ULTRASONIC FLOWMETER TIME DELTA-C
TYPE: FSV-2, FSS, FLYD

The latest advance in high performance transit time flow measurement
Superior signal processing and best-in-class anti-bubble performance in a compact and lightweight package

- High accuracy measurement: 1.0% of rate
- Superior anti-bubble performance: Our Advanced ABM method * is adopted.
- Maintenance free operation: Non-invasive setup with no moving parts
- Compact and lightweight: Size and mass reduced by 2/3 (compared with model FLV).
- Flexible communication functions: RS-485 (MODBUS) (option)
- Wide application range: φ13 to φ6000mm applicable pipe diameters
  Extendable rail type detector up to φ50 to φ1200mm
- Quick and easy setup: Simple menu guided setup from the front panel or PC interface

* Advanced ABM method: anti-bubble measuring method.
Applicable pipe diameter is \( \phi 13\text{mm} \) to \( \phi 6000\text{mm} \)

- High accuracy measurement of fluid flow rate: 1.0% of rate
- Quick response: 0.2 sec. or less (quick response mode)
- Minimal Influence by the pressure of measured fluid and temperature
- Superior anti-bubble performance
  (Advanced AMB method * is adopted.)

* Advanced ABM method: anti-bubble measurement method

### Measuring principle

With ultrasonic pulses propagated diagonally between the upstream and downstream sensors mounted on the exterior of the pipe, the flow rate is measured by detecting the time difference caused by the flow.

### Advanced received signal digital processing results in higher performance flow measurement

- Normal propagation
- Propagation interrupted by bubble

- Flow velocity
- [m/s]

- Acceptable value of bubble quantity
- [vol.%]

- In the case of an analog system, measurement failure will occur.

- Summed 128 or 256 times for a single output

- Digital data of the received signals:

**Synchronized summation of received signals**

### Explanation of the extendable rail type detector (type: FSSC)

#### Normal

- pipe diameter \( \phi 50 \) to \( \phi 300\text{mm} \) \(<V \text{ method}>\)

#### Extended on rails

- pipe diameter up to \( \phi 6000\text{mm} \) \(<V \text{ method}>\)

#### Z method

- pipe diameter up to \( \phi 1200\text{mm} \) \(<Z \text{ method}>\)
  (rail removed)

(A detector is simply attached to the exterior of the piping.)

<table>
<thead>
<tr>
<th>Classification</th>
<th>Appearance</th>
<th>Detector type</th>
<th>Applicable pipe inner diameter (mm)</th>
<th>Measured fluid temperature</th>
<th>Mounting/structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extendable rail type</td>
<td></td>
<td>FSSC</td>
<td>( \phi 50 ) to ( \phi 1200 )</td>
<td>-20 to 120°C</td>
<td>- V or Z method mounting</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Jet structure (equivalent to IP65)</td>
</tr>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td>- Submersible type available</td>
</tr>
<tr>
<td>Compact type</td>
<td></td>
<td>FSSA</td>
<td>( \phi 25 ) to ( \phi 225 )</td>
<td>-20 to 100°C</td>
<td>- V method mounting</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>- Jet structure (equivalent to IP65)</td>
</tr>
<tr>
<td>Small diameter type</td>
<td></td>
<td>FSSD</td>
<td>( \phi 13 ) to ( \phi 100 )</td>
<td>-40 to 100°C</td>
<td>- V mounting method</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>- Splash-proof structure (equivalent to IP52)</td>
</tr>
<tr>
<td>High temperature type</td>
<td></td>
<td>FSSH</td>
<td>( \phi 50 ) to ( \phi 400 )</td>
<td>-40 to 200°C</td>
<td>- V or Z method mounting</td>
</tr>
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<td></td>
<td></td>
<td>- Splash-proof structure (equivalent to IP52)</td>
</tr>
<tr>
<td>Large diameter type</td>
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<td>FSSE</td>
<td>( \phi 200 ) to ( \phi 6000 )</td>
<td>-40 to 80°C</td>
<td>- V or Z method mounting</td>
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<tr>
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<td></td>
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<td></td>
<td></td>
<td>- Watertight structure (equivalent to IP67)</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Submersible type available</td>
</tr>
</tbody>
</table>
Both the mass and volume of the flow transmitter are reduced by 2/3!

- **Compact and lightweight flow transmitter (1/3 size of model FLV)**
  Easy to carry and install on a system
  - **<Our FLV type>**
    - Mass: approx 4.5kg
    - 220mm x 230mm
  - **<Our FSV type>**
    - Mass: approx 1.5kg
    - 142mm x 170mm

- **Operation can be performed from the outside panel (In case of IP66 type)**
  Various settings can be made from the front side without opening the cover of the flow transmitter. (Parameter setting, input of mounted pipe data, automatic calculation of mounting dimensions and similar)

- **Parameter setting and data collection can be performed via optional PC communications interface.**

- **Signal and process interfaces are designed with functionality as priority.**
  - **Input signal from the detector**
  - **Analog output 1 point (4 to 20mA, insulated)** (max. load resistance: 600Ω)
  - **Transistor contact 2 points (insulated)** Output frequency: 100P/s max., pulse width 5 to 1000ms)
  - **Communication signal (RS485 communication)** (Insulated)
  - **Power supply voltage (with arrester, 100 to 240VAC or 20 to 30VDC)**

- **Fully equipped with extensive functions**
<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zero adjustment</td>
<td>One-touch adjustment while the flow is stopped</td>
</tr>
<tr>
<td>Damping</td>
<td>Used to reduce the fluctuation of the measured value. Setting range: 0 to 100 sec. (setting per 0.1 sec.)</td>
</tr>
<tr>
<td>Low flow rate cut</td>
<td>Output may be cut when the flow rate is low. Setting range: 0 to 5m/s (setting in 0.01m/s unit)</td>
</tr>
<tr>
<td>Alarm contact output</td>
<td>Contact output at condition of hardware and process faults</td>
</tr>
<tr>
<td>Output burnout</td>
<td>When measurement cannot be made because the pipe is empty or bubbles are entrained in the fluid, contact output is activated while analog output is held.</td>
</tr>
<tr>
<td>Forward and backward ranges</td>
<td>Ranges may be set arbitrarily. The digital output of the operation range is available.</td>
</tr>
<tr>
<td>Auto 2-range</td>
<td>2 forward ranges are independently configurable. Digital output of operation is available.</td>
</tr>
<tr>
<td>Flow switch</td>
<td>Contact output is made when the upper or lower limit values of the instantaneous flow rate are reached</td>
</tr>
<tr>
<td>Total value switch</td>
<td>Contact output is made when the upper limit value of the total flow rate (forward) exceeds the setting value.</td>
</tr>
<tr>
<td>Display of various units</td>
<td>Unit may be set in m/s, L/s, L/min, L/h, L/d, KL/d, ML/d, m³/s, m³/min, m³/h, m³/d, Km³/d, Mm³/d</td>
</tr>
<tr>
<td>Multilingual display</td>
<td>The display language may be selected from 5 choices, including Japanese (Katakana), English, French, Spanish and German.</td>
</tr>
</tbody>
</table>

- **Related products**
  Our product lineup includes such models as: consumed energy calculation, simultaneous measurement of 2 pipes, dual-path measurement. (Refer to the catalog No. 21A1-E-0024)
**Application example**

- The ultrasonic flowmeter is a liquid flowmeter used in various applications.

1. Measuring system for the paint flow rate
   The flow rate of thick paint is measured by a detector mounted on the pipe already constructed.

2. An energy-saving system for measuring and controlling the flow rate of a pump
   A detector is attached to the already constructed pipe to measure the flow rate at the pump outlet, and a regulator is used to implement inverter control of the pump.

3. Flow rate measurement in a water purifying system for semi-conductors
   Advantages of using an ultrasonic flowmeter for the system

   1) It can be easily mounted on the exterior of a pipe, helping reduce mounting cost.
   2) As a sensor, it can operate without coming into contact with fluid, so the fluid is not affected by metallic ions.
   3) This meter, compact and lightweight, can be easily carried and mounted.

4. Consumed energy calculation function
   Calculates the thermal energy received and sent with liquid (water) in cooling and heating.

   - It can be mounted on the pipe already constructed.
   - Small, lightweight and easy to mount

- Major applications
  - Backup for the already constructed flowmeter
  - Water supply and sewage systems (leakage investigation of water pipe and investigation of the flow direction in the water distribution pipe)
  - Power plant (flow rate measurement of the boiler water supply, condenser circulating pump and turbine oil)
  - Various plants (flow rate measurement of cooling water, plating solution and corrosive liquid)
  - Food manufacturing plant (flow rate measurement of raw material and washing water)
  - Semiconductor manufacturing plant (flow rate measurement of pure water)
  - Air-conditioning equipment (flow rate measurement of hot water and chilled water in heating and cooling)
  - Hot spring (Measurement of suction quantity)
Example of system configuration

Flow transmitter (Type: FSV)

Detector (Type: FSS)

Signal cable (Type: FLY)

Paperless recorder (Type: PHF)

RS-485 Communication

4 to 20mA DC

Pulse output

Contact output

Relay

Pulse output

Integrator

Contact output

Relay

Detector (Type: FSS)

RS-485

Contact output

Paperless recorder (Type: PHF)

Flow transmitter (Type: FSV)

Power Supply

< V method >

< Z method >

CODE SYMBOL

Flow transmitter

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<th>Description</th>
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Signal cable

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Detector

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<td>Guide rail</td>
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<td>A</td>
<td>B</td>
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</tbody>
</table>

Outline diagram detector signal cord

SCOPE OF DELIVERY

- Flow transmitter (provided with U-bolt and nuts for pipe mount)
- Detector
- Signal cable
- CD-ROM (contains instruction manual, loader software)

Note: When detector is FSSA, length of signal cable is up to 60m.

*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.
*2) It is selectable only for FSSC type and FSSE type.
### Applicable subjects and operation environment

**Applicable fluid**
- Homogeneous liquids capable of ultrasonic wave propagation
- Bubble quantity: 0 to 12Vol% (reference diameter 50A, water and flow velocity of 1m/s)
- Turbidity of fluid: 10000 degrees (mg/L) or less
- Straight pipe length: upstream side 10D or more, downstream 5D or more (D: pipe inner diameter)
- State of flow: fully developed turbulent or laminar flow in round pipe filled with fluid

**Applicable piping and fluid temperature**

<table>
<thead>
<tr>
<th>Classifi cation</th>
<th>Detector type</th>
<th>Pipe size (inner diameter) φ (mm)</th>
<th>Flow temperature range (°C) (Note 2)</th>
<th>Fluid temperature range (°C) (Note 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compact type</td>
<td>FSSA</td>
<td>25 to 50</td>
<td>20 to +100</td>
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<tr>
<td></td>
<td></td>
<td>50 to 225</td>
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<td></td>
</tr>
<tr>
<td>Extendable rail type</td>
<td>FSSC</td>
<td>50 to 200</td>
<td>20 to +120</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>13 to 100</td>
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</tr>
<tr>
<td>Small diameter type</td>
<td>FSSD</td>
<td>200 to 1000</td>
<td>20 to +80</td>
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<td></td>
<td></td>
<td>500 to 6000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Large diameter type</td>
<td>FSSE</td>
<td>50 to 200</td>
<td>20 to +200</td>
<td></td>
</tr>
<tr>
<td>High temperature type</td>
<td>FSSH</td>
<td>150 to 400</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Flow velocity range**
0 to ±0.3 m/s

**Power supply voltage**
100 to 240VAC 50/60Hz or 20 to 30VDC

**Power consumption**
15VA or less (AC power supply), 6W or less (DC power supply)

**Signal cable** (between the detector and converter)
Coaxial cable (60m max. for compact type detector (FSSA), 300m max. for others)

**Heat resistance**
80°C

**Installation environment**
- Non-explosive area not exposed to direct sunlight, corrosive gas or heat radiation
- Flow transmitter: -20 to 55°C
- Detector: -20 to 60°C

### Performance specifications

<table>
<thead>
<tr>
<th>Accuracy rating</th>
<th>Classifi cation</th>
<th>Detector type</th>
<th>Pipe size (inner diameter) φ (mm)</th>
<th>Flow velocity (m/s)</th>
<th>Accuracy</th>
<th>Plastic pipe</th>
<th>Metal pipe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compact type</td>
<td>FSSA</td>
<td>25 to 50</td>
<td>3 to 32</td>
<td>±0.04 m/s</td>
<td>±2.0% of rate</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>50 to 225</td>
<td>2 to 32</td>
<td>±0.03 m/s</td>
<td>±1.0% of rate</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>200 to 1000</td>
<td>2 to 32</td>
<td>±0.03 m/s</td>
<td>±2.0% of rate</td>
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<td></td>
</tr>
<tr>
<td>Extendable rail type</td>
<td>FSSC</td>
<td>50 to 200</td>
<td>2 to 32</td>
<td>±0.03 m/s</td>
<td>±1.0% of rate</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>300 to 1200</td>
<td>2 to 32</td>
<td>±0.03 m/s</td>
<td>±2.0% of rate</td>
<td></td>
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</tr>
<tr>
<td>Small diameter type</td>
<td>FSSD</td>
<td>13 to 50</td>
<td>2 to 32</td>
<td>±0.03 m/s</td>
<td>±1.0% of rate</td>
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<tr>
<td></td>
<td></td>
<td>50 to 100</td>
<td>2 to 32</td>
<td>±0.03 m/s</td>
<td>±2.0% of rate</td>
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<tr>
<td>Large diameter type</td>
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<td>200 to 300</td>
<td>2 to 32</td>
<td>±0.03 m/s</td>
<td>±1.0% of rate</td>
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<td></td>
<td></td>
<td>300 to 1200</td>
<td>0.75 to 32</td>
<td>±0.0013 m/s</td>
<td>±1.0% of rate</td>
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<td>1200 to 6000</td>
<td>0.75 to 32</td>
<td>±0.0075 m/s</td>
<td>±1.0% of rate</td>
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<td>150 to 400</td>
<td>0.75 to 32</td>
<td>±0.02 m/s</td>
<td>±0.0075 m/s</td>
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</tr>
</tbody>
</table>

**Response time**
- 0.5 sec. (standard mode)
- 0.2 sec. depending on setting (quick response mode)
## 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
- Output: 2 points
- Normal: ON/OFF selectable
- Contact capacity: 30VDC, 50mA
- Output frequency: 100P/s max. (pulse width: 5, 10, 50, 100, 200, 500, 1000ms)

**Serial communication**
RS-485(MODBUS), isolated
Connectable quantity: 31 units
Baud rate: 9600, 19200, 38400bps
Partly: None/Odd/Even selectable
Data: Flow velocity, flow rate, forward total, reverse total, status, etc.

**Display device**
2-color LED (Normal: green, Abnormal: red), LCD display (2 lines of 16 digits, back light provided)

**Indication language**
Japanese (Katakana), English, French, German, Spanish (switchable)

**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) English and metric units selectable.

<table>
<thead>
<tr>
<th>Unit</th>
<th>Metric system</th>
<th>Inch system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Velocity</td>
<td>m/s</td>
<td>ft/s</td>
</tr>
<tr>
<td>Flow rate</td>
<td>L/s, L/min, L/h, L/d, m³/min, m³/d, m³/s, m³/h, m³/1000 ft³/h, ft³/min, ft³/d, ft³/h</td>
<td></td>
</tr>
<tr>
<td>Gal</td>
<td>gal, gal/min, gal/h, gal/d, m³/gal, ft³/gal, ft³/min, ft³/d, ft³/h</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>m³, l, m³/cm³, m³/l, m³/l, m³/gal, m³/gal/h, m³/gal/d, m³/gal/1000 ft³/h, ft³/gal, ft³/min, ft³/d, ft³/h</td>
<td></td>
</tr>
</tbody>
</table>

**Total indication**
Forward or reverse total value indication (negative indication for reverse direction)
Numerals: 8 digits (decimal point is counted as 1 digit) English and metric units selectable.

**Setting function**
Setting available with 4 keys (ESC, △, ▷, ENT) on the flowmeter front

**Zero adjustment**
Set zero/Clear available

**Damping**
0 to 100s (setting per 0.1 sec.) 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/Over-scale/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 20% 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**
Upper limit of the forward total settable (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: IP66 or IP67
Mounting method
Mounted on wall or by 2B pipe / Detector: Clamped on existing piping.

**Acoustic couplant**
Silicone rubber, silicone grease or silicone-free grease

**Note:** The acoustic couplant is a medium that eliminates the gap between detector and pipe.

<table>
<thead>
<tr>
<th>Type</th>
<th>Silicone rubber (type:KE-348W)</th>
<th>Silicone grease (type:G40M)</th>
<th>Silicone-free grease (type:HIGH Z)</th>
<th>Grease for high temperature (type:KS62M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluid temperature</td>
<td>–40 to +150°C</td>
<td>–30 to +150°C</td>
<td>0 to +60°C</td>
<td>–30 to +250°C</td>
</tr>
<tr>
<td>Teflon piping</td>
<td>Not usable</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
</tr>
</tbody>
</table>

## Loader software (standard accessory)

**Compatible PC model**
PC/AT compatible instrument

**Main function**
Software for setting/change of the main unit parameters and for collection of the measured data on PC

**OS**
Windows 2000/XP/7/8

**Memory requirement**
125MB min.

**Hard disk capacity**
Minimum free space of 52MB or more

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## Connection diagram

![Connection diagram](attachment:image.png)
### Outline diagram of the flow transmitter (unit: mm)

<table>
<thead>
<tr>
<th>Type: FSV...S (Weight: 1.5kg)</th>
<th>Type: FSV···H (Weight: 4.9kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Diagram" /></td>
<td><img src="image2.png" alt="Diagram" /></td>
</tr>
</tbody>
</table>

### Outline diagram of detector (unit: mm)

<table>
<thead>
<tr>
<th>Type: FSSC (diameter φ50 to φ1200, Weight: 1kg)</th>
<th>Type: FSSA (diameter φ25 to φ225, Weight: 0.4kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image3.png" alt="Diagram" /></td>
<td><img src="image4.png" alt="Diagram" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type: FSSH (diameter φ50 to φ400, Weight: 1.6kg)</th>
<th>Type: FSSD (diameter φ13 to φ100, Weight: 0.6kg)</th>
<th>Type: FSSE (diameter φ200 to φ6000, Weight: 1.2kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image5.png" alt="Diagram" /></td>
<td><img src="image6.png" alt="Diagram" /></td>
<td><img src="image7.png" alt="Diagram" /></td>
</tr>
</tbody>
</table>

**Caution on Safety**

*Before using products in this catalog, be sure to read their instruction manuals in advance.*