Fuji Electric

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 electrics 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.

Flow transmitter (FLR)

Detector (FSSA)

Detector (FSSC)

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: ±1.5% (±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 Φ50 to Φ1200mm
- − Trouble shooting
- − Easy operation with keypad on the front surface of the flow transmitter

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 ±0.3 ... ±10m/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			-40 to 120°C
	Φ600 to Φ1200 mm		Z method	

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 dowstream.
(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, 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)

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/Underscale/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 waterproot 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

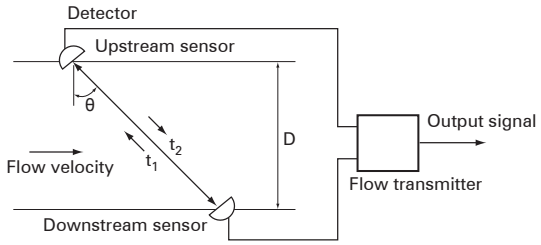
■ PC Loader software

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 6th digit of code symbols).
Note: Communication converter
For tne 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)

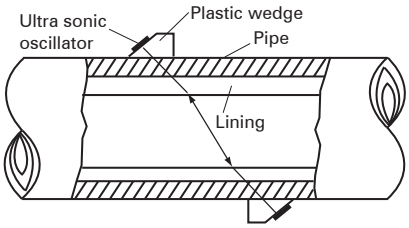
[USB - RS-232C converter]
USB-CVRS9 (manufactured by SANWA SUPPLY)

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.

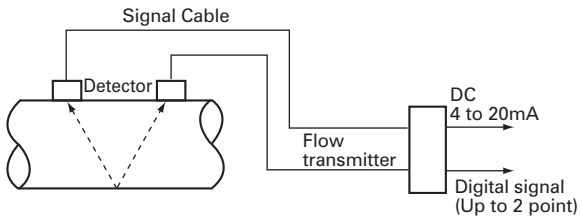


MOUNTING OF DETECTOR

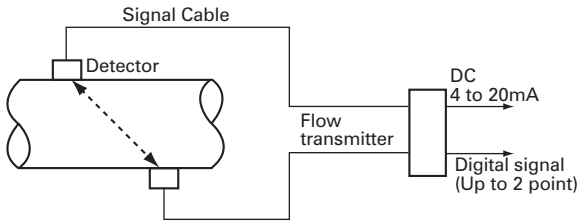


CONFIGURATION DIAGRAM

(1) Single-path system (V method)

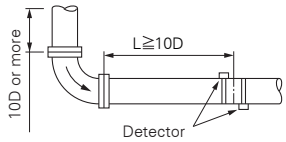
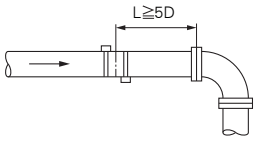
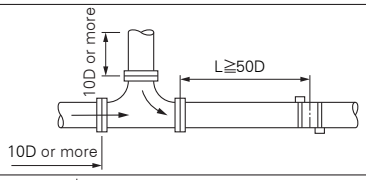
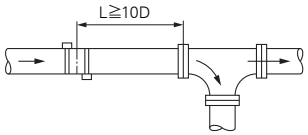
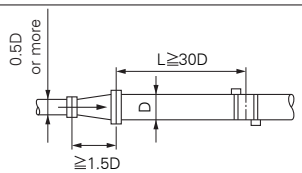
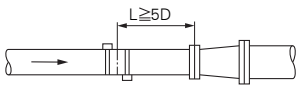
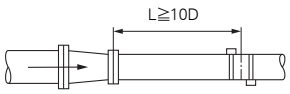
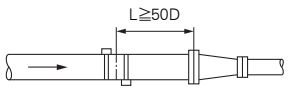
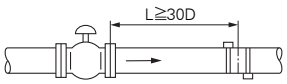
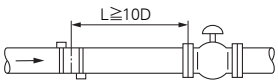
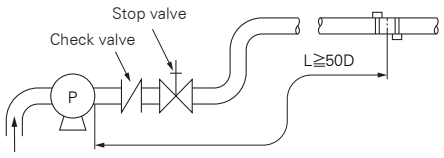


(2) Single path system (Z method)



Conditions on straight pipe

(D : Inside diameter of pipe)

Classification	Upstream side	Downstream side
90 bend		
Tee		
Diffuser		
Reducer		
Various Valve	 In case that flow control valve exists on upstream side.	 In case that flow control valve exists on downstream side.
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	–	**Type** (4th digit)
E		Standard for exports
		Power Supply (5th digit)
1		100 to 240Vac, 50/60Hz
4		20 to 30Vdc
		Communication and Synchronization (6th digit)
Y		None
D		RS-485
	1	**Case structure** (9th digit)
		Jetproof type (IP65)
	A	**Mounting bracket** (10th digit)
		For 2B pipe mount
	B	For wall mount
		Parameter setting, tag plate (11th digit)
	Y	Without
	A	With setting
	B	With setting (Tag plate)
	C	With Tag plate
		Measurment accuracy (12th digit)
	Y	Standard
	C	High accuracy type (Pipe diameter ϕ50mm or more)

<Detector>

1 2 3 4 5 6 7 8	9 10	Description
F S S A 1 A 1 –	Y	
A		<Senser type> (4th digits)
		ϕ25 to ϕ225mm (V method) -20 to 100˚C
1		<Guide rail> (5th digits)
		Provided
		<Mounting belt> (6th digits)
Y		None
A		Stainless belt (1.0m X2)
		<Acoustic coupler> (7th digit) (Note 1)
Y		None
A		Sillicon rubber
B		Sillicon-free grease
		<Water-proof treatment> (9th digit)
	Y	None
		<Tag plate> (10th digit)
	Y	None
	A	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.

Stainless steal belt

SS belt fasten with screws

Wire

<Detector • Rail extension type>

1 2 3 4 5 6 7 8	9 10	Description
F S S C 1 1 –	Y	
C		<Senser type> (4th digits)
		ϕ50 to ϕ1200mm -40 to 120˚C
1		<Guide rail> (5th digits)
		Standard (Rail extension type)
		<Mounting belt> (6th digits) *2
Y		None
A		Stainless steel belt ≤ϕ300mm (1.5m x 2pcs)
C		SS belt fasten with screws ≤ϕ600mm (1m x 4pcs)
D		Wire ≤ ϕ1500mm (5m x 2pcs)
		<Acoustic coupler> (7th digit) (Note 1)
Y		None
A		Sillicon rubber
B		Sillicon-free grease
	Y	<Water-proof treatment> (9th digit) None
		<Tag plate> (10th digit)
	Y	None
	A	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	≤ϕ300mm	≤ϕ600mm	≤ϕ1200mm
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 ϕ50 to ϕ300mm

<V method>

■Extended condition

available pipe diameter up to ϕ600mm

<V method>

■Installation of the supplied rail end.

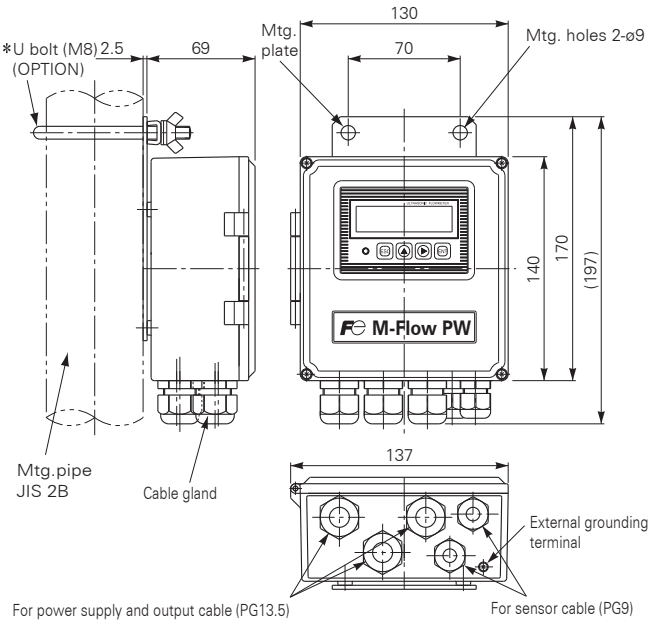
available pipe diameter up to ϕ1200mm

<Z method>

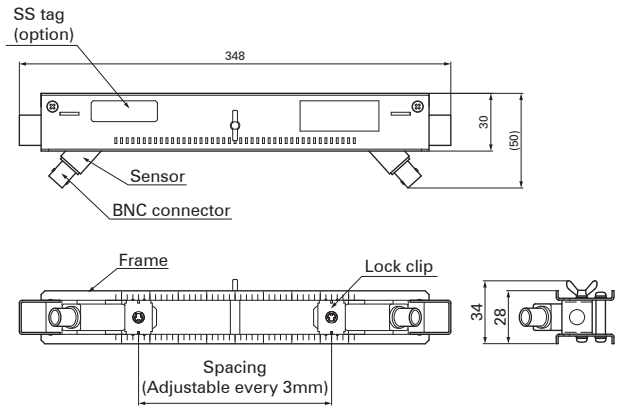
<Signal cable>

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

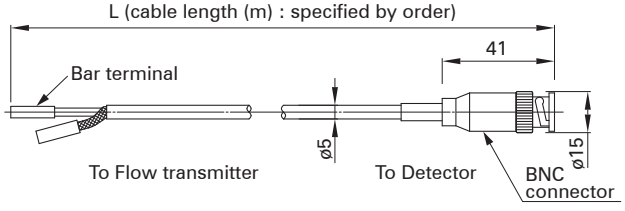
OUTLINE DIAGRAM (Unit:mm)



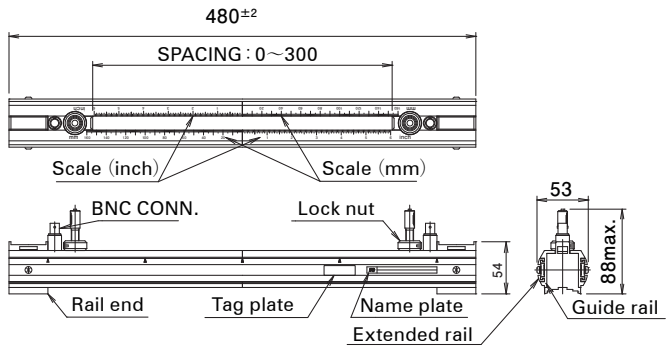
Flow transmitter : Type FLR



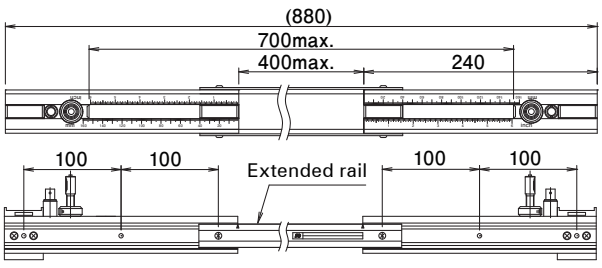
Detecter : Type FSSA



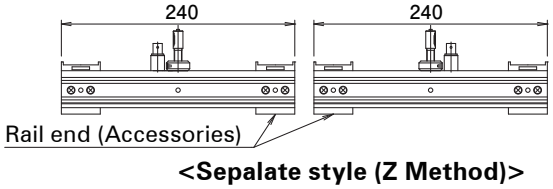
Signal cable : Type FLYA



<Shipment style (V Method)>



<Extended style (Longest, V Method)>

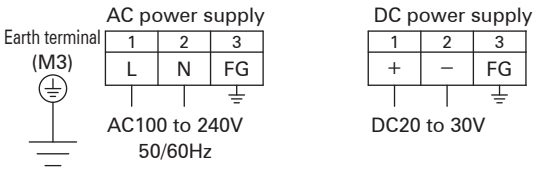


<Sepalate style (Z Method)>

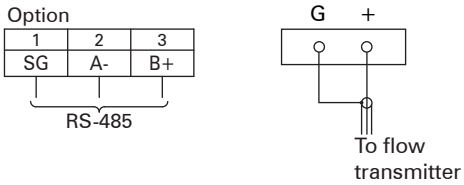
Detecter : Type FSSC

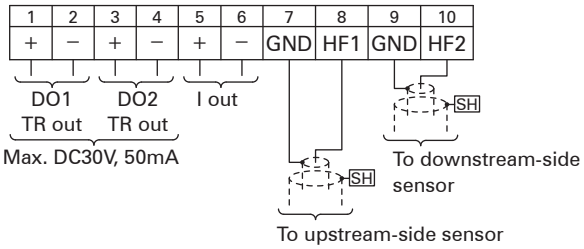
CONNECTION DIAGRAM

<Flow transmitter>



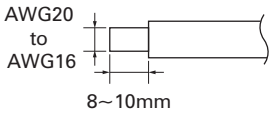
<Detector>



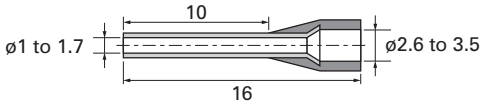


Usable wiring material

• Wire
Gauge: AWG20 (0.5mm²) to AWG16 (1.5mm²)
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
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 5m3/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,
-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			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		1.0038×10⁻⁶m²/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.

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

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

* 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.

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.fjielectric.com/products/instruments/

Printed in Japan