

# Electromagnetic Flowmeters

## Separated Type

### Model : F951

Spec. sheet no. FD09-04

#### Description

The electromagnetic flowmeter can be used to accurately measure the flowrate of liquids, paper pulp, slurry and mineral slurry which has an electrical conductivity greater than 10  $\mu\text{s}/\text{cm}$ .

F951 is a flow measurement system consists of a flowmeter primary and remote mounted converter.



#### Specification

##### Type

Separate type

##### Size

15 ~ 1,000A ( $\frac{1}{2}$  ~ 40")

##### Process connection

Flange type [ANSI, ASME, DIN, JIS, KS, ETC.]

##### Measuring range

0.2 ~ 10 m/s

##### Accuracy

$\pm 0.5$  % Full scale (15 ~ 800A)

$\pm 1.0$  % Full scale (900A ~ : It needs for site calibration.)

##### Lining

Standard : Hard rubber (0 ~ 60 °C)

Option : Teflon (-10 ~ 160 °C) Max. 400A

##### Ambient temperature

-10 ~ 60 °C

##### Conductivity

Standard :  $\geq 10$   $\mu\text{s}/\text{cm}$

Option :  $\geq 5$   $\mu\text{s}/\text{cm}$

##### Power supply

Standard : AC 85 ~ 250 V, 50 ~ 60 Hz

Option : DC 24 V [2-wire Loop power]

##### Power consumption

Max. 15 VA

##### Display

LCD Display with back light

Flowrate : 5-Digit Display

Total : 9-Digit Display

##### Output

Analog : DC 4 ~ 20 mA (Isolated) - Active

Pulse : Open collector pulse

Communication : RS485

##### Protection class

Sensor : IP67

Converter : IP67

##### Special feature

Self check

Empty pipe

Enable to reverse flow direction

Data logging

Error message

##### Electrode signal cable

Standard length : 5 M

Option : Max. 30 M

**1. Base model**

**F951** Electro-Magnetic flowmeter Separated type

**2. Meter size**

<b>A</b>	15A (½")	<b>O</b>	350A (14")
<b>B</b>	20A (¾")	<b>P</b>	400A (16")
<b>C</b>	25A (1")	<b>Q</b>	450A (18")
<b>D</b>	32A (1¼")	<b>R</b>	500A (20")
<b>E</b>	40A (1½")	<b>S</b>	550A (22")
<b>F</b>	50A (2")	<b>T</b>	600A (24")
<b>G</b>	65A (2½")	<b>U</b>	650A (26")
<b>H</b>	80A (3")	<b>V</b>	700A (28")
<b>I</b>	100A (4")	<b>W</b>	750A (30")
<b>J</b>	125A (5")	<b>X</b>	800A (32")
<b>K</b>	150A (6")	<b>Y</b>	900A (36")
<b>L</b>	200A (8")	<b>Z</b>	1000A (40")
<b>M</b>	250A (10")	<b>1</b>	Other
<b>N</b>	300A (12")		

**3. Connection flange**

<b>A</b>	ANSI 150 Lb	<b>H</b>	KS 10K
<b>B</b>	ANSI 300 Lb	<b>I</b>	KS 16K
<b>C</b>	ASME 150 Lb	<b>J</b>	KS 20K
<b>D</b>	ASME 300 Lb	<b>K</b>	DIN PN 10
<b>E</b>	JIS 10K	<b>L</b>	DIN PN 16
<b>F</b>	JIS 16K	<b>M</b>	DIN PN 20
<b>G</b>	JIS 20K	<b>O</b>	Other

**4. Electrode material**

- 1 Titanium
- 2 316L SS
- 3 Hastelloy-C
- 4 Platinum Iridium
- 5 Tantalum
- 6 Other

**5. Ground ring material**

- 1 None
- 2 316L SS
- 3 Hastelloy C
- 4 Platinum Iridium
- 5 Titanium
- 6 Tantalum
- 7 Other

**6. Lining material**

- 1 Hard rubber (Flange : A105)
- 2 PTFE (Flange : A182 F304)
- 3 Other  
(Hard Rubber w/Flange : A182 F304,  
PTFE w/Flange : A182 F316, etc.)

**7. Excitation and signal cable**

- 1 5 M
- 2 10 M
- 3 20 M
- 4 Other (Max. 30 M)

**\* Example Specification**

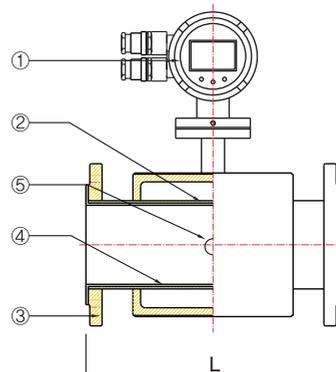
- 1 Connection : 4" ANSI 150Lb RF
- 2 Electrode Material : Titanium
- 3 Ground Ring : None
- 4 Lining Material : Hard Rubber (Flange : A105)

1	2	3	4	5	6	7
F951	I	A	1	1	1	1

Sample ordering code

**Standard material**

No.	Part list	Material
1	Head	Cast Aluminium
2	Body	304SS
3	Flange	Standard : Carbon steel Option : 304SS, etc.
4	Lining	Standard : Hard Rubber Option : Teflon
5	Electrode	Standard : Titanium Option : 316L SS Hastelloy-C Platinum Iridium Tantalum



## Principle of Electromagnetic Flowmeter

### Principle of operation

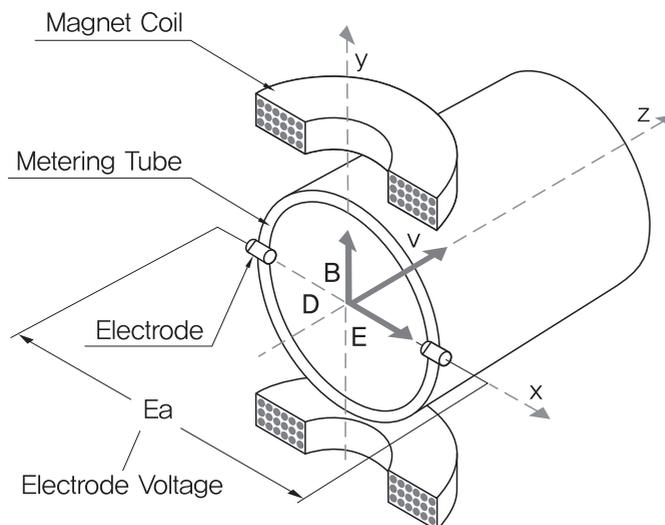
The electromagnetic flowmeters are the ideal flowmeters for metering the flow of all liquids, slurries and sludges that have a specific minimum electrical conductivity. These flowmeters measure accurately, create no additional pressure drop, contain no moving or protruding parts, are wear free and corrosion resistant. Installations are possible in any existing piping system.

The electromagnetic flowmeters has proven itself over many decades and is the preferred flowmeter in the Chemical, Pharmaceutical and Cosmetic Industries. Municipal Water and Waste Water treatment facilities and in the Food and Paper industries.

### Measurement operation

Faraday's Laws of induction form the basis for the electromagnetic flowmeter which states that a voltage is generated in a conductor as it moves through a magnetic field.

This principle is applied to a conductive fluid which flows through the meter tube perpendicular to the direction of the magnetic field. (see the figure 1.)



$E$  = Electrode Voltage  
 $B$  = Magnetic Induction  
 $D$  = Electrode Distance  
 $V$  = Average Flow Velocity  
 $qv$  = Volume Flowrate

$$E_a \sim B \cdot D \cdot v$$

$$qv = \frac{D^2 \pi}{4} \cdot v$$

$$E_a \sim qv$$

Figure 1. Basic operating principle of an Electromagnetic Flowmeter

The voltage induced in the fluid is measured by two electrodes located diametrically opposite to each other. This electrode voltage "Ea" is proportional to the magnetic induction "B", the electrode distance "D" and the average flow velocity "V". Nothing that the magnetic induction "B" and the electrode distance "D" are constant values indicates that a proportionality exists between the electrode voltage "Ea" and the average flow velocity "V". From the equation for calculating the volume flowrate "Ea~qv", it follows that the signal voltage is linear and proportional to the volumetric flowrate.

## Measuring range

In the normal industry application it is better to set the measured medium speed as 2~4m/s.

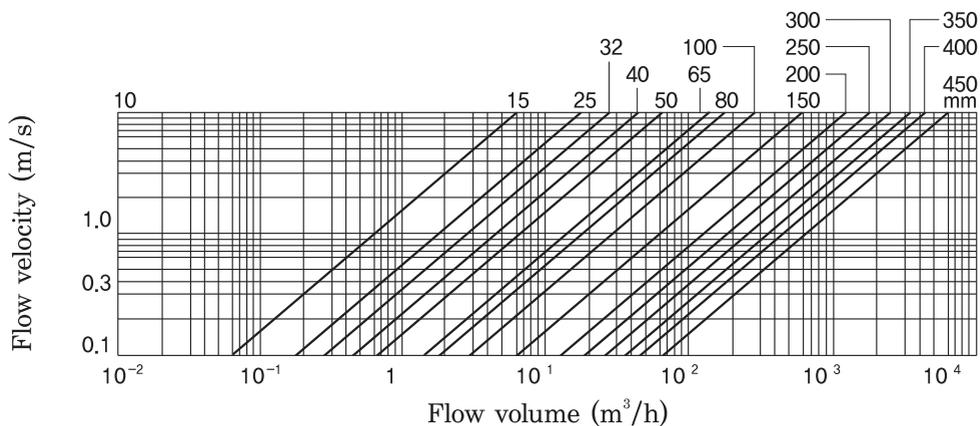
Under the special situation the minimum speed should be more than 0.2m/s and maximum speed less than 8m/s.

If there are solid granules in liquid the usual speed should be less than 3m/s for purpose to avoid the over-attrition between lining and electrical poles.

For viscid liquid the speed can choose as 2m/s the fast flow speed makes for the automatic elimination of obstructive substances glued on poles, therefore improve the inspection's preciseness.

Size (mm)	Flow range				Dimension "L" (mm)	Max. Working Pressure (bar)	Approx Weight (Kg)
	Minimum		Maximum				
	Velocity (m/s)	Flow rate (m³/h)	Velocity (m/s)	Flow rate (m³/h)			
15A		0.19		6.35			7
20A		0.34		11.29			7
25A		0.53		17.64			8
32A		0.87		28.91	200	40	8
40A		1.36		45.71			9
50A		2.12		70.58			10
65A		3.58		119.28			11
80A		5.43		180.68			13
100A		8.48		282.32	250		17
125A		13.25		441.12		16	20
150A	0.2	19.08	10.0	636.21	300		30
200A		33.91		1,129.27	350		41
250A		52.99		1,764.48	400		58
300A		76.30		2,540.86			70
350A		103.86		3,458.39	500		82
400A		135.65		4,517.08			106
450A		171.68		5,716.93		10	116
500A		211.95		7,057.94	600		130
600A		305.21		10,163.43			185
700A		415.42		13,833.55	700		230
800A		542.59		18,068.31	800		300
900A		686.72		22,867.71	900		380
1000A		847.80		28,231.74	1,000	6	480

## Graph Illustration of diameter, Flow speed and Volume of flowmeter



## Grounding

### General information on ground connections

Observe the following items when grounding the device ;

- The flowmeter grounding is one of the most important things for flowmeter installation.
- For plastic pipes or pipes with insulating lining, the grounding is provided by the grounding ring.
- When stray potentials are present, install a grounding ring upstream and downstream of the flowmeter sensor.
- For measurement-related reasons, the potential in the station ground and in the pipeline should be identical.

#### ※ Important Notice

If the flowmeter sensor is installed in plastic or earthenware pipelines, or in pipelines with an insulating lining, transient current may flow through the grounding electrode in special cases.

In the long term, it may destroy the sensor, since the ground electrode will turn in degrade electrochemically.

In these special cases, the connection to the ground must be performed using grounding plates.

Install a grounding ring upstream and downstream of the device in this case.

### Metal pipe with fixed flanges

Use a copper wire (at least 2.5 mm<sup>2</sup>) to establish the ground connection between the sensor, the pipeline flanges and an appropriate grounding point.

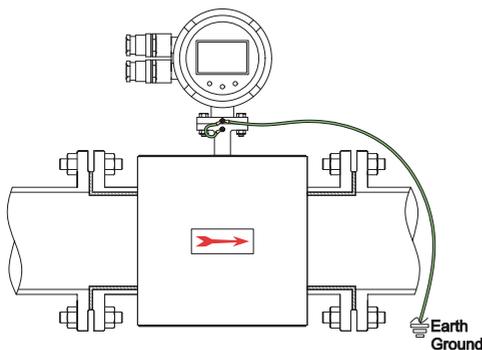


Figure 2. Metal pipe, without liner  
(Over 50A sizes)

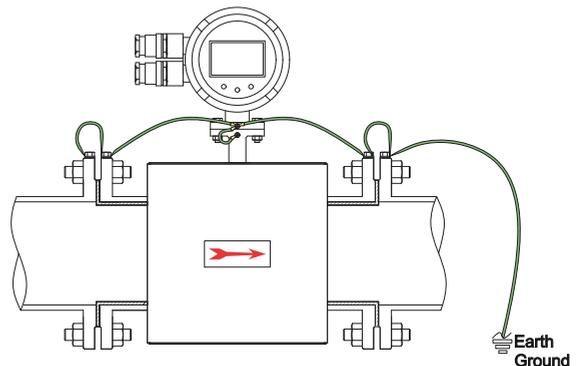


Figure 3. Metal pipe, without liner  
(From 10 to 40A sizes)

### Plastic pipes, non-metallic pipes or pipes with insulating liner

For plastic pipes or pipes with insulating lining, the ground for the measuring agent is provided by the grounding ring. If grounding electrodes are used, the grounding ring is not necessary.

- Install the flowmeter sensor with grounding ring in the pipeline.
- Connect the terminal lug for the grounding ring and grounding connection on the flowmeter sensor with the grounding strap.
- Use a copper wire (min. 2.5 mm<sup>2</sup>) to link the ground connection to a suitable grounding point.

※ It is essential to use this grounding method in an electrolysis process at a plating factory.

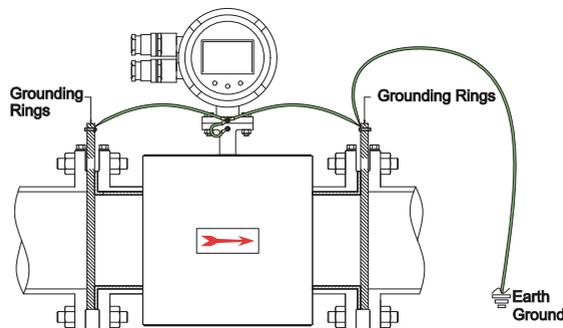


Figure 4. Plastic pipes, non-metallic pipes or pipes with insulating liner

## Grounding

### Ground for pipes with flexible connection

For pipes with flexible connection, it should be welded M16 or 1/4 sized bolts on both sides of the pipes as shown the figure 5 to get proper ground results.

Make sure to use a copper wire (min. 2.5 mm<sup>2</sup>) to link the ground connection to a suitable grounding point.

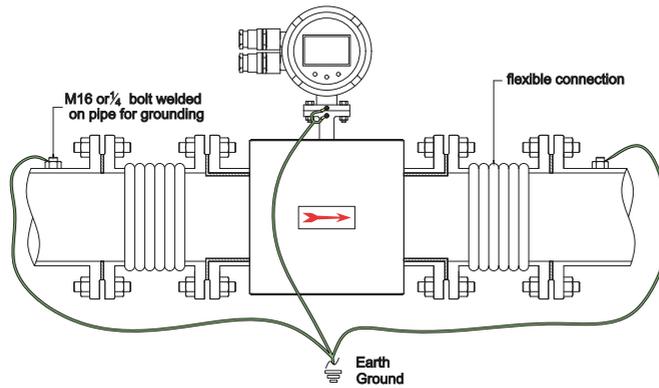
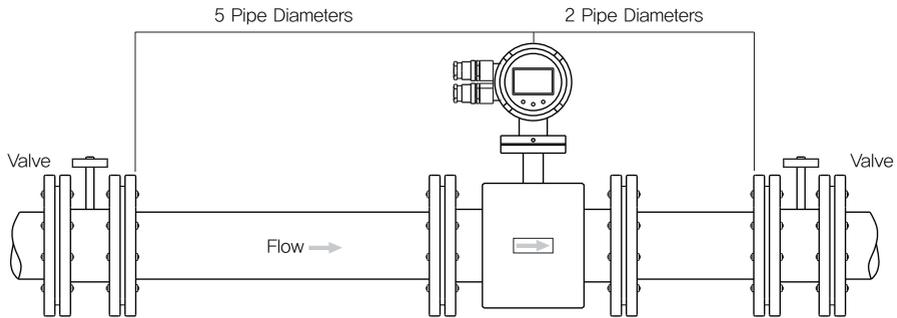


Figure 5. Ground for pipes with flexible connection

## Piping installation

### Upstream downstream piping installation methods (Standard)

To ensure specific accuracy over widely varying process conditions install the flowtube with a minimum of five straight upstream and two pipe diameters downstream from the electrode plan, as shown below. This flowtube placements is usually adequate to allow for disturbances created by elbows, valves and reducers.

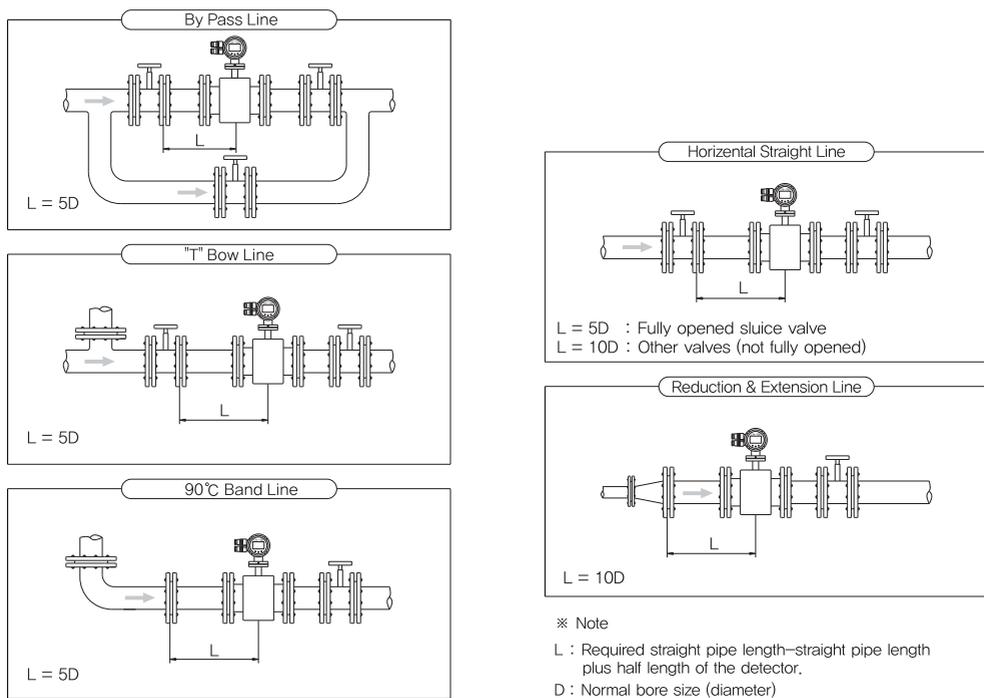


Upstream and Downstream straight pipe diameter

※ Note : It can be measured a correct flowrate only when a detector is full with fluid inside completely. Make sure to operate it with fluid in full inside.

### Required pipe length on piping connections

If various joints are used upstream of the detector outlet, the straight pipe length as show in figure below is required.

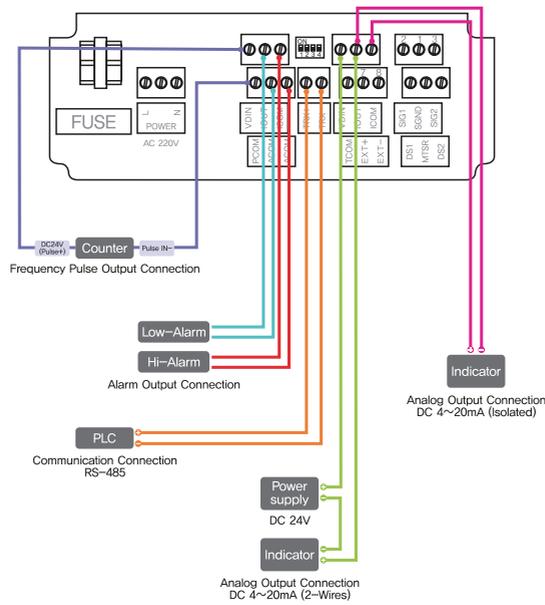


The figure above required straight pipe length on the upstream side

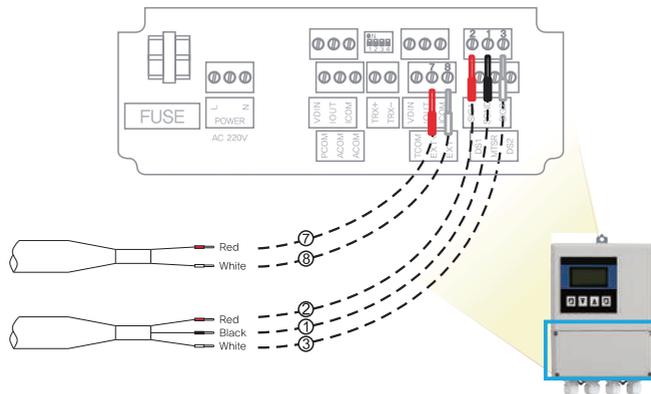
It follows the regulations of JIS B 7554 and KS B 0612 standards for the straight-pipe length installation conditions of electromagnetic flowmeter.

# Wiring

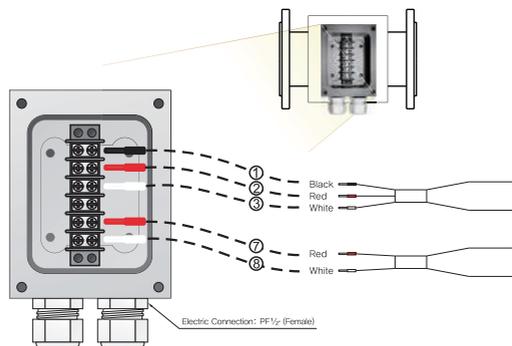
## Controller wiring connection function



## Wiring connection on sensor to converter

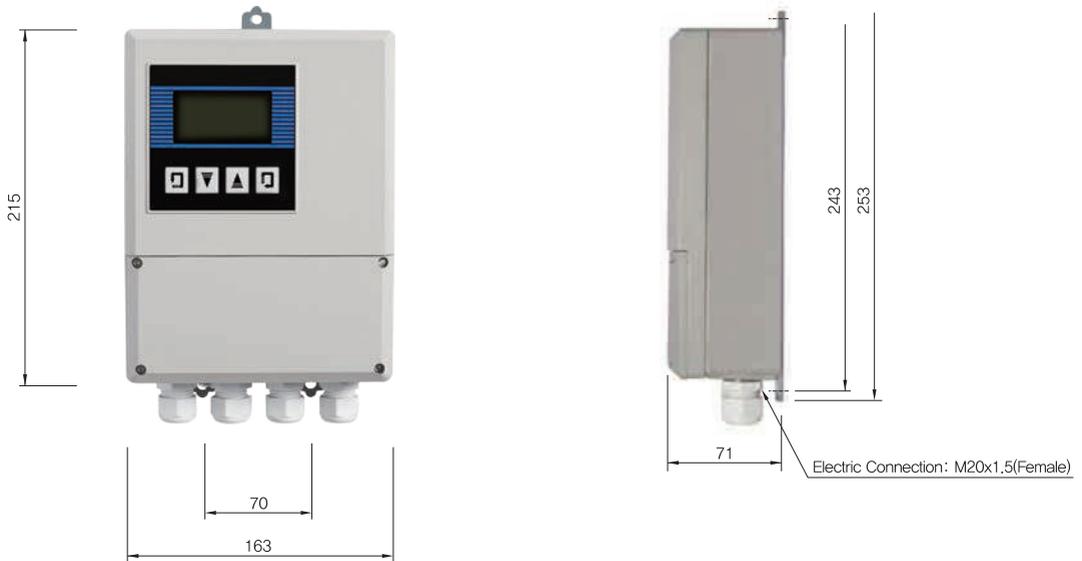


## Wiring connection on sensor

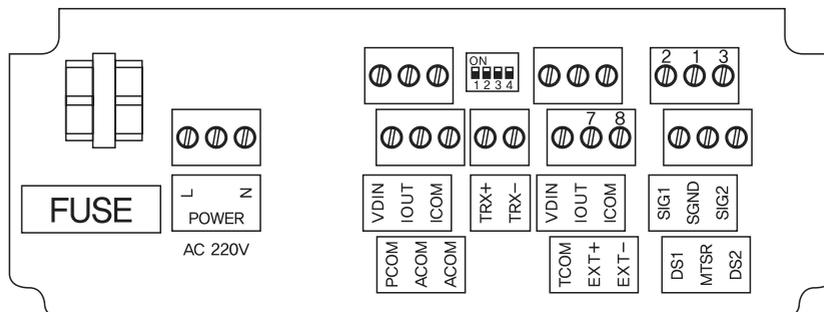


## Dimension

### Converter dimension



### Converter wiring diagram



- 1) Power : AC 85 ~ 250 V (50 ~ 60 Hz) / DC 24 V
- 2) Analogue output : DC 4 ~ 20 mA (Isolated)
- 3) Pulse output : Open collector pulses
- 4) Alarm output : Hi and Low alarm output
- 5) Network function (Option) : RS-485

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