TECHNICAL GUIDANCE

Ideal for flow measurement and control of cleaning and CMP processes

ULTRA-CLEAN ULTRASONIC FLOWMETER

UCUF-M Series

CE RoHS

OUTLINE

The UCUF series ultrasonic flowmeter is designed for measuring small flow rates of ultrapure water and chemical liquids. It is comprised of the UCUF-M detector and SFC converter. All wet parts of the detector are made of special-grade PFA molds for the semiconductor industry and have no moving parts or sealing mechanism such as O-rings which would accumulate liquid components. The simple and smooth construction leaves no residues and is ideal for processes such as semiconductor manufacturing which requires ultimate cleanliness.
The SFC converter significantly reduces the effect of bubbles in liquid, which cause problems in semiconductor and chemical processes. It has an adjustment function to offset the effect on the kinematic viscosity of liquids, making the converter compatible with various chemicals. The DIN rail mount-type saves installation space. The RS485 communication function enables integrated management of the process. For details, see the Technical Guidance of the converter.

FEATURES

- ❑ EMC compliance: EN61326-1
- ❑ RoHS compatible
- ❑ A standardized pitch of 80 mm for connecting tubes
- ❑ Liquids with kinematic viscosity of as high as 40 mm^2/s can be measured.
- ❑ Accuracy: Within ±1% of the reading at flow velocity of 1 m/s or more
- ❑ Wide rangeability of 100:1 (At low cut-off of 1% F.S.)
- ❑ Detector with highly clean construction
- ❑ Corrosion resistant and easy to install

APPLICATIONS

- ❑ Pure water and ultrapure water in the semiconductor manufacturing process
- ❑ Chemical feeding
- ❑ Highly corrosive chemicals
- ❑ Chemical mechanical polishing (CMP) slurries
- ❑ Process liquids of small and medium flow rate
- ❑ Ideal for flow measurement and control of cleaning and CMP processes

OPERATING PRINCIPLE

The measuring fluid flows into the U-shaped tube, changes direction by 90 degrees twice, and goes out as shown in Figure 1. Two piezoelectric transducers A and B are mounted at both ends of the measuring section. They emit and receive ultrasonic waves alternately and measure the traveling times t_A (A to B) and t_B (B to A) through the liquid. Without flow, t_A is equal to t_B. With flow, t_A becomes shorter and t_B longer in proportion to the flow rate. Thus, calculating $t_B - t_A$ gives the flow rate of the liquid. t_A and t_B depend on the size and shape of the tube and liquid viscosity. The actual flow test data are stored in the linearizer in the converter, which enables the UCUF-M to measure flow rates with high accuracy.

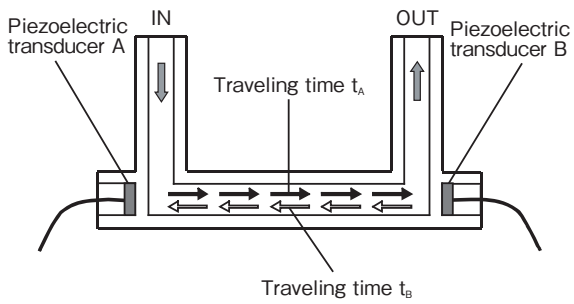


Figure 1 Operating principle

STANDARD SPECIFICATIONS

Measuring fluid : Liquids (those that do not contain air bubbles and permeate or corrode PFA)
Fluid temperature : 10 to 90°C
Ambient temperature : 0 to 60°C
Fluid pressure : 0 to 0.5 MPa
Fluid sound speed : 1000 to 2200 m/s
Fluid kinematic viscosity: 0.8 to 40 mm^2/s
Process connection : PFA tube end (see Table 1)
Enclosure classification : IP65
Location : Indoor
Flow range : See Table 1.

Table 1 Flow range and connecting tube size

Model	Flow rate (L/min)		Connecting tube size
	Min. range	Max. range	
UCUF-02M	0 to 0.01	0 to 0.1	1/4"
UCUF-04M	0 to 0.05	0 to 2.0	1/4"
UCUF-04HM	0 to 0.05	0 to 3.0	3/8"
UCUF-06M	0 to 0.4	0 to 8.0	3/8"
UCUF-10M	0 to 1.0	0 to 20.0	1/2"
UCUF-15M	0 to 3.0	0 to 50.0	3/4"
UCUF-20M	0 to 4.0	0 to 80.0	1"

Accuracy : See Table 2.

Table 2 Accuracy and flow rate

Model UCUF	Flow velocity < 1 m/s		Flow velocity ≥ 1 m/s	
	Flow rate (L/min)	Accuracy (L/min)	Flow rate (L/min)	Accuracy (L/min)
-02M	0 to 0.025	± 0.00025	0.025 to 0.1	±1 %
-04M	0 to 0.8	± 0.008	0.8 to 2	±1 %
-04HM	0 to 0.8	± 0.008	0.8 to 3	±1 %
-06M	0 to 1.7	± 0.017	1.7 to 8	±1 %
-10M	0 to 4.7	± 0.047	4.7 to 20	±1 %
-15M	0 to10.6	± 0.106	10.6 to 50	±1 %
-20M	0 to18.8	± 0.188	18.8 to 80	±1 %

*Quoted accuracy is based on water calibration.
*The accuracy and flow rate range of UCUF-02M do not change at a flow velocity of 1 m/s.

Pressure loss:
Pressure loss for water (kPa) = $C \times Q^2$
Where C: Pressure loss coefficient (see Table 3)
Q: Flow rate (L/min)

Table 3 Pressure loss factor

Model	C
UCUF-02M	16.8
UCUF-04M	4.5
UCUF-04HM	3.04
UCUF-06M	0.9
UCUF-10M	0.142
UCUF-15M	0.0148
UCUF-20M	0.00332

Material : See Table 4.

Table 4 Materials of the flow detector

Parts		No.	Material		
			02M	04M,06M	10M,15M,20M
Wetted part	Body	①	PFA	PFA	PFA
	Tube	②	PFA	PFA	PFA
Sensor cap		③	PP	PP	PP
Cable fitting		④	PP	PVDF	Nitrile
Cable sheath		⑤	PVC	PVC	PVC
Fixing band		⑥	PP	PP	-

See Dimensions for part numbers.

Cable : 2 coaxial cables (5 m) attached
(Up to 30 m with extension cables)
Model code : See Table 5.
Mass : See Table 6.
Connector : SMB, BNC

MODEL CODE

Table 5 Model codes of the flow detector

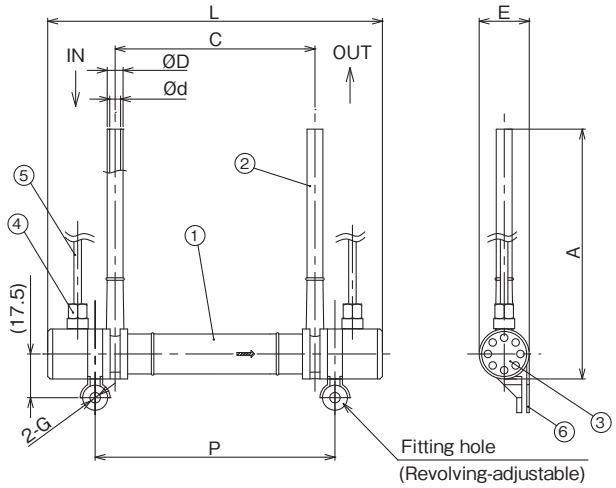
Model code							Description
UCUF-	□□	M	□	-□	□	□	
Size	02						2.5 mm
	04						4 mm (connection 1/4")
	04H						4 mm (connection 3/8")
	06						6 mm
	10						10 mm
	15						15 mm
	20						20 mm
Connector type*1			B				BNC connector
			D				SMB connector
Shape				-U			U-shape (standard)
				-Z			Z-shape
Cable length					5		5 mm (standard)
Special						Blank	Not provided
						/Z	Provided*2

*1 Type of cable connector depends on the type of converter. See Table 7.
*2 For special specifications, add "/Z" at the end of the code and describe the content separately.
Contact Tokyo Keiso in advance about the possibility of manufacture.

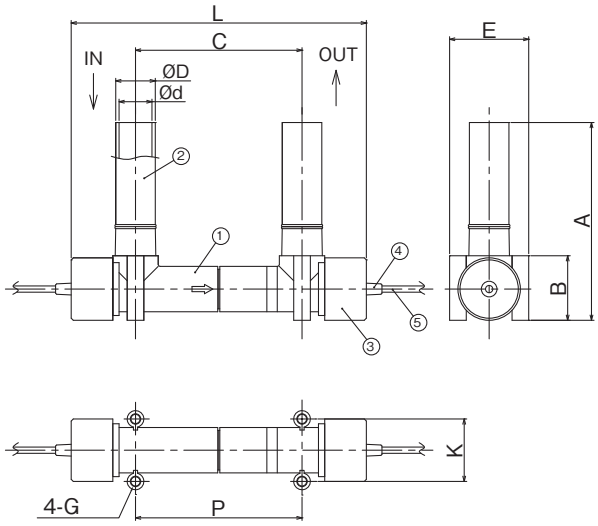
DIMENSIONS

Flow detector

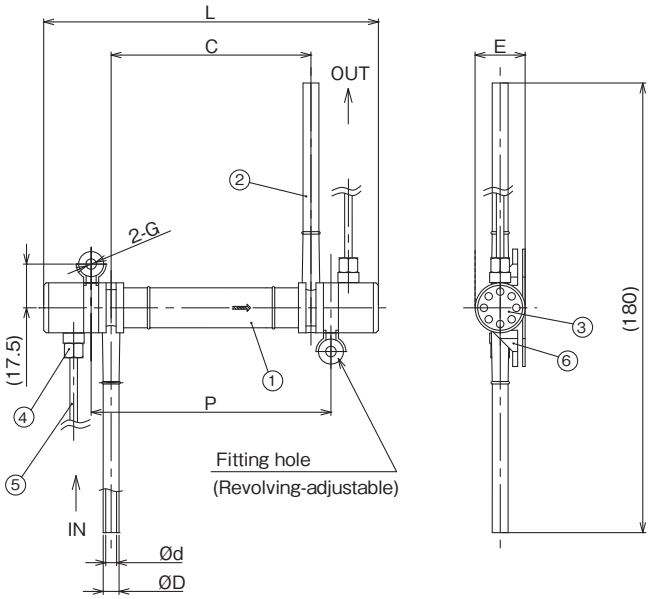
UCUF-02M□-U
UCUF-04(H)M□-U
UCUF-06M□-U



UCUF-10M□-U
UCUF-15M□-U
UCUF-20M□-U



UCUF-02M□-Z
UCUF-04(H)M□-Z
UCUF-06M□-Z



UCUF-10M□-Z
UCUF-15M□-Z
UCUF-20M□-Z

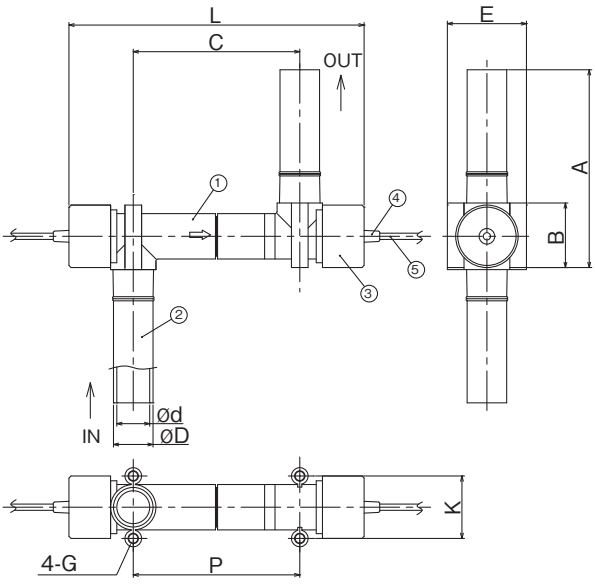


Table 6 Dimensions and mass

Model UCUF	Connecting tube size	Dimension (mm)										Mass (g)		
		D	d	C	L	A	B	E	G	K	P	Flow detector	Cable (5 m)	Total
-02M	1/4"	6.35	4.35	80±1	134±1	100	-	20	φ4.2	-	96±1	100	150	250
-04M	1/4"	6.35	4.35	80±1	134±1	100	-	20	φ4.2	-	96±1	100	150	250
-04HM	3/8"	9.53	6.33	80±1	136±1						98.5±1			
-06M	3/8"	9.53	6.33	80±1	136±1	100	-	20	φ4.2	-	98.5±1	100	150	250
-10M	1/2"	12.70	9.50	80±1	136±1	120	31	32	M4、31	25	80±1	100	150	250
-15M	3/4"	19.00	15.80	80±1	142±1	130	31	38	M5、31	30	80±1	130	150	280
-20M	1"	25.40	22.20	80±1	148±1	140	34	42	M4、34	35	80±1	170	150	320

*For -10M, -15M, and -20M models, the screw depth is added to size G.

APPLICABLE CONVERTERS

Table 7 Applicable converters

Model	Measurement method	Converter					Connector type
		04M	06M	10M	15M	20M	
SFC-900	Digital subtracting correlation	○	○	○	○	○	BNC
SFC017	Digital zero cross	○	○	○	○	○	BNC
SFC2000	Analog trigger	○	○				SMB
SFC2100	Analog trigger			○	○	○	SMB
SFC-010L	Digital zero cross	For the UCUF-02M only					SMB

CAUTIONS ON INSTALLATION

- ❑ To ensure precise, stable measurement, do not bend the connecting tube during installation.
- ❑ To ensure precise, stable measurement, stabilize the liquid temperature (within ±5°C).
- ❑ Keep the instrument pressurized even when it is not in use to avoid the formation of bubbles.
- ❑ Keep the measuring tube filled with liquids. Although the instrument can be installed with horizontal, vertical, or slant tubing, it is recommended to select a position for easy self-draining.
- ❑ Install a control valve downstream of the instrument, if necessary.
- ❑ Install the flow detector and converter away from noise sources such as power relays and solenoid valves.
- ❑ Lay the signal cable away from power cables of high voltage or current.
- ❑ For details on how to connect fittings, see the relevant documents of each manufacturer.

* Specification is subject to change without notice.

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