Continuous measurement of conductivity and thickness of buildup

Application
Developed and built for use in the food and beverages industry.
Meets international hygiene requirements.

Your benefits
- Can be used irrespective of the conductivity of liquid media or pastes
- Flush mount installation, pipes remain piggable
- Easy installation thanks to compact design - even in tight conditions or where access is restricted
- Flexible thanks to two continuous signals, a current output and a frequency output, and digital communication via IO-Link
- Configuration via IO-Link always possible, also if using analog versions (current and frequency outputs)
- Wide range of process connections for installation in new or existing systems
- Robust stainless steel housing, optionally available with IP69 protection
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About this document

Symbols

Safety symbols

⚠️ DANGER
This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.

⚠️ WARNING
This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in serious or fatal injury.

⚠️ CAUTION
This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or medium injury.

NOTICE
This symbol contains information on procedures and other facts which do not result in personal injury.

Symbols for certain types of information and graphics

✔️ Permitted
Procedures, processes or actions that are permitted

✔️✔️ Preferred
Procedures, processes or actions that are preferred

✖️ Forbidden
Procedures, processes or actions that are forbidden

❗️ Tip
Indicates additional information

► Notice or individual step to be observed

1, 2, 3, ...
Item numbers

A, B, C, ...
Views

Reference to documentation
Function and system design

Measuring principle
A low, galvanically isolated AC voltage is applied at the electrodes in contact with the process. If liquid media or pastes come into contact with the electrode, a measurable current flows. In this way, the device determines the conductivity and the dielectric constant ($\varepsilon_r$) of the medium.

The thickness of the buildup is calculated from the ratio between the measuring signals of the two electrodes.

Input

Measured process variable
Electrical conductivity, dielectric constant ($\varepsilon_r$) of the medium

Calculated process variable
Thickness of buildup

Measuring range

<table>
<thead>
<tr>
<th>Conductivity</th>
<th>0 µS/cm to 100 mS/cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum permitted span: 3 000 µS/cm can be ordered; 1 000 µS/cm can be configured at the device via the IO-Link interface</td>
<td></td>
</tr>
</tbody>
</table>

Thickness of buildup
0 to 10 mm

Output

Output signal
The following options can be selected in the Product Configurator, order code for “Output”:

Preconfigured assignment of the outputs:
- Option B
  - OU1: frequency (buildup)
  - OU2: frequency (conductivity)
- Option C
  - OU1: frequency (buildup)
  - OU2: 4 to 20 mA (conductivity)

Select the HT option if the device is to be adjusted to non-conductive media and the measuring range is to be preconfigured.

Variable assignment of the outputs with the conductivity and thickness of buildup parameters:
- Option 7
  - OU1: IO-Link
  - OU2: 4 to 20 mA (off, conductivity or buildup depending on the order, select the HT option)
- Option 8
  - OU1: IO-Link
  - OU2: frequency (off or conductivity depending on the order, select the HT option)

Signal on alarm
The behavior of the output in the event of a failure is regulated in accordance with NAMUR NE43.

Frequency
$f < 260$ Hz

Current
$I < 3.6$ mA (as per NAMUR NE43)
- Failure current is output and “S803” displayed (output: MIN alarm current)
- Periodic checking to establish if it is possible to quit fault state

Signal range
- Frequency, lower range value: 300 Hz
- Frequency, end: 3 000 Hz
- Signal range: 270 to 3 100 Hz
- Current: 3.8 to 20.5 mA
Load  Load for 4 to 20 mA output

Depends on the supply voltage $U_B$ of the power supply unit: do not exceed the maximum load resistance $R_L$ (including supply line resistance) as otherwise it will not be possible to set the corresponding current.

$$R_{L_{\text{max}}} = \frac{U_B \cdot 6.5 \text{ V}}{21 \text{ mA}}$$

![Graph showing Load for 4 to 20 mA output](image)

Power supply

Device plugs  M12 plug: IEC 60947-5-2

Supply voltage  Without digital communication
- 10 to 30 VDC
- IO-Link mode
- 18 to 30 VDC

IO-Link communication is guaranteed only if the supply voltage is at least 18 V.

Power consumption  < 1.4 W

Electrical connection  Connecting the device

⚠️ WARNING
Risk of injury from the uncontrolled activation of processes!
- Switch off the supply voltage before connecting the device.
- Make sure that downstream processes are not started unintentionally.

⚠️ WARNING
Electrical safety is compromised by an incorrect connection!
- In accordance with IEC/EN61010 a suitable circuit breaker must be provided for the device.
- Voltage source: Non-hazardous contact voltage or Class 2 circuit (North America).
- The device must be operated with a fine-wire fuse 500 mA (slow-blow).

Protective circuits against reverse polarity are integrated.
**Connection**

- Pin 1: Supply voltage +
- Pin 2: Current output 4 to 20 mA or frequency 300 to 3000 Hz
- Pin 3: Supply voltage -
- Pin 4: IO-Link communication or frequency 300 to 3000 Hz

**Post-connection check**

- Are the device and cable undamaged (visual inspection)?
- Does the supply voltage match the specifications on the nameplate?
- If supply voltage is present, is the green LED lit?
- With IO-Link communication: is the green LED flashing?

**Overvoltage protection**

Overvoltage category II

**Reverse polarity protection**

Integrated; no damage in the event of reverse polarity or short-circuit

**Short-circuit protection**

The device is protected against overload and short-circuiting.
Intelligent monitoring:
Check for overload in intervals of ~ 1.5 s; normal operation is resumed once the overload/short-circuit is fixed.

**Performance characteristics**

**Reference operating conditions**

- Ambient temperature: constant 20 °C (68 °F) ±5 °C (9 °F)
- Medium: water, conductivity approx. 200 µS/cm
- Medium temperature: 20 °C (68 °F) ±5 °C (9 °F)
  - Conductivity: fully covered, sensor covered by 20 mm of medium
  - Coverage: up to max. 6 mm

**Maximum measured error under reference conditions**

Conductivity

≤ 5 %

**Typical measured error**

Conductivity

- 0 to 2 mS/cm: ≤ 5 % of reading ± 0.2 µS/cm
- 2 to 20 mS/cm: ≤ 7 % of reading
- 20 to 50 mS/cm: ≤ 10 % of reading
- 50 to 100 mS/cm: ≤ 15 % of reading

The sensor must be covered by at least 20 mm of medium.

The data indicated are typical measured errors. In individual cases, the effects of factors such as polarization can result in different values.
Buildup

The typical measured error is between the limits indicated.

![Graph showing buildup measured error]

**Buildup measured error**

<table>
<thead>
<tr>
<th>A</th>
<th>Buildup measured value</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>Actual buildup</td>
</tr>
<tr>
<td>1</td>
<td>0 to 100 mS/cm</td>
</tr>
<tr>
<td>2</td>
<td>0.01 to 20 mS/cm</td>
</tr>
</tbody>
</table>

**Non-repeatability**

**Conductivity**

- 0 to 2 mS/cm: ≤ 0.5 % of reading ± 0.2 µS/cm
- 2 to 20 mS/cm: ≤ 0.75 % of reading
- 20 to 50 mS/cm: ≤ 1.5 % of reading
- 50 to 100 mS/cm: ≤ 2.5 % of reading

**Buildup**

≤ 0.25 mm

**Switch-on time**

< 2 s

**Response time**

**Configurable damping**

- 0.1 to 60 s
- T63: as per set damping. Output has behavior of PT1 element.

**Dead time**

250 ms

**Installation**

**Mounting location**

Installation in vessel, pipe or tank.
4 Installation examples

5 Horizontal orientation → preferred orientation

6 Vertical orientation → formation of buildup or bubbles on the sensor must be taken into account

The possibility of buildup or bubbles forming on the sensor when installed vertically must be taken into account. If the sensor is partially covered, or if encrustations or air bubbles have formed on the sensor, this will be reflected in the measured value.

7 Flush-mounted orientation. Unit of measurement mm (in)

<table>
<thead>
<tr>
<th>Length of connecting cable</th>
<th>Special mounting instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. 25 Ω/core, total capacity &lt; 100 nF</td>
<td>When installing the plug, do not allow moisture to enter the plug or socket area</td>
</tr>
<tr>
<td>IO-Link communication: &lt; 10 nF</td>
<td>Protect housing against impact</td>
</tr>
</tbody>
</table>
## Environment

<table>
<thead>
<tr>
<th><strong>Ambient temperature range</strong></th>
<th>At the housing: –40 to +70 °C (–40 to +158 °F)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Storage temperature</strong></td>
<td>–40 to +85 °C (–40 to +185 °F)</td>
</tr>
<tr>
<td><strong>Humidity</strong></td>
<td>Operation up to 100 %. Do not connect in a condensing atmosphere.</td>
</tr>
<tr>
<td><strong>Operating altitude</strong></td>
<td>Up to 2,000 m (6,600 ft) above sea level</td>
</tr>
<tr>
<td><strong>Pollution degree</strong></td>
<td>Pollution degree 4</td>
</tr>
<tr>
<td><strong>Climate class</strong></td>
<td>DIN EN 60068-2-38/IEC 68-2-38: Test Z/AD</td>
</tr>
</tbody>
</table>
| **Degree of protection**      | • IP65/67 NEMA type 4X enclosure (plastic housing cover)  
                              | • IP66/68/69 NEMA type 4X/6P enclosure (metal housing cover)  |
| **Vibration resistance**      | As per test Fh, EN 60068-2-64:2008: $a_{\text{RMS}} = 50 \text{ m/s}^2$, $f = 5$ to 2,000 Hz, $t = 3 \times 2 \text{ h}$ |
| **Shock resistance**          | As per test Ea, prEN 60068-2-27:2007: $a = 300 \text{ m/s}^2 = 30 \text{ g}$, $3 \times 2 \text{ directions} \times 3 \text{ shocks} \times 18 \text{ ms}$ |
| **Cleaning**                  | Resistant to typical cleaning agents from the outside, in accordance with Ecolab test. |

### Details: Declaration of Conformity

Electromagnetic compatibility in accordance with all the relevant requirements of the EN 61326 series.

Only the requirements of IEC/EN 61131-9 are met if IO-Link communication is used.

If the device is installed in plastic structures, its function may be influenced by strong electromagnetic fields. Emission requirements for class A equipment are met (only for use in “industrial environments”).

## Process

| **Process temperature range** | –20 to +100 °C (–4 to +212 °F)  
                              | • For 1 h: +150 °C (+302 °F)  
                              | • M24 process adapter with EPDM process seal for 1 h: +130 °C (+266 °F) |
| **Process pressure range**    | –1 to +25 bar (–14.5 to +362.5 psi) |
Mechanical construction

Design

Product design

1. M12 plug
2. Plastic housing cover IP65/67
3. Metal housing cover IP66/68/69
4. Housing
5. Process connection
6. Sensor

Dimensions

Unit of measurement mm (in)

A: Device with threaded connection
B: Device with clamp/DIN11851 process connection

Process connections

A: Device with threaded connection; product structure: order code for 'Process connection', options W5J, WSJ, X2J; material: 316L, dimensions in: mm (in)

<table>
<thead>
<tr>
<th></th>
<th>G 3/4&quot;, W5J</th>
<th>G 1&quot;, WSJ</th>
<th>M24 1.5, X2J</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>H1 122 (4.8)</td>
<td>124 (4.88)</td>
<td>122 (4.8)</td>
</tr>
<tr>
<td></td>
<td>H2 28 (1.1)</td>
<td>32 (1.26)</td>
<td>19 (0.75)</td>
</tr>
<tr>
<td></td>
<td>H3 16 (0.63)</td>
<td>19 (0.75)</td>
<td>13 (0.51)</td>
</tr>
</tbody>
</table>
B: Device with clamp/DIN11851 process connection; product structure: order code for ‘Process connection’, options 3CJ, 3EJ, 1AJ, 1CJ; material: 316L; dimensions in: mm (in)

<table>
<thead>
<tr>
<th></th>
<th>Tri-Clamp ISO2852</th>
<th>DIN11851</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DN25-38 (1...1-1/2&quot;), 3CJ</td>
<td>DN40-51 (2&quot;), 3EJ</td>
</tr>
<tr>
<td>H1</td>
<td>117 (4.61)</td>
<td>117 (4.61)</td>
</tr>
</tbody>
</table>

Weight

Approx. 300 g (10.58 oz)

Materials

Sensor:
316L (1.4404), PEEK
(The material PEEK meets the requirements of EU 1935/2004, 10/2011, 2023/2006 and FDA 21 CFR 177.1380)

Process connection:
316L (1.4404/1.4435)

M12 connector:
Housing cover (depending on the design):
- PPSU
- 316L (1.4404/1.4435)

Design ring:
PBT/PC

Housing:
316L (1.4404/1.4435)

Nameplate:
Lasered onto housing

Surface roughness

Wetted sensor surface: Ra ≤ 0.76 µm (30 µin)

Human interface

Operational display (LEDs)

Position of LEDs in housing cover
1 Green (GN), communication status
2 Red (RD), warning/maintenance required

There is no external signaling via LEDs on the metal housing cover (IP69).

Operating concept for devices with IO-Link

Operator-oriented menu structure for user-specific tasks
Quick and safe commissioning
Guided menus for applications

Reliable operation

Operation in the following languages:
Via IO-Link: English
Efficient diagnostic behavior increases measurement availability

- Remedial measures
- Simulation options

System integration

IO-Link information

IO-Link is a point-to-point connection for communication between the device and an IO-Link master. This requires an IO-Link compatible module (IO-Link master) for operation. The IO-Link communication interface enables direct access to the process and diagnostic data. It also provides the option of configuring the device during operation.

The device supports the following characteristics of the physical layer:

- IO-Link specification: version 1.1
- IO-Link Smart Sensor Profile 2nd Edition
- SIO mode: Yes
- Speed: COM2; 38.4 kBaud
- Minimum cycle time: 6 ms
- Process data width: 32 bit
- IO-Link data storage: Yes
- Block configuration: Yes

Regardless of the customer-specific default settings selected, the device always has the option of communicating or being configured via IO-Link.

IO-Link download

http://www.endress.com/download

- Select 'Device Driver' from the list displayed
- In the Type search field, select "IO Device Description (IODD)"
- In the Product Code search field, select the product root
- Click 'Search' button → Select result → Download

Optional: In the Text Search search field, enter the device name.

Certificates and approvals

Currently available certificates and approvals can be called up via the product configurator.

CE mark

The measuring system meets the legal requirements of the applicable EU Directives. These are listed in the corresponding EU Declaration of Conformity along with the standards applied.

Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.

RCM-Tick marking

The supplied product or measuring system meets the ACMA (Australian Communications and Media Authority) requirements for network integrity, interoperability, performance characteristics as well as health and safety regulations. Here, especially the regulatory arrangements for electromagnetic compatibility are met. The products are labelled with the RCM-Tick marking on the name plate.

Sanitary compatibility

The device has been developed for use in hygienic processes. The materials in contact with the process meet FDA requirements as well as the 3-A Sanitary Standard No. 74-xx. Endress+Hauser confirms this by affixing the 3-A symbol to the device. As an option, a certificate of conformity according to EC/1935/2004 can be ordered.
The following certificate copies can be ordered with the device (optional):

- If cleaning in place (CIP) is required, process adapters that comply with 3-A requirements are available. If installed horizontally, ensure that the leakage hole is pointing down. This allows leaks to be detected as quickly as possible.
- To avoid the risk of contamination, install the device according to the EHEDG design principles outlined in document 8 "Hygienic Equipment Design Criteria".
- Suitable connections and seals must be used in order to guarantee a hygienic design according to the latest design version. Hygienic design according to 3-A specifications and the EHEDG "Position Paper".
- For information on 3-A and EHEDG-approved weld-in adapters, see Technical Information TI00426F.
- Gap-free connections can be cleaned of all residue using sterilization in place (SIP) and cleaning in place (CIP), which are industry-standard cleaning methods. Attention must be paid to the pressure and temperature specifications of the sensor and process connections for CIP and SIP processes.

**CRN approval**

Versions with a CRN approval (Canadian Registration Number) are listed in the corresponding registration documents. CRN-approved devices are marked with a registration number. Any restrictions regarding the maximum process pressure values are listed on the CRN certificate.

**Test reports**

The following documents can be ordered with the device (optional):

- Acceptance test certificate as per EN 10204-3.1
- Test report of surface roughness ISO4287/Ra

**Pressure equipment with allowable pressure \( \leq 200 \text{ bar (2900 psi)} \)**

Pressure instruments with a flange and threaded boss that do not have a pressurized housing do not fall within the scope of the Pressure Equipment Directive, irrespective of the maximum allowable pressure.

**Reasons:**

According to Article 2, point 5 of EU Directive 2014/68/EU, pressure accessories are defined as "devices with an operational function and having pressure-bearing housings". If a pressure instrument does not have a pressure-bearing housing (no identifiable pressure chamber of its own), there is no pressure accessory present within the meaning of the Directive.

**Additional certification**

CSA C/US General Purpose

**RoHS**

The measuring system complies with the substance restrictions of the Restriction on Hazardous Substances Directive 2011/65/EU (RoHS 2).

**Ordering information**

Detailed ordering information is available from your nearest sales organization [www.addresses.endress.com](http://www.addresses.endress.com).

**Accessories**

Accessories can be ordered with the device (optional) or separately.
Hexagon tubular socket wrench 32 mm

Order number: 52010156

To mount the device in locations that are difficult to access.

Plug-in jack, elbowed 90°

Plug-in jack M12 IP69
- Terminated connector
- 5 m (16 ft) PVC cable (orange)
- Body: PVC (orange)
- Slotted nut 316L (1.4435)
- Order number: 52024216

Plug-in jack M12 IP67
- Terminated connector
- 5 m (16 ft) PVC cable (gray)
- Body: PUR (blue)
- Slotted nut Cu Sn/Ni
- Order number: 52010285

Core colors for M12 plug:
- 1 = BN (brown)
- 2 = WH (white)
- 3 = BU (blue)
- 4 = BK (black)

Plug-in jack, straight

Plug-in jack M12 IP67
- Straight
- Self-terminated connection to M12 connector
- Body: PBT
- Slotted nut Cu Sn/Ni
- Order number: 52006263
**Process adapter M24 thread**

**Material**
For all versions:
- Adapter
  316L (1.4435)
- Seal
  EPDM

**Process adapter M24 PN25**
Available versions:
- DIN11851 DN50 with slotted nut
- SMS 1 ½"

**Process adapter M24 PN40**
Available versions:
- Varivent F
- Varivent N

---

**Weld-in adapter**

![Image of weld-in adapter]

13 Sample drawing of weld-in adapter

1 Leakage hole

**G ¾"**
Available versions:
- ø 50 mm (1.97 in) - Installation on vessel
- ø 29 mm (1.14 in) - Installation in pipe

**G 1"**
Available versions:
- ø 53 mm (2.09 in) - Installation on vessel
- ø 60 mm (2.36 in) - Installation on pipe

**M24**
Available versions:
- ø 65 mm (2.56 in) - Installation on vessel

---

**Grooved union nut DIN11851**

![Image of grooved union nut]

14 Sample drawing of grooved union nut

**Material**
For all versions:
- 304 (1.4307)

**For milk pipe DIN11851**
Available versions:
- DN25 - F26
- DN40 - F40
- DN50 - F50
Supplementary documentation

The certificates, approvals and other documentation currently available can be accessed as follows:
Endress+Hauser website: www.endress.com → Downloads.

<table>
<thead>
<tr>
<th>Special Documentation</th>
<th>Document type: Operating Instructions (BA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• TI00426F: Adapter and flanges (overview)</td>
<td></td>
</tr>
<tr>
<td>• SD01622P: Weld-in adapter (installation instructions)</td>
<td></td>
</tr>
<tr>
<td>Supplementary device-dependent documentation</td>
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<tr>
<td>Document type: Brief Operating Instructions (KA)</td>
<td></td>
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<tr>
<td>Installation and initial commissioning – contains all functions in the operating menu that are required for a typical measuring task. Functions beyond this scope are not included. BA01925F</td>
<td></td>
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<tr>
<td>Quick guide to the first measured value – includes all essential information from the incoming acceptance to the electrical connection. KA01448F</td>
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