



TECHNICAL GUIDANCE

SONICMAX[®]

UL6300

Ultrasonic Clamp-on Flowmeter

OUTLINE

SONICMAX UL6300 is the ultrasonic flowmeter of the time flight system which combined the highly efficient converter (UFC300) with the clamp-on sensor (UFS6000).

Three kinds of sensors without direct contact to fluid allow wide range flow measurement of pipe size from 15 mm to 4000 mm.

A sensor mounted on the sensor rail and a sensor cable realized simple installation on pipe and easy maintenance.

The highly efficient converter corresponding to a multi-sensor can measure two lines or double line measurement by one set.

Moreover, the digital processing and substantial status diagnostic function enabled stable and high precision measurement for low velocity flow.

Furthermore, flameproof type etc. in combination with a field type converter (UFC300F) is also available.

FEATURES

- ❑ The non-contact measurement system where the sensor is installed on the exterior surface of pipe eliminates the generation of particles, and mixing of metal ions completely.
For this reason, this method is the best for flow measurement of, such as pure water and a chemical liquid.
- ❑ The highly efficient converter corresponding to multi-sensors can measure two lines simultaneously.
It provides precise flow measurement by calibrating uneven flow by measuring two-measuring-lines in one stream.
- ❑ Signal processing system enables stable and precise measurement for low velocity flow.
- ❑ High accuracy measurement of $\pm 1\%$ of indicated values (Connection: 50 mm or more, Velocity: 0.5 m/s or more) is realized.
- ❑ Sensor part is applicable to pipe size from 15 mm to 4000 mm by three kinds of sensors (small / medium / large).
- ❑ Easy mounting and easy maintenance are realized because sensor is integrated on the mounting rail and greasing can be done keeping sensor distance fixed.
- ❑ A terminal box at the end of sensor rail allows easy wiring and cable connection by using composite sensor cable.
- ❑ Blue dot matrix LCD (with backlight) is used for the display (128 × 64 dots, 59 × 31 mm).
A multi-line indication by 1-3-lines of the measured values, and a real-time trend indication, etc. are provided.
- ❑ A quick setup function allows easy change of flow range, pulse rate, etc.
- ❑ A touch panel system by an infrared sensor allows you to alter the settings without removing the cover of the conversion section.



MEASURING PRINCIPLE

As shown in Fig. 1 the ultrasonic is transferred from A to B and B to A in turn with a angle of ψ . 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.

$$t_{AB} = 2L / (C_0 + V_m \cos \psi)$$

$$t_{BA} = 2L / (C_0 - V_m \cos \psi)$$

Where

2L : 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 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:

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

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

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

The distance between A and B (L) and the angle (ψ) 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.

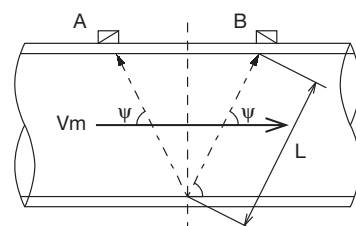
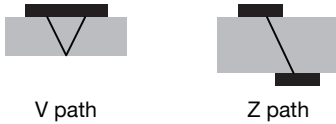


Fig.1 Measurement principle

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 composition: Sensors (2 pcs), Sensor rail, Sensor cover, Converter, Sensor band (2 pcs), Sensor cable (coaxial cable with SMB connector)
* In addition to above items, the large sensor is equipped with followings; each two pairs of sensor rail and its cover: 4 pieces of sensor bands: 3 pieces of sensor cable: 4 pieces of band fastening units: one connection box.
- 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."

Sensor type Piping materials	Small 15 to 100 mm	Medium 50 to 400 mm	Large 200 to 4000 mm
Carbon steel	○	○	○
Stainless steel	○	○	○
PVC	○	○	○
PP	○	○	-
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
(JIS C0920, equivalent to NEMA6)
- Material : Sensor rail; Aluminium alloy
(Alumite processing)
Sensor cover; Aluminium alloy
Sensor band; Stainless steel
Connection box; Aluminium alloy
- Ambient temperature : -40 to +70°C
- Painting : Sensor cover; Polyurethane resin paint
- Color : Sensor cover; Silver / Jade green
- 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 (Wall installation type) specification]

- Protection class : IP65 (JIS C0920, equivalent to NEMA4)
- 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 (Field installation type) specification]

- Protection class : IP66/67
(JIS C0920, equivalent to NEMA6)
- 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)

Explosion proof specification

[ATEX]

- Sensor type : UFS6000-x-EEx
S; Small / M; Medium / L; Large sensor
ATEX [EU ATEX directive (94/9/EC)]
PTB07 ATEX2010X
II 2 G EEx ia IIC T6...T4
- Ambient temperature : -20 to +70°C
of sensor
- Fluid temperature

Temperature class	Sensor surface temperature (Max.)
T6	80°C
T5	95°C
T4	120°C
T6...T4	Sensor surface temperature (Min.)
	-40°C

- Converter type : UFC300F-EEx
 - * Field installation type (UFC300F)
 - ATEX [EU ATEX directive (94/9/EC)]
 - PTB07 ATEX2011X
 - II 2 G EEx de [ia] IIC T6 or EEx d [ia] IIC T6
- Ambient temperature : -40 to +60°C
of converter

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 (≤10 kHz)
 - Less than 100 mA (≤10 Hz)
 - 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.
 - 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 [□]
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.
- HART communication
 - Standard

Accuracy (*)

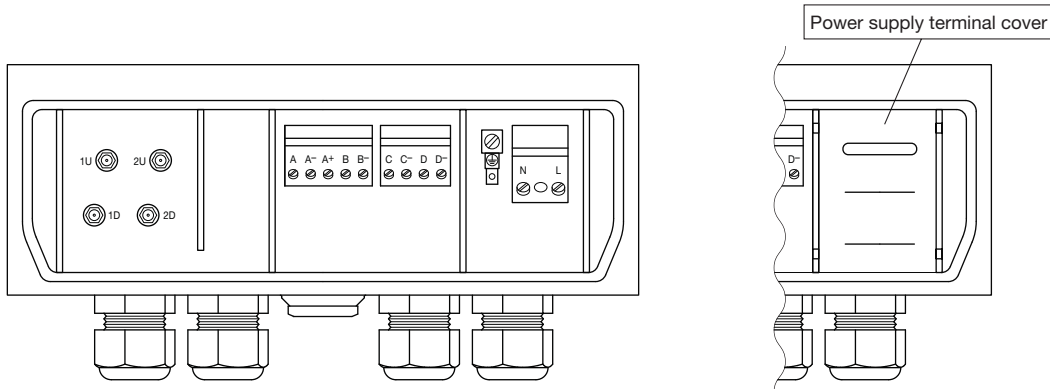
- Indication and Pulse output
 - 1) Pipe size: 50 mm or more:
 - Flow velocity ≥ 0.5 m/s: ±1% of reading
 - Flow velocity < 0.5 m/s; Velocity error of ±0.005 m/s
 - 2) Pipe size: Less than 50 mm
 - Flow velocity ≥ 0.5 m/s: ±3% of reading
 - Flow velocity < 0.5 m/s; Velocity error of ±0.015 m/s
- Current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

(*) Basis proofreading conditions

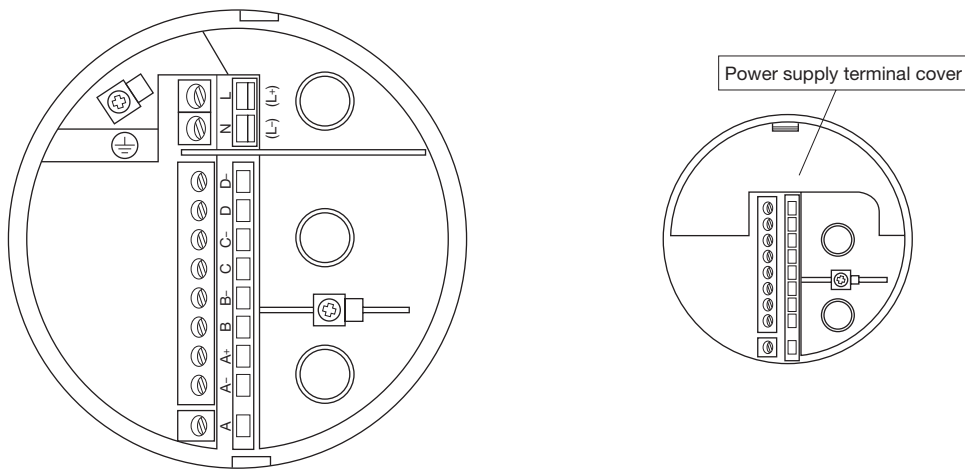
- Fluid : Water
- Fluid temperature : 20 to 25°C
(Temperature fluctuation: ±0.5°C)
- Piping material : Stainless steel (SS316)
- Upstream/Downstream : 20D/10D (D: Diameter)
- pipe length
- Pipe size : 100 mm

POWER SUPPLY AND INPUT-AND-OUTPUT CABLE ELECTRIC CONNECTION

UFC300W (Wall installation type)



EGC300F (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.

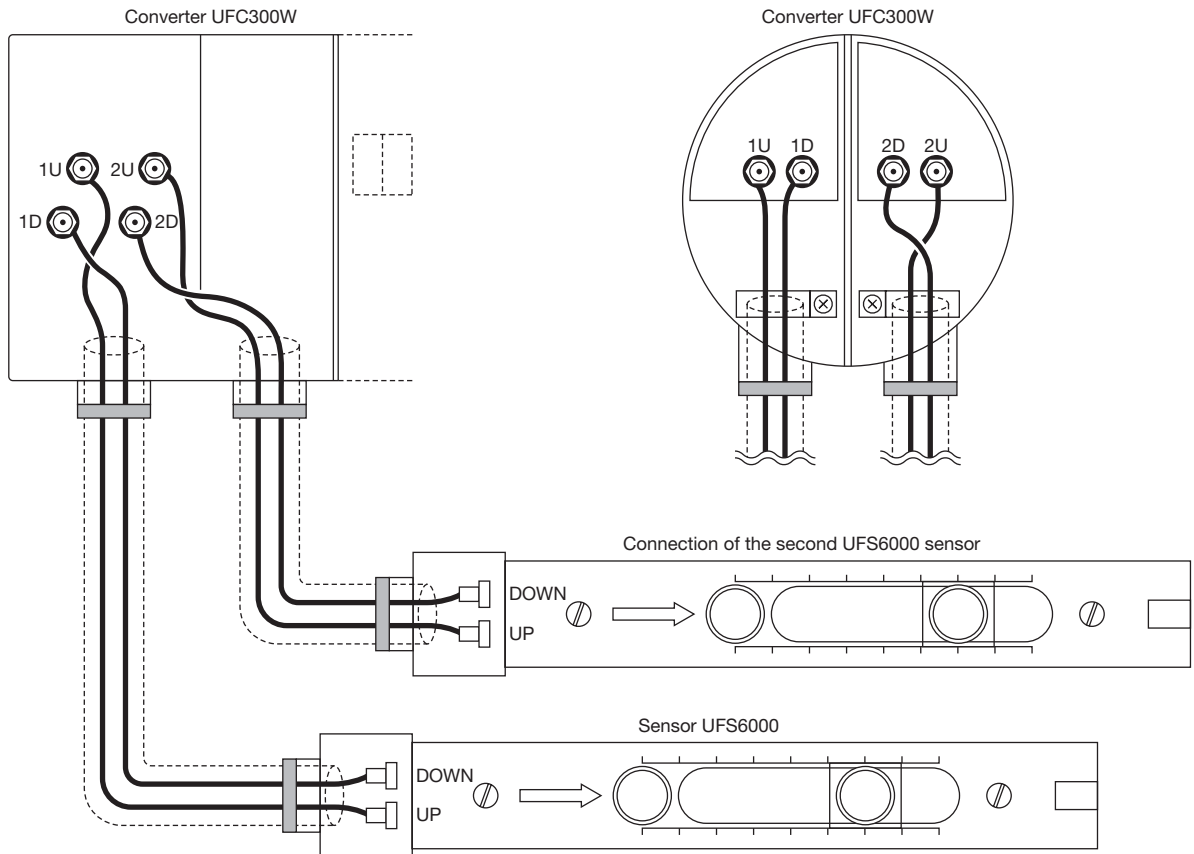
Terminal symbol	Polarity	Converter for 1-line measurement (Std.)	Converter for 2-line measurement
A	+	Current output (External power supply)	Current output (External power supply)
A-	-		

- Terminal type : Plug-in type screw terminal
- Applicable cable size : Power cable ; 0.5 to 2.5 mm²
Signal cable ; 0.5 to 1.5 mm² (UFC300W)
; 0.5 to 2.5 mm² (UFC300F)

ELECTRIC CONNECTION OF CONVERTER AND SMALL / MEDIUM SENSOR

UFC300W (Wall installation type)

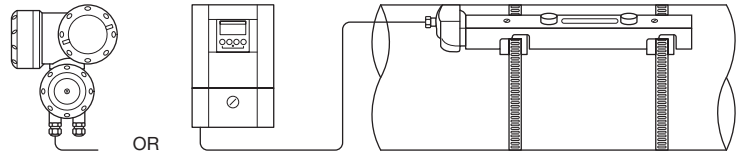
UFC300F (Field installation type)



COMBINATION EXAMPLES OF CONVERTER AND SMALL / MEDIUM SIZE SENSORS

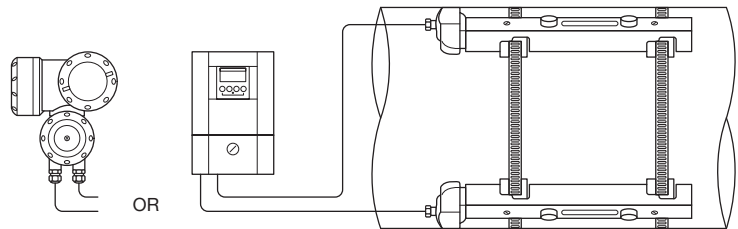
1) Converter for 1-line measurement (Std.)

- Converter for 1-line measurement
- Sensor × 1 set



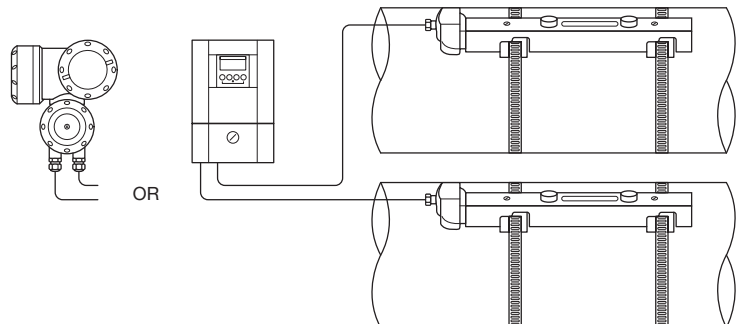
2) Dual measurement

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



3) Converter for 2-line measurement

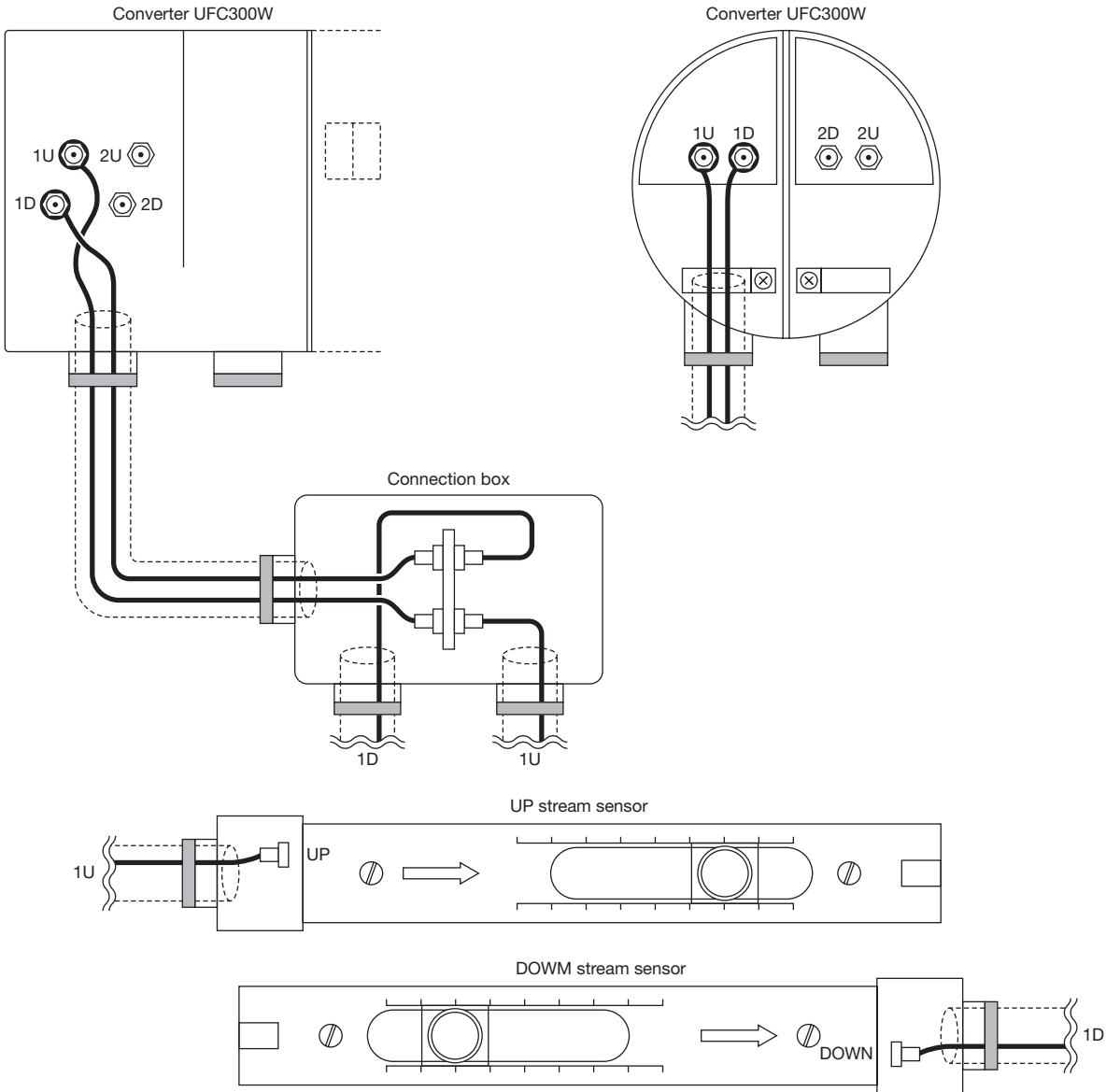
- Converter for 1-line measurement
- Sensor × 2 set



ELECTRICAL CONNECTION OF CONVERTER AND LARGE SENSOR

UFC300W (Wall installation type)

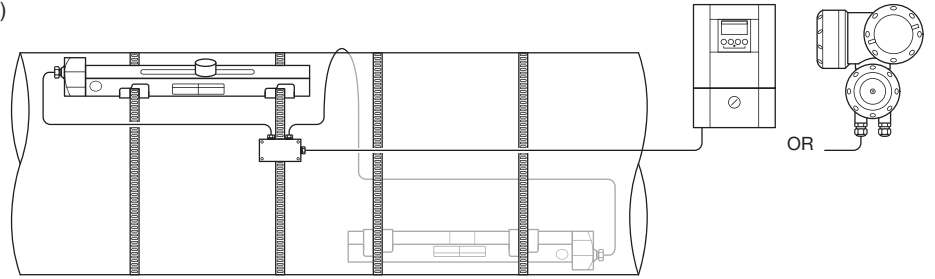
UFC300F (Field installation type)



COMBINATION EXAMPLES OF CONVERTER AND LARGE SENSOR

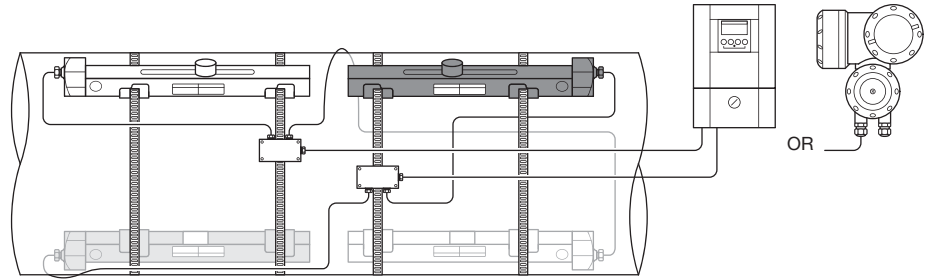
1) Converter for 1-line measurement (Std.)

- Converter for 1-line measurement
- UP/DOWN stream sensor × 1 set
- Connection box × 1



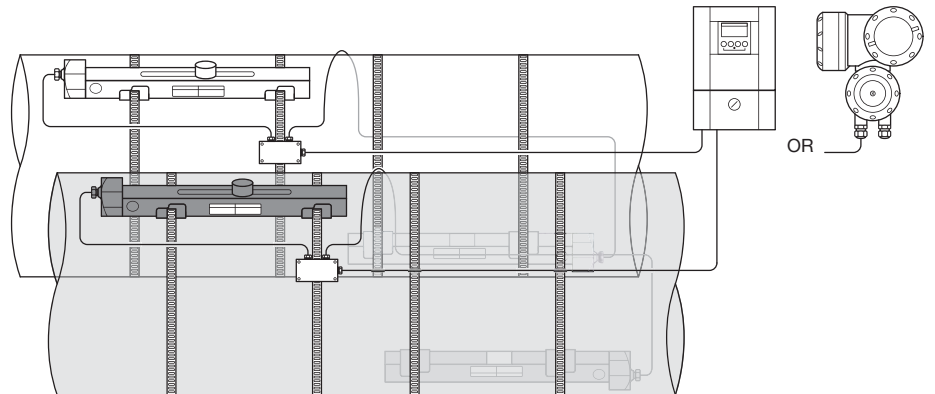
2) Dual measurement

- Converter for 1-line measurement
- UP/DOWN stream sensor × 2 set
- Connection box × 2



3) Converter for 2-line measurement

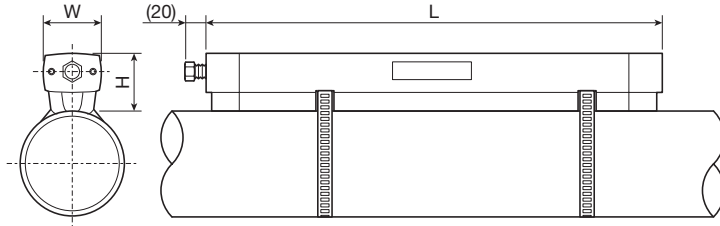
- Converter for 1-line measurement
- UP/DOWN stream sensor × 2 set
- Connection box × 2



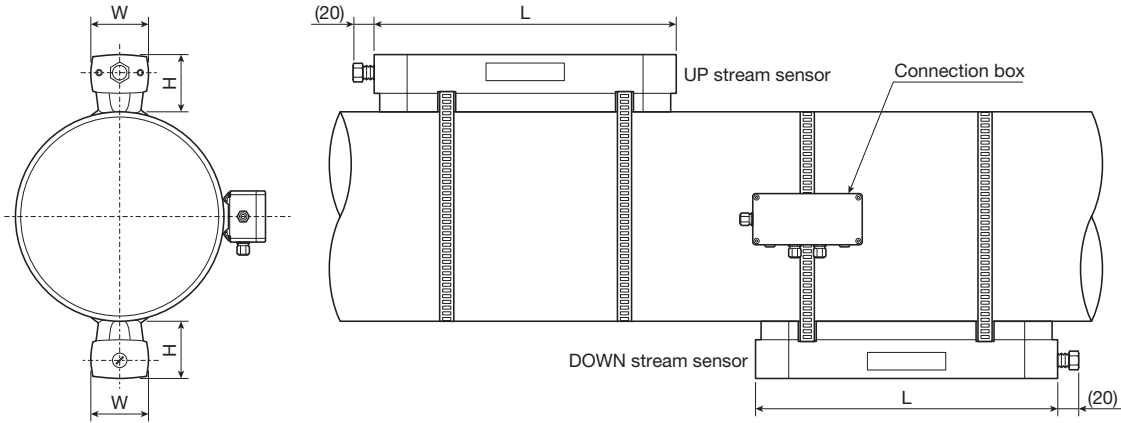
DIMENSIONS

Sensor UFS6000

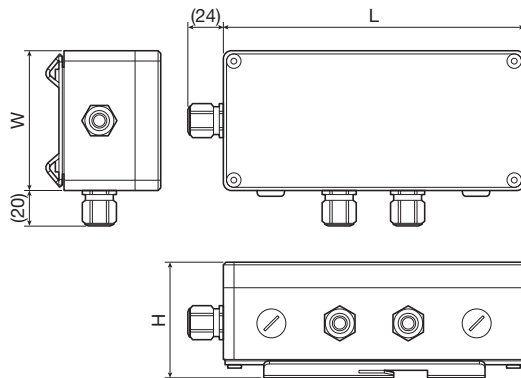
- Small / Medium sensor



- Large sensor



- Connection box

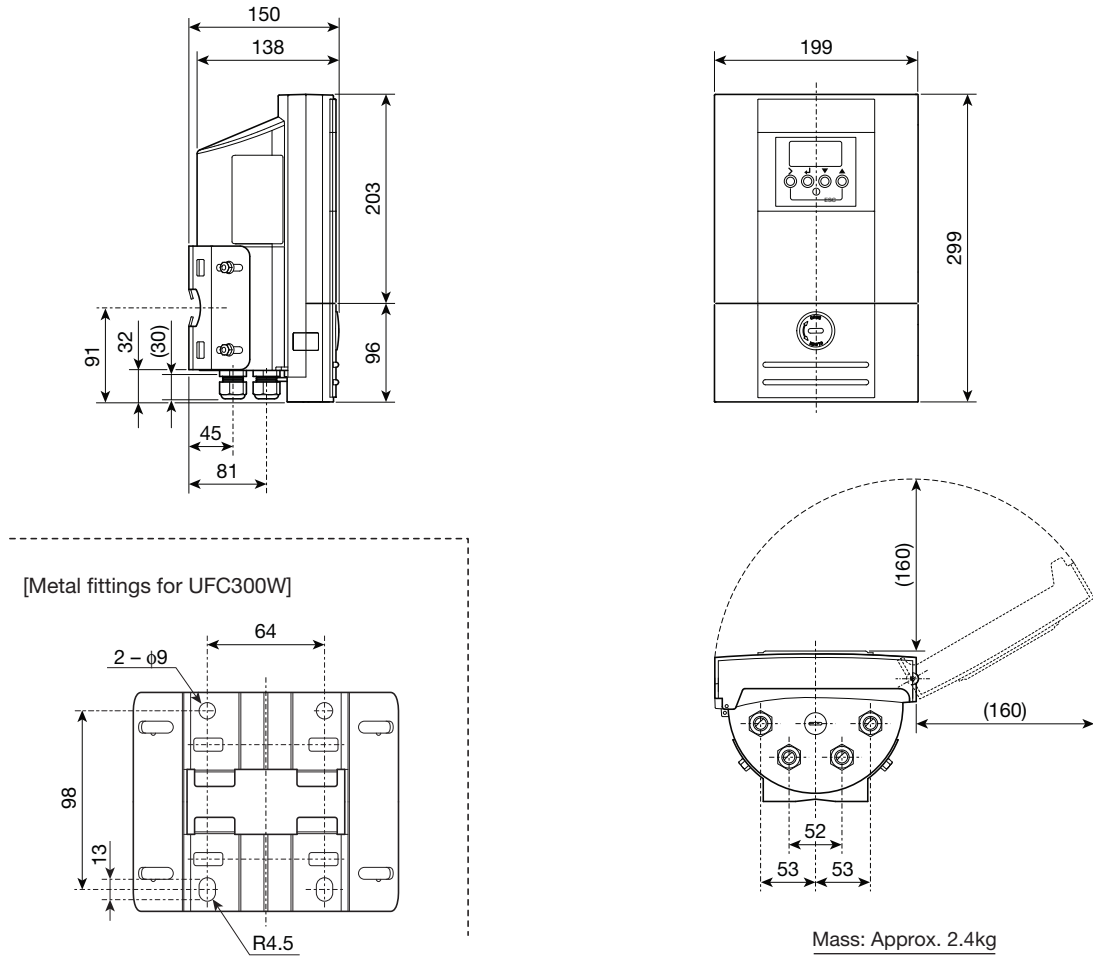


Item	Dimension (mm)			Mass (Approx. kg)
	L	H	W	
Small sensor	497	71	63	2.7
Medium sensor	827	71	63	3.6
Large sensor	497	71	63	2.7
Connection box	177	67	82	0.9

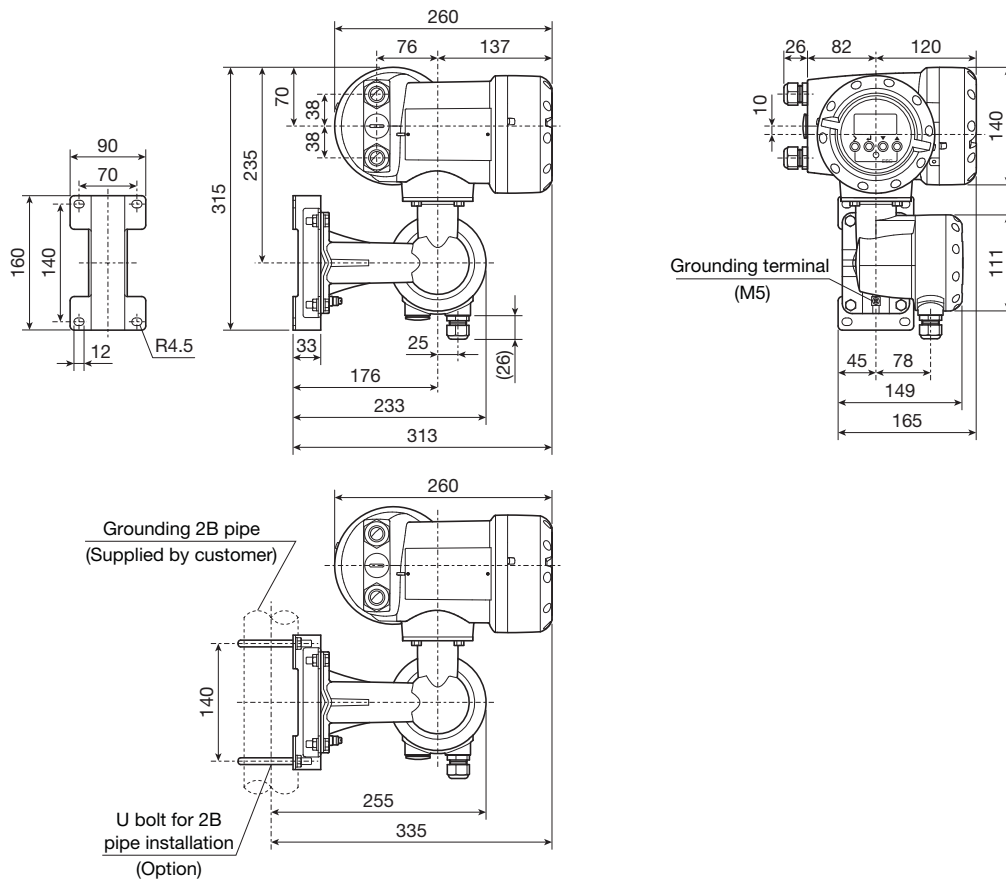
(Note 1) A large sensor has total 2 sensor rails, one for upstream and one for downstream.

(Note 2) Don't install sensors on the top and on the bottom of a horizontal pipe line.

UFC300W (Wall installation type)



UFC300F (Field installation type)



MODEL AND SPECIFICATION CODE

Representation type: UL6300

Individual type: Refer to following table.

Specification	Sensor	Converter	
		Wall installation	Field installation
General type	UFS6000	UFC300W	UFC300F
ATEX	UFS6000-x-EEEx	-	UFC300F-EEEx
TIIS	[Preparing]	-	[Preparing]

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

Specification code

Sensor specification code	V N 6 0 4	1 0 7	0 0	0 2 1 0 0 0 0 0 0 0	Description	Standard
Sensor code	V N 6 0				Sensor model : UFS6000, 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" *1	○
Version	0				Standard (Max.120°C)	○
Type of protection	0				General type (Non-protection)	○
	1				ATEX	
	H				TIIS (Preparing)	
(Fixed code)	7				Always 7	○
Connectable converter type	D				UFC300F (Field installation type)	
	E				UFC300W (Wall installation type)	○
Material of sensor rail	0				Standard (Aluminium alloy)	○
Sensor cable length *2	1				10 m	○
	3				20 m	
	5				30 m	
Standard calibration	0				Calibration	○
(Fixed code)				0 2 1 0 0 0 0 0 0 0	Always 021000000	○
Special feature	(Blank)				Not provided	○
	/Z				Provided *4	

Converter specification code	V N 3 2 4	2 0 5 1 2	1 0 0	Description	Standard
Converter code	V N 3 2			Converter model : UFC300	○
(Fixed code)	4			Always 4	○
Type	H			UFC300F (Field installation)	
	N			UFC300W (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	
	H			TIIS (Preparing)	
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)				Always 205	○
Housing			1	Standard	○
(Fixed code)			2	Always 2	○
Output type			1 0 0	For 1 sensor : Standard (Current output + Pulse output + Control input + Status output)	○
			6 A E	For 2 sensors : (2 × Current outputs + 2 × Pulse outputs)	
(Fixed code)			1 0 0	Always 100	○
Special feature	(Blank)			Special feature	○
	/Z			Not provided Provided *4	

*1 2 pieces of 6 m cable between connection box and upstream sensor/downstream sensors are supplied.

*2 means cable length between connection box and converter for large sensor.

*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.

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 flow of low Reynolds No. (approximately less than 10,000)
- 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

Reference : JEMIMA standard JEMIS-32

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 ³ /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
Sensor specification code :
VN6042007E1100210000000
Converter specification code :
VN324NA0620512100100
2. Option
Refer to the option code and specify by the symbol.

* Specification is subject to change without notice.

TOKYO KEISO CO., LTD.

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