

TIME DELTA SERIES

ULTRASONIC FLOWMETER <TIME DELTA-C>

DATA SHEET

FSV, FLS/FLW/FLD

This flowmeter is a clamp-on type ultrasonic flow meter based on transit-time measuring method. Making full use of the latest electronics and digital signal processing technologies, we realized a compact and light-weight design, and improved the accuracy and easiness to use while keeping with anti-bubble performance. The communication function (MODBUS: Option) is also applicable.

FEATURES

1. Compact and light-weight

Thanks to the adoption of the latest electronics and digital signal processing technologies, the flow transmitter size and mass are 1/3 of our traditional instrument.

2. Full variety of sensors

The flowmeter can be used with various types of sensors applicable for wide range of pipe size ($\phi 13$ to $\phi 6000$ mm) and fluid temperature (-40 to +200°C).

3. High accuracy

The flowmeter is designed for high accuracy (better than $\pm 1.0\%$ of rate) by dynamic correction of fully-developed flow profile. Reynolds Number is calculated and a meter factor (K) is automatically applied for best accuracy at all flow velocities. Further, the adoption of new sound velocity measurement system permits measurements of fluids of unknown sound velocity. Moreover, affection from fluid temperature and pressure is negligible (Auto-Temp./Press. compensation).

4. Excellent resistance against aerated flow

Fuji's unique ABM feature improves measurement reliability for different flow like slurries, sludge, raw sewage and bubble-contained flow (acceptable up to air bubble of 12% volume at 1m/s velocity).

5. Quick response

With the use of high-speed micro-processor suited for digital signal processing, the fast response time is realized.

6. Multi-lingual

The following languages are supported for display: Japanese (Katakana), English, German French, and Spanish.

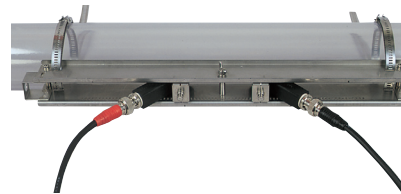
7. Excellent performance and easy operation

LCD and function keys are allowing easy configuration and trouble shooting.

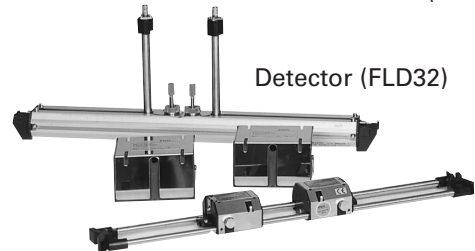
- LCD with back light
- Easy mounting of sensor
- Trouble shooting
- Easy operation with keypad on outer surface of flow transmitter housing.



Flow Transmitter (FSV)



Detector
(FLSE12)
(FLSE22)



Detector (FLD32)

Detector (FLW)

SPECIFICATIONS

Operational specifications

System configuration:

Single-path system of a flow transmitter (Model FSV) and a detector (Model FLS/FLW/FLD)

Applicable fluid:

Homogenous liquid where the ultrasonic signal can be transmitted
 Bubble quantity: 0 to 12vol% (for pipe size 50A, water, velocity 1m/s)
 Fluid turbidity: 10000mg/L max.
 Type of flow: Fully-developed turbulent or laminar flow in a full-filled pipe

Flow velocity range:

0 to $\pm 0.3 \dots \pm 32$ m/s

Power supply:

100 to 240V AC +10%/-15%, 50/60Hz;
 or 20 to 30V DC

Signal cable (between detector and converter):

Coaxial cable (5m standard, 300m (60m for popular detector (FLS)) max.)
 Heat resistance: 80°C

Installation environment:

Non-explosive area without direct sunlight, corrosive gas and heat radiation.

Ambient temperature:

Flow transmitter: -20 to +55°C

Detector: -20 to +80°C

Ambient humidity:

95% RH max.

Grounding: Class D (100 Ω)

Arrester: Provided as standard at output and power supply

Applicable piping and fluid temperature:

Detector	Pipe size (inner diameter)	Applicable pipe material	Mounting method	Fluid temperature range (Note 3)
Popular type	FLSE12	ø25 to ø100 mm	V method	-20 to 100°C Heat shock resistance 140°C, 30min
		ø50 to ø100 mm		
	FLSE22	ø50 to ø225 mm		
		ø50 to ø225 mm		
Common type	FLD22	ø13 to ø100 mm	V method	-40 to 100°C
	FLW1	ø50 to ø400 mm	V or Z method	-40 to 80°C
	FLW4	ø200 to ø1200 mm		
	FLW5	ø200 to ø6000 mm		
	FLD32	ø50 to ø400 mm		

Note 1: If the pipe material is PP or PVDF, select FLW11, FLW41 or FLW5.
 Note that the wall thickness is 15mm or less for PP, and 9mm or less for PVDF.
 Note 2: For cast iron pipe, lining pipe, old steel pipe or others through which the ultrasonic signal could not be transmitted easily, select FLW11, FLW41 or FLW50.
 Lining material: Tar epoxy, mortar, rubber, etc.
 * In case the lining is not glued to a pipe, the measurement may be impossible.
 Straight pipe length: Typically 10D for upstream and 5D for downstream.
 (D: Pipe inner diameter)
 Refer to conditions on straight pipe for details
 (Japan Electric Measuring Instruments Manufacturers' Association Standard JEMIS-032).

Note 3: If silicone-free grease is used as acoustic coupler, the fluid temperature range is 0 to 60°C regardless of the detector.

Performance specifications

Rated accuracy:

Detector	Pipe size (diameter)	Applicable pipe material	Flow velocity	Accuracy	
Popular type	FLSE12	Plastic	2 to 32m/s	2.0% of rate	
			0 to 2m/s	0.04m/s	
	ø50 to ø100 mm	Metal pipe	2 to 32m/s	1.0% of rate	
			0 to 2m/s	0.02m/s	
	FLSE22	Plastic	2 to 32m/s	1.0% of rate	
			0 to 2m/s	0.02m/s	
ø50 to ø225 mm	Metal pipe	2 to 32m/s	2.0% of rate		
		0 to 2m/s	0.04m/s		
Common type	FLD22	Plastic, metal pipe	2 to 32m/s	2.5% of rate	
			0 to 2m/s	0.05m/s	
	ø50 to ø100 mm		2 to 32m/s	1.5% of rate	
			0 to 2m/s	0.03m/s	
	FLW12		ø50 to below ø300	2 to 32m/s	1.0% of rate
	FLD32		ø300 to ø6000 mm	0 to 2m/s	0.02m/s
FLW51	1 to 32m/s	1.0% of rate			
FLW11	ø50 to below ø300	0 to 1m/s	0.01m/s		
		2 to 32m/s	1.5% of rate		
	ø300 to ø6000 mm	0 to 2m/s	0.03m/s		
		1 to 32m/s	1.5% of rate		
FLW41	ø300 to ø6000 mm	0 to 1m/s	0.015m/s		
FLW50		0 to 1m/s	0.015m/s		

Response time: 0.5s (standard mode)
 0.2s as selected (quick response mode)

Power consumption: 15VA max. (AC power supply)
 6W max. (DC power supply)

Functional specifications

Analog signal: 4 to 20mA DC (1 point)
 Load resistance: 1 kΩ max.

Digital output: Forward total, reverse total, alarm, acting range, flow switch, total switch assignable arbitrarily
 (1) Mechanical relay contact (isolated, socket provided, arrester incorporated)
 • Output: 1 point
 • Normal: Open/Close selectable
 • Contact capacity: 240V AC, 30V DC, 1A
 • Output frequency: 1P/s max. (pulse width: 50, 100, 200ms)
 (2) Transistor contact (isolated, open collector, arrester incorporated)
 • Outputs: 2 points
 • Normal: ON/OFF selectable
 • Contact capacity: 30V DC, 0.1A
 • Output frequency: 1000P/s max. (pulse width: 5, 10, 50, 100, 200ms)

Digital input: 1 point (no-voltage contact) (option)/
 Set zero, Preset total assignable

Serial communication (option): RS-232C equivalent or RS-485, isolated, arrester incorporated
 Connectable quantity: 1 unit (RS-232C)/up to 31 units (RS-485: MODBUS)
 Baud rate: 9600, 19200, 38400bps
 Parity: None/Odd/Even selectable
 Stop bits: 1 or 2 bits selectable

Cable length: 15m max. (RS-232C)/1km max. (RS-485)

Data: Flow velocity, flow rate, forward total, reverse total, status, etc.

Display device: 2-color LED (Normal: green, Extraordinary: red)
LCD with 2 lines of 16 characters and back light

Indication language: Japanese (Katakana)/English/French/German/Spanish (changeable)

Flow velocity/flow rate indication:
Instantaneous flow velocity, instantaneous flow rate indication (minus indication for reverse flow)
Numerals: 8 digits (decimal point is counted as 1 digit)
Unit: Metric/Inch system selectable

	Metric system	Inch system
Velocity	m/s	ft/s
Flow rate	L/s, L/min, L/h, L/d, kL/d, ML/d, m ³ /s, m ³ /min, m ³ /d, km ³ /d, Mm ³ /d, BBL/s, BBL/min, BBL/h, BBL/d, kBBL/d, MBBL/d	gal/s, gal/min, gal/h, gal/d, kgal/d, Mgal/d, ft ³ /s, ft ³ /min, ft ³ /d, Kft ³ /d, Mft ³ /d, BBL/s, BBL/min, BBL/h, BBL/d, kBBL/d, MBBL/d

Note: The "gal" means USgal.

Total indication: Forward or reverse total value indication (negative indication for reverse direction)
Numerals: 8 digits (decimal point is counted as 1 digit)
Unit: Metric/Inch system selectable

	Metric system	Inch system
Total	mL, L, m ³ , km ³ , Mm ³ , mBBL, BBL, KBBL	gal, kgal, ft ³ , kft ³ , Mft ³ , mBBL, BBL, kBBL, ACRE-ft

Configuration: Fully configurable from the 4-key pad (ESC, △, ▽, ENT) on the surface of flow transmitter's housing case by menu-driven software

Zero adjustment: Set zero/Clear available

External zero adjustment:

Set zero available upon digital input setting

Damping: 0 to 100s (every 0.1s) for analog output and flow velocity/flow rate indication

Low flow rate cutoff:

0 to 5m/s in terms of flow velocity

Alarm: Digital output available for Hardware fault or Process fault

Burnout: Analog output: Hold/Overscale/Under-scale/Zero selectable
Flow rate total: Hold/Count selectable
Burnout timer: 0 to 100s (every 1s)

Bi-directional range:

Forward and reverse ranges configurable independently.

Hysteresis: 0 to 10% of working range
Working range applicable to digital output

Auto-2 range: 2 forward ranges configurable independently

Hysteresis: 0 to 10% of working range
Working range applicable to digital output

Flow switch: Lower limit, upper limit configurable independently

Digital output available for status at actuated point

Total switch: Forward total switching point configurable

Digital output available when actuated

External total preset:

Preset total settable upon contact input setting

Physical specifications

Type of enclosure:

Flow transmitter: IP66

Detector:

FLS (popular type):

IP65 (When waterproof BNC connector is provided)

FLW (common type):

IP67 (When the terminal block is filled with silicon rubber after wiring)

FLW (submersible type): IP68

FLD (small diameter and high temperature type): IP52

Mounting method:

Flow transmitter: Mounted on wall or by 2B pipe

Detector: Clamped on pipe surface

Acoustic coupler:

Silicone rubber, silicone grease or silicone-free grease

Note: The acoustic coupler is a medium that eliminates a gap between detector and pipe

Type of acoustic coupler:

Type	Silicone rubber (KE-348W)	Silicone grease (G40M)	Silicone-free grease (HIGH Z)	Grease for high temperature (KS62M)
Fluid temperature	-40 to +100°C	-40 to +100°C	0 to +60°C	-30 to +250°C
Teflon piping	×	○	○	○

In case of Teflon piping, use grease.

Procure silicone grease (G40M), if necessary, as an optional accessory.

Material:

Flow transmitter: Aluminum alloy

Detector:

Detector	Sensor housing	Sensor cover	Guide rail
FLSE1	PBT	-	SUS304
FLSE2	PBT	-	SUS304
FLD22	PBT	-	Aluminum alloy + plastic
FLW1	PBT	SUS304	SUS304 + plastic
FLW4	PBT	SUS304	-
FLW5			
FLD32	SUS304	-	SUS304 + aluminum alloy

- Signal cable:** FLY3 (applicable detector: FLS)
- Structure: Heat-resisting high-frequency coaxial cable (3D2V)
 - Sheath: Flame-resisting PVC
 - Outer diameter: ϕ 5mm
 - Termination: M3 amp terminal (flow transmitter side) and BNC connector (sensor side)
- FLY8, FLY9 (applicable detector: FLW, FLD)
- Structure: High frequency coaxial cable (double shield)
 - Sheath: Black flame-resisting PVC
 - Outer diameter: ϕ 7.5mm
 - Termination: M3 amp terminal (flow transmitter side) and M4 amp terminal. Note, however, that the detector side of FLD22 and FLD32 is provided with BNC connector (FLY9).
 - Mass: Approx. 90g/m
- Dimensions:** Flow transmitter: H170xW142xD70mm
- Detector: H50xW228xD34mm (FLSE1)
H50xW348xD34mm (FLSE2)
H90xW300xD53mm (FLD22)
H40xW500xD80mm (FLW1)
H40xW72xD60mm (FLW4)
H62xW104xD93mm (FLW5)
H205xW530xD52mm (FLD32)
- Mass:** Flow transmitter: 1.5kg
- Detector: 0.3kg (FLSE1)
0.4kg (FLSE2)
0.6kg (FLD22)
1.0kg (FLW1)
0.4kg (FLW4)
1.4kg (FLW5)
1.6kg (FLD32)

■ Loader software

Provided as standard

- Compatible model is PC/AT compatible instrument.
- Operation is undefined for PC98 series (NEC).
- Main functions: Software for Main unit parameter setting/change on PC
- OS: Windows 2000/XP
- Memory requirement: 125MB min.
- Disk unit: CD-ROM drive compatible with Windows 2000/XP
- Hard disk capacity: Minimum vacant capacity of 52MB or more

Note: Loader cable (Model ZP*FSVTK4J1236) is additionally necessary.

Note: USB-RS232C converter

For PC that does not support RS-232C serial interface, a converter is necessary for connecting the PC and main unit.

USB-RS232C converter should be combined with the above loader cable.

<Recommendation>

USB-CVRS9 (manufactured by Sanwa Supply)

CODE SYMBOL

<Flow transmitter>

1	2	3	4	5	6	7	8	9	10	11	12	13	14	Description
F	S	V												(Destination) (4th digit) Standard (Japanese) Standard (English)
														(Communication) (5th digit) None RS232C+DI RS485+DI
														(Use) (6th digit) Single measuring path
														(Power supply) (7th digit) AC100 to 240V 50/60Hz DC20 to 30V
														(Case structure) (9th digit) Standard (IP66)
														(Wire connection port) (10th digit) Weatherproof gland provided [G1/2 and G3/8 (internal threads)]
														(Combination with explosion-proof detector) (11th digit) None
														(Parameter setting) (12th digit) None Setting provided Setting provided + tag Tag
														(Mounting method) (13th digit) Pipe mount Wall mount
														(Area) (14th digit) N America E Europe, Middle East, Africa A Asia

<Detector, small diameter/high temperature type>

1	2	3	4	5	6	7	8	9	Description
F	L	D							Type (4th, 5th and 6th digits) Small diameter sensor (ø13 to ø100), V method
									High-temperature sensor *1 (ø50 to ø400), V or Z method
									Belt, acoustic coupler (7th digit) For fixed type
									Coaxial cable (9th digit) None

*1: For turbid fluid or old pipe, cast iron pipe, mortar lining pipe or others through which the ultrasonic signal could not be transmitted easily, use an optional guide rail (TK4C6164C1), and carry out mounting by Z method.

Applicable diameter range
V method: ø50 to ø250
Z method: ø150 to ø400

*4: As standard acoustic coupler, silicone rubber (KE-348W) is provided for small diameter sensor, or grease for high temperature (KS62M) for high-temperature sensor.

<Detector, common type>

1	2	3	4	5	6	7	8	9	10	11	Description
F	L	W									Type (4th, 5th and 6th digits) Small sensor (ø50 to ø400) } V method Small sensor*2 (ø50 to ø400) } Middle sensor (ø200 to ø1200) } V or Z method Large sensor (ø200 to ø6000) } Large sensor*2 (ø200 to ø6000) }
											Optional specification (7th digit) None Tag indication provided
											Mounting method (11th digit) Y Standard 2 Z method mounting (for small sensor)

*2: For old pipe, or cast iron pipe, mortar lining pipe or others through which the ultrasonic signal could not be transmitted easily, select FLW11 or FLW50.

*3: Procure a signal cable of Model FLY.

*5: As standard acoustic coupler, silicone rubber (KE-348W) is provided.

<Detector, submersible type>

1	2	3	4	5	6	7	8	9	10	11	Description
F	L	W									Type (4th, 5th and 6th digits) Small sensor, submersible type (ø50 to ø250) } V or Z method Small sensor, submersible type *2 (ø50 to ø250) } Middle sensor, submersible type (ø200 to ø1200) } Large sensor, submersible type (ø200 to ø6000) } V or Z method Large sensor, submersible type *2 (ø200 to ø6000) }
											Optional specification (7th digit) None Tag indication provided
											Signal cable (9th and 10th digits) B Y 10 m C Y 20 D Y 30 E Y 40 F Y 50 G Y 60 H Y 70 J Y 80 K Y 90 L Y 100 M Y 110 N Y 120 P Y 130 Q Y 140 R Y 150 Z Y Others
											Mounting method (11th digit) Y Standard 2 Z method mounting (for small sensor) ø50 to ø400

*2: For old pipe, or cast iron pipe, mortar lining pipe or others through which the ultrasonic signal could not be transmitted easily, select FLW11 or FLW50.

*3: Procure a signal cable of Model FLY.

*5: As standard acoustic coupler, silicone rubber (KE-348W) is provided.

<Detector, popular type>

1	2	3	4	5	6	7	8	9	10	Description
F	L	S	E							Version (4th digit) Standard
										Type (5th and 6th digits) Small diameter detector (ø25 to ø100mm) } V method Small detector (ø50 to ø225mm) }
										Acoustic coupler (7th digit) (Note) None Silicone rubber Silicone-free grease
										Optional specification (10th digit) Y None B Tag

Note: Normally select silicone rubber as acoustic coupler. Silicone rubber in tube (100g) is furnished. If you place an order for several units, 1 tube may suffice for every 5 units. Select silicone-free grease for semiconductor manufacturing equipment or the like that is vulnerable to silicone. The silicone-free grease is water-soluble and, therefore, cannot be used in environment exposed to water or on piping subjected to a condensation. Since the grease does not set, a periodic maintenance (cleaning, refilling every about 6 months at normal temperature) is necessary.

CODE SYMBOL

<Signal cable>

• For detector FLS

1	2	3	4	5	6	7	8	Description
F	L	Y					1	Type of sensor (4th digit code) (for FLS)
			3					Cable length (5, 6 and 7th digit)
			0	0	5			5 m
			0	1	0			10 m
			0	1	5			15 m
			0	2	0			20 m
			0	2	5			25 m
			0	3	0			30 m
			0	4	0			40 m
			0	5	0			50 m
			0	6	0			60 m
			Z	Z	Z			Others (contact us)

• For detector FLW and FLD

1	2	3	4	5	6	7	8	Description
F	L	Y					1	Type of sensor (4th digit)
			8					Small and large sensor (for FLW)
			9					Small dia and high temp sensor (for FLD)
			0	0	5			Cable length (5,6 and 7th digit)
			0	1	0			5 m
			0	1	5			10 m
			0	1	5			15 m
			0	2	0			20 m
			0	2	5			25 m
			0	3	0			30 m
			0	3	5			35 m
			0	4	0			40 m
			0	4	5			45 m
			0	5	0			50 m
			0	5	5			55 m
			0	6	0			60 m
			0	6	5			65 m
			0	7	0			70 m
			0	7	5			75 m
			0	8	0			80 m
			0	8	5			85 m
			0	9	0			90 m
			0	9	5			95 m
			1	0	0			100 m
			1	1	0			110 m
			1	2	0			120 m
			1	3	0			130 m
			1	4	0			140 m
			1	5	0			150 m
			Z	Z	Z			Others (contact us)

Conditions on straight pipe

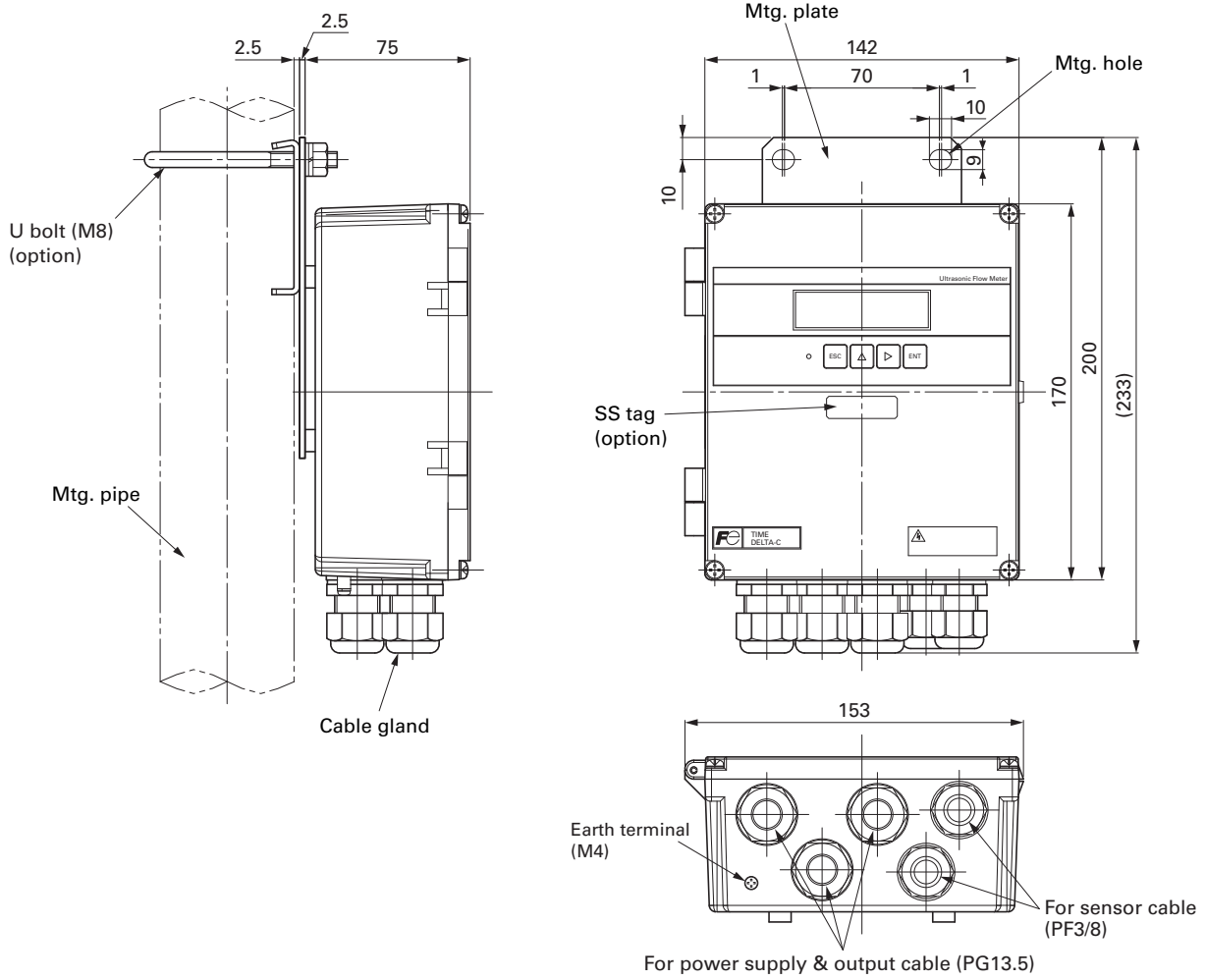
Note: Must be procured unless the sensor is a submersible type.

(D : Inside diameter of pipe)

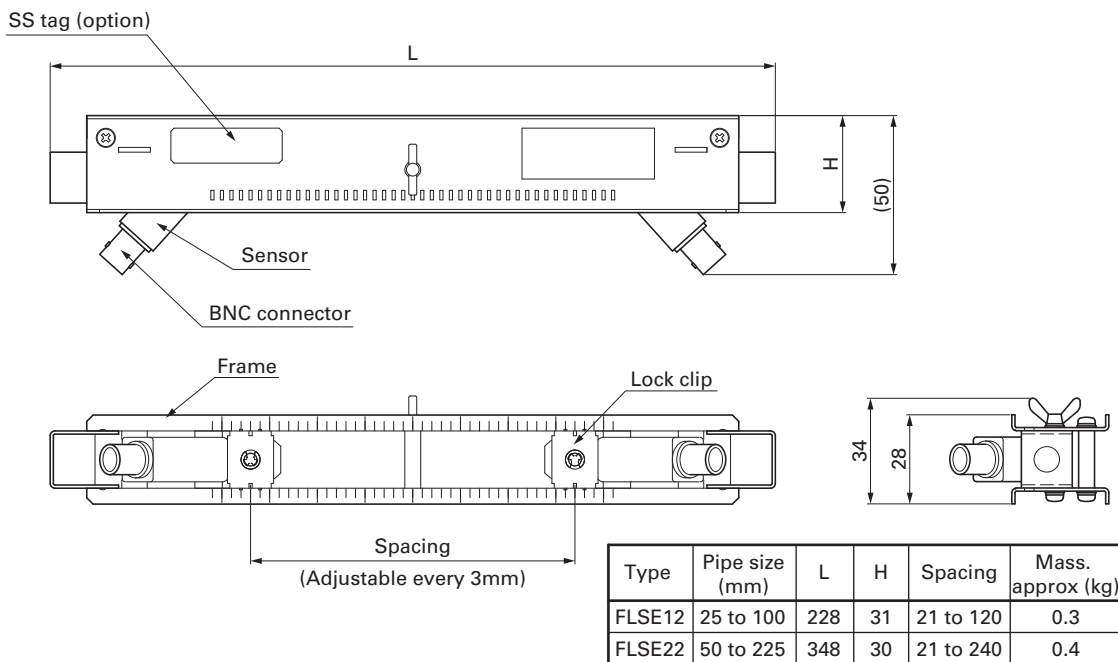
Classification	Upstream side	Downstream side
90 bend		
Tee		
Diffuser		
Reducer		
Various Valve		
Pump		

(Note) The source : JEMIS-032

OUTLINE DIAGRAM (Unit:mm)

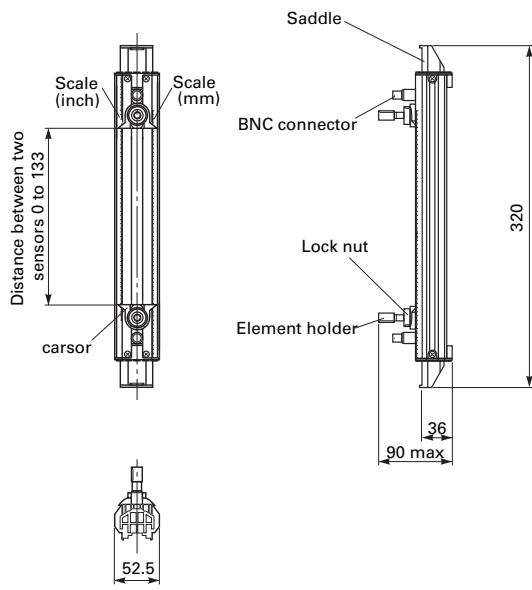


Flow transmitter : FSV

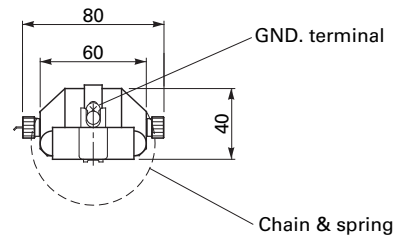
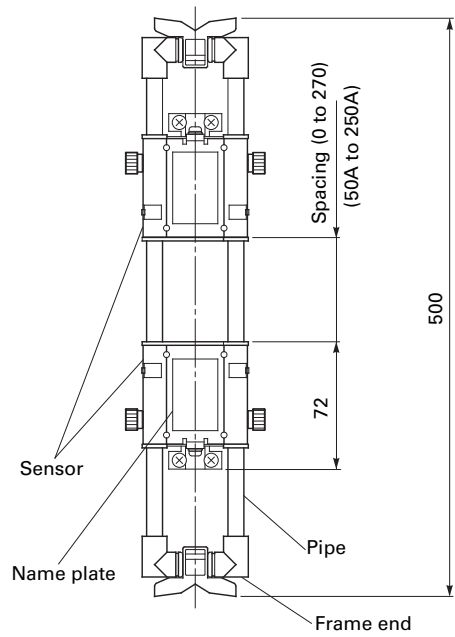


Detector (type : FLSE□2) (popular type)

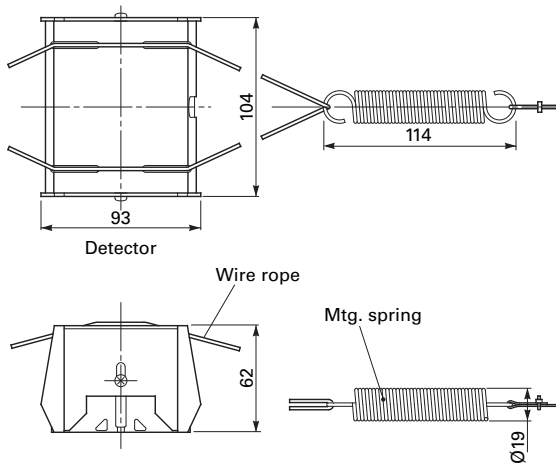
OUTLINE DIAGRAM (Unit:mm)



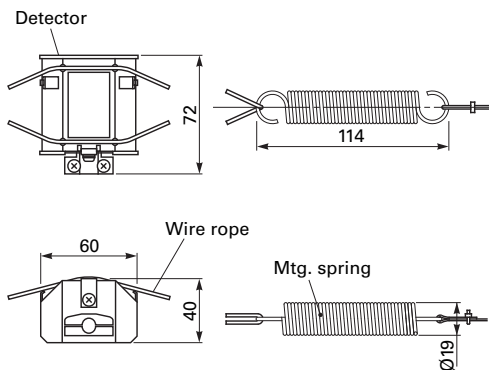
Detector FLD22 (Small diameter sensor)



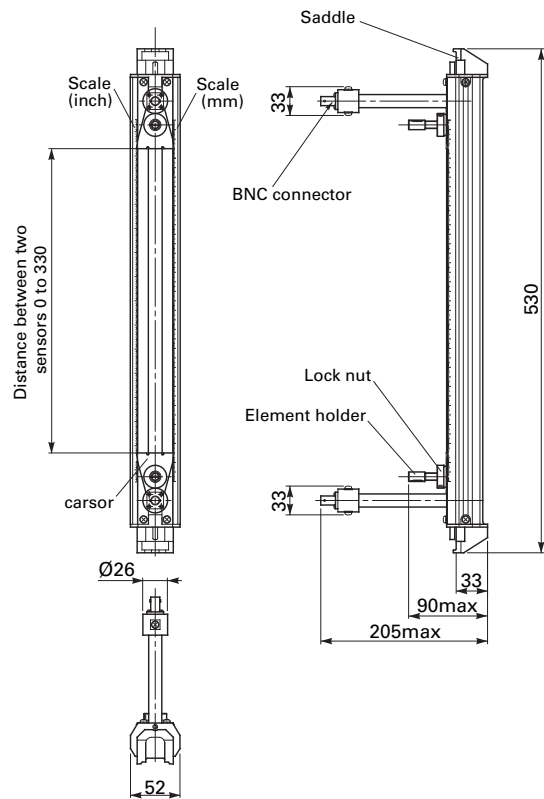
Detector FLW1 (Small sensor)



Detector FLW5 (Large sensor)



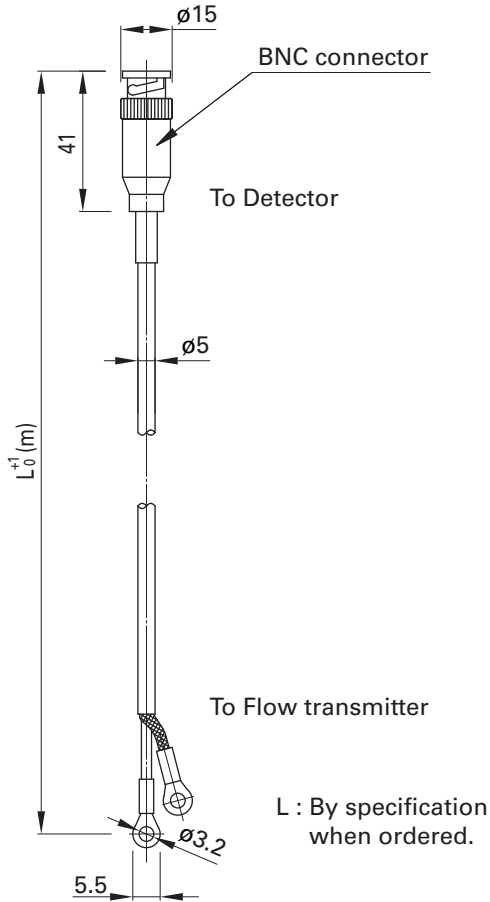
Detector FLW4 (Middle sensor)



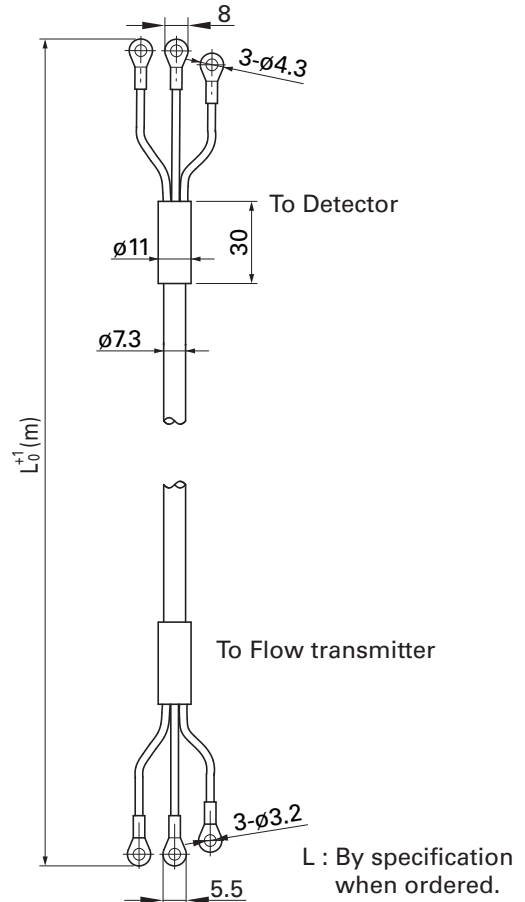
Detector FLD32 (High-temperature sensor)

OUTLINE DIAGRAM (Unit:mm)

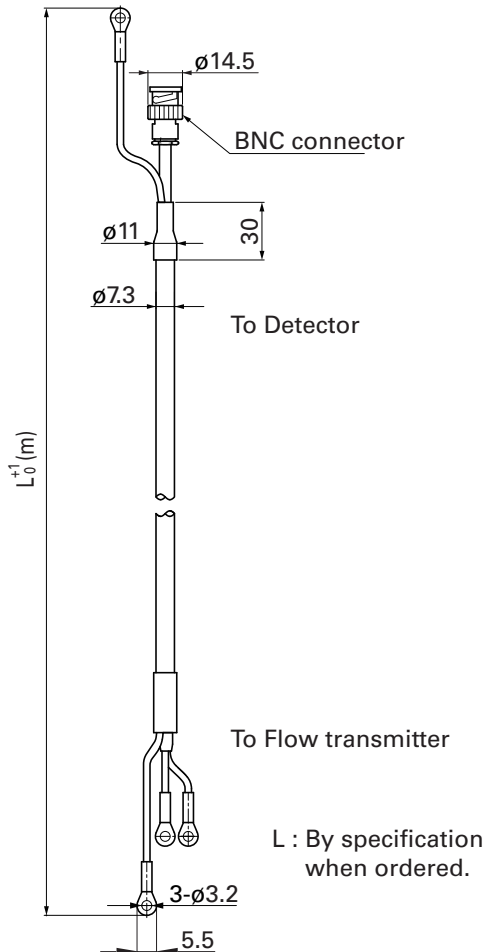
Signal cable : FLY3 (For FLS)



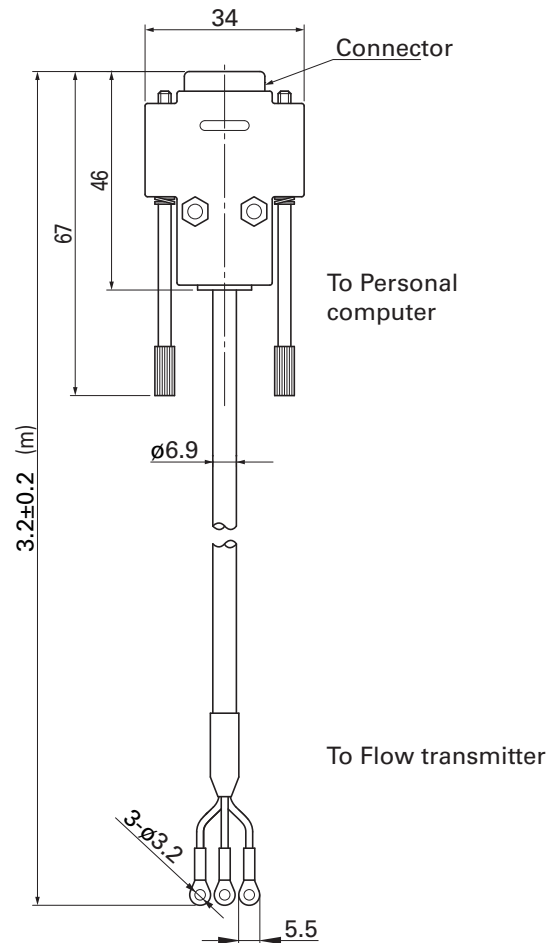
Signal cable : FLY8 (For FLW)



Signal cable : FLY9 (For FLD)

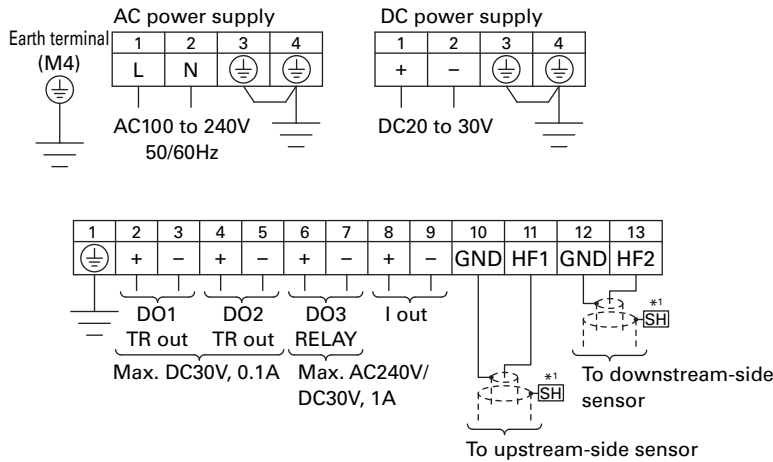


Loader cable : ZZP*FSVTK4J1236

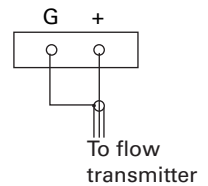


CONNECTION DIAGRAM

<Flow transmitter>



<Detector>



*1) Only for double shield coaxial cable (type FLY8, 9)

SCOPE OF DELIVERY

- Flow transmitter (provided with U-bolt and nuts for pipe mount)
- Detector (provided with mounting fixture and acoustic coupler)
- *The acoustic coupler is option for popular type detectors.
- CD-ROM (contains instruction manual, loader software)

ITEMS DESIGNATED ORDERING

1. Detector code symbols
2. Flow transmitter code symbols
3. Signal cable code symbols
4. For large sensor: Mounting pipe size
5. Tag No. as necessary
6. If parameter setting is specified, send back the attached parameter specification table duly filled.

OPTIONAL ACCESSORIES

	Name	Drawing No.
1	Guide vail for high-temperature sensor	ZZP*FSVTK4C6164C1
2	Loader cable	ZZP*FSVTK4J1236
3	Silicon grease	ZZP*FLD1-C100

<Parameter specification table>

Setting item		Initial value	Setting value	Setting item		Initial value	Setting value	
ID No		0000						
Language		English						
Measuring conditions	System unit	Metric		Total output	Total mode	Stop		
	Flow unit	m³/h			Total rate	0m³		
	Total unit	m³			Total preset	0m³		
	Outer diameter	60.00mm			Pulse width	50.0msec		
	Pipe material	PVC pipe			Burnout (total)	Hold		
	Wall thickness	4.00mm			Burnout timer	10sec		
	Lining material	Without lining		Output conditions	DO1 output type (Note 1)	Not used		
	Lining thickness	-			DO1 output actuation	ON when actuated		
	Kind of fluid	Water			DO2 output type	Not used		
	Viscosity	1.0038×10 ⁻⁶ m²/s			DO2 output actuation	ON when actuated		
	Sensor mount	V metod			DO3 output type	Not used		
	Sensor type	FLS_12			DO3 output actuation	ON when actuated		
	Transmission voltage	80Vpp			DI1 input type	Not used		
					DI1 input actuation	ON when actuated		
			Operation mode		Standard			
Output conditions	Damping	5.0sec		Communication	Communication mode	RS-232C		
	Cut off	0.150m³/h			Baud rate	9600bps		
	Display	1st line	Flow velocity (m/s)			Parity	Odd	
		1st line decimal point position	****.***			Stop bit	1 bit	
	Display	2nd line	Flow rate (m³/h)			Station No.	1	
		2nd line decimal point position	****.***					
	Analog output	Range type	Single range					
		Full scale 1	15.000m³/h					
		Full scale 2	0.000m³/h					
		Range HYS.	10.00%					
		Burnout (current)	Hold					
		Burnout timer	10sec					
		Output low limit	-20%					
		Output high limit	120%					
Rate limit	0.000m³/h							
Rate limit timer	0sec							

Note1: When total pulse output has been selected for DO1, DO2 or DO3 specify total pulse value and total pulse width so that conditions 1 and 2 shown below are satisfies.

$$\text{Condition 1 : } \frac{\text{Flow span-1} \cdot [\text{m}^3/\text{s}]}{\text{total pulse value} \cdot [\text{m}^3]} \leq \begin{cases} 1000 & [\text{In the case of DO1 and DO2}] \\ 1 & [\text{In the case of DO3}] \end{cases}$$

$$\text{Condition 2 : } \frac{\text{Flow span-1} \cdot [\text{m}^3/\text{s}]}{\text{total pulse value} \cdot [\text{m}^3]} \leq \frac{1000}{2 \times \text{total pulse width} \cdot [\text{ms}]}$$

* In the case of 2 ranges, perform calculations using either flow span-1 or flow span-2, whichever is greater.

⚠ Caution on Safety

*Before using this product, be sure to read its instruction manual in advance.

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