Electromagnetic Flow Meter Instruction

Henan Ruizhiyang Automation Instruments Co., Ltd.

Table of Contents

www.rzyflowmeter.com

1.Overview, Features and Applications of Electromagnetic Flowmeter

1.1Product Overview

Electromagnetic Flowmeter (EMF) is a new type of flow measuring instrument that developed rapidly with the advancement of electronic technology in the 1950s–1960s.

It is based on the principle of electromagnetic induction. The flow rate of a conductive fluid is measured according to the induced electromotive force generated when the conductive liquid passes through a magnetic field.

1.2 Product Features

- Measurement is not affected by fluid density, viscosity, temperature, pressure, or conductivity variations. The linear measurement principle ensures high accuracy.
- No obstruction or moving parts in the measuring tube, resulting in low pressure loss. It does not cause additional energy loss or blockage. Suitable for energy-saving applications, especially for solid-liquid two-phase media such as sewage, slurry, ore pulp, and paper pulp.
- Low installation requirements: straight pipe section upstream ≥ 5D, downstream ≥ 3D (D = inner diameter).
- Wide nominal diameter range: DN3–DN3000. Multiple liner and electrode options are available to meet various conductive fluid measurement requirements.
- Optional communication outputs: MODBUS-RS485, HART, GPRS, PROFIBUS.
- Converter uses a 32-bit embedded microprocessor with full digital processing, fast computation speed, strong anti-interference capability, high reliability and accuracy. Turndown ratio up to 1500:1.
- High-definition backlit LCD display with full English menu operation, easy to use and learn.
- Conductivity measurement function for empty pipe detection, with self-check and self-diagnosis capability.
- Built-in totalizer displays forward cumulative flow, reverse cumulative flow, and instantaneous flow.
- Insertion-type electromagnetic flowmeter allows on-site hot tapping installation without flow interruption, offering significant installation and cost advantages.

1.3 Product Applications

Electromagnetic flowmeters are used to measure volumetric flow of conductive fluids in closed pipelines.

They are widely applied in industries such as petroleum, chemical engineering, steel metallurgy, water supply and drainage, irrigation, water treatment, environmental wastewater monitoring, paper making, pharmaceuticals, and food processing for flow measurement and process control.

Operating Environment Conditions

- Ambient temperature:
  Sensor: -25°C to +60°C
  Converter: -10°C to +60°C
- Relative humidity: 5%–95%

Operating Conditions

- Fluid conductivity: ≥ 5 μS/cm
  (Typical conductivity of tap water or raw water: approximately 100–500 μS/cm)

2. Working Principle

2.1 Mathematical and Physical Model

The measurement principle of the electromagnetic flowmeter sensor is based on Faraday's law of electromagnetic induction.

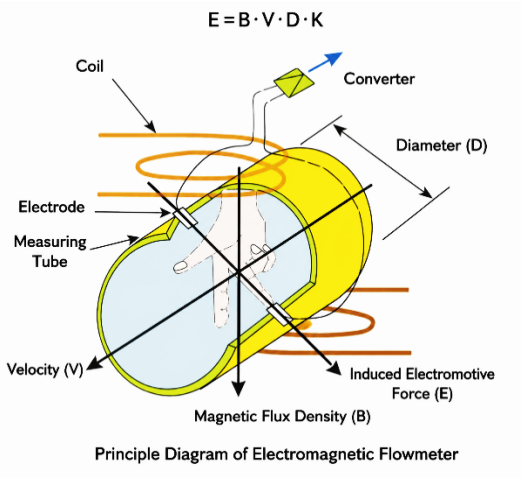
A pair of electrodes is installed on the pipe wall perpendicular to both the pipe axis and the magnetic field lines. When a conductive fluid flows through the measuring tube and cuts the magnetic field lines, an induced electromotive force is generated.

The induced voltage is detected by the electrodes and its value is:

$E = K \times B \times V \times D$

Where:

- E — Induced electromotive force
- K — Instrument constant
- B — Magnetic flux density
- V — Average flow velocity in the measuring tube cross-section
- D — Inner diameter of the measuring tube



Principle Diagram of Electromagnetic Flowmeter

When measuring flow, the conductive fluid moving through a magnetic field generates an induced voltage proportional to the average velocity. Therefore, the fluid must have conductivity above a minimum threshold.

The signal is collected by electrodes and transmitted to the converter via cables. After signal processing and computation, instantaneous flow and total flow are displayed on the converter screen.

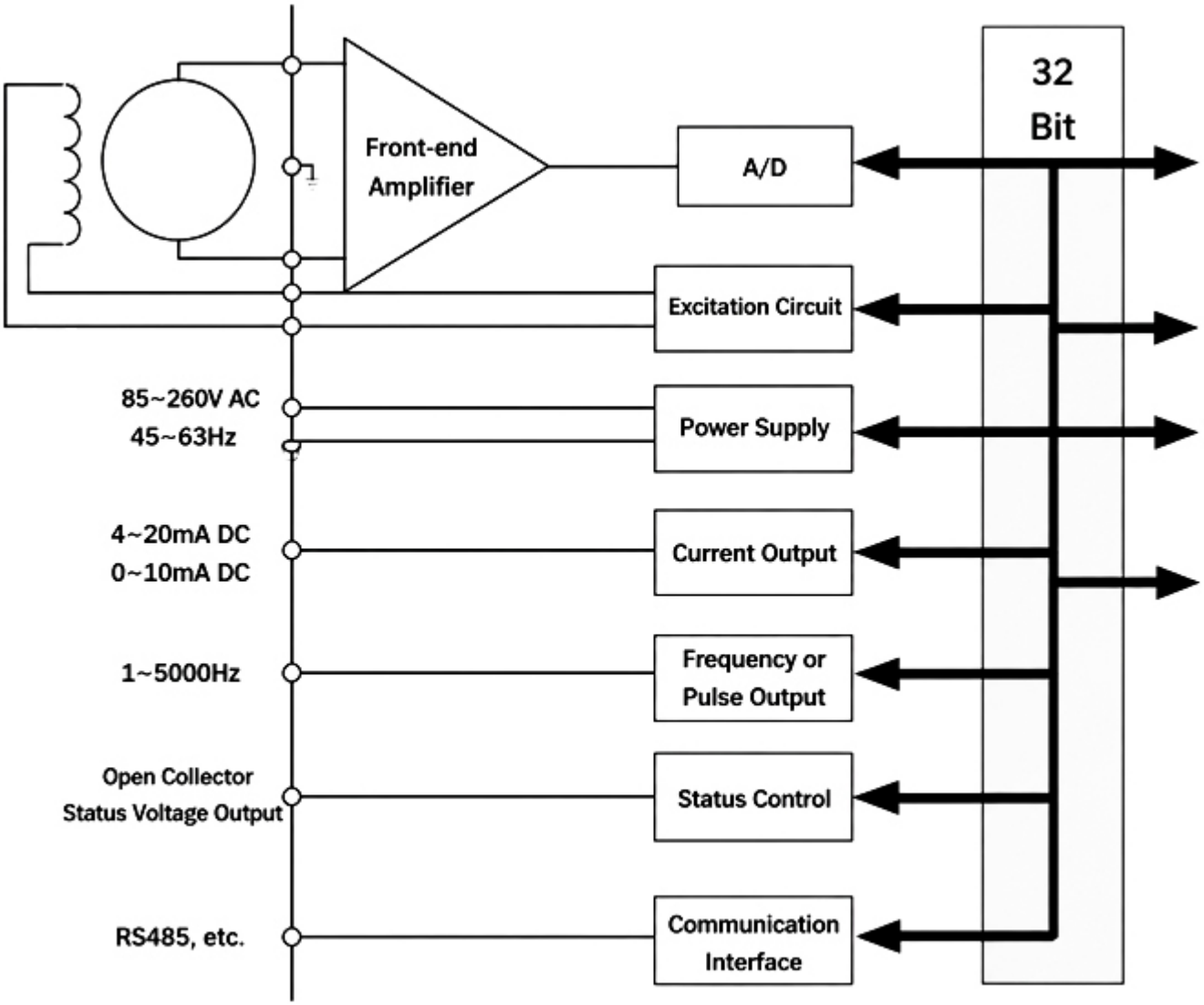
2.2 Converter Circuit Structure

The electromagnetic flowmeter converter supplies a stable excitation current to the sensor excitation coil.

The preamplifier amplifies the induced electromotive force generated by the sensor and converts it into standard current or frequency signals for flow display, control, and regulation.

The converter circuit structure is responsible for:

- Providing excitation current to the sensor coil
- Amplifying weak electrode signals
- Converting signals into standard outputs
- Suppressing interference signals


Front-end
Amplifier
A/D
32
Bit
Excitation Circuit
85~260V AC
45~63Hz
Power Supply
4~20mA DC
0~10mA DC
Current Output
1~5000Hz
Frequency or
Pulse Output
Open Collector
Status Voltage Output
Status Control
RS485, etc.
Communication
Interface

3. Product Structure and Types

3.1 Product Structure Composition

The electromagnetic flowmeter is mainly composed of the magnetic circuit system, measuring tube, electrodes, housing, and converter. Among these, the magnetic circuit system, measuring tube, electrodes, and housing together form the electromagnetic sensor.

- **Magnetic circuit system:** generates a uniform DC or AC magnetic field.
- **Measuring tube:** provides a passage for the conductive fluid. To prevent magnetic flux shunting or short-circuiting, the tube must be made of non-magnetic, low electrical conductivity, low thermal conductivity materials with sufficient mechanical strength. Materials include non-magnetic stainless steel, fiberglass, or high-strength plastics.
- **Electrodes:** extract the induced electromotive force proportional to the flow signal. They are typically made of non-magnetic stainless steel and are installed flush with the liner to avoid flow disturbance.
- **Lining:** an electrically insulating layer on the inner wall of the measuring tube and flange sealing surface. It improves corrosion resistance and prevents short-circuiting of the induced signal through the metal pipe wall. Common materials include rubber, fluoroplastics, and ceramics with resistance to corrosion, high temperature, and abrasion.
- **Converter:** amplifies and converts the weak induced signal into a standard output signal while suppressing interference. It processes the electrode signal and outputs a unified DC signal.

3.2 Product Types

Electromagnetic flowmeters are classified into:

- **Integral type (compact type)**
- **Remote split type**

The split type requires a dedicated cable to connect the converter and the sensor. Both types can be used in explosion-proof environments when applicable.

3.3 Electrodes and Linings

The electromagnetic flowmeter offers 7 types of electrode materials and 7 types of liner materials for selection.

Table 1: Electrode Materials and Applications

No.	Electrode Material	Application Range
1	316L	Suitable for water, wastewater, and weakly corrosive media such as inorganic and organic acids
2	Hastelloy B (HB)	Excellent resistance to hydrochloric acid of all concentrations below boiling point; also resistant to sulfuric acid, phosphoric acid, hydrofluoric acid, organic acids, alkalis, and non-oxidizing salts
3	Hastelloy C (HC)	Resistant to oxidizing acids such as nitric acid and mixed acids; also resistant to oxidizing salts (Fe^{3+}, Cu^{2+}), hypochlorite solutions, and seawater at elevated temperatures
4	Titanium (Ti)	Resistant to seawater, chlorides, hypochlorites, oxidizing acids (including fuming nitric acid), organic acids, and alkalis; not resistant to strong reducing acids unless oxidizers are present

5	Tantalum (Ta)	Excellent corrosion resistance similar to glass; resistant to almost all chemical media except hydrofluoric acid, fuming sulfuric acid, fuming nitric acid, and alkalis
6	Platinum-Iridium Alloy	Suitable for almost all chemical media except aqua regia and ammonium salts
7	Tungsten Carbide	High wear resistance, suitable for abrasive media such as pulp, slurry, and ore mixtures

Table 2: Liner Materials, Properties and Applications

No.	Liner Material	Main Properties	Application Range
1	Chloroprene Rubber (CR)	Oil-resistant, solvent-resistant, oxidation-resistant, good elasticity and wear resistance, but poor low-temperature performance	Non-strong acid/alkali/oxidizing media at 0°C–80°C; wastewater and slurry
2	Fluorosilicone Rubber (FVMQ)	Good low-temperature performance (-55°C), excellent heat resistance (up to 180°C)	-25°C to 150°C non-abrasive and non-corrosive media; high-temperature fluids
3	Polyurethane (PU)	Excellent wear resistance and elasticity; poor acid and alkali resistance	-25°C to 60°C; strongly abrasive media such as mineral slurry, coal slurry, mud
4	PFA (Perfluoroalkoxy)	Excellent hydrophobic and non-stick properties; strong corrosion resistance; moderate wear resistance	-25°C to 140°C; non-strong abrasive and hygienic applications
5	FEP (F46)	Hydrophobic and non-stick; corrosion resistance second only to PFA; moderate wear resistance	-25°C to 100°C; hygienic and non-abrasive media
6	PTFE	Most chemically stable plastic; resistant to boiling acids, strong alkalis, and most solvents; poor wear resistance and vacuum resistance	-25°C to 140°C; strong corrosive media and hygienic applications
7	Ceramic (Al_2O_3)	High wear resistance, excellent corrosion resistance, high stability and accuracy, good thermal shock resistance	Chemical industry, mining, food industry

Note:
Before selection, full understanding of electrode and liner properties is required. For complex working conditions, consultation with the manufacturer is recommended.

4. Technical Performance Specifications

4.1 Complete Unit and Sensor

Standard	Electromagnetic Flow Sensor “JB/T 9248-1999			
Verification Regulation	JJG 1003-2007 Electromagnetic Flowmeter			
Maximum flow velocity	15m/s			
Fluid conductivity	≥5μS/cm			
Accuracy class	±0.2% of reading, ±0.5% of reading			
Nominal Diameter (mm)	3、6、10、15、20、25、32、40、50、65、80、100、125、150、200、250、 300 、350 、400 、450 、500 、600 、700 、800 、900 、1000 、1200 、1400 、 1600、1800、2000、2200、2400、2600、2800、3000			
Nominal Pressure	10.0MPa、6.3MPa、4.0MPa、2.5MPa、1.6MPa、1.0MPa、0.6MPa			
Ambient Temperature	Sensor	-25℃ ~ +60℃		
	Converter / Integral type	-10℃ ~ +60℃		
Liner Materials	Chloroprene rubber, PTFE, polyurethane rubber, FEP, PFA, ceramic, etc.			
Signal Electrode Type	Fixed type, scraper type, removable type			
Electrode/Ground Electrode Materials	316L, Hastelloy B, Hastelloy C, Titanium (Ti), Tantalum (Ta), Platinum-Iridium alloy, Tungsten carbide			
Flange Materials	Carbon steel, stainless steel (304, 316, 316L)			
Flange Standards	National standard, Mechanical Ministry standard, Chemical industry standard (ANSI and JIS available upon request)			
Grounding Ring Material	Stainless steel 1Cr18Ni9Ti			
Electrical Interface	M18×1.5, M20×1.5			
Transmission Distance	For split type, cable length between sensor and converter should be ≤ 100 m			
Protection Rating	Complete Unit: IP65	Sensor IP68 Converter IP65	Sensor IP67 Converter IP65	Complete Unit IP68
Power Supply	220 VAC, 24 VDC, 3.6 V battery, dual power supply options			
Power Consumption	< 20 W			
Display Function	Chinese/English display, showing instantaneous flow, cumulative flow, and alarm status (excitation alarm, empty pipe alarm, flow limit alarm)			

4.2 Flow Range

Pipe Diameter - Flow Rate - Flow Velocity Reference Table

Flow velocity (m/s) / Pipe diameter (mm)	0.3	0.4	0.5	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0
3	0.008	0.01	0.013	0.025	0.05	0.075	0.1	0.125	0.15	0.175	0.2	0.225	0.25
6	0.03	0.04	0.05	0.1	0.2	1.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
10	0.09	0.11	0.14	0.28	0.57	0.85	1.1	1.4	1.7	2	2.3	2.5	2.8
15	0.2	0.3	0.4	0.6	1.3	1.9	2.5	3.2	3.8	4.5	5.1	5.7	6.3
20	0.4	0.5	0.6	1.1	2.3	3.4	4.5	5.7	6.8	7.9	9	10	11
25	0.6	0.7	0.9	1.8	3.5	5.3	7.1	8.8	11	12	14	16	17
32	0.9	1.2	1.4	2.9	5.8	8.7	12	14	17	20	23	26	28
40	1.4	1.8	2.3	4.5	9	14	18	23	27	32	36	41	45
50	2.2	2.8	3.5	7.1	14	21	28	35	42	49	57	64	70
65	3.6	4.8	6	12	24	36	48	60	72	84	96	100	110
80	5.4	7.2	9	18	36	54	72	90	100	120	140	160	180
100	8.4	11	14	28	57	85	110	140	170	190	220	250	280
125	14	17	22	44	80	130	170	220	260	300	350	390	440
150	20	25	32	64	120	190	250	310	380	440	500	570	630
200	34	45	57	110	220	340	450	560	670	790	900	1000	1100
250	54	71	88	180	350	530	700	880	1000	1200	1400	1500	1700
300	77	100	120	250	500	760	1000	1200	1500	1700	2000	2200	2500
350	110	140	180	350	690	1000	1300	1700	2000	2400	2700	3100	3400
400	140	180	230	450	900	1300	1800	2200	2700	3100	3600	4000	4500
450	180	230	290	570	1100	1700	2300	2800	3400	4000	4500	5100	5700
500	220	280	360	710	1400	2100	2800	3500	4200	4900	5600	6300	7000
600	310	410	510	1000	2000	3000	4000	5100	6100	7100	8100	9100	10000
700	420	550	700	1400	2700	4100	5500	7000	8300	9600	11000	12000	13000
800	550	720	910	1800	3100	5400	7200	9000	10000	12000	14000	16000	18000
900	690	920	1200	2300	4500	6800	9100	11000	13000	16000	18000	20000	22000
1000	850	1100	1500	2800	5600	8500	11000	14000	16000	19000	22000	25000	28000
1200	1300	1600	2100	4100	8100	12000	16000	20000	24000	28000	32000	30000	40000
1400	1700	2200	2800	5500	11000	16000	22000	27000	33000	38000	44000	50000	55000
1600	2200	2900	3700	7200	14000	21000	29000	36000	43000	50000	57000	65000	72000
1800	2800	3700	4600	9200	18000	27000	36000	45000	54000	64000	73000	82000	91000
2000	3400	4500	5700	11000	22000	34000	45000	56000	67000	79000	90000	100000	110000
2200	4200	5500	6900	14000	27000	41000	56000	68000	82000	95000	110000	120000	130000
2400	4900	6500	8200	16000	32000	48000	68000	8100	97000	110000	130000	140000	160000
2600	5800	7600	9600	19000	38000	57000	76000	95000	110000	130000	150000	170000	190000
2800	6700	8900	12000	22000	44000	66000	88000	110000	130000	150000	170000	190000	220000
3000	7700	10000	13000	25000	50000	76000	100000	120000	150000	170000	200000	220000	250000

4.3 Protection Rating Description

According to GB 4208 standard:

- **IP65 (Jet-proof type):**
  Allows water spray from any direction at 30 kPa, flow rate 12.5 L/min, nozzle distance 3 m.
- **IP67 (Immersion type):**
  Temporary immersion in water up to 1 m depth for 30 minutes.
- **IP68 (Submersible type):**
  Long-term operation under water (typically up to 5 m depth, subject to manufacturer agreement).

Note: Selection should be based on installation environment. For buried or high-humidity installations, split type is recommended with sensor IP68 and converter installed indoors or in a protective enclosure.

4.4 Explosion-Proof Description

- DN3–DN600 integral type: Ex (ia) IIC T5
- DN3–DN1600 split type (sensor & converter in hazardous area): Ex (ia) IIC T5
- DN3–DN1600 split type (converter in safe area): Ex (ia) IIC T4

Explosion-proof classification explanation:

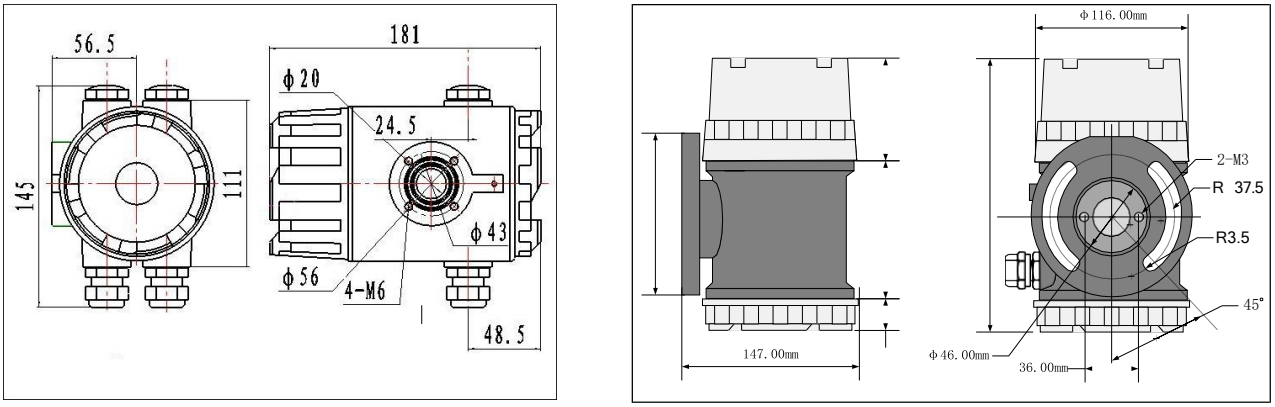
- Ex: Explosion-proof marking
- ia: Intrinsically safe type
- IIC: Gas group IIC
- T5 / T4: Temperature class

4.5 Main Performance of Converter

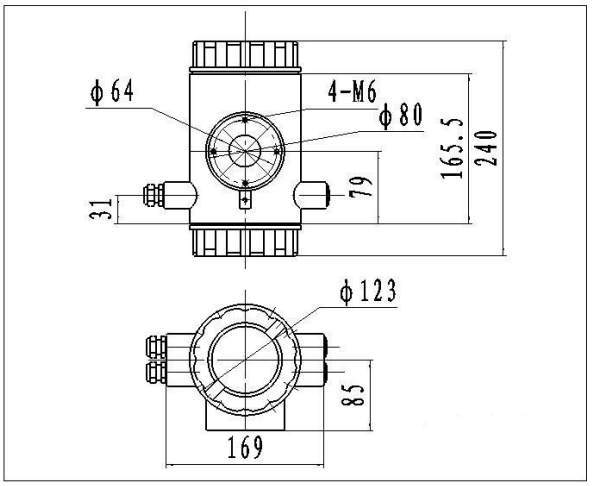
- **Power supply:**
  - AC: 85–250 V, 45–63 Hz, < 20 W
  - DC: 20–36 V switching power supply
  - Battery: 3.6 V lithium battery
- **Configuration & operation:**
  - 4-key programming
  - Optional handheld programmer or PC software (RS485 / RS232)
  - High-definition backlit LCD
  - Empty pipe detection and self-diagnosis
- **Communication (optional):**
  MODBUS, HART, GPRS, PROFIBUS
- **Analog output:**
  Dual isolated outputs: 0–10 mA / 4–20 mA
  Load resistance:
  - 0–10 mA: 0–15 kΩ
  - 4–20 mA: 0–750 Ω
- **Frequency output:**
  1–5000 Hz, opto-isolated (>1000 VDC)
  Max load: 250 mA, 36 VDC
- **Pulse output:**
  Pulse equivalent: 0.001 L to 1.000 m³ per pulse
  Pulse width: automatic 50 ms, high frequency converts to square wave
- **Flow direction output:**
  +10 V for forward flow, 0 V for reverse flow
- **Alarm output:**
  Two-channel transistor open-collector alarm outputs with opto-isolation.
- Max. withstand voltage: 36 VDC; maximum collector current when conducting: 250 mA.
- Alarm statuses: empty pipe alarm, excitation alarm, flow overrange alarm.

5.Converter Overall Dimensions

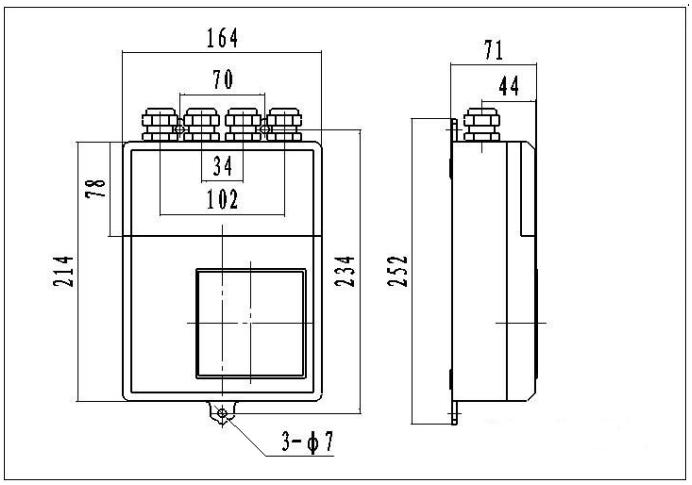
5.1 Converter Overall Dimensions



512B (Grey) Round Type Dimensions



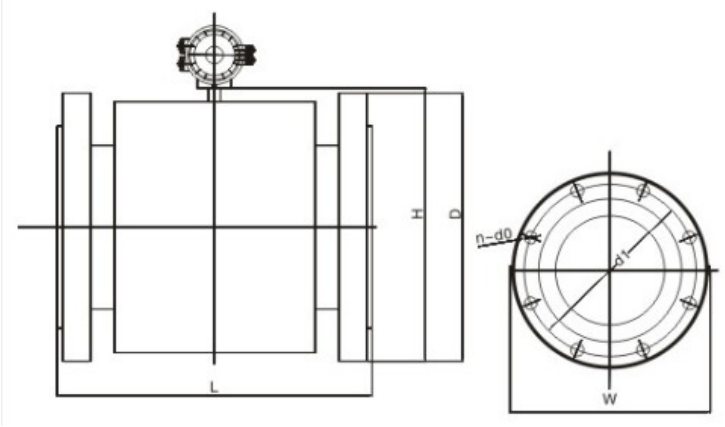
412B (Blue) Round Type Dimensions



212B (Square Type) Dimensions

5.2 Sensor External and Installation Dimensions

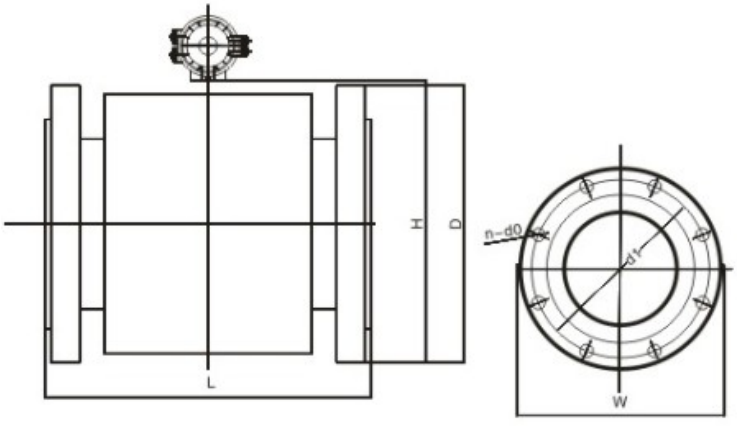
DN3–DN150 (1.6 MPa / 4.0 MPa) Sensor and Integral Type



Overall Dimensions Flange Standard: GB/T 9119-2010

Nominal Diameter DN	L	H	Nominal Diameter DN	Pressure 1.6MPa					Pressure 4.0MPa				
				D	d_1	d_0	n	b	D	d_1	d_0	n	b
3	200	142	3	90	60	14	4	14	90	60	14	4	14
6	200	142	6	90	60	14	4	14	90	60	14	4	14
10	200	142	10	90	60	14	4	14	90	60	14	4	14
15	200	147	15	95	65	14	4	16	95	65	14	4	16
20	200	154	20	105	75	14	4	18	105	75	14	4	18
25	200	156	25	115	85	14	4	18	115	85	14	4	18
32	200	166	32	140	100	18	4	18	140	100	18	4	18
40	200	172	40	150	110	18	4	20	150	110	18	4	20
50	200	191	50	165	125	18	4	20	165	125	18	4	20
65	250	200	65	185	145	18	8	20	185	145	18	8	22
80	250	218	80	200	160	18	8	22	200	160	18	8	22
100	250	242	100	220	180	18	8	22	235	190	22	8	26
125	250	277	125	250	210	18	8	22	270	220	26	8	26
150	300	302	150	285	240	22	8	24	300	250	26	8	28

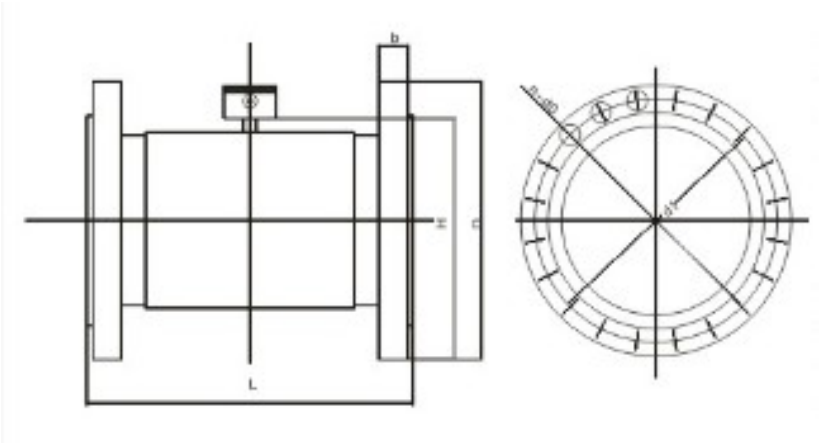
DN200–DN600 (1.0 / 1.6 MPa) Sensor and Integral Type



Overall Dimensions Flange Standard: GB/T 9119-2010

Nominal Diameter DN	L	H	Nominal Diameter DN	Pressure 1.6MPa					Pressure 1.0MPa				
				D	d_1	d_0	n	b	D	d_1	d_0	n	b
200	350	362	200	340	295	22	12	26	340	295	22	8	24
250	450	412	250	405	355	26	12	28	395	350	22	12	26
300	500	472	300	460	410	26	12	32	445	400	22	12	28
350	550	522	350	520	470	26	16	35	505	460	22	16	30
400	600	572	400	580	525	30	16	38	565	515	26	16	32
450	600	626	450	640	585	30	20	42	615	565	26	20	35
500	600	676	500	715	650	33	20	46	670	620	26	20	38
600	600	776	600	840	770	36	20	52	780	725	30	20	42

DN700–DN3000 (0.6 / 1.0 MPa) Sensor Dimensions



Overall Dimensions Flange Dimensions (Standard GB/T 9119-2010)

Nominal Diameter DN	L	H	Nominal Diameter DN	Pressure MPa	D	d_1	d_0	n	b
700	700	866	700	1.0	895	840	30	24	30
800	800	966	800		1015	950	33	24	32
900	900	1076	900		1115	1050	33	28	34
1000	1000	1200	1000		1230	1160	36	28	34
1200	1200	1406	700	0.6	860	810	26	24	26
1400	1400	1632	800		975	920	30	24	26
1600	1600	1832	900		1075	1020	30	24	26
1800	1800	2036	1000		1175	1120	30	28	26
2000	2000	2236	1200		1405	1340	33	32	28
2200	2200	2436	1400		1630	1560	36	36	32
2400	2400	2636	1600		1830	1760	36	40	34

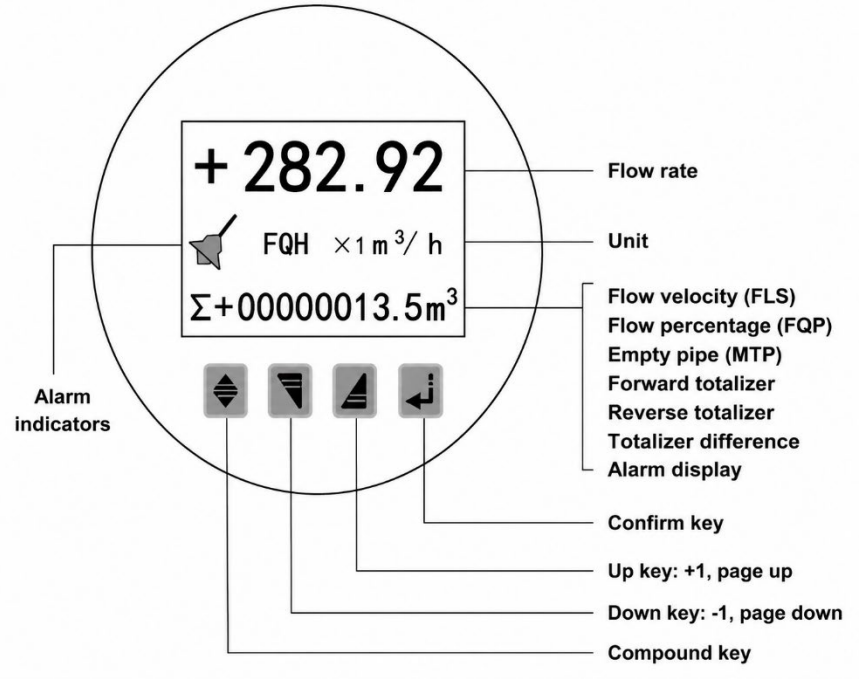
2600	2600	2836	1800		2045	1970	39	44	36
2800	2800	3036	2000		2265	2180	42	48	38
3000	3000	3236	2200		2475	2390	42	52	42
			2400		2685	2600	42	56	44
			2600		2905	2810	48	60	46
			2800		3115	3020	48	64	48
			3000		3315	3220	48	68	50

Notes

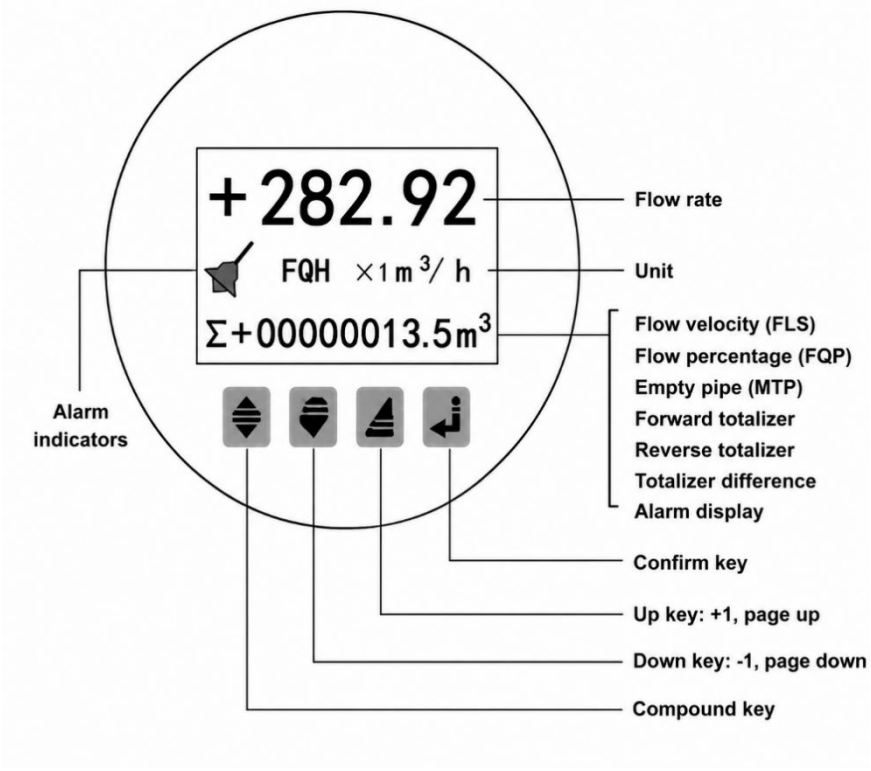
- D: Flange outer diameter
- d1: Bolt circle diameter
- d0: Bolt hole diameter
- n: Number of bolt holes
- b: Flange thickness
- L: Sensor overall length
- H: Height

6. Converter Menu Structure and Parameter Settings

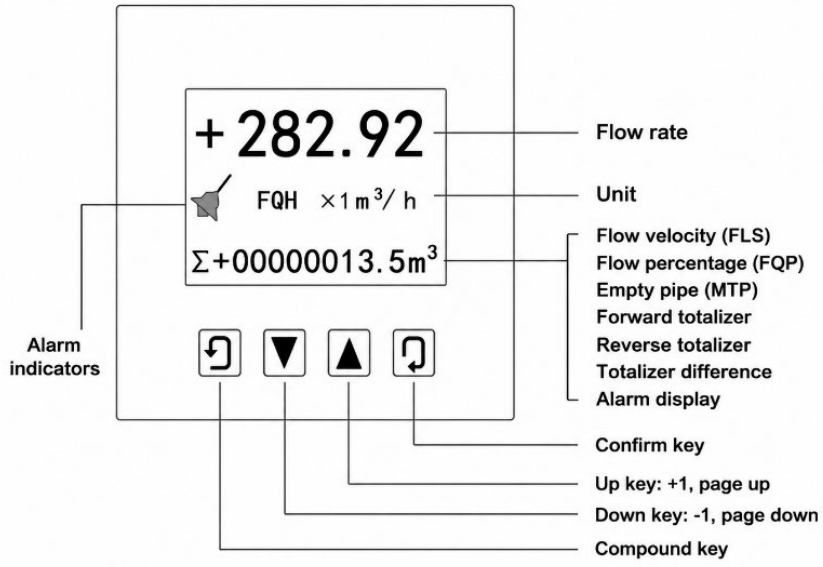
6.1 Keypad Types and Display Interface



512B (Grey) Round Type Keypad Definition & Display



412B (Blue) Round Type Keypad



212B Square Type Keypad

6.2 Key Functions (Including Converter Buttons, Infrared Remote, and Magnetic Pen Operation)

1. Functions in Measurement Mode

- **Down key:** cycles lower display line
- **Up key:** cycles upper display line
- **Combined key + Confirm key:** enter parameter setting mode
- **Confirm key:** return to measurement mode

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2. Functions in Parameter Setting Mode

- **Down key:** decrease digit value
- **Up key:** increase digit value
- **Combined key + Down key:** move cursor left
- **Combined key + Up key:** move cursor right
- **Confirm key:** enter/exit submenu
- **Long press (2 seconds):** return to measurement mode

Operating Notes

- When using the “combined key”, press the combined key first, then press Up or Down.
- If no operation is performed within 3 minutes, the system automatically returns to measurement mode.
- Flow direction correction can be adjusted using “+ / -” selection at the leftmost digit.
- Flow unit can be switched in the flow range menu using Up/Down keys.

6.3 Parameter Setting and Access Passwords

To enter parameter settings, the instrument must be switched from measurement mode to configuration mode.

In measurement mode:

- Press **Combined Key + Confirm Key** → password interface appears (default: 00000)
- Enter correct password according to authorization level
- Press **Combined Key + Confirm Key again** → enter parameter setting mode

---

Password Levels

The instrument uses **6 levels of passwords**:

- Level 1–4: User passwords
- Level 5–6: Manufacturer passwords

Different levels correspond to different access permissions.

Recommendation

- Level 1–3 passwords: assigned by user
- Level 4 password: mainly used for totalizer reset, should be assigned to authorized personnel

---

6.4 Parameter Menu List (Overview)

No.	Parameter	Method	Password Level	Range	Notes
1	Language	Select	2	Chinese / English	User selectable
2	Communication Address	Numeric	2	0–99	
3	Baud Rate	Select	2	300–38400	
4	Pipe Diameter	Select	2	3–3000 mm	
5	Flow Unit	Select	2	Various flow units	
6	Range Setting	Numeric	2	0–99999	
7	Damping Time	Select	2	1–64	
8	Flow Direction	Select	2	Forward / Reverse	
9	Zero Adjustment	Numeric	2	±9999	
10	Low Flow Cutoff	Numeric	2	0–599.99%	
11	Cutoff Display	Select	2	Enable / Disable	
12	Integration Unit	Select	2	0.001–1 m³ / L	
13	Reverse Output	Select	2	Enable / Disable	
14	Current Output Type	Select	2	0–10 mA / 4–20 mA	
15	Pulse Output Type	Select	2	Frequency / Pulse	
16	Pulse Unit	Select	2	0.001–1 m³ / L	
17	Frequency Range	Select	2	1–5999 Hz	
18	Empty Pipe Alarm	Select	2	Enable / Disable	
19	Empty Pipe Threshold	Numeric	2	59999%	
20	High Alarm Enable	Select	2	Enable / Disable	
21	High Alarm Value	Numeric	2	0–599.99%	
22	Low Alarm Enable	Select	2	Enable / Disable	
23	Low Alarm Value	Numeric	2	0–599.99%	
24	Excitation Alarm	Select	2	Enable / Disable	
25	Total Reset Password	Numeric	4	0–99999	
26	Sensor Code 1	Factory	4	Year/Month	

27	Sensor Code 2	Factory	4	Serial No.	
28	Excitation Mode	Select	4	Mode 1 / 2 / 3	
29	Sensor Coefficient	Numeric	4	0.0000–5.9999	User calibration
30	Flow Correction Enable	Select	4	Enable / Disable	View only
31	Flow Correction Point 1	User setting	5	Based on flow velocity	Calibration point
32	Flow Correction Value 1	User setting	5	0.0000–1.9999	Correction factor
33	Flow Correction Point 2	User setting	5	Based on flow velocity	
34	Flow Correction Value 2	User setting	5	0.0000–1.9999	
35	Flow Correction Point 3	User setting	5	Based on flow velocity	
36	Flow Correction Value 3	User setting	5	0.0000–1.9999	
37	Forward Total Low Word	Editable	5	00000–99999	
38	Forward Total High Word	Editable	5	00000–99999	
39	Reverse Total Low Word	Editable	5	00000–99999	
40	Reverse Total High Word	Editable	5	00000–99999	
41	Password 1	Editable	5	00000–99999	
42	Password 2	Editable	5	00000–99999	
43	Password 3	Editable	5	00000–99999	
44	Password 4	Editable	5	00000–99999	
45	Current Output Zero Trim	Numeric	5	0.0000–1.9999	
46	Current Output Full-scale Trim	Numeric	5	0.0000–3.9999	
47	Factory Calibration Coefficient	Numeric	5	0.0000–5.9999	Factory use
48	Instrument Code 1	Factory	6	Production date	Year/month
49	Instrument Code 2	Factory	6	Serial number	
50	Factory Reset	Factory	6	Initialization password	Reserved

6.5 Parameter Description (Key Items)

6.5.1 Language

Supports Chinese and English interface selection.

6.5.2 Communication Address

Used in multi-device communication. Range: 01–99 (0 reserved).

6.5.3 Baud Rate
Selectable: 300 / 600 / 1200 / 2400 / 4800 / 9600 / 19200 / 38400.

6.5.4 Pipe Diameter
Range: 3–3000 mm depending on sensor configuration.

6.5.5 Flow Unit
Selectable units:
L/s, L/min, L/h, m³/s, m³/min, m³/h

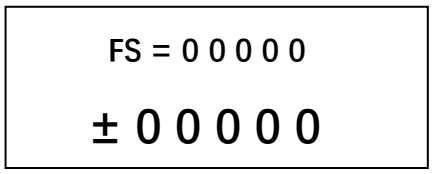
6.5.6 Range Setting
Defines full-scale flow. Lower limit is automatically zero.
Key relationships:
- Percentage output = measured flow / full scale × 100%
- Frequency output = ratio × full-scale frequency
- Current output = ratio × full-scale current + base value

Pulse output is not affected by range setting.

6.5.7 Damping Time
Long damping improves stability for pulsating flow.
Short damping improves response speed for process control.

6.5.8 Flow Direction Selection
Allows software correction of flow direction without rewiring excitation or signal lines.

6.5.9 Zero Adjustment
Must be performed with full pipe and no flow.



Displayed:

- Upper line: FS (measured zero value)
- Lower line: zero correction value

When the FS reading is not "0", adjust the correction value to make FS = 0.
Note: If adjusting the downlink correction value causes the FS value to rise, flip the positive/negative sign of the downlink value to calibrate FS to zero.
The flow zero correction value is a fixed constant matched to the sensor, which shall be recorded on the sensor record sheet and nameplate.
The recorded sensor zero point is a flow velocity value in mm/s, and its sign is opposite to that of the correction value.

6.5.10 Low Flow Cutoff
The low flow cutoff is expressed as a percentage of full scale.

When activated, the user can choose to:

- Cut off flow display, flow velocity, and percentage output simultaneously, OR
- Only cut off analog/frequency outputs while retaining display

---

6.5.11 Flow Totalization Unit

The converter display is a 9-digit counter with a maximum value of 999,999,999.
Totalized unit:

- L (liter)
- m³ (cubic meter)

Selectable pulse equivalents:

- 0.001 L
- 0.010 L
- 0.100 L
- 1.000 L
- 0.001 m³
- 0.010 m³
- 0.100 m³
- 1.000 m³

6.5.12 Reverse Output Function

When the reverse output enable parameter is set to Enable, the converter outputs pulses and current corresponding to the flow value as long as fluid flows.
When the reverse output enable parameter is set to Disable, if fluid flows in reverse direction, the converter pulse output shall be 0, and the current output shall be zero signal (4mA or 0mA).

6.5.13 Current Output Type

Selectable:

- 0–10 mA
- 4–20 mA

6.5.14 Pulse Output Mode

Two modes available:

1) Frequency Output

Continuous square wave output proportional to flow.
Formula:
Frequency = (Measured Flow / Full Scale) × Full-scale Frequency

---

2) Pulse Output

Each pulse represents a fixed flow volume (pulse equivalent).
Used mainly for totalization systems.
Output type is typically open collector (OC), requiring external power supply and load.

6.5.15 Pulse Equivalent Selection

Pulse value options:

Pulse Equivalent	Flow Value	Pulse Equivalent	Flow Value
1	0.001L/cp	5	0.001m^3/cp

2	0.01L/cp	6	0.01m^3/cp
3	0.1L/cp	7	0.1m^3/cp
4	1.0L/cp	8	1.0m^3/cp

Smaller pulse equivalent → higher pulse frequency → lower accumulation error.

6.5.16 Frequency Output Range

The frequency output corresponds to full-scale flow (100%).

Adjustable range:

- 1 Hz to 5000 Hz

6.5.17 Empty Pipe Alarm Enable

The converter includes an empty pipe detection function without additional electrodes.

When enabled:

- If pipe is not full, the meter detects empty pipe condition
- Outputs (analog, pulse, digital) are forced to zero
- Flow display shows zero

6.5.18 Empty Pipe Alarm Threshold

When pipe is full (with or without flow), the threshold can be adjusted based on measured conductivity.

Display:

- Upper line: measured conductivity
- Lower line: set threshold

Recommended setting:

- 3–5 times the actual measured conductivity

6.5.19 High Alarm Enable

Enable or disable high limit alarm function.

6.5.20 High Alarm Value

Range:

- 0% to 199.9% of full scale

Alarm activates when exceeded.

6.5.21 Low Alarm Function

Same principle as high alarm, used for low limit detection.

6.5.22 Excitation Alarm

- Enabled: excitation fault alarm active
- Disabled: excitation alarm function off

6.5.23 Total Reset Password

Used to authorize totalizer reset operations.

6.5.24 Excitation Mode Selection

Three excitation frequencies:

- Mode 1: 1/16 power frequency
- Mode 2: 1/20 power frequency
- Mode 3: 1/25 power frequency

Selection guidance:

- Small diameter sensors → Mode 1
- Large diameter sensors → Mode 2 or 3

Important: Calibration must match operating excitation mode.

6.5.25 Forward Total High/Low Word

Used for adjusting or maintaining forward accumulated total.

Maximum value:

- 999,999,999

6.5.26 Reverse Total High/Low Word

Same function as forward total, used for reverse accumulation.

6.5.27 Spike Suppression Enable

Used for slurry, pulp, and particle-containing media.

When enabled:

- Activates rate-of-change suppression algorithm
- Reduces signal spikes caused by electrode impact or friction

---

6.5.28 Spike Suppression Coefficient

Selectable velocity thresholds:

0.010, 0.020, 0.030, 0.050, 0.080, 0.100, 0.200, 0.300, 0.500, 0.800 m/s

Lower value → higher sensitivity suppression

Selection must be tested according to real conditions

6.5.29 Spike Suppression Time

Unit: milliseconds (ms)

Defines duration threshold:

- Shorter than set time → treated as noise
- Longer than set time → treated as real flow change

6.5.30 User Password 1–4

User-defined access passwords for different authorization levels.

6.5.31 Current Output Zero Adjustment

Factory calibration for:

- 0 mA or 4 mA output accuracy

6.5.32 Current Output Full-scale Adjustment

Factory calibration for:

- 10 mA or 20 mA accuracy

6.5.33 Factory Calibration Coefficient

Factory parameter used to normalize measurement circuits, ensuring interchangeability accuracy of 0.1%.

6.5.34 Instrument Codes 1 & 2

Records production date and serial number of converter.

7. Installation Notes and Installation Diagrams

7.1 Installation Precautions for Electromagnetic Flowmeter

7.1.1 Installation Position

- **Pipeline must be completely filled with liquid**
  It is essential that the measuring tube is always full. Otherwise, measurement errors or unstable readings may occur.
- **Avoid air bubbles**
  Air bubbles in the measuring tube will affect measurement accuracy. Pipeline design should prevent gas accumulation.
  If installed near valves, place the flowmeter upstream of the valve to avoid pressure drop-induced bubble formation.
- **Vertical installation recommended for slurry or solid-liquid media**
  Flow direction should be from bottom to top to ensure full pipe condition.

7.1.2 Installation Orientation

- If electrodes are not horizontal, air or sediment may accumulate at the top or bottom, causing errors.
- The junction box or converter should be installed on the upper side of the pipeline system for better protection and readability.

7.1.3 Straight Pipe Requirements

- Avoid installing equipment that disturbs magnetic field or flow profile near the measuring section.
- Recommended straight pipe length:
  - Upstream: ≥ 5D
  - Downstream: ≥ 3D
- For severe disturbances (bends, valves), longer straight sections are required.
- Valves should preferably be installed downstream to avoid unstable flow measurement.
- Avoid injecting chemicals near the upstream side unless sufficient mixing length is provided (~5D).

7.1.4 Installation Environment Requirements

- Avoid strong magnetic fields (large motors, transformers, etc.)
- Install in dry and well-ventilated areas
- Avoid high humidity or water accumulation locations
- Ambient temperature should not exceed 60°C; humidity ≤ 95%
- Ensure easy access for maintenance

Pipeline Installation Requirements

- Horizontal, vertical, or inclined installation is allowed
- Electrodes must remain in a horizontal position
- Ensure measuring tube is always full of liquid
- For horizontal installation, installation elevation should be slightly lower than pipeline to ensure back pressure
- For solid-liquid media, vertical installation is preferred to reduce wear

---

Special Installation Conditions

1. Large Diameter Installation

- Often installed underground
- Requires concrete pit with sufficient space
- Includes drainage system and protective cover
- Sensor should be installed on supports with expansion joints downstream

---

2. PTFE Liner Installation

- PTFE liners are sensitive to negative pressure
- Vacuum conditions may deform liner and damage sealing
- Not suitable for vacuum pipelines
- Avoid installation on pump suction side
- Install valve downstream instead

7.1.5 Grounding Requirements

(1) Installation on Metal Pipes

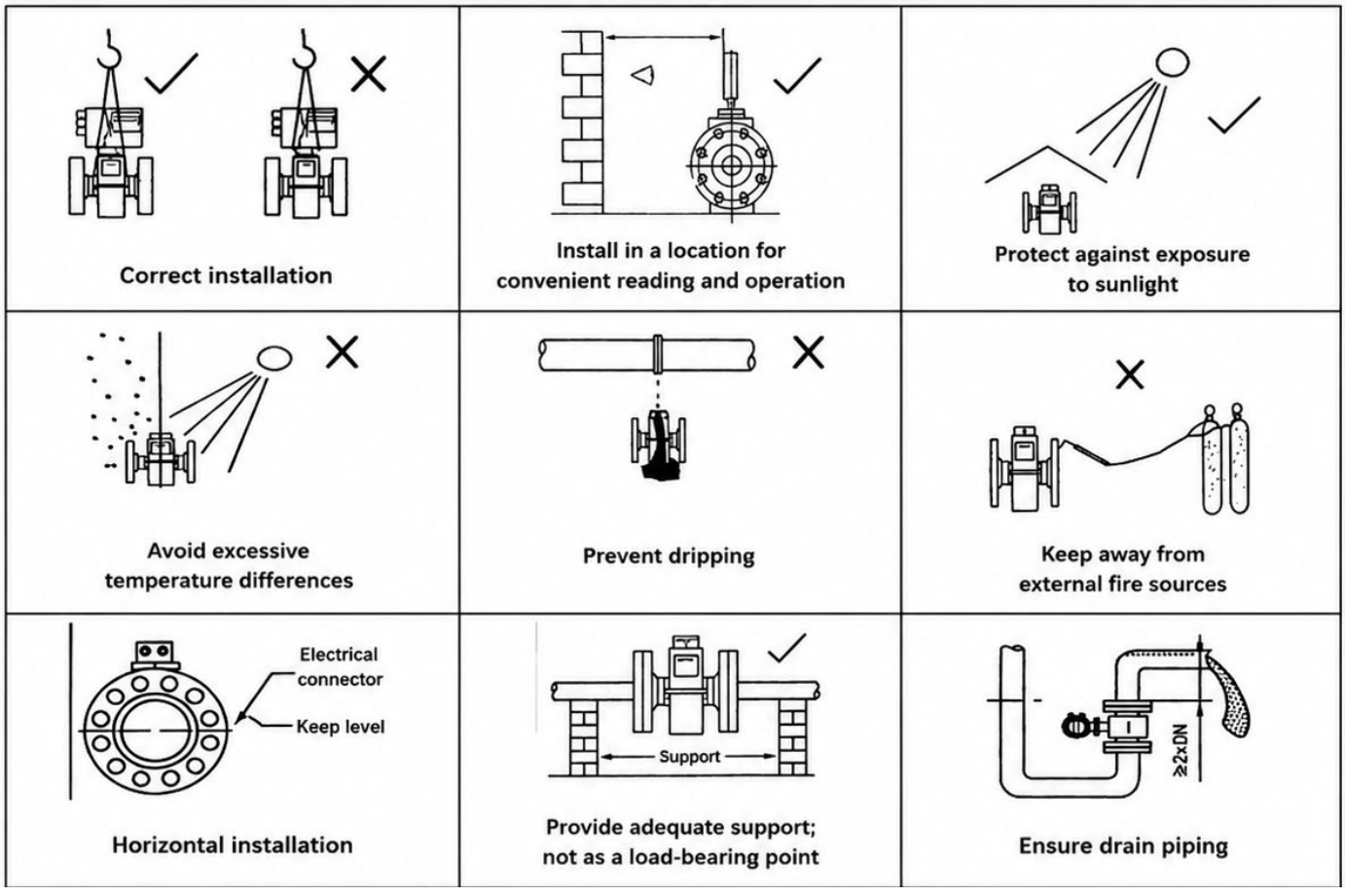
- Metal pipelines are usually grounded naturally
- Additional grounding is optional but recommended for stability

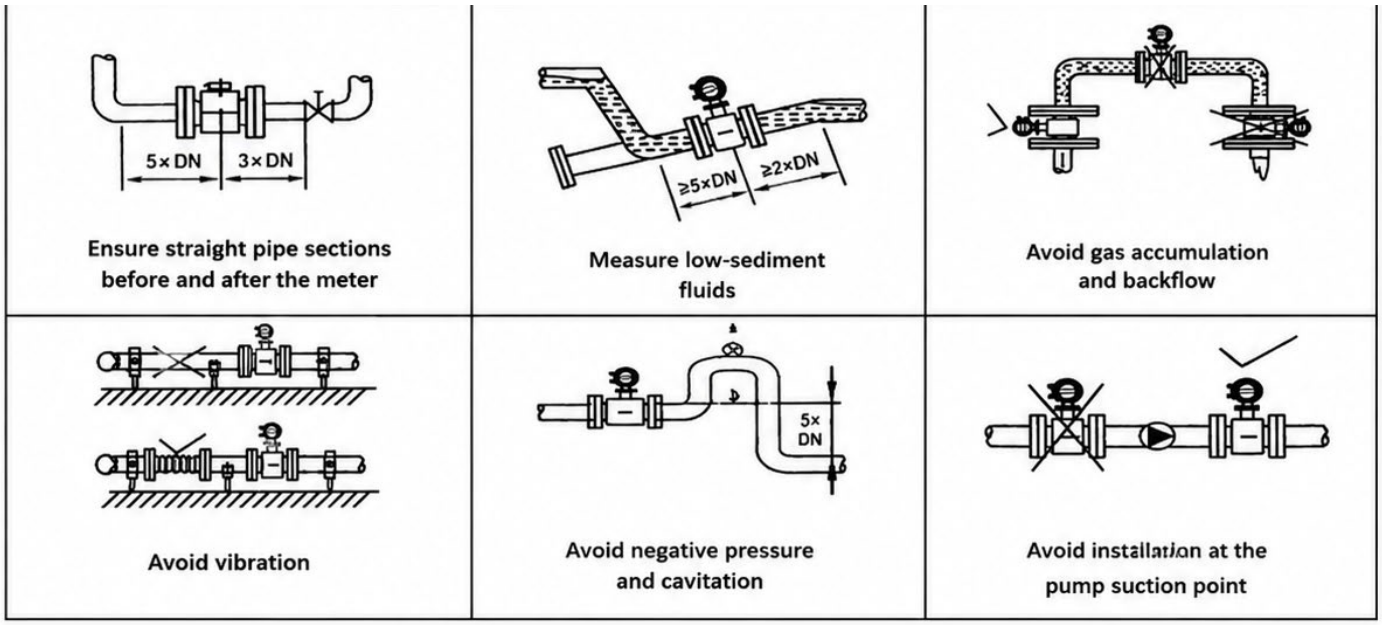
(2) Installation on Non-metal Pipes or Insulated Pipes

- Grounding rings or metal short pipes must be installed at both ends
- Connect grounding rings to sensor grounding terminal
- If corrosion prevents metal rings, grounding electrodes may be installed on pipe wall

---

7.2 Installation Diagrams (Guidelines)



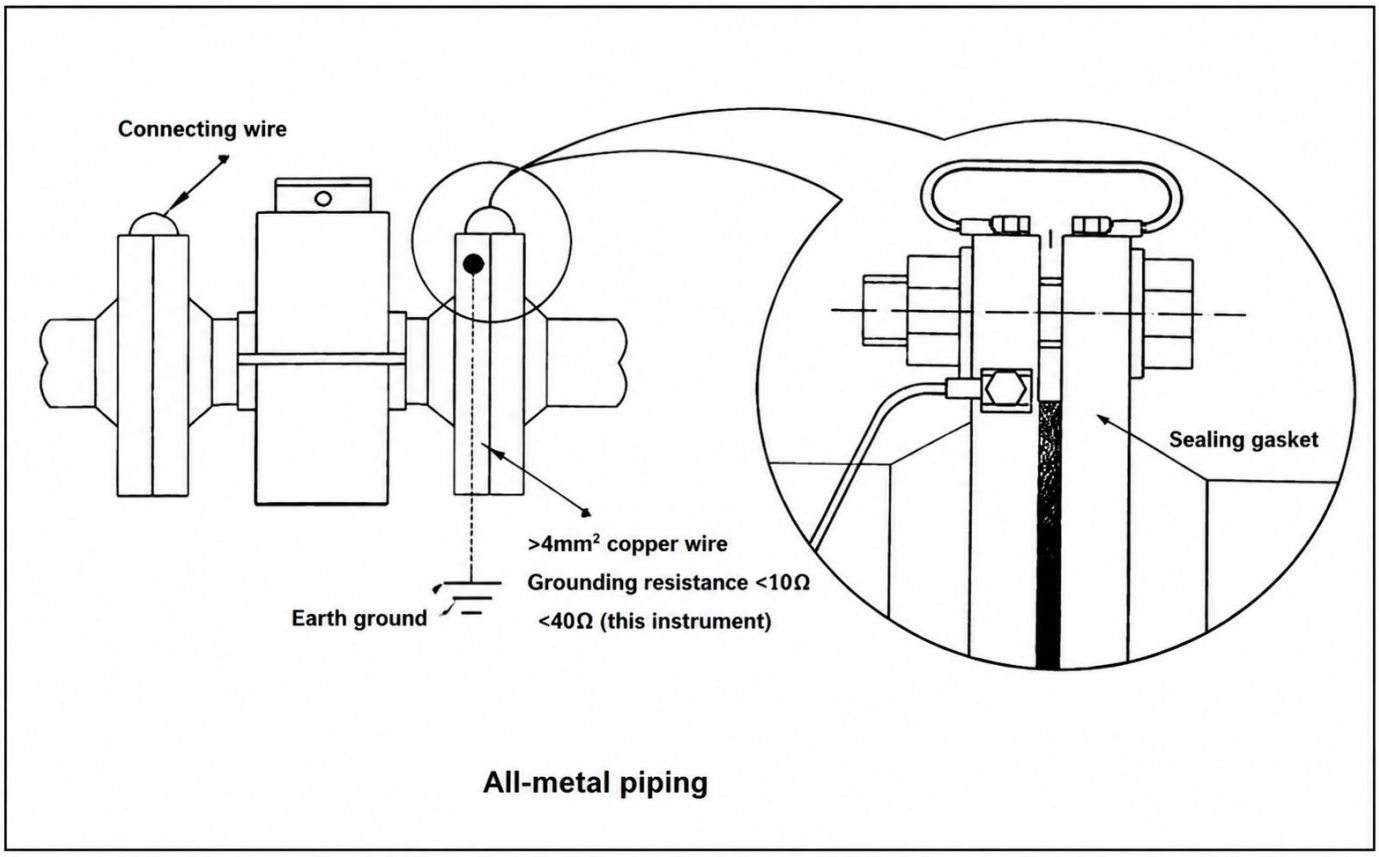


Important Note

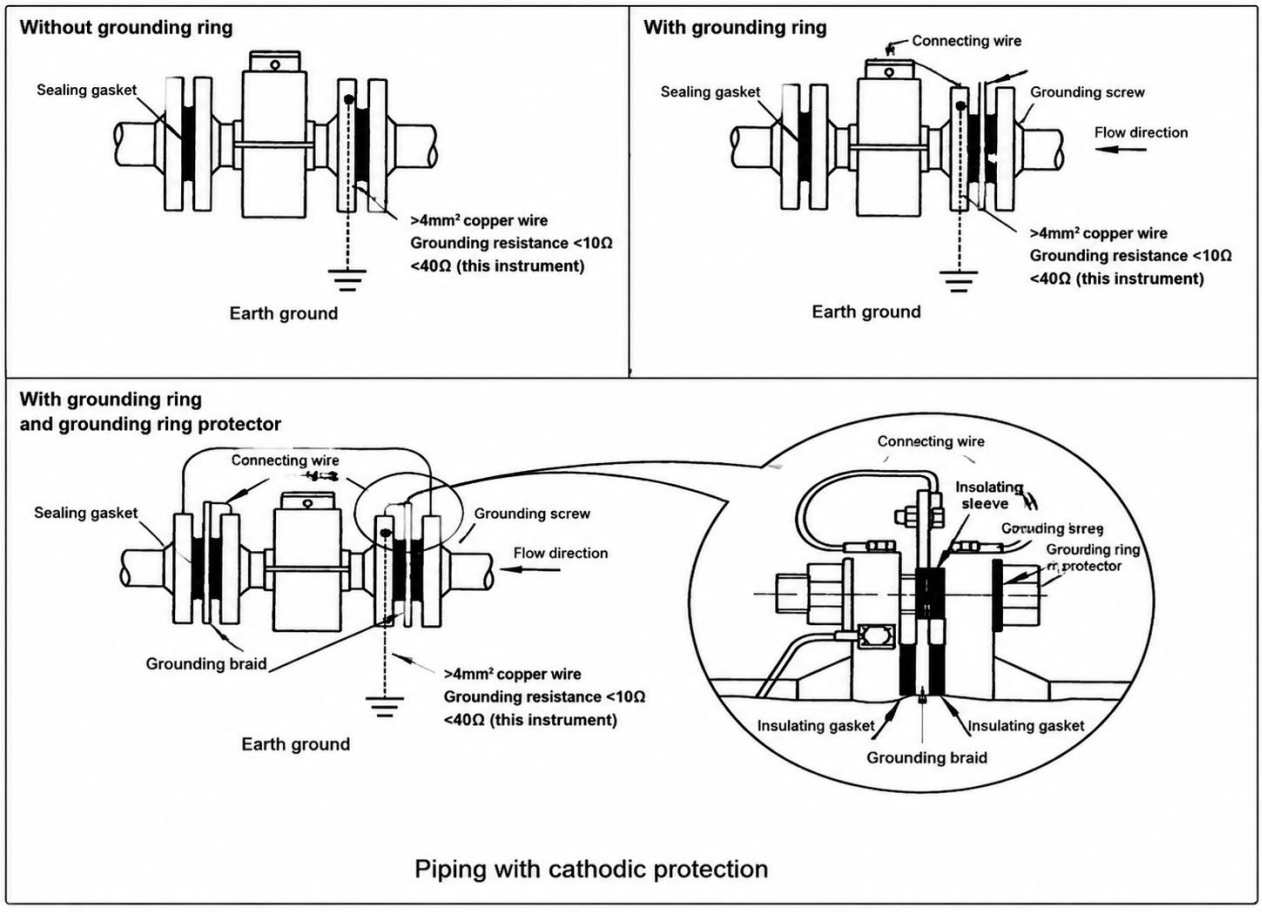
For complex or special working conditions, users should consult the manufacturer before installation to ensure optimal system design and performance.

8. Electrical Wiring of the Electromagnetic Flowmeter

8.1 Grounding of Flowmeter and Pipeline

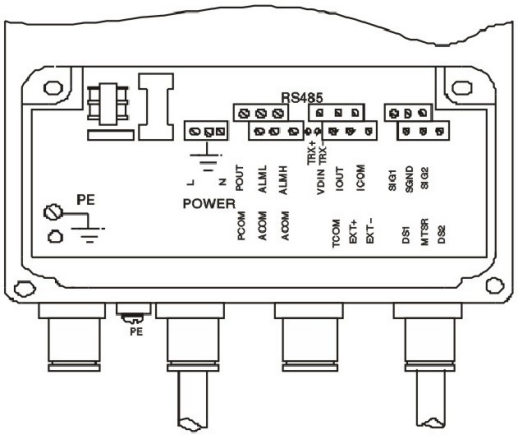


All-metal piping



Piping with cathodic protection

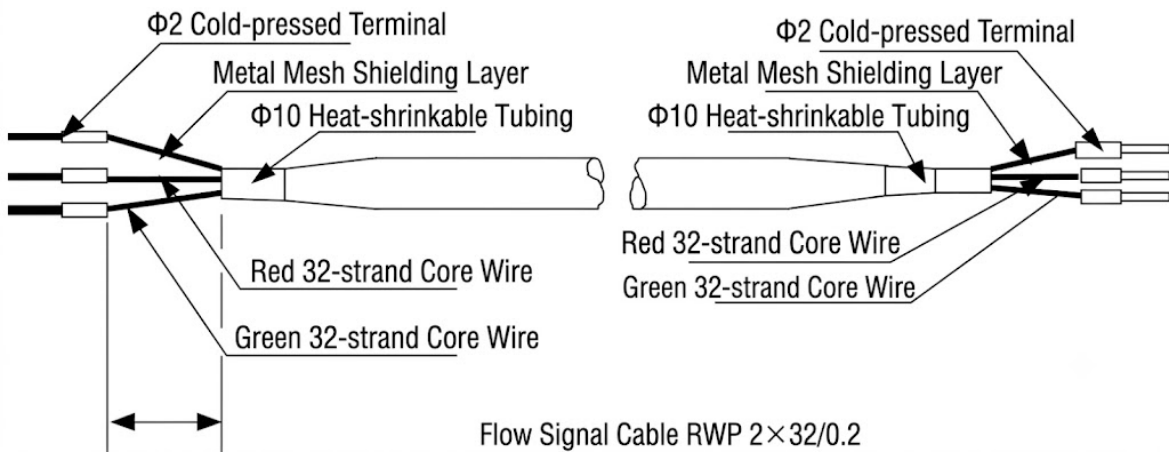
8.2 Converter Terminal Block and Markings



(1) Square-type Converter Terminal Block and Markings (212B)

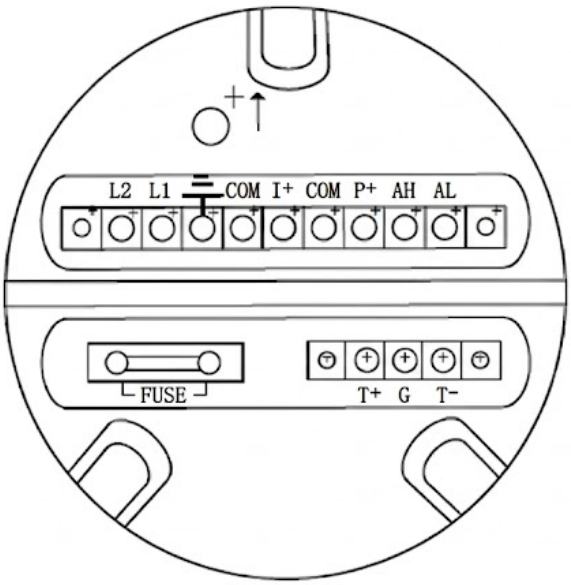
SIG 1	Signal 1	Connection to Remote Sensor
SGND	Signal Ground	
SIG 2	Signal 2	
DS 1	Excitation Shield 1	
DS 2	Excitation Shield 2	
EXT+	Excitation Current +	
EXT−	Excitation Current −	
VDIN	24 V DC Two-wire Power Input	Analog Current Output
IOUT	Analog Current Output	
ICOM	Analog Current Output Ground	
POUT	Flow Rate (Pulse) Output	Frequency or Pulse Output
PCOM	Frequency (Pulse) Output Ground	
ALMH	High Limit Alarm Output	Alarm Outputs (Two Channels)
ALML	Low Limit Alarm Output	
ACOM	Alarm Output Ground	
TRX+	Communication Input (RS485-A)	Communication Input
TRX−	Communication Input (RS485-B)	
TCOM	RS232 Communication Ground	

Meaning of Each Terminal for Model 212B Square Transmitter



Cable Treatment & Marking for Square Meter Connected to Sensor

(2) Round-type Converter (412B Blue) Terminal Block and Markings

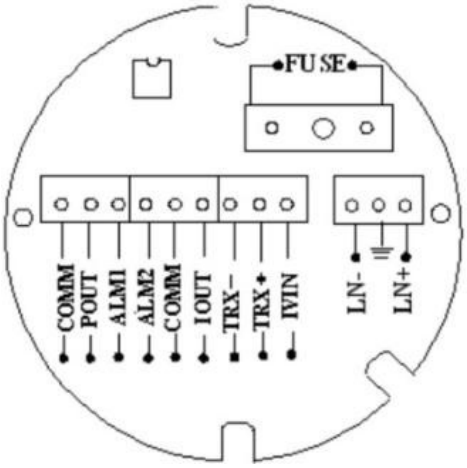


Terminal Wiring Diagram for 412B Round Meter

I+:	Flow current output
COM:	Current output ground
P+:	Bidirectional flow frequency (pulse) output
COM:	Frequency (pulse) output ground
AL:	Lower limit alarm output
AH:	Upper limit alarm output
COM:	Alarm output ground
FUSE:	Input power fuse
T+:	Communication input (RS485-A)
T-:	Communication input (RS485-B)
G:	RS232 communication ground
L1:	220V (24V) power input
L2:	220V (24V) power input

Terminal Marking Definition for Each Terminal of Model Model 412B Round Meter

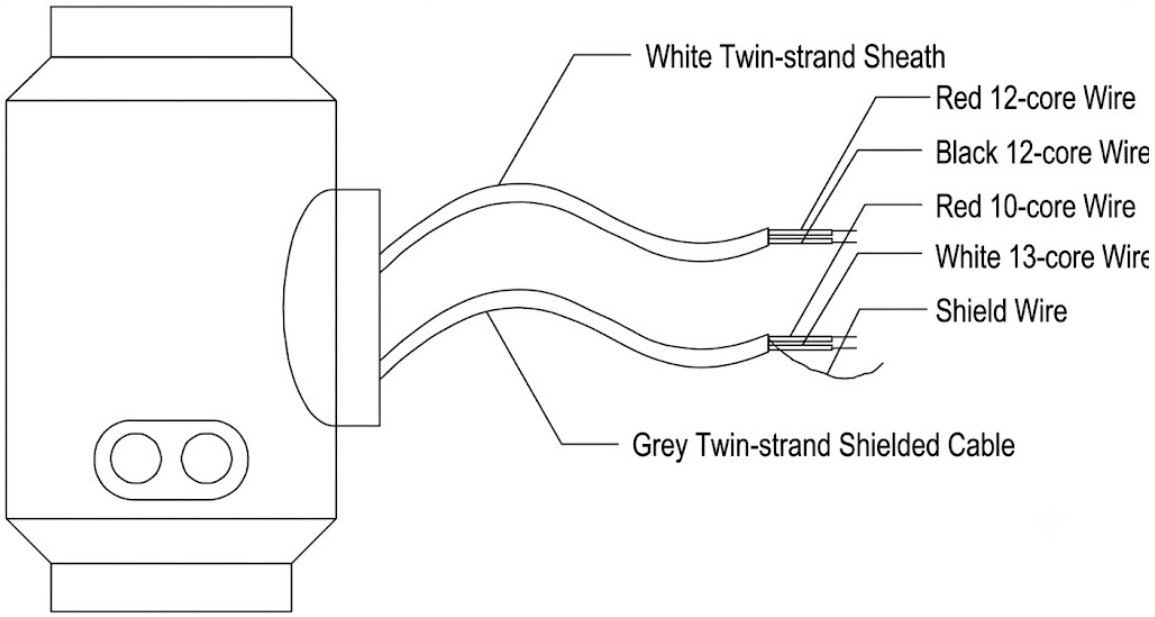
(3) Round-type Converter (512B Grey) Terminal Block and Markings



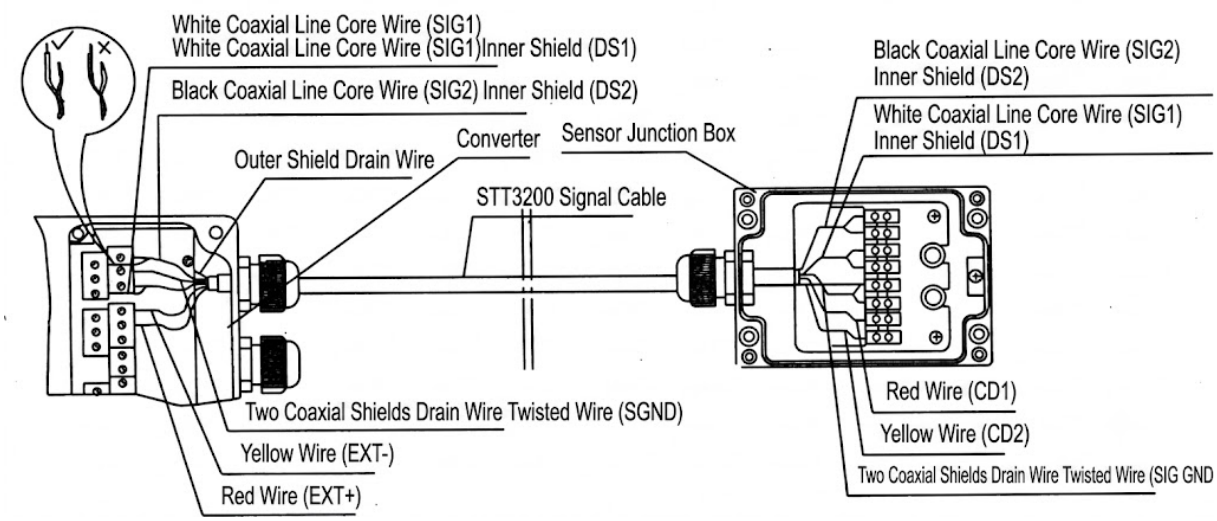
Terminal Wiring Diagram for Model 512B Round Meter

POUT:	Bidirectional flow frequency (pulse) output
ALM1:	Upper limit alarm output
ALM2:	Lower limit alarm output
COMM:	Frequency, pulse, current commini (ground wire)
COMM:	Frequency, pulse, current commini (ground wire)
IOUT:	Flow current ouput (two-wire current output)
IVIN	Two-wire system 24V voltage input
TRX+	Commution input
TRX-:	Commuration input
LN+:	220V power input
LN-:	220V power input

Terminal Label Definition for All Terminals of Model 512B Round Meter



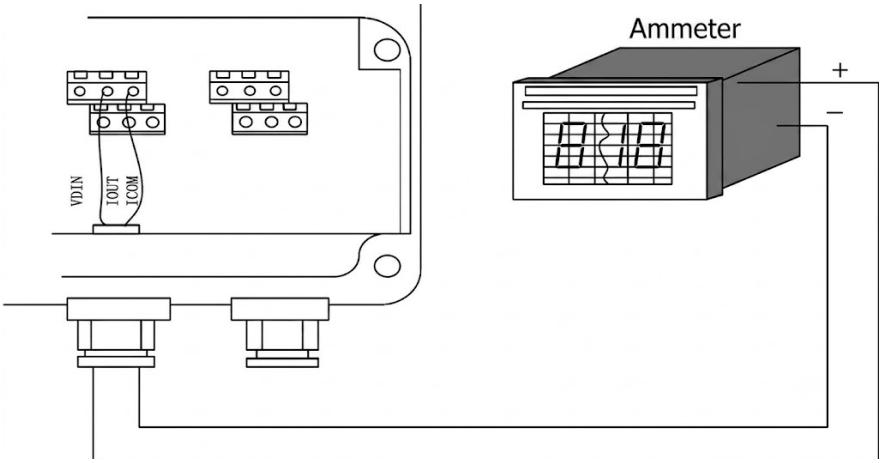
Signal Cable Treatment and Marking for Round Meter



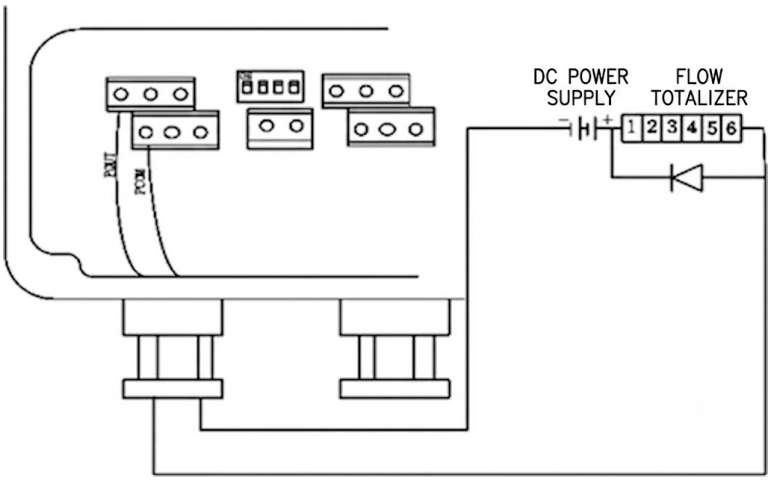
Connection Between Split Type Sensor and Transmitter

8.3 Output Signal Wiring

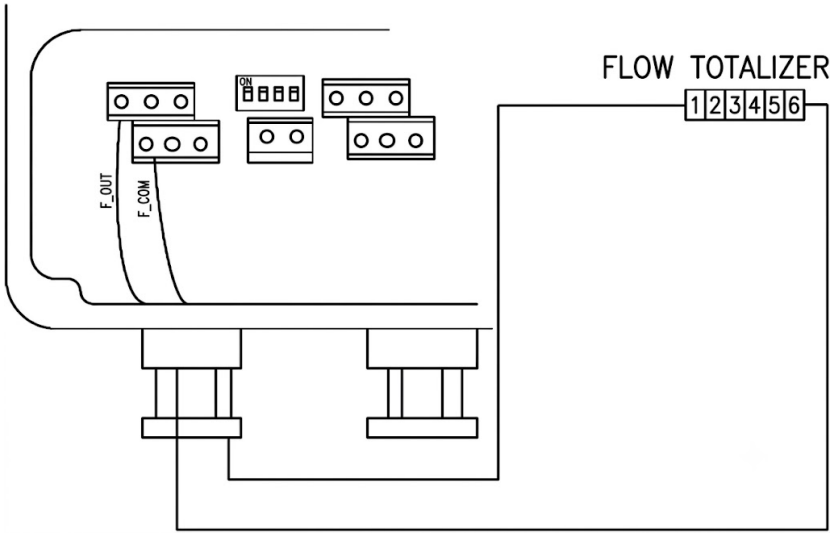
When DIP switch No.1 beside the terminal block is toggled to the ON position, the converter internally supplies +28V power and a 10kΩ pull-up resistor to isolated open-collector frequency outputs (PUL+, PUL-), alarm outputs (ALM+, ALM-) and status control terminal (1NSW).
Accordingly, for frequency output application, set DIP switch No.1 to ON, and extract the frequency signal via terminals PUL+ and PCOM.
DIP switch No.2 and No.3 serve as RS485 communication terminating resistors: the resistors are enabled when toggled to ON, and disabled when set to OFF.



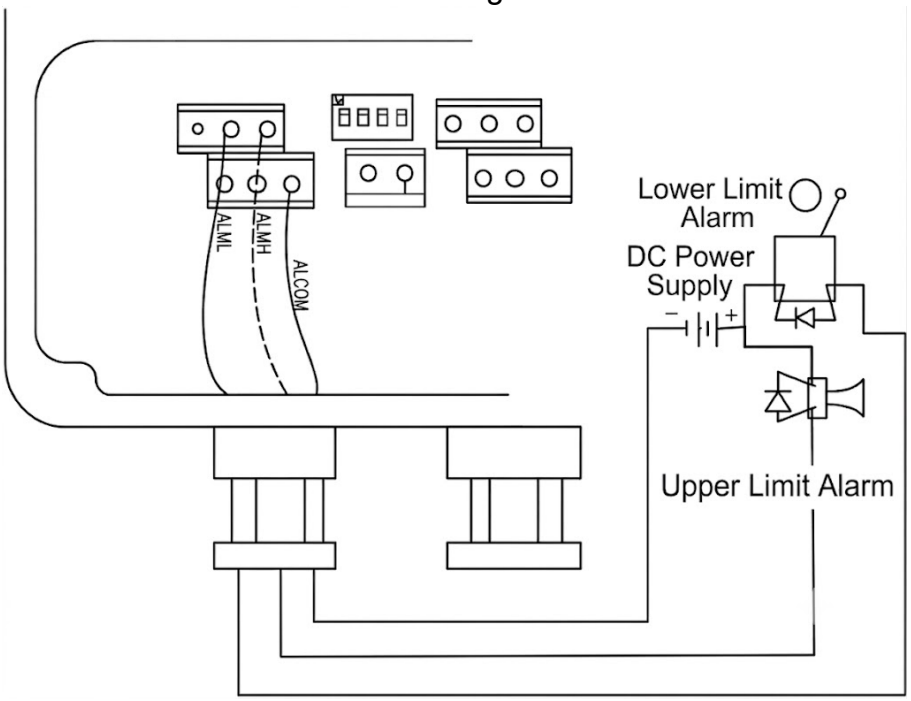
Current Output Wiring Diagram



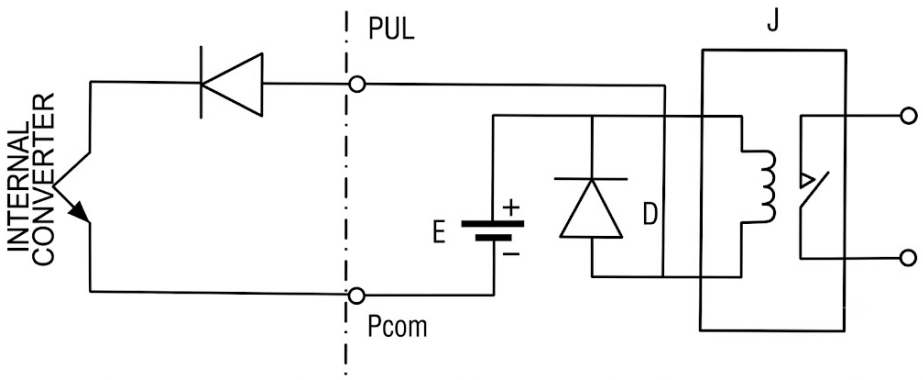
Electromagnetic Counter Wiring Diagram



Electronic Counter Wiring



Digital Output Connected to Optocoupler (e.g. PLC)



General intermediate relays require an excitation voltage E of 12 V or 24 V. D stands for freewheeling diode. Most intermediate relays are internally equipped with this diode at present. If the relay itself does not integrate a freewheeling diode, users shall install one externally.

9. Self-Diagnosis Information and Troubleshooting

The electromagnetic flow converter adopts a surface-mount PCB design. The unit is not serviceable by the user and must not be opened.
The intelligent converter is equipped with a self-diagnostic function. Except for power supply and hardware failures, most operational faults can be detected and displayed as alarm messages. These messages appear in the upper-right corner of the display with a symbol.
During measurement mode, pressing the down key allows page scrolling to view fault information. The system may display one of the following status conditions:

- Normal flow condition
- Empty pipe normal
- System normal

9.1 No Display

Check the following:

- Whether the power supply is connected properly
- Whether the power fuse is intact
- Whether the supply voltage meets requirements
- Whether the display contrast is properly adjusted

If the above items are normal and the display still does not work, the converter should be returned to the manufacturer for repair.

9.2 Excitation Alarm

Check the following:

- Whether excitation terminals EX1 and EX2 are open-circuit
- Whether the total resistance of the excitation coil is less than 150 Ω

If both are normal, the converter may be faulty.

9.3 Empty Pipe Alarm

Check the following:

- Whether the measuring pipe is completely filled with fluid
- Short-circuit signal terminals SIG1, SIG2, and SGND
    - If the empty pipe alarm disappears, the converter is normal
    - Possible causes: low fluid conductivity or incorrect empty pipe threshold/range settings
- Whether signal wiring is correct
- Condition of sensor electrodes:

1. When flow is zero, conductivity ratio should be < 100%
2. With flow present, resistance between SIG1/SIG2 and SGND should be < 50 kΩ (for water; measured using analog multimeter preferred)

- Measure DC voltage between DS1 and DS2:
    - Should be < 1 V
    - Higher values indicate electrode contamination, requiring cleaning

---

9.4 Upper Limit Alarm

- Indicates that current output and frequency (or pulse) output have exceeded range
- Increase the flow range setting to clear the alarm

9.5 Lower Limit Alarm

- Indicates output current and frequency (or pulse) are below range
- Reduce the flow range setting to clear the alarm

9.6 System Configuration Error

- The converter can automatically detect and prompt incorrect settings such as:
  - Flow range configuration errors
  - Flow integration unit errors
  - Pulse equivalent setting errors
- Users should correct parameter settings accordingly

9.7 Inaccurate Flow Measurement

Check the following:

- Whether the measuring pipe is fully filled with fluid
- Whether signal wiring is correct
- Whether sensor coefficient and zero point are correctly set according to nameplate or calibration sheet

---

9.8 Zero Flow Reading / No Flow Indication

Check the following:

- Whether inlet and outlet valves are open
- Whether fluid is actually flowing in the pipeline

9.9 Unstable Flow Reading

Check the following:

- Whether upstream and downstream straight pipe lengths meet requirements (typically 5D upstream and 2–3D downstream)
- Whether proper grounding is provided
- Whether the pipeline is fully filled with liquid

10. Complete Supply Scope

The electromagnetic flowmeter shall be supplied in accordance with the purchase contract.

Standard delivery includes:

- Electromagnetic flowmeter (complete set or split type as ordered)

Documents supplied with the Electromagnetic flow meter include:

- Instruction manual (User's Guide)
- Product test/inspection report
- Certificate of conformity

Each set includes one copy of each document.

---

11. Transportation and Storage

To prevent damage during transportation, the original factory packaging must be maintained until the product arrives at the installation site.

Storage conditions (indoor storage required):

- Must be protected from rain and moisture
- Low mechanical vibration and no impact conditions
- Ambient temperature: -20°C to +60°C
- Relative humidity: not higher than 80%

---

12. Operation

Before commissioning the flowmeter, perform the following checks:

- Check whether the flowmeter was damaged during transportation or installation
- Verify that the power supply voltage matches the nameplate specification
- Ensure all wiring connections are correct

After inspection:

- Open the pipeline valves to ensure the measuring tube is fully filled with liquid
- Remove any air or leakage in the system

Then:

- Switch on the power supply
- The flowmeter generally requires a warm-up time of about 10 minutes before normal operation

---

During operation:

If any problem occurs, refer to the self-diagnosis and troubleshooting section (Part 9).

If the instrument still does not operate properly, contact the manufacturer for technical support.

Product Warranty Card

Warranty & Service

This product complies with the national Three Guarantees policy. Customers may present this warranty card and purchase invoice for maintenance at our after-sales service department or authorized distributors.

The product is covered by a one-year warranty. Within one year from the date of manufacture, any natural failure of components shall be repaired or replaced free of charge.

Warranty Terms

The warranty is only valid under normal operating conditions. The following damages are excluded from warranty coverage: damage caused by improper operation, human error, operation not in accordance with the instruction manual, unauthorized repair or modification by third parties, disassembly by the user, and damage resulting from force majeure.

We will provide dedicated service for you. This warranty does not cover freight costs for accessories.

1. This warranty card is only valid when presented together with the purchase invoice.
2. Please bring the original warranty card and original invoice for maintenance service.
3. Alteration of this warranty card by the user is prohibited.
4. Please keep this document properly for future warranty claims.

Model No.: _____

Serial No.: _____ (Fill in the serial number shown on the inspection certificate)

Customer Company Name: _____

Contact Person: _____ Tel.: _____

Maintenance Record:

Service Date	Disposition Method	Fault Description	Technician