Fuji Electric

TIME DELTA SERIES <TIME DELTA-C>

# ULTRASONIC FLOWMETER <Advanced type>

DATA SHEET

FSV-2, 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, the flowmeter is designed for 2-path system capable of simultaneously measuring 2 pipes, and energy calculation by connecting with temperature sensor, while keeping with the resistance to air bubbles. It is an effective solution for measurement and management of the energy used in energy-saving systems such as heating and air conditioning applications.

Flow transmitter (FSV)

Detector (FSSC)

Detector (FSSE)

## FEATURES

**1. Advanced function**
- Improved stability and accuracy by using 2-path system
- Capability of simultaneously measuring 2 pipes by one transmitter (Difference calculation possible).
- Energy measurement in combination with temperature sensor

**2. High accuracy**
The flowmeter is designed for high accurary (better than ±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).

**3. 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).

**4. Full variety of sensors**
The flowmeter can be used with various types of sensors applicable for wide range of pipe size (ø13 to ø6000mm) and fluid temperature (-40 to +200°C).

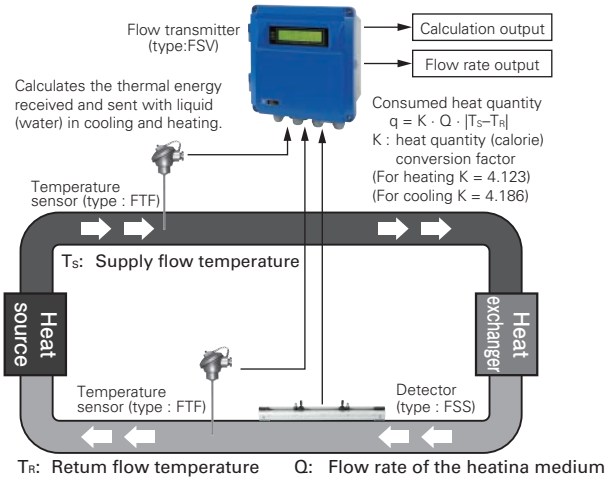
**5. Quick response**
With the use of high-speed micro-processor suited for digital signal processing, the fast response time is realized.

**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
- − Extendable rail type detector up to ø50 to ø1200mm
- − Trouble shooting
- − Easy operation with keypad on the front surface of the flow transmitter

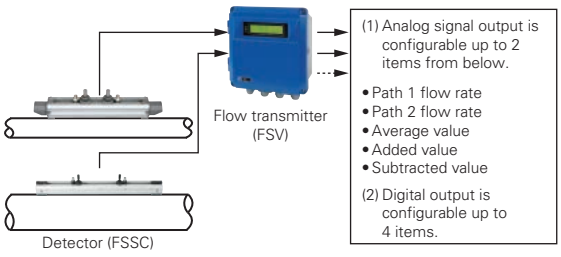
## FUNCTIONAL DIAGRAM

**Consumed energy calculation function**

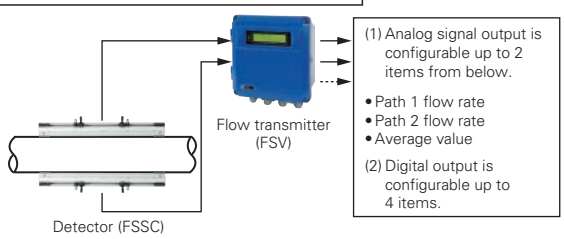



TR: Return flow temperature  Q: Flow rate of the heatina medium

**2-channel measurement (for 2 pipes)**




**2-path measurement (for 1 pipe)**



# SPECIFICATIONS

## Operational specifications

**System configuration:**
Single-path or 2-path system with a flow transmitter (Model FSV) and a detector (Model FSS) (2-pipe version is also available)
See functional diagram for the definition of 2-path and 2-pipe measurement.
Energy measurement by transmitter, detector, and resistance bulb (pt100).
Either 2-path/2-pipe measurement or energy measurement can be selected.

**Applicable detector:**
FSSA (2MHz), FSSC (1MHz), FSSD (2MHz), FSSE (0.5MHz), FSSH (2MHz)

**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 ... ±32m/s

**Power supply:** 100 to 240V AC +10%/-15%, 50/60Hz

**Signal cable (between detector and converter):**
Coaxial cable (150m max.) applicable up to 300m depending on the condition.
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 +60°C

**Ambient humidity:**
Flow transmitter: 95%RH max.
Detector: 90%RH max.

**Grounding:** Class D (100 Ω)

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

**Applicable piping and fluid temperature:**
2-pipe/energy calculation: ø13 to ø6000mm
2-path measurement: ø50 to ø6000mm

<table 1>

| Detector Type | Pipe size (inner diameter) ø (mm) | Mounting method | Fluid temperature range (°C) (Note 2) | Applicable pipe material (Note 1) |
|---|---|---|---|---|
| FSSA | 25 to 50 | V method | -20 to +100 | Plastic (PVC, Others) |
| | 50 to 225 | | | Plastic (PVC, Others)<br>Metal pipe (Stainless steel, Carbon steel, Copper, Aluminum, Others) |
| FSSC | 50 to 600 | V method | -40 to +120 | |
| | 200 to 1200 | Z method | | |
| FSSD | 13 to 100 | V method | -40 to +100 | |
| FSSE | 200 to 1000 | V method | -40 to +80 | |
| | 500 to 6000 | Z method | | |
| FSSH | 50 to 200 | V method | -40 to +200 | |
| | 150 to 400 | Z method | | |

Note1) Please select the FSSC type or FSSE type if following condition.
- When pipe material is PP and thickness is 15mm or more
- When pipe material is PVDF and thickness is 9mm or more
- When pipe material is cast iron pipe, lining pipe, old steel pipe or others through which the ultrasonic signal could not be transmitted easily.
  Lining material: Tar epoxy, mortar, rubber, etc.
  * If the lining is not properly glued to a pipe, the measurement may be impossible.

Note2) When silicon grease is used as acoustic coupler, Fluid temperature limit is 0 to 60°C no matter what detector is selected.

Note3) Heat-resistant shock temperature: for 30 minutes at 150°C For the detector FSSA or FSSC

Note4) For pipes with a diameter of 300 mm or larger, we recommend to use FSSE and mount it by Z method.

## Performance specifications

**Rated accuracy:** <table 2>

| Detector Type | Pipe size (diameter) ø (mm) | Flow velocity (m/s) | Accuracy | |
|---|---|---|---|---|
| | | | Plastic pipe | Metal pipe |
| FSSA | 25 to 50 | 2 to 32 | ±2.0% of rate | – |
| | | 0 to 2 | ±0.04m/s | – |
| | 50 to 225 | 2 to 32 | ±1.0% of rate | ±2.0% of rate |
| | | 0 to 2 | ±0.02m/s | ±0.04m/s |
| FSSC | 50 to 200 | 2 to 32 | ±1.5% of rate | |
| | | 0 to 2 | ±0.03m/s | |
| | 200 to 1200 | 2 to 32 | ±1.0% of rate | |
| | | 0 to 2 | ±0.02m/s | |
| FSSD | 13 to 50 | 2 to 32 | ±1.5% to ±2.5% of rate | |
| | | 0 to 2 | ±0.03 to ±0.05m/s | |
| | 50 to 100 | 2 to 32 | ±1.5% of rate | |
| | | 0 to 2 | ±0.03m/s | |
| FSSE | 200 to 300 | 2 to 32 | ±1.5% of rate | |
| | | 0 to 2 | ±0.03m/s | |
| | 300 to 1200 | 0.75 to 32 | ±1.5% of rate | |
| | | 0 to 0.75 | ±0.0113m/s | |
| | 1200 to 6000 | 1 to 32 | ±1.0% of rate | |
| | | 0 to 1 | ±0.02m/s | |
| FSSH | 50 to 300 | 2 to 32 | ±1.0% of rate | |
| | | 0 to 2 | ±0.02m/s | |
| | 300 to 400 | 0.75 to 32 | ±1.0% of rate | |
| | | 0 to 0.75 | ±0.0075m/s | |

**Response time:**
1s (standard mode)
0.2s as selected (quick response mode)

**Power consumption:**
30VA max. (AC power supply)

## Functional specifications

**Analog signal:**
4 to 20mA DC (2 points maximum)
Load resistance: 600Ω max.

**Digital output:**
Forward total, reverse total, totalized energy, temperature alarm, and cooling/heating modes, alarm, acting range, flow switch, total switch
assignable arbitrarily
Transistor contact (isolated, open collector)
- Outputs: 4 points max.
- Normal: ON/OFF selectable
- Contact capacity: 30V DC, 50mA
- Output frequency: 100P/s max. (pulse width: 5, 10, 50, 100, 200, 500, 1000ms)

**Serial communication (option):**
RS-485 (MODBUS), isolated, arrester incorporated
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, energy flow, energy calculation for cooling system, energy calculation for heating system, temperature, etc.

**Display device:**
2-color LED (Normal: green, Extraordinary: red)
2 indicator lamps (for path 1 and 2)
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

| | |
|---|---|
| Velocity | m/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 |

**Energy indication:**
indication of energy consumption
energy consumption of heat medium
energy flow:
MJ/h, GJ/h, BTU/h, kBTU/h, MBTU/h, kW, MW
totalized energy:
MJ, GJ, BTU, kBTU, MBTU, kWh, MWh
J: Joule/BTU: British thermal unit/W: Watt
Note1) Minus-totalization of thermal energy is not available when the flow direction is reverse.
Note2) The amount of thermal energy is detected as zero when the difference in temperature is 0.5°C or less.
Temperature indication: °C, K
Operation mode:
Cooling mode, Heating mode, Cooling/heating automatic change mode
Temperature input:
Input type: Resistance bulb (Pt100, 3-wire)
Input range: -40 to + 200°C
Indication accuracy (at 23°C): ±1.0% FS

**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

**Output setting:** <table 3>

| Measuring mode | Output type | Analog signal | Digital output |
|---|---|---|---|
| 2-path | Path 1 flow rate<br>Path 2 flow rate<br>Average value | 2 points max. (select from the lieft column) | 4 points max. |
| 2-pipe | Path 1 flow rate<br>Path 2 flow rate<br>Average value<br>Added value<br>Subtracted value | 2 points max. (select from the left column) | 4 points max. |
| Energy flow | Path 1 flow rate<br>Energy flow | 2 points max. | 4 points max. |

**Burnout:**
Analog output: Hold/Overscale/Underscale/Zero selectable
Flow rate total: Hold/Count selectable
Burnout timer: 10 to 900s (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: IP67
Detector:
FSSA, FSSC: IP65 (When waterproof BNC connector is provided)
FSSD, FSSH: IP52
FSSE: IP67 (Silicone rubber is filled up on the terminal block)
FSSC, FSSE (waterproofing): IP68
(submerged resistant structure for 5days)

**Mounting method:**
Flow transmitter: Mounted on wall or by 2B pipe
Detector: Clamped on pipe surface

**Acoustic coupler:**
Acoustic coupler is a filling between detector and pipe.
Type of acoustic coupler: <table 4>

| Type | Silicone rubber (KE-348W) | Silicone grease (G40M) | Silicone-free grease (HIGH Z) | Grease for high temperature (KS62M) |
|---|---|---|---|---|
| Fluid temperature | -40 to +150°C | -30 to +150°C | 0 to +60°C | -30 to +250°C |
| Teflon piping | × | ○ | ○ | ○ |

In case of Teflon piping, use grease.

**Material:**
Flow transmitter: Aluminum alloy
Detector: <table 5>

| Detector Type | Sensor housing | Cover | Guide rail |
|---|---|---|---|
| FSSA | PBT | – | SUS304 |
| FSSC | PBT | – | Aluminum alloy + PBT |
| FSSD | PBT | – | Aluminum alloy + PBT |
| FSSE | PBT | SUS304 | – |
| FSSH | SUS304 | SUS304 | Aluminum alloy |

**Signal cable:**
• Structure: Heat-resisting high-frequency coaxial cable
• Sheath: Flame-resisting PVC
• Outer diameter: ø7.3mm
Terminal treatment: <table 6>

| | |
|---|---|
| Cable type | FLYD |
| Applicable detector | FSSA, FSSC, FSSD, FSSE, FSSH |
| Terminal of flow transmitter side | Rod terminal ×2<br>Amplifier terminal (M3) ×1 |
| Terminal of detector side | BNC connector × 1<br>Amplifier terminal (M4) ×1 |

Dimension, Mass: <table 7>

| Type | | Dimensions (mm) | Mass.(kg) |
|---|---|---|---|
| Flow transmitter | FSV | H240 × W247 × D134 | 5 |
| Detctor | FSSA | H50 × W348 × D34 | 0.4 |
| | FSSC | H88 × W480 × D53 | 1 |
| | FSSD | H90 × W320 × D52.5 | 0.6 |
| | FSSE | H67 × W78 × D84 | 1.2 |
| | FSSH | H205 × W530 × D52 | 1.6 |
| Signal cable | FLYD | ø7.3mm | 90g/m |

**External terminal of flow transmitter:**
plug terminal

## EU Directive Compliance CE

**LVD (2014/35/EU)**
EN 61010-1
**EMC (2014/30/EU)**
EN 61326-1 (Table 2)
EN 55011 (Group 1 Class A)
EN 61000-3-2 (Class A)
EN 61000-3-3
EN 61326-2-3
**RoHS (2011/65/EU)**
EN 50581

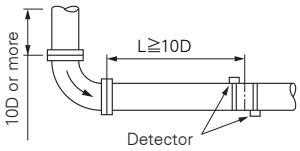
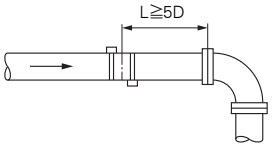
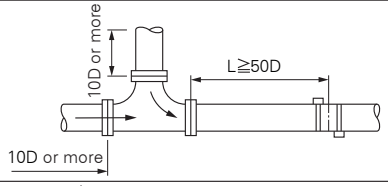
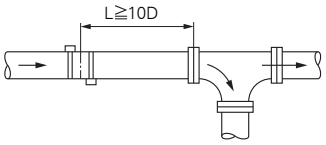
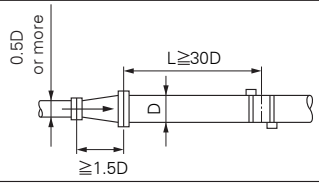
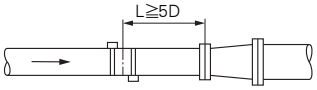
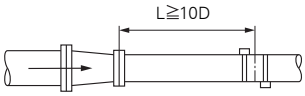
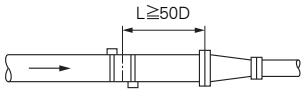
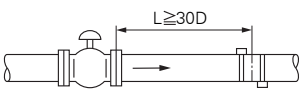
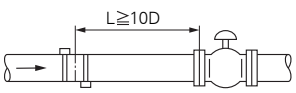
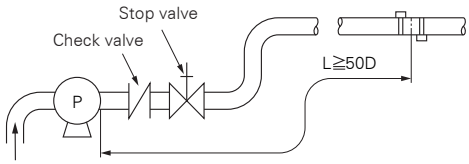
## ■ PC Loader software

Provided as standard
•Compatible model is PC/AT compatible instrument.
•Main functions: Software for Main unit parameter setting/ change on PC
•OS: Windows 2000/XP/Windows 7 (Home Premium, Professional) or Windows 8 (Professional)
•Memory requirement: 125MB min.
•Disk unit: CD-ROM drive compatible with Windows 2000/ XP/Windows 7 (Home Premium, Professional) or Windows 8 (Professional)
•Hard disk capacity: Minimum vacant capacity of 52MB or more
Note: Optional communication board (specified at the 5th 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)

## Conditions on straight pipe

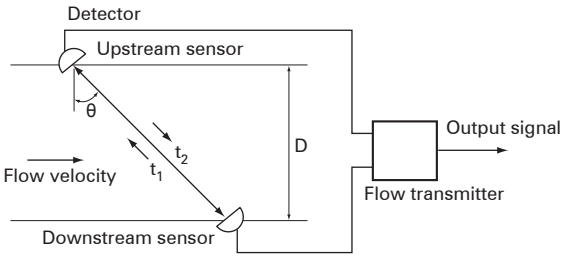
( D : Inside diameter of pipe)

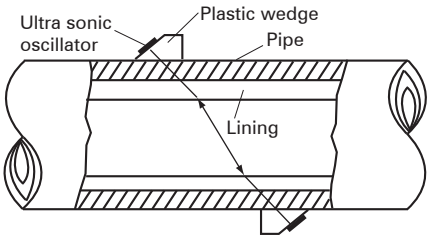
| Classification | Upstream side | Downstream side |
|---|---|---|
| 90 bend |  |  |
| Tee |  |  |
| Diffuser |  |  |
| Reducer |  |  |
| Various Valve |  In case that flow control valve exists on upstream side. |  In case that flow control valve exists on downstream side. |
| Pump |  | |

(Note) The source : JEMIS-032

## MEASURING PRINCIPLE

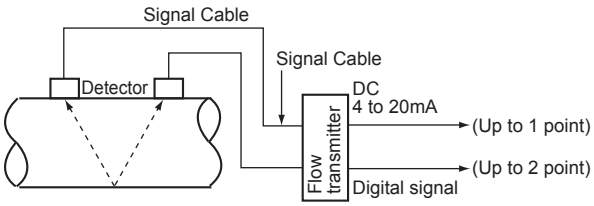
With ultrasonic pulses propagated diagonally between the upstream and downstream sensors, flow rate is measured by detecting the time difference obtained by the flow of fluid.



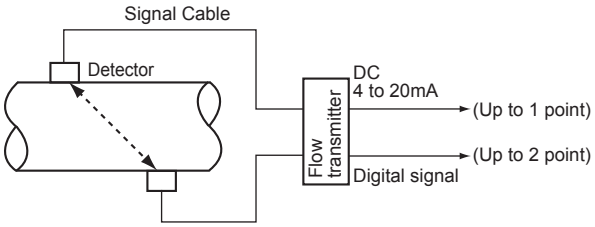




## CONFIGURATION DIAGRAM

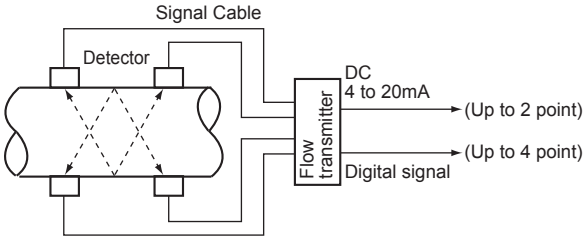
**(1) Single path system (V method)**



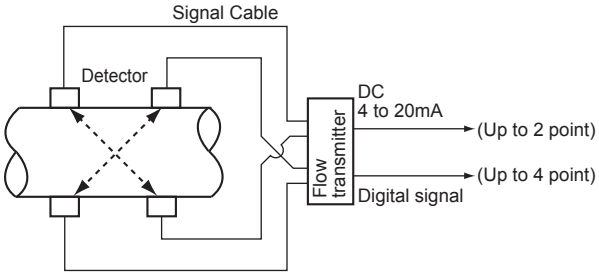

**(2) Single path system (Z method)**



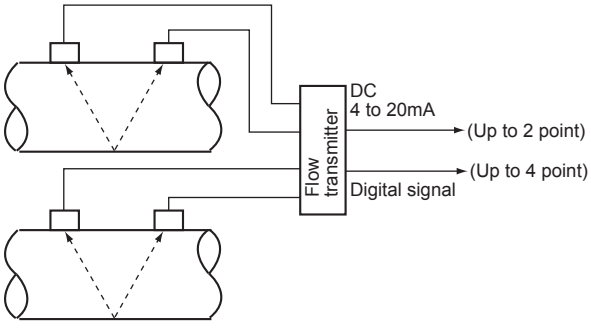

**(3) 2-path system (V method)**



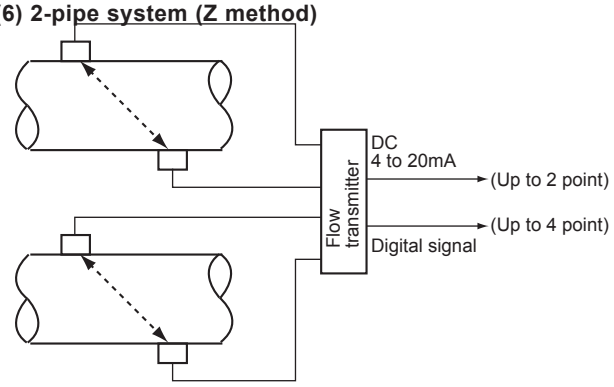

**(4) 2-path system (Z method)**



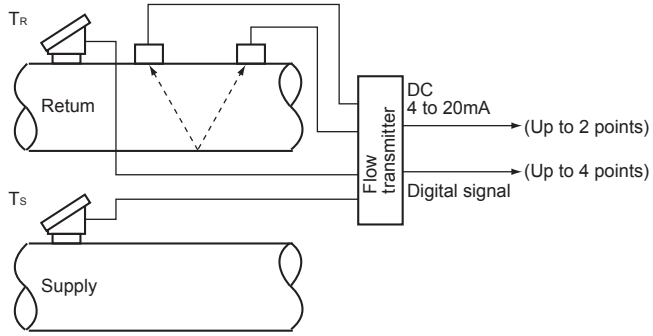

**(5) 2-pipe system (V method)**



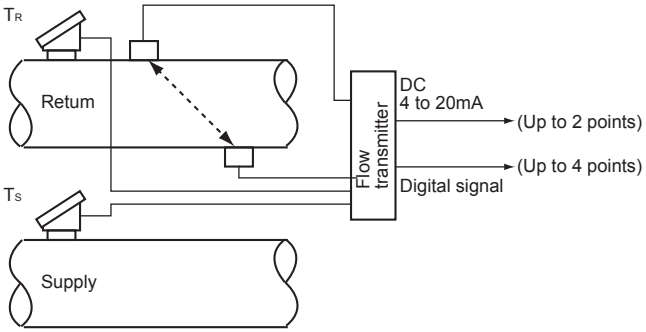

**(6) 2-pipe system (Z method)**




**(7) Energy flow measurement (V method)**




**(8) Energy flow measurement (Z method)**



# CODE SYMBOL

## <Flow transmitter>

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | Description |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| F | S | V | | | | 1 | 2 | – | L | | | | |
| | | | S | | | | | | | | | | (Destination) (4th digit)<br>Standard (Japanese)<br>Standard (English) |
| | | | E | | | | | | | | | | |
| | | | | Y | | | | | | | | | (Communication) (5th digit)<br>None<br>RS485 |
| | | | | D | | | | | | | | | |
| | | | | | A | | | | | | | | (Use) (6th digit)<br>2-path/2-pipe<br>Single path/energy |
| | | | | | B | | | | | | | | |
| | | | | | | 1 | | | | | | | (Power supply) (7th digit)<br>AC100 to 240V 50/60Hz |
| | | | | | | | | | L | | | | (Case structure) (9th digit)<br>IP67 |
| | | | | | | | | | | Y | | | (Wire connection port) (10th digit)<br>Weatherproof gland provided<br>Union (for pilica) with gland |
| | | | | | | | | | | A | | | |
| | | | | | | | | | | | Y | | (Combination with explosion-proof detector) (11th digit) *1<br>None<br>Provided |
| | | | | | | | | | | | A | | |
| | | | | | | | | | | | | Y | (Parameter setting) (12th digit)<br>None<br>Setting provided<br>Setting provided + tag<br>Tag |
| | | | | | | | | | | | | A | |
| | | | | | | | | | | | | B | |
| | | | | | | | | | | | | C | |
| | | | | | | | | | | | | | (Mounting method) (13th digit)<br>Wall mount<br>Pipe mount |
| | | | | | | | | | | | | B | |
| | | | | | | | | | | | | C | |

*1) HumiSeal coated PCB

## <Detector>

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Description |
|---|---|---|---|---|---|---|---|---|---|---|
| F | S | S | A | 1 | | | 1 | – | Y | |
| | | | A | | | | | | | <Senser type> (4th digits)<br>ø25 to ø225mm (V method) |
| | | | | 1 | | | | | | <Guide rail> (5th digits)<br>Provided |
| | | | | | Y | | | | | <Mounting belt> (6th digits)<br>None<br>Stainless belt (1.0m × 2) |
| | | | | | A | | | | | |
| | | | | | | Y | | | | <Acoustic coupler> (7th digit) *2<br>None<br>Sillicon rubber<br>Sillicon-free grease<br>Silicon grease |
| | | | | | | A | | | | |
| | | | | | | B | | | | |
| | | | | | | C | | | | |
| | | | | | | | | | Y | <Watwe-proof treatment>(9th digit)<br>None |
| | | | | | | | | | A | <Tag plate> (10th digit)<br>None<br>Provided |

*2) 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.

## <Detector>

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 10 | 11 | Description |
|---|---|---|---|---|---|---|---|---|---|---|
| F | S | S | C | 1 | | | 1 | – | | |
| | | | C | | | | | | | <Senser type>(4th digits)<br>ø50 to ø1200mm |
| | | | | 1 | | | | | | <Guide rail>(5th digits)<br>Provided (Extendable rail type) |
| | | | | | Y | | | | | <Mounting belt>(6th digits) *3<br>None<br>Stainless belt (1.5m×2)<br>SS belt fasten with screws (1.0m×4)<br>Wire ≤ ø1500m (5m×2) |
| | | | | | A | | | | | |
| | | | | | C | | | | | |
| | | | | | D | | | | | |
| | | | | | | Y | | | | <Acoustic coupler> (7th digit) *2<br>None<br>Silicon rubber (KE348)<br>Silicone-free grease (HIGH-Z)<br>Silicone grease (G40M) |
| | | | | | | A | | | | |
| | | | | | | B | | | | |
| | | | | | | C | | | | |
| | | | | | | | Y | | | <Watwe-proof treatment>(9th digit)<br>None<br>Provided (with signal cable 10m) |
| | | | | | | | A | | | |
| | | | | | | | | Y | | <Tag plate> (10th digit)<br>None<br>Provided |
| | | | | | | | | A | | |

*3) Please refer to the table 9 to serect the mounting belt at 6th digits.

[Table 9] How to select at 6th digits.

| Mounting method | ≤ø300mm | ≤ø600mm | ≤ø1200mm |
|---|---|---|---|
| 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 ø50 to ø300mm
<V method>

■Extended condition

available pipe diameter up to ø600mm
<V method>

■Installation of the supplied rail end.

available pipe diameter up to ø1200mm
<Z method>

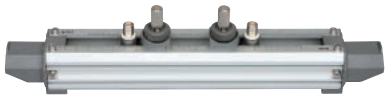
## Belt appearance for attachment of the detector.

Stainless belt

SS belt fasten with screws

wire

## <Detector>



| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Description |
|---|---|---|---|---|---|---|---|---|---|---|
| F | S | S | D | 1 | | | 1 | – | Y | |
| | | | D | | | | | | | <Senser type>(4th digits)<br>ø13 to ø100mm (-40 to 100°C) |
| | | | | 1 | | | | | | <Guide rail>(5th digits)<br>Provided |
| | | | | | Y | | | | | <Mounting belt>(6th digits)<br>None |
| | | | | | A | | | | | Stainless belt (1.5m×2) |
| | | | | | C | | | | | SS belt fasten with screws (1.0m×4) |
| | | | | | | Y | | | | <Acoustic coupler> (7th digit)<br>None |
| | | | | | | A | | | | Silicon rubber (KE348) |
| | | | | | | B | | | | Silicone-free grease (HIGH-Z) |
| | | | | | | C | | | | Silicone grease (G40M) |
| | | | | | | | | Y | | <Water-proof treatment>(9th digit)<br>None |
| | | | | | | | | | Y | <Tag plate> (10th digit)<br>None |
| | | | | | | | | | A | Provided |

## <Detector>

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Description |
|---|---|---|---|---|---|---|---|---|---|---|
| F | S | S | E | 1 | | | 1 | – | | |
| | | | E | | | | | | | <Senser type>(4th digits)<br>ø200 to ø6000mm (-40 to 80°C) |
| | | | | 1 | | | | | | <Guide rail>(5th digits)<br>None |
| | | | | | Y | | | | | <Mounting belt>(6th digits)<br>None |
| | | | | | D | | | | | Wire (≤ ø1500mm) |
| | | | | | E | | | | | Wire (≤ ø6000mm) |
| | | | | | | Y | | | | <Acoustic coupler> (7th digit)<br>None |
| | | | | | | A | | | | Silicon rubber (KE348) |
| | | | | | | B | | | | Silicone-free grease (HIGH-Z) |
| | | | | | | C | | | | Silicone grease (G40M) |
| | | | | | | | | Y | | <Water-proof treatment>(9th digit)<br>None |
| | | | | | | | | A | | Provided (with signal cable 10m) |
| | | | | | | | | | Y | <Tag plate> (10th digit)<br>None |
| | | | | | | | | | A | Provided |

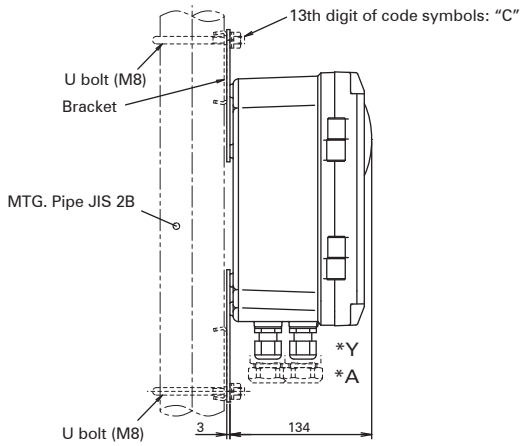
## <Detector>

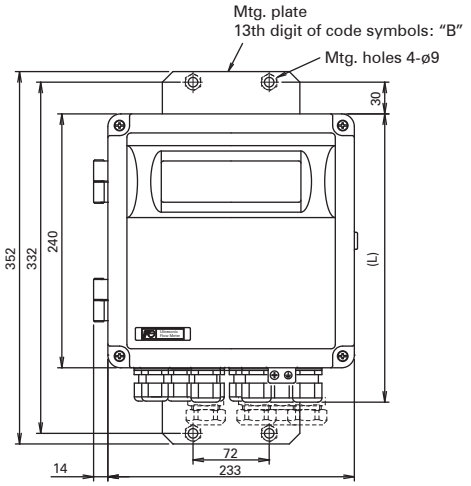
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Description |
|---|---|---|---|---|---|---|---|---|---|---|
| F | S | S | H | 1 | | | 1 | – | Y | |
| | | | H | | | | | | | <Senser type>(4th digits)<br>ø50 to ø400mm (-40 to 200°C) |
| | | | | 1 | | | | | | <Guide rail>(5th digits)<br>Provided |
| | | | | | Y | | | | | <Mounting belt>(6th digits)<br>None |
| | | | | | A | | | | | Stainless belt (1.5m×2) |
| | | | | | C | | | | | SS belt fasten with screws (1.0m×4) |
| | | | | | | Y | | | | <Acoustic coupler> (7th digit)<br>None |
| | | | | | | D | | | | High-temperature grease (KS62M) |
| | | | | | | | | Y | | <Water-proof treatment>(9th digit)<br>None |
| | | | | | | | | | Y | <Tag plate> (10th digit)<br>None |
| | | | | | | | | | A | Provided |

## <Signal cable>

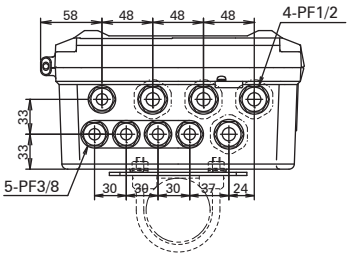
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | Description |
|---|---|---|---|---|---|---|---|---|
| F | L | Y | D | | | | 1 | |
| | | | D | | | | | Type of sensor (4th digit)<br>for FSSA, FSSC, FSSD, FSSE, FSSH |
| | | | | 0 | 0 | 5 | | Cable length (5,6 and 7th digit)<br>5 m |
| | | | | 0 | 1 | 0 | | 10 m |
| | | | | 0 | 1 | 5 | | 15 m |
| | | | | 0 | 2 | 0 | | 20 m |
| | | | | 0 | 2 | 5 | | 25 m |
| | | | | 0 | 3 | 0 | | 30 m |
| | | | | 0 | 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) |

## OUTLINE DIAGRAM (Unit:mm)



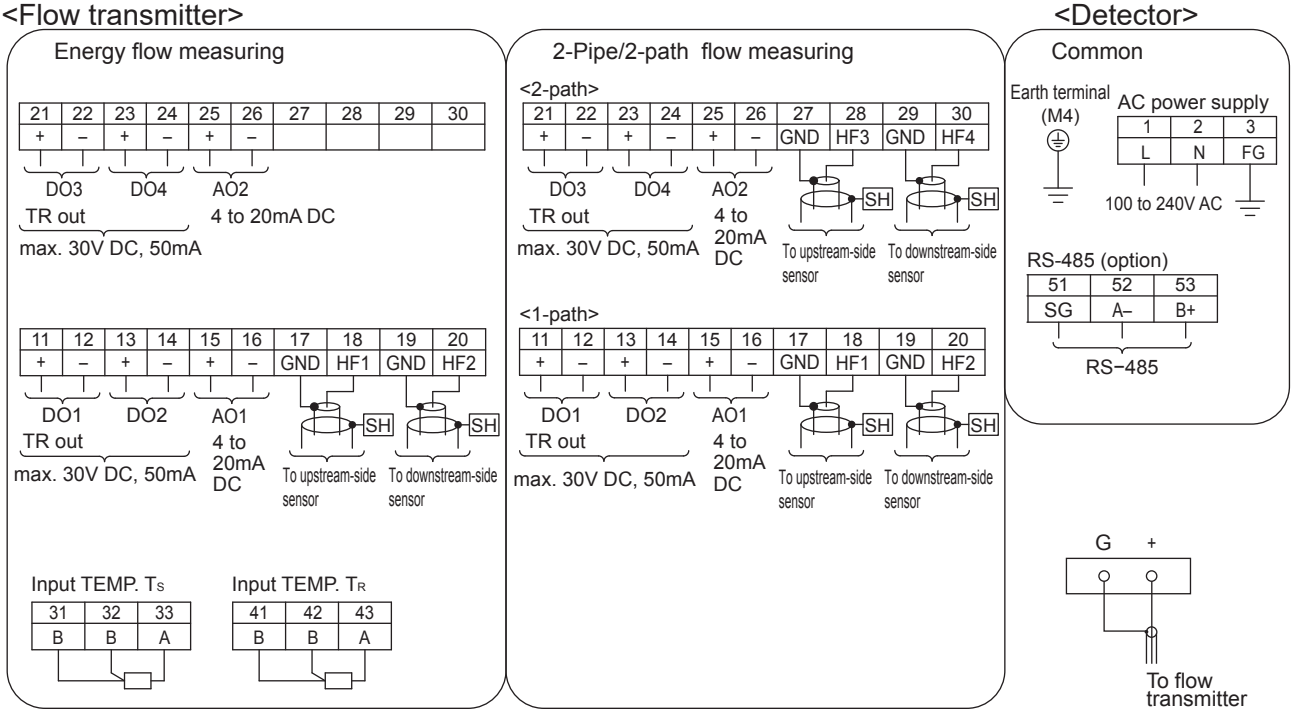

| 10th digit of the code symbols | Conduit connection | L | Applicable cable | |
|---|---|---|---|---|
| | | | PF1/2 | PF3/8 |
| *Y | With waterproof gland | 273 | ø6 to 12 | ø5 to 10 |
| *A | Waterproof gland with union plug (for plica tube PV-5#17) | 294 | max. ø14 | |




## CONNECTION DIAGRAM

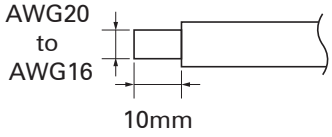
<Flow transmitter>

<Detector>

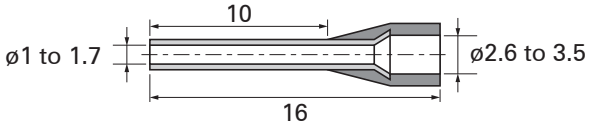



### Usable wiring material

- Wire
  Gauge: AWG20 (0.5mm²) to AWG16 (1.5mm²)
  Strip-off length: 10mm

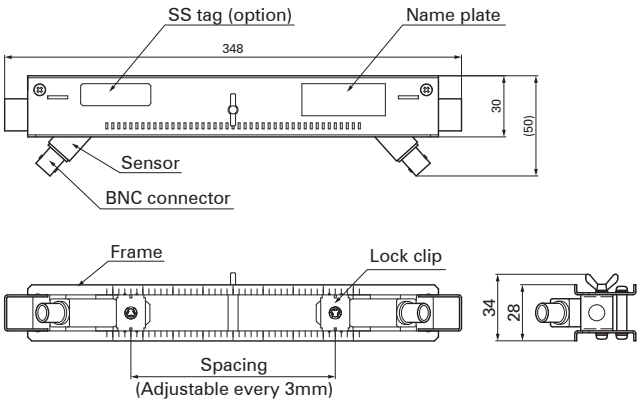



- Bar terminal
  Weidmüller
  www.weidmuller.com

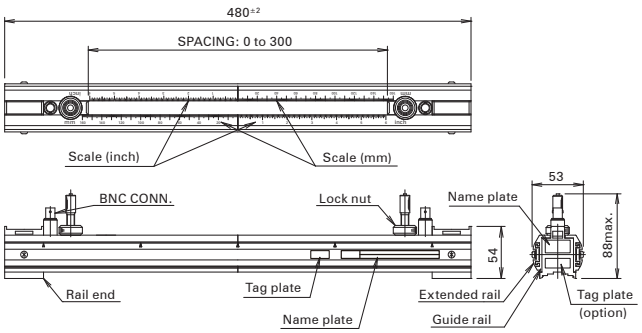


# OUTLINE DIAGRAM (Unit:mm)

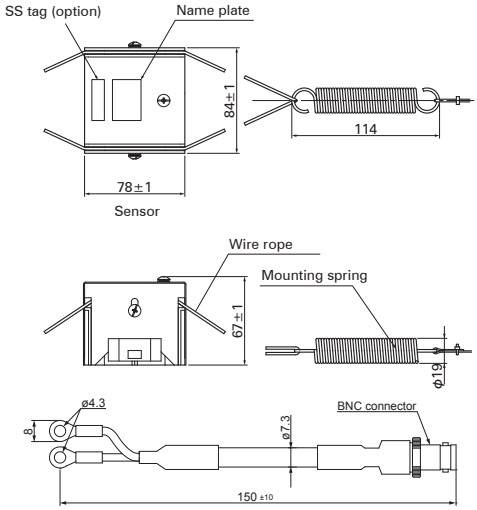
## Detecter : Type FSSA



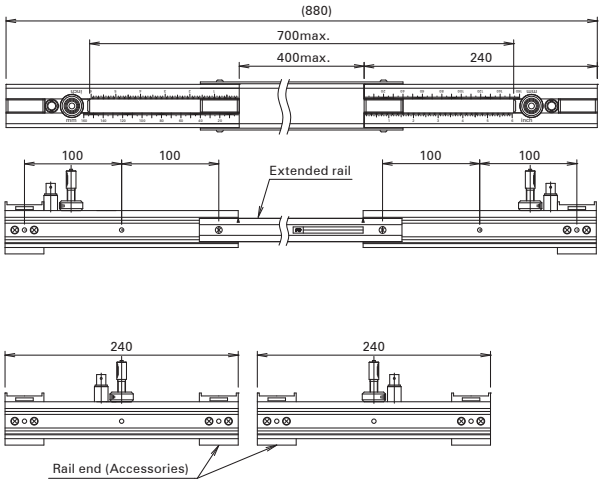

## Detecter : Type FSSC



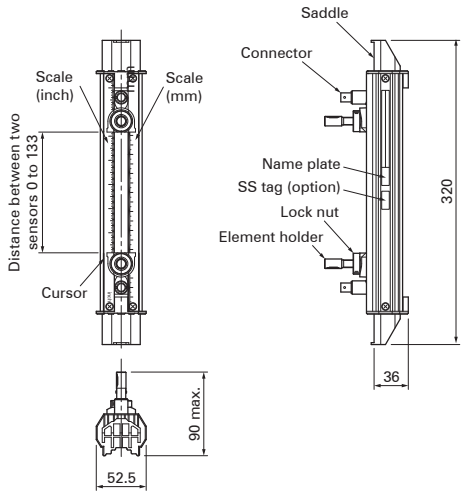

## Detecter : Type FSSE



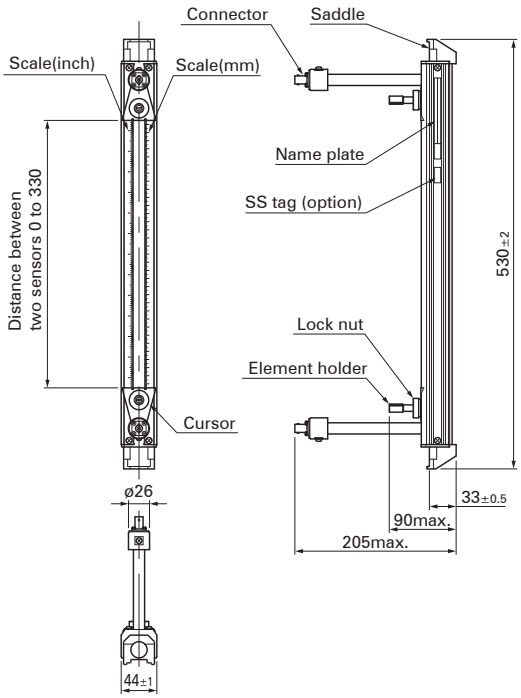

Signal cable conversion cord (accessories)



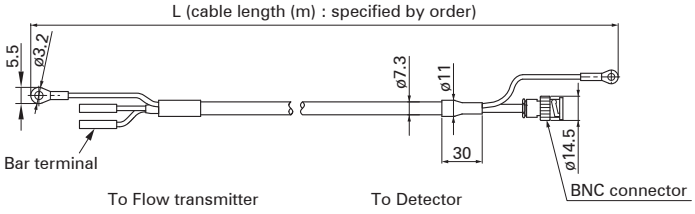

## Detecter : Type FSSD




## Detecter : Type FSSH




## Detecter : Type FLYD



## SCOPE OF DELIVERY

■ For 1-channel and 2-path version
- Detector (Type: FSS) ×2: provided with mounting fixture and acoustic coupler according to specified code of symbol. For type FSSE, cable adapter (15cm) is also provided.
- Flow transmitter (Type: FSV) ×1: provided with U-bolt and nuts for pipe mount.
- Signal cable (Type: FLY) 2 pairs
- CD-ROM (contains instruction manual, loarder software)

■ For energy measurement version
- Detector (Type: FSS) ×1: provided with mounting fixture and acoustic coupler according to specified code of symbol. For type FSSE, cable adapter (15cm) is also provided.
- Flow transmitter (Type: FSV) ×1: provided with U-bolt and nuts for pipe mount.
- Signal cable (Type: FLY) 1 pair
  * Resistance bulb (Pt100, 3-wire) is needed.
- CD-ROM (contains instruction manual, loarder software)

■ For 2-pipe version
- Detector (Type: FSS) ×2: provided with mounting fixture and acoustic coupler according to specified code of symbol. For type FSSE, cable adapter (15cm) is also provided.
- Flow transmitter (Type: FSV) ×1: provided with U-bolt and nuts for pipe mount.
- Signal cable (Type: FLY) 2 pairs
- CD-ROM (contains instruction manual, loarder 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. Code symbol for resistance bulb (Pt100, 3-wire)
6. If parameter setting is specified, send back the attached parameter specification table duly filled.

## OPTIONAL ACCESSORIES

| | Name | Drawing No. |
|---|---|---|
| 1 | Silicone grease (G40M) | ZZP*45231N5 |
| 2 | Silicone rubber (KE348W) | ZZP*45735N2 |
| 3 | Silicone-free grease (HIGH-Z) | ZZP*TK7M0981P1 |
| 4 | High-temperature grease | ZZP*TK7G7983C1 |

## 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$^3$/h with ø100mm)
- 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 Measurement mode: 1-path/energy measurement> 1/2

| Setting item | | | Initial value | Setting value | Setting range |
|---|---|---|---|---|---|
| ID No | | | 0000 | | ID No. is invalid when 0000 is selected. |
| Language | | | Japanese | | English, Japanese, German, French, Spanish |
| Measurement mode | | | 1 path | | 1 path, 2 path, 2 pipes |
| Calculation output | | | — | — | Average, Addition, Sub (CH1-CH2), Sub (CH2-CH1) |
| Operation mode | | | Normal | | Normal, High speed |
| System unit | | | Metric | | Metric or Inch |
| Measuring conditions | Unit | Flow unit | $m^3/h$ | | L/s, L/min, L/h, L/d, kL/d, ML/d, $m^3/s$, $m^3/min$, $m^3/h$, $m^3/d$, $km^3/d$, $Mm^3/d$, BBL/s, BBL/min, BBL/h, BBL/d, kBBL/d, MBBL/d |
| | | Total unit | $m^3$ | | mL, L, $m^3$, $km^3$, $Mm^3$, mBBL, BBL, kBBL |
| | | Temperature unit | ℃ | | °C, K, F |
| | | Thermal unit | MJ/h | | MJ/h, GJ/h, BTU/h, kBTU/h, MBTU/h, kW, MW |
| | | Total unit (thermal) | MJ | | MJ, GJ, BTU, kBTU, MBTU, kWh, MWh |
| | Process setting | Outer diameter | 60.00 mm | | 6.00 to 6200.00 mm |
| | | Pipe material | PVC | | Carbon steel, Stainless, PVC, Copper, Cast iron, Aluminum, FRP, Ductile iron, PEEK, PVDF, Acrylic and PP<br>Pipe sound velocity<br>(Sound velocity: [m/s, ft/s]) |
| | | Wall thickness | 4.00 mm | | 0.10 to 100.00mm |
| | | Lining material | No lining | | No lining, Tar epoxy, Mortar, Rubber, Teflon, Pyrex glass, PVC<br>Lining S.V. (Sound velocity: [m/s, ft/s]) |
| | | Lining thickness | — | | 0.01 to 100.00 mm |
| | | Kind of fluid | Water | | Water, seawater, dist. water, ammonia, alcohol, benzene, bromide, ethanol, glycol, kerosene, milk, methanol, toluol, lube oil, fuel oil, petrol and refrigerant R410<br>Fluid S.V. (Sound velocity: [m/s, ft/s]) |
| | | Viscosity | $1.0038\times10^{-6}$ $m^2/s$ | | 0.001 to 999.999×$10^{-6}$ $m^2/s$ |
| | | Sensor mounting method | V method | | V method, Z method |
| | | Sensor type | FSSA | | FSSA/FSSG,FLS_12/FLS_22,FSSC,FSG_32, FSG_31/FSG_41,FSSE/FSG_50,FSSF/FSG_51, FSD12,FSSD/FSD22,FSSH/FSD32 |
| | Energy measuremet | Energy mode | Used | | Not used, Used |
| | | Operation mode | Cooling | | Cooling, Heating, Air-conditionning |
| | | Thermal coefficient for cooling | 4.186 | | 1.000 to 9.999 |
| | | Thermal coefficient for heating | 4.123 | | 1.000 to 9.999 |
| Output conditions | Damping | | 5.0 sec | | 0.0 to 100.0 sec |
| | Low flow cut | | 0.15 $m^3/h$ | | 0 to 5 m/s in terms of flow velocity |
| | Analog output | Analog output 1 source channel | CH1：Thermal flow | | CH1: Flow rate, CH1: Thermal flow |
| | | Analog output 2 source channel | CH1：Flow rate | | CH1: Flow rate, CH1: Thermal flow |
| | | Kind | Flow rate | | Velocity, Flow rate |
| | | Range type | Single | | Single, Auto 2, Bi-dir, Bi-dir Auto 2 |
| | | Full scale 1 | 15.000 $m^3/h$ | | 0, ±0.3 to ±32 m/s in terms of flow velocity |
| | | Full scale 2 | 0.000 $m^3/h$ | | 0, ±0.3 to ±32 m/s in terms of flow velocity |
| | | Full scale 1 (thermal) | 0.000 MJ/h | | 0.000000 to 99999999 |
| | | Full scale 2 (thermal) | 0.000 MJ/h | | 0.000000 to 99999999 |
| | | Hysteresis | 10.00% | | 0.00 to 20.00% |
| | | Burnout (current) | Hold | | Not used, Hold, Lower, Upper and Zero |
| | | Burnout timer | 10 sec | | 10 to 900 sec |
| | | Output limit low | -20% | | -20 to 0% |
| | | Output limit high | 120% | | 100 to 120% |
| | Total output | Total mode | Stop | | Start, Stop, Reset |
| | | Total rate | 0 $m^3$ | | 0.000000 to 99999999 |
| | | Total preset | 0 $m^3$ | | 0.000000 to 99999999 |
| | | Total rate (thermal) | 0 MJ | | 0.000000 to 99999999 |
| | | Total preset (thermal) | 0 MJ | | 0.000000 to 99999999 |
| | | Pulse width | 50 msec | | 5m sec, 10 msec, 50 msec, 100 msec, 200 msec, 500 msec, 1000 msec |
| | | Burnout (total) | Hold | | Not used, Hold |
| | | Burnout timer | 10 sec | | 10 to 900 sec |

## <Parameter specification table Measurement mode: 1-path/energy measurement> 2/2

| Setting item | | | Initial value | Setting value | Setting range |
|---|---|---|---|---|---|
| Output conditions | Contact output | DO1 output type | Not used | | Not used, +Total pulse, -Total pulse, Full scale 2, Alarm [All, Hardware fault, Process error]<br>Flow switch<br>・Flow SW high [ ]<br>・Flow SW low [ ],<br>Total switch [ ],<br>AO range over, Pulse range over, –Flow direction,<br>H: Total pulse (T), C: Total pulse (T), Full scale 2 (T), Flow switch (T)<br>・Flow SW high [ ]<br>・Flow SW low [ ] ,<br>Total switch (T) [ ] ,<br>AO range over (T), P: range over (T), Air-conditioning, Temp. alarm |
| | | DO1 output operation | Active ON | | Active ON, Active OFF |
| | | DO2 output type | Not used | | Same as “DO1 output type” |
| | | DO2 output operation | Active ON | | Active ON, Active OFF |
| | | DO3 output type | Not used | | Same as “DO1 output type” |
| | | DO3 output operation | Active ON | | Active ON, Active OFF |
| | | DO4 output type | Not used | | Same as “DO1 output type” |
| | | DO4 output operation | Active ON | | Active ON, Active OFF |
| | Display | Content of display 1st Line | Thermal flow (MJ/h) | | Velocity, Flow rate, Flow rate (%), +Total (Actual), +Total pulse, -Total (Actual), -Total Pulse,<br>H: Total (thermal), H: Total pulse (T), C: Total (thermal), C: Total pulse (T), Thermal flow, Thermal flow (%), Supply temp., Return temp., Temp difference |
| | | Decimal point position of display 1st line | ****. *** | | *. ******, **. *****, ***. ****, ****. ***, *****. **, ******. *, ******** |
| | | Content of display 2nd Line | Flow rate (m/s) | | Velocity, Flow rate, Flow rate (%), +Total (Actual), +Total pulse, -Total (Actual), -Total Pulse,<br>H: Total (thermal), H: Total pulse (T), C: Total (thermal), C: Total pulse (T), Thermal flow, Thermal flow (%), Supply temp., Return temp., Temp difference |
| | | Decimal point position of display 2nd line | ****. *** | | *. ******, **. *****, ***. ****, ****. ***, *****. **, ******. *, ******** |
| Communication | Communication mode | | RS-485 | | MODBUS |
| | Baud rate | | 9600 bps | | 9600 bps, 19200 bps, 38400 bps |
| | Parity | | Odd | | None, Odd, Even |
| | Stop bit | | 1 bit | | 1 bit, 2 bits |
| | Station No. | | 1 | | 1 to 31 |
| LCD | LCD backlight | | ON | | ON, OFF |
| | Lights-out time | | 5 min | | 0 to 99 min |
| | | | | | |

# <Parameter specification table Measurement mode: 2-path> 1/2

| Setting item | | | Initial value | Setting value | Setting range |
|---|---|---|---|---|---|
| ID No | | | 0000 | | ID No. is invalid when 0000 is selected. |
| Language | | | Japanese | | English, Japanese, German, French, Spanish |
| Measurement mode | | | 2 pipes | | 1 path, 2 path, 2 pipes |
| Calculation output | | | Average | | Average, Addition, Sub (CH1-CH2), Sub (CH2-CH1) |
| Action mode | | | Normal | | Normal, High speed |
| System unit | | | Metric | | Metric or Inch |
| Measuring conditions | Unit | Flow unit | $m^3/h$ | | L/s , L/min , L/h , L/d , kL/d , ML/d , $m^3/s$ , $m^3/min$ , $m^3/h$ , $m^3/d$ , $km^3/d$ , $Mm^3/d$ , BBL/s , BBL/min, BBL/h, BBL/d, kBBL/d, MBBL/d |
| | | Total unit | $m^3$ | | mL, L, $m^3$, $km^3$, $Mm^3$, mBBL, BBL, kBBL |
| | Process setting | Outer diameter | 60.00 mm | | 6.00 to 6200.00 mm |
| | | Pipe material | PVC | | Carbon steel, Stainless, PVC, Copper, Cast iron, Aluminum, FRP, Ductile iron, PEEK, PVDF, Acrylic and PP<br>Pipe sound velocity<br>(Sound velocity: [m/s, ft/s]) |
| | | Wall thickness | 4.00 mm | | 0.10 to 100.00 mm |
| | | Lining material | No lining | | No lining, Tar epoxy, Mortar, Rubber, Teflon, Pyrex glass, PVC<br>Lining S.V. (Sound velocity: [m/s, ft/s]) |
| | | Lining thickness | — | | 0.01 to 100.00 mm |
| | | Kind of fluid | Water | | Water, seawater, dist. water, ammonia, alcohol, benzene, bromide, ethanol, glycol, kerosene, milk, methanol, toluol, lube oil, fuel oil, petrol and refrigerant R410<br>Fluid S.V. (Sound velocity: [m/s, ft/s]) |
| | | Viscosity | $1.0038\times10^{-6}$ $m^2/s$ | | 0.001 to $999.999\times10^{-6}$ $m^2/s$ |
| | | Sensor mounting method | V method | | V method, Z method |
| | | Sensor type | FSSA | | FSSA/FSSG,FLS_12/FLS_22,FSSC,FSG_32, FSG_31/FSG_41,FSSE/FSG_50,FSSF/FSG_51, FSD12,FSSD/FSD22,FSSH/FSD32 |
| Output conditions | Damping | | 5.0 sec | | 0.0 to 100.0 sec |
| | Low flow cut | | 0.15 $m^3/h$ | | 0 to 5 m/s in terms of flow velocity |
| | Analog output | Analog output 1 source channel | CH1: Flow rate | | CH1: Flow rate, CH2: Flow rate, CH3: Flow rate (Note2) |
| | | Analog output 2 source channel | CH2: Flow rate | | CH1: Flow rate, CH2: Flow rate, CH3: Flow rate (Note2) |
| | | Kind | Flow rate | | Velocity, Flow rate |
| | | Range type | Single | | Single, Auto 2, Bi-dir, Bi-dir Auto 2 |
| | | Full scale 1 | 15.000 $m^3/h$ | | 0, ±0.3 to ±32 m/s in terms of flow velocity |
| | | Full scale 2 | 0.000 $m^3/h$ | | 0, ±0.3 to ±32 m/s in terms of flow velocity |
| | | Hysteresis | 10.00% | | 0.00 to 20.00% |
| | | Burnout (current) | Hold | | Not used, Hold, Lower, Upper and Zero |
| | | Burnout timer | 10 sec | | 10 to 900 sec |
| | | Output limit low | -20% | | -20 to 0% |
| | | Output limit high | 120% | | 100 to 120% |
| | Total output | Total mode | Stop | | Start, Stop, Reset |
| | | Total rate | 0 $m^3$ | | 0.000000 to 99999999 |
| | | Total preset | 0 $m^3$ | | 0.000000 to 99999999 |
| | | Pulse width | 50 msec | | 5 msec, 10 msec, 50 msec, 100 msec, 200 msec, 500 msec, 1000 msec |
| | | Burnout (total) | Hold | | Not used, Hold |
| | | Burnout timer | 10 sec | | 10 to 900 sec |
| | Contact output | DO1 source channel | CH1 | | CH1, CH2, CH3 |
| | | DO1 output type | Not used | | Not used, +Total pulse, -Total pulse, Full scale 2, Alarm [All, Hardware fault, Process error]<br>Flow switch<br>・Flow SW high [ ]<br>・Flow SW low [ ],<br>Total switch [ ],<br>AO range over, Pulse range over, –Flow direction |
| | | DO1 output operation | Active ON | | Active ON, Active OFF |
| | | DO2 source channel | CH1 | | CH1, CH2, CH3 |
| | | DO2 output type | Not used | | Same as “DO1 output type” |
| | | DO2 output operation | Active ON | | Active ON, Active OFF |
| | | DO3 source channel | CH1 | | CH1, CH2, CH3 |
| | | DO3 output type | Not used | | Same as “DO1 output type” |
| | | DO3 output operation | Active ON | | Active ON, Active OFF |
| | | DO4 source channel | CH1 | | CH1, CH2, CH3 |
| | | DO4 output type | Not used | | Same as “DO1 output type” |
| | | DO4 output operation | Active ON | | Active ON, Active OFF |

## <Parameter specification table Measurement mode: 2-path> 2/2

| Setting item | | | Initial value | Setting value | Setting range |
|---|---|---|---|---|---|
| Output conditions | Display | Source channel of display 1st line | CH1 | | CH1, CH2, CH3 |
| | | Content of display 1st line | Flow rate ($m^3$/h) | | Velocity, Flow rate, Flow rate (%), +Total (Actual), +Total pulse, -Total (Actual), -Total Pulse |
| | | Decimal point position of display 1st line | ****. *** | | *. ******, **. *****, ***. ****, ****. ***, *****. **, ******. *, ******** |
| | | Source channel of display 2nd line | CH2 | | CH1, CH2, CH3 |
| | | Content of display 2nd line | Flow rate ($m^3$/h) | | Velocity, Flow rate, Flow rate (%), +Total (Actual), +Total pulse, -Total (Actual), -Total Pulse |
| | | Decimal point position of display 2nd line | ****. *** | | *. ******, **. *****, ***. ****, ****. ***, *****. **, ******. *, ******** |
| Communication | Communication mode | | RS-485 | | MODBUS |
| | Baud rate | | 9600 bps | | 9600 bps, 19200 bps, 38400 bps |
| | Parity | | Odd | | None, Odd, Even |
| | Stop bit | | 1 bit | | 1 bit, 2 bits |
| | Station No. | | 1 | | 1 to 31 |
| LCD | LCD backlight | | ON | | ON, OFF |
| | Lights-out time | | 5 min | | 0 to 99 min |
| | | | | | |

# <Parameter specification table Measurement mode: 2-pipe> 1/2

| Setting item | | | Initial value | Setting value | | Setting range |
|---|---|---|---|---|---|---|
| ID No | | | 0000 | | | ID No. is invalid when 0000 is selected. |
| Language | | | Japanese | | | English, Japanese, German, French, Spanish |
| Measurement mode | | | 2 pipes | | | 1 path, 2 path, 2 pipes |
| Calculation output | | | Average | | | Average, Addition, Sub (CH1-CH2), Sub (CH2-CH1) |
| Action mode | | | Normal | | | Normal, High speed |
| System unit | | | Metric | | | Metric or Inch |
| Setting item | | | Initial value | Path 1 (CH1) | Path 2 (CH2) | Setting range |
| Measuring conditions | Unit | Flow unit | $m^3/h$ | | | L/s , L/min , L/h , L/d , kL/d , ML/d , $m^3/s$ , $m^3/min$ , $m^3/h$ , $m^3/d$ , $km^3/d$ , $Mm^3/d$ , BBL/s , BBL/min, BBL/h, BBL/d, kBBL/d, MBBL/d |
| | | Total unit | $m^3$ | | | mL, L, $m^3$, $km^3$, $Mm^3$, mBBL, BBL, kBBL |
| | Process setting | Outer diameter | 60.00 mm | | | 6.00 to 6200.00 mm |
| | | Pipe material | PVC | | | Carbon steel, Stainless, PVC, Copper, Cast iron, Aluminum, FRP, Ductile iron, PEEK, PVDF, Acrylic and PP<br>Pipe sound velocity<br>(Sound velocity: [m/s, ft/s]) |
| | | Wall thickness | 4.00 mm | | | 0.10 to 100.00 mm |
| | | Lining material | No lining | | | No lining, Tar epoxy, Mortar, Rubber, Teflon, Pyrex glass, PVC<br>Lining S.V. (Sound velocity: [m/s, ft/s]) |
| | | Lining thickness | — | | | 0.01 to 100.00 mm |
| | | Kind of fluid | Water | | | Water, seawater, dist. water, ammonia, alcohol, benzene, bromide, ethanol, glycol, kerosene, milk, methanol, toluol, lube oil, fuel oil, petrol and refrigerant R410<br>Fluid S.V. (Sound velocity: [m/s, ft/s]) |
| | | Viscosity | $1.0038\times10^{-6}$ $m^2/s$ | | | $0.001$ to $999.999\times10^{-6}$ $m^2/s$ |
| | | Sensor mounting method | V method | | | V method, Z method |
| | | Sensor type | FSSA | | | FSSA/FSSG,FLS_12/FLS_22,FSSC,FSG_32, FSG_31/FSG_41,FSSE/FSG_50,FSSF/FSG_51, FSD12,FSSD/FSD22,FSSH/FSD32 |

| Setting item | | | Initial value | Path 1 (CH1) | Path 2 (CH2) | Calculated value (CH3) | Setting range |
|---|---|---|---|---|---|---|---|
| Output conditions | Damping | | 5.0 sec | | | — | 0.0 to 100.0 sec |
| | Low flow cut | | 0.15 $m^3/h$ | | | — | 0 to 5m/s in terms of flow velocity |
| | Analog output | Analog output 1 source channel | CH1: Flow rate | | | | CH1: Flow rate, CH2: Flow rate, CH3: Flow rate (Note2) |
| | | Analog output 2 source channel | CH2: Flow rate | | | | CH1: Flow rate, CH2: Flow rate, CH3: Flow rate (Note2) |
| | | Kind | Flow rate | | | Flow rate | Velocity, Flow rate |
| | | Range type | Single | | | | Single, Auto 2, Bi-dir, Bi-dir Auto 2 |
| | | Full scale 1 | 15.000 $m^3/h$ | | | | 0, ±0.3 to ±32 m/s in terms of flow velocity |
| | | Full scale 2 | 0.000 $m^3/h$ | | | | 0, ±0.3 to ±32 m/s in terms of flow velocity |
| | | Hysteresis | 10.00% | | | | 0.00 to 20.00% |
| | | Burnout (current) | Hold | | | | Not used, Hold, Lower, Upper and Zero |
| | | Burnout timer | 10 sec | | | | 10 to 900 sec |
| | | Output limit low | -20% | | | | -20 to 0% |
| | | Output limit high | 120% | | | | 100 to 120% |
| | Total output | Total mode | Stop | | | | Start, Stop, Reset |
| | | Total rate | 0 $m^3$ | | | | 0.000000 to 99999999 |
| | | Total preset | 0 $m^3$ | | | | 0.000000 to 99999999 |
| | | Pulse width | 50 msec | | | | 5 msec, 10 msec, 50 msec, 100 msec, 200 msec, 500 msec, 1000 msec |
| | | Burnout (total) | Hold | | | | Not used, Hold |
| | | Burnout timer | 10 sec | | | | 10 to 900 sec |
| | Contact output | DO1 source channel | CH1 | | | | CH1, CH2, CH3 |
| | | DO1 output type | Not used | | | | Not used, +Total pulse, -Total pulse, Full scale 2, Alarm [All, Hardware fault, Process error]<br>Flow switch<br>・Flow SW high [ ]<br>・Flow SW low [ ],<br>Total switch [ ],<br>AO range over, Pulse range over, –Flow direction |
| | | DO1 output operation | Active ON | | | | Active ON, Active OFF |
| | | DO2 source channel | CH1 | | | | CH1, CH2, CH3 |
| | | DO2 output type | Not used | | | | Same as “DO1 output type” |
| | | DO2 output operation | Active ON | | | | Active ON, Active OFF |
| | | DO3 source channel | CH1 | | | | CH1, CH2, CH3 |
| | | DO3 output type | Not used | | | | Same as “DO1 output type” |
| | | DO3 output operation | Active ON | | | | Active ON, Active OFF |
| o | | DO4 source channel | CH1 | | | | CH1, CH2, CH3 |

## <Parameter specification table Measurement mode: 2-pipe> 2/2

| Setting item | | | Initial value | Setting value | Setting range |
|---|---|---|---|---|---|
| | | DO4 output type | Not used | | Same as “DO1 output type” |
| | | DO4 output operation | Active ON | | Active ON, Active OFF |
| | Display | Source channel of display 1st line | CH1 | | CH1, CH2, CH3 |
| | | Content of display 1st line | Flow rate ($m^3$/h) | | Velocity, Flow rate, Flow rate (%), +Total (Actual), +Total pulse, -Total (Actual), -Total Pulse |
| | | Decimal point position of display 1st line | ****. *** | | *. ******, **. *****, ***. ****, ****. ***, *****. **, ******. *, ******** |
| | | Source channel of display 2nd line | CH2 | | CH1, CH2, CH3 |
| | | Content of display 2nd line | Flow rate ($m^3$/h) | | Velocity, Flow rate, Flow rate (%), +Total (Actual), +Total pulse, -Total (Actual), -Total Pulse |
| | | Decimal point position of display 2nd line | ****. *** | | *. ******, **. *****, ***. ****, ****. ***, *****. **, ******. *, ******** |
| Communication | Communication mode | | RS-485 | | MODBUS |
| | Baud rate | | 9600 bps | | 9600 bps, 19200 bps, 38400 bps |
| | Parity | | Odd | | None, Odd, Even |
| | Stop bit | | 1 bit | | 1bit, 2 bits |
| | Station No. | | 1 | | 1 to 31 |
| LCD | LCD backlight | | ON | | ON, OFF |
| | Lights-out time | | 5 min | | 0 to 99 min |
| | | | | | |

Note1: When total pulse output has been selected for DO1, DO2, DO3, DO4 specify total pulse value and total pulse width so that conditions 1 and 2 shown below are satisfies.

Condition 1 : $\frac{\text{Flow span-1*}[m^3/s]}{\text{total pulse value*}[m^3]} \leqq 100[Hz]$ Condition 2 : $\frac{\text{Flow span-1*}[m^3/s]}{\text{total pulse value*}[m^3]} \leqq \frac{1000}{2 \times \text{total pulse width [ms]}}$

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

Note1: The definition of channels
Channel 1 (CH1) is assigned for the output from path 1.
Channel 2 (CH2) is assigned for the output from path 2.
Channel 3 (CH3) is assigned for the calculation output (any of average value, added value, and subtracted value).

[Remarks]

Information in this catalog is subject to change without notice.
Read the instruction manuals thoroughly before using the products.

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