

## TIME DELTA SERIES

# ULTRASONIC FLOWMETER <M-Flow PW>

### DATA SHEET

FLR-3, FSS, FLY

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 the equipment with improved anti-bubble performance and high accuracy. The communication function (MODBUS: Option) is also applicable.

## FEATURES

### 1. 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).

### 2. High accuracy

Standard accuracy:  $\pm 1.5\%$  ( $\pm 1.0\%$  is also available)  
Adoption of new sound velocity measurement system permits measurements of fluids of unknown sound velocity. Further, affection from fluid temperature and pressure is negligible.

### 3. Compact and light-weight

Thanks to the adoption of the latest electronics, the flow transmitter is compact size and light weight.

### 4. Quick response

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

### 5. Multi-lingual

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

### 6. Excellent performance and easy operation

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

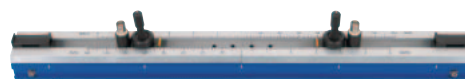
- LCD with back light
- Easy mounting of sensor
- Extendable rail type detector up to  $\Phi 50$  to  $\Phi 1200\text{mm}$
- Trouble shooting
- Easy operation with keypad on the front surface of the flow transmitter



Flow transmitter (FLR)



Detector (FSSA)



Detector (FSSC)

## SPECIFICATIONS

### Operational specifications

#### System configuration:

Single-path system of a flow transmitter (Model FLR) and a detector (Model FSS)

#### 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  $\pm 0.3 \dots \pm 10\text{m/s}$

**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, 60m max.)  
Heat resistance: 80°C

**Installation environment:**  
Non-explosive area without direct sunlight,  
corrosive gas and heat radiation.

**Ambient temperature:**  
Flow transmitter: -20 to +50°C  
Detector: -20 to +60°C

**Ambient humidity:**  
90%RH max.

**Grounding:** Class D (100 Ω or less)

**Arrester:** Provided as standard at power supply

**Applicable piping and fluid temperature:**

Detector Type	Pipe size (inner diameter)	Applicable pipe material	Mounting method	Fluid temperature range (Note 3)
FSSA	Φ25 to Φ50 mm	Plastic (PVC, etc.) (Note 1)	V method	-20 to +100°C Heat shock resistance 150°C, 30min
	Φ50 to Φ225 mm	Plastic (PVC, etc.) (Note 1) Metal pipe (SS, steel pipe, copper pipe, aluminum pipe, etc.) (Note 2)		
FSSC	Φ50 to Φ600 mm		Z method	-40 to 120°C
	Φ600 to Φ1200 mm			

Note 1: Limit of pipe wall thickness: 15mm or less for PP, 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 FSSC.

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:**

<Standard type>

Plastic pipe

Detector Type	Internal diameter	Velocity: 2m/s or higher	Velocity: Less than 2m/s
FSSA	Φ25 to Φ50mm	±2.5% of rating	±0.05m/s
FSSA, C	Φ50 to Φ1200mm	±1.5% of rating	±0.03m/s

Metal pipe

Detector Type	Internal diameter	Velocity: 2m/s or higher	Velocity: Less than 2m/s
FSSA, C	Φ50 to Φ1200mm	±2% of rating	±0.04m/s

<High accuracy type>

Plastic pipe and metal pipe

Detector Type	Internal diameter	Velocity: 2m/s or higher	Velocity: Less than 2m/s
FSSA	Φ50 to Φ225mm	±1.0% of rating	±0.02m/s
FSSC	Φ200 to Φ1200mm	±1.0% of rating	±0.02m/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: 600Ω max.

**Digital output:** Forward total, reverse total, alarm, acting range, flow switch, total switch assignable arbitrarily  
Transistor contact (isolated, open collector)  
• Outputs: 2 points  
• Normal: ON/OFF selectable  
• Contact capacity: 30V DC, 50mA  
• Output frequency: 1000P/s max. (pulse width: 5, 10, 50, 100, 200, 500, 1000ms)

**Serial communication (option):**

RS-485 (MODBUS), isolated  
Connectable quantity: 31 units  
Baud rate: 9600, 19200, 38400bps  
Parity: None/Odd/Even selectable  
Stop bits: 1 or 2 bits selectable  
Cable length: 1km max.  
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, m³/s, m³/min, m³/d, km³/d, Mm³/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, ft³/s, ft³/min, ft³/d, Kft³/d, Mft³/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, m³, km³, Mm³, mBBL, BBL, KBBL	gal, kgal, ft³, kft³, Mft³, mBBL, BBL, KBBL, ACRE-ft

**Configuration:** Fully configurable from the 4-key pad (ESC, △, ▽, ENT)

**Zero adjustment:** Set zero/Clear available

**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
- Backup of power failure:** backup by non-volatile memory

### Physical specifications

- Type of enclosure:**  
Flow transmitter: FLR: IP65  
Detector:  
FSSA, FSSC:  
IP65 (When waterproof BNC connector is provided)
- Mounting method:**  
Flow transmitter: Mounted on wall or by 2B pipe  
Detector: Clamped on pipe surface
- Acoustic coupler:**  
Silicone rubber 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-free grease (HIGH Z)
Fluid temperature	-40 to +150°C	0 to +60°C
Teflon piping	×	○

In case of Teflon piping, use grease.

- Material:** Flow transmitter: Plastic alloy  
Detector:

Detector Type	Sensor housing	Guide rail
FSSA	PBT	SUS304
FSSC	PBT	Aluminum alloy + plastic

- Signal cable:** Type: FLYA  
• Structure: Heat-resisting high-frequency coaxial cable (3D2V)  
• Sheath: Flame-resisting PVC  
• Outer diameter: Φ5mm  
• Termination: Bar terminal (flow transmitter side) and BNC connector (sensor side)  
• Mass: Approx. 45g/m
- Dimensions:** Flow transmitter:  
H140×W137×D68mm  
Detector: H50×W348×D34mm (FSSA)  
H88×W480×D53mm (FSSC)
- Mass:** Flow transmitter: 0.8kg  
Detector: 0.4kg (FSSA)  
1.0kg (FSSC)
- External terminal of flow transmitter:** plug terminal

### ■ PC 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 or Windows 7 (Home Premium, Professional)
- Memory requirement: 125MB min.
- Disk unit: CD-ROM drive compatible with Windows 2000/XP or Windows 7 (Home Premium, Professional)
- Hard disk capacity: Minimum vacant capacity of 52MB or more

Note: Optional communication board (specified at the 6<sup>th</sup> digit of code symbols).

Note: Communication converter

For the PC that supports RS-232C serial interface, RS-232C - RS-485 converter is needed for connecting the PC and main unit.

For the PC that does not support RS-232C serial interface, additionally, USB - RS232C converter is also needed.

<Recommendation>

[RS-232C - RS-485 converter]

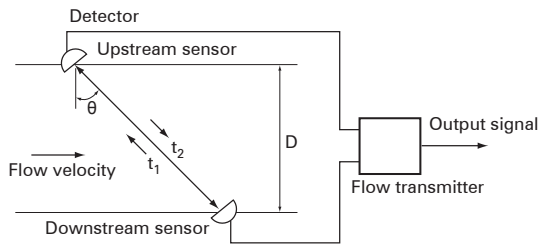
RC-770X(manufactured by SYSMEX RA)

[USB - RS-232C converter]

USB-CVRS9 (manufactured by SANWA SUPPLY)

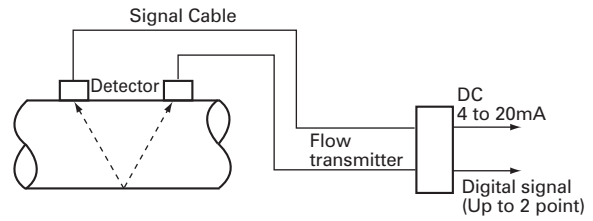
## MEASURING PRINCIPLE

With ultrasonic pulses propagated diagonally between the upstream and downstream sensors, flow rate is measured by detecting the time difference obtained by the flow of fluid.

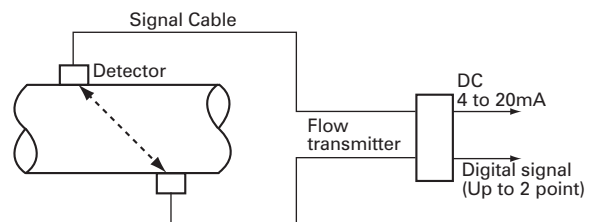


## CONFIGURATION DIAGRAM

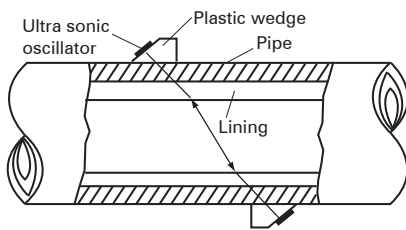
### (1) Single-path system (V method)



### (2) Single path system (Z method)



## MOUNTING OF DETECTOR



### Conditions on straight pipe

(D : Inside diameter of pipe)

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

(Note) The source : JEMIS-032

## CODE SYMBOL

### <Flow transmitter>

1	2	3	4	5	6	7	8	9	10	11	12	Description
F	L	R	E		Y	3	-	1				Type (4th digit) Standard for exports
			E									Power Supply (5th digit) 100 to 240Vac, 50/60Hz 20 to 30Vdc
			1									Communication and Synchronization (6th digit) None RS-485
			4									Case structure (9th digit) Jetproof type (IP65)
												Mounting bracket (10th digit) For 2B pipe mount For wall mount
												Parameter setting, tag plate (11th digit) Without With setting With setting (Tag plate) With Tag plate
												Measurement accuracy (12th digit) Standard High accuracy type (Pipe diameter $\phi$ 50mm or more)

### <Detector>

1	2	3	4	5	6	7	8	9	10	Description
F	S	S	A	1	A	1	-	Y		<Sensor type> (4th digits) $\phi$ 25 to $\phi$ 225mm (V method) -20 to 100°C
			A							<Guide rail> (5th digits) Provided
			1							<Mounting belt> (6th digits) None Stainless belt (1.0m X2)
										<Acoustic coupler> (7th digit) (Note 1) None Silicone rubber Silicone-free grease
										<Water-proof treatment> (9th digit) None
										<Tag plate> (10th digit) None Provided

Note 1: 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.

### Belt appearance for attachment of the detector.



### <Detector • Rail extension type>

1	2	3	4	5	6	7	8	9	10	Description
F	S	S	C	1		1	-	Y		<Sensor type> (4th digits) $\phi$ 50 to $\phi$ 1200mm -40 to 120°C
			C							<Guide rail> (5th digits) Standard (Rail extension type)
			1							<Mounting belt> (6th digits) *2 None Stainless steel belt $\leq \phi$ 300mm (1.5m x 2pcs) SS belt fasten with screws $\leq \phi$ 600mm (1m x 4pcs) Wire $\leq \phi$ 1500mm (5m x 2pcs)
										<Acoustic coupler> (7th digit) (Note 1) None Silicon rubber Silicon-free grease
										<Water-proof treatment> (9th digit) None
										<Tag plate> (10th digit) None Provided

Note2) Please refer to the table 1 for mounting belt to be selected at 6th digits.

[Table1] How to select at 6th digits.

Mounting method	$\leq \phi$ 300mm	$\leq \phi$ 600mm	$\leq \phi$ 1200mm
V method	A or C	C	D
Z method	C	D	D

### Explanation of the extendable rail type detector

#### ■Unextended condition



available pipe diameter up to  $\phi$ 50 to  $\phi$ 300mm

<V method>

#### ■Extended condition



available pipe diameter up to  $\phi$ 600mm

<V method>

#### ■Installation of the supplied rail end.



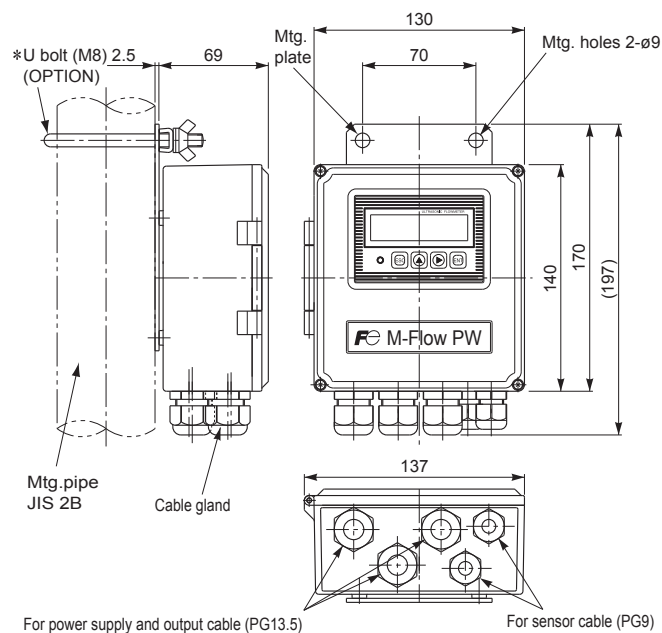
available pipe diameter up to  $\phi$ 1200mm

<Z method>

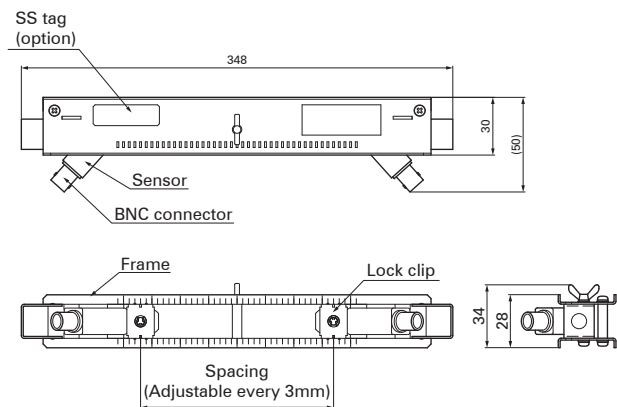
### <Signal cable>

1	2	3	4	5	6	7	8	Description
F	L	Y	A			1		Type of sensor (4th digit code) for FSSA, FSSC
			A					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)

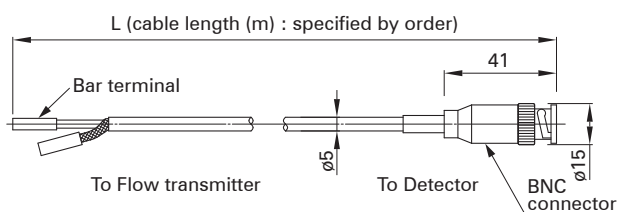
## OUTLINE DIAGRAM (Unit:mm)



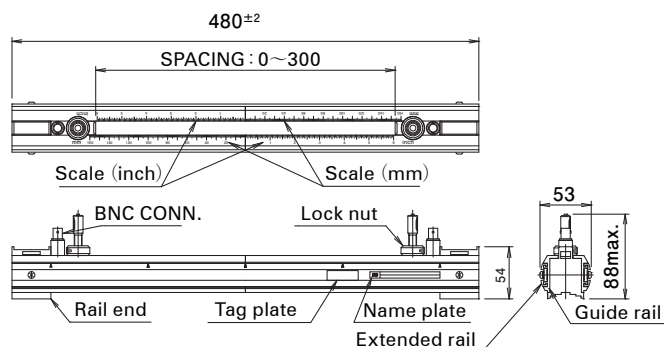
Flow transmitter : Type FLR



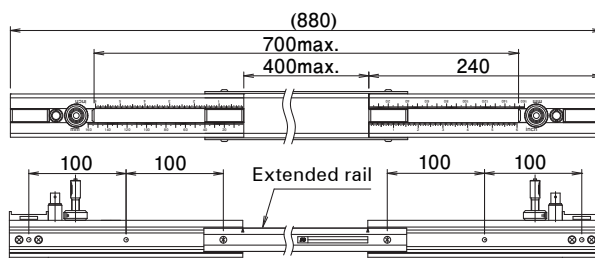
Detector : Type FSSA



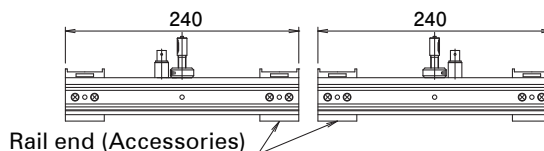
Signal cable : Type FLYA



<Shipment style (V Method)>



<Extended style (Longest, V Method)>



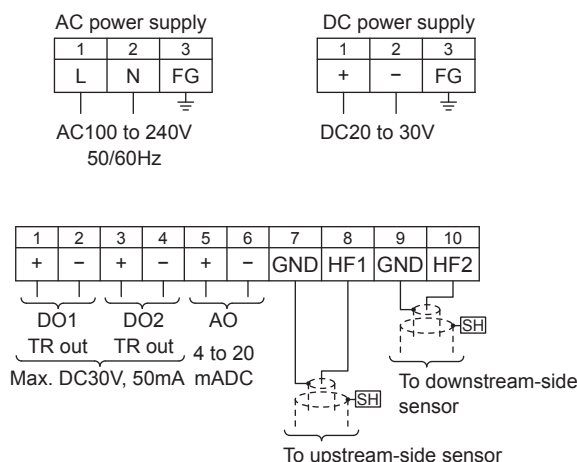
<Sepalate style (Z Method)>

Detector : Type FSSC

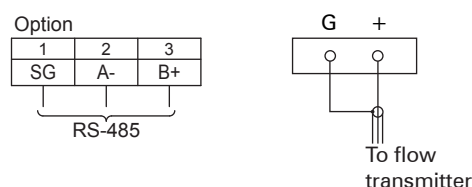


## CONNECTION DIAGRAM

### <Flow transmitter>



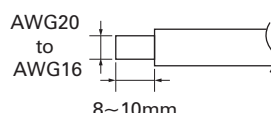
### <Detector>



### Usable wiring material

#### • Wire

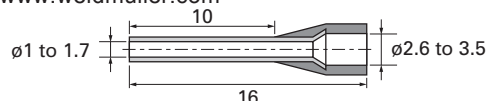
Gauge: AWG20 (0.5mm<sup>2</sup>) to AWG16 (1.5mm<sup>2</sup>)  
Strip-off length: 8~10mm



#### • Bar terminal

Weidmüller

www.weidmuller.com



## SCOPE OF DELIVERY

- Flow transmitter (provided with U-bolt and nuts for pipe mount)
- Detector (provided with mounting fixture and acoustic coupler)
- Signal cable
- 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. Tag No.as necessary(up to 8 alphanumerical characters)
5. If parameter setting is specified, send back the attached parameter specification table duly filled.

## OPTIONAL ACCESSORIES

	Name	Drawing No.
1	Silicone rubber (KE348W)	ZZP*45735N2
2	Silicone-free grease (HIGH-Z)	ZZP*TK7M0981P1
3	Stainless steal belt (1.5m x 2pcs)	ZZP*TK7L6658P4
4	SS belt fasten with screws (1m x 4pcs)	ZZP*TK7M7073P1
5	Wire set (5m x 2pcs)	ZZP*TK7N5813C4

## Checked items before purchase

Following conditions may cause failure of the measurement or to reduce the accuracy by this flow meter.

Please consult and ask Fuji Electric for checking with actual equipment previously if you have hard to judge the appropriate application.

#### 1)Fluid

- If fluid contains a large amount of bubbles (approx. 12vol% or more at 1m/s flow rate)
- If fluid has bad turbidity 10000(mg/L) or more,
- If fluid contains slurry or solid materials (about 5wt%)
- If flow rate is low Reynolds No.10000 or less, (reference: flow rate 5m<sup>3</sup>/h with φ100mm)
- If it is circulating oil, liquid medicine of low concentration, waste liquid and hot spring,

#### 2)Pipe

- If inside pipe is rusty carbon steel pipe,
- If inside pipe having adhering substances and sediment
- If outer surface of cast-iron pipe is rough,
- If pipe wall is tick such as ruinous pipe,(PP material 15mm or more, PVDF material 9mm or more)
- If it is SGPW pipe,
- If lining pipe is removed from pipe,(Teflon,PVC,Glass)
- If it is rubber pipe,

#### 3) Length of the straight pipe

For accurate measurement, straight pipes are needed between up and down stream side of the measuring part. Please meet the straight pipe conditions according item4.

## Caution on use

- 1) Do not damage the sensor or signal mounted on the pipe.
- 2)Make sure to fill the fluid inside the pipe to measure .
- 3)When you use horizontal pipe, it is recommended to install the sensor horizontally.
- 4)When you use the grease as acoustic coupler to install the sensor for outdoor use, it is recommended to install the waterproof cover to prevent from the degradation.

<Parameter specification table>

Setting item		Initial value	Setting value	Setting item		Initial value	Setting value
ID No		0000		Output conditions	Total output	Total mode	Stop
Language		English				Total rate	0m³
Measuring conditions	System unit	Metric				Total preset	0m³
	Flow unit	m³/h				Pulse width	50.0msec
	Total unit	m³				Burnout (total)	Hold
	Outer diameter	60.00mm				Burnout timer	10sec
	Pipe material	PVC pipe			Output conditions	DO1 output type (Note 1)	Not used
	Wall thickness	4.00mm				DO1 output actuation	ON when actuated
	Lining material	Without lining				DO2 output type	Not used
	Lining thickness	—				DO2 output actuation	ON when actuated
	Kind of fluid	Water				Operation mode	Standard
	Viscosity	1.0038×10 <sup>-6</sup> m²/s					
	Sensor mount	V metod					
	Sensor type	FSSA					
Output conditions	Damping	5.0sec		Communication	Communication mode	RS-485	
	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	
		2nd line	Flow rate (m³/h)		Station No.	1	
		2nd line decimal point position	****.***				
	Analog output	Range type	Flow rate				
		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 specify total pulse value and total pulse width so that conditions 1 and 2 shown below are satisfies.

$$\text{Condition 1 : } \frac{\text{Flow span-1} \times [\text{m}^3/\text{s}]}{\text{total pulse value} \times [\text{m}^3]} \leq 100[\text{Hz}]$$

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

\* 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.

**F** Fuji Electric Co., Ltd.

International Sales Div  
Sales Group

Gate City Ohsaki, East Tower, 11-2, Osaki 1-chome,  
Shinagawa-ku, Tokyo 141-0032, Japan

<http://www.fujielectric.com>

Phone: 81-3-5435-7280, 7281 Fax: 81-3-5435-7425

<http://www.fjelectric.com/products/instruments/>