Control Category 4 PLe SIL3
SAFETY LIQUID LEAK SENSOR

SQ4 SERIES
Certified by NRTL
Conforming to SEMI-S2
Conforming to Machinery & EMC Directive
Certified

Improved productivity
Two-stage detection

Compliance with international safety standards
Safety certification

*As of October 2010; according to research by Panasonic Electric Works SUNX.
A Safety Liquid Leak Sensor Offering Unparalleled Productivity and Safety

Introducing the SQ4 Series

Featuring a two-stage detection system for improved productivity and reliable safety performance that complies with international standards

- **Improved productivity**
  - Simplify preventive maintenance and maintenance planning
  - Reduce damage to work in progress in case of a leak
  - Improve yields
  - Trigger an emergency stop in the event of a malfunction

- **Two-stage detection**
  - Lights up when conditions are normal (and at incipient liquid leak detection)
  - Lights up at incipient liquid leak detection (and at abnormal leak detection)
  - Lights up at abnormal liquid leak detection

**Use as a warning**
- First stage: Initial detection (non-safety output)
  - Report the occurrence of an incipient liquid leak to the production supervisor and perform equipment maintenance after removing any work in progress.

**Ensure productivity**
- By quickly detecting even small liquid leaks (incipient leaks), personnel can perform preventive maintenance or plan maintenance, thereby reducing both downtime and damage to work in progress.

**Ensure safety**
- In the event of a high-volume liquid leak (an abnormal liquid leak), the target equipment is stopped immediately to ensure safety.

- **The SQ4 can also be used alone.**

The SQ4 can also be used without a controller, allowing the benefits of two-stage detection to be added to existing equipment by augmenting or replacing existing detection systems.

*As of October 2010; according to research by Panasonic Electric Works SUNX.*
Two-stage detection addresses both incipient liquid leaks (by generating a warning) and abnormal liquid leaks (by initiating an emergency stop).

On the bottom of the sensor are two detection units, one located at the front and one at the center. If a liquid leak occurs in front of the sensor, the front detection unit will detect even a small incipient leak. When the leak increases in volume and reaches the center of the sensor, it will be detected as an abnormal leak. While previous implementations of two-stage liquid leak detection have relied on two separate sensors installed at different heights, the SQ4 delivers the same full-featured detection capability in a single sensor unit.

The SQ4 can also detect human error (improper installation).

In addition to detecting liquid leaks, the SQ4 can detect both human error (such as a failure to install the sensor) and sensor malfunctions. If the sensor itself or the sensor and its mounting bracket have become dislodged, have been improperly installed, or are suffering from a broken cable connection, light from the emitter will not reach the receiver, causing the device to generate the same output as if a liquid leak had occurred.
The SQ4 is the first device of its kind in the industry to earn safety certification, demonstrating that it delivers safety performance of the highest caliber.

The SQ4 system is designed to fulfill safety requirements imposed by international standards. When used in combination, the SQ4-A sensor and SQ4-C11 controller meet category 4 / PLe / SIL3 requirements under ISO 13849-1:2008, which has been updated to add probability criteria to the existing risk evaluation system (in the control category). Allowing the functional safety of programmable electronic control systems and related devices to be evaluated. The sensor fulfills category 1 / PLC / SIL1 requirements when used in a standalone configuration.

Dual CPUs deliver an advanced level of safety control.

The controller’s two independent CPUs mutually check the unit’s operating state, and redundant signal processing and output circuits ensure safety. Failure mode and effect analysis (FMEA) further increases operational safety.

Reduce wiring and lower costs by daisy-chaining controllers and other safety equipment.

The controller’s safety input function can be used to connect wiring used to daisy-chain controllers together as well as input from safety contacts (2NC) on emergency stop switches, safety door switches, and other devices. In this way, safety output can be aggregated onto a single line to reduce safety circuit wiring and lower costs.

*FMEA comprises a systematic method for analyzing latent failures and defects so that they can be prevented from manifesting themselves.

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**PRODUCT CONFIGURATION**

**Whole set: Category 4, PLe, SIL3**

**Sensor: Category 1, PLc, SIL1**

Sensor SQ4-A2□
Mounting bracket set MS-SQ4-Z□

**ORDER GUIDE**

**Sensors**

<table>
<thead>
<tr>
<th>Type</th>
<th>Appearance</th>
<th>Sensing object (Note 1)</th>
<th>Model No.</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>For standard liquid</td>
<td>Material: Polypropylene</td>
<td>Water etc.</td>
<td>SQ4-A21-P</td>
<td>PNP open-collector transistor</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SQ4-A21-N</td>
<td>NPN open-collector transistor</td>
</tr>
<tr>
<td>For chemical liquid</td>
<td>Material: PFA</td>
<td>Sulfuric acid, Hydrochloric acid, Phosphoric acid, Ammonia, Fluorinert (Note 2), Galden (Note 2) or Fluorine etc.</td>
<td>SQ4-A22-P</td>
<td>PNP open-collector transistor</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SQ4-A22-N</td>
<td>NPN open-collector transistor</td>
</tr>
</tbody>
</table>

Notes: 1) The agents mentioned above are examples. It may not be detected depending on viscosity the agent. Before using this device, check the detecting liquid and installation condition.
2) Fluorinert™ is the world wide trademark of 3M. Galden is the world wide trademark of Solvay Solexis.

**Mounting bracket set**

Make sure to purchase the sensor and controller as a set.

<table>
<thead>
<tr>
<th>Type</th>
<th>Appearance</th>
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<th>Model No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>For standard liquid</td>
<td>Material: Polypropylene</td>
<td>Water etc.</td>
<td>MS-SQ4-21</td>
</tr>
<tr>
<td>For chemical liquid</td>
<td>Material: PFA</td>
<td>Liquids with comparatively low surface tension such as Fluorinert (Note), Galden (Note), and Hydrogen fluoride</td>
<td>MS-SQ4-22</td>
</tr>
<tr>
<td></td>
<td>Material: PVC</td>
<td>Liquids such as low-concentration hydrogen fluoride</td>
<td>MS-SQ4-23</td>
</tr>
<tr>
<td></td>
<td>Material: PVC</td>
<td>Liquids such as low-concentration hydrogen fluoride</td>
<td>MS-SQ4-24</td>
</tr>
</tbody>
</table>

Note: Fluorinert™ is the world wide trademark of 3M. Galden is the world wide trademark of Solvay Solexis.

**Connectors**

Make sure to purchase the connector when using the controller.

<table>
<thead>
<tr>
<th>Designation</th>
<th>Model No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hook-up connector (e-CON)</td>
<td>CN-EP2</td>
<td>For SQ4-A21□ (PVC cable) It is used to connect to the controller. Yellow 5 pcs. per set</td>
</tr>
<tr>
<td></td>
<td>CN-EP3</td>
<td>For SQ4-A22□ (PFA cable) It is used to connect to the controller. Orange 5 pcs. per set</td>
</tr>
</tbody>
</table>

**Controller**

<table>
<thead>
<tr>
<th>Type</th>
<th>Appearance</th>
<th>Model No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety controller</td>
<td> </td>
<td>SQ4-C11</td>
<td>Up to 4 safety liquid leak sensors can be connected. Control category 4, PLe SIL3</td>
</tr>
</tbody>
</table>
## SPECIFICATION

### Sensors

<table>
<thead>
<tr>
<th>Type</th>
<th>For standard liquid</th>
<th>For chemical liquid</th>
</tr>
</thead>
<tbody>
<tr>
<td>PN output</td>
<td>SQ4-A21-P</td>
<td>SQ4-A22-P</td>
</tr>
<tr>
<td>NPN output</td>
<td>SQ4-A21-N</td>
<td>SQ4-A22-N</td>
</tr>
</tbody>
</table>

**Sensing object:**
- Water (Standard liquid) (Note 2)
- Sulfuric acid, Hydrochloric acid, Phosphoric acid, Ammonia, Fluorinert (Note 3), Galden (Note 3), Hydrofluoric acid etc. (Note 2)

**Supply voltage:** 12 to 24 V DC ±10 %, Ripple P-P 10 % or less

**Current consumption:** 30 mA or less

**Utilization category:** DC-12, DC-13

**Leakage detection output**
- <PNP output type>
  - PNP open-collector transistor
  - Maximum source current: 50 mA
  - Applied voltage: Same as the supply voltage (between detection output and +V)
  - Residual voltage: 2.5 V or less (at 50 mA source current)
- <NPN output type>
  - NPN open-collector transistor
  - Maximum sink current: 50 mA
  - Applied voltage: Same as the supply voltage (between detection output and 0 V)
  - Residual voltage: 2 V or less (at 50 mA sink current)

**Response time:** 10 ms or less

**Output operation**
- ON when initial detection, OFF when detection leakage or wrong installation

**Initial leakage detection output**
- <PNP output type>
  - PNP open-collector transistor
  - Maximum source current: 50 mA
  - Applied voltage: Same as the supply voltage (between auxiliary output and +V)
  - Residual voltage: 2.5 V or less (at 50 mA source current)
- <NPN output type>
  - NPN open-collector transistor
  - Maximum sink current: 50 mA
  - Applied voltage: Same as the supply voltage (between auxiliary output and 0 V)
  - Residual voltage: 2 V or less (at 50 mA sink current)

**Response time:** 50 ms or less

**Output operation**
- ON when normal condition, OFF when initial detection or accidental leakage

### Controller

**Model No.:** SQ4-C11

**Applicable standards:**
- ISO 13849-1 (Category 4, PLe), IEC 60947-5-2, IEC 61508-1 to 7 (SIL3), IEC 62061 (SIL3)
- JIS B 9705-1 (Category 4), JIS C 6508-1 to 7 (SIL3)
- EN 60947-5-2, EN 55011 Class A, EN 61000-6-2, EN 50178, EN ISO 13849-1 (Category 4, PLe), EN 61508-1 to 7 (SIL3)
- ANSI/UL 508, CAN/CSA C22.2 No.14
- S1-G.2009, S2-W.5-2009
- Conforming to SEMI-S2-0310a

**Power voltage:** 24 V DC, 15 %, Ripple P-P 10 % or less

**Consumption current:** 200 mA or less

**Control output (OSSD 1, OSSD 2):**
- <Selecting PNP output>
  - PNP open-collector transistor / NPN open-collector transistor (switch method)
  - Maximum source current: 200 mA
  - Applied voltage: Same as power voltage (between control output to +V)
  - Residual voltage: 2.5 V or less (at 200 mA source current)
- <Selecting NPN output>
  - NPN open-collector transistor
  - Maximum sink current: 200 mA
  - Applied voltage: Same as power voltage (between control output to 0 V)
  - Residual voltage: 2 V or less (at 200 mA sink current)

**Response time:** 20 ms or less (excluding the response time of the sensor)

**Operation mode (Output operation):**
- ON when initial detection, OFF when detection leakage or wrong installation

**Utilization category:** DC-12, DC-13

**Sensor monitor output (AUX1, 2, 3, 4, Non-safety output):**
- <Selecting PNP output>
  - PNP open-collector transistor / NPN open-collector transistor (switch method)
  - Maximum source current: 60 mA
  - Applied voltage: Same as power voltage (between sensor monitor output to +V)
  - Residual voltage: 2.5 V or less (at 60 mA source current)
- <Selecting NPN output>
  - NPN open-collector transistor
  - Maximum sink current: 60 mA
  - Applied voltage: Same as power voltage (between sensor monitor output to 0 V)
  - Residual voltage: 2 V or less (at 60 mA sink current)

**Response time:** 100 ms or less (excluding the response time of the sensor)

**Operation mode (Output operation):**
- ON when normal condition, OFF when initial detection or accidental leakage

**Utilization category:** DC-12, DC-13

**Lockout output:** OFF for lockout (Rating: Same as sensor monitor output)

**Auxiliary output:** Negative logic output of control output 1/2 (OSSD 1/2) (Rating: Same as sensor monitor output) / Auxiliaries output ON when control output 1/2 (OSSD 1/2) is OFF

**Functions:**
- Interlock / lockout cancel / Test input / External device monitor / Safety input / Control output polarity selection / Non-safety output polarity selection / Sensor connection number setting

**Protection:**
- IP20 (IEC) (However, it should be in IP54 protection structure of control panel)

**Ambient temperature / humidity:** -10 to +55 °C (No dew condensation or icing allowed) (Note 4), Storage: -20 to +55 °C / 35 to 85 % RH, Storage: 35 to 85 % RH

**PPFD:** 2.55 × 10^4 (when connecting 4 safety liquid connecting sensors)

**Material:**
- Main unit case: PC / ABS (alloy)
- Protection: IP20 (IEC) (However, it should be in IP54 protection structure of control panel)
- Utilization category: DC-12, DC-13

**Notes:**
1. Where measurement conditions have not been specified precisely, the conditions used were an ambient temperature of +20 °C ±68 °F.
2. The agents mentioned above are examples. It may not be detected depending on viscosity the agent.
3. Fluorinert™ is the world wide trademark of 3M. Galden is the world wide trademark of Solvay Solexis.
4. Liquid being detected should be also kept within the rated ambient temperature range.
I/O CIRCUIT AND WIRING DIAGRAMS

Sensors
SQ4-A-N  NPN output type

Controller
SQ4-C11

Color code
(Brown) +V
(Black) Leakage direction output
(White) Initial leakage detection output
(Blue) 0 V
50 mA max.

For operation with PNP output

Manual / Auto reset can be selected by the wiring of the reset input terminals (X1, X2, and X3).

KA, KB: External devices

Forced guide relay, magnet contactor or monitored valve

PRECAUTIONS FOR PROPER USE

- This product is a sensor for detecting leak of fluids.
- When this product is used with safety devices, construct the system such that the device itself.

- This device has been developed / produced for industrial use only.
- Before using this device, check whether the device performs properly with the functions and capabilities as per the design specifications.
- Avoid using this device in an explosive atmosphere because this product does not have an explosive-proof protective construction.

Installation

- There is the detection mount difference by directivity of a liquid leakage. When there are a direction from which a liquid leakage happens, and an inclination, please install the nose-of-cam side (opposite side of a cable) of a sensor towards a top.
- Use the mounting bracket MS-SQ4-□ (optional) which suits the liquid to detect.
- Periodical checking of operation is recommended with the liquids which are not dangerous (water, alcohol, etc.).
- The amount of detection may change with the conditions of the installation surface.
- Be sure to use the mounting bracket MS-SQ4-□ (optional) when installing this device to avoid human error, etc. Reliable detection cannot be guaranteed when this sensor is used alone.

Leakage detection condition and variation factor

- Leak detection part of this product properly detects the leakage in the following condition.
  1. Detection range: Area except backward of this product (liquid must enter to the detection range)
  2. Material of installation surface: Hard vinyl chloride or Stainless steel
  3. Surface condition for installation: Glossy surface (surface roughness: corresponding 0.4 μmRa) and clean surface.
  4. Installation surface angle: Horizontal

- This product may not detect properly liquid in following element.
  1. Liquid kind, consistency (surface tension) and air bubble incorporation.
  3. Wrong selection of dedicated mounting bracket.
- Check the detecting liquid and the installation condition before use.
### DIMENSIONS (Unit: mm in)

**SQ4-A21-□**

**Assembly dimensions with mounting bracket for MS-SQ4-21**

**SQ4-A22-□**

**Assembly dimensions with mounting bracket**

**MS-SQ4-□**

**Mounting bracket set**

**Attachment**

**PVC / PFA mounting bracket**

**Model No.**

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>MS-SQ4-21</td>
<td>2.5</td>
<td>5.6</td>
</tr>
<tr>
<td>MS-SQ4-22</td>
<td>2.5</td>
<td>5.4</td>
</tr>
<tr>
<td>MS-SQ4-23</td>
<td>0.3</td>
<td>3.4</td>
</tr>
<tr>
<td>MS-SQ4-24</td>
<td>2.5</td>
<td>5.6</td>
</tr>
</tbody>
</table>

Notes:

1. Drawing above is for PFA mounting bracket. PVC mounting brackets do not incorporate stainless steel bushes.
2. The size of mounting holes is ø4.3 mm ø0.169 in.

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