Unaffected by foam or bubbles on the surface

Eliminating False Detection

THE INDUSTRY’S FIRST SENSING GUIDE PULSE LEVEL SENSOR

Water  Oil  Chemicals  Viscous Liquids

STABLE DETECTION OF EVERY TYPE OF LIQUID

Build-up resistant, maintenance free
Our unique algorithm for liquid level detection allows for monitoring of every type of liquid. Continuous stable detection has been achieved under any environment. This is a new-generation of level sensing that eliminates all factors of false detection that were problems with conventional level sensors.
Conventional Issues Eliminated

Conventional level sensors were commonly associated with false readings and unstable detections. Along with these concerns, external factors such as build-up, foam, and rust would further amplify these issues with conventional level sensors. These problems are eliminated with the new Sensing Guide Pulse Level Sensor.

Your benefit

The FL Series solves all of the problems associated with conventional level sensors, to provide reliable readings and stable detection. This helps to prevent costly downtime from situations such as boil-dry, tank overflow, or unintended liquid depletion.

Stable Detection Achieved

When guide pulse technology was discovered, the concept of level sensing was forever changed. The FL series harnessed this detection method and enhanced it with its unique “TriSense Technology.” This includes three unparalleled algorithms that expand the versatility and usability of this series.

Your benefit

While guide pulse technology improved upon conventional issues, the unique sensing style of the FL series extends this technology much further. This includes being able to detect liquids more than just of water, ignore obstacles in the environment, and automatically adjust detection to account for build-up.

Integration Simplified

The FL series can be setup in seconds with only three simple steps. It can also integrate into any situation with its variety of output options, including four independent level outputs. Along with this, the multiple models available allow it to be used in any environment.

Your benefit

With the FL Series, innovative technology does not have to require a complex setup. The immediate startup process will save valuable time on initial setup. Between its multiple output options and various models available, the FL series will provide stable detection that lasts in any environment.
Conventional level sensing methods present unique problems

**CONVENTIONAL METHOD 1**

**FLOAT TYPE**

This type monitors a "float" that sits on the surface of the liquid. Since moving parts are required, it is subject to false detection due to breakage or the float becoming stuck.

**PROBLEMS**

- False detection caused by the float becoming stuck
- False detection caused by breakage of the float
- False detection caused by bubbles/foam on the surface
- Not compatible with viscous liquids

**CONVENTIONAL METHOD 2**

**ELECTRODE TYPE**

This type works by measuring the conductivity between electrodes. Since it can only detect electrical conductivity, detection is affected by the environment.

**PROBLEMS**

- False detection caused by coatings/rust
- False detection caused by condensation
- Not compatible with non-conductive liquids
- Not compatible with viscous liquids

**CONVENTIONAL METHOD 3**

**ULTRASONIC TYPE**

This type uses the reflection principle of ultrasonic sound waves. Since sound waves tend to spread, detection is affected by objects inside the tank.

**PROBLEMS**

- False detection caused by spreading sound waves
- False detection caused by ripples
- False detection caused by vapor from the liquid
- False detection caused by bubbles/foam on the surface

**CONVENTIONAL METHOD 4**

**CAPACITANCE TYPE**

This type monitors the capacitance generated between the liquid and tank wall. Detection is affected by the changes in the property or temperature of the liquid.

**PROBLEMS**

- False detection caused by changes in the liquid property
- False detection caused by a change in temperature
- Adjustment using an empty tank is required
- Not applicable with plastic tanks
False detection caused by these factors can be eliminated

**BUILD-UP**
Even when viscous foreign materials or metal powders adhere to the probe (sensing section), false detection is prevented.

**VAPOR**
Even when the liquid is heated and emits vapor in the tank, sensing is stable without any false detection.

**RIPPLES**
Even when the liquid surface has ripples caused by a mixing propeller in the tank, detection is stable without any false detection.

**CONDENSATION**
Even when condensation forms on the probe (sensing section) due to a difference in the temperatures inside and outside of the tank, there is no worry for false detection. Liquid temperature up to 150°C 302°F* is acceptable.

**FOAM**
Even when foam forms on the surface due to mixing of the liquid, the FL Series can measure the surface immediately below the foam instead of the upper surface of the foam.

**RUST/COATING**
Even in environments where a coating or rust accumulates continuously on the probe (sensing section), stable sensing is ensured.

**CHANGE IN PROPERTY**
Even when several different liquids are being mixed or the property of the liquid changes due to temperature variation, detection is stable.

**OBSTACLES**
Detection is stable without being affected by any obstacles such as heaters or mixing propellers inside the tank.

* When the sanitary type is used
New liquid level detection technology achieves truly stable detection

The foundation of the FL Series is rooted in the guide pulse method of detection, which involves no moving parts. This method was further reinforced by TriSense Technology, originally developed by KEYENCE, resulting in a new “Sensing Guide Pulse Method.” The algorithms, which can handle various sensing conditions, eliminate false detection and achieve stable detection all of the time.

GUIDE PULSE METHOD DETECTION PRINCIPLE

The sensor transmits a pulse signal to the liquid along the guide probe. It then receives the pulse signal reflected off of the liquid surface and determines the distance (level) from the time between the transmission and reception of the pulse signal. The detected distance \( L \) is determined by using the formula \( L = \frac{1}{2} \times T \times C \), where \( T \) is the time between the transmission and reception, and \( C \) is the speed of the pulse.
1. SENSING OF ANY LIQUID

The sensor automatically adjusts to properly detect any liquid. Along with water, other liquids such as oils and chemicals can now be detected with ease.

**Automatic relative permittivity identification algorithm**

The sensor automatically determines and adjusts to the type of liquid being measured, by monitoring the speed of the pulse signal passing through the liquid. Unlike conventional guide pulse level sensors, various types of liquids such as water, oils, or chemicals can be detected without any adjustment.

* Relative permittivity = Liquid surface reflectance

2. SENSING OF THE INSTALLATION ENVIRONMENT

The environment around the probe is recognized and ignored. Even when the space is limited or there is an obstacle nearby, the sensor learns its installation environment in real time* and eliminates the risk of false detection.

**Automatic environment update algorithm**

The sensor automatically stores data from the waves being reflected by the environment around the probe. By sensing and differentiating the waves reflected from the surroundings, it eliminates false detection caused by changes in the installation environment. The data of waves reflected from the surroundings is updated in real time, ensuring the detection of the liquid surface only.

* When using the automatic environment update function

3. SENSING OF THE PROBE CONDITION

The probe, which transmits pulse signals, is continuously monitoring for buildup. Based on this data, the FL Series is able to appropriately adjust its sensitivity to ensure stable detection.

**Probe sensing algorithm**

The sensor automatically optimizes liquid level detection by differentiating between the liquid level and build-up on the probe. This ensures stable detection for long periods of time. If there is too much accumulation or environmental changes to conduct stable detection, a warning signal can be issued before problems occur.
Functions ensuring ease of use

START UP IMMEDIATELY AFTER INSTALLATION

Startup is almost immediate after installation of the probe. Simply input the probe length and necessary output thresholds directly on the unit to start stably detecting liquid level. This eliminates the need for empty tank adjustment and other time consuming tasks associated with conventional level sensors.

OUTPUT SPECIFICATIONS

In addition to four independent outputs and one analog output (4 to 20 mA), stability warning and alarm outputs are provided as standard.

SCALING FUNCTION

The liquid level can be displayed not only in mm, cm, m and inch but also as a capacity (%). The sensor also features an “offset function” to allow addition/subtraction to the display values and an “auto-zero function” to set any level to zero. Multiple display options are available to account for any situation.
Three unique models for any condition

**STANDARD TYPE**

Controller model  
**FL-001**

Not only water but also oils, coolants, and other non-corrosive liquids can be detected.

- Water/oil model
- Applicable for liquids containing solid particulates
- Applicable for viscous liquids

**SANITARY TYPE**

Controller model  
**FL-S001**

This model features CIP/SIP-compatible fluid-end materials and can be used in food or chemical industries.

- Food/chemical industry model
- Ready for CIP/SIP cleaning
- Applicable for viscous liquids

**PLASTIC TYPE**

Controller model  
**FL-C001**

This model can be used for all chemical liquids including hydrochloric acid, nitric acid, and hydrogen fluoride.

- Chemical tank model
- Applicable for corrosive liquids
- Applicable for viscous liquids
FREE-CUT DESIGN

The probe of the standard type can be cut to a required length according to the measurement range.

* Free-cut is available with the standard type only.
* The minimum length for the probe is 100 mm (3.3')

STANDARD COMPLIANCE

These units have been evaluated for compliance with the Hygienic Equipment Design Criteria of the EHEDG and 3-A Sanitary Standards.

System Setup

<table>
<thead>
<tr>
<th>CONTROLLER (Required)</th>
<th>PROBE (Required)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Standard type</strong></td>
<td></td>
</tr>
<tr>
<td>FL-001</td>
<td></td>
</tr>
<tr>
<td>OP-87558 cap for sanitary type controller included</td>
<td></td>
</tr>
<tr>
<td><strong>Sanitary type</strong></td>
<td></td>
</tr>
<tr>
<td>FL-S001</td>
<td></td>
</tr>
<tr>
<td><strong>Plastic type</strong></td>
<td></td>
</tr>
<tr>
<td>FL-C001</td>
<td></td>
</tr>
<tr>
<td>FL-P20 (200 mm 0.66&quot;)</td>
<td></td>
</tr>
<tr>
<td>FL-P40 (400 mm 1.31&quot;)</td>
<td></td>
</tr>
<tr>
<td>FL-P60 (600 mm 1.97&quot;)</td>
<td></td>
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<tr>
<td>FL-P80 (800 mm 2.62&quot;)</td>
<td></td>
</tr>
<tr>
<td>FL-P100 (1000 mm 3.28&quot;)</td>
<td></td>
</tr>
<tr>
<td>FL-P120 (1200 mm 3.94&quot;)</td>
<td></td>
</tr>
<tr>
<td>FL-P140 (1400 mm 4.59&quot;)</td>
<td></td>
</tr>
<tr>
<td>FL-P160 (1600 mm 5.25&quot;)</td>
<td></td>
</tr>
<tr>
<td>FL-P180 (1800 mm 5.91&quot;)</td>
<td></td>
</tr>
<tr>
<td>FL-P200 (2000 mm 6.56&quot;)</td>
<td></td>
</tr>
<tr>
<td>FL-SP20 (200 mm 0.66&quot;)</td>
<td></td>
</tr>
<tr>
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<td></td>
</tr>
<tr>
<td>FL-CP20 (200 mm 0.66&quot;)</td>
<td></td>
</tr>
<tr>
<td>FL-CP40 (400 mm 1.31&quot;)</td>
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<td></td>
</tr>
<tr>
<td>FL-CP200 (2000 mm 6.56&quot;)</td>
<td></td>
</tr>
</tbody>
</table>
### CABLE (Required)
- **Standard power supply cable**
  - The following are standard PVC cables.
  - **Straight cable**
    - OP-87564 (2 m 6.6')
    - OP-87565 (5 m 16.4')
    - OP-87566 (10 m 32.8')
  - **L-shaped cable**
    - OP-87568 (2 m 6.6')
    - OP-87569 (5 m 16.4')
    - OP-87570 (10 m 32.8')

- **Stainless steel power supply cable**
  - The following are PVC cables with stainless steel (SUS316L) connectors. Use in situations where rust is a concern for the connectors.
  - **Straight cable**
    - OP-87647 (2 m 6.6')
    - OP-87648 (5 m 16.4')
    - OP-87649 (10 m 32.8')
  - **L-shaped cable**
    - OP-87650 (2 m 6.6')
    - OP-87651 (5 m 16.4')
    - OP-87652 (10 m 32.8')

- **Oil-resistant power supply cable**
  - The following are PUR cables with high resistance to oil environments.
  - **Straight cable**
    - OP-87582 (2 m 6.6')
    - OP-87583 (5 m 16.4')
    - OP-87584 (10 m 32.8')
  - **L-shaped cable**
    - OP-87586 (2 m 6.6')
    - OP-87587 (5 m 16.4')
    - OP-87588 (10 m 32.8')

### OPTIONAL ACCESSORIES
- **Gasket for FL-001**
  - (Inorganic fiber + Oil-resistant rubber)
  - OP-87548
  - Seal material for improved mounting sealability.

- **Condensation prevention attachment for FL-001 (SUS303)**
  - OP-87551
  - Installing this attachment between the device and the tank prevents condensation when the medium is at a lower temperature than the ambient temperature and condensation forms on the bottom of the device.
  - Includes two gaskets (OP-87548).

- **Cap for FL-C001**
  - OP-87563
  - This cap offers protection for the operating surface of the device in corrosive environments.
  - The cap prevents the display from being visible.
  - An O ring (FKM) is included for the cap.

- **Nut for FL-C001 G3/4 (PPS)**
  - OP-87645
  - Use for mounting to a top panel with a nut.

- **Cap for FL-S001**
  - OP-87558
  - [Included with FL-S001]
  - This cap offers improved waterproof performance beyond the IP67 rating of the device with no cap. The cap includes a transparent plastic window on the top for checking the display.
  - Material: SUS304, PPSU, EPDM

- **Flange plate for FL-001 (SUS303)**
  - Corresponding to G3/4 JIS5K50A
  - OP-87573
  - Corresponding to G3/4 JIS5K50A
  - OP-87574
  - Use for mounting via a flange plate.
  - Includes one gasket (OP-87548).

- **Nut for FL-001 G3/4 (SUS303)**
  - OP-87642
  - Use for mounting to a top panel with a nut.
Situation 1
Detecting the liquid level inside a tank/bath

To ensure stable detection, install the sensor so that the installation distances are greater than or equal to the recommend distances for A through E below.

A : Min. distance from wall
B : Min. distance from obstacles
C : Min. distance from bottom
D : Min. distance between adjacent FL sensors
E : Min. diameter for metal or plastic nozzles

<table>
<thead>
<tr>
<th>Tank/bath material</th>
<th>Liquid</th>
<th>Model</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E*</th>
<th>Notes</th>
</tr>
</thead>
</table>
| **Metal**          | Water  | FL-001| 30| 59| 10| 150| 30 | - Since false detection will occur if the probe is touching the wall, a distance of at least 30 mm ø1.18” is recommended for A. If the probe will not be touching the wall, a distance of 30 mm ø1.18” or less is possible. The closer the probe is to the metal wall, the greater the signal strength will be, resulting in greater detection stability. - Prorusions or uneven surfaces inside the tank/bath will be considered obstacles. As such, ensure a distance of B or more.
|                   |        | FL-001| 30| 59| 10| 150| 30 | - Metal flanges offer higher signal strength than plastic flanges, resulting in greater detection stability.
|                   |        | FL-001| 30| 59| 10| 150| 30 | - Use plastic bolts to secure a plastic flange. Metal bolts may be considered obstacles, reducing detection stability. As such, ensure a distance of B or more.
|                   | Oil    | FL-001| 30| 59| 10| 150| 30 | - If metal (including brackets) is present on the exterior of the plastic wall, it may be considered as an obstacle when the guide pulse passes through the plastic, reducing detection stability. As such, ensure a distance of B or more.
|                   |        | FL-001| 30| 59| 10| 150| 30 | - Concrete reduces signal strength, resulting in unstable detection. Ensure A is 200 mm ø7.87” or more. For concrete top panels, installation of a metal nozzle (figure below) is recommended.
| **Plastic**        | Water  | FL-001| 30| 59| 10| 150| 30 | - Concrete reduces signal strength, resulting in unstable detection. Ensure A is 200 mm ø7.87” or more. For concrete top panels, installation of a metal nozzle (figure below) is recommended.
|                   |        | FL-001| 30| 59| 10| 150| 30 | - Concrete reduces signal strength, resulting in unstable detection. Ensure A is 200 mm ø7.87” or more. For concrete top panels, installation of a metal nozzle (figure below) is recommended.
|                   | Oil    | FL-001| 30| 59| 10| 150| 30 | - Concrete reduces signal strength, resulting in unstable detection. Ensure A is 200 mm ø7.87” or more. For concrete top panels, installation of a metal nozzle (figure below) is recommended.
| **Concrete**       | Water  | FL-001| 30| 59| 10| 150| 30 | - Concrete reduces signal strength, resulting in unstable detection. Ensure A is 200 mm ø7.87” or more. For concrete top panels, installation of a metal nozzle (figure below) is recommended.
|                   |        | FL-001| 30| 59| 10| 150| 30 | - Concrete reduces signal strength, resulting in unstable detection. Ensure A is 200 mm ø7.87” or more. For concrete top panels, installation of a metal nozzle (figure below) is recommended.
|                   | Oil    | FL-001| 30| 59| 10| 150| 30 | - Concrete reduces signal strength, resulting in unstable detection. Ensure A is 200 mm ø7.87” or more. For concrete top panels, installation of a metal nozzle (figure below) is recommended.

* Values in the table are typical examples. * Do not secure the probe directly.

Supplemental information for nozzle installation

1. With a nozzle diameter of ø30 to ø100 mm ø1.18” to ø3.94”

Since the nozzle will be considered an obstacle, be sure to follow the procedure below.

1. Configure the mask setting using the nozzle length as the mask setting length.
2. Perform calibration after the liquid level height has dropped to 150 mm ø5.91” or more from the discharge hole of the nozzle.

* The above is not necessary if the nozzle diameter is ø100 mm ø3.94” or more.

2. When metal nozzles cannot be used on the inside of a concrete top panel

When installing the device as shown below, the guide pulse is absorbed by the concrete and the detection signal is dampened.

Accordingly, the inner diameters shown in the table below must be ensured for the concrete.

<table>
<thead>
<tr>
<th>Thickness of concrete</th>
<th>Inner diameter of concrete</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 300 mm ø1.18”</td>
<td>ø200 mm ø7.87” or more</td>
</tr>
<tr>
<td>300 mm ø1.18” or more</td>
<td>ø400 mm ø15.75” or more</td>
</tr>
</tbody>
</table>
**Situation 2**

**Detecting the liquid level inside a pipe**

To ensure stable detection, install the sensor so that the installation distances are greater than or equal to the recommend distances for A through D below.

A : Min. inner diameter of pipe  
B : Min. distance from obstacles in the pipe  
C : Min. distance from bottom  
D : Min. distance from metal outside the pipe

### UNDETECTABLE AREAS (COMMON FOR ALL INSTALLATIONS)

Depending on the model and probe length, the following undetectable areas exist at the root of the FL unit and at the tip. Stable detection will not be possible within this undetectable area.
MOUNTING TO A TANK

Standard type FL-001
The FL-001 can be installed to a tank in two ways.

- Bore a screw hole for mounting and attach the controller directly to the tank.
- Use a flange plate to mount the controller.

The FL-001 can be rotated 340 degrees after mounting.

MOUNTING TO A TANK (PLASTIC)

Plastic type FL-C001
The FL-C001 can be installed to a plastic tank in two ways.

- Bore a screw hole for mounting and attach the controller directly to the tank.
- Use a flange plate to mount the controller.

In both cases, tighten the mounting nut until it spins freely. At least 8 mm 0.31" of plate thickness is required.

The FL-C001 can be rotated 360 degrees after mounting.

MOUNTING TO A TANK (METAL)

Sanitary type FL-S001
A 2S ferrule is used to mount the FL-S001A to a metal tank.
Use a gasket and a mounting part for the sanitary type of size 2S.
Since the FL-S001 is mounted via a ferrule, the device can be mounted and rotated freely 360 degrees.

MOUNTING TO A TOP PANEL

Standard/Plastic type FL-001, FL-C001
Bore a through hole in the top panel placed on a bath and mount the controller with a nut (SUS nut: OP-87642, plastic nut: OP-87645). The plate thickness is 6 mm 0.24" or less for the OP-87642, and 5 mm 0.20" or less for the OP-87645. Avoid use in environments affected by high temperature or high vibration.

I/O CIRCUIT DIAGRAM/PIN ASSIGNMENT

When NPN output is selected

<table>
<thead>
<tr>
<th>Pin assignment for the M12 connector cable (optional)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. White</td>
</tr>
<tr>
<td>2. Brown</td>
</tr>
<tr>
<td>3. Green</td>
</tr>
<tr>
<td>4. Yellow</td>
</tr>
<tr>
<td>5. Grey</td>
</tr>
<tr>
<td>6. Pink</td>
</tr>
<tr>
<td>7. Blue</td>
</tr>
<tr>
<td>8. Red</td>
</tr>
</tbody>
</table>

When PNP output is selected
### Specifications

<table>
<thead>
<tr>
<th>Model</th>
<th>Standard (G3/4)</th>
<th>Sanitary type</th>
<th>Plastic type</th>
</tr>
</thead>
<tbody>
<tr>
<td>FL-001</td>
<td>FL-S001</td>
<td>FL-C001</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Measurement range</th>
<th>100 to 2000 mm 3.94&quot; to 78.74&quot;</th>
<th>200 to 2000 mm 7.87&quot; to 78.74&quot;</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Relative permittivity of measurable media**</th>
<th>2 or more</th>
<th>3 or more</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Resolution**</th>
<th>±0.04&quot;</th>
<th>±0.04&quot;</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Linearity**</th>
<th>±3 mm ±0.12&quot;</th>
<th>±3 mm ±0.12&quot;</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Temperature characteristics</th>
<th>0.1 mm/°C</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Undetectable area</th>
<th>From the top end**</th>
<th>From the bottom end**</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>25 mm 0.98&quot;</td>
<td>10 mm 0.39&quot;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Response time of comparator output</th>
<th>0.4 s minimum</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Sideways torque of the probe</th>
<th>6 N m</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Tank pressure</th>
<th>-0.1 to +0.5 MPa</th>
<th>-0.1 to +1 MPa</th>
<th>-0.1 to +0.1 MPa</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Fluid end</th>
<th>Probe: SUS304</th>
<th>Sheath: PFA Probe: SUS304 (do not connect this directly)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Housing</td>
<td>Metal section of the housing: SUS304, SUS303 Plastic section of the housing: PBT, NR, NBR, EPR, EPDM, PTFE, PPSU, PET Plastic section of the housing: PPS, PPSU, FKM, PTFE, PPSU, PET</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Connection bore diameter</th>
<th>G3/4</th>
<th>25 ferrule</th>
<th>G3/4 on the dedicated probe side</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Output</th>
<th>Comparator output/Alarm output</th>
<th>Analog output</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NPN/PNP open collector (selectable)</td>
<td>4 to 20 mA, maximum load resistance: 350 Ω (Response time: 0.1 s after comparator output determined [90% response])</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Analog output accuracy</th>
<th>Resolution</th>
<th>±0.1 mA (Zero point = 4 mA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full scale accuracy</td>
<td>±0.2 mA (Full scale = 20 mA)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Environmental resistance</th>
<th>Ambient temperature</th>
<th>-20 to +60°C -4 to +140°F</th>
<th>-20 to +60°C -4 to +140°F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative humidity</td>
<td>35 to 85% (No condensation)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Target medium temperature</td>
<td>-20 to +150°C -4 to +302°F</td>
<td>-20 to +150°C -4 to +302°F</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vibration resistance</th>
<th>10 to 55 Hz, 0.75 mm 0.03&quot; double amplitude in X, Y and Z directions, 2 hours respectively</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shock resistance</td>
<td>300 m/s² in 6 directions, 3 times respectively</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Enclosure rating</th>
<th>IP67</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Power supply voltage</th>
<th>10 to 30 VDC, ripple (P-P) 10% included, Class 2 or LPS</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Current consumption</th>
<th>300 mA max. (at 10 V)/120 mA max. (at 30 V) (excluding load)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Applicable cable</th>
<th>8-pin M12 connector</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Weight</th>
<th>400 g</th>
<th>670 g</th>
<th>380 g</th>
</tr>
</thead>
</table>

### (Sanitary type) EHEDG certification

Sanitary type of main unit (FL-S001) has been certified by EHEDG under the following conditions:

- Type EL Class I
- Be sure to consider the following specifications when using this product as an EHEDG certified product.
- Use the sanitary type gasket (OP-87555).
- Use the dedicated sanitary type adapter (OP-87557) to install the main unit.
- When installing the sanitary type adapter (OP-87557) in the tank, keep the surface roughness of Ra ≤ 0.8 μm 0.03 Mil for the welded part of adapter and inside the tank.

### (Sanitary type) Compliance with 3-A sanitary standard

Sanitary type of main unit (FL-S001) with PFA sheath (FL-Spxxx) complies with the 3-A sanitary standard. Be sure to consider the following specifications when using this product as a 3-A sanitary standard-conforming product.

- Type EL Class I
- Be sure to consider the following specifications when using this product as a 3-A sanitary standard-conforming product.
- The gasket material must comply with the relevant requirements of 3-A Standard 18- for contact with specific product and cleaning solutions at the temperatures required for processing and cleaning/sterilization as applicable.
- When installing the ferrule to the vessel, welding on the product contact surface shall form a flush joint to the inside surface of the vessel and have surface finish Ra ≤ 0.8μm 0.03 Mil.