



Ultrasonic measuring instruments

Using ultrasound in information processing applications

Ultrasonic waves can be used in information processing applications by transmitting signals from an ultrasonic sensor through a medium (liquid, solid, or gas).

Typical application examples include level meters, flowmeters, and non-destructive inspection devices.

Characteristics of ultrasound

- The speed of sound is slower than that of radio waves and light, so measurement results are more accurate. Ultrasound is particularly useful when performing measurements in a solid or medium with low light transmittance, or when measuring distance to a transparent object that does not reflect light.
- Ultrasonic wavelengths are shorter and have better directivity than those at audible frequencies.
- Attenuation of ultrasonic waves is greater than that of audible frequencies, so the waves tend to travel shorter distances.

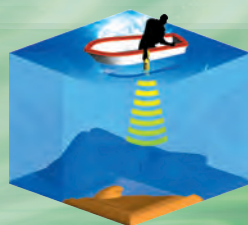
Level meter

- Non-contact level measurement ▶ page29
- Interface level measurement ▶ page32



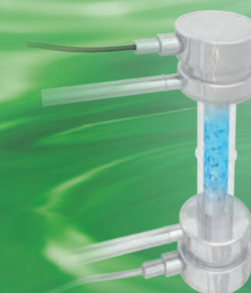
Depth sounder

- Water depth measurement ▶ page31



Flowmeter

- ▶ page34



Level meter

■ Non-contact level measurement

There is no physical contact between the sensor and surface, enabling continuous measurement of tank levels even under dusty conditions.

■ Interface level measurement

The interface level can be measured in cloudy sewage water or in deep tanks, without dropping the sensor down to the sediment layer.

Depth sounder

■ Water depth measurement

The distance to the bottom surface is determined by emitting ultrasonic waves and measuring the echo return time, which is similar to how fish finders work.

Flowmeter

Ultrasonic waves are used to measure the fluid velocity, which is then used to calculate the flow rate.

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Ultrasonic non-contact level measurement

HD320



HD323



Principle

Ultrasonic waves transmitted from the sensor are reflected back from the measured object, and the distance is calculated based on the echo return time. This makes it possible to perform operations such as measuring the liquid level inside a tank, or monitoring the remaining amount of materials in a tank.

$$\text{Distance} = \text{Speed of sound} \times \text{Time}$$

The distance to the measured surface is calculated based on the speed of sound and the time elapsed between the transmission of the signal and the return of the echo. The distance to the bottom of the tank is set in advance, so that the amount of liquid remaining in the tank can be calculated.

Advantages

Levels can be monitored without any contact with the materials that are measured. Levels can be monitored continuously, even under dusty conditions.

Low-cost model with two-wire system, featuring a graphic LCD display

- Two-wire system reduces the cost of installation, wiring, and operation
- Graphic LCD display shows the A-mode waveform
- When performing measurements, masking can be applied to objects positioned between the sensor and target

Main applications and usage examples

- Management of liquid level in tanks
- Management of sewage level inside pipes
- Measurement of water level in lakes, ponds, and rivers



■ Measurement of liquid level



■ Management of river water level



Model No.	HD320 / HD323
Number of channels	1
Frequency	50 kHz
Measurement target	Liquid
Measurement distance range	0.25 to 7.5 m
Resolution	Measurement: 1 mm Display: 1 mm
Accuracy	±0.25% F.S. (±18.8 mm)
Data update cycle	10 sec
Sensor directivity angle	14° (-6 dB) 10° (-3 dB)
Power source	Voltage: 24 V DC ±10% Power consumption: 0.6 W
Display	Graphic LCD
Display size	HD320: LCD (28.1 x 9.1 mm) HD323: LCD (50 x 25 mm)
Output	4 to 20 mA current output Resolution: 12 bits (Max. load resistance 500Ω, 24 V)

Use resin nuts, flanges, etc. for installation.

Do not use metal nuts, flanges, etc. Doing so may cause measurement errors.

	Main unit (Sensor)
Ambient operating temperature	-20 to +70°C
Material	PP (Polypropylene)
Protection standard	IP65 equivalent (Without lid: IP20 equivalent)
Dimensions	dia. 93 x 110 mm
Wiring cable length	10 m
Weight	350 g
Mounting screws (former JIS)	G2 (PF2)

What is a two-wire system?

A two-wire system supplies electric power through the data line, so that the electrical wiring can be performed with only two lines (the power + data wire, and the ground wire).

HD350-A



HD353-A



Low-cost DSP level meter

- Graphic LCD display shows the A-mode waveform
- Wide measurement range, from 0.3 to 10 m
- When performing measurements, masking can be applied to objects positioned between the sensor and target
- Remote operation is enabled with RS-485 (MODBUS[®] protocol), 4 to 20 mA current output, and alarm output contact points

Main applications and usage examples

- Management of liquid/powder levels in tanks
- Measurement of water level in lakes, ponds, and rivers



Model No.	HD350-A / HD353-A
Number of channels	1
Frequency	50 kHz
Measurement target	Liquid/powder
Measurement distance range (1/2 for powder)	0.3 to 10 m
Resolution	Measurement: 1 mm Display: 1 mm
Accuracy	±0.25% F.S. (±2.5 cm)
Data update cycle	0.5 sec
Sensor directivity angle	14° (-6 dB) 10° (-3 dB)
Power source	Voltage: 12 V - 24 V DC ±10% Power consumption: 3 W
Display	Graphic LCD
Display size	HD350: LCD (28.1 x 9.1 mm) HD353: LCD (50 x 25 mm)
Alarm output	1 point each for upper/lower
Output	4 to 20 mA current output Resolution: 12 bits (Max. load resistance 500Ω)
Interface	Transmission distance: Max. 1200 m

Use resin nuts, flanges, etc. for installation.

Do not use metal nuts, flanges, etc. Doing so may cause measurement errors.

	Main unit (Sensor)
Ambient operating temperature	-20 to +70°C
Material	PP (Polypropylene)
Protection standard	IP65 equivalent (Without lid: IP20 equivalent)
Dimensions	dia. 93 x 110 mm
Wiring cable length	10 m
Weight	350 g
Mounting screws (former JIS)	G2 (PF2)

Option • 30 m cable (HD-002) ○ P41



* MODBUS is the registered trademark of Schneider Electric USA, Inc.

HD1200



■ TS40T-5

■ TS40-5



Equipped with DSP that achieves stable measurement

- A unique level detection algorithm is achieved with DSP, which enables stable measurement by eliminating the effects of noise and unwanted reflection
- Two sensors can be connected to the main unit at the same time, so measurement can be performed at two separate locations with different measurement ranges
- Log data can be stored on a micro SD™ card
- Standard-equipped with a weir type flowmeter function

Main applications and usage examples

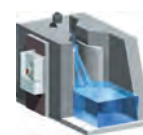
- Management of liquid/powder levels in tanks
- Measurement of water level in lakes, ponds, and rivers
- Weir type flow measurement



■ Measurement of liquid level



■ Measurement of powder level



■ Application in large capacity weir

Model No.	HD1200
Number of channels	2
Frequency	10 to 60 kHz (selected according to sensor specifications)
Measurement target	Liquid/powder
Resolution	Measurement: 1 mm Display: 1 mm
Accuracy	±0.25% F.S.
Data update cycle	Approx. 2 sec (varies depending on sensor specifications)
Power source	Voltage: 100 V - 240 V AC ±10% Power consumption: 10 VA
Display	LCD display (with backlight)
Output	Alarm output: 4 points per channel 250 V AC, 5 A (relay contact) 4 to 20 mA current output: Resolution: 1/4000 (Max. load resistance 600 Ω)
Interface	RS485 (Transmission distance: Max. 1200 m) RS232C (Transmission distance: Max. 10 m)
External memory	microSD™

Model No.	HD1200
Ambient operating temperature	-20 to 70°C
Material	ABS
Structure	IP66 equivalent
Dimensions (W x D x H mm)	176 x 84 x 237
Weight	1.8 kg

Note: Weir type flowmeter is available for CH1 only.

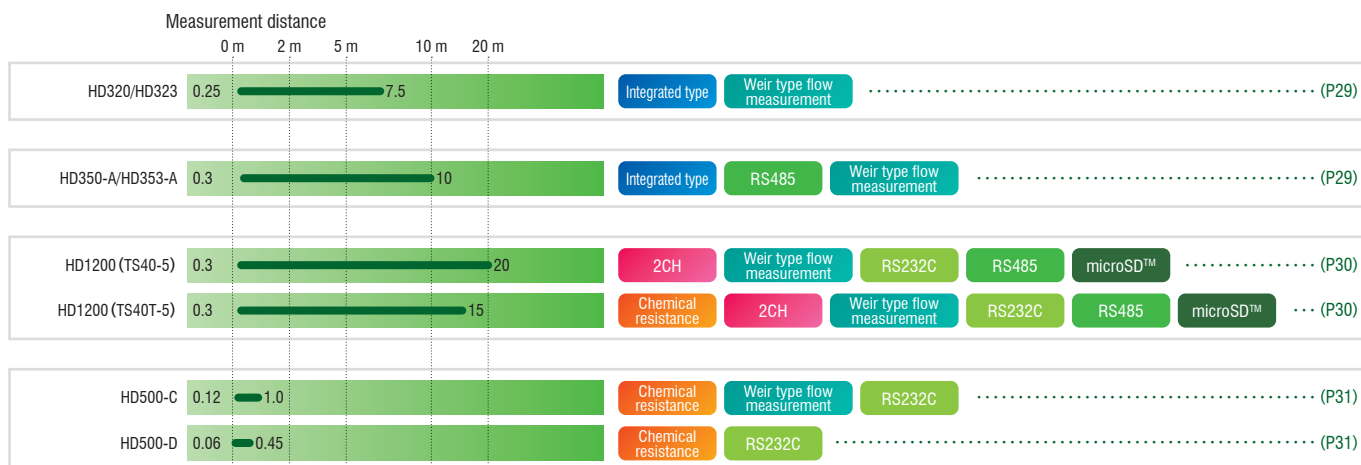
* microSD™ is the trademark or registered trademark of SD Card Association.

Model No.	Sensor	
	TS40-5	TS40T-5
Frequency	40 kHz	
Measurement distance range (1/2 for powder)	0.3 to 20 m	0.3 to 15 m
Sensor directivity angle	12° (-6 dB) 8° (-3 dB)	22° (-6 dB) 16° (-3 dB)
Ambient operating temperature	-20 to 70°C	
Material	Epoxy/silicone/PP	PVDF
Structure	IP68 equivalent	IP68 equivalent
Dimensions	dia. 84 x 90mm	dia. 98 x 87 mm
Sensor cable length	5 m	
Weight	500 g	860 g
Sensor mounting screws (former JIS)	R1 (PT1)	G1 (PF1)

* The sensors cannot be used in a hydrofluoric acid environment.

* Contact us if sensor cable extension is required.

Ultrasonic level meter selection guide



* Please select the model that the desired measurement distance is around the middle of covering range.

HD500

Series



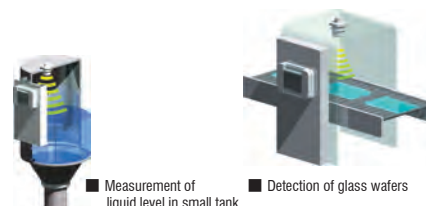
Standard Sensor

Chemical-resistant resin (PFA) sensor enables use with chemicals, and short distances can be measured with accuracy

- Use of high frequency minimizes the dead zone and enables measurement of short distances
- RS232C, 4 to 20 mA current output, and alarm output contacts facilitate integration into various systems

Main applications and usage examples

- Management of liquid level in small tanks
- Detection and positioning of objects on production lines



Model No.	HD500-C	HD500-D
Number of channels	1	
Frequency	200 kHz	400 kHz
Measurement target	Liquid	
Measurement distance range	0.12 to 1.0 m	0.06 to 0.45 m
Resolution	Measurement	0.1 mm
	Display	0.1 mm
Accuracy	±0.25% F.S. (±0.25 cm)	±0.25% F.S. (±0.1 cm)
Data update cycle	0.05 sec	
Sensor directivity angle	10° (-6 dB)	5° (-6 dB)
	7° (-3 dB)	4° (-3 dB)
Power source	Voltage	12 V - 24 V DC ±15%
	Power consumption	3 W (500 mA when started)
Display	4-digit LED	
Output	Alarm output	2 points each for upper/lower 30 V DC 0.1 A (NPN open collector)
	4 to 20 mA current output	Resolution: 16bit (Max. load resistance 450Ω)
Interface	RS232C (Transmission distance: Max. 10 m)	

	Main unit	Sensor
Ambient operating temperature	0 to 50°C	
Material	ABS	PFA Cable: FEP CAPCON: PVDF CAPCON inner seal: PPE-V
Structure	IP43 equivalent	IP65 equivalent
Dimensions (W x D x H mm)	113 x 52.5 x 94	dia. 42 x 39
Sensor cable length	—	2 m
Max. sensor cable length	—	2 m
Wiring cable length	Not provided	—
Weight	300 g	150 g
Sensor mounting screws (former JIS)	—	M32 P1.0

• Only the HD500-C is standard-equipped with the weir type flowmeter function
The flow rate can also be measured for a triangular weir

Water depth measurement

Ultrasonic Depth sounder

PS-7 Series



PS-7



PS-7FL

Principle

Ultrasonic waves are transmitted from a sensor placed in water, and the depth is calculated based on the amount of time it takes for the echo to return from the bottom surface (river or sea floor).

$$\text{Distance} = \text{Speed of sound} \times \text{Time}$$

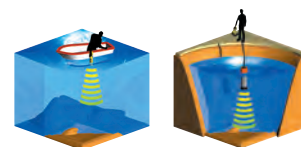
The distance to the measured surface is calculated based on the speed of sound and the time elapsed between the transmission of the signal and the return of the echo.

Equipped with a float sensor that enables water depth measurement even when the surface is out of reach

- Durable and easy to use, with an impact-resistant design that is waterproof to 50 m (PS-7)
- To operate, simply press and hold the switch on the case for 2 to 3 seconds, and aim the sensor in the desired direction
- * Measurement may not be performed properly if slime, seaweed, or other materials are present in the water.
- The unit is powered by a dry-cell battery (006P). Power automatically turns OFF approx. 10 seconds after releasing the power switch
- Equipped with high impact-resistant float sensor. The 10 m cable enables depth measurement from a distance (PS-7FL)

Main applications and usage examples

- Measurement of water depth at construction sites
- Measurement of water depth at survey sites



Model No.	PS-7	PS-7FL
Number of channels	1	
Frequency	200 kHz	
Measurement target	Bottom underwater surface	
Measurement range	0.6 to 80 m	
Sensor directivity angle (half of full angle of sound pressure)	24°	15°
Power source	9 V DC (006P dry-cell battery)	
Display	LCD display (with backlight)	

Model No.	PS-7	PS-7FL
Ambient operating temperature	0 to 50°C	
Dimensions (mm)	dia. 42 x 198	main unit: dia. 42 x 198 Float sensor: dia. 50 x 140
Sensor cable length	—	10 m
Weight	190 g	main unit: 170 g Float sensor: 320 g

Ultrasonic interface level measurement

Ultrasonic interface level meter

HL2000



Principle

One characteristic of ultrasonic waves is that they reflect off the interfaces between different media. When ultrasonic waves are transmitted from a sensor placed in water, the position of an interface can be calculated based on the amount of time it takes for the echo to return from the interface.

Advantages

Measurement is performed without having to make contact with the sediment. The interface level can be measured in cloudy sewage water or in deep tanks, without dropping the sensor down the sediment layer.

Enables stable measurement of sludge interface in sedimentation tanks

- Non-contact measurement is performed with a stationary sensor, which eliminates the risk of the sensor interfering with the rake. The sensor also does not disturb the interface, enabling long-term stable measurement
- Distances of 0.4 to 10 m from the sensor transmission surface can be measured
- Two sensors can be connected to the unit at the same time, so interface measurements can be performed at two locations (The second sensor is optional)

Main applications and usage examples

- Management of interfaces in sedimentation tanks at industrial wastewater treatment facilities
- Management of interfaces in sedimentation tanks at sewage treatment facilities

Model No.	HL2000
Number of channels	2
Frequency	400 kHz
Measurement target	Sludge interface
Measurement distance range	0.4 to 10 m
Resolution	Measurement: 1 cm Display: 1 cm
Data update cycle	1 sec
Sensor directivity angle (half of full angle of sound pressure)	6°
Power source	Voltage: 100 V - 240 V AC ±15% Power consumption: 10 VA
Display	LCD display (with backlight)
Output	Alarm output: 2 points each for upper/lower channel 250 V AC, 30 V DC, 5 A (relay contact) 4 to 20 mA current output: Resolution: 16 bits, 1 point per channel (Max. load resistance 450 Ω)
Interface	RS232C (Transmission distance: Max. 10 m)

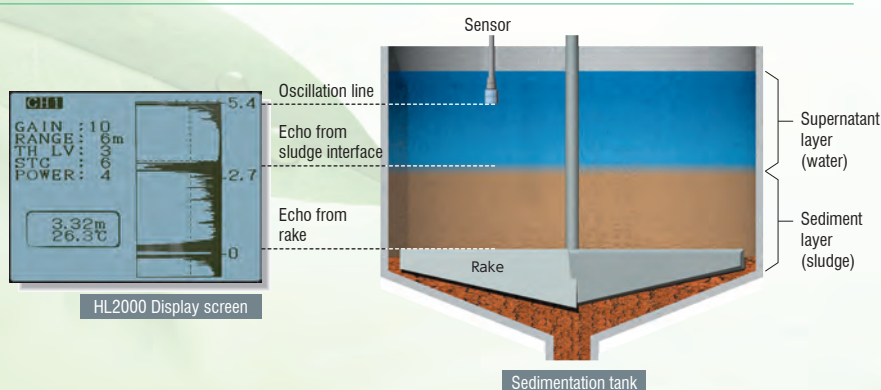
	Main unit	Sensor
Ambient operating temperature	-10 to 60°C	-5 to 60°C
Material	Painted steel	Case: PVC Cable: PVC
Structure	IP54 equivalent	IP68 equivalent
Dimensions (W x D x H mm)	280 x 92.5 x 322	dia. 80 x 95
Sensor cable length	—	20 m
Max. sensor cable length	—	100 m*
Weight	3.6 kg	2.2 kg

* Contact us if sensor cable extension is required.

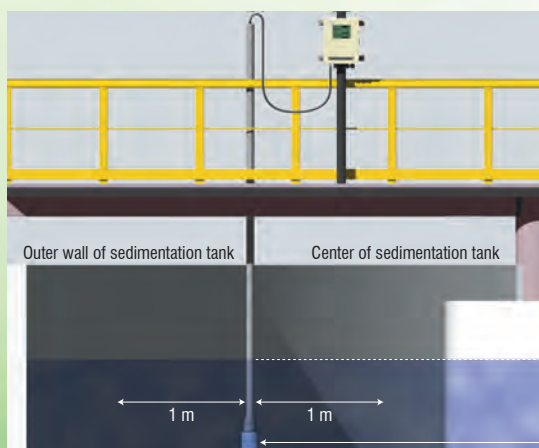
■ Option ● Cleaning nozzle

Ultrasonic interface level meter concept and application example

Concept

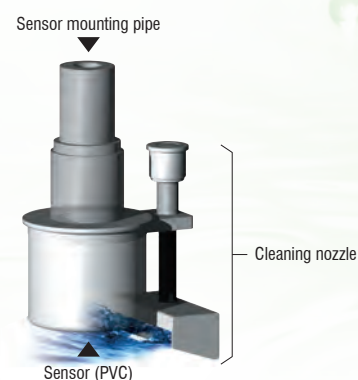


Application example



Sensor cleaning procedure

- Contamination on the sensor surface interferes with sludge interface measurement. Use the cleaning nozzle to keep the sensor clean.
- Constantly supply water to the cleaning nozzle. (The recommended flow rate is 20 L/min.)



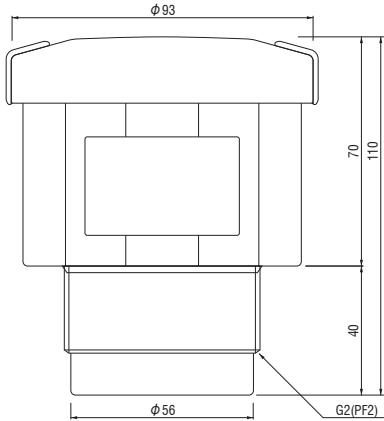
Water surface

- Make sure that there are no obstacles within a 1 m radius of the sensor.

Sensor

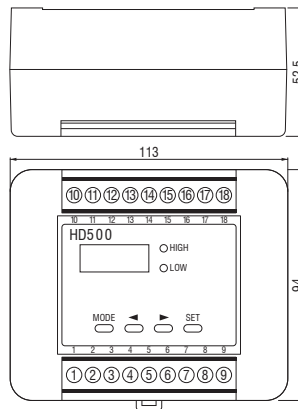
■ HD320 • HD323 • HD350-A • HD353-A

■ Main unit (Sensor)

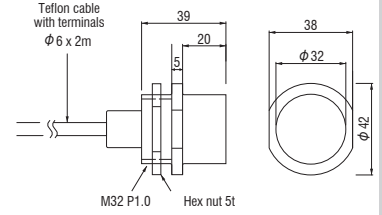


■ HD500-C / D

■ Main unit

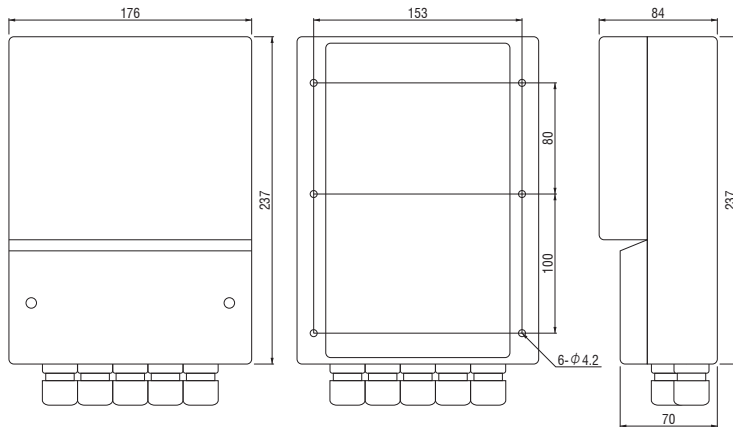


■ Standard Sensor

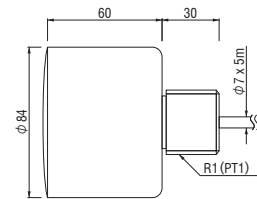


■ HD1200

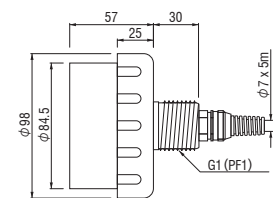
■ Main unit



■ TS40-5

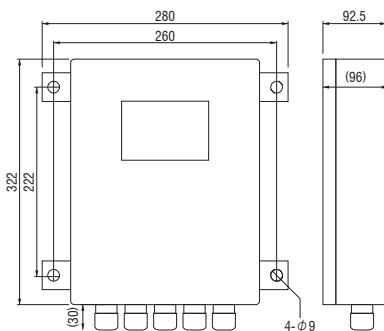


■ TS40T-5

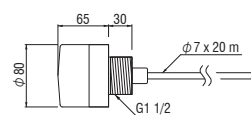


■ HL2000

■ Main unit

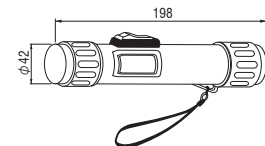


■ Sensor

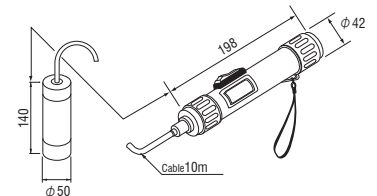


■ PS-7/7FL

■ Main unit (PS-7)



■ Main unit (PS-7FL)



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Ultrasonic flow measurement

Ultrasonic flowmeter

HLF800 Series



Converter HLF810

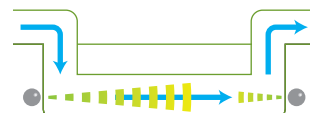


Converter HLF820



Principle

Propagation time difference measurement method: Ultrasonic waves are used to measure the fluid velocity, which is then used to calculate the flow rate. Sensors installed upstream and downstream transmit ultrasonic waves to each other in the forward and reverse directions of flow. The fluid velocity is determined based on the differences between the arrival times of the ultrasonic waves at each sensor, and this velocity is used to calculate the flow rate.

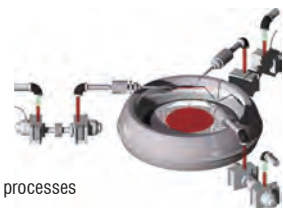


Advantages

- No structures are placed in the piping, so the flow rate can be measured with minimal pressure loss.
- A wide range of flow rates can be measured, from high to low.

Equipped with a digital signal processor that enables high-precision, stable flow measurement

- Stable flow measurement is achieved with our unique signal arithmetic processing method performed by a digital signal processor (DSP)
- The ability to use two channels saves space and improves cost effectiveness
- Wiring work is simplified with detachable sensors and cables
- With no moving parts in the flow path, there is minimal pressure loss
- The use of NEW PFA on all liquid contact surfaces provides high corrosion resistance, which is suitable for measuring the flow rates of DIW or chemical liquids
- Complies with EMC (EN 61326) and RoHS directives
- Able to select from models with a display (HLF820) or without a display (HLF810)



Main applications and usage examples

- Measuring the flow of deionized water or ultrapure water for semiconductor manufacturing processes
- Managing the flow of highly corrosive chemical liquids used in chemical treatment processes
- Measuring the flow of slurry liquids for chemical mechanical polishing (CMP) processes



Converter

Model No.	HLF810	HLF820
Measurement method	Measuring propagation time difference between sending and receiving ultrasonic wave	
Accuracy	± 1% F.S. (DIW at 20°C)	
Data update cycle	0.01 sec	
Power source	Voltage 24 V DC ± 10% (21.6 to 26.4 V)	
Power consumption	4 W	5 W
Display	—	Vacuum fluorescent display (VFD), 16 characters x 2 lines
Digital input	Open collector input or non-voltage contact input, 2 points Selectable from integrated value reset or zero-point adjustment	
Output	4 to 20 mA current output	2 points Resolution: 12 bits (Max. load resistance 600 Ω)
	Digital output	Open collector output (Max. 35 V/0.1 A), 2 points Selectable from comparison, integrated pulse, instantaneous frequency, or error output
Interface	RS485 (MODBUS® protocol, RTU mode) Up to 32 converters can be concatenated (Address setting: 1 to 32) Baud rate: 9600, 19200, 38400, 57600bps	
Case material	ABS	
Ambient operating temperature	0 to 50°C (No condensation)	
Weight	130 g	230 g
Installation method	DIN rail	Panel mount

* MODBUS is the registered trademark of Schneider Electric USA, Inc.

Sensor

Model No.	HLFS01-04	HLFS01-06	HLFS01-08	HLFS01-12	HLFS01-16
Measurement target	Ultrapure water/Deionized water/Chemical liquids				
Flow rate measurement range	0 to 2 L/min	0 to 6 L/min	0 to 20 L/min	0 to 50 L/min	0 to 80 L/min
Connection tube size	1/4"	3/8"	1/2"	3/4"	1"
Max. operating pressure	0.5 MPa (0 to 90°C)/0.2 MPa (90 to 200°C)				*1
Fluid temperature	Standard type		0 to 90°C		—
	High-temperature type		0 to 200°C		
Ambient operating temperature	0 to 180°C		0 to 80°C		
Liquid contact surface material	NEW PFA				
Weight	90 g	110 g	130 g	160 g	212 g
Pressure loss factor	3.7863	0.6937	0.1146	0.0138	0.0033

*1 0.5 MPa (0 to 60°C) / 0.2 MPa (60 to 200°C)

Pressure loss

$$\Delta P = A Q^2$$

ΔP: Pressure loss [kPa]

A: Pressure loss factor (DIW at 20°C)

Q: Flow rate [L/min]

Connection cable between converter and sensor

Model No.	HLFS01 cable 5 m	HLFS01 cable 7 m
Material	ETFE	
Length	5 m	7 m
Weight	150 g	210 g

Type name and specifications

HLFS01 - ○ ○ △ □

Applicable temperature

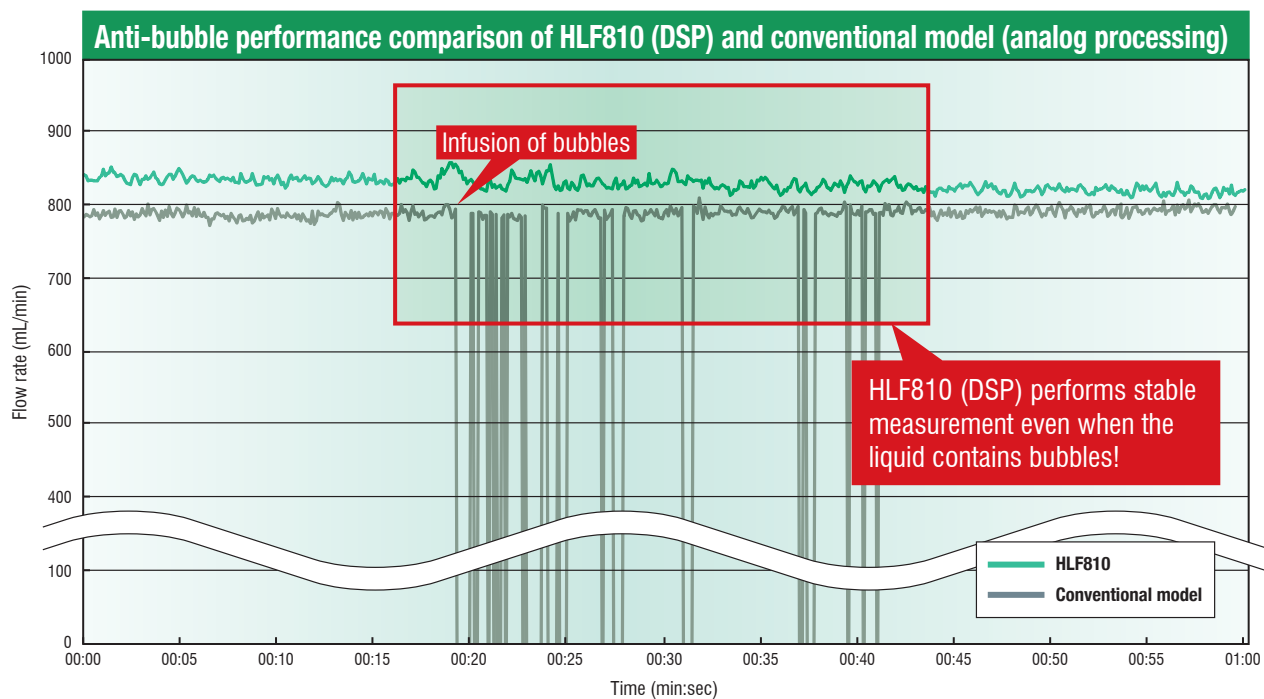
None: Standard, 0 to 90°C
K: High-temperature, 0 to 200°C (or up to 180°C for 04 type)

Shape U: U-shape Z: Z-shape

04: 1/4"
06: 3/8"
08: 1/2"
12: 3/4"
16: 1"

Connection tube size

* See table above for flow rates



* The data in the graph has been offset to improve readability.

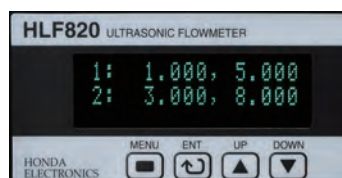
Two different sizes of sensors can be connected to the same converter

The ability to connect two sensors to one converter saves space and improves cost performance, by enabling flow rates to be measured at multiple locations. The sensors can be used to measure the flow rates of different fluids, or different sizes of sensors can be connected.



Equipped with VFD display

The vacuum fluorescent display (VFD) provides excellent visibility. (HLF820 only)



Supports measurement of high-temperature chemical liquids

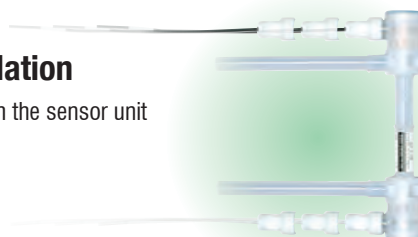
Suitable for use in recent applications that incorporate a diversity of chemicals at a wide range of temperatures. All liquid contact surfaces are made of NEW PFA, which provides excellent chemical resistance. Our self-developed transducers enable flow measurement at high temperatures of up to 200°C (K type). *The maximum temperature for the Q4 size model is 180°C.



Detachable cables enable easy installation

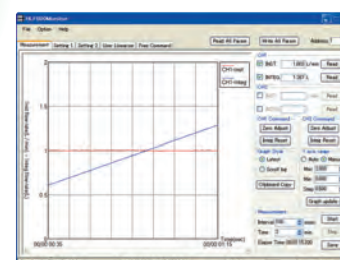
Setup is simplified with cables that can be detached from the sensor unit before installation, and then reattached later.

Cable lengths of 5 m or 7 m can be selected.



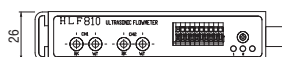
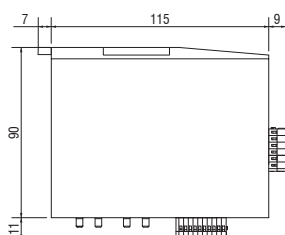
RS-485 enables remote monitoring via computer

With the standard-equipped RS-485 communication function, the dedicated control software (HLF800 Monitor) can be used on a computer to set the parameters and monitor the flow rate data remotely.

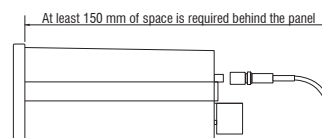
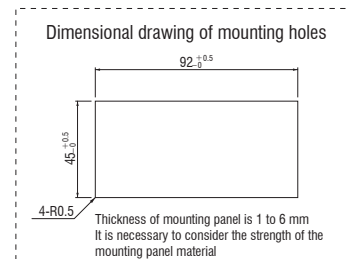
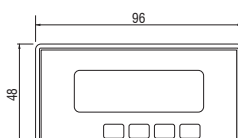
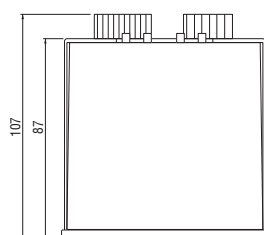


HLF810/820

Converter (HLF810)

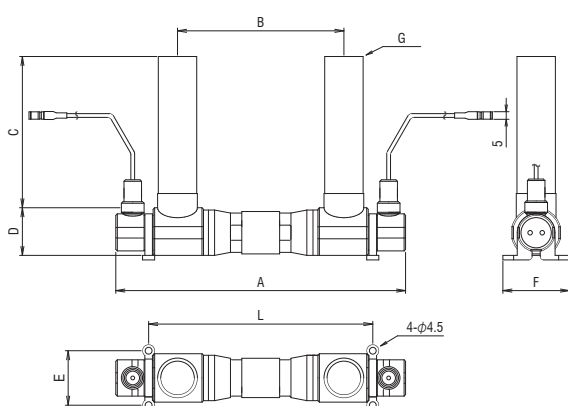
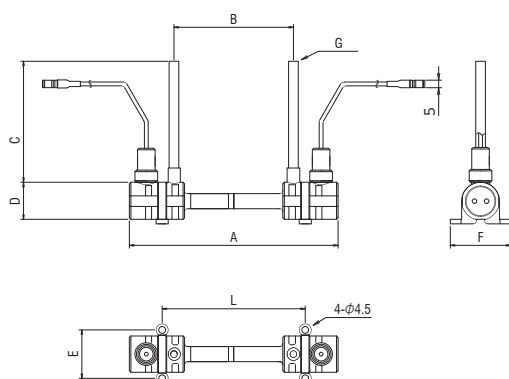


Converter (HLF820)



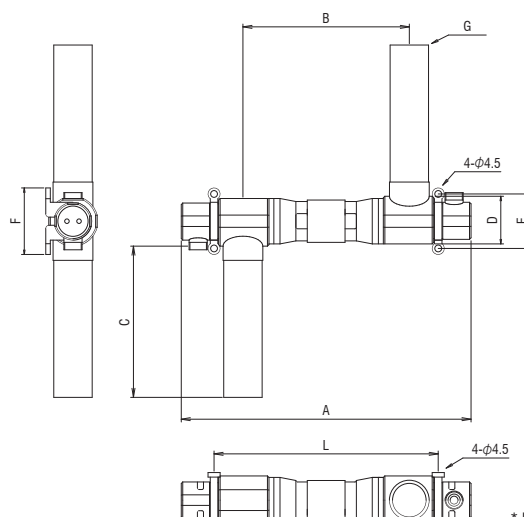
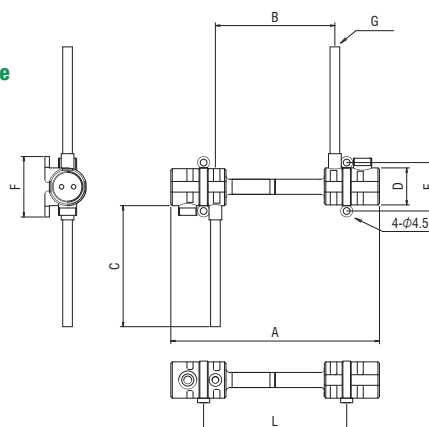
Sensor (HLFS01)

U-shape



* HLFS01-16 only

Z-shape



* HLFS01-16 only

Model No.	A	B	C	D	E	F	G	L
HLFS01-04	138	80	80	24.5	32	40	1/4"	94.6
HLFS01-06	145	80	100	24.5	32	40	3/8"	101.6
HLFS01-08	178	110	100	24.5	32	40	1/2"	134.6
HLFS01-12	184	110	100	24.5	32	40	3/4"	140.6
HLFS01-16	192	110	100	31.5	36	44	1"	148.2

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(Unit: mm)

* Actual product dimensions may vary slightly from those provided here.