User Manual

User Manual for MGH Smart Electromagnetic Flowmeter

Thank you for choosing the [MGH smart electromagnetic flowmeter]. This product is manufactured and delivered under our strict quality control.

This manual records the necessary precautions for the use of this product so that you can use it correctly.

Please read this manual carefully before use and keep it properly.

Note: The possible technical changes in the future are not explained separately. August 2021

A. Electromagnetic Flowmeter

1. Purpose and Scope of Application

1.1 Purpose

An electromagnetic flowmeter is composed of an electromagnetic flow sensor and an electromagnetic flow converter. It is a meter made according to Faraday's law of electromagnetic induction for measuring the volumetric flow of conductive liquid and slurry in closed pipes. The electromagnetic flowmeter has a variety of output signals for the user to choose. The electromagnetic flowmeter is used in chemical industry, electric power, mining and metallurgy, water supply and drainage, paper making, medicine, food, environmental protection and other industrial sectors.

1.2 Product Features

a. The measurement is not affected by the change of fluid density, viscosity, temperature, pressure and conductivity;

b. There are no components that impede the flow and no pressure loss in the measuring tube; the straight pipe section has lower requirements. It is particularly adapted for slurry measurement;

c. It can output linear analog signals or frequency signals directly proportional to the flow velocity, with a wide measuring range;

d. The product uses low-frequency square wave excitation with low power consumption and zero point stability.

1.3 Scope of Adaptation

Ambient temperature: Split electromagnetic flow sensor: (-25~+65) °C Split converter: (-25~+65) °C

Integrated electromagnetic flowmeter: （-25 - +65 ） C

Relative humidity: (5~90) %;

Atmospheric pressure: (86~106) KPa;

1.4 Operating Conditions

Fluid conductivity: Not less than 5 $_{M}$ s/cm;

Nominal pressure: 4.0MPa DN (15, 20, 25, 32, 40, 50, 65, 80, 100, 150)
1.6MPa DN to be defined by the user
1.0MPa DN (200, 250, 300)

Temperature of measured medium:

Split type: <60C (polyurethane lining)
<80C (soft rubber lining)
<100C (FEP lining)
<150C (PTFE lining)

Integrated type: <80°C

Rated supply voltage: 220V ±11 V AC/ (47.5-52.5) Hz; 24V DC

2. Specifications and Technical Parameters

2.1 Executive Standards

The product performance meets the industry standards of Electromagnetic Flowmeter (JB/T 9248-2015) and Verification Regulation of Electromagnetic Flowmeters (JJG1033-2007).

2.2 Key Components

The key components of the electromagnetic flowmeter are: converter circuit board assembly, coil assembly, and electrodes. Any key component plays an important role in the overall performance of the electromagnetic flowmeter.

2.3 Basic Parameters and Performance Indicators

See Tale 1

No.	Model	Specification	Accuracy Class
1	MGH	DN (15, 20, 25, 32, 40, 50, 65, 80, 100, 125, 150, 200, 250, 300)	0.2 0.3 0.5

Table 1 Basic parameters and performance indicators

Flow velocity range: (0~10) m/s
Measuring tube material: 304
Lining material: Soft rubber, polyurethane rubber, PTFE, and FEP
Electrode material: Stainless steel 0Cr18Ni12Mo2Ti, Hastelloy B, Hastelloy C, titanium, and tantalum
Connecting flange material: Q235
Shell protection: IP68 (split type only), and IP65

The electromagnetic flowmeter converter adopts a new generation of 32-bit embedded microprocessor control technology, displays measurement parameters in various languages, and can take two structural forms: integrated type and split type.

Product Features

• Programmable frequency low-frequency rectangular square wave excitation improves the stability of flow measurement with extremely low power consumption;

• 32-bit embedded microprocessor control and DSP digital filtering technology are adopted, with fast, accurate calculation and stable data measurement;

• With all digital processing and strong anti-interference, it ensures reliable, accurate measurement, with a flow measurement range up to 1500;

• A switch power supply is adopted, applicable to a wide range of power supply voltage; it can adapt to a variation range of 86V-265V with high EMC resistance;

• With a multi-language menu, the product is easy to use, operate, understand and learn;

• The 128x64 dot matrix HD backlit LCD displays large characters with a character height of 10mm;

• The product is operated by keys, and the menu can be set and operated by infrared remote control, meeting explosion-proof and non-contact setting requirements;

• It can measure bidirectional flows and display forward and reverse flows. There are three integrators inside which can display integrated forward flow, integrated reverse flow and integrated differential flow respectively. The integrated flow is displayed in 10 bits.

• It provides constant excitation currents to the sensor and can be used with different types of electromagnetic flow sensors

• It has a multi-function intelligent converter, self-check and self-diagnosis functions, and rich alarm content, with automatic monitoring of the working status of the instrument;

• When the power is off, EEPROM can protect the setup parameters and integrated flow value;

• It is available in split type and integrated type;

• Programmable alarm with custom output;

• Pulse width and pulse equivalent can be set by the user;

• With input control, the instrument can be controlled remotely;

• The inspection interface for the sensor and converter can be used to check the sensor and converter without disassembly. The online calibration of the electromagnetic flowmeter can be realized by using the electromagnetic flowmeter test box;

• It comes with output port test function, and can analog the output current port and the digital output port at 0%, 25%, 50%, 75% and 100% of the measuring range;

• It uses modbus communication signal output by default, and can be configured with HART and PROFIBUS-DP communication functions;

• It has both 4~20mA and pulse signal output function (pulse signal is passive signal);

• Factory data recovery is available;

• The SensorData module has the functions of flowmeter parameter replication and automatic read-in;

• The black box data logging function records all the data of instrument operation;

• Optional batch control;

• Optional timing upon power-off;

• Optional heat (cooling capacity) metering, used for heat metering in the thermal system and cooling capacity metering in the air conditioning system;

Technical Data

Normal Working Conditions

Ambient temperature: (-25~+65) °C
Relative humidity: (5~90) %
Rated voltage: 220V±11V AC/（47.5~52.5）Hz; 24V DC;
Power: Less than 20W

Accuracy Class

0.2　　0.3　　0.5

Repeatability Error

0.07%, 0.1% and 0.17% of the measured value

Current Output

Current output: (4~20) mA
Load resistance: (0~750) Q
Basic error: The above basic error of measurement plus ±10uA

Frequency and Pulse Output

Frequency output: Forward and reverse flow output; the upper limit of output frequency can be set within (1~5000) Hz; transistor open collector output with photoelectric isolation; the external power supply is not larger than 30V; the maximum current of the collector is 250 mA when it is on.

Pulse output: Forward and reverse flow output; output pulse up to 15,000 pulses per second; the maximum pulse width is 25ms; transistor open collector output with photoelectric isolation; the external power supply is not larger than 30V; the maximum current of the collector is 250 mA when it is on. With built-in pull-up resistors, frequency output and pulse output can use an internal 24V power supply.

Display

Display in simplified Chinese/traditional Chinese/English/Italian; 5 bits for instantaneous flow and 10 bits for integrated flow.

Alarm Output

Fully isolated phototransistor open collector alarm (passive signal) output. The external power supply is not larger than 30V, and the maximum current of the collector is 250mA when it is on.

Alarm state: Empty tube alarm, excitation alarm, reverse flow alarm, power failure alarm, abnormal inhibition alarm, upper limit alarm, lower limit alarm, integrated flow overflow alarm, peak inhibition alarm, and noise sensitivity alarm.

Communication Function

Mod-bus RTU communication output, with lightning protection. HART communication and Profibus-DP communication can be provided upon the request of the user.

Damping Time

(2~100) s

Isolation

The insulation voltage between analog output, (frequency) pulse output, alarm output and the ground should not be less than 500V.

Input Control

The instrument with input control can achieve the following functions:

- Clear the integrated flow of the instrument (integrated forward and reverse flow can be cleared separately)
- Clear the instantaneous flow
- Flow retention (for stable process control)

3. Working Principle and Composition

3.1 Working Principle

All electromagnetic flowmeters use Faraday's law of electromagnetic induction:

$$Um = KxBxVxD$$

Wherein,

Um is the measured induced voltage generated by the flow surface of the fluid; this voltage signal is taken at the two electrodes.

K is the correction coefficient of the sensor.

B is the magnetic field intensity, which is perpendicular to the flow direction of the fluid.

V is the flow velocity of the fluid.

D is the inner diameter of the measuring tube.

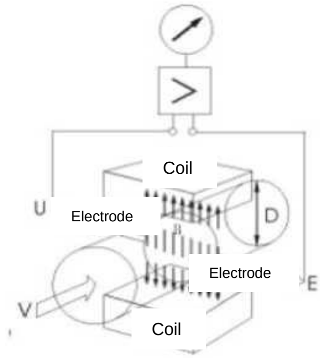


Figure 1

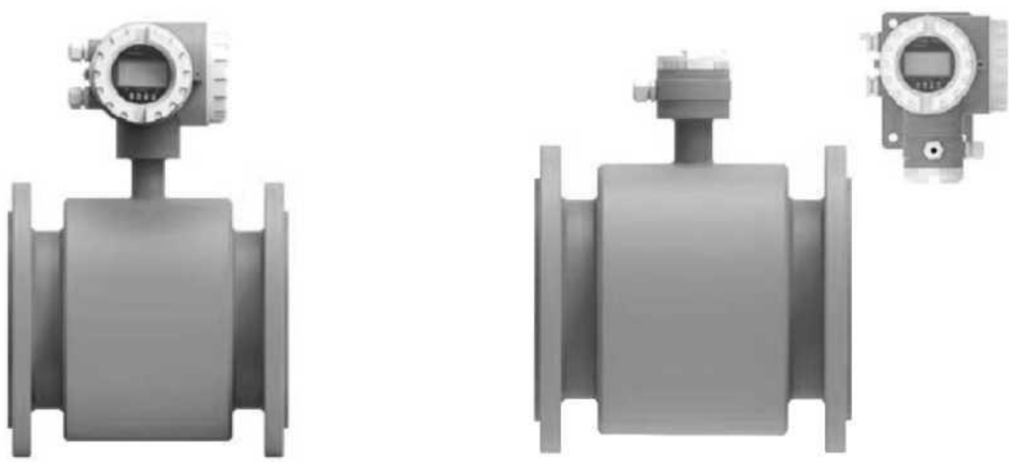
A voltage signal is generated when a conductive fluid cuts magnetic field lines in a magnetic field. The magnetic field is generated by electrification of the sensor coil and is transmitted to the measuring tube through the measuring tube wall. The electric signal generated by the fluid medium moving in a magnetic field is proportional to the flow velocity of the fluid and can be detected on the electrodes. See Figure 1. The magnetic field is divided into constant current magnetic field and alternating current magnetic field.

3.2 Composition

The electromagnetic flowmeter is composed of an electromagnetic flow sensor and an electromagnetic flow converter.

3.2.1 Composition Forms

The MGH electromagnetic flowmeter is available in integrated type and split type, as shown in Figure 2.



Integrated type

Split type

Figure 2

3.2.2 Model Selection Codes

The MGH electromagnetic flowmeter has multiple options. In order to facilitate user's model selection and factory production management, digital codes are used to represent all the elements of the product. See the model selection table (Table 1).

Model	Specification	Type	Power Type		Nominal Pressure	Lining Material	Electrode Material		Accessories	Communication Mode	Protection Grade	Application Scenario	Definition
MGH	XXXX	X	X	—	X	X	X	—	X	X	X	X	
	0015												DN15
	0020												DN20
	0025												DN25
	0032												DN32
	0040												DN40
	0050												DN50
	0065												DN65
	0080												DN80
	0100												DN100
	0125												DN125
	0150												DN150
	0200												DN200
	0250												DN250
	0300												DN300
		1											Integrated type
		2											Split type
			1										24VDC
			2										220VAC
			3										220VAC high precision converter
			4										Special function
					1								4.0MPa
					2								1.0MPa
					3								0.6MPa
					4								1.6MPa
					5								1.0MPa clip-on
					6								Special order (specify)
						1							Soft rubber (DN50-DN300)
						2							Polyurethane rubber
						3							PTFE
						4							FEP（DN15~DN20）
						5							Special material
							1						Stainless steel
							2						Hastelloy B
							3						Hastelloy C
							4						Titanium
							5						Tantalum
							6						Platinum-iridium alloy
							7						Special material (specify)
									0				Not required
									1				Grounding flange
									2				Inlet protection flange
									3				Ground electrode (3 electrodes)
									4				Special requirements (specify)
										1			None
										2			Reserved
										3			HART
										4			Mod—Bus
										5			Profibus—DP
										6			Special mode (specify)
											1		IP65
											2		IP68
												T	General

												Ex	Ex d ia (ia Ga) mb II CT6 Gb
												R	Heat/cooling capacity metering

Table 1

3.3 Overall Dimensions and Connection Dimensions of the Instrument

3.3.1 Overall Dimensions and Connection Dimensions of MGH Integrated Electromagnetic Flowmeter

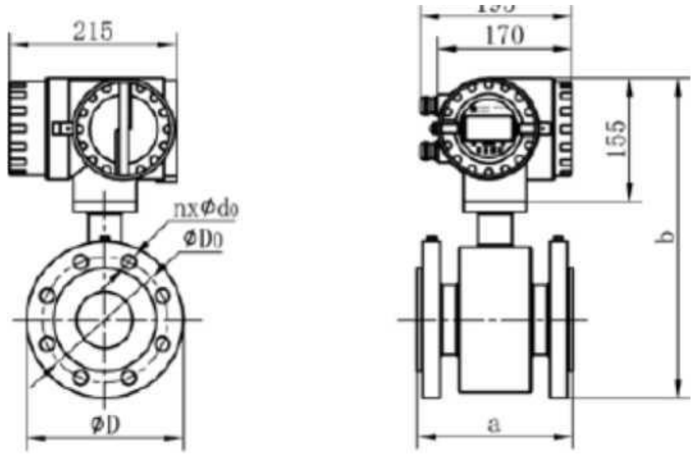


Figure 3: Overall dimensions and connection dimensions of MGH integrated electromagnetic flowmeter

Unit: mm

Model	Nominal Pressure **(MPa)**	Overall Dimensions of Sensor		Connection Dimensions of Flange		Bolt		Net Weight **(kg)**
		a	**b**	**D**	**D_o**	**d_o**	**n**	
15	4.0	200	325	95	65	14	4	9
20	4.0	200	330	105	75	14	4	9
25	4.0	200	335	115	85	14	4	10
32	4.0	200	350	140	100	18	4	12
40	4.0	200	360	150	110	18	4	12
50	4.0	200	375	165	125	18	4	14
65	4.0	200	390	185	145	18	8	16
80	4.0	200	405	200	160	18	8	17
100	4.0	250	435	235	190	22	8	24
125	4.0	250	465	270	220	26	8	31
150	4.0	300	495	300	250	26	8	38
200	1.0	350	540	340	295	22	8	47
250	1.0	450	610	395	350	22	12	64
300	1.0	500	655	445	400	22	12	75

Table 2: Connection dimensions of MGH integrated electromagnetic flowmeter

Model	Nominal Pressure **(MPa)**	Overall Dimensions of Sensor		Connection Dimensions of Flange		Bolt		Net Weight **(kg)**
		a	**b**	**D**	**D_o**	**d_o**	**n**	
15	1.6	200	325	95	65	14	4	9
20	1.6	200	330	105	75	14	4	9
25	1.6	200	335	115	85	14	4	10
32	1.6	200	350	140	100	18	4	12
40	1.6	200	360	150	110	18	4	12
50	1.6	200	375	165	125	18	4	14
65	1.6	200	390	185	145	18	8	16
80	1.6	200	405	200	160	18	8	17
100	1.6	250	428	220	180	18	8	24
125	1.6	250	455	250	210	18	8	31
150	1.6	300	488	285	240	22	8	38
200	1.6	350	540	340	295	22	12	47
250	1.6	450	615	405	355	26	12	64
300	1.6	500	663	460	410	26	12	75

Table 2-1: Connection dimensions of MGH integrated electromagnetic flowmeter

Note: For products of DN350 or above, please consult our business department.

3.3.2 Overall Dimensions and Connection Dimensions of MGH Split Electromagnetic Flowmeter

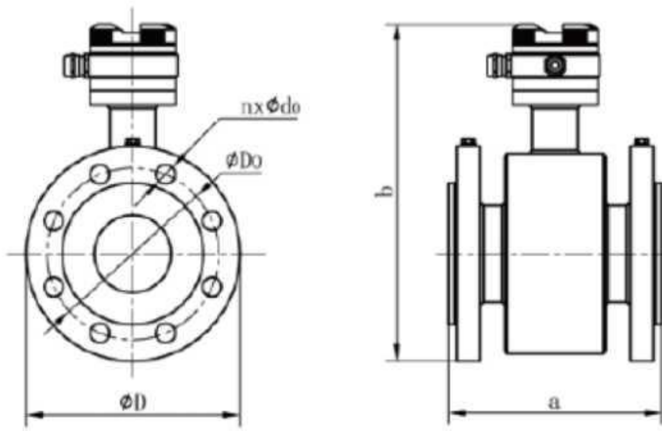


Figure 4: Overall dimensions of MGH split electromagnetic flowmeter

Unit: mm

Model	Nominal Pressure **(MPa)**	Overall Dimensions of Sensor		Connection Dimensions of Flange		Bolt		Net Weight **(kg)**
		a	**b**	**D**	**D_0**	**d_0**	**n**	
15	4.0	200	255	95	65	14	4	5
20	4.0	200	255	105	75	14	4	5
25	4.0	200	255	115	85	14	4	5.5
32	4.0	200	265	140	100	18	4	8
40	4.0	200	270	150	110	18	4	8
50	4.0	200	285	165	125	18	4	10
65	4.0	200	305	185	145	18	8	12
80	4.0	200	315	200	160	18	8	13
100	4.0	250	350	235	190	22	8	20
125	4.0	250	380	270	220	26	8	27
150	4.0	300	405	300	250	26	8	34
200	1.0	350	450	340	295	22	8	43
250	1.0	450	520	395	350	22	12	60
300	1.0	500	565	445	400	22	12	71

Table 3: Connection dimensions of MGH split electromagnetic flowmeter

Model	Nominal Pressure **(MPa)**	Overall Dimensions of Sensor		Connection Dimensions of Flange		Bolt		Net Weight **(kg)**
		a	**b**	**D**	**D_0**	**d_0**	**n**	
15	1.6	200	255	95	65	14	4	5
20	1.6	200	255	105	75	14	4	5
25	1.6	200	255	115	85	14	4	6
32	1.6	200	264	140	100	18	4	8
40	1.6	200	270	150	110	18	4	8
50	1.6	200	287	165	125	18	4	10
65	1.6	200	302	185	145	18	8	12
80	1.6	200	318	200	160	18	8	13
100	1.6	250	343	220	180	18	8	20
125	1.6	250	370	250	210	18	8	27
150	1.6	300	400	285	240	22	8	34
200	1.6	350	450	340	295	22	12	43
250	1.6	450	525	405	355	26	12	60
300	1.6	500	575	460	410	26	12	71

Table 3-1: Connection dimensions of MGH split electromagnetic flowmeter

Note: For products of DN350 or above, please consult our business department.

3.4 Flange Selection

Except in special cases, metric flanges should be selected, and the flanges paired with the sensor should be manufactured in the metric system. When choosing companion flanges, users should note the specifications of process pipes in the order contract. Flange connection dimensions should meet the following standards (see Table 4):

4.0 MPa DN (15, 20, 25, 32, 40, 50, 65, 80, 100, 150)	GB/T9119-2010
1.6 MPa DN (15, 20, 25, 32, 40, 50, 65, 80, 100, 150, 200, 250, 300）	GB/T9119-2010
1.0 Mpa DN (200, 250, 300)	GB/T9119-2010

Table 4: Flange pressure grade and corresponding standard

Connecting flanges and mounting dimensions are shown in Figure 5, Table 5, Table 6 and Table 7.

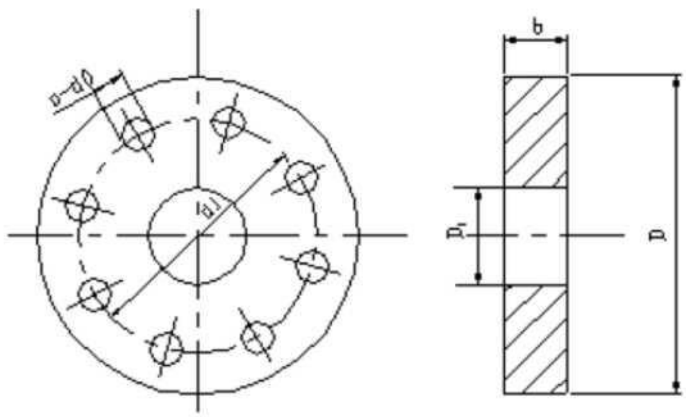


Figure 5: Connecting flange

Unit: mm

DN	4.0MPa						
	D	d_i	d_o	Th	n	b	D_i
15	95	65	14	M12	4	14	$19^{+0.5}_{0}$
20	105	75	14	M12	4	16	$26^{+0.5}_{0}$
25	115	85	14	M12	4	16	$33^{+0.5}_{0}$
32	140	100	18	M16	4	18	$39^{+0.5}_{0}$
40	150	110	18	M16	4	18	$46^{+0.5}_{0}$
50	165	125	18	M16	4	20	$59^{+0.5}_{0}$
65	185	145	18	M16	8	22	$78^{+0.5}_{0}$
80	200	160	18	M16	8	24	$91^{+0.5}_{0}$
100	235	190	22	M20	8	26	110^{+1}_{0}
125	270	220	26	M24	8	28	135^{+1}_{0}
150	300	250	26	M24	8	30	161^{+1}_{0}

Table 5: GB/T9119-2010

Unit: mm

DN	1.0MPa						
	D	d_1	d_o	Th	n	b	D_1
200	340	295	22	M20	8	24	222^{+1}_{0}
250	395	350	22	M20	12	26	276^{+1}_{0}
300	445	400	22	M20	12	26	328^{+1}_{0}

Table 6: GB/T9119-2010

Unit: mm

DN	1.6MPa						
	D	**d_i**	**d_o**	**Th**	**n**	**b**	**D_i**
15	95	65	14	M12	4	14	$19^{+0.5}_{0}$
20	105	75	14	M12	4	16	$26^{+0.5}_{o}$
25	115	85	14	M12	4	16	$33^{+0.5}_{0}$
32	140	100	18	M16	4	18	$39^{+0.5}_{0}$
40	150	110	18	M16	4	18	$46^{+0.5}_{0}$
50	165	125	18	M16	4	20	$59^{+0.5}_{0}$
65	185	145	18	M16	8	20	$78^{+0.5}_{0}$
80	200	160	18	M16	8	20	$91^{+0.5}_{0}$
100	220	180	18	M16	8	22	110^{+1}_{0}
125	250	210	18	M16	8	22	135^{+1}_{0}
150	285	240	22	M20	8	24	161^{+1}_{0}
200	340	295	22	M20	12	26	222^{+1}_{0}
250	405	355	26	M24	12	29	276^{+1}_{0}
300	460	410	26	M24	12	32	328^{+1}_{0}

Table 7: GB/T9119-2010

Note: ※The size should be determined according to the actual pipe size.

4. Installation

There are safety regulations for the design, testing and power supply of electromagnetic flowmeters. Users must strictly abide by the relevant provisions of this manual to ensure the safe operation of the electromagnetic flowmeter.

4.1 Safety Measures

In order to ensure personal and equipment safety, the following measures should be taken:

a. Select the installation location and install the electromagnetic flowmeter according to the relevant section of the user manual and consider the environmental requirements of the related equipment in the electromagnetic flowmeter;

b. Installation and maintenance personnel must be professionally trained;

c. Install the sensor and pipe of the electromagnetic flowmeter correctly to ensure the seal is safe and reliable; the fluid pressure should not exceed the maximum working pressure specified on the nameplate;

d. When connecting wires for the electromagnetic flowmeter, power it off and take some measures to prevent electric shock accidents;

e. The hoisting equipment of the electromagnetic flowmeter should comply with safety regulations. The cable connected in the factory should not be used as the hauling rope during the hoisting of the electromagnetic flowmeter. The cable head of an IP68 electromagnetic flowmeter should be protected from moisture during installation, and the cable should not be damaged during installation. See 4.3 for the position where the electromagnetic flowmeter is connected to the hoisting rope.

4.2 Check before Installation

a. Check the flange, lining, housing and outlet plug for damage;

b. Open the cover and check for loose or damaged wiring and printed circuit boards;

c. Check whether the model number on the nameplate is consistent with the order number.

4.3 Hoisting

The electromagnetic flowmeter can be hoisted as shown in Figure 6. The safety load and protective measures of hoisting equipment should comply with relevant regulations. Do not hoist the instrument with a rope knot at the converter housing (integrated electromagnetic flowmeter) or junction box (split electromagnetic flowmeter sensor).

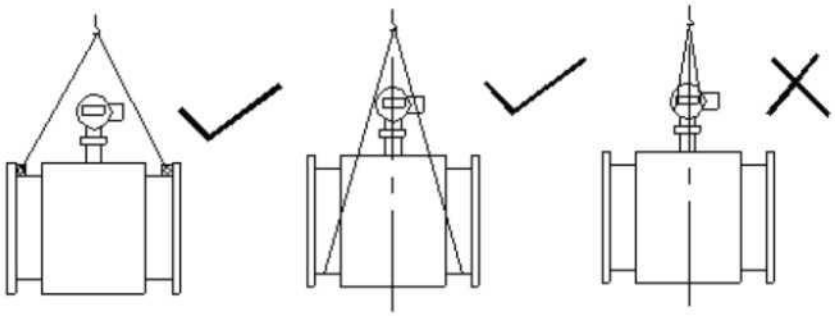


Figure 6

4.4 Sensor Installation

The electromagnetic flowmeter can automatically detect the forward and reverse flow directions. Since the manufacturer defines the flow direction arrow on the instrument as the forward flow direction, the flow direction arrow should be consistent with the actual forward flow direction on the site when installing the instrument.

To ensure the accuracy of measurement, make sure there is a straight pipe section with a length 5 times the pipe diameter upstream of the sensor. When devices such as taper pipes, pore plates and valves are more than 5 times the pipe diameter from the sensor, their influence on measurement accuracy can be ignored. There should be a straight pipe section with a length not less than 3 times the pipe diameter downstream of the sensor.

4.5 Installation Location

As long as the flow velocity in the measuring tube is distributed symmetrically, the measurement result of the electromagnetic flowmeter is independent of the flow velocity distribution in principle.

The electromagnetic flowmeter can be installed horizontally or vertically, but there should be no sediment on the surface of the electrode when the electromagnetic flowmeter is installed horizontally, as shown in Figure 7.

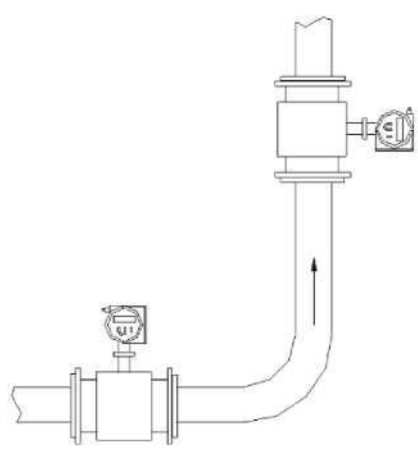


Figure 7: Electromagnetic flowmeter installed horizontally or vertically on pipe

If there is a bend, flow regulating valve or half-open ball valve upstream of the electromagnetic flowmeter, a rectifier should be installed or there should be a straight pipe section of a certain length to improve the flow field distribution. Length requirements for upstream and downstream straight pipe sections are shown in Figure 8.

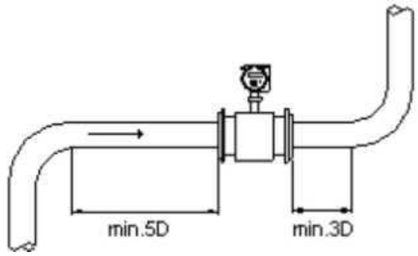


Figure 8: Installation Requirements for Straight Pipe Sections during Electromagnetic Flowmeter Installation

The electromagnetic flow sensor must be installed in a fluid-filled pipe; otherwise the electromagnetic flowmeter must be installed in a siphon pipe, as shown in Figure 9.

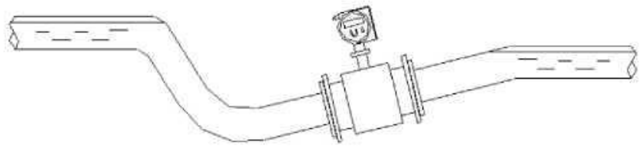


Figure 9: Make sure the measuring tube is filled with fluid when installing

The electromagnetic flowmeter should not be installed on a pipe with an empty end. When it is installed downstream of a pipe, make sure that the pipe is full of flowing medium, as shown in Figure 10.

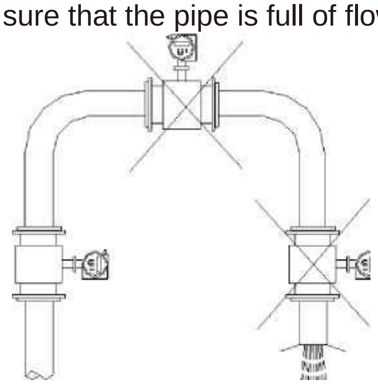


Figure 10: Electromagnetic flowmeter installed in a pipe with an empty end

If the electromagnetic flowmeter is installed at a high position, avoid bubbles that may accumulate in the pipe, as shown in Figure 11

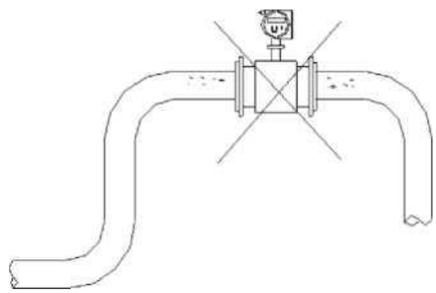


Figure 11: Electromagnetic flowmeter installed at a high position

4.6 Installation Site Selection

If the installation site is vulnerable to exposure to sunlight or rain, additional shelter should be added. The instrument should be protected from strong vibration, excessive temperature changes and long-term exposure to rain. The instrument should be protected from damage by leaking corrosive liquid. The magnetic field intensity at the installation site should be less than 400A/m. The selection of installation sites is shown in Figure 12.

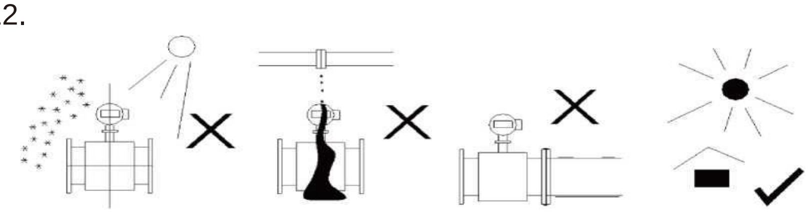


Figure 12: Selection of installation sites

4.7 Pipe Connection

The sensor itself should not be used as a load support, and should be supported by the pipe holding it. The sensor should be installed so that it is not subjected to large tension stress. Consider eliminating the influence of stress due to thermal expansion of adjacent pipes. See Figure 13.

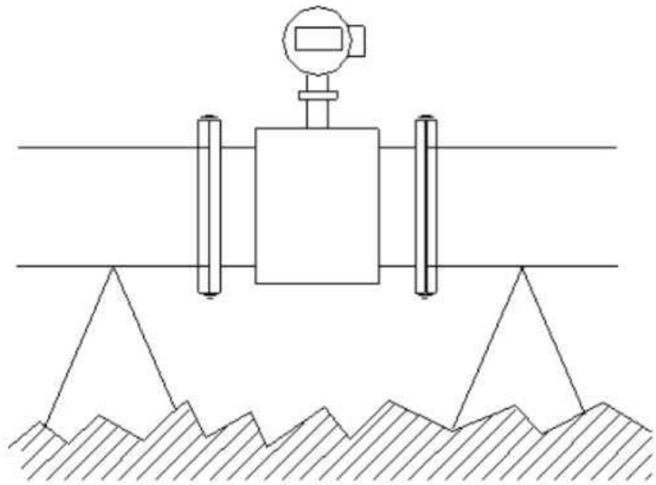


Figure 13: Support position

4.8 Installation Requirements

a. When installing the sensor, make sure that the measuring tube is coaxial with the process pipe. For sensors with a nominal diameter below DN50, the axis deviation should not exceed 1.5mm; for DN50~DN300, the axis deviation should not exceed 2mm;
b. The flange gasket installed between flanges should have good corrosion resistance. The inner diameter of the gasket should be consistent with that of the electromagnetic flowmeter. The gasket should be installed coaxially with the pipe, and should not protrude into the pipe;
c. The threads of bolts and nuts fastening the instrument should be intact and well lubricated. A torque wrench should be used to tighten bolts according to flange size and torque.
d. When welding the companion flange, tighten the companion flange and the flange of the electromagnetic flowmeter with bolts, and hoist the flowmeter to the pipe. First, perform spot welding between the companion flange and the pipe (ensure that the flange is coaxial with the pipe) to fix the companion flange. Next, remove the electromagnetic flowmeter, and perform process welding of the companion flange to prevent the lining from being damaged by high temperature during companion flange welding.

Note: The weld surface inside the pipe should be smooth.

e. When welding or flame cutting the pipe adjacent to the sensor, take isolation measures to prevent the lining from being heated. If the flowmeter is installed in a well or works under water, seal the sensor junction box with sealant after installing and debugging the system (for example, if the protection grade of IP68 is selected, the junction box has been sealed before leaving the factory).

4.9 Wetted (Grounding) Flange

a. Wetted (grounding) flange

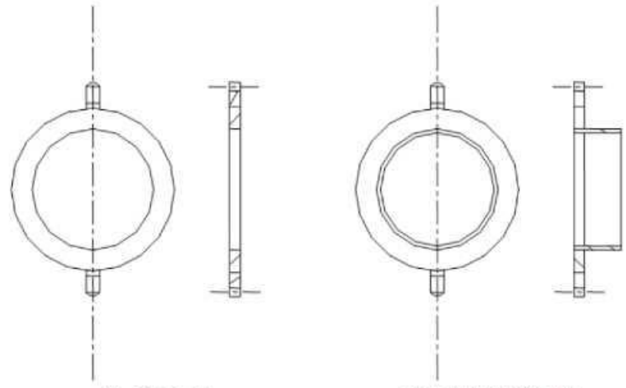
Material: 304

Thickness: 3mm

For non-conductive pipes, make sure the instrument has zero potential at the potential of the measured fluid. The grounding flange is installed between the sensor flange and the pipe flange. For the sensor lined with PTFE, in order to protect PTFE flanging from damage, the user needs to choose whether the grounding flange is provided when the instrument leaves the factory.

b. Inlet protection flange

If the measured medium contains small particles, the inlet end of the sensor should be equipped with an inlet protection flange whose edge extends into the inner diameter of the sensor, so as to reduce the wear on the lining. The inlet protection flange has the dual purposes of protecting the lining and the wetted (grounding) flange. See Figure 14.



Grounding flange Inlet protection flange

Figure 14: Grounding flange type

c. Wetted electrode

If the pipe transmitting the measured medium is made of engineering plastics such as PVC and PP, in order to ensure that the electromagnetic flowmeter is reliably connected with the liquid, the measuring tube should be equipped with a wetted electrode or grounding ring, especially flow measurement of highly corrosive liquid, and precious metals are used as wetted electrodes to reduce the cost.

4.10 Grounding and Anti-electrical Interference Measures

The measuring circuit of the electromagnetic flowmeter takes the potential of the measured fluid as zero potential. In most cases, the measured fluid has zero potential, so grounding is actually about connecting to the measured fluid. The grounding wire of the sensor is connected to the flanged metal conduit which is insulated from the measured fluid by lining. Therefore, the sensor flange and the flange (or conductor) in contact with the fluid should be connected with a 2.5mm^2 copper wire. The grounding resistance should be less than 10Q.

In most cases, no special measures are required for sensor installation, except that the signal cable should be removed from the power cable.

If cathode protection is used in the piping system where the sensor is installed or electrolysis is used in the process, measures should be taken to ensure that:

a. The power-frequency current will not flow through the fluid in the sensor;
b. Any power-frequency current flowing through the sensor body will not exceed 10A (effective value).

To reduce the impact of the magnetic field, the following measures are taken:

a. In a metal piping system, the connection of the sensor to an adjacent pipe enables the instrument to obtain the potential of the measured fluid, as shown in Figure 15. In this connection, the current flowing through the sensor body should not 10A (effective value). Bolts should not be used instead of equipotential connections in flange installation. Equipotential connections must be added as shown in Figure 16
b. For non-conductive pipes, a grounding flange shall be installed between the flanges at both ends of the sensor and the pipe flange. See Figure 17.
c. Some systems, such as piping networks with cathode protection, will generate an interfering potential because the system potential is not completely ground potential. To eliminate such electrical interference, connect both ends of the unlined tube to the sensor as shown in Figure 18.

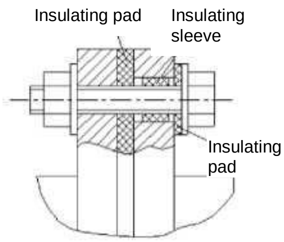


Figure 15: Insulating sleeve and pad

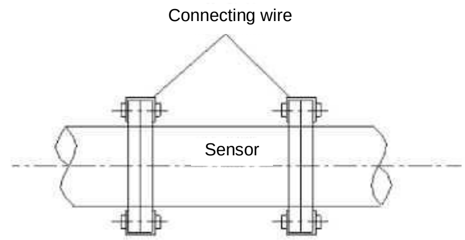


Figure 16: Sensor connection

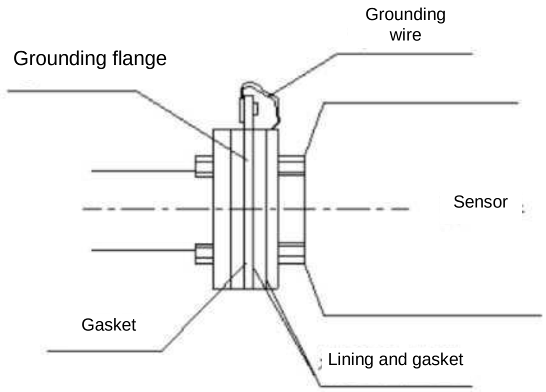


Figure 17: Sensor connection in a non-conductive pipe

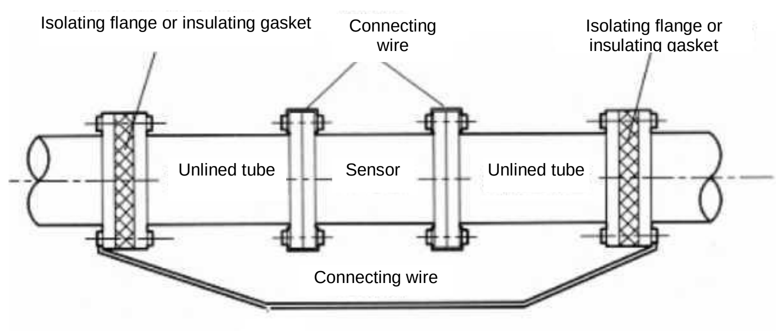


Figure 18: Sensor connection in an unlined tube

5. Electrical Wiring

In order to ensure reliable sealing of the outlet plug, a cable with a circular section with a diameter of 8mm should be used for wiring.

5.1 Wiring between Sensor and Converter

The wiring between the electromagnetic flowmeter sensor and the converter is completed by the manufacturer. This section applies only to the split electromagnetic flowmeter. For wiring between the split electromagnetic flowmeter sensor and the converter, see the section of converter in this manual. If the sensor is installed in water or in areas vulnerable to flooding, choose the protection grade of IP68.

5.2 Output and Power Supply Wiring

For output and power supply wiring, see the section of converter in the manual. All output cables and power cables should be supplied by the user.

5.3 Wiring Requirements

Wiring should be done after the power supply is cut off.

a. After confirming the cable model, connect the cable correctly and firmly as required;

b. When peeling a cable, do not damage the reserved insulating layer. For the flow signal core wire, as long as it can be connected, peel off the shielding layer as little as possible;

c. The cable length between the sensor and the converter is related to factors such as fluid conductivity and field electrical interference. The cable length can be simply estimated by the following formula:

L=5x4

Wherein, L represents cable length, 6 represents fluid conductivity (us/cm).

However, the cable length generally should not exceed 100m. In order to ensure the measurement accuracy and reduce interference, the converter should be installed as close to the sensor as possible.

d. The model specifications of the excitation connection cable and the flow signal cable are RVVP-2x1mm^2 and RVVP-3x1mm^2 08 shielded cable respectively.

6. Operation

All safety clauses and regulations in the above sections shall be observed.

The following checks should be carried out before the electromagnetic flowmeter is put into operation:

a. Check the electromagnetic flowmeter for damage during transportation and installation;

b. Check whether the power supply voltage is consistent with the nominal voltage on the nameplate;

c. Check whether a fuse with the correct current value is used;

d. Check whether the instrument is properly grounded.

After inspection, open the pipe valve to fill the system with liquid. Eliminate leaks and residual gases in the system. Switch on the instrument, and the electromagnetic flowmeter works normally after 30min of preheating after power-on.

7. Maintenance

Read the safety clauses in each section before maintenance. When the sensor is confirmed to be faulty, please contact our after-sale service department or designated service provider.

7.1 Routine Maintenance

Visually check whether the electrical connection is damaged and whether the instrument works normally.

7.2 Fault Check and Analysis

7.2.1 Basic Principles of Fault Check

a. Check whether the electromagnetic flowmeter pipeline valves are all open, whether the pipe is full of liquid, whether the electromagnetic flowmeter works at a flow rate close to the upper limit of the flow range;

b. Check whether the power supply devices such as the power supply, switch and fuse of the instrument are normal;

c. Check whether the fault point is in the cable or in the instrument;

d. Check whether the converter number and instrument coefficient are consistent with the corresponding value on the sensor nameplate;

e. Check whether the full measuring range of the electromagnetic flowmeter is set correctly, and check whether the measuring range of the secondary instrument is consistent with the full measuring range of the electromagnetic flowmeter;

f. Check whether the output connection of the electromagnetic flowmeter is correct and whether the grounding is good;

g. Check the converter according to Section B Converter.

7.2.2 Summary of Fault Analysis and Phenomena

Fault Source		Fault Phenomenon				
Category	Name	**1**. No signal output	**2**. Output jitter	**3**. Zero instability	4. The flow measurement inconsistent with the applied reference value	**5**. Output beyond full scale
Piping system and related equipment	1. Improper installation		V		V	V
	2. Pipe not filled with liquid					
	1) Small amounts of gas in a stratified flow		V		V	
	2) Increased gas in a stratified or wavy flow		V		V	
	3) Bubble flow or plug flow				V	
	4) Liquid level below the electrode					V
	3. Gas trapped in the piping system		V		V	
	4. Gas drawn into the piping system		V		V	
	5. Pulsation caused by oscillation of reciprocating pump or control valve		V		V	
	6. Flow state changes during use		V		V	
Fluid	1. Liquid containing gas		V		V	
	2. Liquid containing a solid phase					
	1) Slurry noise		V			
	2) Electrode contamination		V	V		
	3) Conductive or insulating deposit covering the electrode or lining	V		V		
	4) The lining is worn or the flow area is altered by deposition				V	
	3. The conductivity is not uniform or near the threshold		V	V		
	4. Mismatch of materials of wetted parts	V	V			
	5. Flow noise		V			
Environment	1. High-intensity magnetic field		V			
	2. Strong electromagnetic wave		V			
	3. Stray current in the pipe		V			
	4. Ground potential change			V	V	
	5. Invasion of moisture	V		V	V	

Table 9: Summary of Fault Analysis and Phenomena

7.2.3 Fault Check and Measures Taken

7.2.3.1 No Signal Output Fault Check and Measures Taken

A. Check for any power supply fault;
B. Check for any fault of the connecting cable system;
C. Check the flow direction of fluid and whether the pipe is filled with fluid;
D. Check whether the sensor is intact and check the inner wall of the measuring tube;

E. Check for any converter fault;

7.2.3.2 Output Jitter Fault Check and Measures Taken

A. The undulation (or pulsation) of the flow itself
B. The pipe is not filled with liquid or the liquid contains air bubbles
C. External electromagnetic interference
D. Verify physicals properties of liquid
E. Investigate the matching of liquid and electrode material

7.3 Return-to-Factory Repair

If the electromagnetic flowmeter sensor needs to be returned to the factory for repair as confirmed by the user or our on-site service technician, please return the electromagnetic converter with it.

Note: Before returning the electromagnetic flowmeter to the factory, please clean the surface and lining of the electromagnetic sensor, and indicate the name of the measured medium, especially corrosive, oxidizing, toxic and harmful media; otherwise we have the right to refuse repair.

8. Supply Integrity

A complete instrument set includes a sensor and a converter. For the split electromagnetic flowmeter, the cable connecting the sensor and the converter should be supplied by the user, or the user can order the required quantity of cables from us, and we will supply according to the quantity ordered.

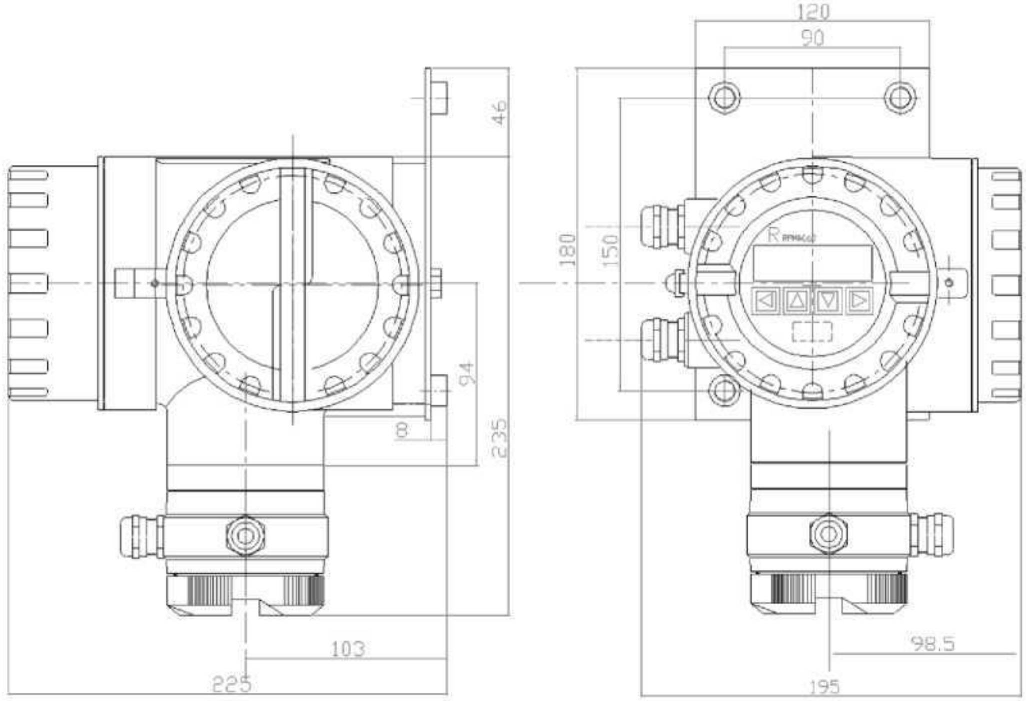
9. Transport and Storage

In order to prevent the instrument from being damaged during transit, the packing condition as shipped by the manufacturer should be maintained during storage. Storage conditions are as follows :(1) protect against rain and moisture, and avoid impact; (2) temperature range (-20~+65) °C, humidity should be less than 90%, preferably about 50%; and (3) store the used sensor and clean the measured medium attached to the lining and electrode surface in advance.

B Converter

10 Converter Structure

The combination of converter and sensor has two forms: integrated type and split type. See Figure 19 for the size of the split converter.

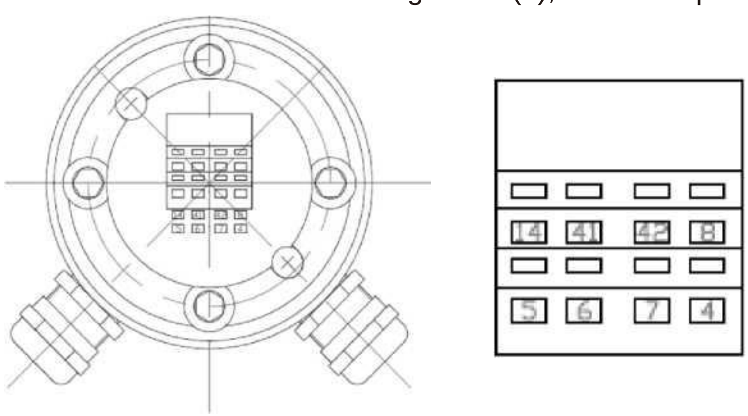


It is recommended to configure the instrument protecting box with dimensions greater than: 300mm (length) x 400mm (width) x 400mm (height). Figure 19: Dimension of fixing hole for mounting plate of split converter is 90x 150mm

11 Flowmeter Wiring

11.1 Wiring between Converter and Sensor of Electromagnetic Flowmeter

This section applies to the connection of the signal line and the excitation line between the sensor and the converter of our split electromagnetic flowmeter. The labels on the terminal boards on the junction boxes of the sensor and the converter are consistent. Upon wiring, the sensor and converter correspond to each other one by one according to the labels of cable colors. The non-explosion-proof junction boxes of split sensor and converter are shown in Figure 20 (a), and the explosion-proof junction boxes of split sensor and converter are shown in Figure 20 (b).

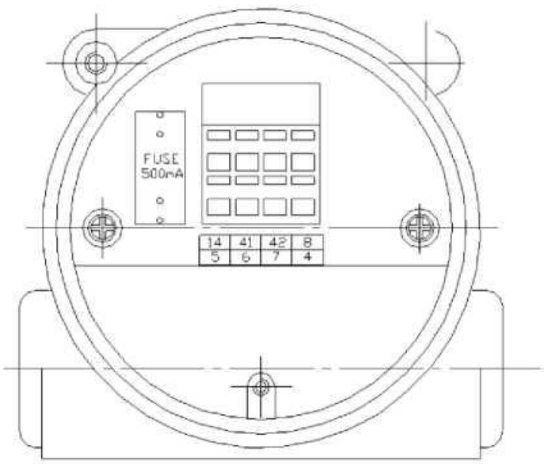


The terminal numbers in the upper row from left to right are: 14, 41, 42 and 8

The terminal numbers in the lower

row from left to right are 5, 6, 7 and 4

Figure 20 (a): Non-explosion-proof junction boxes of split sensor and converter



The terminal numbers in the upper row from left to right are: 14, 41, 42 and 8. The terminal numbers in the lower row from left to right are 5, 6, 7 and 4. The excitation fuse is mounted on the terminal board of the converter.

Figure 20 (b): Explosion-proof junction boxes of split sensor and converter

The color of the cable or the label of the cable on the IP68 split sensor must be connected according to the following requirements, as shown in Table 10.

	Terminal Number	Name	Cable color for IP68 sensors	
Terminals in the upper row	14	Null		Excitation Cable
	41	Excitation line 1	Brown	
	42	Excitation line 2	Black	
	8	Grounding wire measurement	Yellow-Green	Signal Cable
Terminals in the lower row	5	Electrode 1 shielding		
	6	Electrode 1	Brown	
	7	Electrode 2	White	
	4	Electrode 2 shielding		

Table 10: Cable label and wiring of the split type

The user must use the 08 shielded cable of RVVP2x1.0mm^2 as the excitation connection cable and a 08 shielded cable of RVVP3x 1.0mm^2 as the signal connection cable. Upon special requirements, the signal connection cable should be a 3-core multilayer shielded cable.

For effective IP68 protection, use cables with outer diameters as follows:

•Cable gland M16x1.5: 05-010

• Cable gland M20 x1.5: 05-09

The connection method of shielded cable between sensor and converter is as follows:

• Thread the sensor cable into the screw sleeve and press down the cable gland.

• Tighten the locking cap on the cable gland until the cable is tightly connected to the cable gland.

Note: The protection grade of the cable used should not be lower than that of the sensor. Power must be cut off before the uncovering and wiring of explosion-proof electromagnetic flowmeter.

The connection and wiring diagrams of the sensor and converter of the split electromagnetic flowmeter are shown in Figure 21.

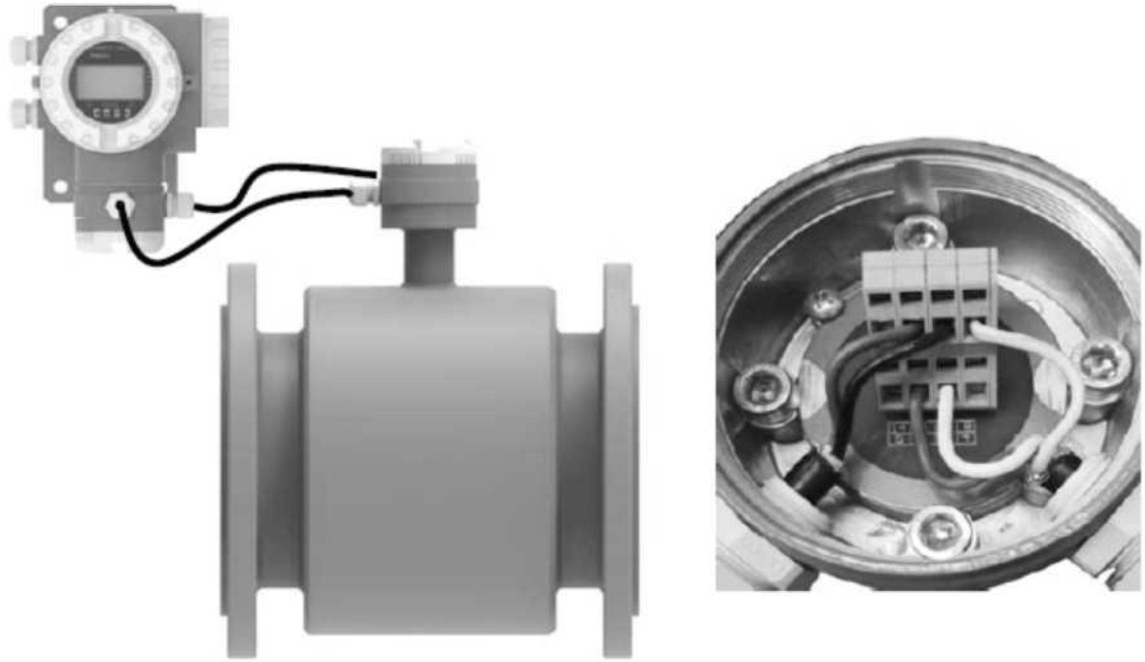


Figure 21: Connection and wiring of sensor and converter of split electromagnetic flowmeter

11.2 Wiring of Converter of Electromagnetic Flowmeter

Function Description of Converter Terminal

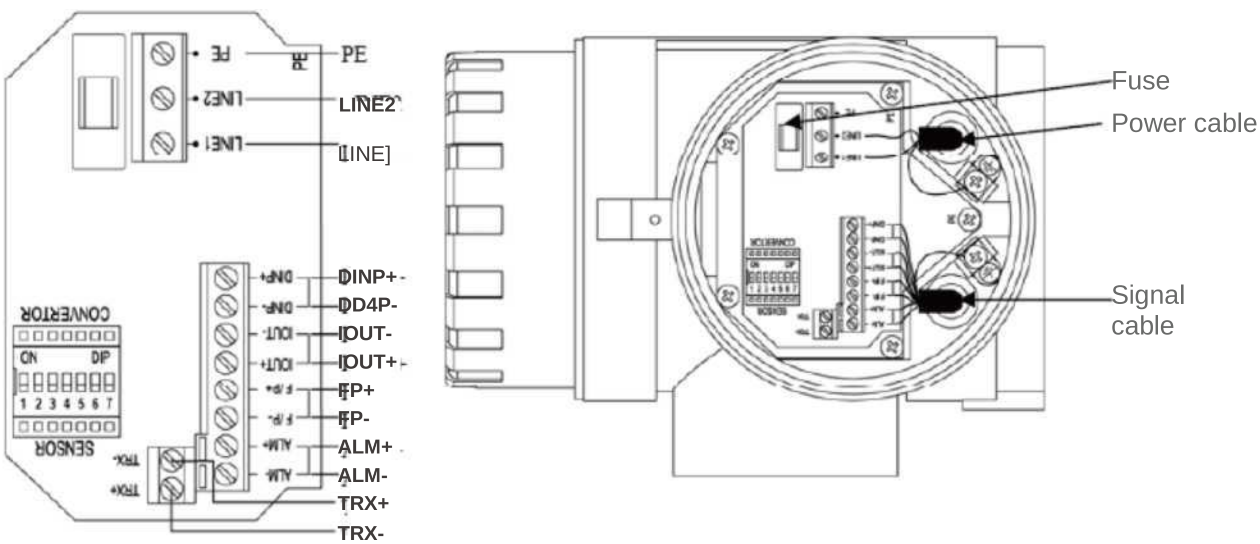


Figure 22: Power, output and signal connections of the integrated type

See Table 11 for wiring instructions

Function	Wiring Terminal	Instructions	Remarks
Power supply input	LINE1	Positive pole	220VAC power supply connected to live wire, and 24VDC power supply connected to positive pole
	LINE2	Negative pole	220VAC power supply connected to zero line, and 24VDC power supply connected to negative pole
	PE	Protective earthing	
4-20mA output	IOUT+	Positive current output	When HART communication is adopted, it is also used as the output port of HART communication
	IOUT-	Negative current output	
Pulse/frequency output	F/P+	Positive isolation pulse/frequency output	Passive signal output, and complete signal isolation
	F/P-	Negative isolation pulse/frequency output	
Alarm status output (Passive on-off output)	ALM+	Positive isolation alarm output	Open collector output, and complete signal isolation
	ALM-	Negative isolation alarm output	
Input control	DINP+	Positive input control	Short circuit of two terminals, and effective input control function
	DINP-	Negative input control	
Communication output	TRX+		Default port of Modbus Output. For other communication functions, the port may be redefined. Please consult the manufacturer's technician
	TRX-		

Table 11: Wiring instructions

Remarks: When HART communication is used, 250Q resistor is connected in series at the (4 ~ 20) mA output terminal, and communication lines are connected in parallel at both ends of the resistor. **Special note:** For real flow calibration in the laboratory, please use PO mode of pulse/frequency output.

11.3 Output Signal Wiring

11.3.1 4~20mA Analog Signal Wiring

The output line of 4~20mA is connected to the IOUT+ and IOUT- terminals on the terminal board, and the remote terminal can be connected to the integrator or Ai module of PLC and DCS (4~20mA input). The transmission line should be less than 1.5 km, and the signal is active. See Figure 23:

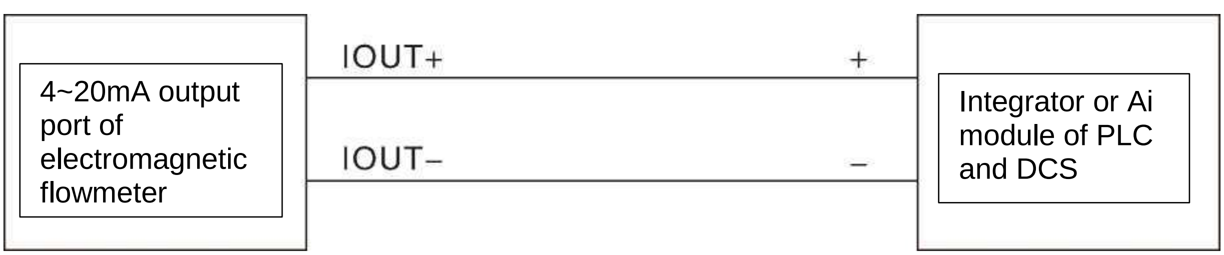


Figure 23: 4-20mA analog wiring

11.3.2 PO Frequency/Pulse Signal Wiring

The pulse/frequency output line is connected to the F/P + and F/P- terminals on the terminal board, and the remote terminal can be connected to the integrator or Di module of PLC and DCS (digital input). The signal is passive, and it's the complete isolated output. When it is used, it needs an external DC power supply (no more than 30VDC) and a pull-up current limiting resistor in series. When it is turned on, the maximum collector current is 250mA. See Figure 24:

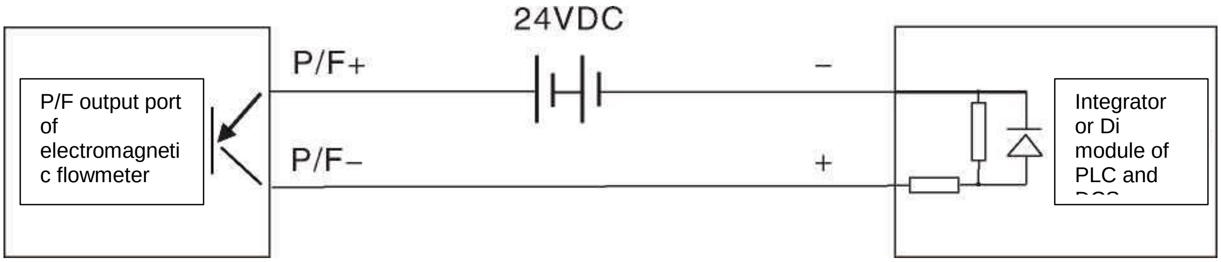
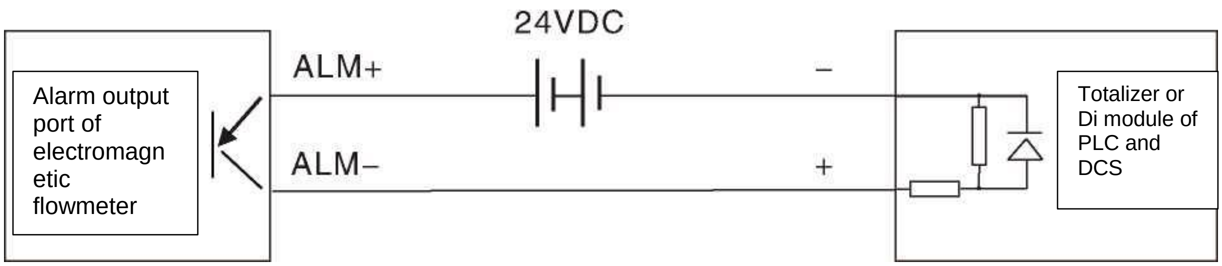


Figure 24: PO frequency/pulse signal wiring

11.3.3 Isolation Alarm Signal Wiring

The alarm signal output port is for open collector output (OC gate). The signal is passive, and it's the complete isolated output. When it is used, it needs an external DC power supply (no more than 30VDC) and a pull-up current limiting resistor in series to ensure that the maximum collector current is 250mA when it is turned on.



See Figure 25:

11.3.4 Modbus Communication Signal Wiring

Communication lines RS485 and Mod-bus share a communication port. Two communication lines (twisted pairs should be used) are connected to TRX+ and TRX- terminals on the terminal board. Port A of the upper computer is connected to TRX+ and port B is connected to TRX-, and the distance between

Figure 25: Isolation alarm output wiring

communication lines should be less than 1.5 km. See Figure 26:

12 Instrument Parameter Setting

The instrument has two operating states: Automatic measurement

Parameter setting

In the automatic measurement state, the instrument automatically completes each measurement function and displays the corresponding measurement data. In the parameter setting state, the user uses four panel

Figure 26: Modbus communication signal wiring

buttons to complete the instrument parameter setting.

◄ Button (left): Move the cursor to the left upon parameter setting.

► Button (right): Enter the main menu. Move the cursor to the right upon parameter setting.

▲Button (up): Turn up the menu, and the number plus 1; when the LCD cursor is under this button, press this button to enter the next menu.

▼ Button (down): Turn down the menu, and the number minus 1; when the LCD cursor is under this button, press this button to return to the previous menu

12.1 Button Function Description

See Figure 27:

Fluid direction, alarm code, second timing-
Instantaneous flow scale-

■*- Instantaneous flow
4 Instantaneous flow unit
—Percentage value of flow
—Integrated flow
- Infrared receiving tube
-Operation button

Figure 27: Converter keyboard and display

12.1.1 Button Function in Automatic Measurement State

► Button (right): Enter the main menu

▼Button (down): Press this button cyclically, and the LCD will display the measured parameters in the bottommost line cyclically

12.1.2 Button Function in Parameter Setting State

◄ Button (left): The cursor moves to the left.

► Button (right): The cursor moves to the right.

▲Button (up): Turn up the menu, and the number plus 1; when the LCD cursor is under this button, press this button to enter the next menu.

▼Button (down): Turn down the menu, and the number minus 1; when the LCD cursor is under this button, press this button to return to the previous menu.

Note: In the parameter setting state, if there is no button operation for 2 minutes, the instrument will automatically return to the measurement state.

12.1.3 Display Information in Measurement State

The flowmeter display in the measurement state is shown in Figure 23. When the buttons are pressed in turn, the measurement data such as integrated forward flow, integrated reverse flow, net integrated flow, flow percentage, conductance ratio and flow velocity will be displayed in a loop in the bottommost line of the display screen. The alarm code is displayed in the middle of the flow symbol and the second timing symbol. See Figure 28:

Figure 28: Menu display parameters

—2+ integrated forward flow
—2- integrated reverse flow
—2D net integrated flow
—flow percentage
— flow velocity
—conductance ratio

12.1.4 Alarm Information in Measurement State

The printed circuit board of electromagnetic flowmeter converter adopts surface soldering technology, which can be repaired by users. So, the user cannot open the converter housing. MGH intelligent converters have highly effective self-diagnosis function, except for power supply and hardware circuit faults, and it can give correct alarm information for faults in general applications. This information is prompted on the left side of the display as follows:

SYS ——System excitation alarm; MTP ——Empty fluid pipe alarm;
CUT ——Small signal cut alarm; REV ——Reverse flow cut alarm;
HIG ——Maximum flow alarm; LOW——Minimum flow alarm;
ABN ——Abnormal inhibition alarm; PSM ——Peak inhibition alarm;
FST——Noise sensitivity alarm;

12.1.5 Parameter Setting Function Button Operation

To set or modify the instrument parameters, switch the instrument into the parameter setting state from the measurement state. In the measurement state, press "►" to show the parameter setting password (00000).

Input the corresponding password, move the cursor to “▲” on the LCD, and then press “▲” to enter the first menu of "Parameter Setting". Then move the cursor to “▲” on the LCD, and then press “▲” to enter the next menu. To find the "Instrument Communication Address" menu, press “▲” or “▼” to find the menu to be modified. After modifying the parameter, move the cursor to “▼” on the LCD, and then press “▼” to return to the previous menu. At this time, the parameters are automatically saved. Move the cursor to “▼” on the LCD, and then press “▼” to return to the first menu until you return to the measurement state.

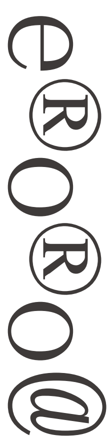
We provide users with 4 levels of passwords: Level 1 passwords (02000) are held by users for instrument installation and instrument operators; Level 2 passwords (02008) are held by the relevant responsible personnel of the user, and some parameters can be modified; Level 3 passwords (02013) are held by the user's manager, and the password for clearing and calculating the total amount can be set; Level 4 passwords (02018) are held by the calibration personnel of the manufacturer; Level 5 passwords are used by senior debugging personnel of the manufacturer; please contact the manufacturer if necessary.

The password for language setting is 16818. Input 16818 to set the language.

12.1.6 Infrared Programmer

The electromagnetic flowmeter is often used in explosion-proof applications where uncovering to set parameters is not allowed, so the infrared programmer is specially designed to facilitate menu setting without opening the cover in other occasions. See Figure 29 for the appearance of the infrared programmer:

Infrared transmitting tube



Button (Enter): Press this button to enter the password setting screen in the measurement state. Input the password to enter the parameter setting state and enter the lower menu;

Button (Return): For parameter setting, save the data and return to the previous menu;

Button (Left): The contrast fades in the measurement state, and the cursor moves to the left in the parameter setting state;

Button (Right): The contrast gradually brightens in the measurement state, and the cursor moves to the right in the parameter setting state;

Button (Add): In the measurement state, contents are shown in the bottommost line of the screen in a loop. The number plus 1 at the cursor in the parameter setting status, and turn the page up;

Button (Minus): The number minus 1 at the cursor in the parameter setting state, and turn the page down;

①Button (number 2): Number input at the cursor;

Figure 29: Infrared programmer keyboard layout

When setting parameters, please align the infrared transmitting tube with the infrared receiving tube of the LCD panel (the center above the button)

12.2 Function Screen and Detailed Parameter Name

12.2.1 Function Screen

See Table 12

Parameter No.	Function	Description
1	Parameter setting	Select this function to enter the parameter setting screen
2	Total reset	Select this function to clear the total amount of meter
3	Factory parameter backup	Select this function to permanently back up factory parameters
4	Factory parameter recovery	Select this function to re-transfer factory backup parameters to this machine

5	Clear time limit	Reserved function
6	System modification record	Reserved function

Table 12: Function screen (level 1 menu)

12.2.2 Parameter Navigation Index

Measurement State

Parameter setting —► Total reset —► Factory parameter backup

Factory parameter recovery —►Clear time limit —► System modification record

Measurement Parameter —►Digital output parameters —► Pulse output parameters

Sensor parameters —►Communication parameters —► Advance d service

Measurement Parameter

- Flow unit
- Flow integrating unit
- Enable reverse output
- Instrument
- Range setting
- Measurement damping time
- Analog output damping
- Peak inhibition selection
- Peak inhibition range
- Peak inhibition time
- Anomaly inhibition time
- Flow direction option
- Enable signal cut
- Small signal cut point
- Fluid density
- Flow zero correction
- Factory calibration coefficient
- Total Reset password
- Input function selection

Digital output parameters

- Alarm output selection
- Upper limit alarm value
- Lower limit alarm value
- Empty pipe alarm threshold
- Empty pipe zero correction
- Empty pipe range correction
- Empty pipe damping time
- Low total alarm
- High total alarm

Pulse output parameters

- Pulse output mode
- Pulse unit
- Pulse equivalent
- Pulse width
- Lower limit of pulse output
- Pulse output range
- Current output mode
- Current zero correction
- Current fullness correction
- Current output test
- Output function test

Sensor parameters

- Measuring tube diameter
- Excitation frequency selection
- Sensor coefficient value
- Velocity correction allowance
- Velocity correction point 1
- Velocity correction number 1
- Velocity correction point 2
- Velocity correction number 2
- Velocity correction point 3
- Velocity correction number 3
- Velocity correction point 4
- Velocity correction number 4
- Velocity correction point 5
- Sensor code 1
- Sensor code 2

Communication parameters

- Instrument communication mode
- Instrument communication address
- Instrument communication speed
- Instrument calibration mode

Advance d service

- Security code 1
- Security code 2
- Security code 3
- Security code 4
- Instrument code 1
- Instrument code 2
- Low forward total
- High forward total
- Low reverse total
- High reverse total

12.2.3 Detailed Parameter Name

Table 13: List of Detailed Parameter Menu Names (Level 2 Menu)

No.	Menu Name	Setting Mode	Content	Password Level
I	Flow parameters	Select		
1	Flow unit	Select	L/h, L/m, L/s, m3/h, m3/m, m3/sUK/h, UK/m, UK/s, US/h, US/m, US/skg/h, kg/m, kg/s, t/h, t/m, t/s	2
2	Flow integrating unit	Select	0.001m3 ～1m3, 0.001L ～1L0.001UKG ～1UKG, 0.001USG ～ 1USG0.001kg ～1kg, 0.001ton ～1ton	2
3	Enable reverse output	Select	Disabled, enabled	2
4	Instrument range setting	Preset	0～99999	2
5	Measurement damping time	Select	1 ～60S	2
6	Analog output damping	Select	0-250s	2
7	Peak inhibition selection	Select	Disabled, enabled	3
8	Peak inhibition range	Preset	Set by flow velocity; 0.001m/s-1.000m/s	3
9	Peak inhibition time	Select	2～30s	3
10	Anomaly inhibition time	Select	0～99s	2
11	Flow direction option	Select	Forward, reverse	2
12	Enable signal cut	Select	Disabled, enabled	2
13	Small signal cut point	Preset	000.00 (set by flow quantity)	2
14	Fluid density	Preset	0 ～1.9999	2
15	Flow zero correction	Preset	0 - ± 9999	2
16	Factory calibration coefficient	Preset	0.0000～5.9999	5
17	Total reset password	Modified by user	0～99999	3
18	Input function selection	Select	Inhibiting input function, forward total reset, reverse total reset, flow hold and flow reset	4
II	Digital output parameters	Select		
1	Alarm output selection	Select	Inhibiting alarm output, reverse total alarm, forward total alarm, abnormal signal alarm, reverse alarm output, system alarm output, empty pipe alarm output, signal cut alarm, lower limit alarm output and upper limit alarm output	4
2	Upper limit alarm value	Preset	Set by flow	2
3	Lower limit alarm value	Preset	Set by flow	2
7	Empty pipe alarm threshold	Preset	0～59999	2
8	Empty pipe zero correction	Preset	0 - ± 9999	5
9	Empty pipe range correction	Preset	0～5.9999	5
10	Empty pipe damping time	Select	10～60s	2
11	Low total alarm	Preset	0-99999	2

12	High total alarm	Preset	0-19999	2
III	Pulse output parameters			
1	Pulse output mode	Select	PO frequency output/PO pulse output	2
2	Pulse unit	Select	m3, Ltr, UKG, USG, kg, t	2
3	Pulse equivalent	Preset	00.001 ～59.999	2

4	Pulse width	Select	0.5～1999.9ms	2
5	Frequency output lower limit	Preset	0- 5000 Hz	2
6	Frequency output range	Preset	1 ～5000 Hz	2
7	Current output mode	Select	4mA, 4-20mA	5
8	Current zero correction	Preset	0.0000～0.9999	5
9	Current full scale correction	Preset	0.0000～0.9999	5
10	Current output test	Preset	0.00～99.99	1
11	Output function test	Select	0%, 25%, 50%, 75%, 100%	1
IV	Sensor parameters			
1	Measuring tube diameter	Select	3～3000	2
2	Excitation frequency selection	Select	50Hz: 4.167Hz, 5.000 Hz, 6.250 Hz, 12.500 Hz 60Hz: 2.500 Hz, 3.333 Hz, 5.000 Hz, 10.000 Hz	4
3	Sensor coefficient value	Preset	0.0000～5.9999	4
4	Enbale flow velocity correction	Select	Enabled / Disabled	2
5	Velocity correction point 1	Set by user	Set by flow velocity (with 4 decimal places)	4
6	Velocity correction number 1	Set by user	Set by flow velocity (with 4 decimal places)	4
7	Velocity correction point 2	Set by user	Set by flow velocity (with 4 decimal places)	4
8	Velocity correction number 2	Set by user	Set by flow velocity (with 4 decimal places)	4
9	Velocity correction point 3	Set by user	Set by flow velocity (with 4 decimal places)	4
10	Velocity correction number 3	Set by user	Set by flow velocity (with 4 decimal places)	4
11	Velocity correction point 4	Set by user	Set by flow velocity (with 4 decimal places)	4
12	Velocity correction number 4	Set by user	Set by flow velocity (with 4 decimal places)	4
13	Velocity correction point 5	Set by user	Set by flow velocity (with 4 decimal places)	4
14	Sensor code 1	Set by user	Year, month of manufacture (0-99999)	4
15	Sensor code 2	Set by user	Product number (0-99999)	4
V	Communication parameters			
1	Instrument communication mode	Select	MODBUS-A, HART, PROFIBUS	2
2	Instrument communication address	Preset	1 ~ 250 (No communication by default for address 0)	2
3	Instrument communication speed	Select	300 ～38400	2
4	Instrument calibration mode	Select	No Parity,1 stop, Odd Parity,1 St, Even Parity,1 S. , No Parity,2 stop, Odd Parity,2 St, Even Parity,2 S	2
VI	Advanced services			
1	Security code 1	Modified by user	0～99999	5
2	Security code 2	Modified by user	0～99999	5
3	Security code 3	Modified by user	0～99999	5
4	Security code 4	Modified by user	0～99999	5
5	Instrument code 1	Set by manufacturer	Year, month of manufacture (0-99999)	5
6	Instrument code 2	Set by manufacturer	Year, month of manufacture (0-99999)	5
7	Low forward total	Modified by user	0～99999	5
8	High forward total	Modified by user	0～9999	5

9	Low reverse total	Modified by user	0～99999	5
10	High reverse total	Modified by user	0～9999	5

12.3 Parameter Function Explanation

12.3.1 Flow Parameters

Flow unit

The flow display units are: L/s, L/m, L/h, m^3/s> m^3/m> m^3/h> uk/s, uk/m, uk/h, us/s, us/m, us/h, kg/s, kg/m, kg/h, t/s, t/m, t/h. Users can select an appropriate flow unit according to process requirements and usage habits.

Flow integrating unit

The flow integrating display of the converter is a 10-bit counter, with a maximum allowable value of 9999999999.

The integrating unit can be: L, m3, ukg, usg, kg, and t. This unit is automatically set to be the same as the flow unit. If the flow unit is L/h, L/m, L/s, the integrating unit is L; if the flow unit is m3/h, m3/m, m3/s, the integrating unit is m3; if the flow unit is uk/s, uk/m, uk/h, the integrating unit is ukg; if the flow unit is us/s, us/m, us/h, the integrating unit is usg; if the flow unit is kg/s, kg/m, kg/h, the integrating unitiskg; if the flow unit is t/s, t/m, t/h, the integrating unit is t.

The flow integrating equivalent is: 0.001L, 0.010L, 0.100L, 1.000L
0.001m3, 0.010m3, 0.100m3, 1.000m3
0.001ukg, 0.010ukg, 0.100ukg, 1.000ukg
0.001usg, 0.010usg, 0.100usg, 1.000usg
0.001kg, 0.010kg, 0.100kg, 1.000kg
0.001t, 0.010t, 0.100t, 1.000t

Enable reverse output

When the “enable reverse output” parameter is set to “Disable”, if the direction of fluid flow is opposite to that indicated on the nameplate, the converter will output pulse and current according to the flow value.

When the “enable reverse output” parameter is set to “Enable”, if the fluid flows in the reverse direction, the converter displays normal flow velocity, output pulse of “0”, current output signal of “0” (4mA) and instantaneous flow quantity of “0”, but the internal reverse integrator is still integrating flow.

When the “enable reverse output” parameter is set to “Enable” and “Alarm Output” is selected, if the fluid flows in the reverse direction, the converter displays normal flow quantity, output pulse of “0”, current output signal of “0” (4mA) and instantaneous flow quantity of “0”.The ALAM+ and ALAM- outputs have output signals, which are OC gate outputs.

Instrument range setting

The instrument range setting value refers to determining the flow upper limit (instrument range), which is for the output signal and percentage display. The corresponding output is 20mA, which corresponds to the current output upper limit and frequency (pulse) output upper limit and 100% display value. The flow lower limit is automatically set to “0”.

Therefore, the instrument range setting determines the range limit, and also the corresponding relationship between percentage display, frequency output, current output and flow:

Percentage display value (%) = (flow measurement value/ range value) * 100 %;

Frequency output value (Hz)= (flow measurement value/ range value) * frequency full range value;

Current output value (mA) = (flow measurement value/ range value) *20 .00+ 4.000;

The pulse output value is not affected by the range setting of the instrument;

Measurement damping time

It refers to the filtering time; long measurement damping time can improve the stability of instrument flow display and output signal, which is suitable for the measurement of total integrated pulsating flow; short measurement damping time results in faster response speed, which is suitable for production process control. The measurement damping time is: 1S, 2S, 3S, 4S, 6S, 8S, 10S, 15S, 30S, 60S, which can be set by selection.

Enable peak inhibition

For the flow measurement of pulp, mud and other slurries, the “peak pseudo-signal” will be caused by the friction or impact of solid particles in fluid on the measuring electrode. To overcome such pseudo-signals, the converter is designed with a peak inhibition function. The peak fluctuation flow value and peak width time are set by the user, and the converter will inhibit the peak pseudo-signal conforming to the set value, so as to minimize the flow fluctuation.

The parameter of “Enable Peak Inhibition” has two functions: 1) if set as “Enable”, the peak inhibition function is enabled; 2) if set as “Disable”, the peak inhibition function is disabled and the noise sensitivity test is enabled.

Peak inhibition range

This parameter has two functions:

1) When “Enable Peak Inhibition” is set to “Enable”, this value confirms the initial value of peak inhibition, which is used to set the flow velocity fluctuation value of pseudo-signals to be inhibited. If the current flow velocity fluctuation is higher than this initial value, this change is considered to be due to peak pseudo-signal, and the system will cut it and display PSM alarm. If the current flow velocity fluctuation is lower than this initial value, this change is considered to be caused by the real change of flow velocity, and the system recognizes it is to measure the change of flow velocity.

2) When “Enable Peak Inhibition” is set to “Disable”, this value determines the sensitivity test to noise. If “FST” is frequently displayed, it is recommended to increase the value of “Peak Inhibition Range”.

Peak inhibition time

This parameter selects the peak width time of peak pseudo-signals to be inhibited. The noise error is in seconds, and the peak inhibition range technique can eliminate the coarse error noise, as shown in Figure 30.

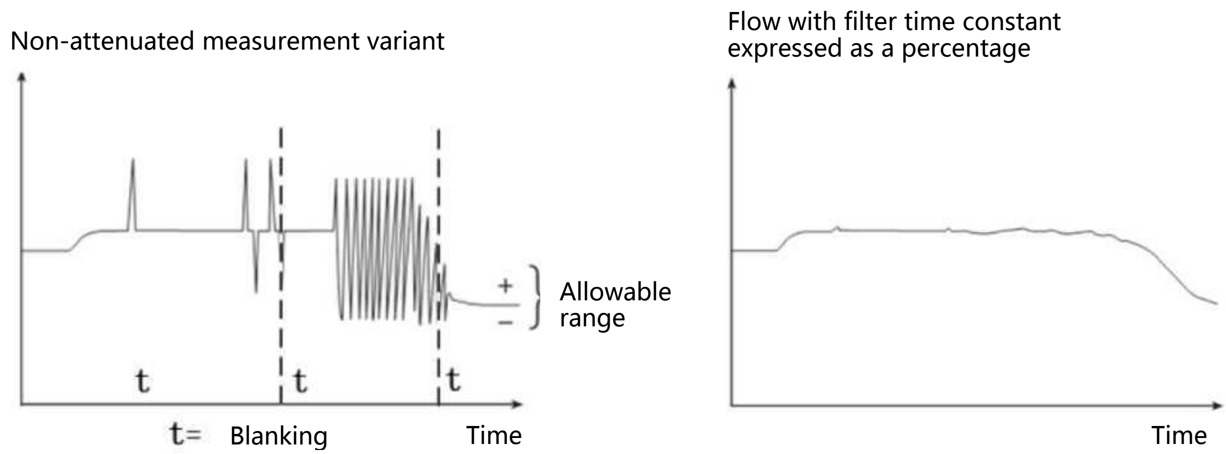


Figure 30: Using peak inhibition range technique to eliminate coarse error noise

Abnormal inhibition time

For abnormal situations like bubbles in the water, in order to prevent the flow from returning to “zero”, the converter is designed with abnormal inhibition function on hardware and software. When abnormal situations are detected, the converter displays an “ABN” abnormal alarm.

This will inhibit the abnormal flow in a period of time, prevent the flow from returning to “zero” and minimize the flow fluctuation.

This parameter is used for the duration of abnormal inhibition. The value ranges from 0 to 99s; this function will be turned off when 0s is selected.

Flow direction option

If the user considers that the fluid direction during debugging is inconsistent with the designed, he/she can change the flow direction setting parameters, instead of changing the excitation line or signal line connection.

Enable signal cut

When this parameter is set to “Disable”, as long as the fluid flows, the converter will output pulses and currents at the flow value.

When this parameter is set to “Enable”, if the flow fluid is lower than the flow set at CUT point, the converter displays normal flow velocity, small signal cut (CUT), output pulse of “0”, current output signal of “0” (4mA) and instantaneous flow quantity of “0”.

When this parameter is set to “Enable” and “Alarm Output Mode” to “Signal Cut Alarm”, if the fluid flow is lower than the flow set at CUT point, the converter displays normal flow velocity, small signal cut (CUT), output pulse of “0”, current output signal of “0” (4mA) and instantaneous flow quantity of “0”. The ALAM+ and ALAM-outputs have output signals, which are OC gate outputs.

Small signal cut point

This parameter is expressed in terms of flow value and used in conjunction with Enable Signal Cut.

Fluid density

The fluid density unit is automatically selected. This parameter is effective when the mass units of kg/s, kg/m, kg/h, t/s, t/m, t/h are selected in Flow Unit. When the flow unit is set to kg/s, kg/m, kg/h, the density unit is automatically kg/L. When the flow unit is set to t/s, t/m, t/h, the density unit is automatically t/m3.

Flow zero correction

When correcting “zero”, make sure that the sensor tube is filled with stationary fluid. Flow zero is expressed in terms of flow velocity in mm/s. The flow zero correction of converter is shown as follows:

FS =±0 0 0 0 0

±0000

Upper small fonts: FS represents the measured zero value of instrument. Lower large fonts: Flow zero correction value;

When the FS display is not “0”, the correction value should be adjusted to make FS = 0. Note: If the lower correction value is changed, the FS value increases, the plus or minus signs of lower values need to be changed so that FS can be corrected to zero.

Factory calibration coefficient

This coefficient is the calibration coefficient of the converter, which is used by the manufacturer. When the converter leaves the factory, the converter is calibrated with a special standard calibrator, so that all the converters are consistent, so as to ensure the interchangeability and measurement accuracy of the converter. When the converter fails, it can be replaced with a converter with the same excitation current. After resetting the “Measuring Tube Diameter” and “Sensor Coefficient Value” menus, the measurement accuracy of the instrument will not change.

Total reset password

The user can set this password with one password at Level 3 or higher, and then enter it in “Total Reset”. If correct, the password will automatically change to “00000” after pressing “OK”, and the integrated flow will be reset successfully. If incorrect, there is no change in the password area after pressing “OK”, and the integrated flow fails to be reset.

The steps for resetting the integrated flow are as follows:

(1) Press “▶”(right key) to display the parameter setting password (00000), and input the corresponding password, move the cursor to “▲” (up) on the LCD, and then press “▲” to enter the level 1 menu “parameter setting”;

(2) Press “▼”(down) once, and the menu page turns to “Total Reset”;

(3) Move the cursor to “▲” on the LCD, and then press “▲” again to display the reset password “00000”;

(4) Enter the correct reset password (not the password for entering the menu), move the cursor to “▲” on the LCD, and then press “▲” again; if correct, the password automatically changes to “00000”, the reset is successful; if incorrect, there is no change in the password area, the reset is failed.

(5) Move the cursor to “▼”, and then press “▼” to return to the measurement state.

Input function selection

To meet the requirements of special users and processes, part of the flowmeter display status can be controlled by external signals. This function can be controlled by an input signal from the external IN_C port. When the IN_C and COM terminals are at low points, the normal function is effective and set by the user. When selecting “Net Flow Reset”, the net integrated flow of instrument is automatically set to zero; when selecting “Forward Flow Reset”, the integrated forward flow is reset, and net integrated flow is automatically adjusted; when selecting “Reverse Flow Reset”, the integrated reverse flow is reset, and net integrated flow is automatically adjusted; when selecting “Flow Reset”, the instantaneous flow is displayed as zero, the current output is 4.000mA, and the frequency output is 0Hz; when selecting “Flow Hold”, the display will stabilize at the value before setting, and the output will remain unchanged.

12.3.2 Digital output parameters

Alarm output selection

This parameter defines the functions of ALAM+ and ALAM- outputs, which can be set as “Disable Alarm Output, Reverse Total Alarm, Forward Total Alarm, Abnormal Signal Alarm, Reverse Alarm Output, System Alarm Output, Empty Pipe Alarm Output, Signal Cut Alarm, Lower Limit Alarm Output and Upper Limit Alarm Output”.

Upper limit alarm value

This parameter is calculated by flow quantity and set by numerical value. The user sets an appropriate flow quantity value in this parameter. When the instantaneous flow quantity of the instrument is higher than this value during operation, it will be output and displayed according to the parameters of “Alarm Output Function”.

Lower limit alarm value

The lower limit alarm value is calculated by flow quantity, and set by numerical value. The user sets an appropriate flow quantity value in this parameter. When the instantaneous flow quantity of the instrument is lower than this value during operation, it will be output and displayed according to the parameters of “Alarm Output Function”.

Empty pipe alarm threshold

When the pipe is filled with fluid (with or without flow velocity), the measured conductivity will be displayed on the upward of this parameter, and the empty pipe alarm threshold is set on the downward. The empty pipe alarm threshold can be set as 3~5 times of the measured conductivity.

Empty pipe zero correction

When the pipe is filled with fluid, if MZ value is large, the user can correct the empty pipe zero. While correcting, make sure that the sensor pipe is filled with fluid. The zero correction is shown as follows:

MZ - 0 0 0 1 5 + 0 0 0 0

Upward: MZ represents the measured zero value of empty pipe.

Downward: Zero correction value of empty pipe.

Firstly, according to the measured MT value, adjust the zero correction value to make MZ =5-10 (note: if the downward correction value is increased, the MZ value will decrease).

This parameter can be changed only when the password is level 5.

Empty pipe range correction

When the MT value measured by the converter is too small, the user can correct the empty pipe range. While correcting, make sure that there is no fluid in the sensor pipe. The empty pipe range correction display is as follows:

MR - 0 0 1 0 7
1.0 0 0 0

Upward: MR represents the measured range value of empty pipe.

Downward: Range correction value of empty pipe.

When the downward correction value is increased, the MR value increases; when the downward correction value is decreased, the MR value decreases. The user can adjust the MR to an appropriate value (MR=500 advised) according to actual needs, so the measured conductivity value at empty pipe is basically the actual corrected MR value.

This parameter can be changed only when the password is level 5.

Empty pipe damping time

This parameter is the lag time of empty pipe detection, ranging from 10~60s.

Low total alarm

When the “Alarm Output Function” is set to “Total Alarm”, the alarm value is divided into 5 high levels (high total alarm) and 5 low levels (low total alarm).

High total alarm

When the “Alarm Output Function” is set to “Total Alarm”, the alarm value is divided into 5 high levels (high total alarm) and 5 low levels (low total alarm).

12.3.3 Pulse output parameters

Pulse output mode

There are two pulse output modes: frequency output and pulse output:

PO frequency output mode: the frequency output is a continuous square wave, and the frequency value corresponds to the flow percentage.

Frequency output value = (measured flow value /instrument range limit) * output range + output lower limit (0Hzby default).

Pulse output mode: the pulse output is a rectangular wave pulse train; each pulse represents a flow equivalent of the pipeline. The pulse equivalent is set by the following two parameters: “pulse equivalent unit” and “pulse equivalent”. Pulse output mode is mostly used for total flow accumulation, which is generally connected with the integrating meter (or PLC).

There are two pulse output modes: PO pulse output and DO pulse output.

PO pulse output: active pulse; corresponding hardware interface: FP+ and FP-terminal output.

DO pulse output: passive pulse; corresponding to ALAM+ and ALAM- terminal output, isolated from 4~20mA output (※ the alarm will only be displayed but not output in this mode).

Frequency and pulse outputs are generally in OC gate form; therefore, it should be externally connected with DC power supply and load. See 11.3.2 and 11.3.3 for details.

Pulse unit

The converter has four pulse equivalent units: m3, L, UKG, USG, kg, and t.

Pulse equivalent

Pulse equivalent refers to the flow value represented by a pulse. This means: the pulse equivalent of meter needs to be set according to the “pulse equivalent unit” and “pulse equivalent”, ranging from 0.001~59.999m3, 0.001~59.999L, 0.001~59.999ukg, 0.001~59.999usg, 0.001~59.999kg, 0.001~59.999t.

At the same flow quantity, if the pulse equivalent is small, the output pulse frequency will be high and the integrated flow error will be small.

Pulse width

The pulse output is active at low level, and pulse width is 0.5---1999ms. See Table 14 for details.

No.	Pulse Width (ms)	Maximum Output Pulse per Hour (p/h)
1	0.5	3600000
2	1	1800000
3	5	360000
4	10	180000
5	50	36000
6	100	18000
7	500	3600
8	999	1800
9	9999	180

Table 14: Pulse Width - Maximum Output Pulse

Frequency output lower limit

The frequency output range of the converter corresponds to the zero of flow measurement, and the default value is 0Hz.

Frequency output range

The frequency output range of the converter corresponds to the upper limit of flow measurement.

Current output mode

At present, users can only choose 4~20 mA current output.

Current zero correction

The current output zero of the converter is adjusted at the factory, so that the current output accuracy is 4.000mA.

Current full scale correction

The current full scale of the converter is adjusted at the factory, so that the current output accuracy is 20.00mA.

Current output test

After adjusting the current zero correction and current full-scale correction, the user can use this parameter to test the output current linearity of the converter. Regardless of whether the flowmeter is really flowing, the user can set 0, 20.00, 50.00, 70.00, and 99.99 to check the linearity of output current.

Output function test

This function is designed to check whether the current output and frequency output ports are normal. The selection range is0%, 25%, 50%, 75%, 100%; 0% corresponds to 4mA and 0Hz, and 100% corresponds to 20mA and the maximum output frequency (see “Frequency Output Range” in 12.3.3 Pulse Parameters). When this function is enabled, both current output and frequency output ports simultaneously output percentages corresponding to the setting, independent of the corresponding value in the actual measurement state. In the measurement state, this function will be automatically disabled.

12.3.4 Sensor parameters

Measuring tube diameter

MGH electromagnetic flowmeter can choose matching nominal diameter of 3~3000mm according to table lookup.

DN (15, 20, 25, 32, 40, 50, 65, 80, 100, 125, 150, 200)

Excitation frequency selection

The converter can provide six excitation frequency options (the default power supply is 50Hz and excitation frequency is 6.25 Hz before delivery). The user can set according to the actual situation:

50Hz power supply mode: 3.125Hz, 4.167 Hz, 6.250 Hz;

The excitation frequency is set at the factory, and cannot be changed by users at will. Once changed (as required), it needs to be re-calibrated.

Sensor coefficient

Sensor coefficient refers to calibration coefficient of the entire electromagnetic flowmeter. The coefficient is actually calibrated and stamped on the sensor plate.

Enable flow velocity correction

The “enable flow velocity correction” menu can be set to “Enable” or “Disable”. When selecting “Enable”, the function of “flow correction points 1-5” is available; according to the set flow correction point, it can be segmented to ensure the maximum accuracy of flowmeter. When selecting “Disable”, the function of “flow correction points 1-5” is unavailable. This function is mainly used by manufacturer(s). If users really need to use it, they can ask the manufacturer(s) for the corresponding use method.

Sensor code 1

Sensor code 1 can be used to mark the ex-factory time and serial number of the matching sensors, which is convenient for manufacturers and users to trace the source.

Sensor code 2

Sensor code 2 has the same function as sensor code 1.

12.3.5 Communication Parameters

Instrument communication mode

The converter can provide three communication modes: MODBUS-A (standard RTU format), HART communication (current loop communication), PROFIBUS-DP. This menu is used to define the communication mode between the flowmeter and upper computer. The converter comes standard with Modbus-A signals, while maintaining 4-20mA and pulse output functions.

Instrument communication address

The communication address ranges from 01 ~250. Address 0 is reserved.

Instrument communication speed

Instrument BPS selection range: 300, 600, 1200, 2400, 4800, 9600, 19200, 38400.

Instrument calibration mode

In order to meet the flexibility of customer programming and adapt to different PLC systems or DCS systems, the optional verification methods are:

(1) No Parity, 8 data, 1 stop

(2) Odd Parity, 8 data, 1st.

(3) Even Parity, 8 data, 1s.

(4) No Parity, 8 data, 2stop

(5) Odd Parity, 8 data, 2st.

(6) Even Parity, 8 data, 2s.

12.3.6 Advanced Services

Passwords 1-4

In order to enable users to manage flowmeters in different levels, operators or managers at different levels use different passwords; each password should be modified by the administrator at a higher level. If you use a level-5 password to enter, you can modify passwords 1-4.

Instrument code 1-2

Instrument code 1-2 records the factory time and number of the converter.

High/low forward total

When the password access to the menu is correct, the user can modify the integrated forward flow, which is mainly used for instrument maintenance/replacement.

The user can modify the integrated forward flow (Z+) by entering with the level-5 password; generally, the set integrated flow cannot exceed the maximum value (9999999999) counted by the counter. 5 digits on the right of integrated forward flow correspond to the “low forward total”, while 5 digits on the left correspond to the “high forward total”.

High/low reverse total

When the password access to the menu is correct, the user can modify the integrated reverse flow, which is mainly used for instrument maintenance/replacement.

The user can modify the integrated reverse flow (Z-) by entering with the level-5 password; generally, the set integrated flow cannot exceed the maximum value (9999999999) counted by the counter. 5 digits on the right of integrated reverse flow correspond to the “low reverse total”, while 5 digits on the left correspond to the “high reverse total”.

12.4 Setting Example

Modify the instrument communication address 001 to 005.

a. Start
b. | 00000
c. Parameter setting
d. Measurement parameter
e. Communication parameter
f. I Instrument Communication Mode I
g. I Instrument Communication Address I
h. 001
i. I Instrument Communication Address I
j. I Communication Parameter I
k. I Parameter Setting I
l• End

(Press "▶" once)

（Enter the password, add 1 to the number of ▲, subtract 1 from the number of ▼, move the cursor of ◀ to left, move the cursor of ▶ to right. After entering the password, press "▶" twice, move the cursor to the bottom of "▲" on the LCD, and press "▲" once to enter the menu ）

(Press "▶" twice, move the cursor to the bottom of "▲" on the LCD, and press "▲" once to enter)

(Press "▲" 5 times to turn pages in the level 1 menu)

(Press "Return" twice to turn pages in the level 2 menu, move the cursor to the bottom of "▲" on the LCD, and press "▲" once to enter)

(Press A] twice to turn pages in the third menu, move the cursor to the bottom of "▲" on the LCD, and press "▲" once to enter)

(Press "▶" twice, move the cursor to the bottom of "▲" on the LCD, and press "▲" once to enter)

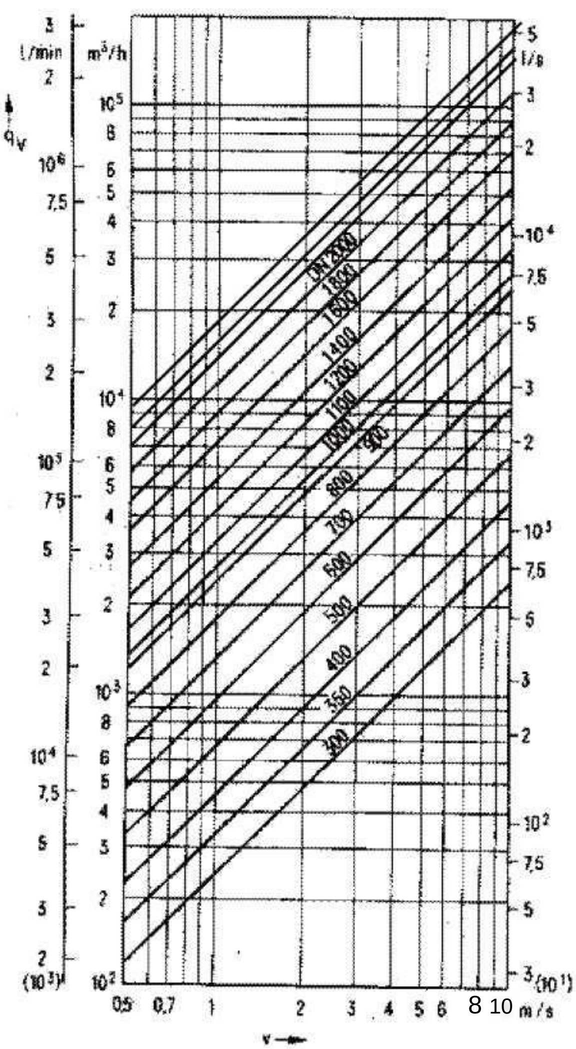
(Change to 005, press "▶" once, move the cursor to the bottom of "▼" on the LCD, and press "▼" once to back to Instrument Communication Address)

(Press "▶" once, move the cursor to the bottom of "▼" on the LCD, and press "▼" once to back to Communication Parameter)

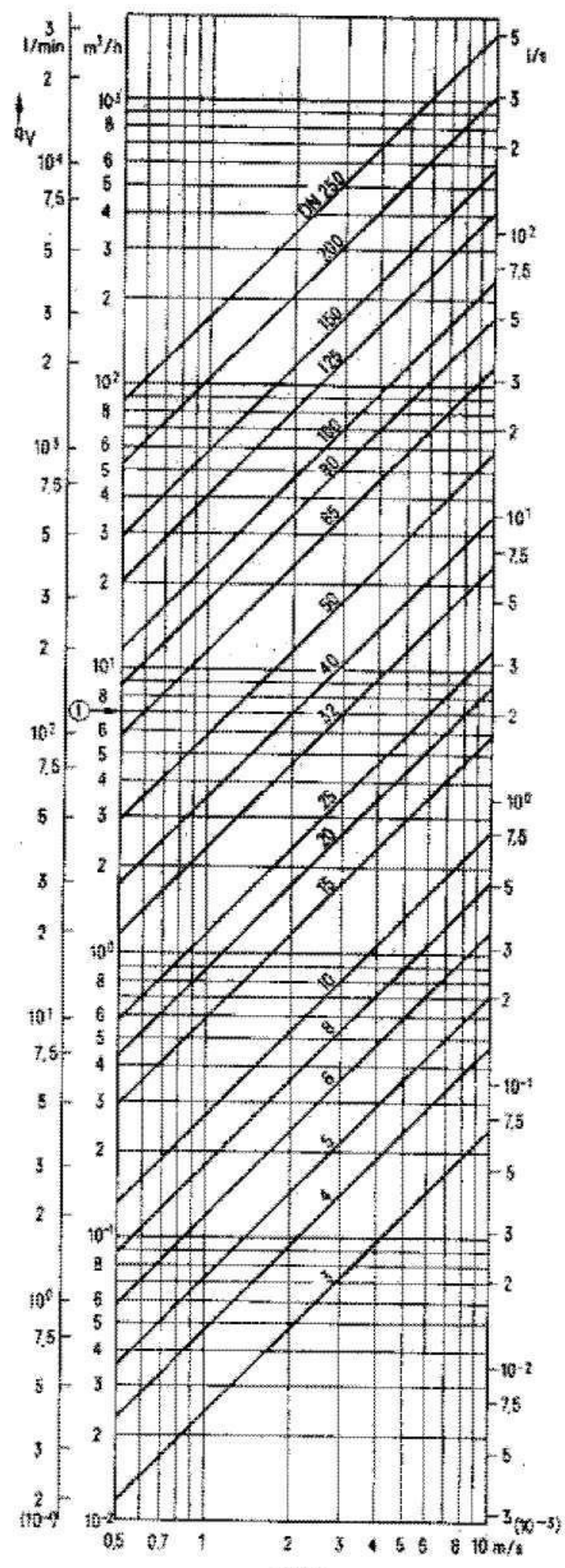
(Press "▶" once, move the cursor to the bottom of "▼" on the LCD, and press "▼" once to back to Parameter Setting)

(Press "▶" once, move the cursor to the bottom of "▼" on the LCD, and press "▼" once to back to the measurement state)

Attached Figure: Conversion between Volumetric Flow and Flow Velocity



Flow Nomogram of Specifications DN300-DN2600



Flow Nomogram of Specifications DN15~ DN250

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