



Datasheet

Coriolis Mass Flow meter

AI-CM600



## Datasheet

### Coriolis Mass Flow Meter AI-CM600

The Coriolis mass flow meter is a new type of flow measurement instrument developed based on the principle of the Coriolis force. It can directly measure the mass flow rate, density, and temperature of the fluid in a closed pipeline. It can be widely applied in industries such as chemical engineering, petroleum, food, pharmaceuticals, and paper making.

#### Applications

- Chemical engineering
- Petroleum
- Food
- Pharmaceuticals
- Paper making



#### Features

- directly measures the mass flow of fluids.
- Wide measuring range and high accuracy.
- Low installation requirements, no front and rear straight pipe section requirements.
- Wide range of applications, in addition to normal fluid measurement can also measure the general fluid measurement instrument is more difficult to measure the industrial media, such as high-viscosity fluids, a variety of slurries, suspensions and so on.
- can be online measurement of the measured medium density, temperature and other parameters, and as a result of the derivation of the measurement of the concentration of solutes in solution.
- Reliable operation and low maintenance.



**Coriolis Mass Flow Meter**

### Principle

When a particle in a pipe that rotates around a fixed point P (the center of rotation) moves towards or away from the center of rotation, an inertial force will be generated. The principle is shown in Figure 1.

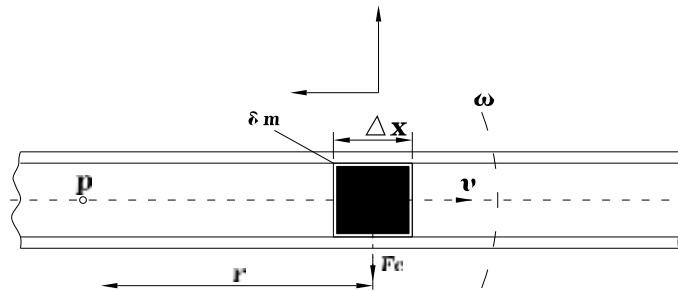


Figure 1 Mass flow measurement principle

In the figure, a particle with a mass of  $\delta m$  moves to the right at a constant velocity  $u$  in the pipeline, while the pipeline rotates around the fixed point P at an angular velocity  $\omega$ . At this time, the particle will obtain two acceleration components:

- (1) The normal acceleration  $a_r$  (centripetal acceleration), whose magnitude is equal to  $\omega^2 r$  and whose direction is towards point P.
- (2) The tangential acceleration  $a_t$  (Coriolis acceleration), whose magnitude is equal to  $2\omega u$  and whose direction is perpendicular to  $a_r$ .

The force generated by the tangential acceleration is called the Coriolis force, and its magnitude is equal to  $F_c = 2\omega u \delta m$ . In Figure 1, the fluid

$\Delta m = \rho A \Delta X$ . Therefore, the Coriolis force can be expressed as:

$$\Delta F_c = 2\omega u \times \delta m = 2\omega \times u \times \rho \times A \times \Delta X = 2\omega \times \delta q_m \times \Delta X$$

where A represents the cross-sectional area inside the pipeline, and

$$\Delta q_m = \delta dm / dt = u \rho A.$$

For a specific rotating pipeline, its frequency characteristics are fixed, and  $\Delta F_c$  depends only on  $\delta q_m$ . Therefore, the mass flow rate can be measured by directly or indirectly measuring the Coriolis force. The Coriolis principle mass flow meter operates according to the above principle.

In actual flow meters, rotational motion is not realized; instead, pipeline vibration is used. The schematic diagrams of its principle are shown in Figures 2, 3, and 4. Both ends of a curved pipeline are fixed, and a vibrating force (at the resonant frequency of the pipeline) is applied to the middle position between the two fixed points, making the pipeline vibrate at its natural frequency  $\omega$  with the fixed points as the axis. When there is no fluid flowing in the pipeline, the pipeline is only affected by the externally applied vibrating force, and the two halves of the pipeline vibrate in the same direction with no phase difference. When there is fluid flow, affected by the Coriolis force  $F_c$  of the medium particles flowing in the pipeline (in the two halves of the pipeline, the Coriolis forces  $F_1$  and  $F_2$  are equal in magnitude but opposite in direction, as shown in Figure 2), the two halves of the pipeline twist in opposite directions, generating a phase difference (as shown in Figures 3 and 4). This phase difference is proportional to the mass flow rate. The design of the flow meter is to convert the measurement of the Coriolis force into the measurement of the phase time difference on both sides of the vibrating tube. This is the working principle of the Coriolis mass flow meter.

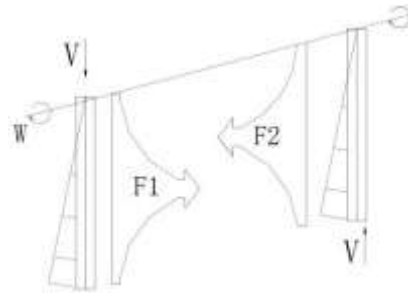


Figure 2

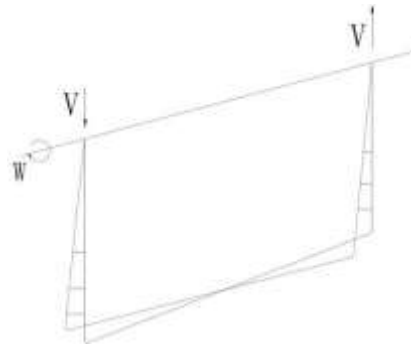


Figure 3

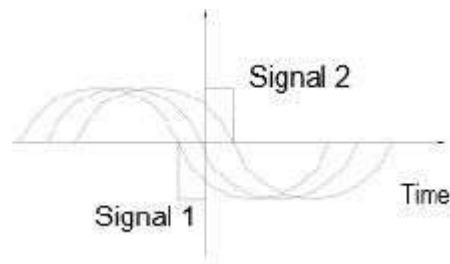


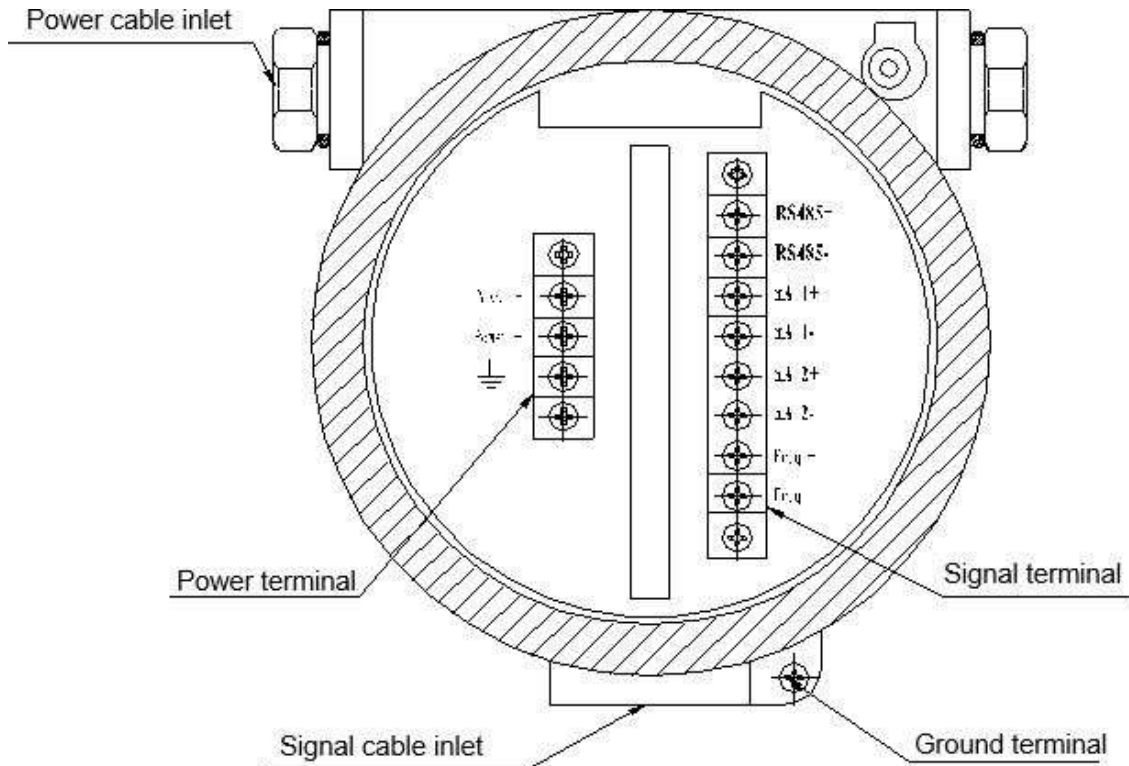
Figure 4

| Parameters                    |  |
|-------------------------------|--|
| Measured Variables            | Mass Flow, Density, Temperature                          |
| Nominal Diameter              | Straight Pipe Type: DN8 - DN80                           |
|                               | U-shaped Type: DN20 - DN150                              |
|                               | Triangular Type: DN3 - DN15                              |
| Flow Rate Range (L/min)       | Refer to Table 2 and Table 3                             |
| Density Measurement Range     | (0.3 - 3.000) g/cm <sup>3</sup>                          |
| Temperature Measurement Range | (-200 - 300) °C  |
| Transmitter Output            | (4 - 20) mA, Output Load (250 - 600) Ω                   |
| Communication Output          | RS485 Interface, MODBUS-RTU Communication Protocol; Hart |
| Frequency (Pulse) Output      | Pulse Width: 50%   |
|                               | Active: Output Current 10 mA, Open-circuit Voltage 24 V  |
| Power Source                  | 24 VDC / 220 VAC   |
| P Power Consumption           | ≤ 15 W   |

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|                                     |  |
|-------------------------------------|--|
| Power Supply - Electrical Interface | M20×1.5  |
| Accuracy                            | Flow: Class 0.2, Class 0.5<br>Density: $\pm 0.002 \text{ g/cm}^3$<br>Temperature: $\pm 1 \text{ }^\circ\text{C}$   |
| Repeatability                       | 1/2 of the Measurement Error   |
| Medium Temperature                  | Standard Type: (-50 - 200) $^\circ\text{C}$ , (-20 - 200) $^\circ\text{C}$<br>High-temperature Type: (-50 - 350) $^\circ\text{C}$<br>Low-temperature Type: (-200 - 200) $^\circ\text{C}$ |
| Process Pressure                    | (0 - 4.0) MPa  |
| Pressure Drop                       | The pressure drop corresponding to the maximum flow rate is 100 kPa (with water as the medium)   |
| Temperature                         | -40 $^\circ\text{C}$ to +60 $^\circ\text{C}$   |
| Humidity                            | 35% - 95%  |
| Protection Grade                    | IP67   |

## Wiring

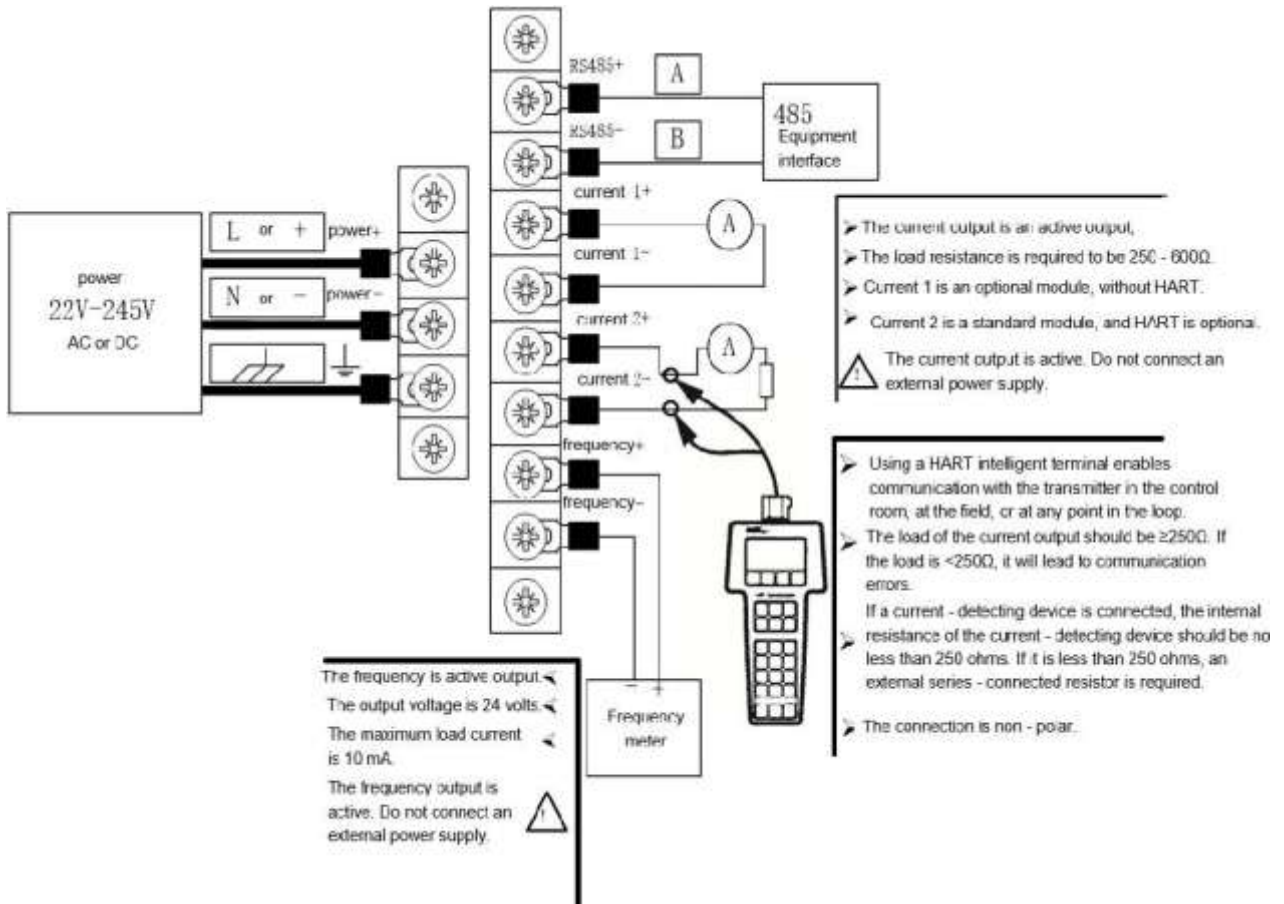


Flow meter terminals

### Terminal Definitions

| Symbols        | Explanation                                   |
|----------------|---|
| RS485+, RS485- | RS485 serial communication interface          |
| mA1+, mA1-     | The first (4 - 20) mA output interface        |
| mA2+, mA2-     | The second (4 - 20) mA output interface       |
|                | Hart output interface (optional)              |
| Freq+, Freq-   | Frequency (pulse) output interface            |
| Power+, Power- | Power supply interface                        |
| ⊕              | Protective earth for the converter instrument |

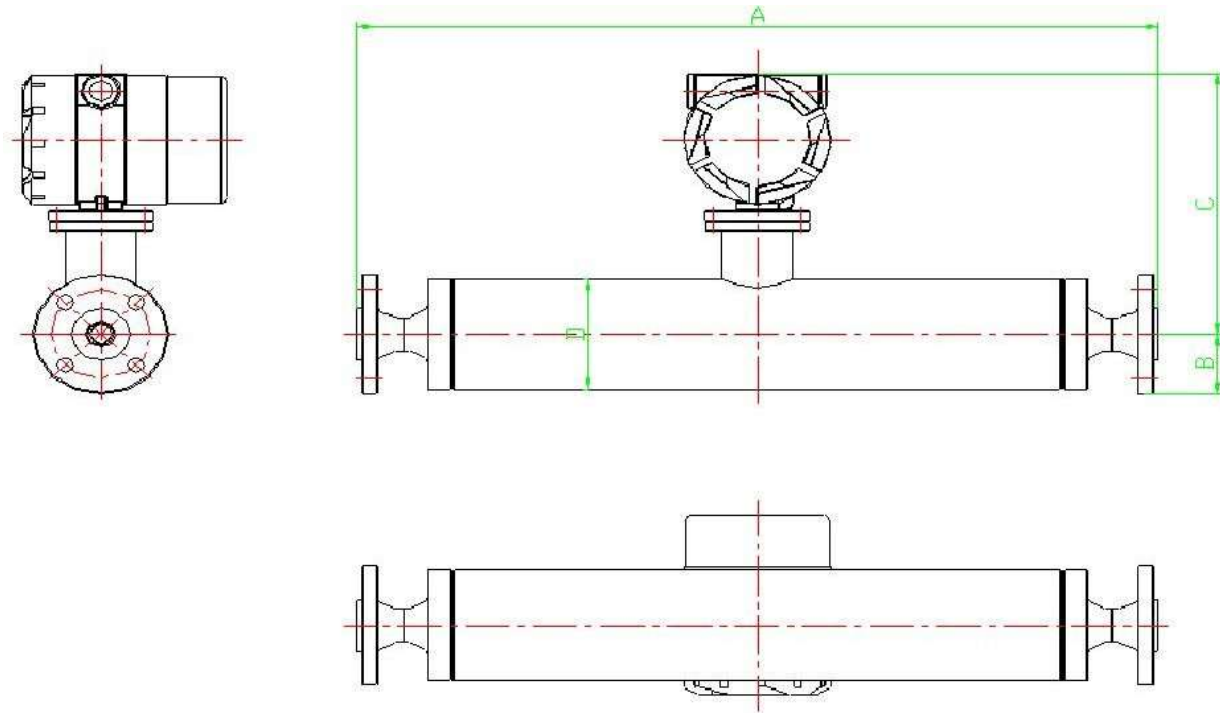
### Wiring diagram of the transmitter



## Dimensions

### Straight pipe type Coriolis mass flow meter external dimensions

### Ordinary type straight pipe mass flow meter one-piece external dimensions

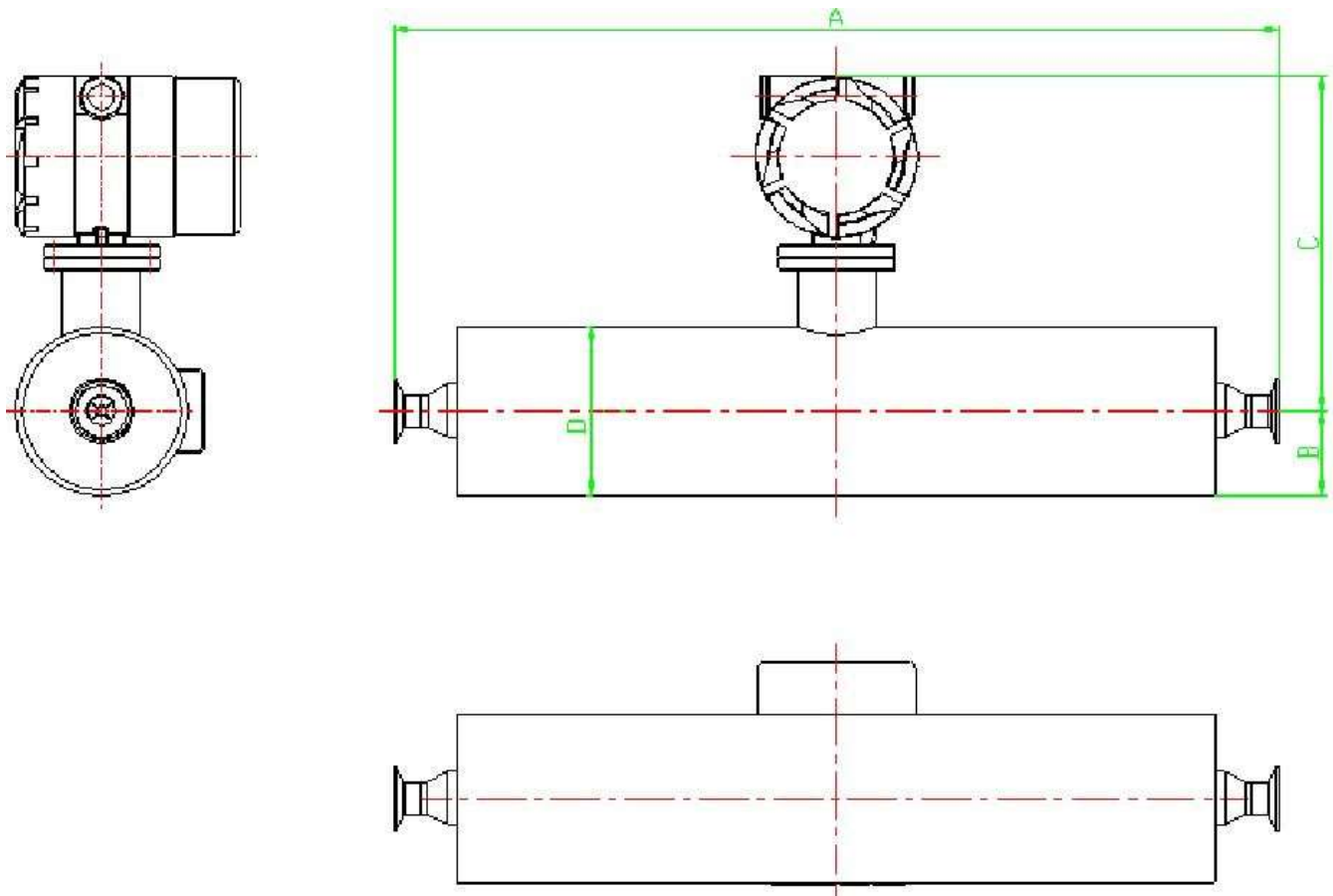


General straight pipe mass flow meter one-piece appearance diagram

### Ordinary type ordinary type straight tube mass flow meter one-piece external dimensions

| Diameter | A    | B    | C     | D     | weight |
|----------|------|------|-------|-------|--------|
|          | mm   | mm   | mm    | mm    | kg     |
| DN8      | 492  | 45   | 235   | 82    | 10     |
| DN10     | 542  | 47.5 | 238   | 87    | 12     |
| DN15     | 622  | 52.5 | 238   | 87    | 13     |
| DN20     | 685  | 57.5 | 251   | 106.5 | 18     |
| DN25     | 751  | 70   | 257   | 117   | 23     |
| DN32     | 867  | 70   | 264   | 137   | 31     |
| DN40     | 963  | 78.5 | 279   | 157   | 37     |
| DN50     | 1053 | 82.5 | 279   | 157   | 42     |
| DN80     | 1185 | 115  | 311.5 | 219   | 66     |

**Sanitary Straight Pipe Mass Flow Meter Integral External Dimensions**



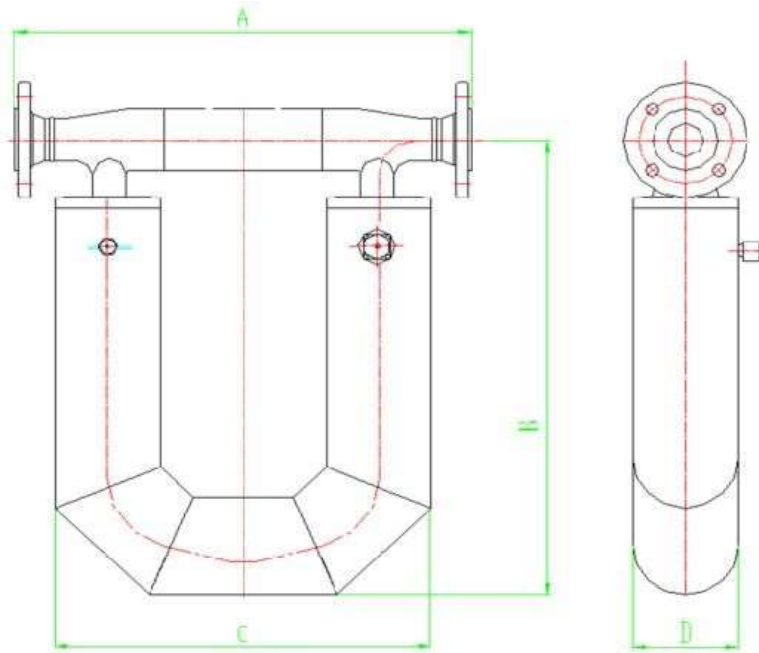
Sanitary straight pipe mass flow meter shape diagram

Sanitary straight pipe mass flow meter external dimensions

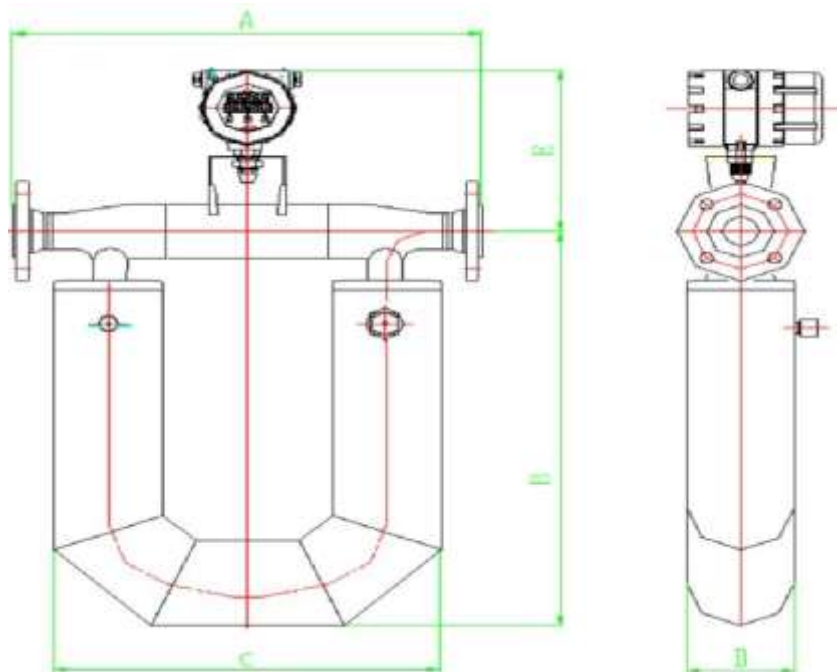
| Diameter | A   | B    | C   | D   | weight |
|----------|-----|------|-----|-----|--------|
|          | mm  | mm   | mm  | mm  | kg     |
| DN20     | 598 | 54   | 257 | 108 | 17     |
| DN25     | 680 | 66.5 | 261 | 133 | 23     |
| DN32     | 680 | 66.5 | 261 | 133 | 23     |
| DN40     | 792 | 70   | 273 | 140 | 28     |
| DN50     | 864 | 79.5 | 283 | 159 | 36     |
| DN65     | 948 | 79.5 | 283 | 159 | 42     |

**Non-straight pipe type Coriolis mass flow meter external dimensions**

**U-type Coriolis mass flow meter external dimensions**



Split U-type Coriolis Mass Flow Meter Outline Schematic Diagram

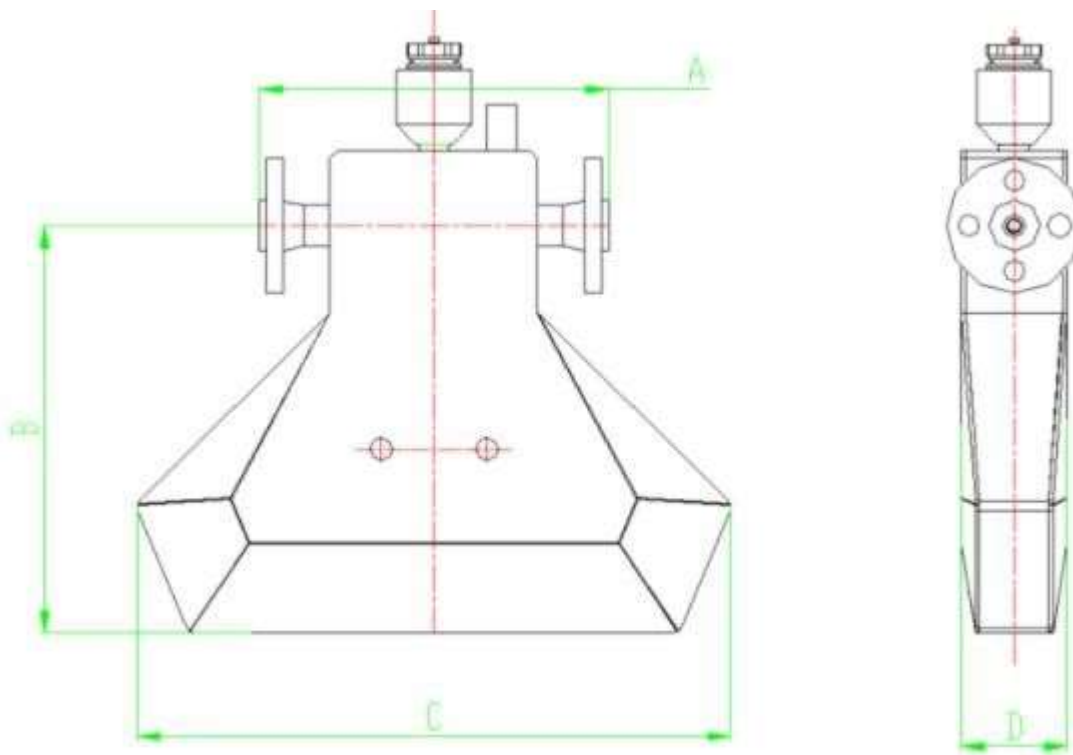


One-piece U-type Coriolis mass flow meter outline schematic diagram

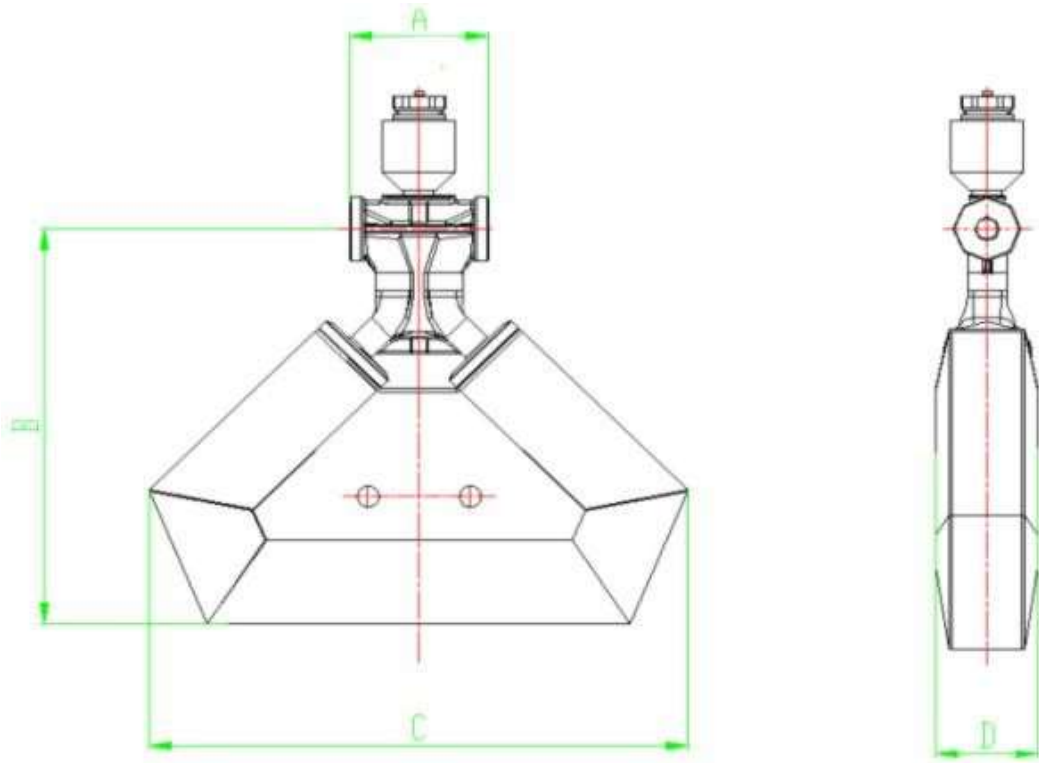
Type Structure Sensor External Dimensions

| Diameter | A    | B    | C    | D   | E   | weight |
|----------|------|------|------|-----|-----|--------|
|          | mm   | mm   | mm   | mm  | mm  | kg     |
| DN10     | 450  | 324  | 380  | 60  | 236 | 7.2    |
| DN15     | 456  | 324  | 380  | 60  | 236 | 7.5    |
| DN20     | 540  | 478  | 468  | 108 | 245 | 17     |
| DN25     | 540  | 492  | 468  | 108 | 245 | 17.5   |
| DN32     | 544  | 517  | 468  | 108 | 245 | 24     |
| DN40     | 600  | 635  | 500  | 140 | 267 | 32     |
| DN50     | 606  | 653  | 500  | 140 | 267 | 36     |
| DN80     | 866  | 857  | 779  | 219 | 316 | 87.5   |
| DN100    | 950  | 977  | 833  | 273 | 340 | 165    |
| DN150    | 1300 | 1223 | 1144 | 324 | 340 | 252    |

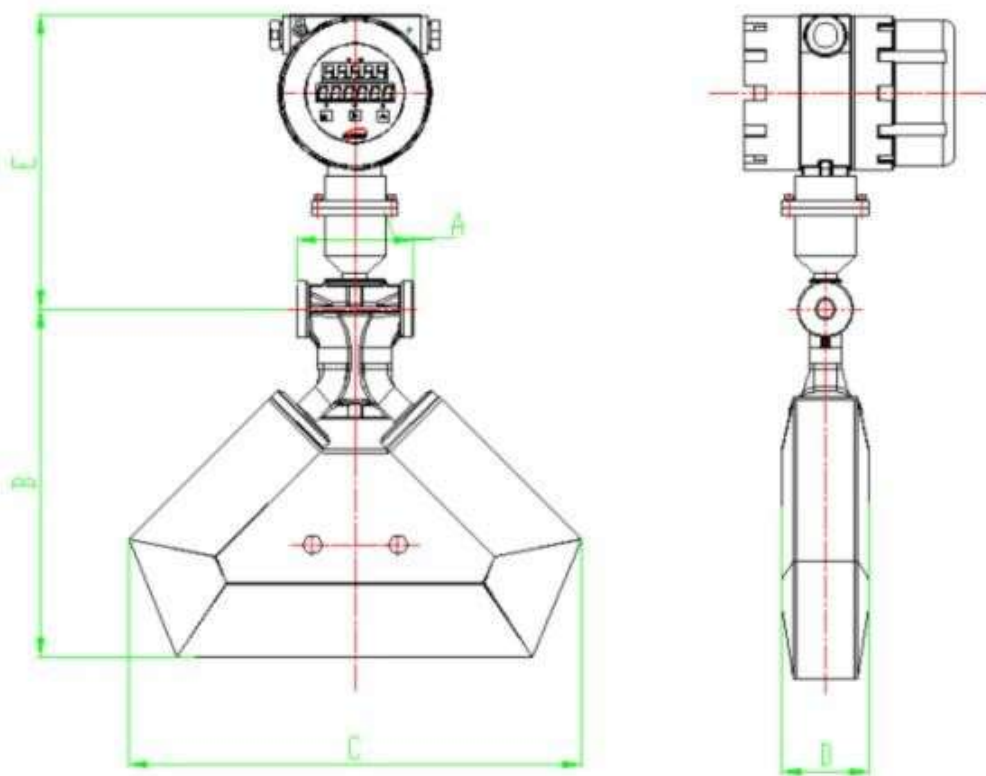
Triangular Coriolis Mass Flow Meter External Dimensions



DN3~DN8 Split Triangular Coriolis Mass Flow Meter Outline Schematic Diagram



DN10~DN15 Split Triangular Coriolis Mass Flow Meter Outline Schematic Diagram



One-piece delta type Coriolis mass flow meter outline schematic diagram

## Triangular Coriolis Mass Flow Meter External Dimensions

| Diameter | A   | B   | C   | D    | E   | weight |
|----------|-----|-----|-----|------|-----|--------|
|          | mm  | mm  | mm  | mm   | mm  | kg     |
| DN3      | 196 | 176 | 250 | 54   | 270 | 4.8    |
| DN6      | 250 | 263 | 360 | 70.5 | 289 | 8.1    |
| DN8      | 250 | 275 | 395 | 70.5 | 289 | 8.2    |
| DN10     | 95  | 283 | 370 | 70.5 | 264 | 6.5    |
| DN15     | 95  | 302 | 405 | 70.5 | 264 | 6.5    |

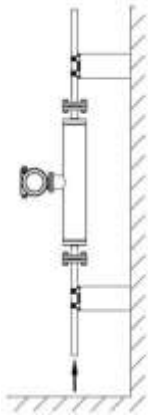
## Notes:

(1) A dimensions will be changed according to the connection method, here is only the reference size. For split DN10~DN15 size flowmeter it is the clamping section size, others are the standard configuration flange-to-flange size.

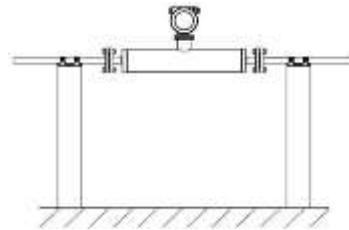
(2) E indicates the size of the part of total height increase after the integrated installation of the converter

## Installation

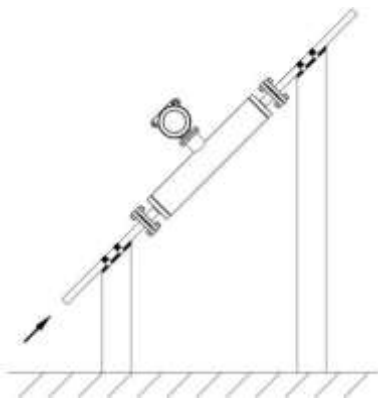
### Straight Pipe Mass Flow Installation



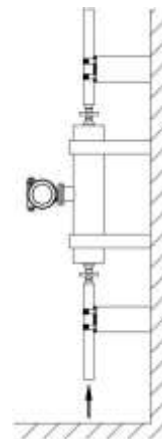
Vertical mounting schematic



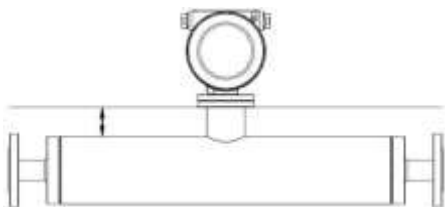
Horizontal mounting schematic



Angle Mounting Schematic

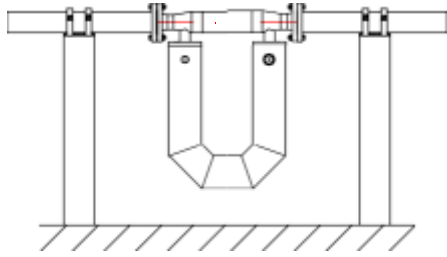


Installation diagram of sanitary straight pipe mass flow meter

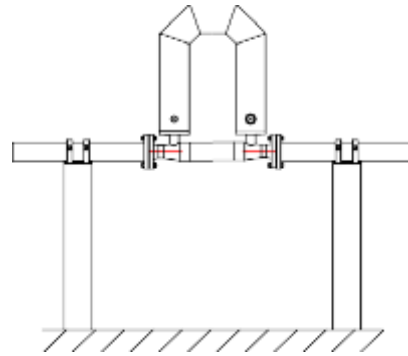


Schematic diagram of insulated and heated straight tube mass flow meters

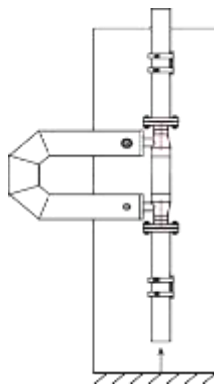
**Non-Straight Pipe Mass Flow Installation**



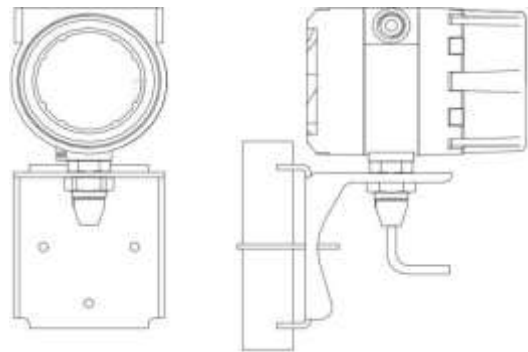
horizontal vertical facing down installation



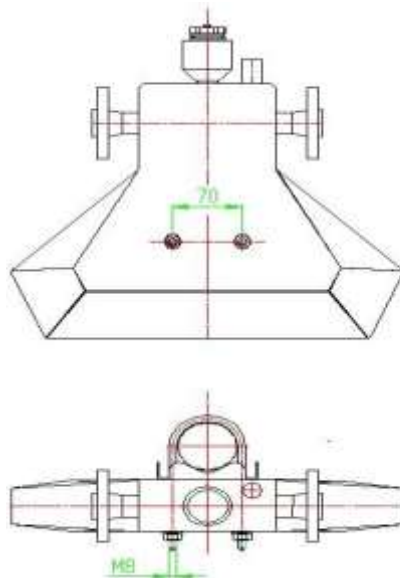
horizontal vertical facing up installation



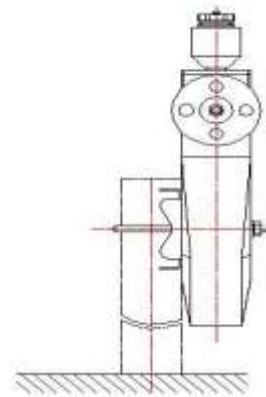
Vertical (Flag) Installation Schematic



Schematic diagram of fixation of converter with bracket



Schematic diagram of bracket fixation



## Ordering Code

| AI-CM600-U-03-H-E-C1-K-AM-TM-WB-00                            |             |   |   |    |   |    |    |    |    | Description |  |
|---|-------------|---|---|----|---|----|----|----|----|-------------|--|
| AI-CM600  | -           | - | - | -  | - | -  | -  | -  | -  | -           |  |
| Sensor type   | U<br>S<br>Z |   |   |    |   |    |    |    |    |             | U-type<br>triangles<br>straight pipe               |
| Nominal Diameter  | 03          |   |   |    |   |    |    |    |    |             | DN3  |
|   | 06          |   |   |    |   |    |    |    |    |             | DN6(1/8")  |
|   | 08          |   |   |    |   |    |    |    |    |             | DN8(1/4")  |
|   | 10          |   |   |    |   |    |    |    |    |             | DN10(3/8")   |
|   | 15          |   |   |    |   |    |    |    |    |             | DN15(1/2")   |
|   | 20          |   |   |    |   |    |    |    |    |             | DN20(3/4")   |
|   | 25          |   |   |    |   |    |    |    |    |             | DN25(1")   |
|   | 32          |   |   |    |   |    |    |    |    |             | DN32(1.25")  |
|   | 40          |   |   |    |   |    |    |    |    |             | DN40(1.5")   |
|   | 50          |   |   |    |   |    |    |    |    |             | DN50(2")   |
|   | 80          |   |   |    |   |    |    |    |    |             | DN80(3")   |
|   | 1C          |   |   |    |   |    |    |    |    |             | DN100(4")  |
|   | 1G          |   |   |    |   |    |    |    |    |             | DN150(6")  |
| XX  |             |   |   |    |   |    |    |    |    | other       |  |
| Thread Type Standard  |             |   | H |    |   |    |    |    |    |             | HG/T 20592 flange                                  |
|   |             |   | I |    |   |    |    |    |    |             | ISO2852 clamp                                      |
|   |             |   | X |    |   |    |    |    |    |             | other  |
| Nominal pressure  |             |   |   | E  |   |    |    |    |    |             | PN40   |
|   |             |   |   | D  |   |    |    |    |    |             | PN25   |
|   |             |   |   | C  |   |    |    |    |    |             | PN16   |
|   |             |   |   | XX |   |    |    |    |    |             | other  |
| Measuring tube, process connection material and body material |             |   |   |    |   | C1 |    |    |    |             | 316SS,304SS,304SS                                  |
|   |             |   |   |    |   | XX |    |    |    |             | other  |
| Accuracy  |             |   |   |    |   |    | K  |    |    |             | 0.5class   |
|   |             |   |   |    |   |    | F  |    |    |             | 0.2class   |
|   |             |   |   |    |   |    | XX |    |    |             | other  |
|   |             |   |   |    |   |    |    | AM |    |             | 4-20mA+Pulse+RS485, 24VDC                          |
|   |             |   |   |    |   |    |    | AK |    |             | 4-20mA+HART+Pulse, 24VDC                           |
| Output and Power Supply                                       |             |   |   |    |   |    |    | AA |    |             | 4-20mA + Pulse + RS485, 220VAC                     |
|   |             |   |   |    |   |    |    | AB |    |             | 4-20mA + HART + Pulse, 220VAC                      |
|   |             |   |   |    |   |    |    |    | BK |             | 4-20mA+Pulse+RS485, 24VDC/220VAC dual power supply |
|   |             |   |   |    |   |    |    |    | BL |             | 4-20mA+HART+Pulse, 24VDC/220VAC dual power         |
|   |             |   |   |    |   |    |    |    |    |             |  |

|   |    |   |
|---|----|---|
| High Temperature resi                                       | TM | supply  |
|   | TN | -50-200°C                                       |
|   | TP | -50-300°C                                       |
|   | TQ | -200-200°C                                      |
|   | XX | -20-200°C                                       |
| Electrical interface, housing material and protection class | WD | other   |
|   | W8 | One Piece, M20 x 1.5 Cable Plug, Aluminum, IP67 |
|   | XX | Split, M20 x 1.5 Cable Plug, Aluminum, IP67     |
| Split cable length  | 00 | other   |
|   | 02 | 0m  |
|   | 10 | 2m  |
|   | 15 | 10m   |
|   | 20 | 15m   |
|   | 25 | 20m   |
|   | 30 | 25m   |
|   | 40 | 30m   |
|   | 50 | 40m   |
|   | XX | 50m   |
|   | XX | other   |



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