Liquid detection in the semiconductor and FPD manufacturing processes
### Sensor Selection by Process and Equipment

Liquid detection and measurement sensors & switches play key roles in a variety of equipment and processes.

#### Chiller
- **Circulation fluid level detection**
  - Easy liquid level detection without adjustment work.
  - Pipe-mounted liquid level switches with built-in amplifier Model HPQ-T1

#### Scrubbers
- **Scrubbing liquid temperature measurement**
  - Chemical temperature measurement
    - Reduces element failure caused by condensation.
    - Chemical-resistant temperature sensors Model YYQZ01

#### Scrubbers
- **Detection of scrubbing liquid level in tank**
  - All-resin structure means no metallic contamination.
  - Tank-inserted fiber-optic sensors Model HPF-D02 / HPF-D033

#### Chemical Temperature Measurement
- **Resist solution flow rate measurement**
  - Compact, lightweight flowmeter can be used anywhere with any solution.
  - Micro flow rate liquid flow meter Model F7M

#### IPA Liquid Level Detection
- **Fail-safe detection of liquid level upper and lower limits**
  - Pipe-mounted fiber-optic liquid level sensors Model HPF-T034E / HPF-T035E

#### Resist Solution Level Detection
- **Space-saving, gang-mountable**
  - Pipe-mounted liquid level switches with built-in amplifier Model HPQ-DP11 / HPQ-DP12

#### Resist Solution Leaks in Tight Spaces
- **Secure installation in tight spaces**
  - Liquid leak switches with built-in amplifier Model HPQ-D2

#### IPA Liquid Leaks in Explosive Atmospheres
- **Suitable for liquid leak detection in explosive atmospheres**
  - Liquid leak switches fiber-optic sensors Model HPF-D040

#### Water Detection
- **Bend radius of 20 mm for easy routing**
  - Chemical-resistant fiber-optic sensors Model HPF-T029 / HPF-T035 / HPF-D014

#### Cleaning
- **Single wafer cleaning system**
  - Batch type cleaning machine
  - Etcherr

#### Equipment Examples
- **Coater/developer - Steppe**
  - Resist solution level detection
    - Compact, lightweight flowmeter can be used anywhere with any solution.
  - Micro flow rate liquid flow meter Model F7M

#### Specifications
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## Sensor Selection by Chemical and Application

Liquid detection and measurement sensors & switches for a variety of chemicals and uses

### Liquid Leak Detection
- **Acid/alkali chemicals**
  - Liquid leak switches with built-in amplifier
    - Model HPQ-D1
    - Model HPQ-D11
    - Model HPQ-D12
    - Model HPQ-D13
    - Model HPQ-D21
    - Model HPQ-D22
    - Model HPQ-D23

- **IPA etc. organic solvents**
  - Liquid leak detection fiber-optic sensor
    - Model HPF-D040
    - Model HPF-D041
    - Model HPF-D042

- **Resist solution**
  - Liquid leak switches with built-in amplifier
    - Model HPQ-D2
    - Model HPQ-D12
    - Model HPQ-D13
    - Model HPQ-D21
    - Model HPQ-D22
    - Model HPQ-D23
    - Model HPQ-DP11/HPQ-DP12

- **Circulation fluid/pure water/water**
  - Liquid leak switches with built-in amplifier
    - Model HPQ-DP11/HPQ-DP12
    - Model HPQ-DP13

### Liquid Level Detection
- **Tank-inserted fiber-optic sensors**
  - Model HPF-D027/HPF-D033

- **Pipe-mounted fiber-optic liquid level sensors**
  - Model HPF-T032/HPF-T032E/HPF-T034/HPF-T034E

- **Pipe-mounted liquid level switches with built-in amplifier**
  - Model HPQ-T1
  - Model HPQ-T2
  - Model HPQ-T1-002
  - Model HPQ-T1-003
  - Model HPQ-T1-004
  - Model HPQ-T1-005

### Temperature Measurement
- **Chemical-resistant temperature sensor**
  - Model YYQZ01

### Object Detection
- **Chemical-resistant fiber-optic sensors**
  - Model HPF-T029/HPF-T035/HPF-D014

### Flow Rate Measurement
- **Micro flow rate liquid flow meter**
  - Model F7M

Note: Models for use with a standard SUS (etc.) sheath are also available.
Characteristics

- Single wafer cleaning system
- Batch type cleaning machine
- Etcher

- Liquid leak detection fiber-optic sensors
  Model HPF-D040
  Sensor: PFA
  Mounting base: PVC

- IPA liquid level detection
  Pipe-mounted fiber-optic liquid-level sensor
  Model HPF-T032E/HPF-T034E

- Chemical temperature measurement
  Chemical-resistant temperature sensors
  Model YYQZ01
  Operating temperature: -20°C to 80°C

- Acid/alkali chemical liquid leak detection
  Liquid leak switches with built-in amplifier
  Model HPQ-Q1
  Switch: PFA
  Mounting base: PVC

- Acid/alkali chemical liquid leak detection
  Liquid leak switches with built-in amplifier
  Model HPQ-Q1
  Switch: PFA
  Mounting base: PVC

- IPA liquid leak detection
  Liquid leak detection fiber-optics
  Model HPF-D040
  Sensor: PFA
  Mounting base: PVC

- IPA liquid level detection
  Pipe-mounted fiber-optic liquid-level sensor
  Model HPF-T032E/HPF-T034E

- Chemical temperature measurement
  Chemical-resistant temperature sensors
  Model YYQZ01
  Operating temperature: -20°C to 80°C

- Acidic/alkaline chemical flow rate measurement
  Thermal Micro Flow Meter
  Micro flow rate liquid flow meter
  Model F7M

- Fail-safe detection for upper and lower limits
  16 light axes cancel the influence of water droplets and air bubbles, and achieve stable detection.

- Quick turnaround after a leak, with no need for absorbent paper
  Easy maintenance
  After leak detection, simply wipe the detector surface—a much easier process than with detection tape or a liquid-absorbing model.

- Suitable for liquid leak detection in explosive atmospheres.
  PFA protects the sensor and cable. PFA protects the sensor and fiber-optic cable. SUS is partially used on the mounting base.

- Less element failure by condensation
  Two models with different materials are available.
  Temperature measurement ranges
  0 to 200°C (FEP) 0 to 250°C (PFA)

- To resist corrosive fluids, liquid-contacting areas are made of fused quartz and fluororesin
  This micro flow meter has an IP65 protective structure with a surface that is completely metal-free, so it can be used in environments where it is exposed to splashing liquid.
Heat dissipation from the heater changes depending on the flow rate. As the flow rate rises, the amount of heat transferred to the fluid increases, and the power consumption of the heater increases. By measuring the heater’s power consumption, the flow rate can be calculated.

Secure installation in tight spaces

Equipped with locking mechanism
Secure installation is ensured by using the support lever on the switch.

Space-saving and gang-mountable

Indicator and operation selector switch are on the side, so even when switches are gang-mounted, it is easy to make adjustments while viewing the indicator.

Fits various pipe diameters
Switches fit on pipe diameters of 8 to 13 mm, 3 to 7 mm, and 1/16 inch. They can be mounted using a cable tie or M3 screw.

Measurement of 50 ml/min and lower flow rates

This flowmeter employs a thermal measurement principle and MEMS sensing technology, making it possible to measure micro flow rates (50 ml/min and less), which is difficult to accomplish with conventional measurement methods.
RTD element is embedded in Teflon resin to greatly reduce element failure caused by condensation.

**HEAT TREATMENT**

**Circulation fluid level**

- **Circulation fluid leak detection**

**Leak detection for chiller circulation fluid**

Pipe-mounted liquid level switches with built-in amplifier

- Model HPQ-T

**Detection of chiller circulation fluid level**

- **Easy liquid level detection without tuning**
  - Refractive detection ensures sufficient gain between light-ON and dark-ON light levels. This switch is also suitable for liquids with poor light transmission (such as resist liquid and waste fluids).

  - Operation panel located on the side
  - With the indicator and operation selector switch located on the side, even when switches are gang-mounted, it is easy to make adjustments while checking the indicators.

**Accurate detection regardless of liquid conductivity**

- The switch detects liquid leaks optically, so it does not rely on liquid conductivity.
- Accessories for indirect detection of liquid leaks, such as liquid absorbing paper, are unnecessary.

**Detection of scrubber liquid level in tank**

- **Tank-inserted fiber-optic sensors**
  - Model HPF-D027
  - Model HPF-D033

**Detection of scrubbing liquid leak**

- **Scrubbing liquid temperature measurement**

**Temperature measurement for scrubber liquid**

- Chemical-resistant temperature sensors
  - Model YY0201

**Easy liquid level detection without tuning**

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- With the indicator and operation selector switch located on the side, even when switches are gang-mounted, it is easy to make adjustments while checking the indicators.

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**Temperature measurement for scrubber liquid**

- Chemical-resistant temperature sensors
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**Easy liquid level detection without tuning**

- Refractive detection ensures sufficient gain between light-ON and dark-ON light levels. This switch is also suitable for liquids with poor light transmission (such as resist liquid and waste fluids).

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- Chemical-resistant temperature sensors
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**Detection of scrubber liquid level in tank**

- **Tank-inserted fiber-optic sensors**
  - Model HPF-D027
  - Model HPF-D033

**Temperature measurement for scrubber liquid**

- Chemical-resistant temperature sensors
  - Model YY0201
Liquid leak detectors with built-in amplifier

Model HPQ-D1_/HPQ-D2_

Optical type

Built-in amplifier, no absorbent paper required, usable with various liquids.

 gekrümmte Oberfläche unterhalb.

Acids or alkaline liquids, IPA, (isopropyl) alcohol, pure water, Fluorinert, Galden, etc.

Notes: For explosion-proof applications, be sure to select a suitable fiber type. Fluorinert and Galden are registered trademarks of 3M and Solvay Solexis respectively. Fluorinert, Galden, etc. (isopropyl alcohol), pure water, Acids or alkaline liquids, IPA, etc. are suitable with various liquids. Built-in amplifier, no absorbent paper required, usable with various liquids.

PFA protection for switch and cable

PVC bracket is available for acid/alkali detection, PFA protection for switch and cable, and PFA (with some SUS) for organic solvent detection.

Easy maintenance

After leak detection, simply wipe the detector surface—a much easier process than with detection tape or a liquid-absorbing model.

Suitable for export equipment

CE marking, UL certified. Wide variety of output modes and types are available.

- N/O, N/C output
- NPN, PNP output

Suitable for other equipment

- N/O output
- NPN output

Operation indicator

Switch status can be checked from the body side.

Normal state (green LED lit) Liquid leakage (red LED lit)

Operation may be unstable depending on the color and condition of the mounting surface or the liquid. Before use, carefully check switch operation in the actual situation.

For Model HPQ-D11/12/21 models, a switch with 5m cable (2m PFA tube) is also available.

For product details, contact one of our sales representatives or an Azbil dealer.
Liquid leak detectors with built-in amplifier

Model HPQ-DP11/HPQ-DP12

Built-in amplifier, no absorbent paper required, usable with various liquids.

For pure water, industrial water, Fluorinert, Galden, etc.

Notes: For explosion-proof applications, be sure to select a suitable fiber type.
Fluorinert™ is a registered trademark of 3M and Galden™ is a registered trademark of Solvay Solexis.

Optical method detects liquid leakage directly
Detection is possible immediately after installation even without sensitivity adjustment.
Accessories used in indirect detection of leaks, such as absorbent paper, are unnecessary.
Detection performance does not depend on the conductivity of the target liquid.

Fast and easy maintenance
After leak detection, simply wipe off the detector’s surface—a much easier process than with detection tape or a liquid-absorbing model.

CATALOG LISTING

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<th>Detection method &amp; shape</th>
<th>Bracket material</th>
<th>Operation mode</th>
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Note: Model with 5 m cable is also available.

SPECIFICATIONS

Catalog listing: HPQ-DP11, HPQ-DP12

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</table>
Liquid leak detection fiber-optic sensors

Model HPF-D040

Inherently safe product. PFA protects sensor and cable. Saves space.

PFA protects sensor and cable. Usable in an atmosphere with organic solvents such as IPA. Notes: SUS is partially used on the mounting bracket.

Saves space
Sensor head has a height of only 9.9 mm.

DETECTION PRINCIPLE

When a leak is detected, no light reaches the receiver. Since the same is true in a fiber cable break or disconnection, operation is fail-safe. Install in the pan with a stud.

CATALOG LISTING

<table>
<thead>
<tr>
<th>Shape (mm)</th>
<th>Cable</th>
<th>Length</th>
<th>Catalog listing</th>
</tr>
</thead>
<tbody>
<tr>
<td>R20</td>
<td>5m</td>
<td></td>
<td>HPF-D040</td>
</tr>
</tbody>
</table>

SPECIFICATIONS

<table>
<thead>
<tr>
<th>Appearance</th>
</tr>
</thead>
</table>

Detection method: Retroreflective (contact type)
Compatible amplifier (Model No.): HPX-EG
Compatible target liquid: IPA (isopropyl alcohol)
Operating temperature: -30 to +70°C
Material: Sensor: PFA. Cable: polyethylene (PFA coated). Bracket: PFA (and SUS)

Cleaning

Cleaning: CMP
Heat Treatments

Heat Treatment: -

Object Detection

Object Detection: -
Tank-inserted fiber-optic sensors
Model HPF-D027/HPF-D033

All-resin structure ensures no metal contamination.
- 4mm diameter allows easy running of cables.
- Reliable detection by preventing liquid cling!

Reliable detection by preventing liquid cling!
Proprietary tip structure prevents liquid from clinging to the tip, eliminating a cause of faulty operation.

Recommended compatible amplifier unit
Auto sensitivity switch function
This function automatically optimizes the sensitivity setting during auto tuning, affording easy operation while delivering the highest detection performance.

Catalog Listing
Diffuse scan

<table>
<thead>
<tr>
<th>Type</th>
<th>Shape</th>
<th>Code</th>
<th>Catalog listing</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 dia</td>
<td>6 dia</td>
<td>4 dia &amp; 13 dia</td>
<td>HPF-D033</td>
</tr>
<tr>
<td>6 dia</td>
<td>4 dia</td>
<td>6 dia &amp; 13 dia</td>
<td>HPF-D027</td>
</tr>
</tbody>
</table>

Specifications

<table>
<thead>
<tr>
<th>Catalog listing</th>
<th>HPF-D027</th>
<th>HPF-D033</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>Retroreflective (contact type)</td>
<td>HPX-EG</td>
</tr>
<tr>
<td>Detection method</td>
<td>Repeat accuracy: 1 mm or less (for water)</td>
<td></td>
</tr>
<tr>
<td>Compatibility</td>
<td>Minimum target liquid: Liquid</td>
<td></td>
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<tr>
<td>Pressure resistance</td>
<td>20V ± 10%</td>
<td></td>
</tr>
<tr>
<td>Operating temperature</td>
<td>Polyethylene (PFA coated)</td>
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</table>

External dimensions

- Model HPF-D033
  - Resin head: Fluorescent resin (PFA) tube, dia. 4 4
  - Bend radius: 2000 min. 200 min.
  - Length: 2×dia. 1

- Model HPF-D027
  - Resin head: Fluorescent resin (PFA) tube, dia 4
  - Bend radius: 2000 min. 200 min.
  - Length: 2×dia. 1
Pipe-mounted fiber-optic liquid level sensors

Model HPF-T032/HPF-T032E
HPF-T034/HPF-T034E

Fail-safe detection of tank upper and lower liquid level limits
- An array of 16 optical axes eliminates the effects of air bubbles and water droplets
- PFA-jacketed fiber
- Fits a wide range of pipe diameters.
- Location of the optical axes is clearly marked.

Array of 16 optical axes eliminates the effects of air bubbles and water droplets
Fiber-optic cables protected by chemical-resistant resin can be run through machines and equipment safely (Model HPF-T032 and HPF-T034 only).

PFA-jacketed optical fiber
Adverse effects from air bubbles and water droplets are reduced, resulting in reliable detection.

Fits a variety of pipe diameters.
Design for pipes 3 to 19 mm in dia.

Position of optical axes is marked
Position of the optical axis array is easily visible.

<table>
<thead>
<tr>
<th>DETECTION PRINCIPLE</th>
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<tbody>
<tr>
<td>Operating principle of Model HPF-T032 and T032E</td>
</tr>
</tbody>
</table>

- Liquid present
  - Light received
  - (When pipe contains air bubbles or is clogged)
  - Light received
  - (When liquid is present)
  - Light received

- Liquid absent
  - Light received
  - (When liquid is absent)
  - Light received

- Operating principle of Model HPF-T034 and T034E

<table>
<thead>
<tr>
<th>Catalog listing</th>
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</table>

- Use with PFA transparent pipe with wall thickness of 1 mm.
- Depending on the pipe used, internal surface, or the liquid inside the pipe, detection may not be possible due to absorption, refraction, or reflection effects. The use of a test pipe may be necessary to test the operation before use.
- If the fluid is used with other than the recommended pipe, material, or wall thickness, please test before use or consult our sales staff.

- If water is used with other than the recommended pipe material, wall thickness, please test before use or consult our sales staff.

| EXTERNAL DIMENSIONS |

- Unit: mm

<table>
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<tr>
<th>DETECTION PRINCIPLE</th>
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<tr>
<td>Operating principle of Model HPF-T032 and T032E</td>
</tr>
</tbody>
</table>

- Liquid present
  - Light received
  - (When pipe contains air bubbles or is clogged)

- Liquid absent
  - Light received

- Operating principle of Model HPF-T034 and T034E

<table>
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<th>Catalog listing</th>
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</table>

- Use with PFA transparent pipe with wall thickness of 1 mm.
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- If water is used with other than the recommended pipe material, wall thickness, please test before use or consult our sales staff.

<table>
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<th>Catalog listing</th>
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Pipe-mounted liquid level switches with built-in amplifier

Model HPQ-T1_/HPQ-T2_

Just by mounting the switch on a pipe, the surface of the liquid can be easily detected.

- Reliable detection
- Operation panel is located on the side.
- Fits various pipe diameters
- The same model can be used for upper or lower limit detection.

**Reliable detection**

Refraction-based detection ensures sufficient gain between light-OH and dark-ON light levels. This switch is also suitable for liquids with poor light transmission (such as photosensitive liquid and waste fluids).

**Fits various pipe diameters**

Switches fit on pipes with diameters of 1/16 inch, 3 to 7 mm, and 8 to 13 mm. They can be mounted using a cable tie or M3 screw.

**Operation panel on the side**

Indicator and operation selector switch are located on the side. Even when switches are gang-mounted, they can be adjusted while viewing the indicator.

**Same model handles upper or lower limit detection**

Note: For pipe diameters of 8 mm or less, please contact us.

**Sensitivity adjustment**

Adjustable sensitivity switches with adjustable sensitivity are also available. Note: For pipe diameters of 8 mm or less, please contact us.

**Optical axis position**

Detection repeatability of 1 mm or less

Note: The slit width is 1 mm, and therefore repetitive detection is possible at an accuracy of that width or less.

- This varies depending on the condition of the liquid.

**Example of fail-safe setup**

**Example of recommended settings**

- Upper limit level
- Supply stop level
- Lower limit level

**Output circuit diagram**

- Model HPQ-T1_/HPQ-T2_
Chemical-resistant temperature sensors
Model YYQZ01

Ideal for temperature control in wet process treatment tanks and piping!

Two models with different temperature ranges of 0 to 200 °C (FEP) and 0 to 250 °C (PFA) are available.

RTD element is embedded in Teflon resin to greatly reduce element failure caused by condensation.

SPECIFICATIONS

<table>
<thead>
<tr>
<th>Protection tube material</th>
<th>Lead connection method</th>
<th>Temperature measurement range</th>
<th>Rated current</th>
<th>Tolerance</th>
<th>Terminal size</th>
<th>Casing listing</th>
</tr>
</thead>
<tbody>
<tr>
<td>FEP</td>
<td>3-wire method</td>
<td>0 to 200 °C (FEP)</td>
<td>1mA</td>
<td>Class B</td>
<td>M3.5</td>
<td>YYQZ01BF420010B0</td>
</tr>
<tr>
<td>PFA</td>
<td>3-wire method</td>
<td>0 to 250 °C (PFA)</td>
<td>1mA</td>
<td>Class B</td>
<td>M3.5</td>
<td>YYQZ01BP420010B0</td>
</tr>
</tbody>
</table>

EXTERNAL DIMENSIONS

- **4 mm dia. type**
  - Protection tube length: 200 mm
  - Lead length: 1 m

- **6 mm dia. type**
  - Protection tube length: 200 mm
  - Lead length: 1 m

Customizing service

We offer customized cables with protection tube lengths of 100 to 1000 mm and lead lengths of 1 to 10 m. Please contact a sales representative for details.

Chemical-resistant fiber-optic sensors
Model HPF-T029/HPF-T035/HPF-D014

Simply cut the PFA-jacketed cable to length and insert as is into the amplifier.*

Bend radius of R20mm with 2.2mm tube diameter*

Previous models

SPECIFICATIONS

<table>
<thead>
<tr>
<th>Type</th>
<th>Size</th>
<th>Shape</th>
<th>Cables</th>
<th>Scanning distance (mm)</th>
<th>Core (mm)</th>
<th>Catalog listing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thru scan</td>
<td>6.7 mm dia.</td>
<td>Top</td>
<td>R20</td>
<td>2 m</td>
<td>1.0 dia.</td>
<td>HPX-EG</td>
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<tr>
<td>Top</td>
<td>6.7 mm dia.</td>
<td>Side</td>
<td>R20</td>
<td>2 m</td>
<td>1.0 dia.</td>
<td>HPX-EG</td>
</tr>
<tr>
<td>Diffuse scan</td>
<td>0 mm dia.</td>
<td>Side</td>
<td>R20</td>
<td>2000 mm</td>
<td>2×1.0 dia.</td>
<td>HPX-AG</td>
</tr>
<tr>
<td>Side</td>
<td>6.7 mm dia.</td>
<td>Side</td>
<td>R20</td>
<td>2 m</td>
<td>1.0 dia.</td>
<td>HPX-EG</td>
</tr>
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EXTERIOR DIMENSIONS

- **Model HPF-T029**
  - Lens: 3.0 dia.
  - Core: 1.0 dia.

- **Model HPF-T035**
  - Lens: 3.0 dia.
  - Core: 1.0 dia.

- **Model HPF-D014**
  - Lens: 3.0 dia.
  - Core: 1.0 dia.
Micro flow rate liquid flow meter

Model F7M

Thermal micro flow rate liquid flow meter, achieving high-functionality measurement and usability

Features & Merits of the F7M

Combining a thermal MEMS sensor that is commonly used for gas flow meters and a flow path that is made of highly corrosion-resistant fused quartz glass, the product can measure both instantaneous and totalized flow value of micro flow rates of several mL/min, which is difficult to do with a high degree of reproducibility using traditional measurement methods. Compared with conventional methods, the measurement method used by this new product is less susceptible to changes in the fluid state (e.g., bubbles, pulsations, and fluid temperature) (although it may be necessary to change the settings parameters), and micro flow rates can be measured more easily. Measuring the flow rates allows for more reliable data management by replacing alternative measures, such as managing the pump rotation speed, measuring the weight, and managing the fluid supply time. In addition, with the event functions it is possible to detect empty pipes and the presence of bubbles, and to monitor the status of pulsation.

Measures 30 mL/min or lower

Features the thermal measurement principle using MEMS sensing technology. Measuring micro flow rates of several mL/min, which traditionally has been difficult, is now possible. (Measurement range: 0.1 to 10 mL/min, 0.3 to 30 mL/min)

Flexible installation and wide range of fluids

Compliant with IP65 protection rating.

- Exterior contains no metal, providing improved resistance to corrosive fluids, allowing use in environments with liquid spray.
- Can be used for a variety of fluids, so long as they do not corrode fused quartz glass (the material of the flow path) or fluoroflex (the material of the fitting).
- The sensor does not come into contact with any fluids.

Straight flow path

The straight flow channel means pressure loss is lower and cleaning is easier, with no puddles of liquid.

Compact, light-weight, and easy to install

- This model is more compact and lighter than its predecessors.
- By using the included mounting bracket, it can be easily installed on a surface (for horizontal pipe connection).
- It can also be installed for vertical pipe connection.
- A separate converter (amplifier) is not required.

SPECIFICATIONS

<table>
<thead>
<tr>
<th>Model F7M9010</th>
<th>F7M9030</th>
<th>F7M9050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurable flow rate range (for water (H2O))</td>
<td>0.1 to 10 mL/min</td>
<td>0.2 to 10 mL/min</td>
</tr>
<tr>
<td>Measurement accuracy</td>
<td>±5 % rdg. (at 20 % or more of the flow rate range), ±1 % FS (at less than 20 % of the range) in the volumetric flow rate measured by Azbil’s flow rate calibration equipment under standard conditions*1.</td>
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</tr>
<tr>
<td>Measurable range of temperature (where the fluid and ambient temperatures are the same)</td>
<td>Water (H2O)</td>
<td>Water (H2O)</td>
</tr>
<tr>
<td>Temperature range of measurement</td>
<td>0 °C to 50 °C</td>
<td>0 °C to 50 °C</td>
</tr>
<tr>
<td>Accuracy and repeatability-guaranteed fluid rate range/liquid (at 10 °C)</td>
<td>0.2 to 50 mL/min</td>
<td>0.2 to 50 mL/min</td>
</tr>
<tr>
<td>Temperature range of measurement</td>
<td>5 °C to 50 °C</td>
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</tr>
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<td>Pressure resistance</td>
<td>700 kPa</td>
<td>700 kPa</td>
</tr>
<tr>
<td>Measurement accuracy</td>
<td>0.5 to 50 °C (without condensation or freezing) (5 to 60 °C at transportation and storage)</td>
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</tr>
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<td>Repeatability</td>
<td>±5 % rdg. (at 20 % or more of the flow rate range), ±1 % FS (at less than 20 % of the range) in the volumetric flow rate measured by Azbil’s flow rate calibration equipment under standard conditions*1.</td>
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</tr>
</tbody>
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EXTERNAL DIMENSIONS

Model F7M
PRECAUTIONS FOR HANDLING (Installation)

Model HPQ-T032/HPQ-T34
Mounting method
- For Model HPQ-T, a fiber-optic sensor is installed in the fiber-optic socket. When mounting the switch with a suitable fiber-optic socket, ensure that the fiber is correctly connected.

Model HPQ-D1/HPQ-D2
Installation
- Attach the switch on a horizontal surface. Ensure the switch is securely attached to avoid any vibrations or movements.

Model HPQ-DP
Mounting method
- Mount the fiber-optic switch using either an M3 screw or a bolt. Ensure that the fiber is correctly connected to avoid any vibrations or movements.

Model HPQ-D27/HPQ-D33
Mounting method
- To install the fiber-optic sensor, use a commercially available fluorine resin joint that matches the outside diameter of the PFA tube.

Model HPQ-T1/HPQ-T2
Mounting method
- This switch is fiber-optic mounted using either an M3 screw or a bolt. Ensure that the fiber is correctly connected to avoid any vibrations or movements.

Model HPF-T032/HPF-T35/HPF-D014
Mounting method
- When using a flange mounting base, insert the mounting base into the hole of the switch casing, and then slide the base forward until it is in place.

Model HPF-EU05/HPF-EU10
Characteristics of Scanning Distance by Combination with Fiber Extender (Typical values)

<table>
<thead>
<tr>
<th>Product name</th>
<th>Unit mm</th>
<th>Description</th>
<th>Fiber specifications</th>
<th>Catalog listing</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFA chemical proof</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Model HPQ photoelectric switch
- Use to extend fibers by为一体式的接头，使输出信号更稳定。

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Model HPQ photoelectric switch
- Use to extend fibers by为一体式的接头，使输出信号更稳定。
The ISO 9000 (quality management system) family of standards and ISO the ISO since 1952.

The ISO started activities in 1947 and has its headquarters in Geneva, Switzerland.

The organization works for standardization in fields other than the electrical field and has about 90 participating countries. Japan has joined the ISO since 1952.

ISO 9000 (quality management system) family of standards and ISO 14000 (environmental management system) family of standards are well known in Japan.

UL standards (region: United States of America)

1. About UL standards

In the United States, since states and local governments have the right to make safety regulations, some safety regulations are locally adopted, as in the case of principal cities such as New York, Los Angeles, Chicago, and San Francisco. However, in spite of all local regulations, approval is required not only locally but also at the state and federal level. Manufacturers generally obtain UL approval, either by UL itself or by UL’s affiliated companies, to ensure product safety to individual states or local government authorities. Additionally, in recent years, due to increased communication with the Canadian Standards Association (CSA), there is a move to harmonize UL and CSA standards.

2. About UL

UL (Underwriters Laboratories Inc.) is a private nonprofit organization that promotes public safety by protecting human life and property from fire and other hazards. Its services include testing, inspection, and certification. UL was organized as a result of fires that occurred frequently in the cities, and a cause was almost always a large number of electrical devices that were used without having been tested. The accidents were a cause of concern in the insurance business, and a dedicated investigation group was organized, followed by the Underwriters Electric Bureau, a nonprofit organization and the predecessor of UL, in 1894. This became Underwriters Laboratories Inc. in 1901. Since then its function has expanded to areas other than electricity. Although UL does not have any administrative power, it is the top authority for safety testing and product certification in the USA, based on its extensive experience and ability to issue product safety certification. UL is also a standards organization (US national levels Council of Canada) as a testing and certification organization. Therefore, UL conducts evaluation of products to be shipped to Canada in accordance with CSA standards and regulations, and can approve to apply a special UL mark, UL, for Canada. The UL mark is formally approved throughout Canada.

3. UL mark (for shipment to the U.S.)

This mark certifies that the UL has approved each product for safety. To obtain the UL mark, manufacturers must comply with UL’s approval procedures, which require detailed testing. UL’s mark is used for products intended for the United States.

CUL listing mark

This mark is used for independently functioning final products that are to be shipped to Canada. It certifies that the products have been tested by UL, based on Canada’s CSA standards.

CUL US listing mark

This new listing was introduced in 1996 to certify products comply with the safety requirements of both Canada and the U.S.

Recognized component mark for shipment to Canada

This mark recognizes that samples of a part that does not function independently or a part with limited functions have been tested by UL and comply with the applicable UL standards.

Recognized component mark for shipment to Canada

This mark is used for parts/materials/components for shipment to the Canadian market. It certifies that the products have been verified by UL to satisfy Canada’s safety regulations.

Recognized component mark for shipment to the United States and Canada

This mark is used for parts/materials/components that comply with the safety requirements of both Canada and the U.S.

FM standards (region: United States of America)

FM stands for the Factory Mutual Insurance Company. It is a private insurance company founded in 1903 to provide insurance for factories and commercial facilities. In addition to insurance services, it provides risk management services for factories and commercial facilities, developing business not only in North America but also in South America, Europe, the Middle East, Africa, and the Asia-Pacific region.

An affiliated company, FM Approvals, is a third-party certification body that offers certification and testing services for products for industrial and commercial property loss prevention. It grants FM Approval to products that have been tested to comply with the requirements of FM standards.

CSA standards (region: Canada)

1. About CSA standards

The Standards Council of Canada (SCC) coordinates standardization and establishes independent national standards. Actual production of standards is entrusted to various standards organizations. At present, six organizations produce Canadian national standards on behalf of the SCC. One of these is the CSA, which produces CSA standards. Although CSA standards are nonbinding, in some cases they are applied by federal or state level. The CSA strives to protect human life and property, and produces important safety standards.

2. About the CSA

The CSA (Canadian Standards Association) is an independent non-governmental, non-profit organization. As the largest Canadian standards-establishing organization, the CSA provides services for standards-establishing organization not only for testing and establishing standards, but also by evaluating products. In addition, the CSA participates in the activities of various international organizations, such as the ISO and IEC, as a representative of Canada.

3. CSA mark

This mark certifies that the product has been verified by the CSA to satisfy Canadian standards as a product for the Canadian market.

4. CSA mark for use in Canada and the U.S.

This mark certifies that the product has been verified by the CSA to satisfy both Canadian standards and U.S. standards as a product for the Canadian market.

European standards (EN standards)

1. About CE marking

CE mark

In order to make the best use of the advantages obtained by European unification, the European Union (EU) Commission modified the safety regulations in order to produce unified regulations by product category, such as machinery, toys, and medical devices. This was done in 1989 under the European Directive (EC Directive) officially announced in 1989. Documents such as the Machinery Directive, EMC Directive (regulations on the compatibility of electromagnetic waves generated by electrical products), Low Voltage Directive, and Medical Device Directive were issued. At the same time, the system of grouping CE marking by product category began.

The CE Mark, which was not thoroughly explained in the directive, is a system of marking products intended for EU markets with CE. Products cannot be listed as CE-approved on that basis alone. The term “CE” indicates adherence by the manufacturer to the applicable EN standards.

About EN standards

EC directives as those mentioned above are laws that must be observed. However, they contain only basic regulations written in general terms, resulting in difficulty in concrete understanding. Therefore, many manufacturers now design products based on what are known as EN standards.

In parallel with unifying the regulations (EC directives) in the EU area, the industrial standards and safety standards of each country are also being unified. This unification of standards is being carried out by two organizations. One is the European Committee for Standardization (CEN) and the European Committee for Electrotechnical Standardization (CENELEC). Both the CEN and CENELEC are national standards organizations that are represented by their national committees, beginning with letters EN (European Norm) and are called EN standards. EN based standards exist in concrete product design by giving numerical values and drawings pertaining to the safety requirements of EC directives.

About VDE

VDE stands for the Association for Electric, Electronic and Information Technologies. It provides testing and certification services to ensure safety of electrical products under EN and other standards.

SIL

SIL (safety integrity level) is a measure of the performance of a safety function provided by a control system as defined in IEC 61508. There are five performance levels, PL a through PL e. The required level is determined by comprehensively considering the severity of harm, the frequency and duration of exposure to a hazard, and the probability of avoiding or limiting harm.

Performance Level (PL)

This is an indicator of the performance of safety-related parts of control systems as defined in IEC 61508. There are five performance levels, PL a through PL e. The required level is determined by comprehensively considering the severity of harm, the frequency and duration of exposure to a hazard, and the probability of avoiding or limiting harm.

TÜV standards (region: Germany)

TÜV (Technologies) is a testing and certification body that offers testing and certification services to ensure the safety of electrical products under EN and other standards.

Radio Waves Act (KC mark) (region: Korea)

KC mark (Korea certification mark)

The KC mark is a voluntary certification system established in November 1987 by the Korean Occupational Safety and Health Agency (KOSHA) to reduce occupational accidents and ensure the health and safety of workers using radio equipment. The KC mark is determined by comprehensively considering the severity of harm, the frequency and duration of exposure to a hazard, and the probability of avoiding or limiting harm.

About WHG

WHG prescribes overfill prevention for containers of water polluting liquids. WHG (Wasserhaushaltgesetz), Water Resource Act, is a German law which regulates the consumption of water.

About GB standards

The Chinese National Standards (GB Standards) are based on IEC Standards. The range of items subject to CCC was announced by the CNCA on July 1, 2002, categorized by HS codes, commodity descriptions and comments, and certified by product with an HS code that is not among those subject to CCC does not need a CCC mark. Even if the HS code is on the list, the product might not be subject to the GB Standards. Therefore, obtaining CCC marking is required only if both the HS code and GB standards are applicable.

About S-mark

The S-mark is a voluntary certification system established in 1987 by the Korean Occupational Safety and Health Agency (KOSHA) to reduce occupational accidents and ensure the health and safety of workers using radio equipment. The S-mark is defined by comprehensively considering the severity of harm, the frequency and duration of exposure to a hazard, and the probability of avoiding or limiting harm.

About WHG certificate

WHG (Wasserhaushaltgesetz), Water Resource Act, is a German law which regulates the consumption of water.