

ULTRA Vortexor

Smart Ultrasonic Vortex Flowmeter

Model VRX10A

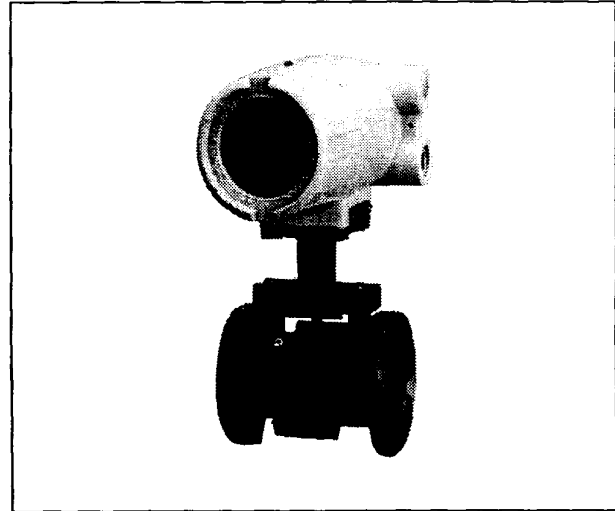
Overview

Calculates volume flow rate accurately and reliably in a range of liquids. Based on the versatile vortex-shedding principle, the Vortexor uses ultrasonic waves to locate and measure the highly-predictable Von Karman vortices generated by a shedder bar inserted into a flow. The Vortexor calculates the number of vortices, which is proportionate to the flow rate.

The Vortexor outputs a signal of 4 - 20 mA DC pulse or alarm proportional to flow rate, and transmits it to the receiver.

Special features

- (1) Minimal pressure loss. Only the strut is immersed in the flow path. Because the Vortexor has no movable parts, the pressure loss is low.
- (2) Highly-reliable sensors. Twin sensor pairs mounted on the flow-pipe's exterior detect the frequency of generated vortices. Vortexor's ultrasonic-wave sensors never come into contact with the measured liquid.
- (3) System integrity assured. If one pair of ultrasonic sensors malfunctions, the Vortexor automatically takes the defective sensor-pair offline, while its second pair of sensors continues performing flowrate measurement.
- (4) Defeats fluid density changes. Because the replaceable ultrasonic sensor is a double sensor, Vortexor is far less likely to be affected by changes in fluid density.
- (5) Wide applicability. It is possible to measure the flow rate of a liquid^(*), regardless of its electric conductivity, provided that the liquid has a kinetic viscosity of $20 \times 10^{-6} \text{ m}^2/\text{s}$ or less, and is defined as anti-corrosive (for use with SUS 316L). In addition, the Vortexor accommodates a wide range of fluid temperature and pressure conditions.
- (6) Output proportional to volume flow rate. Select analog outputs of 4 - 20 mA DC and pulse, or analog outputs of 4 - 20 mA DC and alarm.
- (7) Display an instantaneous, integrated, or total integrated value, as well as the alarm status.



- (8) Equipped with data handling functionality. The handheld Smart communicator (SFC) facilitates changes to set values and verification. The SFC also lets you perform a self-check of the status of the flowmeter and/or ultrasonic sensors. If the Vortexor is equipped with an indicator, SFC also enables changes to set values and verification on-site using the key switch.

Wide applicability

- (1) The Vortexor measures flow in a wide variety of fluids, including pure water, ion-exchange water, service water, sewage, and industrial water.
- (2) Applicable to measure fluid with a kinetic viscosity of $20 \times 10^{-6} \text{ m}^2/\text{s}$ or less, such as organic solvents (ethylene, alcohol, etc.) or other solvents.
- (3) It is also possible to measure gasoline, kerosene, light oil, and type "A" heavy oil.

^(*) Avoid using Vortexor to measure liquid containing chlorine ions or that causes crevice corrosion.

Structure

JIS pressure-resistant, explosion-proof structure (Integral type) : ExdIIBT4

Waterproof (Integral type) : JIS C0920 waterproofing standards, IEC IP66 equivalent.

Installation Notes

To ensure correct flow measurement, carefully read the installation notes in this specification (See P.3).

Standard Specifications

Measured fluid : Liquid

Fluid condition:

- Viscosity 20×10^{-6} m²/s or less
- Non-aerating (no bubbles present)
- No significant, characteristic ripples or ripple pressure
- No slurry invasion, non-adhesive

Measurable range :

Within the ranges specified in Tables 1 and 2

Guaranteed accuracy for flow rate range:

Re > 25,000 and flow speed of 0.3 m/s or more

Measurable flowrate range :

Flow rate of 0.1 m/s or more; 0.15 m/s or more for 25 A;
0.12 m/s or more for 40 A

Accuracy :

- ±1% of rate (pulse output)
- ±1% of rate ±0.1% FS (4 - 20 mA DC output)

Replay ability :

±0.2% of the specified value

Fluid temperature :

- 20 to +160°C (waterproof model)
- 20 to +120°C (explosion-proof model)

Fluid pressure :

Maximum of 5 MPa

Ambient temperature :

-20 to +60°C

Ambient humidity :

10 % to 95 % RH (non-condensing)

Power-supply voltage :

21.6 V DC to 26.4 V DC (see Figure 1 for relationship between power-supply voltage and load resistance)

Output signal :

- 4 - 20 mA DC, pulse, alarm : 4-wire
- 4 - 20 mA DC : 2-wire
- Pulse : Open collector pulse : 3-wire
30 V DC, 50 mA
- Alarm : Open collector contact : 3-wire
- Rating : 30 V DC, 50 mA

Communication :

Via SFC (Smart field communicator)

Data Setting :

Setting by SFC or key switch (when equipped with an indicator)

Constant at damping :

1 s to 199 s, variable

Piping connection :

Wafer connection, Flange connection

Construction :

- Vortexor Main unit : SCS 16 (SUS 316L equivalent)
- Additional material for wetted components : SUS316L
- Materials for non-wetted components : SUS316, SCS14
- Converter case : Aluminum alloy

Paint u:

Acrylic resin paint (converter case, cover)

Wiring connection :

G1/2 internal thread, 1/2 NPT internal thread, CM20 internal thread

Calibration method :

Actual flow calibration using water

Indicator :

- LCD eight-digit (optional)
- Total integrated value, instantaneous value, reset integrated-value display, alarm display
- Countermeasures for a power outage: Maintains the integrated value using EEPROM

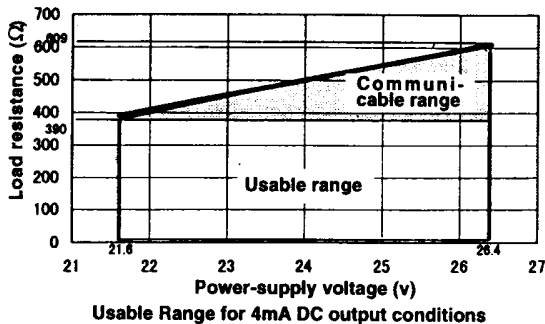
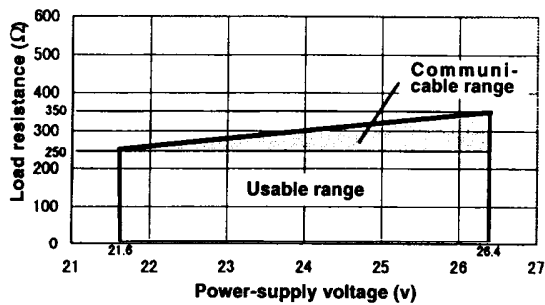


Figure 1

Options

Test reports :

test results based on actual flow calibration for the Vortexor flowmeter are available in both Japanese and English language versions. Please contact your representative.

Certification of traceability :

measurement control system structure diagram, proof of calibration, and test reports.

Mill sheet :

shows materials and a "charge number" for components that come into contact with liquid (wetted parts).

Strength calculation sheet :

a set of documents showing strength calculations for the housing, cap, and welded parts.

Water-removal treatment :

The Vortexor is shipped after water and water droplets have been removed from parts that have come into contact with liquid.

Oil-removal treatment :

the Vortexor is shipped after oil has been removed from parts that have come into contact with oil.

Gasket for pipes :

mount this gasket when installing the Vortexor detector on a pipe.

Tag-number attachment :

stamp the stainless steel plate with specified tag number and attach it to the Vortexor. The tag number can be up to eight characters in length. Valid characters are capital letters, whole numbers, and hyphens (-).

Tropicalization treatment :

The Vortexor treatment to protect against severe conditions during transportation and storage. Tropicalization includes corrosion-proofing, moisture-proofing, and rustproofing.

Diameter	Minimum flow rate that assures accuracy of $\pm 1\%$ of the specified value (m ³ /h)												Maximum measurable flow rate (m ³ /h)
	Kinetic Viscosity ($\times 10^{-6}$ m ² /s)												
	0.3	0.5	0.7	1	2	3	4	5	7	10	20		
25	0.6	0.9	1.2	1.7	3.4	5.1	6.8	8.5	12	—	—	—	14
40	0.7	1.1	1.6	2.2	4.4	6.6	8.8	11	16	22	—	—	36
50	0.8	1.3	1.8	2.5	5.0	7.5	10	13	18	25	50	—	60
80	1.4	2.3	3.2	4.6	9.2	14	19	23	32	46	92	—	115
100	2.3	3.7	5.2	7.4	15	23	30	37	52	74	148	—	200

Table 1 Guaranteed Accuracy of Flow Rate Range

Diameter	Minimum measurable flow rate (m ³ /h) (Note 1)												Maximum measurable flow rate (m ³ /h)
	Kinetic Viscosity ($\times 10^{-6}$ m ² /s)												
	0.3	0.5	0.7	1	2	3	4	5	7	10	20		
25	0.1	0.15	0.2	0.28	0.6	0.9	1.2	1.4	2.0	2.8	5.7	—	14
40	0.2	0.3	0.4	0.53	1.0	1.5	2.0	2.5	3.5	5.0	10.0	—	36
50	0.3	0.4	0.52	0.74	1.4	2.0	2.7	3.4	4.7	6.7	14	—	60
80	0.5	0.8	1.0	1.4	2.4	3.6	4.8	6.0	8.4	12	24	—	115
100	1.0	1.5	1.8	2.4	3.9	5.8	7.7	9.6	14	20	39	—	200

Table 2 Measurable Flow Rate Range (Note 2)

(Note 1) Although accuracy is not guaranteed when measurement is performed with the flow rate ranging from the minimum measurable flow rate to the minimum flow rate that ensures accuracy of $\pm 1\%$ of rate, it is possible to obtain output of a sufficient accuracy.

(Note 2) Reference measurement accuracy obtained using the flow rate ranging from the minimum measurable flow rate to the minimum flow rate that ensures accuracy of $\pm 1\%$ of rate is $\pm 2\%$ FS scale when the full scale is the maximum measurable flow rate.

Installation specifications

Installation Notes

Prolonged use with stable accuracy requires first installing the Vortexor to ease daily checks and allow stable operation. The following guidelines should be considered when selecting an installation location:

- (1) Install in any orientation, either horizontally, vertically, or diagonally, as long as the pipe is always filled with liquid. The converter cannot be mounted remotely from the detector. **For submerged use, avoid contact of converter case with water.**
- (2) When installing on a vertical pipe, ensure that the measured liquid flows from bottom to top and always fills the pipe.
- (3) Avoid locations that experience large temperature fluctuations.

- (4) Use supports. Although the flowmeter possesses a good vibration-proof structure, it is advisable, to protect piping and joints, to keep vibration and shock below 9.8 m/s².
- (5) Main unit is made of a stainless-steel-aluminum alloy. Avoid exposure to corrosive environments.
- (6) Water-proof structure of this flowmeter is JIS C0920 (IEC IP66) equivalent Vortexor not intended for submerged use.
- (7) Install in a location having sufficient inspection clearance.
- (8) Install in a location having sufficient wiring and piping clearance.

⚠ Caution
<ul style="list-style-type: none"> Measurement may not be possible in a gas-liquid two-phase flow or a flow containing bubbles (aerated flow). Avoid exposing the flow to liquids containing air bubbles. <p>Accurate measurement may not be possible when bubbles are trapped in the flowmeter. Ensure that no bubbles are trapped in the flowmeter pipe during installation.</p> <ul style="list-style-type: none"> Avoid water coming into direct contact with the flowmeter, as doing so may damage the flowmeter and/or power supply.

Notes on Installation of Piping and Equipment

Prolonged use with stable accuracy, consider the following points during installation of piping and equipment:

- (1) Match the flow direction of the fluid with the direction indicated on the flowmeter.
- (2) Install straight pipes (of lengths specified in Table 3) upstream and downstream of the flowmeter.
- (3) To ensure an accurate flow-rate measurement, the in-

Table 3 Required Lengths for Straight Pipe

Piping for the Upper Stream	Straight Pipe Length for the Upstream side	Straight Pipe Length for the downstream side
One 90° bend	Diameter x a factor of 23 or greater	Diameter x a factor of 5 or greater
Two or more bends on the same surface	Diameter x a factor of 25 or greater	Diameter x a factor of 5 or greater
Two or more bends on a different surface	Diameter x a factor of 40 or greater	Diameter x a factor of 5 or greater
Ingot pipe	Diameter x a factor of 15 or greater	Diameter x a factor of 5 or greater
Expansion pipe	Diameter x a factor of 27 or greater	Diameter x a factor of 5 or greater
Gate valve	Diameter x a factor of 15 or greater	Diameter x a factor of 5 or greater

ternal diameter of the pipe connected immediately before and after the flowmeter, should be of a size equivalent to or larger than the internal diameter of the flowmeter pipe.

Table 4 Connection Pipe

Diameter	Internal Diameter of the Flowmeter	Connection Pipe
25A to 50A	Comparable to schedule 40	Schedule 40 or greater
80A to 100A	Comparable to schedule 80	Schedule 80 or greater

- (4) To ensure accurate flowrate measurement, ensure the gasket connecting the flowmeter and the connection pipe, does not obstruct into the flow path.
- (5) If a pressure tap is required to ensure accurate flowrate measurement, install it at a distance of 2 - 7 times the flowmeter diameter, away from the downstream edge of the flowmeter. If a temperature tap is required, install it at a distance of 1 - 2 times the diameter, downstream away from the pressure tap.
- (6) When installing piping, ensure that the flowmeter and connection pipe are coaxial. A gap in the coax (gap at the center) will cause unstable instrument errors. Use the collar shipped with the flowmeter.
- (7) Large ripples, such as those caused by a bellows pump, may create variance in the measurement. Use a damper to minimize rippling.
- (8) For a line with valves, such as globe valves, that may be generating irregularity (drift) in the flow, install the flowmeter upstream of such valves.
- (9) When installing a heat converter that significantly modifies the liquid temperature, install it downstream of the flowmeter. If it must be installed upstream, maintain a sufficient distance from the flowmeter.
- (10) Cavitation decreases the accuracy of the flow rate measurement. To prevent cavitation, be sure to maintain the lowest pressure in the line downstream (which is located at a distance of 2~7 times the Diameter of the flowmeter) at a pressure higher than or equal to the result of the formula shown below.

$$P_d = 2.7 \times \Delta P + 1.3 \times P_0$$

P_d : Downstream pressure (kPa, absolute pressure)

ΔP : Pressure loss (kPa)

P_0 : Vapor pressure of fluid at the temperature during measurement

(kPa, absolute pressure)

The following formula is used to calculate pressure loss:

$$\Delta P = c \times \gamma$$

ΔP : Pressure loss (kPa)

c : Pressure loss coefficient (according to Figure 2)

γ : Fluid density (kg/m³)

⚠ Caution

- Ensure that the internal diameter of the connection pipe is the same as or more than the internal diameter of that of the flowmeter. Using a smaller connection pipe will result in variations in the flowmeter.
- Install the gasket of the flowmeter and the connection pipe so as to ensure that they are kept within the flow route. Otherwise, a variance error will result.
- Control rippling in piping, as ripples will result in instrumental error.
- To prevent cavitation, maintain a certain back-pressure (pressure downstream of the flowmeter). Cavitation will result in instrument errors.

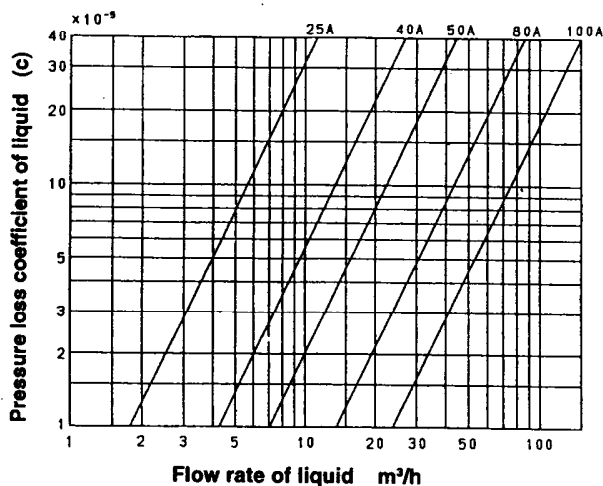


Figure 2 Pressure Loss Coefficient

Wiring

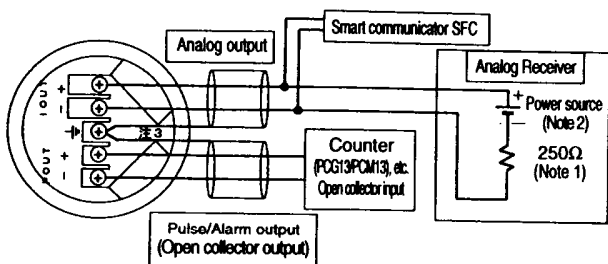
Wiring

- (1) Follow Figure 3 to wire external cables for the flowmeter, power supply, and external equipment.

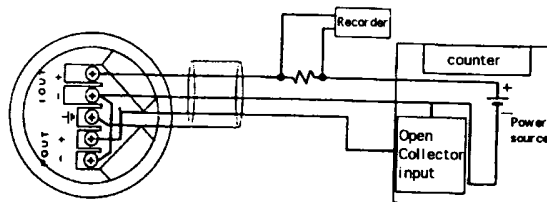
Note 1. To make use of the communication function via the smart communicator, load resistance of 250 Ω or more is required, including the cable resistance (see Figure 1).

Note 2. Supply power for the flowmeter

Note 3. When grounding the cable shield, use one-point grounding on the flowmeter side or the upper side of the equipment.



**Figure 3 Connection Diagram:
Using Analog output and pulse or contact output**



**Figure 4 Connection Diagram:
Using Pulse or alarm output only**

- (2) Analog output

The Analog transmission loop of this flowmeter is created by establishing load resistance between the + line and - line of the analog output line. The analog output line is also used as a power-supply line for the flowmeter.

- (3) Pulse output / Alarm output

The Pulse output / Alarm output of this flowmeter is an open collector output. Using the current limit resistance, connect a power source between pulse/alarm output line and the COM line to be used. Ensure that the value of the current limit resistance does not exceed the capacity of the pulse output.

- (4) Remove the terminal cover from the amplifier and the dustproof cover from the wiring connection before attempting to perform wiring.
- (5) To prevent noise, conduit tubes and ducts should be used for external wiring.

Wiring Notes

- (1) The cable specifications are as follows:

Recommended cable : CVVS, CEVS

Table 5

Flowmeter output	Number of leads	Cross-section area of the cable
Analog output only	2-cores shield	2mm ²
Analog output + Pulse output, or Analog output	2-cores shield x 2	2mm ²
Pulse or Alarm output only	3-cores shield	2mm ²

- (2) To prevent noise, avoid locations containing noise sources, such as heavy-duty motors, converters, and power supplies for motors, as well as locations containing high-voltage and high electric currents.
- (3) When using an explosion-proof specification, use the included (or optional) pressure-resistant packing adaotor(metal fittings).

⚠ Warning

When using in a dangerous environment, use the specified pressure-resistant packing metal fittings at the mouth of the cable. If they are not used, or if different metal fittings are used, the equipment is not guaranteed to be explosion-proof, and an explosion may occur.

Contents of Model Number Tables

Basic Model No.	Selections				Optional selections				Options(Up to seven selectable)
VRX10A									
Diameter	2 5mm	0 2 5							X None
	4 0mm	0 4 0							A Test report
	5 0mm	0 5 0							B Certification of traceability
	8 0mm	0 8 0							C Mill sheet
	1 0 0mm	1 0 0							D Strength calculation sheet
Body material	SCS 16		S						E Water-removal treatment
Flange rating	JIS 10K Wafer			11					F Oil-removal treatment
	JIS 20K Wafer			12					H Gasket for pipes
	JIS 30K Wafer			13					J Tag-number attachment
	JIS 40K Wafer			14					K Tropicalization treatment
	JPI 150 Wafer			61					<input type="checkbox"/> Others
	JPI 300 Wafer			62					
	ANSI 150 Wafer			21					
	ANSI 300 Wafer			22					
	DIN PN10 Wafer			41					
	DIN PN16 Wafer			42					
	DIN PN25 Wafer			43					
	DIN PN40 Wafer			44					
	JIS G3451 F12 Wafer			31					
	JIS 10K Flange			J1					
	JIS 20K Flange			J2					
	ANSI 150 Flange			A1					
	ANSI 300 Flange			A2					
	JPI 150 Flange			P1					
	JPI 300 Flange			P2					
	Output (Note 1)	4-20mA DC+Pulse			P	X Indicator		None	
4-20mA DC+Alarm			A	A	(Note 3)	With LCD indicator			
Wiring connection	G1/2 One conduit			G1	X	Explosion-proof approval (Note 4)	None		
	G1/2 Two conduits			G2	J		JIS explosion-proof EXdIIBT4 (Wiring connection should be G1/2)		
	1/2 NPT One conduit			N1	X	Finish	Standard paint		
	1/2 NPT Two conduits			N2	1		Anti-corrosion paint		
	CM20 One conduit			C1	2		Multiple coats of anti-corrosion paint		
	CM20 Two conduits			C2					
Installation (Note 2)	Horizontal piping installation, integral type			H	X	Bolts/Nuts	None		
	Vertical piping installation, integral type			V	1		SUS304 (Wafer connection only)		
Calibration flow	Standard three-point calibration			3					
	Five-point calibration			5					

Note Explosion-proof model includes a pressure-resistant packing cable adapter for exclusive use.

VRX10A Sizing form

Please fill this form when you ask us for the VRX10A estimate

Model No. : VRX10A - - -

Fluid : _____ Normal temp. : _____ [°C] Max. temp. : _____ [°C]

Normal press. : _____ [kPa, MPa, kgf/cm²]

Min. press. : _____ [kPa, MPa, kgf/cm²]

Density : _____ [kg/m³] Viscosity : _____ [cP, Pa·s]

Measuring range : _____ [m³/h, /min, Others ()]

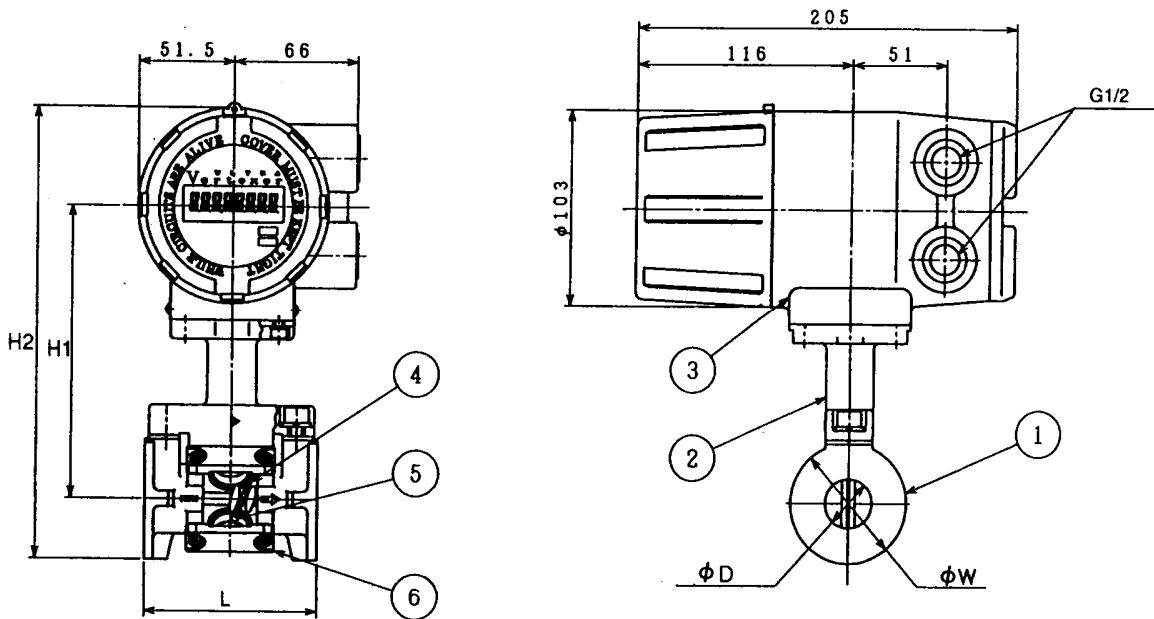
TAG NO. : _____

Dimensions

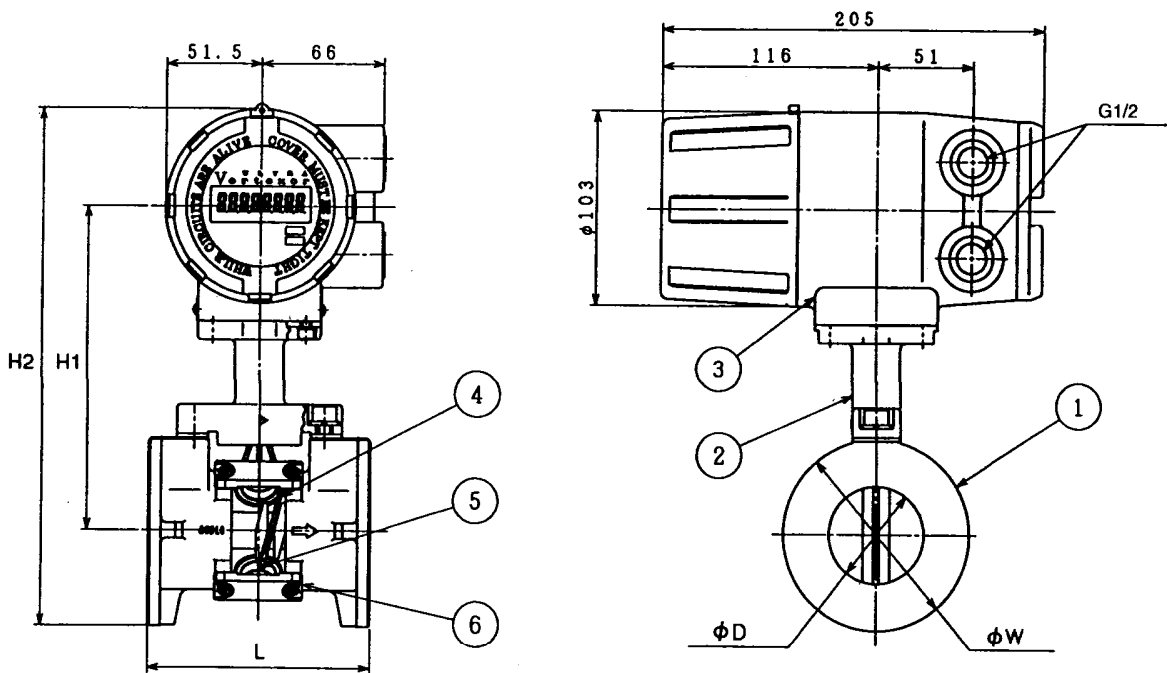
(Unit: mm)

[Integral Type with Indicator]

25A~40A



50A~100A

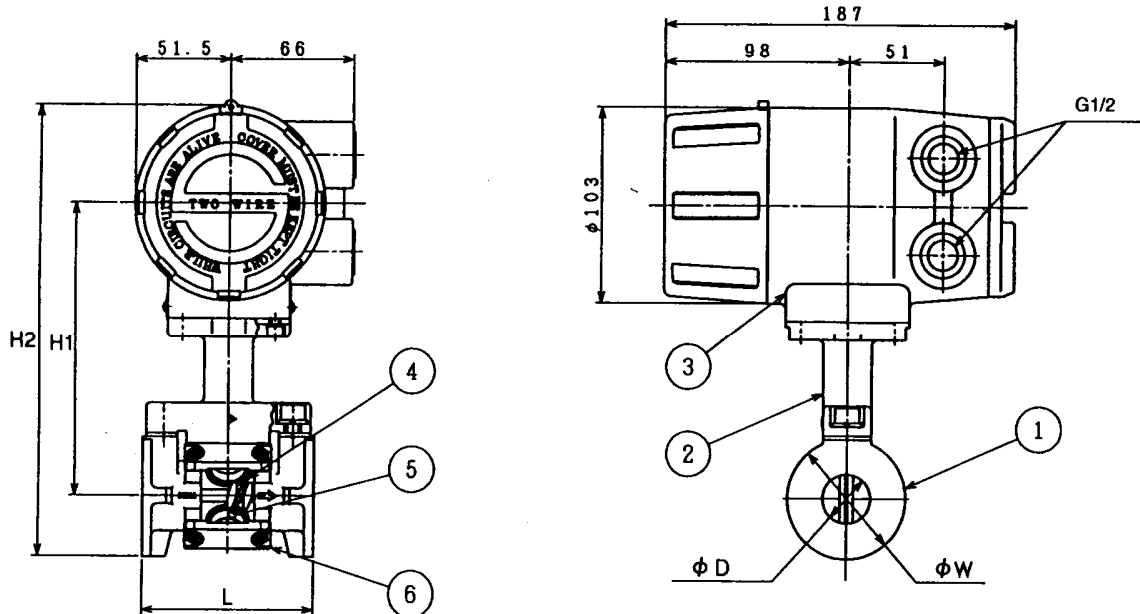


Nominal caliber		25	40	50	80	100
Length	L	93	106	120	160	180
Height	H1	155.0	163.5	173.0	177.5	189.0
	H2	238.0	255.5	274.5	292.5	319.1
Case width	ϕW	63	81	100	127	157
Inner diameter	ϕD	25.7	39.7	51.1	71.1	93.8
Mass (kg)		4	4.5	5	7	8.5

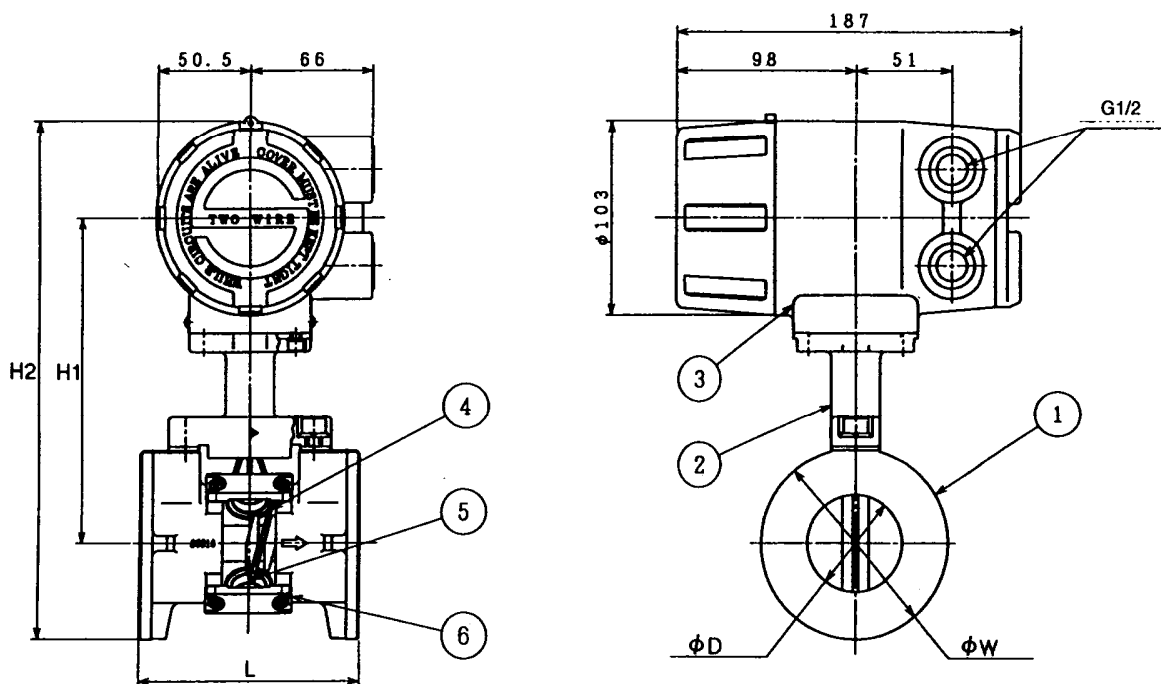
[Integral Type without Indicator]

25A~40A

(Unit: mm)

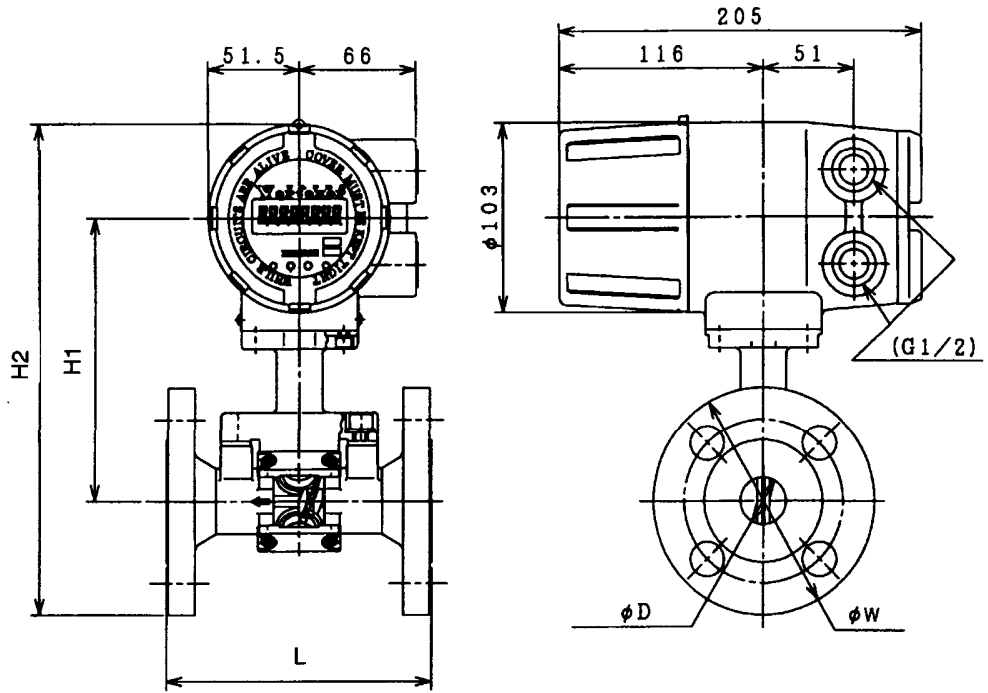


50A~100A

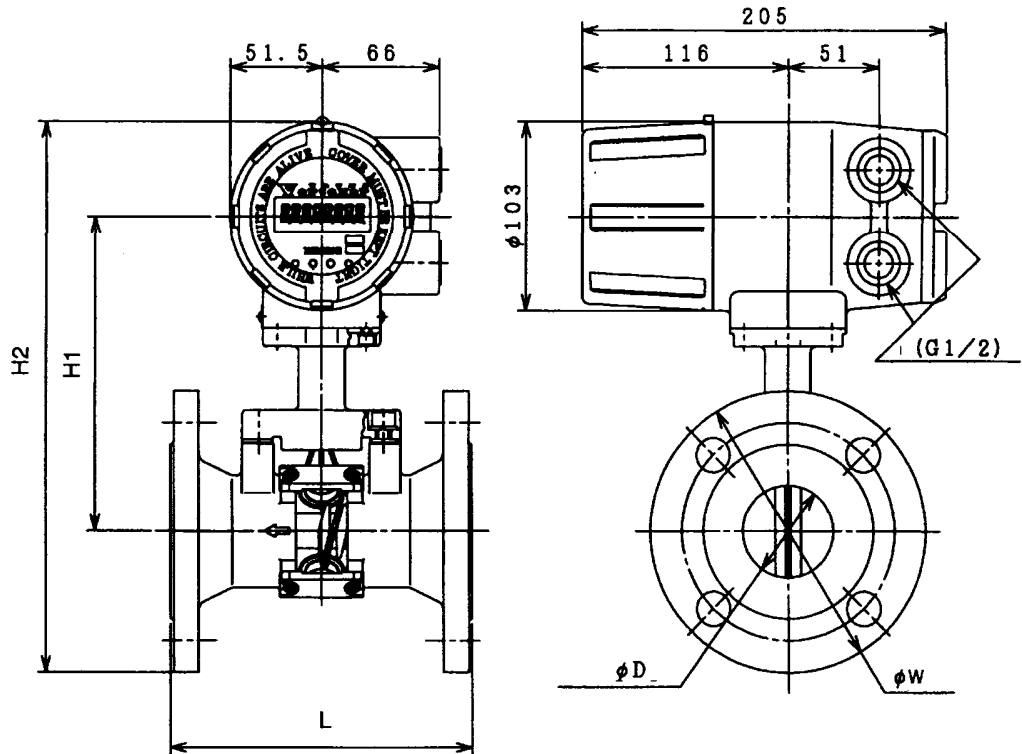


Nominal caliber		25	40	50	80	100
Length	L	93	106	120	160	180
Height	H1	155.0	163.5	173.0	177.5	189.0
	H2	238.0	255.5	274.5	292.5	319.1
Case width	ϕW	63	81	100	127	157
Inner diameter	ϕD	25.7	39.7	51.1	71.1	93.8
Mass (kg)		4	4.5	5	7	8.5

25A~40A



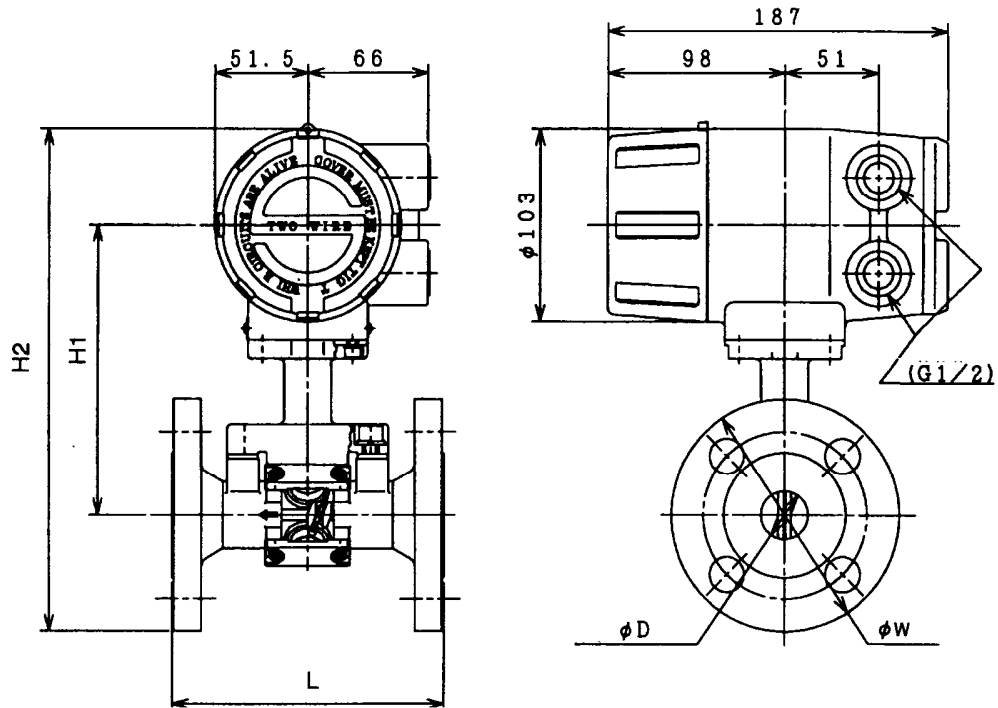
50A~100A



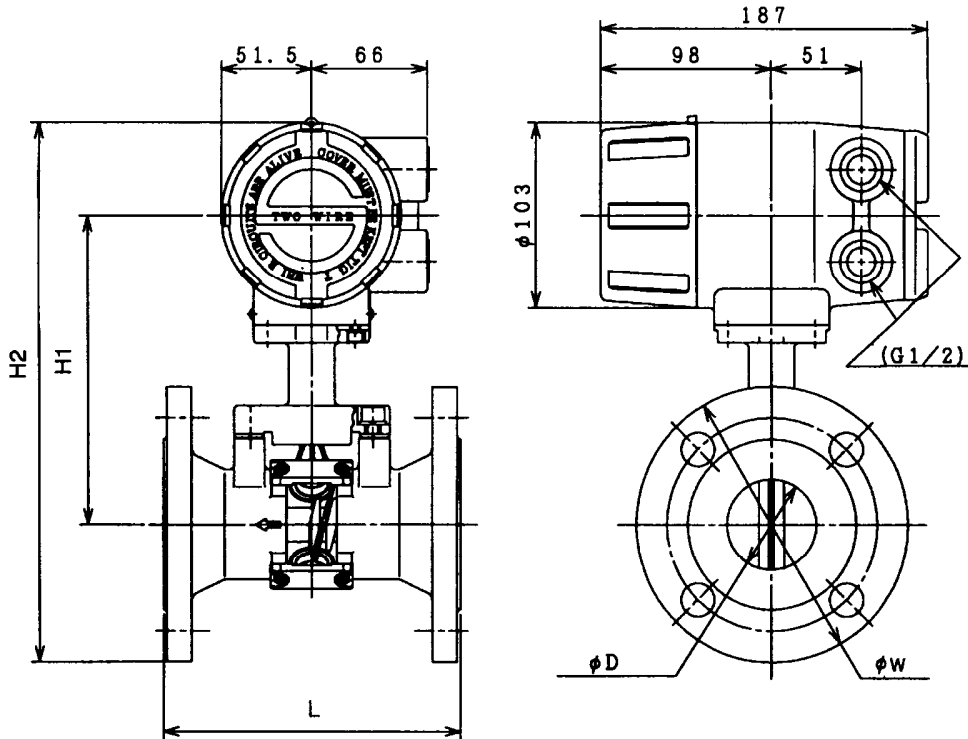
Nominal caliber		25	40	50	80	100
Length	L	150.0	150.0	170.0	200.0	220.0
Height	H1	155.0	163.5	173.0	177.5	189.0
	H2	238.0	255.5	274.5	292.5	319.1
Case width	φ W	63.0	81.0	100.0	127.0	157.2
Inner diameter	φ D	25.7	39.7	51.1	71.1	93.8
Mass (kg)	JIS10K	6.1	7.3	8.7	12.5	16.0
	JIS20K	6.6	7.7	8.8	15.0	20.0
	JPI/ANSI150	5.8	7.0	9.2	15.5	21.0
	JPI/ANSI300	6.8	9.5	6.8	19.0	30.0

[Integral Type with Indicator]

25A~40A



50A~100A



Nominal caliber		25	40	50	80	100
Length	L	150.0	150.0	170.0	200.0	220.0
Height	H1	155.0	163.5	173.0	177.5	189.0
	H2	238.0	255.5	274.5	292.5	319.1
Case width	ϕW	63.0	81.0	100.0	127.0	157.2
Inner diameter	ϕD	25.7	39.7	51.1	71.1	93.8
Mass (kg)	JIS10K	6.1	7.3	8.7	12.5	16.0
	JIS20K	6.6	7.7	8.8	15.0	20.0
	JPI/ANSI150	5.8	7.0	9.2	15.5	21.0
	JPI/ANSI300	6.8	9.5	6.8	19.0	30.0

Specifications are subject to change without notice.

YAMATAKE

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Yamatake Korea Co., Ltd.
Yamatake (Thailand) Co., Ltd.
Yamatake Philippines, Inc.
PT. Yamatake Berca Indonesia
Yamatake Controls Singapore Pte. Ltd.
YCV Corporation

: China 86-10-6326-9844/55
: China 86-21-5793-5334
: Korea 82-2-785-0280-2
: Thailand 66-2-210-0900-7
: Philippines 63-2-817-6452
: Indonesia 62-21-230-5538/5539
: Singapore 65-778-5966
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