

### OUTLINE

Our clamp-on type Ultrasonic Flowmeter **UL350** has enabled applications to piping in various kinds by enhancing the permeation property of ultrasonic wave. "Time-Flight" type flowmeter is capable of measuring a flow rate of metallic and plastic piping ranging from 25 to 1000 mm in nominal diameter.

A detector (an ultrasonic sensor) is mounted outside an existing piping by clamping method, so that it does not get into contact with the measuring fluid at all, and there are no concerns about the mixture of solid material and metallic ion into the fluid, the corrosion of sensor by chemical, and the pressure loss by installing the flowmeter.

### FEATURES

- ❑ The sensor of ultrasonic flowmeter UL350 is clamped on just outside of an existing pipe without any piping modification and time consuming installation work.
- ❑ By adopting a DSP and an AD converters, the flow measurement has been speeded up, and the resistance to bubbles has been improved.
- ❑ Because of the noncontact measurement method, the formation of bubbles and the mixture of metallic ion have been completely prevented.
- ❑ Installing the flowmeter does not cause the pressure loss because of no obstacles in the measuring pipe.
- ❑ The ultrasonic flowmeter is not affected by the pressure or conductivity of fluids.
- ❑ Excellent in long-term stability because of no moving part.
- ❑ Providing the following functions: Forward/backward flow rate display, totalizing display, analog output, pulse output, status output.
- ❑ Capable of controlling the flow rate with digital data by RS-485 serial output. (Forward/backward flow rate output, totalizing output, and status output by the Modbus protocol)
- ❑ A multi-drop connecting method has greatly reduced the signal wire.
- ❑ Complied with RoHS. Applying for EMC standards.

### MEASUREMENT PRINCIPLE

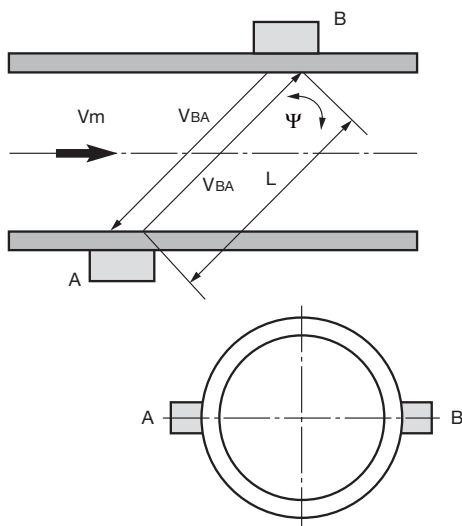


Fig. 1

As shown in Fig. 1, an ultrasonic is transferred from A to B and B to A in turn with a angle of  $\psi$ . The required durations of transfer of two directions are different when measuring medium is moving from up stream to down stream. The durations of transfer are expressed by the following formula.

$$t_{AB} = L / (C_0 + V_m \cos \psi)$$

$$t_{BA} = L / (C_0 - V_m \cos \psi)$$

Where

- L : Distance between A and B
- $V_m$  : Average velocity of medium
- $C_0$  : Sonic speed in stable medium
- $t_{AB}$ ,  $t_{BA}$  : Duration of transfer of Ultra Sonic from A to B and B to A

By measuring the difference of the transfer duration, the average velocity of medium can be calculated. The calculation is done by the following formula:

$$2V_m \cos \psi = L / t_{AB} - L/t_{BA}$$

$$\psi = L (t_{BA} - t_{AB}) / (t_{BA} \times t_{AB})$$

$$V_m = L (t_{BA} - t_{AB}) / (2\cos \psi \times t_{BA} \times t_{AB})$$

The distance between A and B (L) and the angle ( $\psi$ ) are known, and the average velocity is mathematically calculated.



**STANDARD SPECIFICATIONS**

- Measuring method : Ultrasonic time-flight type (Ultrasonic path: Reflex mode / V path or Diagonal mode / Z path)
- Construction : Sensor, Converter, Exclusive coaxial cable with BNC connector, sensor fixing rail
- Sensor mounting : Piping clamp-on type
- Measuring fluid : Liquids in which Ultrasonic waves propagate  
\*Refer to P5.[ POINTS TO BE CHECKED BEFORE MODEL SELECTION ]
- Measurable fluid sonic velocity range : 1,000 to 2,500 m/s
- Measurable fluid kinematic viscosity range : 0.30 to 40.00 mm<sup>2</sup>/s
- Fluid temperature : Up to 90°C (Surface temperature of piping)
- Measurable pipe (Nominal diameter) : 25 mm (min) to 1000 mm (max)  
Note: Refer to "POINTS TO BE CHECKED BEFORE USING" when selecting the specifications.
- Measurable flow velocity range : 0 to 10 m/s
- Settable full scale flow velocity range : Maximum 10 m/s at settable full scale
- Accuracy : ±2% of the reading at the condition that flow velocity is 1m/s or more and Reynolds number is 10000 or more.  
: Flow velocity error is ±2 cm/s at the condition that flow velocity is less than 1m/s.
- Display : 16-digit, 2-line alphanumeric LCD (with backlight) and status display LEDs (3 pieces)  
Display data : Flow rate, totalizing flow rate, various status
- Power supply : 100 to 230 V AC 50/60Hz ( 85 to 264 V AC 50/60Hz is acceptable)
- Power consumption : 12 VA or less
- Cable entry : For power/output (M20 x 1.5, 3 pieces);  
With waterproof cable gland (Applicable cable diameter: ø8.0 to ø13.0)  
For sensor; Waterproof BNC connector (2 pieces)

- Outputs
  - 1) Analog output : 4 to 20 mA DC, Load resistance: 500Ω or less
  - 2) Pulse output : Open collector output  
Load rating 30 V DC, 50 mA, Low level 2V or less  
Pulse width: 0.5 ms (max.1000pps), 50 ms (max.10pps), 100 ms (max.5pps), 500 ms (max.1pps), 1s (0.5 pps or less): It is selected by the number of the maximum setting pulses.
  - 3) Status output : Open collector output  
Load rating 30 V DC, 50 mA, Low level 2 V or less  
Status 1 : Hold output  
Status 2 : Empty pipe detection  
Status 3 : Forward or backward flow detection
  - 4) Serial output : RS-485 serial output, Modbus protocol  
Transmission speed/distance — 2,400, 4,800, 9,600 or 19,200 PPS, 1.2 km (Max. total distance at the time of multi-drop connection)  
Slave addresses: 1 to 31
- Damping setting : 0 to 100 s (Settable in increments of 1s step)  
\* Valid for display, analog output and pulse output.  
There is a response delay of 0.5 s, even if damping is set to 0 s.
- Low cutoff setting : 0 to 30% of the maximum flow rate (Settable in increments of 1%)  
\* Valid for display, analog output and pulse output.
- Parameter setting : Set with the key switches on the front panel of converter.
- Other additional functions
  - 1) Analog and pulse simulation output function (For loop check)
  - 2) Forward/backward direction measuring function
- Converter mounting method : Mounted onto the wall or 2 inch pipe
- Enclosure : Converter / IP65 Jet-proof,  
Sensor / IP65 Jet-proof (guaranteed with BNC connectors coupled)
- Material : Sensor housing / Heat-resisting ABS  
Sensor mounting rail / Aluminum  
Converter housing / Heat-resisting ABS
- Painting of converter : Housing cover = Blue  
: Housing body = Light gray
- Sensor ambient temperature : -10 to 70°C
- Converter ambient temperature and humidity : -20 to 50°C, 10 to 90% RH (No dew condensation)
- Sensor signal cable : Standard 10 m (Up to 60 m)

Table 1. Sensor selection table

Pipe material	Nominal pipe size (D)	Sensor type	Sensor installation	Sensor rail length	Sensor rail for support	Code of sensor combination
PVC/Polyethylene	25A≤D≤40A	A sensor (2MHz)	V	320 × 1 pc	320 × 1 pc	1
	50A≤D≤150A			320 × 1 pc	Not provided	5
	200A≤D≤300A			620 × 1 pc		4
Stainless steel (thickness≤sch40)	25A≤D≤150A	A sensor (2MHz)	V	320 × 1 pc	Not provided	5
	200A≤D≤400A			620 × 1 pc		4
	450A≤D≤1000A	B sensor (1MHz)	Z	620 × 2 pc		4
SGP	25A≤D≤40A	A sensor (2MHz)	V	320 × 1 pc	Not provided	5
	50A≤D≤150A	B sensor (1MHz)				5
	200A≤D≤1000A					Z
SGPW (galvanize)	25A≤D≤40A	A sensor (2MHz)	V	320 × 1 pc	Not provided	5
	50A≤D≤150A	B sensor (1MHz)				5
	200A≤D≤300A					Z
PP (thickness≤15mm)/ PVDF (thickness≤9mm)	25A≤D≤40A	A sensor (2MHz)	V	320 × 1 pc	320 × 1 pc	1
	50A≤D≤150A	B sensor (1MHz)		320 × 1 pc	Not provided	5
	200A≤D≤400A			620 × 2 pc		4
PP (thickness>15mm)/ PVDF (thickness>9mm)	25A≤D≤40A	B sensor (1MHz)	V	320 × 1 pc	320 × 1 pc	1
	50A≤D≤150A			320 × 2 pc	Not provided	5
	200A≤D≤400A		Z	620 × 2 pc		4
PE (Polyethylene) lining	25A≤D≤150A	B sensor (1MHz)	V	320 × 1 pc	Not provided	5
	200A≤D≤1000A		Z	620 × 2 pc		4

Note 1 When the measuring pipes are sch.80 or more including stainless steel pipe, consult us in advance.

Note 2 "V" in the sensor installation column denotes V path, reflex mode and "Z" denotes Z path, diagonal mode.

Note 3 The sensor rail for support is used for the pipes made of resin with 40 mm or less.

Note 4 V path, reflex mode is generally used for the pipes with 400 mm or less. However, there are some cases where Z path, diagonal mode is adequate depending on the pipe material or surface conditions of the pipe. If such situation is expected, select the sensor rails with 2 pieces in advance.

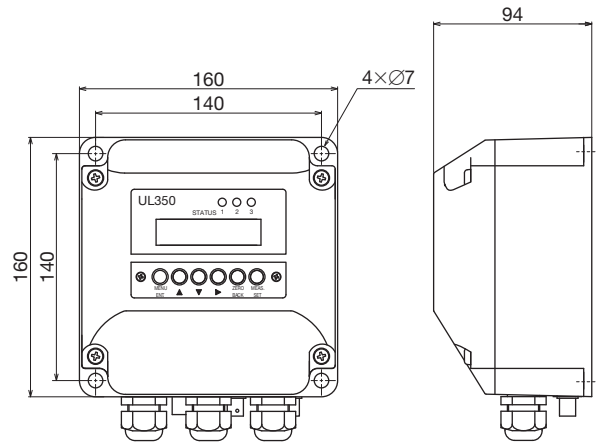
Note 5 When the size of measuring pipes are unknown or especially expected to be more than 100 mm or more, select the long sensor rail with 2 pieces as the short sensor rails may not work well.

Note 6 See the MODEL CODE for the sensor combination.

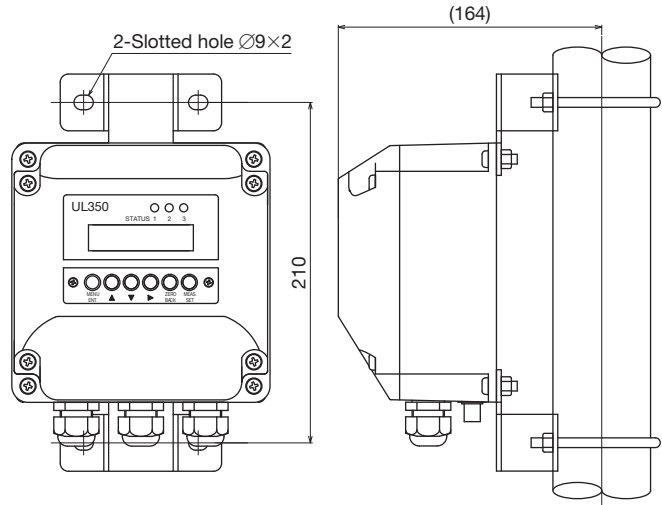
**DIMENSIONS**

**CONVERTER**

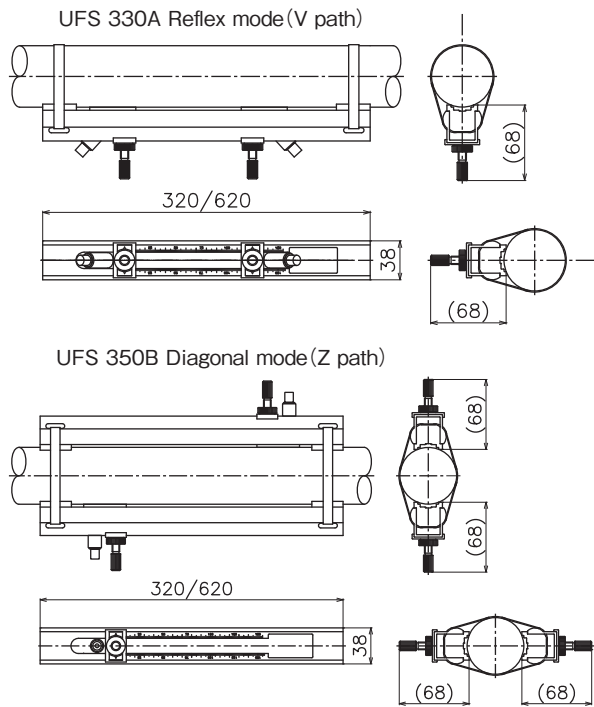
- Wall mount type



- 2" pipe mount



**SENSOR**



**FLOW RATE RANGE/SIZE**

Nominal diameter (mm)	Possible scale range (m <sup>3</sup> /h)	
	Minimum	Maximum
25	0.684	22.80
32	1.167	38.91
40	1.568	52.27
50	2.556	85.21
65	4.192	139.7
80	5.857	195.2
100	9.948	331.6
125	15.00	500.1
150	21.28	709.4
200	36.80	1226
250	57.07	1902
300	81.25	2708
350	101.3	3377
400	133.2	4442
500	209.5	6984
600	0.301 (km <sup>3</sup> /h)	10.06 (km <sup>3</sup> /h)
700	0.409 (km <sup>3</sup> /h)	13.66 (km <sup>3</sup> /h)
800	0.538 (km <sup>3</sup> /h)	17.95 (km <sup>3</sup> /h)
900	0.684 (km <sup>3</sup> /h)	22.82 (km <sup>3</sup> /h)
1000	0.843 (km <sup>3</sup> /h)	28.10 (km <sup>3</sup> /h)

[Note] The above-mentioned flow rates have been calculated for the SUS Sch. 10s pipes, at the minimum range flow velocity of 0.3 m/s and maximum range flow velocity of 10 m/s. (The flow rate range may differ slightly, depending on the piping standard.)

**WIRING DIAGRAM**

CN1			CN2							CN3					
Power supply (AC)			Analog output 4 to 20mADC	Totalized pulse output	External totalization reset	Status output				Serial Output RS485					
						ST1	ST2	com	ST3						
(3P)			(2P)	(2P)	(2P)	(4P)				(3P)					
⏏	L1	L2	+	-	+	-	+	-	+	+	com	+	+	-	GND

Note 1 :

- ST1 (Status 1) : Hold output
- ST2 (Status 2) : Empty pipe detection
- ST3 (Status 3) : Forward or backward flow detection

Note 2 :

The detachable connectors are used.

## MODEL CODE

### ● Sensor

Sensor Model code				Description
UFS330	A			A sensor (2 MHz)(*)
UFS350	B			B sensor (1 MHz)(*)
Sensor combination		1		Short sensor rail × 2 pcs, Sensor rail for support × 1 pc(*)
		4		Long sensor rail × 2 pcs(*)
		5		Short sensor rail × 2 pcs(*)
Cable length		1		10 m (Standard)
		2		20 m
		3		30 m
		4		40 m
		5		50 m
		6		60 m
Additional functions		(Blank)		NA
		/Z		Provided

\* Refer to Table 1. Sensor selection table.

### ● Converter

Converter Model code				Description
UFC350	A			
Power supply	A			100 to 230 V AC 50/60Hz
	-			
Mounting		1		Wall mount type
		2		2" pipe mount type
Serial output		1		Standard
		-		
Additional functions		(Blank)		NA
		/Z		Provided

## POINTS TO BE CHECKED BEFORE MODEL SELECTION

It may be unable to make measurement when falling into the following conditions.

Contact us in advance. When it cannot be judged whether it is suitable, we are prepared to make preliminary test by the actual equipment.

#### 1) Liquid

- The liquid containing a lot of bubbles (over 2% only as a guide).
- The liquid containing slurry and solid material (over 5Vol.% only as a guide).
- The liquid of low Reynolds number (less than Re.10000 only as a guide).
- Liquids other than water such as lean chemical solutions, oils, waste waters and hot spring water.
- Liquids which attenuate Ultrasonic waves  
(Typical example:acetic acid)

\*This flowmeter cannot be used for High concentration acetic acid aqueous solution (above 50%) .

#### 2) Piping

- The inside wall of carbon steel pipe is rusty.
- Adhesion and sediment are in a pipe.
- The outside surface of cast iron pipe is coarse.
- SGPW pipe [The galvanized steel pipe for water service (white gas pipe)]
- Lined pipe
- Steel pipe in more than ø500 mm

#### 3) Straight runs

The accurate flow measurement requires straight runs both upstream and downstream of the flow sensor as shown at the next page.

**REQUIRED STRAIGHT RUNS**

D : Nominal diameter

Reference : JEMIMA standard JEMIS-32

Classification	Required upstream straight length	Required downstream straight length
90° bend		
Tee		
Expansion pipe		
Reducer		
Valve		
Pump		

**PRECAUTION FOR USE**

- 1) Pipe shall be always filled with fluid.
- 2) In the case of horizontal piping, please do not mount a sensor on the upper and the lower part of piping.
- 3) When you wrap a sensor in an insulating material, be careful not to exceed the ambient temperature limits of a sensor.
- 4) In order to prevent the sensor grease from degrading when installed outside, we recommend you to mount the waterproof cover which covers a sensor assembly.

\* Specification is subject to change without notice.



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