

#### OUTLINE

**SONICMAX** UL6300 V2 is an ultrasonic flowmeter using the time-of-flight system, combining a highly efficient converter (UFC300 V2) with a clamp-on sensor (UFS6000 V2).

Three kinds of sensor without direct contact with the fluid enable the measurement of a wide range of flow, for pipe sizes from 15 mm to 4000 mm.

A new type of converter with a stainless steel sensor rail and an integrated sensor cable allows simpler installation on pipes, easier maintenance, and higher weather resistance than existing models. Moreover, the highly efficient converter compatible with multiple sensors is easier to use, enabling stable high-precision measurement of low-velocity flow with digital signal processing system and powerful status diagnostic functions.

#### FEATURES

- ❑ The non-contact measurement system where the sensor is installed on the exterior surface of the pipe completely eliminates the generation of particles and mixing of metal ions, making the method ideal for flow measurement of pure water and chemical liquids.
- ❑ The highly efficient converter compatible with multiple sensors can measure two lines simultaneously. Precise flow measurement is ensured by calibrating uneven flow by measuring two lines in one stream.
- ❑ The digital signal processing system enables stable and precise measurement of low-velocity flow. Measurement accuracy is  $\pm 1\%$  of the indicated value (connection: 50 mm or more, velocity: 0.5 m/s or more).
- ❑ The sensor part can be used for pipe sizes ranging from 15 mm to 4000 mm by three kinds of sensor (small/medium/large).
- ❑ Mounting and maintenance are made easy by integrating the sensor rail, sensor, and cable. Also, weather resistance is improved by using stainless steel for the sensor rail as standard.
- ❑ A connection box allows integration of the cable extension and cable connection.
- ❑ A blue dot matrix LCD (with backlight) is used for the display (128  $\times$  64 dots, 59  $\times$  31 mm). Bar graph indication, multi-line indication, real-time trend indication, etc. are provided.
- ❑ A quick setup function makes it easy to change the flow range, pulse rate, etc.
- ❑ A new button switch for changing the settings improves operability along with the infrared sensor of the existing model.



#### MEASURING PRINCIPLE

As shown in Fig. 1 the ultrasonic is transferred from A to B and B to A in turn with an angle of  $\psi$ . The required duration of transfer of two directions is different when measuring medium is moving from upstream to downstream. The duration of transfer is expressed by the following formula.

$$t_{AB} = 2L / (C_o + V_m \cos \psi)$$

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

Where

2L : Distance between A and B

$V_m$  : Average velocity of medium

$C_o$  : Sonic speed in stable medium

$t_{AB}$ ,  $t_{BA}$  : Duration of transfer of Ultrasonic 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:

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

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

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

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

Calculating average velocity  $V_m$  and cross-sectional area of pipe, the result is indicated and transmitted as the output.

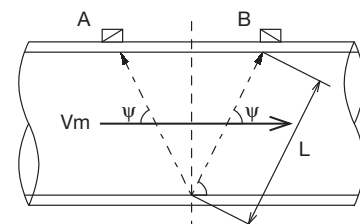


Fig.1 Measurement principle

**STANDARD SPECIFICATION**

**Common specification**

- Measurement method : Ultrasonic time flight system
  - Sensor installation : Clamp on pipe
  - Measurable pipe size : Small sensor:  
15 mm/1/2" to 100 mm/4"  
Medium sensor:  
50 mm/2" to 400 mm/16"  
Large sensor (Preparing):  
200 mm/8" to 4000 mm/160"
- Sensor installation : Small / Medium sensor; V path  
Large sensor; V path and Z path



- Instrument components: Sensors (2), Sensor rail (with 10m co-axial sensor cable with SMB connector), Sensor band (2), Converter  
\*1 In addition, the large sensor is equipped with two pairs of sensor rail with sensor cable, sensor bands (4), and band fastening units (4).  
\*2 A connection box and extension cable are added when extending the sensor cable.
- Measuring fluid : The liquids which ultrasonic waves transmit through  
\* See also liquid properties at chapter "READ BEFORE USE."
- Fluid temperature : -40 to +120°C at surface of pipes on which sensors are installed.
- Pipe material : Carbon steel, Stainless steel, PVC, PP, PVDF, others  
\* See detail material table below for each size of sensor.  
See piping materials at chapter "READ BEFORE USE."

Piping materials \ Sensor type	Small 15 to 100 mm	Medium 50 to 400 mm	Large 200 to 4000 mm
Carbon steel	○	○	○
Stainless steel	○	○	○
PVC	○	○	○
PP: Thickness ≤ 15 mm	○	○	○
PVDF	*	*	*
FRP	*	*	*
PE lining pipe	-	○	○
PVC lining pipe	-	*	*
Others	*	*	*

○ : Applicable - : Not applicable \* : Consult us for details.

- Measuring range : Velocity Min.; 0 to 0.5 m/s  
Max.; 0 to 20 m/s  
Flow rate Min.; 0 to 0.319 m³/h  
(Pipe size 15 mm)  
Max.; 0 to 904778 m³/h  
(Pipe size 4000 mm)

**Sensor specification**

- Protection class : IP66/67 (IEC 60529)
- Material : Sensor rail: Stainless steel  
Sensor band: Stainless steel  
Band fastening unit: Stainless cast steel
- Ambient temperature : -40 to +70°C
- Cable entry : 1 × M16 with watertight gland

**Converter specification**

- Cable entry : 2 × M20 (with watertight glands)  
2 × G1/2 female thread  
2 × 1/2 NPT female thread  
(Option: Watertight glands for G1/2)  
(Option: Number of wiring connection; 3)  
\* Sensor cable entry: M20 watertight gland (Std.)
- Supply voltage : 100 to 230 V AC (85 to 250 V AC)  
24 V DC (9 to 31 V)
- Supply frequency : 48 to 63 Hz (AC)
- Power consumption : Approx. 22 VA (AC)  
Approx. 12 W (DC)
- Ambient temp. : -40 to +65°C (For operation)  
-50 to +70°C (For storage)

[UFC300W V2 (Wall installation type) specification]

- Protection class : IP65/66 (IEC 60529)
- Housing material : Polyamide resin
- Color : Off-white (Converter housing / Terminal box cover), Jade green (Converter cover)
- Installation : Wall installation  
(Option: Fittings for 2B pipe installation)

[UFC300F V2 (Field installation type) specification]

- Protection class : IP66/67 (IEC 60529)
- Housing material : Aluminum alloy
- Painting : Siloxane coating
- Color : Grey (Converter housing/Terminal box housing)  
Jade green  
(Converter cover/Terminal box cover)
- Installation : Wall installation  
(Option: U bolt for 2B pipe installation)

\* For the explosion-proof type, see the EXPLOSION-PROOF SPECIFICATIONS section described later.

**Indication and output specification**

- Indicator : Blue, dot matrix LCD (With backlight)  
128 × 64 dots (59 × 31 mm)  
Indication function :  
Process data display screen; 2 screens  
One to three lines are displayed at one screen.  
Contents of indication; Flow rate, velocity, total flow  
Trend data display screen; 1 screen  
Real-time trend of flow rate etc.
- Current output : Current output: 4 to 20 mA DC  
(Max. 22 mA, at scale out mode)  
Internal power supply : Less than 1000ohms (Load resistance)  
External power supply : Less than 32 V DC (External voltage)

- Pulse output
  - Open collector output
    - Load rating : Less than 32 V DC, 20 mA ( $\leq 10$  kHz)
      - Less than 100 mA ( $\leq 100$  Hz)
      - ON : residual voltage less than 0.2 V (circuit voltage 10 mA)
      - OFF : leak current less than 0.05 mA (external circuit voltage 32 V)
    - Pulse rate : 2 to 36,000,000 pulse/h (0.00056 Hz to 10 kHz)
    - Pulse width : One of the following selectable
      - 1) Automatic; Pulse width by which duty factor to be 50% at full scale
      - 2) Duty factor; 1:1 fixed
      - 3) Free setting; 0.05 to 2000 m/s
- Status output
  - Open collector output
    - Rating : Less than 32 V DC, 100 mA Max.
      - ON : residual voltage less than 0.2 V (circuit voltage 10 mA)
      - OFF : leak current less than 0.05 mA (external circuit voltage 32 V)
    - Contents of output : One of the following selectable
      - 1) No status output (Standard factory setting)
      - 2) Identification of flow direction
      - 3) Over range
      - 4) Error
      - 5) Flow alarm
- Control input
  - Voltage input
    - Low : 0 to 2.5 V DC, High : 19 to 32 V DC
    - Contents : One of the following selectable
      - 1) No control input (Standard factory setting)
      - 2) Output hold
      - 3) Output lock to 0%
      - 4) Total counter reset
      - 5) Error reset

- Description of input and output terminal

Terminal	1-line measurement		2-line measurement
	Standard setup	Switchover by reprogramming	
A (A, A+ / A-)	Current output	-	Current output
B (B / B-)	Status output	Control input	Current output <sup>(*)</sup>
C (C / C-)	Status output	-	Pulse output
D (D / D-)	Pulse output	Status output	Pulse output

(\*) B terminal : For internal power supply

- Low flow cutoff
  - Current output, Pulse output, Indicator (Separate setting is possible.)
  - Setting value; 0.0 to 20.0% FS
- Damping time constant
  - Current output, Pulse output, Indicator (Separate setting is possible.)
  - Current output; 0.1 to 100.0s
  - Pulse output, Indicator; 0.0 to 100.0s
- Isolation of input and output
  - Each circuit of power supply, sensor signal, terminal A, terminal B, terminal C, and terminal D are isolated.

## Standard functions

- Customer's free measuring unit setting function
  - Volume (or mass) and time unit in 7 characters can be created.
- Automatic zero adjustment function
  - Zero adjustment is automatically conducted at "ZERO ADJUST MODE" (Subject to zero flow)
- Bi-directional flow measurement function
  - A flow-direction distinction signal is outputted in state output and current.
- Self-diagnosis function
  - The following conditions are indicated by error message; Functional diagnosis : CPU, Memory, Software, Sensor connection, Input and Output module, and Output connection
  - Status diagnosis : Sensor signal lost, Over range, Counter over flow, and Power fail detection
- Memory save function for power fail
  - Operation parameters and totalization figures are stored for more than 10 years by EEPROM (Non volatile memory).
- Testing function
  - Simulating output function for current, pulse and status outputs are integrated.
  - Current output test: Arbitrary output (0.0 to 22.0 mA)
  - Pulse output test : Arbitrary output (1 Hz to 10 kHz)
  - Status output test : On/Off
- Touch sensor setting function (Infrared radiation)
  - By four infrared sensors, data setup from exterior is possible without removing cover.
  - Data setup is also possible by using the buttons directly after removing the cover.
- HART communication
  - Standard (HART 7)

## Accuracy (\*)

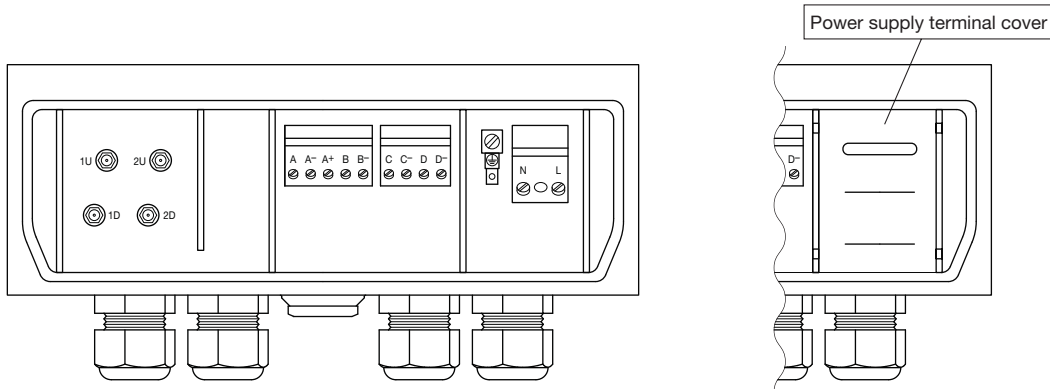
- Indication and Pulse output
  - 1) Pipe size: 50 mm or more:
    - Flow velocity  $\geq 0.5$  m/s:  $\pm 1\%$  of reading
    - Flow velocity  $< 0.5$  m/s; Velocity error of  $\pm 0.005$  m/s
  - 2) Pipe size: Less than 50 mm
    - Flow velocity  $\geq 0.5$  m/s:  $\pm 3\%$  of reading
    - Flow velocity  $< 0.5$  m/s; Velocity error of  $\pm 0.015$  m/s
- Current output :Additional error of  $\pm 0.01$  mA be added onto display and pulse output.

(\*) Basis proofreading conditions

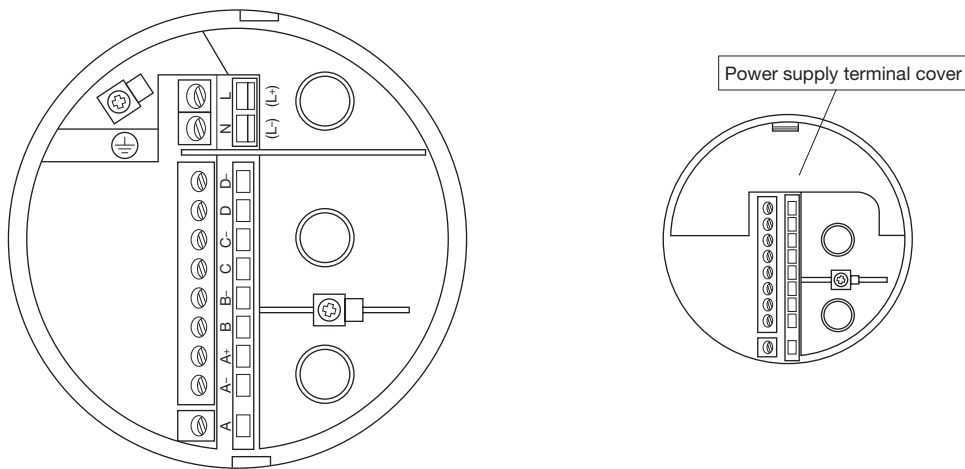
Fluid	: Water
Fluid temperature	: 20 to 25°C (Temperature fluctuation: $\pm 0.5^\circ\text{C}$ )
Piping material	: Stainless steel (SS316)
Upstream/Downstream	: 20D/10D (D: Diameter)
pipe length	
Pipe size	: 100 mm

**POWER SUPPLY AND INPUT-AND-OUTPUT CABLE ELECTRIC CONNECTION**

**UFC300W V2 (Wall installation type)**



**UFC300F V2 (Field installation type)**



Terminal	Terminal	The common converter for 1-line / 2-line measurement
L/L+	(+)	AC power supply : L • N / DCpower supply : L+ • L-
N/L-	(-)	
⊕		Grounding

Terminal symbol	Polarity	Converter for 1-line measurement (Std.)	Converter for 2-line measurement
A+	+	Current output (Internal power supply)	Current output (Internal power supply)
A	-		
B	+	Status output / Control input	Current output (Internal power supply)
B-	-		
C	+	Status output	Pulse output
C-	-		
D	+	Pulse output / Status output	Pulse output
D-	-		

Terminal A can supply the circuit power of current output from the outside in the following combination.

Terminal symbol	Polarity	Converter for 1-line measurement (Std.)	Converter for 2-line measurement
A	+	Current output (External power supply)	Current output (External power supply)
A-	-		

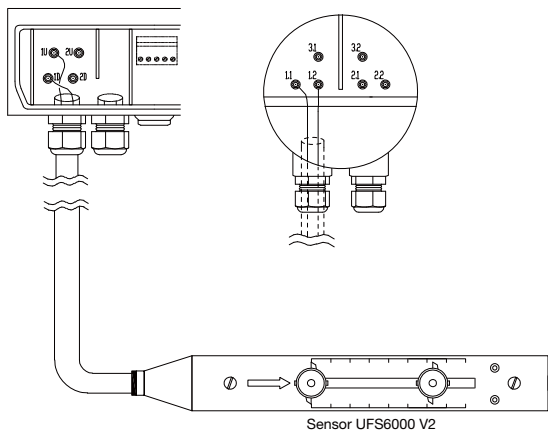
- Terminal type : Plug-in type screw terminal
- Applicable cable size : Power cable ; 0.5 to 2.5 mm<sup>2</sup>  
Signal cable ; 0.5 to 1.5 mm<sup>2</sup> (UFC300W V2)  
; 0.5 to 2.5 mm<sup>2</sup> (UFC300F V2)

## ELECTRIC CONNECTION OF CONVERTER AND SMALL / MEDIUM SENSOR

### Electric connection

Converter UFC300W V2  
(Wall installation type)

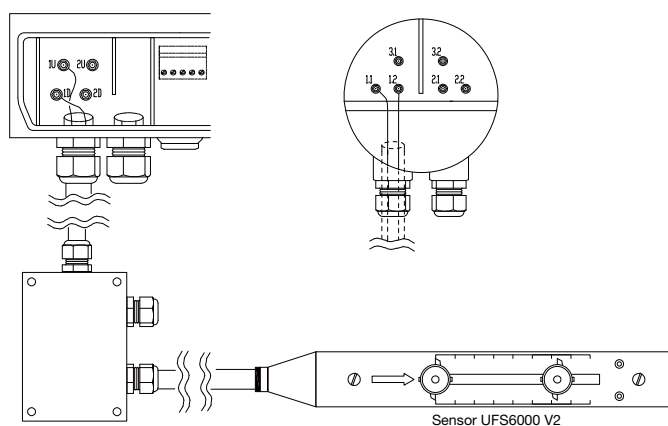
Converter UFC300F V2  
(Field installation type)



### Electric connection when using extension cable

Converter UFC300W V2  
(Wall installation type)

Converter UFC300F V2  
(Field installation type)



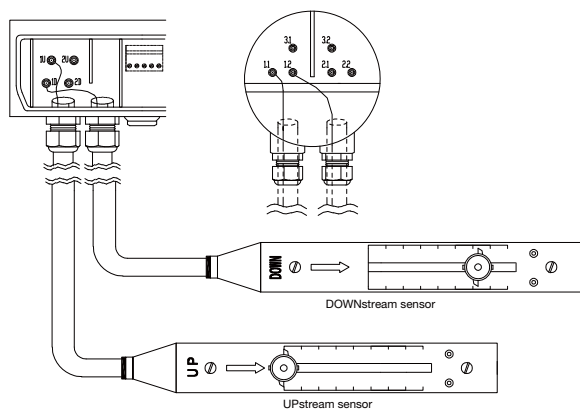
\* A connection box is required when extending the cable.

## ELECTRIC CONNECTION OF CONVERTER AND LARGE SENSOR

### Electric connection

Converter UFC300W V2  
(Wall installation type)

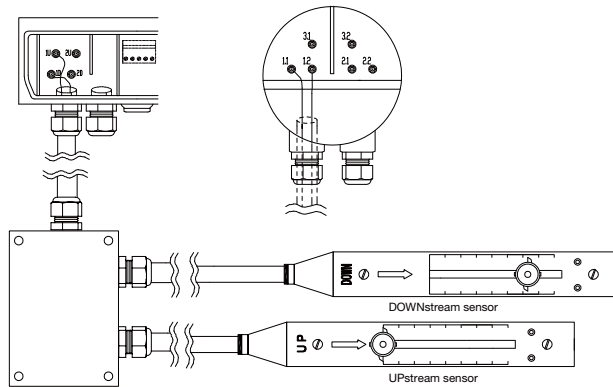
Converter UFC300F V2  
(Field installation type)



### Electric connection when using extension cable

Converter UFC300W V2  
(Wall installation type)

Converter UFC300F V2  
(Field installation type)

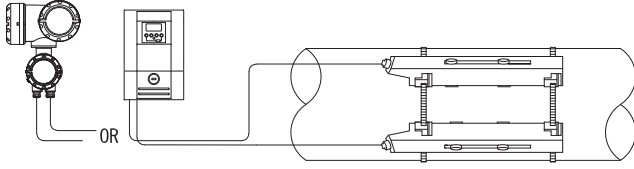


\* A connection box is required when extending the cable.

**EXAMPLES OF COMBINING THE CONVERTER AND SMALL/MEDIUM/LARGE SENSOR FOR SPECIAL MEASUREMENT**

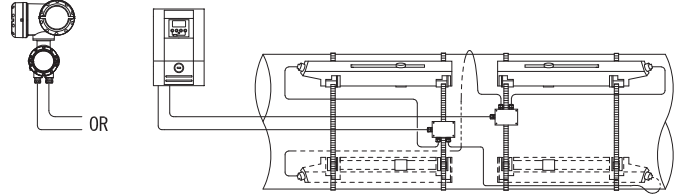
Dual measurement (Small / Medium sensor)

- Converter for 1 line measurement
- Sensor × 2 set



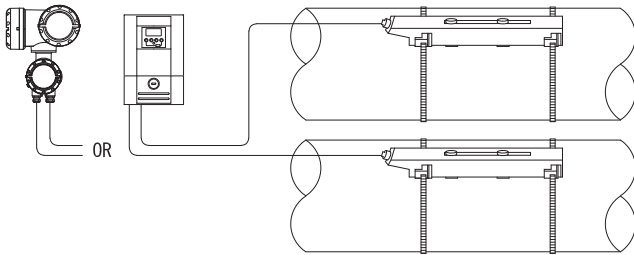
Dual measurement (Large sensor)

- Converter for 1 line measurement
- Sensor × 2 set
- Connection box × 2



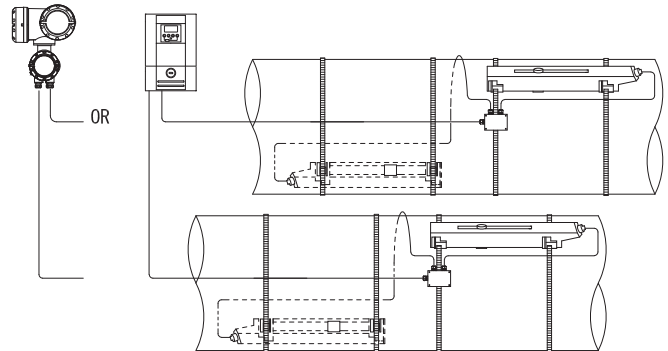
Converter for 2 lines measurement (Small / Medium sensor)

- Converter for 2 lines measurement
- Sensor × 2 set



Converter for 2 lines measurement (Large sensor)

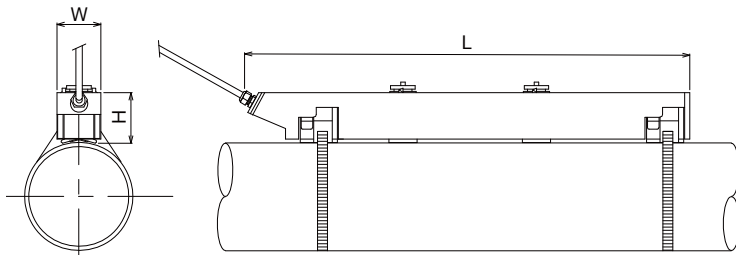
- Converter for 2 lines measurement
- Sensor × 2 set
- Connection box × 2



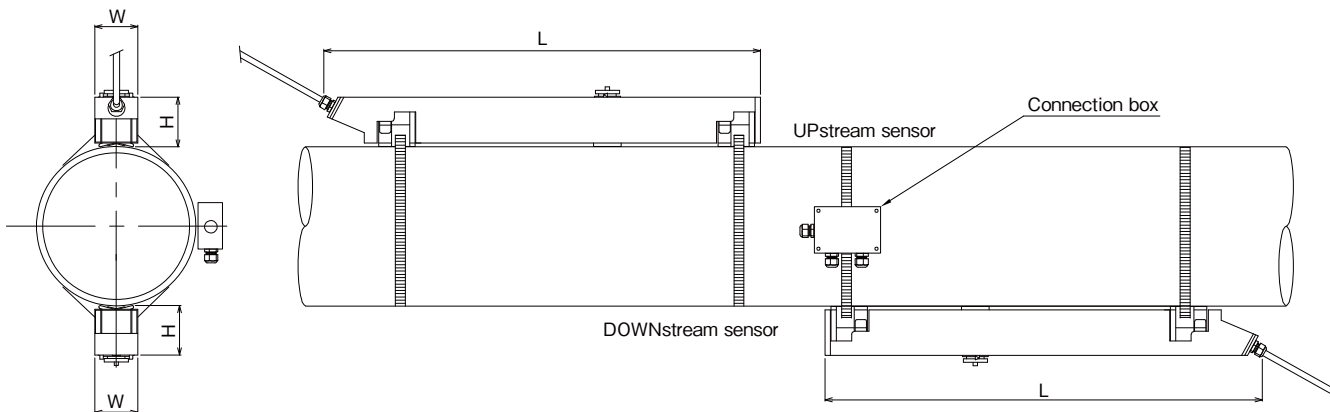
**DIMENSIONS**

**Sensor UFS6000 V2**

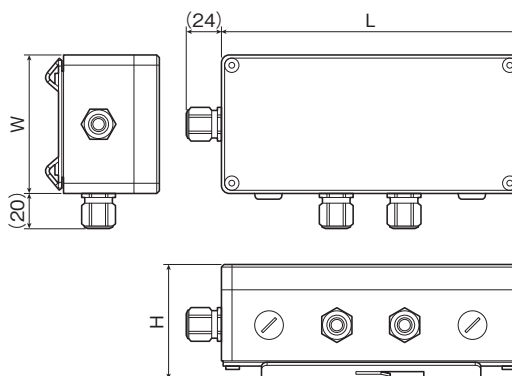
- Small / Medium sensor



- Large sensor



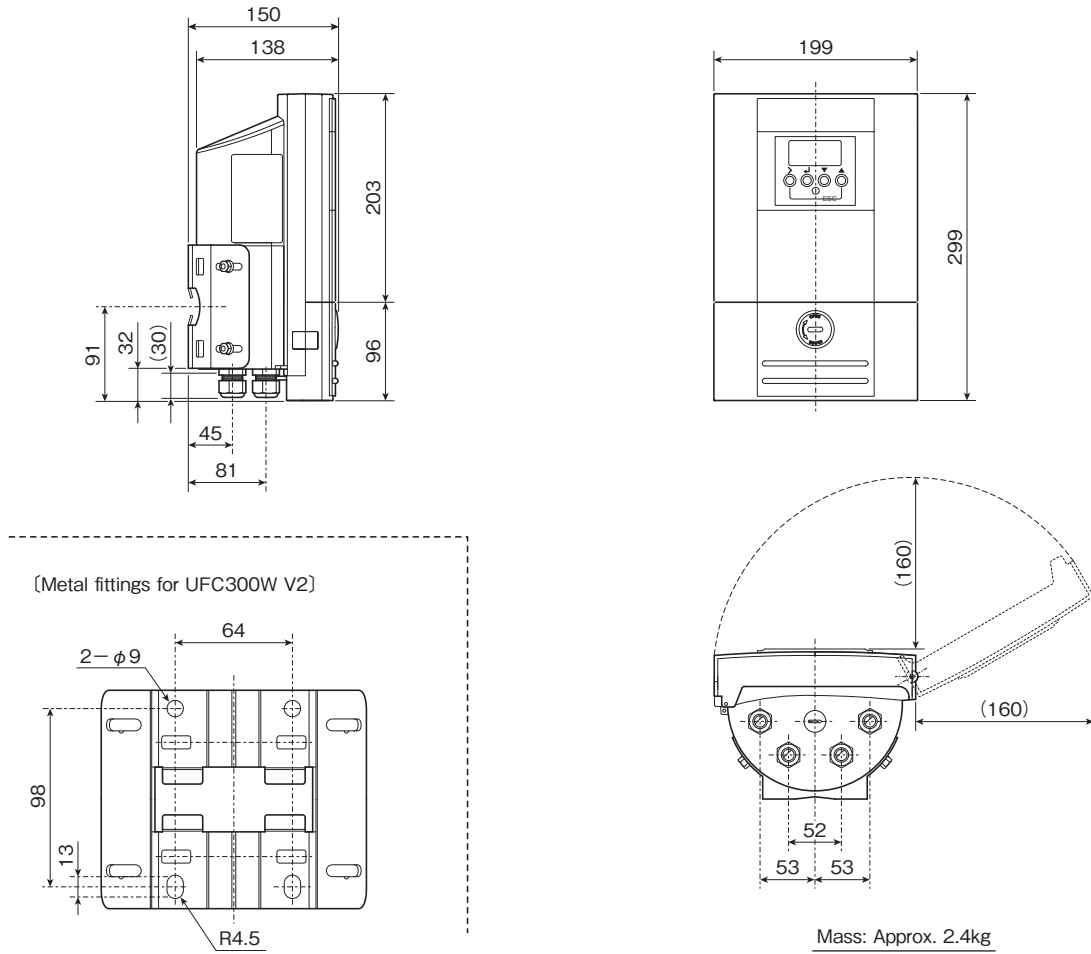
- Connection box



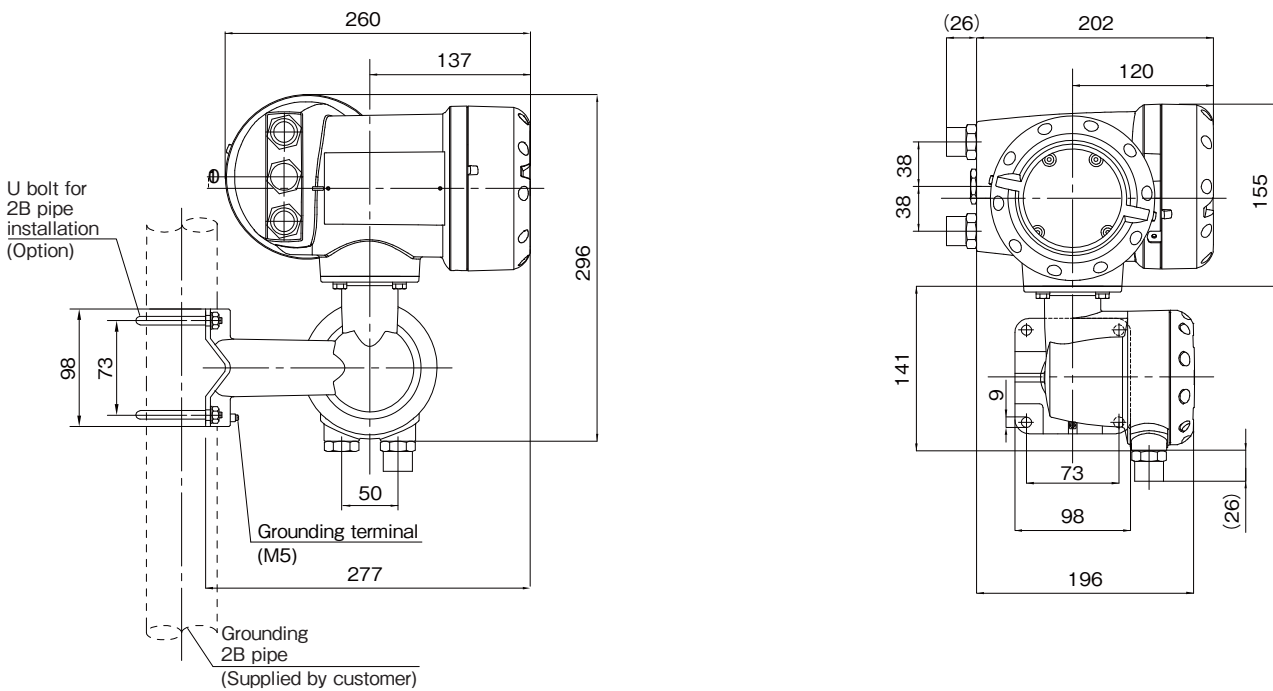
Item	Dimension (mm)			Mass (Approx. kg)
	L	H	W	
Small sensor	412	69	50	1.9
Medium sensor	741	69	50	2.6
Large sensor	412	69	50	3.6
Connection box	210	67	115	0.9

(Note 1) A large sensor has total 2 sensor rails, one for upstream and one for downstream.  
 (Note 2) Don't install sensors on the top and on the bottom of a horizontal pipe line.

**UFC300W V2 (Wall installation type)**



**UFC300F V2 (Field installation type)**





**MODEL AND SPECIFICATION CODE**

Representation type: UL6300 V2

Individual type: Refer to following table.

Specification	Sensor	Converter	
		Wall installation	Field installation
General type	UFS6000 V2	UFC300W V2	UFC300F V2
ATEX	UFS6000-x-EEx	-	UFC300F-EEx

x : S; Small / M; Medium / L; Large

**Specification code**

Sensor specification code	VNE2	4	0	7	0	0	Description	Std.
Sensor code	VNE2						Sensor model : UFS6000 V2 series, Clamp-on type	○
(Fixed code)	4						Always 4	○
Sensor size / Nominal size	2						Small : 15 mm / 1/2" to 100 mm / 4"	○
	7						Medium : 50 mm / 2" to 400 mm / 16"	○
	E						Large : 200 mm / 8" to 4000 mm / 160"	○
Version	0						Standard (Max.120°C)	○
Type of protection	0						General type (Non-protection)	○
	1						ATEX	○
(Fixed code)	7						Always 7	○
Connectable converter type	D						UFC300F V2 (Field installation type)	○
	E						UFC300W V2 (Wall installation type)	○
Material of sensor rail	2						Standard (Stainless)	○
Sensor cable length *1, *2	S						10m (Standard)	○
	3						21 m (15 m between converter and junction box, 6 m between junction box and sensor, 21 m in total)	○
	5						31 m (25 m between converter and junction box, 6 m between junction box and sensor, 31 m in total)	○
Standard calibration	0						Calibration	○
(Fixed code)						021000000000000000	Always 021000000000000000	○
Special feature	(Blank)						Not provided	○
	/Z						Provided *4	○

Converter specification code	VNG0	4					1	2	Description	Std.
Converter code	VNG0								Converter model : UFC300 V2 series	○
(Fixed code)	4								Always 4	○
Type	H								UFC300F V2 (Field installation)	○
	N								UFC300W V2 (Wall installation type)	○
Power supply	1								24 V DC (12 to 24 V)	○
	A								100 to 230 V AC (85 to 250 V)	○
Type of protection	0								General type (Non-protection)	○
	1								ATEX	○
Cable entry *3	4								1/2 NPT female thread	○
	5								G1/2 female thread	○
	6								M20 with watertight gland	○
	H								G1/2 with pressure tight packing adapter	○
(Fixed code)						300		Always 300	○	
Housing							1		Standard	○
(Fixed code)							2		Always 2	○
Output type								100	For 1 sensor : Standard (Current output + Pulse output + Control input + Status output)	○
								6AE	For 2 sensors : (2 × Current outputs + 2 × Pulse outputs)	○
(Fixed code)								10000000000000	Always 10000000000000	○
Special feature	(Blank)								Not provided	○
	/Z								Provided *4	○

\*1 The sensor cable length is 10 m as standard.

\*2 Extension cable: cable between converter and junction box (Cable length between junction box and sensor is fixed to 6 m)

\*3 Standard electrical connection of sensor cable is M20 water proof cable gland.

Specify a G1/2 pressure tight packing adapter (its code: H) for TIIS explosion proof construction.

\*4 In case that special feature are involved, put [/Z] at the end of spec. code and specify the details. It is recommended to consult TOKYO KEISO for such availability before ordering.

## EXPLOSION-PROOF SPECIFICATIONS

## ● ATEX

## &lt; Converter &gt;

Certificate No.	: CSANe 21ATEX1015X
Model	: UFC300F-Ex
Marking	: II 2G Ex db [ia] II C T6 Gb or Ex db eb [ia] II C T6 Gb
Ambient temperature	: -40°C to +65°C (Aluminum enclosure)
Electrical Data	
Power supply	: 100 – 230 V ac -15%/+10%, 50/60Hz, 22 VA or 12 – 24 V dc -10%/+30%, 12 W (PELV) or 24 V ac/dc (PELV) : -24 V ac -15%/+10%, 50/60Hz, 22 VA -24 V dc -25%/+30%, 12 W Um = 253 V
Measuring sensor circuit	: In type of protection intrinsic safety “i” (EPL Gb) with the following maximum values: Uo = 8.2 V dc, Io = 190 mA, Po = 390 mW (linear characteristic), Co = 760 nF and Lo = 1.4 mH or Co = 1400 nF and Lo = 0.5 mH
I/O circuit	: Status output, passive, Pulse output, passive : I <sub>max</sub> =100 mA, U <sub>max</sub> =32 V Control input : I <sub>max</sub> =100 mA, U <sub>max</sub> =32 V Current output, passive, HART : U <sub>max</sub> =32 V Um = 253 V

## &lt; Sensor &gt;

Certificate No.	: CSANe 21ATEX2014X
Model	: UFS6000-x-Ex
Marking	: II 2G Ex ia II C T6...T4 Gb
Ambient temperature	: -40°C to +70°C (see tables below);
Fluid temperature	: -40°C to +120°C (see tables below).

Temperature class	Ambient temperature	Max. process temperature
T6	60°C	80°C
T5	70°C	95°C
T4	70°C	120°C

## Electrical Data :

Sensor supply circuit (fixed cable with internal SMB connector) :

In type of protection intrinsic safety Ex ia II C, only for connection to an intrinsically safe circuit, with the following maximum values : U<sub>i</sub> = 8.5 V ; I<sub>i</sub> = 250 mA ; P<sub>i</sub> = 531 mW ; C<sub>i</sub> = 4.5 nF ; L<sub>i</sub> = 400 μH

## READ BEFORE USE

Following services may impair the designed functions of the flowmeters.

Customers are kindly requested to consult us about the assessment of its application including conducting actual tests before putting into services.

### 1) Measuring liquid properties

- Liquids contained large amounts of bubbles (approximately more than 2%)
- Liquids contained slurries and solids (approximately more than 5weight%)
- Liquid of which the velocity of sound in the liquid is unknown
- Chemicals with changing properties such as concentration, density and viscosity

### 2) Installed pipe properties

- Inside carbon steel pipe is rusty
- Adhesives and residues inside pipe
- Clearance gap between lining and pipe itself, for example PVC lining pipe case
- Rough outer surface of cast iron pipe, for example
- PVDF pipe more than 9 mm in thickness
- PP pipe more than 15 mm in thickness
- Pipe more than 1000 mm in diameter

### 3) Required straight length

Precise flow measurement requires both upstream and downstream straight lengths as indicated in table below.

D : Nominal pipe diameter

Source: Japan Electric Measuring Instruments Manufacturers' Association (JEMIS 032)

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

## FLOW RATE RANGE

Inner diameter (mm)	Possible scale range (m <sup>3</sup> /h)	
	Min. (Velocity: 0 to 0.5 m/s)	Max. (Velocity: 0 to 20 m/s)
15	0 to 0.319	0 to 12.7
20	0 to 0.566	0 to 22.6
25	0 to 0.884	0 to 35.3
40	0 to 2.27	0 to 90.4
50	0 to 3.54	0 to 141
65	0 to 5.98	0 to 238
80	0 to 9.05	0 to 361
100	0 to 14.2	0 to 565
125	0 to 22.1	0 to 883
150	0 to 31.9	0 to 1272
200	0 to 56.6	0 to 2261
250	0 to 88.4	0 to 3534
300	0 to 128	0 to 5089
350	0 to 174	0 to 6927
400	0 to 227	0 to 9047
500	0 to 354	0 to 14137
600	0 to 509	0 to 20357
700	0 to 693	0 to 27708
800	0 to 905	0 to 36191
900	0 to 1146	0 to 45804
1000	0 to 1414	0 to 56548
1500	0 to 3181	0 to 127234
2000	0 to 5655	0 to 226194
3000	0 to 12724	0 to 508938
4000	0 to 22620	0 to 904778

## PRECAUTION FOR USE

- 1) Provide upstream and downstream straight lengths.
- 2) Mount the sensor to the piping which is always filled with liquid.
- 3) Don't install sensors on the top and on the bottom of a horizontal pipe line.
- 4) Keep sensor less than allowable temperature especially when the sensor covered by insulation materials.
- 5) When installing outdoors for use, it is recommended to attach a waterproof cover to the sensor in order to prevent deterioration of sensor grease.

## STANDARD ACCESSORIES

- Parameter sheet : 1
- Instruction manual : 1

## OPTION

- G1/2 watertight glands for cable entry : 1 set [Symbol : WG]
- Number of wiring connection : 3 [Symbol : 3G]
- 2B pipe installation metal fitting [Symbol: PM]
- Converter data (parameter) setting [Symbol : DS]  
Inform us of the piping specification, flow range and pulse rate etc.

## ORDERING INSTRUCTIONS

Specify the following when ordering :

1. Model and spec. code  
Example : Model : UL6300 V2  
Sensor specification code :  
VNE242007E2S002100000000000000  
Converter specification code :  
VNG04NA06300121001000000000000
2. Option  
Refer to the option code and specify by the symbol.

\* Specification is subject to change without notice.

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