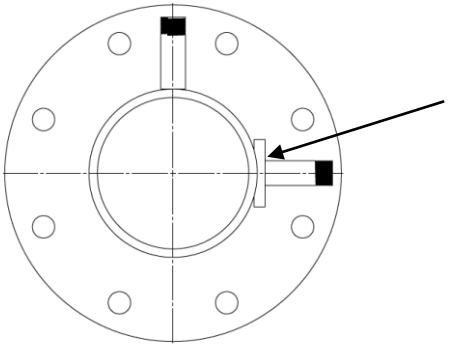


The base of Hot-tapped insertion types

⃠ No welding in explosive environment

⚠ Carry out the welding operation in accordance with the requirement of special environment.

When installing, place the base on the top of pipe, and make the through-hole of base be perpendicular to axis of pipe. The good welding location of base and welding process is as below.



Good welding location of base

The installation of standard insertion type

Identify an appropriate location for the flow meter.

Confirm the inner diameter and wall thickness of pipe

- Place the other part of meter into ball valve, and calculate the insertion depth according to the inner diameter and wall thickness of pipe.This step doesn't need to screw the nut by hand.
- Turn the connecting rod of sensor to make the mark direction of sensor as the same flow direction.
- According the calculated data on site, ensure the insertion depth by corresponding calibration on the connecting rod, and then screw the nut lightly.
- If the meter is horizontal installation, the display of meter can be installed in the direction of 90°, 180° or 270° to meet various requirements.

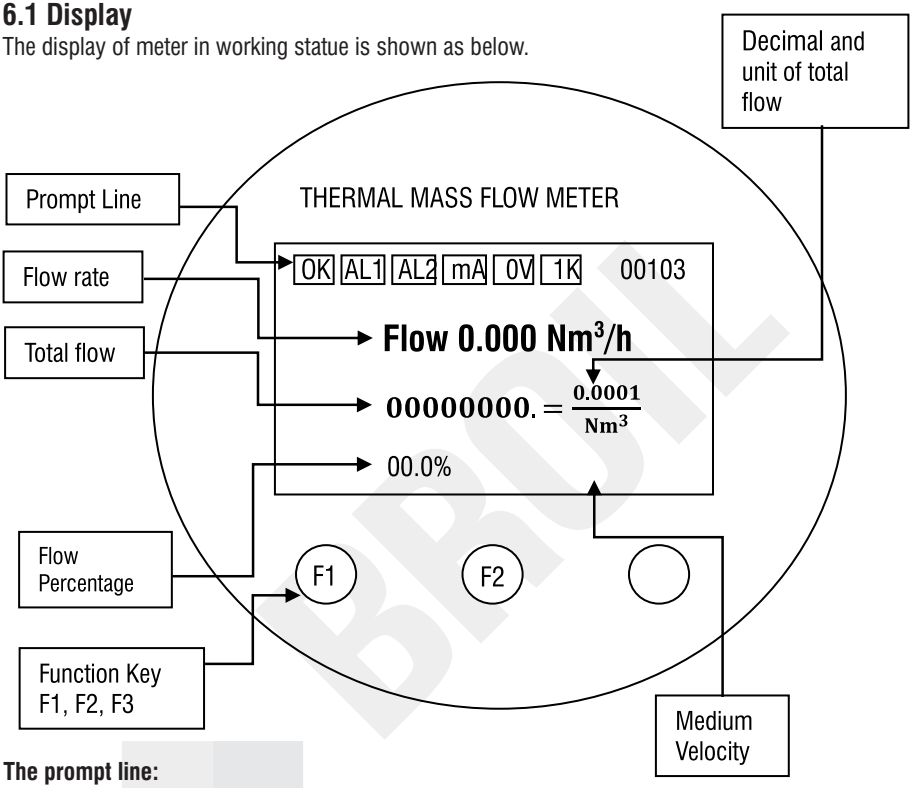
The installation of hot-tapped insertion type

- Before installation, please conform the connection type and installation fittings.
- Before installation, the site must be shut down, and strictly follow the rules of factory.
- Identify an appropriate location for the flow meter.
- According to length requirement of meter, cut the pipe, and install the flanges and bolts on the pipe.
- Ensure the mark direction of meter is as the same flow direction, the display is perpendicular to horizontal plane, the axis of pipeline is paralleled to horizontal plane. the error can't be more than ±2.5, and then fix the meter by bolts.

6. Operation and Programming

6.1 Display

The display of meter in working statue is shown as below.



The prompt line:

OK: The meter can do self-checking. If the system is normal after self-checking. It will display OK, else it will display **ERR**, the error information can be checked in "Self-test" set-up menu.

AL1: Alarm information. **AL1** means path 1 alarming, and **AL2** means path 2 alarming.

mA: If the current output is more than 20mA, it displays **mA**, else it will be blank.

OV: If the operation parameters overflow, it display **OV**, else it will be blank.

1K: For convenience of display and read, when the total flow is more than 10 000 000, it display **1K**, and the is the display total flow multiplied by 1000.

00103: Information of communication status. The first three digits indicate meter Address; the forth digit indicates parity check (0: none; 1: odd; 2: even); and the Fifth digit indicate baud rate is 9600, it will display "00103".

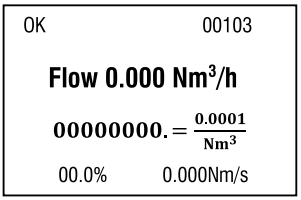
After powering on, the meter will do self- checking. If the system is normal after Self-checking, it will display **OK**, else it will display **ERR**. The error information can Be checked in "Self-Test" set-up menu.

When the meter works fine or after powering on, the meter will do self-checking. If the system is abnormal after self-checking. The meter will display the submenu of error self-checking (Detail in self-checking menu). 1～2 seconds later. The meter will enter the main menu automatically. Else the meter will enter the main menu directly

The meter has three function keys: F1, F2 and F3. F1 is shift Key, F2 is Enter/Next Key, and F3 is Modify Key. (If there are special functions of keys, please follow the Instruction below the LCD)

6.2 Parameter Setup

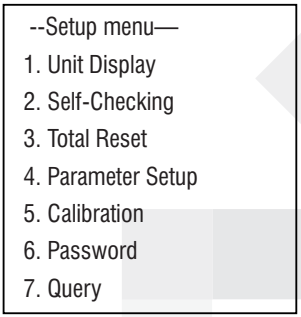
6.2.1 Main Menu



In main menu, press F2 to enter setup menu.

In setup menu, press F1 and F2 at the same time to enter main menu.

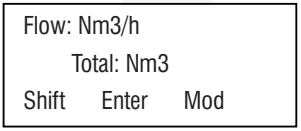
6.2.2 Setup Menu



In main menu, press F2 to enter setup menu.

In setup menu, press F1 to select submenu, and press F2 to enter submenu.

6.2.3 Unit Display



In setup menu, press F1 to select “Unit Display”, and press F2 to enter.

Press F1 to select the Unit of flow or total, and press F3 to modify the unit.

Flow: The Unit of flow rate. The can be selected Nm3/ h, Nm3/min, Nl/h,Nl/min, t/h, t/min, kg/h and kg/min.

Total: The Unit of total flow. The unit can be selected Nm3, Nl, t and kg.

Select the needed unit, and then press F2 Enter Key, the main menu will display With the selected unit.

6.2.4 Self- Checking

Self- Checking			
Clock	√	Memory	√
Power	√	AD Con	√
Param	√	Sensor	√

In setup menu, press F1 to select "Self- Checking", and press F2 to enter.

If the meter display ERR in main menu, press Keys to enter this submenu to check the details of running statue √ is ok, and × means this option is abnormal.

After powering on, the meter will do self-checking. If there are one or some abnormal options, the meter will display the self-test menu. When the meter is running. It also can enter this menu to check the running statue of meter.

6.2.5 Total Reset

Reset Password
000000
Shift Enter Mod

In setup menu, press F1 to select "Total Reset", and press F2 to enter.

Press F1 to password, input reset password (default password is 000000), press F1 to Shift digit, and press F3 to change the digit's Number.

After inputting password, press F2 to enter Total reset submenu.

Total Reset
0000000.0000
Shift Enter Reset

In order to prevent error operation, press F1 and F3 keys at the same time to do total reset.

After finishing total reset, the display shows 0000000.0000.

In this submenu, press F2 key to enter running time reset.

Running Time Reset
00000000 min
Shift Enter Reset

In order to prevent error operation, press F1 and F3 keys at the same time to do total reset.

After finishing total reset, the display shows 0000000.0000.

In this submenu, press F2 key to enter running time reset.

6.2.6 Parameter Setup

Password Setup
000000
Shift Enter Mod

In setup menu, press F1 to select "Parameter Setup", and press F2 to enter.

Input reset password (default password is 000000), press F1 to shift digit, and press F3 to change the digit's number.

After inputting password, press F2 to finish password setup and enter language setup.

Password Setup 000000 Shift Enter Mod	In setup menu, press F1 to select “Parameter Setup”, and press F2 to enter. Input reset password (default password is 000000), press F1 to shift digit, and press F3 to change the digit’s number. After inputting password, press F2 to finish password setup and enter language setup.
Language English Shift Enter Mod	Press F3 to select the display language, and then press F2 to finish selection and enter Equivalent ID.
Equivalent ID 0100.000 mm Shift Enter Mod	Equivalent ID is used to input the inner diameter of pipe. For rectangular tube, it needs to input a equivalent inner diameter. The unit is mm. The range is 0000.000 ~ 9999.999.
Filter Coe 00 Shift Enter Mod	Filter coefficient. If the flow has a big fluctuation, increase this value to get a stable reading. The range is 0 ~ 32, 0 means no filter.
Low flow cutoff 000000.000 Shift Enter Mod	Low flow cutoff. Cut off the low flow according to the actual situation, and the unit is the same as flow rate. The range is 0000.0000 ~ 9999.9999. Press F2 to enter Density in Standard
Density SC 1.0000 kg/m3 Shift Enter Mod	Density in Standard Condition. (20℃, 101.325KPa). That is used for flow rate display.
Density SC 1.0000 kg/m3 Shift Enter Mod	Density in Standard Condition. (20℃, 101.325KPa). That is used for flow rate display.

Medium: 00 Air Conversion Coe: 01.0000 Shift Enter Mod

The conversion coefficient in meter is reference value, if necessary, modify this value.

The meter contains the conversion coefficient of 59 gases, if the medium is mixed gas, it needs to calculate the coefficient.

The density and conversion coefficient of common gas are shown in appendix 3.

Press F2 to enter Meter factor.

Meter Factor: 1.0000 Shift Enter Mod

The flow rate coefficients, the Meter factor= standard flow / instrument display flow;

Press F2 to enter Full Scale Flow

Full scale Flow Set scale: 0000000.000 Shift Enter Mod

The current output: the set of output variables, a transient flow and velocity of flow can be selected. The instantaneous flow unit: Nm3/h, velocity of flow unit: Nm/s.

Set moves the cursor to the flow, according to the F3 to modify the velocity, move the cursor to the digital press F1 key, F3 key to change the numerical size.

The range of effective range: 0 ～ 9999999.999. Velocity formula in Appendix 4

Address: 001 Baud: 9600 Parity: None Shift Enter Mod

RS485 communication setup.

The meter's address range: 0～255. Baud rate can be selected 1200, 2400, 4800 and 9600. Parity check can be selected none, odd and even.

HART Address: 00 Protect: Close Shift Enter Mod

HART communication setup.

The HART address range: 00～15. Protect is "Close", the HART operator can write data;

Protect is "Open", the HART operator can't write data.

Press F2 to enter frequency output

Output: Pulse Freq: 0000-5000Hz Range: 0000100.000 Shift Enter Mod

Frequency output: Pulse and Equivalent.

If Pulse (Flow rate) is selected, the first value of Freq is the frequency of pulse which is corresponding to flow 0, and the second value of Freq is the frequency of pulse which is corresponding to maximum flow.

Press F3 to enter equivalent output.

Output: Equivalent Coe: 0000.0000 Shift Enter Mod

If Equivalent (Total Flow) is selected, set the equivalent coefficient. The largest coefficient is 1000.

Press F2 to enter path 1 alarm.

Alarm 1: upper flow Alarm: +000000.000 Diff: 000.000 Shift Enter Mod

Path 1 alarm. Set the alarm of upper flow (Upper limitof flow rate), lower flow (Lower limit of flow rate), upper temp (Upper limit of temperature), lower temp (Lower limit of temperature) and none.

Difference value is used to prevent alarm vibration around high alarm value. The difference value can make the alarm vibration in control area, but reduce the control precision at the same time. Set this value according application and experience.

Alarm 2: upper flow Alarm: +000000.000 Diff: 000.000 Shift Enter Mod

Path 2 alarm. The setup is the same as path 1 alarm.

Date and Time 2023-04-18 10:19:59 Shift Enter Mod

The date and time affect the data query and saving. Therefore, set the date and time before recording data.

6.2.7 Calibration

The parameters in this submenu are very important. In order to prevent unauthorized operation or wrong operation, it needs to input password before entering this submenu.

Password 000000 Shift Enter Mod

In setup menu, press F1 to select “Calibration”, and press F2 to enter.

Input the right password to enter calibration submenu.

Press F2 to enter zero voltage value.

Zero Volt: Measure 0.6500V Please confirm the flow is 0 Shift Enter Mod

Zero voltage value is used to set the voltage value while the flow rate is 0.

Before calibration, confirm the flow in pipe is zero, and waiting for more than 30s to steady the flow. Press F1 and F3 keys at the same time until the meter displays success.

Zero Volt: Input 0.6500V Please confirm the flow is 0 Shift Enter Mod

This value is can be input manually. Press F3 to select “Input”, input this value manually, and then press F2 to enter R value.

Note: Don’t input zero voltage value when the meter is running.

R Value (0° C): 1000.000 Ω Shift Enter Mod

The resistance value is used to input the resistance value of temperature sensor.

Press F2 to enter velocity table.

Velocity table: 01 Volt: 00/0000 V Vel: 000.000 Nm/s Shift Enter Mod

Velocity table. Set the voltage and velocity in more than 40 sections.

After calibration, Input the voltage and velocity from small section to large section. (The velocity is zero in section 00).

Press F2 to enter flow correction.

Note: The meter calculates the flow by velocity table. Please don’t modify the data in the table.

Flow correct: Section 0 Flow: 0000000.000 Coe: 000000.0000 Shift Enter Mod

Flow correction. It can correct the flow in 5 sections.

Current: 4mA Actual: 00.0000 Shift Enter Mod

Current calibration. If there is deviation in current output, use this submenu to calibrate current output.

Press F2 to enter zero and coefficient of current.

Zero: +0.0000 Coe: 1.0000 Shift Enter Mod

Current zero and coefficient calibration.

Note: Please don't modify these values when the meter is running.

6.2.8 Password

In this submenu, it can modify the password of total reset, setup and calibration.

Password Total Reset Calibration Shift Enter Mod

Current zero and coefficient calibration.

Note: Please don't modify these values when the meter is running.

Setup password Old: 000000 New: 000001 Shift Enter Mod

After inputting old and new passwords, Press F2 to save setup, the LCD will display "Success", and then return to main menu.

6.2.9 Query

Day Record Month Record Year Record Shift Enter Mod

In setup menu, press F1 to select "Query", and then press F2 to enter.

In query submenu, there are day, month and year records.

Day Record 2023-06-08 150.05 Nm3 Shift Enter Mod

In query submenu, press F1 to select Day Record, and then press F2 to enter.

In Day Record, press F1 to shift cursor position, and press F3 to modify the date.

For example, the "80.03 Nm3"is the totalizer on April 2th, 2012.

The method of querying Month and Year Records is the same as querying Day Record.

Appendix 1 Troubleshooting and Repair

Fault	Cause	Solution
No display	1.No power supply	Get Power supply
	2.SMPS is damaged	Get power supply, if the power indicator light is out, it means that the SMPS is damaged, please contact supplier.
	3.The wirings of DC24V are reversed	Check the Wirings, make the Wirings right
	4. The position of LCD is wrong	Reinstall the LCD
	5.The LCD is damaged	Check the power indicator light. If the light is on, it means that the LCD is damaged. Please contact supplier
Low Velocity	1. The wirings of sensor are reversed	Rewiring or reinstall the sensor
	2. the sensor is dirty	Clean sensor
	3. The sensor is damaged	Return to supplier
	4. Some parameters of flow setting are wrong	Check the parameters setting
Abnormal Velocity And Large fluctuation	1.Some parameters of velocity setting are wrong.	Check the parameters setting
	2.Fluid properties is pulsating in turn	Adjust the system filter
	3. The sensor is dirty	Clean sensor
	4. The sensor is damaged	Return to supplier
Abnormal 4-20 mA output	1.The setting of 20mA range is Wrong	Right setting
	2.The Transmitter has fault	Return to supplier
	3.The connection is not a loop circuit	Check the connection
Abnormal Frequency output	1.Some parameters of frequency setting are wrong	Right settings
	2.The transmitter has fault	Return to supplier
	3.The connection cable is damaged	Check the connection

Abnormal Alarm	1.Some parameters of setting are wrong.	Right settings
	2.The meter has no alarm function	Contact supplier
	3. The relay is damaged	Return to supplier
Abnormal RS485 output	1.The settings of baud rate and address are wrong	Right setting
	2.The wirings are reserved	Rewiring
	3.The connection cable is damaged	Check the connection

Appendix 2 The Density and Conversion Coefficient of Common Gas

According to different gas onsite, the calibration in lab translates the flow rate of actual gas onsite into flow rate of air, and then begins to calibrate the flow rate at present. Therefore, when using the meter onsite, the meter displays mass flow or volume flow of actual gas.

When translating the flow rate of gas into flow rate of air, there is a conversion coefficient table of different gas.

Table 1 The Density and Conversion Coefficient of Common Gas

	Gas	Specific heat (Kal/g* ℃)	Density (g/l,0℃)	Conversion Coefficient
0	Air	0.24	1.2048	1.0000
1	Argon (Ar)	0.125	1.6605	1.4066
2	Arsine (AsH3)	0.1168	3.478	0.6690
3	Boron Tribromide (BBr3)	0.0647	11.18	0.3758
4	Boron Trichloride (BCl3)	0.1217	5.227	0.4274
5	Borane Trifluoride (BF3)	0.1779	3.025	0.5050
6	Borane (B2H6)	0.502	1.235	0.4384
7	Carbone Tetrachloride (CCl4)	0.1297	6.86	0.3052
8	Carbon Tetrafluoride (CF4)	0.1659	3.9636	0.4255
9	Methane (CH4)	0.5318	0.715	0.7147
10	Ethylene (C2H4)	0.3658	1.251	0.5944

11	Ethane (C2H6)	0.4241	1.342	0.4781
12	Allylene (C3H4)	0.3633	1.787	0.4185
13	Propylene (C3H6)	0.3659	1.877	0.3956
14	Propane (C3H8)	0.399	1.967	0.3459
15	Butyne (C4H6)	0.3515	2.413	0.3201
16	Butene (C4H8)	0.3723	2.503	0.2923
17	Butane (C4H10)	0.413	2.593	0.2535
18	Pentane(C5H12)	0.3916	3.219	0.2157
19	Carbinol (CH3OH)	0.3277	1.43	0.5805
20	Ethanol (C2H6O)	0.398	2.055	0.3897
21	Trichloroethane (C3H3Cl3)	0.1654	5.95	0.2763
22	Carbon Monoxide (CO)	0.2488	1.25	0.9940
23	Carbon Dioxide (CO2)	0.2017	1.964	0.7326
24	Cyanide (C2N2)	0.2608	2.322	0.4493
25	Chlorine (Cl2)	0.1145	3.163	0.8529
26	Deuterium (D2)	1.7325	0.1798	0.9921
27	Fluoride (F2)	0.197	1.695	0.9255
28	Germanium Tetrachloride (GeCl4)	0.1072	9.565	0.2654
29	Germane (GeH4)	0.1405	3.418	0.5656
30	Hydrogen (H2)	3.4224	0.0899	1.0040
31	Hydrogen Bromids (HBr)	0.0861	3.61	0.9940
32	Hydrogen Chloride (HCl)	0.1911	1.627	0.9940
33	Hydrogen Fluoride (HF)	0.3482	0.893	0.9940
34	Hydrogen Iodide (HI)	0.0545	5.707	0.9930
35	Hydrogen Sulfide (H2S)	0.2278	1.52	0.8390
36	Helium (He)	1.2418	0.1786	1.4066

37	Krypton (kr)	0.0593	3.739	1.4066
38	Nitrogen (N2)	0.2486	1.25	0.9940
39	Neon (Ne)	0.2464	0.9	1.4066
40	Ammonia (NH3)	0.5005	0.76	0.7147
41	Nitric Oxide (NO)	0.2378	1.339	0.9702
42	Nitrogen Dioxide (NO2)	0.1923	2.052	0.7366
43	Nitrous Oxide(N2O)	0.2098	1.964	0.7048
44	Oxygen(O2)	0.2196	1.427	0.9861
45	Phosphorus Trichloride (PCI)	0.1247	6.127	0.3559
46	Phosphorane(PH3)	0.261	1.517	0.6869
47	Phosphorus Pentafluoride (PF5)	0.1161	5.62	0.3002
48	Phosphorus Oxychloride (POCI3)	0.1324	6.845	0.3002
49	Silicon Tetrachloride (SiCI4)	0.127	7.5847	0.2823
50	Silicon Fluoride (SIF4)	0.1692	4.643	0.3817
51	Silane (SIH4)	0.3189	1.433	0.5954
52	Dichlorosilane (SiH2CI2)	0.1472	4.506	0.4095
53	Trichlorosilane (SiHCI3)	0.1332	6.043	0.3380
54	Sulfur Hexafluoride (SF6)	0.1588	6.516	0.2624
55	Sulfur Dioxide (SO2)	0.1489	2.858	0.6829
56	Titanium Tetrachloride (TiCI4)	0.1572	8.465	0.2048
57	Tungsten Hexafluoride (WF6)	0.0956	13.29	0.2137
58	Xenon (Xe)	0.0379	5.858	1.4066

Appendix 3 Upper Range Value of Common Gas

(Unit: Nm3/h. The follow table can be extended)

Nominal Diameter (mm)	Air	Nitrogen (N_2)	Oxygen (O_2)	Hydrogen(H_2)
15	65	65	32	10
25	175	175	89	28
32	290	290	144	45
40	450	450	226	70
50	700	700	352	110
65	1200	1200	600	185
80	1800	1800	900	280
100	2800	2800	1420	470
125	4400	4400	2210	700
150	6300	6300	3200	940
200	10000	10000	5650	1880
250	17000	17000	8830	2820
300	25000	25000	12720	4060
400	45000	45000	22608	7200
500	70000	70000	35325	11280
600	100000	100000	50638	16300
700	135000	135000	69240	22100
800	180000	180000	90432	29000
900	220000	220000	114500	77807
1000	280000	280000	141300	81120
1200	400000	400000	203480	91972
1500	600000	600000	318000	101520
2000	700000	700000	565200	180480

The flow rate in standard condition: The flow rate is in the condition of 20℃ Temperature and 101.325 kPa pressure.

The unit of flow rate is optional: Nm3/h, Nm3/min, L/h, L/min, t/h, t/min, kg/h Or kg/min.

The reduction formula of flow rate in working condition and flow rate in standard Condition:

$$\mathbf{Qs} = \frac{0.101325 + \mathrm{P}}{0.10325} * \frac{273.15 + 20}{273.15 + t} * Qn$$

Qs: The flow rate in standard condition (Nm3/h).

Qn: The flow rate in working condition (m3/h).

T: The medium temperature in working condition (℃).

P: The medium pressure in working condition (Gauge pressure, MPa).

7. Ordering Code

BT-TMFM	1100	050	P3	OP1	C1	B1	W1	F2	H1	T1	N	C2	A1	DISCRIPTION
Type	1100													Inline
	2200													Insertion
	3300													Other
Line Size		XXX												DN15 ~ DN4000 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.....
Power Supply			P1											24V DC / 230V AC
			P2											Battery Operated
			P3											Other
Output				OP1										4-20 mA
				OP2										4-20 mA + Relay 1 No
				OP3										4-20 mA + Relay 2 Nos
				OP4										4-20 mA + Pulse + High and Low Alarm Output
				OP5										Other

Communication Interface	C1									No Communication
	C2									RS-485
	C3									HART
	C4									Other
Body & Connection Material		B1								SS304
		B2								SS316
		B3								Other
Wetted Material			W1							SS304
			W2							SS316
			W3							PTFE
			W4							As Per Customer Advice
Connection Type				F1						ANSI #150 Flange End
				F2						ANSI #300 Flange End
				F3						DIN PN16 Flange End
				F4						Thread End
				F5						Insertion Type
				F6						As Per Customer Advice
Electronic Housing material and conduit entries					H1					Aluminium Die Casting Housing with Two M20 x 1.5 conduit entries
					H2					Other
Sensor process temperature range						T1				Standard: (-20° C to +200° C)
						T3				Other
Data Logger Cum Totalizer							Y			Required
							N			Not required

Cable	C1		10 Meter
	C2		15 Meter
	C3		30 Meter
	C4		50 Meter
	C5		No Cable
	C6		As Per Customer Advice
Accessories		A1	Not required
		A2	Mating Flange
		A3	Mating Flange + Gasket + Nut Bolt
		A4	As Per Customer Advice

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