Operating Instructions

RIA452

Process indicator
with pump control
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1 Document information

1.1 Document conventions

1.1.1 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.

1.1.2 Electrical symbols

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>−−−−−−−</td>
<td>Direct current</td>
</tr>
<tr>
<td>∼ ∼ ∼ ∼</td>
<td>Alternating current</td>
</tr>
<tr>
<td>∼ ∼ ∼ ∼</td>
<td>Direct current and alternating current</td>
</tr>
<tr>
<td>−−</td>
<td>Ground connection</td>
</tr>
<tr>
<td>A grounded terminal which, as far as the operator is concerned, is grounded via a grounding system.</td>
<td></td>
</tr>
<tr>
<td>−−</td>
<td>Potential equalization connection (PE: protective earth)</td>
</tr>
<tr>
<td>Ground terminals that must be connected to ground prior to establishing any other connections.</td>
<td></td>
</tr>
<tr>
<td>The ground terminals are located on the interior and exterior of the device:</td>
<td></td>
</tr>
<tr>
<td>• Interior ground terminal: potential equalization is connected to the supply network.</td>
<td></td>
</tr>
<tr>
<td>• Exterior ground terminal: device is connected to the plant grounding system.</td>
<td></td>
</tr>
</tbody>
</table>

1.1.3 Symbols for certain types of information

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>✔</td>
<td>Permitted</td>
</tr>
<tr>
<td>Procedures, processes or actions that are permitted.</td>
<td></td>
</tr>
<tr>
<td>✔ ✔</td>
<td>Preferred</td>
</tr>
<tr>
<td>Procedures, processes or actions that are preferred.</td>
<td></td>
</tr>
<tr>
<td>☓</td>
<td>Forbidden</td>
</tr>
<tr>
<td>Procedures, processes or actions that are forbidden.</td>
<td></td>
</tr>
<tr>
<td>✉️</td>
<td>Tip</td>
</tr>
<tr>
<td>Indicates additional information.</td>
<td></td>
</tr>
<tr>
<td>📚</td>
<td>Reference to documentation</td>
</tr>
<tr>
<td></td>
<td>Reference to page</td>
</tr>
<tr>
<td>Symbol</td>
<td>Meaning</td>
</tr>
<tr>
<td>--------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>🌐</td>
<td>Reference to graphic</td>
</tr>
<tr>
<td>🔴</td>
<td>Notice or individual step to be observed</td>
</tr>
<tr>
<td>☞, ☞, ☞...</td>
<td>Series of steps</td>
</tr>
<tr>
<td>←</td>
<td>Result of a step</td>
</tr>
<tr>
<td>🤔</td>
<td>Help in the event of a problem</td>
</tr>
<tr>
<td>🕵️‍♂️</td>
<td>Visual inspection</td>
</tr>
</tbody>
</table>

### 1.1.4 Symbols in graphics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
<th>Symbol</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 2, 3,...</td>
<td>Item numbers</td>
<td>☞, ☞, ☞...</td>
<td>Series of steps</td>
</tr>
<tr>
<td>A, B, C,...</td>
<td>Views</td>
<td>A-A, B-B, C-C,...</td>
<td>Sections</td>
</tr>
<tr>
<td>🔴</td>
<td>Hazardous area</td>
<td>⚪️</td>
<td>Safe area (non-hazardous area)</td>
</tr>
</tbody>
</table>

### 1.1.5 Documentation

For an overview of the scope of the associated Technical Documentation, refer to the following:
- **Device Viewer** ([www.endress.com/deviceviewer](http://www.endress.com/deviceviewer)): Enter the serial number from the nameplate
- **Endress+Hauser Operations app**: Enter serial number from nameplate or scan matrix code on nameplate.

#### Document function

The following documentation may be available depending on the version ordered:

<table>
<thead>
<tr>
<th>Document type</th>
<th>Purpose and content of the document</th>
</tr>
</thead>
</table>
| Technical Information (TI)     | Planning aid for your device  
The document contains all the technical data on the device and provides an overview of the accessories and other products that can be ordered for the device. |
| Brief Operating Instructions (KA) | Guide that takes you quickly to the 1st measured value  
The Brief Operating Instructions contain all the essential information from incoming acceptance to initial commissioning. |
| Operating Instructions (BA)    | Your reference document  
The Operating Instructions contain all the information that is required in the various phases of the life cycle of the device: from product identification, incoming acceptance and storage, to mounting, connection, operation and commissioning through to troubleshooting, maintenance and disposal. |
| Description of Device Parameters (GP) | Reference for your parameters  
The document provides a detailed explanation of each individual parameter. The description is aimed at those who work with the device over the entire life cycle and perform specific configurations. |
2.1  Requirements for the personnel

The personnel for installation, commissioning, diagnostics and maintenance must fulfill the following requirements:

▶ Trained, qualified specialists must have a relevant qualification for this specific function and task.
▶ Are authorized by the plant owner/operator.
▶ Are familiar with federal/national regulations.
▶ Before starting work, read and understand the instructions in the manual and supplementary documentation as well as the certificates (depending on the application).
▶ Follow instructions and comply with basic conditions.

The operating personnel must fulfill the following requirements:

▶ Are instructed and authorized according to the requirements of the task by the facility's owner-operator.
▶ Follow the instructions in this manual.

2.2  Intended use

The process indicator evaluates analog process variables and displays them on its multicolored screen. Processes can be monitored and controlled with the device's outputs and limit relays. The device is equipped with a wide array of software functions for this purpose. Power can be supplied to 2-wire sensors with the integrated transmitter power supply.

▶ The device is an associated apparatus and may not be installed in the hazardous area.
▶ The manufacturer accepts no liability for damages resulting from improper or non-designated use. The device may not be converted or modified in any way.
▶ The device is designed for installation in a panel and must only be operated in an installed state.
2.3 Operational safety

Risk of injury!

- Operate the device only if it is in proper technical condition, free from errors and faults.
- The operator is responsible for interference-free operation of the device.

Modifications to the device

Unauthorized modifications to the device are not permitted and can lead to unforeseeable dangers:

- If modifications are nevertheless required, consult with the manufacturer.

Repair

To ensure continued operational safety and reliability:

- Carry out repairs on the device only if they are expressly permitted.
- Observe federal/national regulations pertaining to the repair of an electrical device.
- Use only original spare parts and accessories from the manufacturer.

2.4 Product safety

This measuring device is designed in accordance with good engineering practice to meet state-of-the-art safety requirements, has been tested, and left the factory in a condition in which it is safe to operate.

It meets general safety standards and legal requirements. It also complies with the EC directives listed in the device-specific EC Declaration of Conformity. The manufacturer confirms this by affixing the CE mark to the device.

2.5 IT security

Our warranty is valid only if the product is installed and used as described in the Operating Instructions. The product is equipped with security mechanisms to protect it against any inadvertent changes to the settings.

IT security measures, which provide additional protection for the product and associated data transfer, must be implemented by the operators themselves in line with their security standards.

3 Incoming acceptance and product identification

Proceed as follows on receipt of the device:

1. Check whether the packaging is intact.
2. If damage is discovered:
   Report all damage immediately to the manufacturer.
3. Do not install damaged components, as the manufacturer cannot otherwise guarantee the material resistance or compliance with the original safety requirements, and can also not be held responsible for the consequences that may result.
4. Compare the scope of delivery against the contents of your order.
5. Remove all the packaging material used for transportation.
6. Do the data on the nameplate match the ordering information on the delivery note?
7. Are the technical documentation and all other necessary documents provided, e.g. certificates?

If one of the conditions is not satisfied, contact your Sales Center.

3.1  Product identification

The following options are available for identification of the device:
• Nameplate specifications
• Enter the serial number from the nameplate in the Device Viewer (www.endress.com/deviceviewer): all the information about the device and an overview of the Technical Documentation supplied with the device are displayed.
• Enter the serial number on the nameplate into the Endress+Hauser Operations App or scan the 2-D matrix code (QR code) on the nameplate with the Endress+Hauser Operations App: all the information about the device and the technical documentation pertaining to the device is displayed.

3.1.1  Nameplate

The right device?

The nameplate provides you with the following information on the device:
• Manufacturer identification, device designation
• Order code
• Extended order code
• Serial number
• Tag name (TAG)
• Technical values: supply voltage, current consumption, ambient temperature, communication-specific data (optional)
• Degree of protection
• Approvals with symbols

► Compare the information on the nameplate with the order.

3.1.2  Name and address of manufacturer

<table>
<thead>
<tr>
<th>Name of manufacturer:</th>
<th>Endress+Hauser Wetzer GmbH + Co. KG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address of manufacturer:</td>
<td>Obere Wank 1, D-87484 Nesselwang or <a href="http://www.endress.com">www.endress.com</a></td>
</tr>
</tbody>
</table>

3.2  Storage and transport

Storage temperature
−30 to +70 °C (−22 to +158 °F)

Maximum relative humidity: < 95 % as per IEC 60068-2-30

Pack the device for storage and transportation in such a way that it is reliably protected against impact and external influences. The original packaging offers the best protection.

Avoid the following environmental influences during storage:
• direct sunlight
• proximity to hot objects
• mechanical vibration
• aggressive media
3.3 Certificates and approvals

For certificates and approvals valid for the device: see the data on the nameplate

Approval-related data and documents: www.endress.com/deviceviewer → (enter the serial number)

4 Installation

4.1 Installation conditions

The permitted ambient conditions must be observed during installation and operation (see the "Technical data" section of the Operating Instructions). The device must be protected from exposure to heat.

4.1.1 Installation dimensions

Required panel cutout 92 mm (3.62 in) x 92 mm (3.62 in). Ensure an installation depth of 150 mm (5.91 in) for the device plus cable. For additional dimensions, see → 1, 9 and the "Technical data" section of the Operating Instructions.

4.1.2 Mounting location

Installation in a panel. The mounting location must be free from vibrations. A suitable electrical, fire-proof and mechanical enclosure must be provided.

4.1.3 Orientation

Horizontal, ±45° in every direction.

4.2 Mounting the indicator

![Diagram of installation in a panel](image-url)
Mounting the indicator

1. Push the device with the sealing ring (item 1) through the panel cutout from the front.
2. Hold the device level and clip the fastening clips (item 2) into the openings provided.
3. Tighten the screws of the fastening clips uniformly using a screwdriver.
4. Remove the protective foil from the display.

5  Electrical connection

<table>
<thead>
<tr>
<th>Terminal</th>
<th>Terminal assignment</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>L/L+</td>
<td>L for AC, L+ for DC</td>
<td>Power supply</td>
</tr>
<tr>
<td>N/L-</td>
<td>N for AC, L+ for DC</td>
<td></td>
</tr>
<tr>
<td>Terminal</td>
<td>Terminal assignment</td>
<td>Description</td>
</tr>
<tr>
<td>----------</td>
<td>---------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>NC</td>
<td>Not connected</td>
<td></td>
</tr>
<tr>
<td>J1</td>
<td>Jumper for locking device operation via hardware. If the jumper is set to J1, the setting cannot be modified.</td>
<td>The device can always be configured with the PC software via RS232 even if the jumper is set to J1.</td>
</tr>
<tr>
<td>J2</td>
<td>Not connected</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>+0/4 to 20 mA</td>
<td>Current input</td>
</tr>
<tr>
<td>12</td>
<td>Signal ground (current)</td>
<td></td>
</tr>
<tr>
<td>81</td>
<td>24 V sensor power supply 1</td>
<td>Transmitter power supply (intrinsically safe if required)</td>
</tr>
<tr>
<td>82</td>
<td>Ground, sensor power supply 1</td>
<td></td>
</tr>
<tr>
<td>41</td>
<td>Normally closed (NC)</td>
<td>Relay 1</td>
</tr>
<tr>
<td>42</td>
<td>Common (COM)</td>
<td></td>
</tr>
<tr>
<td>43</td>
<td>Normally open (NO)</td>
<td></td>
</tr>
<tr>
<td>51</td>
<td>Normally closed (NC)</td>
<td>Relay 2</td>
</tr>
<tr>
<td>52</td>
<td>Common (COM)</td>
<td></td>
</tr>
<tr>
<td>53</td>
<td>Normally open (NO)</td>
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</tr>
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<td>44</td>
<td>Normally closed (NC)</td>
<td>Relay 3</td>
</tr>
<tr>
<td>45</td>
<td>Common (COM)</td>
<td></td>
</tr>
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<td>46</td>
<td>Normally open (NO)</td>
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</tr>
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<td>54</td>
<td>Normally closed (NC)</td>
<td>Relay 4</td>
</tr>
<tr>
<td>55</td>
<td>Common (COM)</td>
<td></td>
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<td>56</td>
<td>Normally closed (NC)</td>
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</tr>
<tr>
<td>141</td>
<td>Normally closed (NC)</td>
<td>Relay 5</td>
</tr>
<tr>
<td>142</td>
<td>Common (COM)</td>
<td></td>
</tr>
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<td>143</td>
<td>Normally open (NO)</td>
<td></td>
</tr>
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<td>151</td>
<td>Normally closed (NC)</td>
<td>Relay 6</td>
</tr>
<tr>
<td>152</td>
<td>Common (COM)</td>
<td></td>
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<tr>
<td>153</td>
<td>Normally open (NO)</td>
<td></td>
</tr>
<tr>
<td>144</td>
<td>Normally closed (NC)</td>
<td>Relay 7</td>
</tr>
<tr>
<td>145</td>
<td>Common (COM)</td>
<td></td>
</tr>
<tr>
<td>146</td>
<td>Normally open (NO)</td>
<td></td>
</tr>
<tr>
<td>154</td>
<td>Normally closed (NC)</td>
<td>Relay 8</td>
</tr>
<tr>
<td>155</td>
<td>Common (COM)</td>
<td></td>
</tr>
<tr>
<td>156</td>
<td>Normally open (NO)</td>
<td></td>
</tr>
<tr>
<td>96</td>
<td>Ground for digital status inputs</td>
<td>Digital inputs</td>
</tr>
<tr>
<td>97</td>
<td>+ digital status input 1</td>
<td></td>
</tr>
<tr>
<td>197</td>
<td>+ digital status input 2</td>
<td></td>
</tr>
<tr>
<td>297</td>
<td>+ digital status input 3</td>
<td></td>
</tr>
<tr>
<td>397</td>
<td>+ digital status input 4</td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>+ analog output</td>
<td>Analog output (optional)</td>
</tr>
<tr>
<td>32</td>
<td>Ground, analog output</td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>+ digital output</td>
<td>Digital output (optional)</td>
</tr>
<tr>
<td>34</td>
<td>Ground, digital output</td>
<td></td>
</tr>
</tbody>
</table>
5.1 Universal input option
The device can be optionally equipped with a universal input instead of the current input.
5.2.1 Connecting the power supply

- Before wiring the device, ensure that the supply voltage corresponds to the specification on the nameplate.
- For the 90 to 250 V\textsubscript{AC} version (mains connection), a switch marked as a circuit breaker, as well as an overload protection device (rated power ≤ 10 A) must be fitted in the supply line near the device (easy to reach).
- For version 20 to 35 V\textsubscript{DC} or 20 to 28 V\textsubscript{AC}: The device must be powered only by a power unit that operates using a limited energy circuit in accordance with UL/EN/IEC 61010-1, Section 9.4 and the requirements in Table 18.

![Diagram of power supply connections](image)

5.2.2 Connecting the external sensors

Active and passive sensors with analog, TC, resistance and RTD sensors can be connected to the device.

Current input 0/4 to 20 mA

![Diagram of current input connections](image)

A Active sensor  
B Passive sensor  
1 Terminal 12 and 82 jumpered internally
Universal input

Connection of 4-wire sensor, transmitter power supply and universal input

A Active sensor, 4-wire
1 Supply
B Active sensor, 4-wire - Power supply via RIA452
C Passive sensor, 2-wire
2 Terminal 12 and 92 jumpered externally

Power supply in the hazardous area

RIA452 + RB223

Connection of 2-wire sensor in the hazardous area to current input 0/4 to 20 mA via RB223

A Passive sensor, 2-wire
B RB223 Ex passive barrier
C Process indicator RIA452 (jumper required for terminal 12 and 92)

Pay attention to the transmitter power supply! A loop check should also be carried out at the maximum loop current.
**RIA452 + RN22**

Connection of 2- or 4-wire sensor in the hazardous area to current input 0/4 to 20 mA via RN22

- **A** Active sensor, 4-wire
- **B** Supply
- **C** Passive sensor, 2-wire
- **D** RN22 Ex passive barrier
- **D** Process indicator RIA452

Pay attention to the transmitter power supply! A loop check should also be carried out at the maximum loop current.

### 5.3 Post-connection check

<table>
<thead>
<tr>
<th>Device condition and specification</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is the device or cable damaged (visual inspection)?</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Electrical connection</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does the supply voltage match the specifications on the nameplate?</td>
<td>90 to 250 V&lt;sub&gt;AC&lt;/sub&gt; (50/60 Hz) 20 to 36 V&lt;sub&gt;DC&lt;/sub&gt; 20 to 28 V&lt;sub&gt;AC&lt;/sub&gt; (50/60 Hz)</td>
</tr>
<tr>
<td>Are all terminals firmly engaged in their correct slot? Is the coding on the individual terminals correct?</td>
<td>-</td>
</tr>
<tr>
<td>Are the mounted cables strain-relieved?</td>
<td>-</td>
</tr>
<tr>
<td>Are the power supply and signal cables correctly connected?</td>
<td>See wiring diagram on the housing</td>
</tr>
<tr>
<td>Are all of the screw terminals well tightened?</td>
<td>-</td>
</tr>
</tbody>
</table>

### 6 Operation options

#### 6.1 Overview of operation options
6.1.1  Display and operating elements

Remove the protective film from the display as this would otherwise affect the readability of the display.

Operational indicator, green, is lit when supply voltage is applied
Fault indicator, red, flashes in the event of a sensor or device error
Limit indicator: the symbol is displayed if a relay is energized.
Status of digital inputs: green indicates ready for operation, yellow indicates a signal is pending
Bar graph, yellow, 42-part, with overranging and underranging in orange/red
7-digit, 14-segment display, white for measured values
9x77 dot matrix display, white, for texts, units and menu icons
Key and padlock symbols, indicate whether device operation is locked (see Section 5.3.3)
Jog/shuttle dial for local display operation

For troubleshooting information, see the 'Troubleshooting' section → 43.

<table>
<thead>
<tr>
<th>Range</th>
<th>Display</th>
<th>Relay</th>
<th>Analog output</th>
<th>Integration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input current is below lower error limit</td>
<td>Display 7777</td>
<td>Fault condition</td>
<td>Configured failure mode</td>
<td>No integration</td>
</tr>
<tr>
<td>Input current above lower error limit and</td>
<td>Display 6666</td>
<td>Normal limit value</td>
<td>Normal behavior with max. 10% overrange. No output &lt; 0 mA/0 V possible</td>
<td>Normal behavior (negative integration not possible)</td>
</tr>
<tr>
<td>Input current in valid range</td>
<td>Display scaled measured value</td>
<td>Normal limit value</td>
<td>Normal behavior with max. 10% overrange. No output &lt; 0 mA/0 V possible</td>
<td>Normal behavior (negative integration not possible)</td>
</tr>
<tr>
<td>Input current below upper error limit and</td>
<td>Display 6666</td>
<td>Normal limit value</td>
<td>Normal behavior with max. 10% overrange. No output &lt; 0 mA/0 V possible</td>
<td>Normal behavior (negative integration not possible)</td>
</tr>
<tr>
<td>Input current above upper error limit</td>
<td>Display 7777</td>
<td>Fault condition</td>
<td>Configured failure mode</td>
<td>No integration</td>
</tr>
</tbody>
</table>

Relay indicator
- Relay not energized: nothing indicated
- Relay energized: (symbol is lit)

Status display for digital inputs
- Digital input configured: (green)
- Signal at digital input: (yellow)
## 6.2 Structure and function of the operating menu

<table>
<thead>
<tr>
<th>M1</th>
<th>Analog input</th>
<th><strong>INPUT</strong></th>
<th><strong>Signal type</strong></th>
<th><strong>Connection type</strong></th>
<th><strong>Curve</strong></th>
<th><strong>Signal damping</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><strong>Signal type</strong></td>
<td><strong>Connection</strong></td>
<td><strong>Curve</strong></td>
<td><strong>Damp</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Unit</strong></td>
<td><strong>Dimension</strong></td>
<td><strong>Decimal point</strong></td>
<td><strong>0% value</strong></td>
<td><strong>100% value</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Offset</strong></td>
<td><strong>Comparison temp</strong></td>
<td><strong>0% value</strong></td>
<td><strong>Dec. point</strong></td>
<td></td>
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</tr>
<tr>
<td>M2</td>
<td>Display</td>
<td><strong>DISPLAY</strong></td>
<td><strong>Assignment</strong></td>
<td><strong>Alternating measured value display</strong></td>
<td><strong>Bar graph assignment</strong></td>
<td><strong>Decimal point bar graph</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>numeric display</strong></td>
<td><strong>Bar graph 0% value</strong></td>
<td><strong>Bar graph 100% value</strong></td>
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<tr>
<td></td>
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<td></td>
<td><strong>Ref. num.</strong></td>
<td><strong>Displ. sw.</strong></td>
<td><strong>Ref. bargraph</strong></td>
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<tr>
<td>M3</td>
<td>Analog output</td>
<td><strong>ANALOG OUT</strong></td>
<td><strong>Assignment</strong></td>
<td><strong>Damping</strong></td>
<td><strong>Output range</strong></td>
<td><strong>Decimal point</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Ref. num.</strong></td>
<td><strong>Out damp</strong></td>
<td><strong>Out range</strong></td>
<td><strong>Dec. point</strong></td>
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<tr>
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<td></td>
<td><strong>0% value</strong></td>
<td><strong>100% value</strong></td>
<td><strong>Offset</strong></td>
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<td></td>
<td><strong>Out 0%</strong></td>
<td><strong>Out 100%</strong></td>
<td><strong>Output in event of error</strong></td>
</tr>
<tr>
<td></td>
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<td></td>
<td><strong>Fail mode</strong></td>
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<td></td>
<td><strong>Failure value</strong></td>
<td><strong>Simulation mA</strong></td>
<td><strong>Simulation volt</strong></td>
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<td></td>
<td><strong>Fail value</strong></td>
<td><strong>Simu mA</strong></td>
<td><strong>Simu V</strong></td>
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<tr>
<td>M5</td>
<td>Digital input 1-4</td>
<td><strong>DIGITAL INP</strong></td>
<td><strong>Function digital input 1-4</strong></td>
<td><strong>Active level 1-4</strong></td>
<td><strong>Sampling duration pump monitoring</strong></td>
<td><strong>Relay simulation</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Function</strong></td>
<td><strong>Level</strong></td>
<td><strong>Sampl. time</strong></td>
<td><strong>Reset the switching frequency and run time</strong></td>
</tr>
<tr>
<td>M10-M17</td>
<td>Limit 1-4 (8)*</td>
<td><strong>LIMIT</strong></td>
<td><strong>Assignment</strong></td>
<td><strong>Function 1-4 (8)</strong></td>
<td><strong>Decimal point</strong></td>
<td><strong>Switch point A</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Ref. num.</strong></td>
<td><strong>Function</strong></td>
<td><strong>Dec. point</strong></td>
<td><strong>Setpoint A</strong></td>
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<td></td>
<td><strong>Hysteresis or switch-back gradient</strong></td>
<td><strong>Switching delay 1-4 (8) in seconds</strong></td>
<td><strong>1st power-up after 24 h delayed by</strong></td>
</tr>
<tr>
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<td><strong>Delay</strong></td>
<td><strong>Sw. delay</strong></td>
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<td></td>
<td><strong>Hysteresis</strong></td>
<td><strong>Alternate function 1-4</strong></td>
<td><strong>Reset the switching frequency and run time</strong></td>
</tr>
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<td><strong>Alternate</strong></td>
<td><strong>Reset</strong></td>
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<tr>
<td>M18</td>
<td>Integration*</td>
<td><strong>Integration</strong></td>
<td><strong>Signal source for integration</strong></td>
<td><strong>Preset counter</strong></td>
<td><strong>Integration base</strong></td>
<td><strong>Decimal point factor</strong></td>
</tr>
<tr>
<td></td>
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<td></td>
<td><strong>Ref. Integr.</strong></td>
<td><strong>Pre-counter</strong></td>
<td><strong>Integr. base</strong></td>
<td><strong>Dec. factor</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Dimension totalizer</strong></td>
<td><strong>Decimal point totalizer</strong></td>
<td><strong>Set preset counter</strong></td>
<td><strong>Set preliminary alarm</strong></td>
</tr>
<tr>
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<td></td>
<td><strong>Dimension</strong></td>
<td><strong>Dec. point T</strong></td>
<td><strong>Set count A</strong></td>
<td><strong>Set count B</strong></td>
</tr>
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<td></td>
<td><strong>Reset totalizer</strong></td>
<td><strong>Flow calculation</strong></td>
<td><strong>Dimension input signal</strong></td>
<td><strong>Dimension of linearized value</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Reset total</strong></td>
<td><strong>Calc flow</strong></td>
<td><strong>Dim. Input</strong></td>
<td><strong>Dim. flow</strong></td>
</tr>
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<td></td>
<td></td>
<td></td>
<td><strong>Decimal point for display</strong></td>
<td><strong>Alpha value</strong></td>
<td><strong>Beta value</strong></td>
<td><strong>Gamma value</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Dec. point</strong></td>
<td><strong>Alpha</strong></td>
<td><strong>Beta</strong></td>
<td><strong>Gamma</strong></td>
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<td></td>
<td><strong>Khafagi-Venturi flumes</strong></td>
<td><strong>Iso-Venturi flumes</strong></td>
<td><strong>Venturi flumes as per British Standard</strong></td>
<td><strong>Parshall flumes</strong></td>
</tr>
</tbody>
</table>
### 6.3 Access to the operating menu via the local display

The operating menu is activated by pressing the jog/shuttle dial for at least 3 seconds.
6.3.1  Operation via the jog/shuttle dial

A) 3-key function

Press = "Enter"
Turn clockwise = "+
Turn counterclockwise = "-

B) List selection

Arrow points down:
Selection is at the start of the picklist. Turning the jog/shuttle dial to the right displays additional entries.

Both arrows are visible:
User is in the middle of the picklist.

Arrow points up:
End of picklist has been reached. By turning the jog/shuttle dial to the left, the user starts moving to the top of the list.

6.3.2  Entering text

1. Press and hold the jog/shuttle dial for at least 3 s.
   The first character starts flashing.
2. To change the character, turn the dial to the left or right.
3. Press the jog/shuttle dial briefly.
   Characters are accepted and the next character flashes.
4. To change the character, turn the dial to the left or right. Select the "<" character to return to the previous character.
5. Press the jog/shuttle dial briefly.
   Characters are accepted and the next character flashes.
6. Set/change all the characters in this way. Once you have set the last character, press the jog/shuttle dial briefly.
   ➔ The entry is accepted.

7. Alternatively, press and hold the jog/shuttle dial at any point for longer than 1 s and then release.
   ➔ The entry is rejected.

**Possible characters**

Text can be entered using the following characters:

- Space
- +ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz0123456789/%
- °23+-;:*()

```
6.3.3  Locking the configuration

**User code**

The configuration can be locked against unauthorized access by entering a four-digit code. This code is defined in item 55 "Parameter/User Code". All the operating parameters remain visible but can only be modified by first entering the user code. The "Key" symbol appears on the display.

If the limit values are also to be locked, set the "Limit Code" to "On" in menu item 55. Limit values can then only be changed after entering the user code. If the limit code is set to "Off", limit values can be changed without entering the user code. All other parameters are locked, however.

**Hardware locking**

Configuration can also be locked using a plug on the back of the device (→ 13, 20). This locking is indicated by a "padlock" symbol on the display. For hardware device locking, set the jumper in the top right-hand corner on the back to position J1.

![Diagram](image)

Position of the jumper on the back of the device

Hardware locking does not affect the PC operating software.
7 Commissioning

7.1 Function check
Make sure that all post-connection checks have been carried out before you commission your device:

Checklist connection check → 15

Remove the protective strip from the display as this restricts display legibility otherwise.

7.2 Switching on the measuring device
Once the operating voltage is applied, the green LED indicates that the device is operational.
- When the unit is delivered, the device parameters are used as per the factory settings.
- When commissioning a device already configured or preset, measuring is immediately started as per the settings. The limit values only switch once the first measured value has been determined.
- The limit values are only activated as per their configuration once a valid measured value is present.

7.3 Configuring the measuring device
This section describes all the configurable device parameters with the associated value ranges and factory settings (default values, shown in bold).
## 7.3.1 Analog input - INPUT/M1

The Analog input menu, displayed as INPUT in the device, contains all the parameters that can be selected for the input.

<table>
<thead>
<tr>
<th>Function (menu item)</th>
<th>Parameter setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Signal type</strong></td>
<td>4 - 20 mA&lt;br&gt;0 - 20 mA&lt;br&gt;0 - 5 mA&lt;br&gt;0 - 100 mV&lt;br&gt;0 - 200 mV&lt;br&gt;0 - 1 V&lt;br&gt;0 - 10 V&lt;br&gt;± 150 mV&lt;br&gt;± 1 V&lt;br&gt;± 10 V&lt;br&gt;± 30 V&lt;br&gt;Type B (IEC584)&lt;br&gt;Type J (IEC584)&lt;br&gt;Type K (IEC584)&lt;br&gt;Type L (DIN43710)&lt;br&gt;Type L (GOST)&lt;br&gt;Type N (IEC584)&lt;br&gt;Type R (IEC584)&lt;br&gt;Type S (IEC584)&lt;br&gt;Type T (IEC584)&lt;br&gt;Type U (DIN43710)&lt;br&gt;Type D (ASTM E998)&lt;br&gt;Type C (ASTM E998)&lt;br&gt;PT50 (GOST)&lt;br&gt;PT100 (IEC751)&lt;br&gt;PT100 (JIS1604)&lt;br&gt;PT100 (GOST)&lt;br&gt;PT500 (IEC751)&lt;br&gt;PT500 (JIS1604)&lt;br&gt;PT500 (GOST)&lt;br&gt;PT1000 (IEC751)&lt;br&gt;PT1000 (JIS1604)&lt;br&gt;PT1000 (GOST)&lt;br&gt;Cu50 (GOST)&lt;br&gt;Cu100 (GOST)&lt;br&gt;30 - 3000 Ohm</td>
<td>Use this function to select the signal type of the connected sensor.&lt;br&gt;(*): Can only be selected with the universal input option.</td>
</tr>
<tr>
<td><strong>Connection</strong></td>
<td>3 Wire&lt;br&gt;4 Wire</td>
<td>Setting for the sensor connection in 3-wire or 4-wire technology.&lt;br&gt;Can only be selected for &quot;Signal type&quot; 30-3000 Ω, PT50/100/1000, Cu50/100.</td>
</tr>
<tr>
<td><strong>Curve</strong></td>
<td>Linear&lt;br&gt;Quad.&lt;br&gt;°C&lt;br&gt;°F&lt;br&gt;Kelvin</td>
<td>Linear or quadratic (Quad.) curve of the sensor used; can be selected for analog signals. °C, °F, Kelvin physical measured variable, can be selected for temperature sensors.</td>
</tr>
<tr>
<td><strong>Damp</strong></td>
<td>0 to 99.9&lt;br&gt;0</td>
<td>Signal damping of the measuring input with first order low pass filter. Time constant can be selected from 0 to 99.9 s.</td>
</tr>
<tr>
<td><strong>Dimension</strong></td>
<td>XXXXXXXXXX&lt;br&gt;%</td>
<td>Use this function to configure the technical unit or a customized text for the measured value of the sensor. Max. length: 9 characters.</td>
</tr>
<tr>
<td><strong>Dec. point</strong></td>
<td>XXXX&lt;br&gt;XXXX.X&lt;br&gt;XXX.XX&lt;br&gt;XX.XXX&lt;br&gt;X.XXXX</td>
<td>Number of decimal places for displaying the measured value.</td>
</tr>
<tr>
<td><strong>0% value</strong></td>
<td>-99999 to 99999&lt;br&gt;0.0</td>
<td>Start value of measured value, can be selected for analog signal types.</td>
</tr>
</tbody>
</table>
**Function (menu item)** | **Parameter setting** | **Description**
---|---|---
100% value | -99999 to 99999 100.0 | End value of measured value, can be selected for analog signal types.
Offset | -99999 to 99999 0.0 | Shifts the zero point of the response curve. This function is used to adjust the sensor.
Comp. temp | Intern Const | Reference temperature for thermocouple measurement. An internal reference junction (=Intern) or a constant value (=Const) can be selected.
Const. temp | 9999.9 20.0 | Fixed reference temperature. Can only be selected if 'Const' is set for 'Cmp. Temp'.
Open circ. | No Yes | Switch cable open circuit detection off or on for thermocouples

### Adjusting the analog input

The input can be adjusted to the sensor using the following parameters. For current, voltage and resistance sensors, a scaled value is calculated from the sensor signal.

For temperature outputs, the scaled value is calculated from linearization tables. The temperature value can be converted to degrees Celsius, degrees Fahrenheit or Kelvin. In addition, the temperature value can be corrected via an offset.

> The signal types 4 to 20 mA, thermocouples and RTD assemblies are monitored for a cable open circuit. Long response times can occur in the case of RTD assemblies.

### 7.3.2 Display - DISPLAY/M2

All the display settings are grouped under this menu item.

<table>
<thead>
<tr>
<th>Function (menu item)</th>
<th>Parameter setting</th>
<th>Description</th>
</tr>
</thead>
</table>
| Ref. num. | Input Lin.table Total(*) Inp.+Lint. Lint.+Tot.(*) Inp.+Lin+Tot(*) Batch(*) | Use this function to select the display value shown on the display (if a combination is selected, e.g. "Inp.+Lint", the display alternates between the selected display values, e.g. measured value [Inp.] and linearized measured value [Lint.])
- Input = measured value
- Lin. table = linearized measured value or current flow for calculation of channel
- Total = integrated value
- Inp.+Lint. = display alternates between measured value and linearized measured value
- Inp.+Tot. = display alternates between measured value and integrated value
- Lint.+Tot. = display alternates between linearized measured value and integrated value
- Inp.+Lin+Tot = measured value, linearized measured value or integrated value
- Batch = preset counter

Settings marked with an asterisk (*) can only be selected if the 'Pulse output' or 'Integration' option is available and has been configured.

| Display sw. | 0 to 99 s 0 | Configurable period for displaying the individual values if combinations of display values have been selected under 'Ref. num.'.
This setting can only be selected if the 'Pulse output' or 'Integration' option is available and has been configured.

| Ref. bargraf | Input Lintab | Selection of the signal source for the bar graph. |
## 7.3.3 Analog output - ANALOG OUT/M3

This menu item is only displayed if your device is equipped with the "Analog output" option.

<table>
<thead>
<tr>
<th>Function (menu item)</th>
<th>Parameter setting</th>
<th>Description</th>
</tr>
</thead>
</table>
| Ref. num.            | Input Lintab      | Use this function to select which value is output at the analog output.  
|                      |                   | • Input = measured value  
|                      |                   | • Lintab = linearized measured value or current flow with calculation of channel |
| Out damp             | 0 to 99.9 0       | Signal damping of the measuring input with first order low pass filter. Time constant can be selected from 0 to 99.9 s. |
| Out range            | Off 0 - 20 mA 4 - 20 mA 0 - 10 V 2 - 10 V 0 - 1 V | Signal type of the output.  
|                      |                   | "Off" switches the output signal off completely. |
| Dec. point           | XXXX XXXX.X XXX.XX XX.XXX X.XXX | Number of decimal places for outputting the measured value. Can be selected for analog signal types |
| Out 0%               | -99999 to 99999 0.0 | Start value of the output signal |
| Out 100%             | -99999 to 99999 100.0 | End value of the output signal |
| Offset               | -999.99 to 999.99 0.00 | Shifts the zero point of the output curve in mA or V |
| Fail mode            | Hold Const Min Max | Output value if a sensor or device error occurs.  
|                      |                   | • Hold = last valid value  
|                      |                   | • Const = user-defined value  
|                      |                   | • Min = output value 3.5 mA for 4 to 20 mA, otherwise 0 V or 0 mA  
|                      |                   | • Max = output value 22.0 mA for 0/20 mA, otherwise 1.1 V or 11 V |
| Fail value           | 0 to 999.99 0.00 | The user-defined value for "Fail mode = Const" is configured here.  
|                      |                   | • Current output: 0 to 22 mA  
|                      |                   | • Voltage output: 0 to 11 V |
### 7.3.4 Digital input - DIGITAL INP./M5

The settings for the digital status inputs, e.g. for monitoring pumps, starting/stopping the counter or resetting the min/max value memory, are grouped in this section.

- In the PUMP function, the assignment of the digital inputs 1 to 4 to the relays 1 to 4 is fixed. Relay 1 is monitored by digital input 1, relay 2 by digital input 2 etc.
- When the 'Batch' function is used, digital input 1 is permanently assigned to a preset value count function. Parameter configuration is then not possible for this digital input.

<table>
<thead>
<tr>
<th>Function (menu item)</th>
<th>Parameter setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simu mA</td>
<td>OFF 0.0 mA 3.6 mA 4 mA 10 mA 12 mA 20 mA 21 mA</td>
<td>Simulates the current output and outputs the selected current at the output, irrespective of the input value. Is automatically switched 'OFF' when the 'Simu mA' menu item is exited. The parameter is only available if the &quot;mA&quot; parameter is set in 'Out range'.</td>
</tr>
<tr>
<td>Simu V</td>
<td>OFF 0.0 V 5.0 V 10.0 V</td>
<td>Simulates the voltage output and outputs the selected voltage at the output, irrespective of the input value. Is automatically switched 'OFF' when the 'Simu V' menu item is exited. The parameter is only available if the &quot;V&quot; parameter is set in 'Out range'.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Function (menu item)</th>
<th>Parameter setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function</td>
<td>Off Pump Res Tot.(<em>) Start/Stop(</em>) Res MinMax</td>
<td>Function of the selected digital input.</td>
</tr>
<tr>
<td></td>
<td>Off = off Pump = pump monitoring (see Pump monitoring function) Res Tot. = reset the totalizer Start/Stop = start or stop the totalizer Res MinMax = reset the min/max memory values</td>
<td></td>
</tr>
<tr>
<td>Parameters marked with an asterisk (*) are only available for the 'Pulse output' option or if this function has been configured.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level</th>
<th>Low High</th>
<th>Selects the side for evaluation.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low = decreasing side High = increasing side</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sampl. time</th>
<th>0 to 99 0</th>
<th>Defines the time (in seconds) within which pump feedback should be expected at the digital input. If there is no feedback within the defined time, an error message is generated and a second pump is activated if more than one pump is available. The setting for the 'Sampl. time' defines the monitoring behavior of the digital input!</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sampl. time = 0 means fault monitoring Sampl. time &gt; 0 means startup monitoring</td>
<td></td>
</tr>
</tbody>
</table>

**Pump monitoring function**

If pump monitoring is to be implemented, digital inputs 1 to 4 are permanently assigned to relays 1 to 4. This function is activated for the relevant digital input using the "Function" parameter. "Pump" must be selected here.

In general, two different types of monitoring are possible. The setting for "Sampl. Time" determines the operating mode chosen.
- Fault monitoring: Sample Time = 0
  In the case of fault monitoring, the level at the digital input is changed by a fault at the pump.
- Startup monitoring: Sample Time > 0
  In the case of startup monitoring, correct start-up of the pump is reported back to the process indicator via a level change at the digital input.

a) Fault monitoring operating mode

In the fault monitoring operating mode, the status signal indicates the availability of the pump. If a fault occurs, the status signal changes accordingly.

In event 1, pump 1 is activated because the level has violated the limit value. Pump 1 remains active until the level has dropped as much as required.

In event 2, an error occurs at pump 1 during operation, the status signal at DI1 changes. This activates pump 2 and the alarm relay (if configured accordingly) and the pump fault is shown as a message on the display.

In event 3, the level has dropped to such an extent that pumping is no longer necessary and pump 2 stops operation.

The fault at pump 1 has been rectified, and the status signal at DI1 changes once more. The alarm relay is reset, see event 4.

In event 5, the alarm relay and the error message on the display are acknowledged by pressing the jog/shuttle dial.

Events 6 and 7 show trouble-free operation of the system.

b) Startup monitoring

In the case of the startup monitoring mode, a change in the status signal is expected at the relevant digital input after a pump has been activated. A waiting time is defined for this (Sample Time, T). Alternating pump control is activated. If the status signal does not change within the time indicated, the pump is considered to be faulty.
Event 1 shows trouble-free operation of pump 1. Pump 1 is activated by a demand signal due to a limit value violation. The status signal at DI1, which changes within T, indicates that the pump is operating correctly, pump 1 continues pumping.

In event 2, there is no feedback at DI1 after pump 1 has been activated and is therefore this pump is considered to be faulty. The alarm relay is activated and an error message is output on the display.

Pump 2 takes over pumping, event 3. This pump sends feedback to DI2 within the defined waiting time. Pumping continues until the level drops below the limit value violation level.

A new limit value violation occurs in event 4. A new attempt is made to start pump 1 due to alternating pump control. Pump 2 takes over (event 5), as no feedback is received after the waiting time has elapsed. If the alarm relay and error message were not already active on the display, they are now.

In event 6, the level is exceeded again and a pump is required. Following alternating pump control, pump 1 is tried again. This time pump 1 sends feedback. The alarm relay is reset.

In event 7, the error message is acknowledged on the display. The status signal at DI has no effect on the acknowledgment of the error message on the display.

- In the PUMP function, the assignment of the digital inputs 1 to 4 to the relays 1 to 4 is fixed. Relay 1 is monitored by digital input 1, relay 2 by digital input 2 etc.
- A faulty pump is always put back into operation depending on the signal at the relevant digital input. The acknowledgment of the error message on the display has no effect on the resumption of pump operation. If a pump is faulty for more than 10 minutes, an attempt is made to restart it when the limit value is violated.

The following parameters must be configured:

<table>
<thead>
<tr>
<th>Menu</th>
<th>Function (menu item)</th>
<th>Setting value</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIGITAL INP./M5</td>
<td>Function</td>
<td>Pump</td>
</tr>
<tr>
<td></td>
<td>Level</td>
<td>Low or High</td>
</tr>
<tr>
<td></td>
<td>Sampl. time</td>
<td>Sampling time in seconds</td>
</tr>
<tr>
<td>LIMIT 1 to 8</td>
<td>Alternate</td>
<td>Yes</td>
</tr>
</tbody>
</table>

7.3.5 Limit values - LIMIT 1 to 8/M10 to 17

If the "Batch" function is used, limit values 1 and 2 are permanently assigned activation in the event of a 'preset counter' and 'preliminary alarm' limit value. These limit values then cannot be configured and they are not shown in the menu structure.
### Function (menu item) | Parameter setting | Description
--- | --- | ---
Ref. num. | Input<br>Lin. table | Use this function to select which value is used:
- Input: scaled value from analog input
- Lin. table: value from linearization table or current flow for calculation of channel

Function | Off<br>Min<br>Max<br>Grad<br>In band<br>Out band<br>Alarm<br>Alarm inverse | Use this function to select limit value and fault monitoring. In the event of device errors or incorrect input values (see error limits range 1 to 4 in \( \rightarrow 42 \)), the relays are switched according to the failure mode (\( \rightarrow 42 \)) set in Rel. Mode.
- Min: minimum with hysteresis \( \rightarrow 29 \)
- Max: maximum with hysteresis \( \rightarrow 29 \)
- Grad: gradient \( \rightarrow 30 \)
- In band: validity range within two values
- Out band: validity range outside two values
- Alarm: relay is used as an alarm relay \( \rightarrow 31 \)
- Alarm inverse: relay is used as an alarm relay; the switching behavior of the relay is safety-oriented so that the relay is de-energized if the power supply fails or if a fault occurs with the display unit.

Dec. point | XXXXX<br>XXXX.X<br>XXX.XX<br>XX.XXX<br>X.XXXX | Number of decimal places for the limit value.

Setpoint A | -99999 to 99999<br>0.0 | Measured value at which a change in the switch state occurs (slope for gradient).

Setpoint B | -99999 to 99999<br>99999 | The second setpoint can be configured for the "In band" and "Out band" operating modes and is only visible if one of these two functions was selected for this relay.

Hysteresis | -99999 to 99999<br>99999 | Use this function to enter the hysteresis for the switching threshold at minimum / maximum as an absolute value.

Delay | 0 to 99<br>0 | Setting for the limit value event delay once the switch threshold is reached (in seconds) \( \rightarrow 31 \).

Alternate | No<br>Yes | Determines the switching function for this relay:
- No: no alternating function; switch point permanently assigned to the relay
- Yes: alternating function \( \rightarrow 32 \)
Relays 1-4 can be used for the alternating function.

Sw. delay | 0 to 99<br>0 | The starting time for 24-hour counting can be selected with Sw. delay. Every time the device is reset, the process of measuring 24 hours and the delay time is restarted. Example \( \rightarrow 33 \).

Sw. period | 0 to 999<br>0 | The limit value is activated cyclically every 24 h for 0 to 999 s. By changing the hour value, activation is delayed by [Sw.delay] hours (example \( \rightarrow 33 \)).

Runtime | | Displays the run time of the connected device, e.g. pump, in hours [h].

Count | | Records the switching frequency of the limit value.

Reset | No<br>Yes | Resets the run time and switching frequency for this limit value.

Simu Relay | Off<br>Low<br>High | Simulation of the selected limit value. Is automatically switched 'OFF' when the menu item is exited.
Min operating mode

The following parameters must be configured:

<table>
<thead>
<tr>
<th>Menu</th>
<th>Function (menu item)</th>
<th>Setting value</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIMIT 1 to 8/M10 to 17</td>
<td>Function</td>
<td>Min</td>
</tr>
<tr>
<td></td>
<td>Setpoint A</td>
<td>Value for switching threshold</td>
</tr>
<tr>
<td></td>
<td>Hysteresis</td>
<td>Value for hysteresis</td>
</tr>
</tbody>
</table>

Max operating mode

The following parameters must be configured:

<table>
<thead>
<tr>
<th>Menu</th>
<th>Function (menu item)</th>
<th>Setting value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Threshold</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Threshold-hysteresis</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Relay</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hysteresis</td>
<td></td>
</tr>
</tbody>
</table>
The following parameters must be configured:

<table>
<thead>
<tr>
<th>Menu</th>
<th>Function (menu item)</th>
<th>Setting value</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIMIT 1 to 8/M10 to 17</td>
<td>Function</td>
<td>Min</td>
</tr>
<tr>
<td></td>
<td>Setpoint A</td>
<td>Value for switching threshold</td>
</tr>
<tr>
<td></td>
<td>Hysteresis</td>
<td>Value for hysteresis</td>
</tr>
<tr>
<td>Grad operating mode</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

![Diagram of Grad operating mode](image)

### 18 Grad operating mode

- **Y**: Measured value
- **t**: Time
- **T_m**: Time for gradient evaluation
- **M_0**: Measured value at time T
- **M_0-m**: Measured value at time (T - T_m)
- **M_1**: Measured value at time T_1
- **M_1-m**: Measured value at time (T_1 - T_m)
- **1**: Relay

The ‘Grad’ operating mode is used to monitor the change of the input signal over time. The time basis T_m for monitoring is set in the ‘PARAMETER/M55 -> Grad. time’ menu.

The difference between the lower-range value M_0-m and the upper-range value M_0 of the interval is calculated. If the calculated value is greater than the value set under ‘Setpoint A’, the relay is switched according to the failure mode (→ 42) set in ‘Rel. Mode’.

The relay is switched on again if the difference between M_1-m and M_1 drops below the value set in ‘Hysteresis’. The sign determines the direction of the signal change. Positive values monitor an increase in the measured value, negative values monitor a decrease. A new value is calculated every second (floating interval).

The following parameters must be configured:

<table>
<thead>
<tr>
<th>Menu</th>
<th>Function (menu item)</th>
<th>Setting value</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIMIT 1 to 8/M10 to 17</td>
<td>Function</td>
<td>Min</td>
</tr>
<tr>
<td></td>
<td>Setpoint A</td>
<td>Value for switching threshold</td>
</tr>
<tr>
<td></td>
<td>Hysteresis</td>
<td>Value for hysteresis</td>
</tr>
<tr>
<td></td>
<td>Grad. time</td>
<td>Interval time in seconds</td>
</tr>
</tbody>
</table>
Alarm operating mode

A relay with the "Alarm" operating mode is activated if the following events occur:

- Analog input (4 to 20 mA) < 3.6 mA (lower Namur limit) or > 21.0 mA (upper Namur limit)
- HW error EEPROM (E101)
  The relay remains energized even after acknowledgment.
- Calibration data not plausible (E103)
  The relay remains energized even after acknowledgment.
- Bus error when reading the min/max data following power-up (E104)
  The relay remains energized even after acknowledgment.
- Bus error when reading the relay data following power-up (E105)
  The relay remains energized even after acknowledgment.
- HW error universal card (E106)
  The relay remains energized even after acknowledgment.
- Pulse buffer overflow (E210)
  The relay is de-energized after acknowledgment.
- Pump error at corresponding digital input x (E22x)
  The relay remains energized even after acknowledgment.

Delay

<table>
<thead>
<tr>
<th>Menu</th>
<th>Function (menu item)</th>
<th>Setting value</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIMIT 1 to 8/M10 to 17</td>
<td>Setpoint A</td>
<td>Value for switching threshold</td>
</tr>
<tr>
<td></td>
<td>Hysteresis</td>
<td>Value for hysteresis</td>
</tr>
<tr>
<td></td>
<td>Delay</td>
<td>Delay time in [s]</td>
</tr>
</tbody>
</table>
If several pumps are used for level control, the alternating switching function ensures that all pumps are utilized evenly. The operating time of the pumps, rather than a permanently assigned switch-on value, is the main factor that determines when a certain pump is switched on.

In total, the first 4 relays (LIMIT 1 to 4) can be included in the alternating pump control system.

Any relays not included in alternating pump control are available as usual.

This function cannot be applied to individual relays. Relays that are not included are not assessed according to the switch-on and switch-off duration.
The following parameters must be configured for the example above:

<table>
<thead>
<tr>
<th>Menu</th>
<th>Function (menu item)</th>
<th>Setting value</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIMIT 1 to 3/M10 to 12</td>
<td>In each case: setpoint A</td>
<td>Value for switching threshold</td>
</tr>
<tr>
<td></td>
<td>In each case: hysteresis</td>
<td>Value for hysteresis</td>
</tr>
<tr>
<td></td>
<td>In each case: alternate</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**24-hour activation function**

Pumps with long downtimes can be activated cyclically with the 24-hour activation function for the time defined in "Sw. period" (0 to 999 s).

The starting time for the 24 h step interval can be postponed by 0 to 23 hours with the 'Sw. delay' setting.

Example: time at the time of configuration is 12 midday; preferred starting time of 24-hour counting 22:00 (10 p.m.) → set 'Sw. delay' to 10.

If the power is switched off, the time for the 24-hour activation function starts again.

The following parameters must be configured for the example above:

<table>
<thead>
<tr>
<th>Menu</th>
<th>Function (menu item)</th>
<th>Setting value</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIMIT</td>
<td>Sw. period</td>
<td>Activation duration</td>
</tr>
<tr>
<td></td>
<td>Sw. delay</td>
<td>Activation delay</td>
</tr>
</tbody>
</table>
This function can only be selected if the "Pulse output" option is available in the device.

<table>
<thead>
<tr>
<th>Function (menu item)</th>
<th>Parameter setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ref. integr.</td>
<td>Input Lintab</td>
<td>Use this function to select which value should be integrated.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Input = measured value</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Lintab = linearized measured value or current flow with calculation of channel</td>
</tr>
<tr>
<td>Pre-counter</td>
<td>Off Count up</td>
<td>Activation of the preset counter</td>
</tr>
<tr>
<td></td>
<td>Count down</td>
<td>• Off = preset counter off</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Count up = count up from zero to the end value</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Count down = count down from the start value to zero</td>
</tr>
<tr>
<td>Integr. base</td>
<td>Off sec min hour</td>
<td>Time basis for integration</td>
</tr>
<tr>
<td></td>
<td>day</td>
<td></td>
</tr>
<tr>
<td>Dec. factor</td>
<td>XXXX XXXX XXX.XX XX.XXX X.XXX</td>
<td>Decimal point position of the conversion factor</td>
</tr>
<tr>
<td>Factor</td>
<td>0 to 99999 1.0</td>
<td>Conversion factor</td>
</tr>
<tr>
<td>Dimension</td>
<td>XXXXXXXXXXXX</td>
<td>The dimension is selected from a list or entered as customized text (max. length: 9 characters).</td>
</tr>
<tr>
<td>Dec. Point T</td>
<td>XXXX XXX.XX XX.XXX XX.XXX X.XXX</td>
<td>Decimal point of totalizer</td>
</tr>
<tr>
<td>Set count A</td>
<td>99999 0.0</td>
<td>End value/start value for preset counter; refers permanently to relay 1.</td>
</tr>
<tr>
<td>Set count B</td>
<td>99999 0.0</td>
<td>Value for preliminary alarm; refers permanently to relay 2.</td>
</tr>
<tr>
<td>Totalizer</td>
<td>99999999</td>
<td>The totalizer can be displayed and edited (e.g. assigned a default value) in this position.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If the maximum value of 99999999 is exceeded, the counter starts again at 0.</td>
</tr>
<tr>
<td>Reset Total</td>
<td>No Yes</td>
<td>Reset totalizer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cannot be configured via the PC operating software.</td>
</tr>
<tr>
<td>Calc. Flow</td>
<td>No Curve Formula</td>
<td>Use this function to select the method of calculating a flow rate based on the channel type or via a formula using the analog input signal (e.g. level signal)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• No = no integration</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Curve = flow calculation with channel type.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If &quot;Curve&quot; is selected, the menu only shows possible channel types for configuration (e.g. Venturi flumes, Parshall flumes, weirs etc.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Formula = flow calculated using a formula</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If &quot;Formula&quot; is selected, the menu only shows possible configuration parameters for entering the formula (e.g. alpha, beta, gamma, C).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Here, the flow is calculated here according to the following formula:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[ Q = C \times (h^{\alpha} + \gamma \times h^{\beta}) ]</td>
</tr>
<tr>
<td>Dim. Input</td>
<td>mm inch</td>
<td>Dimension of the channel size</td>
</tr>
<tr>
<td>Dec. flow</td>
<td>XXXX XXX.X XX.XXX XX.XXX X.XXX</td>
<td>Decimal point for display</td>
</tr>
<tr>
<td>Function (menu item)</td>
<td>Parameter setting</td>
<td>Description</td>
</tr>
<tr>
<td>----------------------</td>
<td>-------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Dim. flow</td>
<td>m³/s, l/s, hl/s, gal/s, USgal/s, USMgal/s, M³/s, m³/min, l/min, hl/min, gal/min, USgal/min, barrels/min, inch³/min, ft³/min, USMgal/min, Ml/min, m³/h, l/h, hl/h, gal/h, USgal/h, barrels/h, inch³/h, ft³/h, USMgal/h, Ml/h, USgal/d, USgal/d</td>
<td>Dimension of linearized value</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• l = liter</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• hl = hectoliter</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• m³ = cubic meter</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Ml = megaliter</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• USgal = US gallon</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• USKgal = US kilogallon</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• USMgal = US megagallon</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• USbl = US barrel</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• gal = imperial gallon</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• inch = inch</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• ft = feet</td>
</tr>
<tr>
<td>Dec. point</td>
<td>XXXX</td>
<td>Decimal point for formula (only if formula-based flow calculation is selected)</td>
</tr>
<tr>
<td></td>
<td>XXXX.X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>XXX.XX</td>
<td></td>
</tr>
<tr>
<td></td>
<td>XXX.XXX</td>
<td></td>
</tr>
<tr>
<td></td>
<td>XXX.XXXXX</td>
<td></td>
</tr>
<tr>
<td>Alpha</td>
<td>-99.999999</td>
<td>Flow exponent α (see &quot;Calc.flow&quot;)</td>
</tr>
<tr>
<td>Beta</td>
<td>-99.99999</td>
<td>Flow exponent β (see &quot;Calc.flow&quot;)</td>
</tr>
<tr>
<td>Gamma</td>
<td>-99.99999</td>
<td>Weighting factor γ (see &quot;Calc.flow&quot;)</td>
</tr>
<tr>
<td>C</td>
<td>-100</td>
<td>Scaling constant C (see &quot;Calc.flow&quot;)</td>
</tr>
<tr>
<td>Flumes</td>
<td>Kha Venturi</td>
<td>Kha-venturi = Khaafagi-Venturi flumes</td>
</tr>
<tr>
<td></td>
<td>ISO Venturi</td>
<td>ISO Venturi = ISO Venturi flumes</td>
</tr>
<tr>
<td></td>
<td>BST Venturi</td>
<td>BST Venturi = Venturi flumes according to British Standard</td>
</tr>
<tr>
<td></td>
<td>Parshall</td>
<td>Parshall = Parshall flumes</td>
</tr>
<tr>
<td></td>
<td>Palmer-Bow</td>
<td>Palmer-Bow = Parshall-Bowlus flumes</td>
</tr>
<tr>
<td></td>
<td>Rect. WTO</td>
<td>Rect. WTO = rectangular weirs (w)</td>
</tr>
<tr>
<td></td>
<td>Rect WThr</td>
<td>Rect WThr = rectangular weir with constriction (w)</td>
</tr>
<tr>
<td></td>
<td>NFXRectWTO</td>
<td>NFXRectWTO = rectangular weir as per NFX (w)</td>
</tr>
<tr>
<td></td>
<td>NFXRectWThr</td>
<td>NFXRectWThr = rectangular weir as per NFX with constriction (w)</td>
</tr>
<tr>
<td></td>
<td>Trap.W TO</td>
<td>Trap.W TO = trapezoidal weir (w)</td>
</tr>
<tr>
<td></td>
<td>V-weir</td>
<td>V-weir = triangular weir (w)</td>
</tr>
<tr>
<td></td>
<td>BST V-weir</td>
<td>BST V-weir = triangular weir as per British Standard</td>
</tr>
<tr>
<td></td>
<td>NFX V-weir</td>
<td>NFX V-weir = triangular weir as per NFX</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Configure (w) width additionally</td>
</tr>
<tr>
<td>Width</td>
<td>999999</td>
<td>Value for width, can only be selected for channel types marked with (w) (see &quot;Flumes-Weir&quot;)</td>
</tr>
<tr>
<td>Kha-Venturi</td>
<td>QV 302</td>
<td>QV 302 = Khaafagi-Venturi flume QV 302</td>
</tr>
<tr>
<td></td>
<td>QV 303</td>
<td>QV 303 = Khaafagi-Venturi flume QV 303</td>
</tr>
<tr>
<td></td>
<td>QV 304</td>
<td>QV 304 = Khaafagi-Venturi flume QV 304</td>
</tr>
<tr>
<td></td>
<td>QV 305</td>
<td>QV 305 = Khaafagi-Venturi flume QV 305</td>
</tr>
<tr>
<td></td>
<td>QV 306</td>
<td>QV 306 = Khaafagi-Venturi flume QV 306</td>
</tr>
<tr>
<td></td>
<td>QV 308</td>
<td>QV 308 = Khaafagi-Venturi flume QV 308</td>
</tr>
<tr>
<td></td>
<td>QV 310</td>
<td>QV 310 = Khaafagi-Venturi flume QV 310</td>
</tr>
<tr>
<td></td>
<td>QV 313</td>
<td>QV 313 = Khaafagi-Venturi flume QV 313</td>
</tr>
<tr>
<td>Function (menu item)</td>
<td>Parameter setting</td>
<td>Description</td>
</tr>
<tr>
<td>---------------------</td>
<td>-------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>QV 316</td>
<td>QV 316 = Khafagi-Venturi flume QV 316</td>
<td></td>
</tr>
<tr>
<td>ISO Venturi</td>
<td></td>
<td>ISO Venturi flumes</td>
</tr>
<tr>
<td>415</td>
<td>415 = ISO Venturi flume 415</td>
<td></td>
</tr>
<tr>
<td>425</td>
<td>425 = ISO Venturi flume 425</td>
<td></td>
</tr>
<tr>
<td>430</td>
<td>430 = ISO Venturi flume 430</td>
<td></td>
</tr>
<tr>
<td>440</td>
<td>440 = ISO Venturi flume 440</td>
<td></td>
</tr>
<tr>
<td>450</td>
<td>450 = ISO Venturi flume 450</td>
<td></td>
</tr>
<tr>
<td>480</td>
<td>480 = ISO Venturi flume 480</td>
<td></td>
</tr>
<tr>
<td>BST Venturi</td>
<td></td>
<td>Venturi flumes as per British Standard</td>
</tr>
<tr>
<td>4&quot;</td>
<td>4&quot; = Venturi flume as per British Standard 4 in</td>
<td></td>
</tr>
<tr>
<td>7&quot;</td>
<td>7&quot; = Venturi flume as per British Standard 7 in</td>
<td></td>
</tr>
<tr>
<td>12&quot;</td>
<td>12&quot; = Venturi flume as per British Standard 12 in</td>
<td></td>
</tr>
<tr>
<td>18&quot;</td>
<td>18&quot; = Venturi flume as per British Standard 18 in</td>
<td></td>
</tr>
<tr>
<td>30&quot;</td>
<td>30&quot; = Venturi flume as per British Standard 30 in</td>
<td></td>
</tr>
<tr>
<td>Parshall</td>
<td></td>
<td>Parshall flumes</td>
</tr>
<tr>
<td>1&quot;</td>
<td>1&quot; = Parshall flume 1 in</td>
<td></td>
</tr>
<tr>
<td>2&quot;</td>
<td>2&quot; = Parshall flume 2 in</td>
<td></td>
</tr>
<tr>
<td>3&quot;</td>
<td>3&quot; = Parshall flume 3 in</td>
<td></td>
</tr>
<tr>
<td>6&quot;</td>
<td>6&quot; = Parshall flume 6 in</td>
<td></td>
</tr>
<tr>
<td>9&quot;</td>
<td>9&quot; = Parshall flume 9 in</td>
<td></td>
</tr>
<tr>
<td>1 ft</td>
<td>1 ft = Parshall flume 1 ft</td>
<td></td>
</tr>
<tr>
<td>1.5 ft</td>
<td>1.5 ft = Parshall flume 1.5 ft</td>
<td></td>
</tr>
<tr>
<td>2 ft</td>
<td>2 ft = Parshall flume 2 ft</td>
<td></td>
</tr>
<tr>
<td>3 ft</td>
<td>3 ft = Parshall flume 3 ft</td>
<td></td>
</tr>
<tr>
<td>4 ft</td>
<td>4 ft = Parshall flume 4 ft</td>
<td></td>
</tr>
<tr>
<td>5 ft</td>
<td>5 ft = Parshall flume 5 ft</td>
<td></td>
</tr>
<tr>
<td>6 ft</td>
<td>6 ft = Parshall flume 6 ft</td>
<td></td>
</tr>
<tr>
<td>8 ft</td>
<td>8 ft = Parshall flume 8 ft</td>
<td></td>
</tr>
<tr>
<td>Palmer-Bow.</td>
<td></td>
<td>Palmer-Bowlus flumes</td>
</tr>
<tr>
<td>6&quot;</td>
<td>6&quot; = Palmer-Bowlus flume 6 in</td>
<td></td>
</tr>
<tr>
<td>8&quot;</td>
<td>8&quot; = Palmer-Bowlus flume 8 in</td>
<td></td>
</tr>
<tr>
<td>10&quot;</td>
<td>10&quot; = Palmer-Bowlus flume 10 in</td>
<td></td>
</tr>
<tr>
<td>12&quot;</td>
<td>12&quot; = Palmer-Bowlus flume 12 in</td>
<td></td>
</tr>
<tr>
<td>15&quot;</td>
<td>15&quot; = Palmer-Bowlus flume 15 in</td>
<td></td>
</tr>
<tr>
<td>18&quot;</td>
<td>18&quot; = Palmer-Bowlus flume 18 in</td>
<td></td>
</tr>
<tr>
<td>21&quot;</td>
<td>21&quot; = Palmer-Bowlus flume 21 in</td>
<td></td>
</tr>
<tr>
<td>24&quot;</td>
<td>24&quot; = Palmer-Bowlus flume 24 in</td>
<td></td>
</tr>
<tr>
<td>27&quot;</td>
<td>27&quot; = Palmer-Bowlus flume 27 in</td>
<td></td>
</tr>
<tr>
<td>30&quot;</td>
<td>30&quot; = Palmer-Bowlus flume 30 in</td>
<td></td>
</tr>
<tr>
<td>Rect.WTO</td>
<td></td>
<td>Rectangular weirs</td>
</tr>
<tr>
<td>5H</td>
<td>5H = rectangular weir WTO/5H</td>
<td></td>
</tr>
<tr>
<td>T5</td>
<td>T5 = rectangular weir WTO/T5</td>
<td></td>
</tr>
<tr>
<td>Function (menu item)</td>
<td>Parameter setting</td>
<td>Description</td>
</tr>
<tr>
<td>---------------------</td>
<td>-------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Rect. WTHR</td>
<td>2H 3H 4H 5H 6H 8H TO T5 2T</td>
<td>Rectangular weir with constriction</td>
</tr>
<tr>
<td></td>
<td>2H = rectangular weir with constriction 2H</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3H = rectangular weir with constriction 3H</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4H = rectangular weir with constriction 4H</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5H = rectangular weir with constriction 5H</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6H = rectangular weir with constriction 6H</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8H = rectangular weir with constriction 8H</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TO = rectangular weir with constriction TO</td>
<td></td>
</tr>
<tr>
<td></td>
<td>T5 = rectangular weir with constriction T5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2T = rectangular weir with constriction 2T</td>
<td></td>
</tr>
<tr>
<td>NFXRect. WTO</td>
<td>5H T5</td>
<td>Rectangular weirs NFX</td>
</tr>
<tr>
<td></td>
<td>5H = NFX rectangular weir TO/5H</td>
<td></td>
</tr>
<tr>
<td></td>
<td>T5 = NFX rectangular weir TO/T5</td>
<td></td>
</tr>
<tr>
<td>NFXRect. WTHR</td>
<td>2H 3H 4H 5H 6H 8H TO T5</td>
<td>NFX rectangular weirs with constriction</td>
</tr>
<tr>
<td></td>
<td>2H = NFX rectangular weir with constriction 2H</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3H = NFX rectangular weir with constriction 3H</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4H = NFX rectangular weir with constriction 4H</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5H = NFX rectangular weir with constriction 5H</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6H = NFX rectangular weir with constriction 6H</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8H = NFX rectangular weir with constriction 8H</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TO = NFX rectangular weir with constriction TO</td>
<td></td>
</tr>
<tr>
<td>Trap. W TO</td>
<td>3H T5</td>
<td>Trapezoidal weirs</td>
</tr>
<tr>
<td></td>
<td>3H = trapezoidal weir W TO/3H</td>
<td></td>
</tr>
<tr>
<td></td>
<td>T5 = trapezoidal weir W TO/T5</td>
<td></td>
</tr>
<tr>
<td>V-weir</td>
<td>22.5 30 45 60 90</td>
<td>Triangular weirs</td>
</tr>
<tr>
<td></td>
<td>22.5 = triangular weir 22.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>30 = triangular weir 30</td>
<td></td>
</tr>
<tr>
<td></td>
<td>45 = triangular weir 45</td>
<td></td>
</tr>
<tr>
<td></td>
<td>60 = triangular weir 60</td>
<td></td>
</tr>
<tr>
<td></td>
<td>90 = triangular weir 90</td>
<td></td>
</tr>
<tr>
<td>BST V-weir</td>
<td>22.5 45 90</td>
<td>Triangular weir as per British Standard</td>
</tr>
<tr>
<td></td>
<td>22.5 = triangular weir as per British Standard 22.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>45 = triangular weir as per British Standard 45</td>
<td></td>
</tr>
<tr>
<td></td>
<td>90 = triangular weir as per British Standard 90</td>
<td></td>
</tr>
<tr>
<td>NFX V-weir</td>
<td>30 45 60 90</td>
<td>NFX triangular weirs</td>
</tr>
<tr>
<td></td>
<td>30 = NFX triangular weir 30</td>
<td></td>
</tr>
<tr>
<td></td>
<td>45 = NFX triangular weir 45</td>
<td></td>
</tr>
<tr>
<td></td>
<td>60 = NFX triangular weir 60</td>
<td></td>
</tr>
<tr>
<td></td>
<td>90 = NFX triangular weir 90</td>
<td></td>
</tr>
</tbody>
</table>
Calculation formula for flow measurement

If you have selected 'Formula' under 'Calc. flow' for flow measurement, the flow is calculated using the following formula:

\[ Q = C \cdot (h^\alpha + \gamma h^\beta) \]

Where:
- \( Q \): flow in m\(^3\)/h
- \( C \): scaling constant
- \( h \): upstream level
- \( \alpha, \beta \): flow exponents
- \( \gamma \): weighting factor

The scaling constant \( C \) must always refer to \( Q \) in m\(^3\)/h, i.e. if \( Q \) is present in another flow unit, \( C \) must be converted.

Examples:
- \( Q \) in l/h with \( C = 2.11\)
  \[
  1 \text{ l/h} = 0.001 \text{ m}^3/\text{h}
  \]
  \[
  \rightarrow C = 2.11 \times 0.001 = 0.00211
  \]
- \( Q \) in USKgal/s with \( C = 0.35\)
  \[
  1 \text{ USKgal/s} = 13627.4444 \text{ m}^3/\text{h}
  \]
  \[
  \rightarrow C = 0.35 \times 13627.4444 = 4769.60554
  \]

A table with values for converting various flow units to m\(^3\)/h is provided in the Appendix.

Integration function/totalizer

With this function, the computed value from the linearization table, or of the current flow rate for channel calculation or of the analog input can be numerically integrated to create a totalizer for example.

The totalizer is calculated as follows:

\[
\text{Totalizer}_{\text{new}} = \text{Totalizer}_{\text{old}} + \text{value} \times \frac{\text{Measuring interval}}{\text{Integration base}} \times \text{conversion factor}
\]

The measuring interval is 0.1 s.

In most cases, the integration base is the same time unit as the time base of the signal to be integrated.

Example: analog input l/s \( \rightarrow \) integration base s !

Simple preset counter
When the preset counter is activated, limit values 1 and 2 are permanently assigned to the preset counter function (output 1 = main switchoff, output 2 = preliminary switchoff). Digital input 1 is permanently assigned to the 'Reset and restart preset counter' function. Accordingly, this reduces the number of free relays that are available. The operating menus for these inputs/outputs are then not displayed.

"Set count B" (limit value B) defines the preliminary switchoff, "Set count A" (limit value A) defines the main switchoff. Limit value (or start value, see "Pre-counter" function → 33) for limit value A and preliminary alarm value for limit value B are user-configurable.

A positive counting direction is defined as follows: from the fixed starting value of zero, start counting up until the set limit value is reached ("Set count A").

A negative counting direction is defined as follows: from the user-configurable starting value ("Set count A"), start counting down until the fixed limit value of zero is reached. The counter is reset and simultaneously restarted via digital input 1 ("Digital Inp.1"). Edge "Digital Inp.1": Low-High = reset and start counter.

The display of the preset counter can be configured under DISPLAY/M2 ... 'Ref.num' = "Batch".

### 7.3.7  Pulse output - PULSE OUT/M19

All the possible settings for the pulse output can be found in this menu item. This menu item can only be selected if your device is fitted with this option.

<table>
<thead>
<tr>
<th>Function (menu item)</th>
<th>Parameter setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dec. value</td>
<td>XXXXX</td>
<td>Decimal point position of the pulse value.</td>
</tr>
<tr>
<td></td>
<td>XXXX.X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>XXX.XX</td>
<td></td>
</tr>
<tr>
<td></td>
<td>XX.XX</td>
<td></td>
</tr>
<tr>
<td></td>
<td>X.XXX</td>
<td></td>
</tr>
<tr>
<td></td>
<td>X.XXXX</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unit value</td>
<td>0 to 99999</td>
<td>Pulse value with which the pulses should be output at the output.</td>
</tr>
<tr>
<td></td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Pulse width</td>
<td>0.04 to 2000ms</td>
<td>Setting for the pulse width at the pulse output. The maximum output frequency depends on the pulse width. $f_{(max)} = 1/(2 \times \text{pulse width})$</td>
</tr>
<tr>
<td></td>
<td>1000.00</td>
<td></td>
</tr>
<tr>
<td>Sim pulseout</td>
<td>Off</td>
<td>Outputs the selected pulses at the pulse output, irrespective of the input value. Is automatically set to &quot;OFF&quot; when exited.</td>
</tr>
<tr>
<td></td>
<td>1 Hz</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10 Hz</td>
<td></td>
</tr>
<tr>
<td></td>
<td>100 Hz</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1000 Hz</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10000 Hz</td>
<td></td>
</tr>
</tbody>
</table>
7.3.8  **Min/Max memory - MIN MAX/M20**

The process indicator can save a minimum and a maximum measured value. The input signal or the signal processed using the linearization table are available as the signal source. The memories are reset manually or using the digital input (→ 25).

<table>
<thead>
<tr>
<th>Function (menu item)</th>
<th>Parameter setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ref. Min/Max</td>
<td>Input</td>
<td>Signal source for the min/max value memory.</td>
</tr>
<tr>
<td></td>
<td>Lintab</td>
<td>● Input = input signal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>● Lintab = linearized input signal or current flow for calculation of channel</td>
</tr>
<tr>
<td>Dec. point</td>
<td>XXXX</td>
<td>Number of decimal places for the min/max value memory.</td>
</tr>
<tr>
<td></td>
<td>XXXX.X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>XXX.XX</td>
<td></td>
</tr>
<tr>
<td></td>
<td>XX.XXX</td>
<td></td>
</tr>
<tr>
<td></td>
<td>X.XXXX</td>
<td></td>
</tr>
<tr>
<td>Min. value</td>
<td>0 to 99999</td>
<td>Displays the current minimum value in the memory.</td>
</tr>
<tr>
<td>Max. value</td>
<td>0 to 99999</td>
<td>Displays the current maximum value in the memory.</td>
</tr>
<tr>
<td>Reset min</td>
<td>No</td>
<td>Resets the minimum value memory.</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Reset Max</td>
<td>No</td>
<td>Resets the maximum value memory.</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>

7.3.9  **Linearization table - LIN. TABLE/M21**

To linearize input variables, a linearization table can be saved in the device, e.g. to correct the level signal of a vessel for volume display.

<table>
<thead>
<tr>
<th>Function (menu item)</th>
<th>Parameter setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Counts</td>
<td>2 to 32</td>
<td>Number of linearization points required. At least two points must be entered.</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Dimension</td>
<td>XXXXXXXXX</td>
<td>The dimension is selected from a list or entered as customized text (max. length: 9 characters).</td>
</tr>
<tr>
<td>Dec. Y value</td>
<td>XXXX</td>
<td>Decimal position for the Y-values of the linearization table.</td>
</tr>
<tr>
<td></td>
<td>XXXX.X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>XXX.XX</td>
<td></td>
</tr>
<tr>
<td></td>
<td>XX.XXX</td>
<td></td>
</tr>
<tr>
<td></td>
<td>X.XXXX</td>
<td></td>
</tr>
<tr>
<td>Del. points</td>
<td>No</td>
<td>Delete all programmed linearization points.</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Show points</td>
<td>No</td>
<td>Display all the programmed linearization points.</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>
Tank linearization

You want to determine the amount of grain filled into a silo, display this information on site and transmit it to a process control system. A 4 to 20 mA level sensor determines the level in the vessel, the relationship between the level (m) and volume (m³) is known and the level is proportional to the sensor current. The calculated volume is output as a 0 to 20 mA signal at the analog output in proportion to the volume. In the event of an error in the system, the analog output outputs an error signal of 21.0 mA.

- **Vessel empty:**
  - Sensor signal 4 mA
  - Level 0 m
  - Numeric display should show 0 (m³)
  - Bar graph should show 0%
  - 0 mA should be present at the analog output
- **Vessel full:**
  - Sensor signal 20 mA
  - Level 10 m
  - Numeric display should show 1500 (m³)
  - Bar graph should show 100%
  - 20 mA should be present at the analog output

<table>
<thead>
<tr>
<th>Sensor signal (mA)</th>
<th>Y value (m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.0</td>
<td>0</td>
</tr>
<tr>
<td>4.32</td>
<td>20</td>
</tr>
<tr>
<td>4.64</td>
<td>50</td>
</tr>
<tr>
<td>4.96</td>
<td>85</td>
</tr>
<tr>
<td>5.28</td>
<td>115</td>
</tr>
<tr>
<td>5.6</td>
<td>160</td>
</tr>
<tr>
<td>5.92</td>
<td>210</td>
</tr>
<tr>
<td>6.24</td>
<td>280</td>
</tr>
<tr>
<td>6.56</td>
<td>400</td>
</tr>
<tr>
<td>20</td>
<td>1500</td>
</tr>
</tbody>
</table>

The following parameters must be configured for the example above:

<table>
<thead>
<tr>
<th>Menu</th>
<th>Function (menu item)</th>
<th>Setting value</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIN. TABLE / M 21</td>
<td>Counts</td>
<td>Number of points (10)</td>
</tr>
<tr>
<td></td>
<td>Dimension</td>
<td>Dimension of the lin. value (m³)</td>
</tr>
<tr>
<td></td>
<td>Show points</td>
<td>Show the linearization points (Yes)</td>
</tr>
<tr>
<td>LINPOINTS 1 to 10 / M23 to 32</td>
<td>Each point</td>
<td>Use point (Used)</td>
</tr>
<tr>
<td></td>
<td>Each X value</td>
<td>X-value (as in table above)</td>
</tr>
<tr>
<td></td>
<td>Each Y value</td>
<td>Y-value (as in table above)</td>
</tr>
</tbody>
</table>
## Linearization points of linearization table - LINPOINTS 1..X/M23..MXX

Displays the value pairs configured for the linearization table. This menu item is only visible if a linearization table has been configured (→ 40) and "Yes" is selected in the 'Show points' parameter in the "LIN. TABLE/M21" menu.

<table>
<thead>
<tr>
<th>Function (menu item)</th>
<th>Parameter setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Point</td>
<td>Used Discard</td>
<td>Use or discard the linearization point.</td>
</tr>
<tr>
<td>X value</td>
<td>-99999 to 99999</td>
<td>X value of the linearization table. Corresponds to the input value.</td>
</tr>
<tr>
<td>Y value</td>
<td>-99999 to 99999</td>
<td>Y value which belongs to the previous X value. Corresponds to the converted measured value.</td>
</tr>
</tbody>
</table>

## Operating parameters - PARAMETER/M55

In this menu item it is possible to configure settings such as the user code, process indicator failure mode according to NAMUR etc.

<table>
<thead>
<tr>
<th>Function (menu item)</th>
<th>Parameter setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>User code</td>
<td>9999</td>
<td>The option of editing the operating parameters is locked after a 4-digit digital sequence is entered. This locking is indicated on the display by a 'key' symbol.</td>
</tr>
</tbody>
</table>
| Limit code           | Off On            | • Off: It is not necessary to enter the user code to change the limit values  
|                      |                   | • On: Limit values are protected by a user code. The menu item is only displayed if a user code has been assigned. |
| Prog. name           | ILU10xA           | Displays the name of the device software currently installed. |
| Version              | V.X.XXX.XX        | Version of the device software currently installed. |
| Func. alt.           | Time Count        | Setting for controlling pump rotation in alternating pump control.  
|                      |                   | • Time = switching duration of the relay  
|                      |                   | • Count = switching frequency of the relay |
| Lock time            | 99.9              | Relay locking time, 0 to 99.9 s |
### 8 Diagnostics and troubleshooting

#### 8.1 Troubleshooting instructions

**NOTICE**

**Explosion hazard from open device in Ex environment**

- In the case of Ex devices, error diagnosis cannot be performed on an open device as this invalidates the type of protection.

<table>
<thead>
<tr>
<th>Display</th>
<th>Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>No measured value displayed</td>
<td>No power supply connected</td>
<td>Check the power supply to the device.</td>
</tr>
<tr>
<td>Power is supplied, device is defective</td>
<td></td>
<td>The device must be replaced.</td>
</tr>
<tr>
<td>The red marking for overranging/underranging on the bar graph is flashing.</td>
<td>The analog output is &gt; 10% above or below the scaled range.</td>
<td>Check the scaling of the analog output (Out 100% or Out 0%).</td>
</tr>
</tbody>
</table>

Errors for which an error code appears on the display are described in the following section →  43.

More information about the display is provided in the "Display" section →  16.

#### 8.2 Process error messages

**NOTICE**

Faults have the highest priority. The corresponding error code is displayed. A fault has occurred if the memory module for writing and reading data is defective or the data could not be read correctly.
8.2.1  Device failure

<table>
<thead>
<tr>
<th>Error code</th>
<th>Cause</th>
<th>Effect</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>E101</td>
<td>Bus error when reading the config/calibration data following power-up</td>
<td>Incorrect device functioning</td>
<td>Device error, notify Service</td>
</tr>
<tr>
<td>E102</td>
<td>Implausible operating data (checksum)</td>
<td>Configuration is lost</td>
<td>Perform a preset</td>
</tr>
<tr>
<td>E103</td>
<td>Implausible calibration data</td>
<td>Incorrect device functioning</td>
<td>Device error, notify Service</td>
</tr>
<tr>
<td>E104</td>
<td>Bus error when reading the min/max data following power-up</td>
<td>Incorrect min/max values</td>
<td>Reset min/max values</td>
</tr>
<tr>
<td>E105</td>
<td>Bus error when reading the relay data following power-up</td>
<td>Incorrect relay data</td>
<td>Reset relay data</td>
</tr>
<tr>
<td>E106</td>
<td>Universal card bus error</td>
<td>Incorrect universal input functioning</td>
<td>Replace universal card, notify Service</td>
</tr>
<tr>
<td>E210</td>
<td>Pulse output Pulse buffer overflow</td>
<td>A maximum of 10 pulses are buffered</td>
<td>Set the parameters of the pulse output in such a way that the maximum frequency is not exceeded</td>
</tr>
<tr>
<td>E221</td>
<td>Pump failure Digital input 1</td>
<td>Relay adopts failure mode</td>
<td>Acknowledge the error via operation or switch power off and on</td>
</tr>
<tr>
<td>E222</td>
<td>Pump failure Digital input 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E223</td>
<td>Pump failure Digital input 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E224</td>
<td>Pump failure Digital input 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E290</td>
<td>Number overshoot due to decimal point shift</td>
<td>Decimal point position cannot be changed</td>
<td>Check decimal point position and number range</td>
</tr>
</tbody>
</table>

The errors listed above can be evaluated with a relay in the "Alarm" and "Alarm inverse" operating mode.

8.2.2  Incorrect entries

<table>
<thead>
<tr>
<th>Error code</th>
<th>Description</th>
<th>Reaction at device</th>
</tr>
</thead>
<tbody>
<tr>
<td>E290</td>
<td>The number of decimal places cannot be increased due to number overflow of dependent parameters.</td>
<td>Error code continues to be shown on the display until a button is pressed.</td>
</tr>
</tbody>
</table>

8.3  Firmware history

Revision history
The version number on the nameplate and in the Operating Instructions indicates the device release: XX.YY.ZZ (example 01.02.01).

<table>
<thead>
<tr>
<th>XX</th>
<th>Change to main version. No longer compatible. The device and Operating Instructions change.</th>
</tr>
</thead>
<tbody>
<tr>
<td>YY</td>
<td>Change to functions and operation. Compatible. The Operating Instructions change.</td>
</tr>
<tr>
<td>ZZ</td>
<td>Fixes and internal changes. No changes to the Operating Instructions.</td>
</tr>
</tbody>
</table>
9  Maintenance

No special maintenance work is required for the device.

9.1  Cleaning

A clean, dry cloth can be used to clean the device.

10  Repair

10.1  General information

In accordance with the Endress+Hauser repair principle, the devices have a modular design and repairs can be carried out by the customer. Contact the supplier for more information on servicing and spare parts.

10.2  Spare parts

Spare parts currently available for the device can be found online at: http://www.products.endress.com/spareparts_consumables. Always quote the serial number of the device when ordering spare parts!
### Spare parts of the process indicator

<table>
<thead>
<tr>
<th>Item no.</th>
<th>Designation</th>
<th>Order no.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Housing front</td>
<td>RIA452X-HA</td>
</tr>
<tr>
<td>2</td>
<td>Housing seal</td>
<td>50070730</td>
</tr>
<tr>
<td>3</td>
<td>Ex cover (rear panel)</td>
<td>51008272</td>
</tr>
<tr>
<td>4</td>
<td>Rotary knob with seal</td>
<td>RIA452X-HB</td>
</tr>
<tr>
<td>5</td>
<td>Relay board</td>
<td>RIA452X-RA</td>
</tr>
<tr>
<td>6</td>
<td>Mainboard 90 to 250 V, 50/60 Hz</td>
<td>RIA452X-MA</td>
</tr>
<tr>
<td></td>
<td>Mainboard 20 to 36 V DC; 20 to 28 V AC, 50/60 Hz</td>
<td>RIA452X-MB</td>
</tr>
<tr>
<td></td>
<td>Mainboard 90-253VAC + analog output</td>
<td>RIA452X-MC</td>
</tr>
<tr>
<td></td>
<td>Mainboard 10-36VDC/20-27VAC + analog output</td>
<td>RIA452X-MD</td>
</tr>
<tr>
<td></td>
<td>Mainboard 90-253VAC + integration + pulse output</td>
<td>RIA452X-ME</td>
</tr>
<tr>
<td></td>
<td>Mainboard 10-36VDC/20-27VAC + integration + pulse output</td>
<td>RIA452X-MF</td>
</tr>
<tr>
<td></td>
<td>Mainboard 90-253VAC + output + integr. (pulse output + analog output)</td>
<td>RIA452X-MG</td>
</tr>
<tr>
<td></td>
<td>Mainboard 10-36VDC + output + integr. (pulse output + analog output)</td>
<td>RIA452X-MH</td>
</tr>
<tr>
<td>7</td>
<td>Standard input card</td>
<td>RIA452X-IA</td>
</tr>
<tr>
<td></td>
<td>Standard input card ATEX, FM, CSA approval</td>
<td>RIA452X-IB</td>
</tr>
<tr>
<td></td>
<td>Multifunction input card</td>
<td>RIA452X-IC</td>
</tr>
<tr>
<td>8</td>
<td>Display board, complete</td>
<td>RIA452X-DA</td>
</tr>
<tr>
<td>10</td>
<td>Terminal (mains) 3-pin</td>
<td>50078843</td>
</tr>
<tr>
<td>11</td>
<td>Terminal (relay 1-8) 6-pin</td>
<td>51005104</td>
</tr>
<tr>
<td>12</td>
<td>Terminal (analog input) 4-pin</td>
<td>51009302</td>
</tr>
<tr>
<td>13</td>
<td>Terminal (analog output, open collector, transmitter power supply) 6-pin</td>
<td>51008588</td>
</tr>
<tr>
<td>14</td>
<td>Terminal (digital inputs) 5-pin</td>
<td>51008587</td>
</tr>
<tr>
<td>15</td>
<td>Jumper operating lock</td>
<td>50033350</td>
</tr>
<tr>
<td>W/O. No.</td>
<td>Casing fastening clip RIA452 (1 pc.)</td>
<td>71035359</td>
</tr>
</tbody>
</table>
10.3  Return

The requirements for safe device return can vary depending on the device type and national legislation.

1. Refer to the web page for information:
   http://www.endress.com/support/return-material
   → Select the region.

2. Return the device if repairs or a factory calibration are required, or if the wrong device was ordered or delivered.

10.4  Disposal

If required by the Directive 2012/19/EU on waste electrical and electronic equipment (WEEE), the product is marked with the depicted symbol in order to minimize the disposal of WEEE as unsorted municipal waste. Do not dispose of products bearing this marking as unsorted municipal waste. Instead, return them to the manufacturer for disposal under the applicable conditions.

11  Accessories

Various accessories, which can be ordered with the device or subsequently from Endress+Hauser, are available for the device. Detailed information on the order code in question is available from your local Endress+Hauser sales center or on the product page of the Endress+Hauser website: www.endress.com.

11.1  Device-specific accessories

<table>
<thead>
<tr>
<th>Designation</th>
<th>Order No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>PC configuration software ReadWin 2000 and serial configuration cable with 3.5 mm jack plug for RS232 port</td>
<td>RIA452A-VK</td>
</tr>
<tr>
<td>PC configuration software ReadWin 2000 and serial configuration cable for USB port with CDI connector</td>
<td>TXU10-AA</td>
</tr>
<tr>
<td>Field housing in IP65 → 25, 48</td>
<td>51009957</td>
</tr>
<tr>
<td>Current simulator active 4-20mA 1-channel, compact housing, 9V block battery</td>
<td>SONDST-S1</td>
</tr>
</tbody>
</table>
12 Technical data

12.1 Input

12.1.1 Measured variable
- Current (standard)
- Digital inputs (standard)
- Current/voltage, resistance, RTD assembly, thermocouples (universal input option)

12.1.2 Measuring range

Current input:
- Current:
  - 0/4 to 20 mA +10% overrange, 0 to 5 mA
  - Short-circuit current: max. 150 mA
  - Input impedance: ≤ 5Ω
  - Response time: ≤ 100 ms

Universal input:
- Current:
  - 0/4 to 20 mA + 10% overrange, 0 to 5 mA
  - Short-circuit current: max. 100 mA
  - Input impedance: ≤ 50Ω
- Voltage:
  - ±150 mV, ±1 V, ±10 V, ±30 V, 0 to 100 mV, 0 to 200 mV, 0 to 1 V, 0 to 10 V
  - Input impedance: ≥ 100 kΩ
- Resistance:
  - 30 to 3000 Ω in 3/4-wire technology
- RTD assembly:
  - Pt100/500/1000, Cu50/100, Pt50 in 3/4-wire technology
  - Measuring current for Pt100/500/1000 = 0.25 mA
Thermocouple types:
- J, K, T, N, B, S, R as per IEC584
- D, C as per ASTME998
- U, L as per DIN43710/GOST
- Response time: \( \leq 100 \text{ ms} \)

Digital input:
- Voltage level –3 to 5 V low, 12 to 30 V high (as per DIN19240)
- Input voltage max. 34.5 V
- Input current typ. 3 mA with overload and reverse polarity protection
- Sampling frequency max. 10 Hz

12.1.3  Galvanic isolation
Towards all other circuits

12.2  Output

12.2.1  Output signal
- Relay, transmitter power supply (standard)
- Current, voltage, pulse, intrinsically safe transmitter power supply (option)

12.2.2  Signal on alarm
No measured value visible on the LC display, no background illumination, no sensor power supply, no output signals, relays behave in safety-oriented manner.

12.2.3  Current/voltage output
Analog output range:
0/4 to 20 mA (active), 0 to 10 V (active)
Load:
- \( \leq 600 \Omega \) (current output)
- Max. output current 22 mA (voltage output)
Signal characteristics:
Freely scalable signal
Galvanic isolation towards all other circuits

12.2.4  Pulse output (open collector)
Pulse output (open collector):
- Frequency range to 2 kHz
- \( I_{\text{max}} = 200 \text{ mA} \)
- \( U_{\text{max}} = 28 \text{ V} \)
- \( U_{\text{low/max}} = 2 \text{ V} \text{ at } 200 \text{ mA} \)
- Pulse width = 0.04 to 2.000 ms

12.2.5  Relay output
Signal characteristics:
Binary, switches when the limit value is reached
Switch function: limit relay switches for the operating modes:
- Minimum/maximum safety
- Alternating pump control function
- Batch function
- Time control
- Window function
- Gradient
- Device malfunction
- Sensor malfunction

Switching threshold:
Freely programmable

Hysteresis:
0 to 99%

Signal source:
- Analog input signal
- Integrated value
- Digital input

Number:
4 in basic unit (can be extended to 8 relays, option)

Electrical specifications:
- Relay type: changeover
- Relay switching capacity: 250 V_AC / 30 V_DC, 3 A
- Switch cycles: typically $10^5$
- Switching frequency: max. 5 Hz
- Minimum switching load: 10 mA / 5 V_DC

Galvanic isolation towards all other circuits

Mixed assignment of low and extra-low voltage circuits is not permitted for neighboring relays.

12.2.6 Transmitter power supply

Transmitter power supply 1, terminal 81/82 (optionally intrinsically safe):

Electrical specifications:
- Output voltage: 24 V ±15%
- Output current: max. 22 mA (for $U_{out} \geq 16$ V, sustained short-circuit proof)
- Impedance: ≤ 345 Ω

Transmitter power supply 2, terminal 91/92:

Electrical specifications:
- Output voltage: 24 V ±15%
- Output current: max. 250 mA (sustained short-circuit proof)

Transmitter power supply 1 and 2:

Galvanic isolation:
Towards all other circuits

HART®

HART® signals are not affected
12.3 Power supply

12.3.1 Terminal assignment

26 Terminal assignment of process indicator

1  Current input (12 and 82 jumpered internally)  7  Transmitter power supply and analog output
2  - passive sensor  8  Open collector output
3  - active sensor  D1 to D4 Digital inputs
4  Power supply  R1 to R4 Relay outputs
5  Interface for PC operating software  R5 to R8 Relay outputs (optional)
6  RS232 interface  J1  Hardware write protection
Universal input option

27 Universal input terminal assignment

1 Current input 0/4 to 20 mA
2 Voltage input ±1 V
3 Voltage input ±30 V
4 Thermocouples
5 RTD assembly, 4-wire
6 RTD assembly, 3-wire

Interface connection data

RS232
- Connection: jack socket 3.5 mm, rear of device
- Transmission protocol: ReadWin 2000
- Transmission rate: 38400 Baud

12.3.2 Supply voltage
- Low voltage power unit 90 to 250 VAC 50/60 Hz
- Extra-low voltage power unit 20 to 36 VDC or 20 to 28 VAC 50/60 Hz
The device must be powered only by a power unit that operates using a limited energy circuit in accordance with UL/EN/IEC 61010-1, Section 9.4 and the requirements in Table 18.

12.3.3 Power consumption
Power consumption max. 24 VA
12.4 Performance characteristics

12.4.1 Reference operating conditions

Power supply: 230 V<sub>AC</sub> ±10%, 50 Hz ±0.5 Hz
Warm-up period: 90 min
Ambient temperature: 25 °C (77 °F)

12.4.2 Maximum measured error

Current input

<table>
<thead>
<tr>
<th>Accuracy</th>
<th>0.1% of full scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resolution</td>
<td>13 bit</td>
</tr>
<tr>
<td>Temperature drift</td>
<td>≤ 0.4%/10 K (18 °F)</td>
</tr>
</tbody>
</table>

Universal input

<table>
<thead>
<tr>
<th>Input:</th>
<th>Range:</th>
<th>Maximum measured error of measuring range (oMR):</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Accuracy</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current</td>
<td>0 to 20 mA, 0 to 5 mA, 4 to 20 mA; overrange: to 22 mA</td>
<td>±0.10%</td>
</tr>
<tr>
<td>Voltage &gt; 1 V</td>
<td>0 to 10 V, ±10 V, ±30 V</td>
<td>±0.10%</td>
</tr>
<tr>
<td>Voltage ≤ 1 V</td>
<td>±1 V, 0 to 1 V, 0 to 200 mV, 0 to 100 mV, ±150 mV</td>
<td>±0.10%</td>
</tr>
<tr>
<td>Resistance thermometer</td>
<td>Pt100, −200 to 600 °C (−328 to 1112 °F) (IEC751, JIS1604, GOST) Pt500, −200 to 600 °C (−328 to 1112 °F) (IEC751, JIS1604) Pt1000, −200 to 600 °C (−328 to 1112 °F) (IEC751, JIS1604)</td>
<td>4-wire: ± (0.10% oMR + 0.3 K (0.54 °F)) 3-wire: ± (0.15% oMR + 0.8 K (1.44 °F))</td>
</tr>
<tr>
<td>Cu100, −200 to 200 °C (−328 to 392 °F) (GOST) Cu50, −200 to 200 °C (−328 to 392 °F) (GOST) Pt50, −200 to 600 °C (−328 to 1112 °F) (GOST)</td>
<td></td>
<td>4-wire: ± (0.20% oMR + 0.3 K (0.54 °F)) 3-wire: ± (0.20% oMR + 0.8 K (1.44 °F))</td>
</tr>
<tr>
<td><strong>Resistance measurement</strong></td>
<td>30 to 3000 Ω</td>
<td>4-wire: ± (0.20% oMR + 0.3 K (0.54 °F)) 3-wire: ± (0.20% oMR + 0.8 K (1.44 °F))</td>
</tr>
<tr>
<td><strong>Thermocouples</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Typ J (Fe-CuNi), −210 to 999.9 °C (−346 to 1382 °F) (IEC584)</td>
<td>± (0.15% oMR + 0.5 K (0.9 °F)) from −100 °C (−148 °F)</td>
<td></td>
</tr>
<tr>
<td>Typ K (NiCr-Ni), −200 to 1372 °C (−328 to 2502 °F) (IEC584)</td>
<td>± (0.15% oMR + 0.5 K (0.9 °F)) from −130 °C (−234 °F)</td>
<td></td>
</tr>
<tr>
<td>Typ T (Cu-CuNi), −270 to 400 °C (−454 to 752 °F) (IEC584)</td>
<td>± (0.15% oMR + 0.5 K (0.9 °F)) from −200 °C (−328 °F)</td>
<td></td>
</tr>
<tr>
<td>Typ N (NiCrSi-NiSi), −270 to 1300 °C (−454 to 2372 °F) (IEC584)</td>
<td>± (0.15% oMR + 0.5 K (0.9 °F)) from −100 °C (−148 °F)</td>
<td></td>
</tr>
<tr>
<td>Typ B (Pt30Rh-Pt6Rh), 0 to 1820 °C (32 to 3208 °F) (IEC584)</td>
<td>± (0.15% oMR + 1.5 K (2.7 °F)) from 600 °C (1112 °F)</td>
<td></td>
</tr>
<tr>
<td>Typ D (W3Re/W25Re), 0 to 2315 °C (32 to 4199 °F) (ASTM5698)</td>
<td>± (0.15% oMR + 1.5 K (2.7 °F)) from 500 °C (932 °F)</td>
<td></td>
</tr>
<tr>
<td>Typ C (W5Re/W26Re), 0 to 2315 °C (32 to 4199 °F) (ASTM5698)</td>
<td>± (0.15% oMR + 1.5 K (2.7 °F)) from 500 °C (932 °F)</td>
<td></td>
</tr>
<tr>
<td>Typ L (Fe-CuNi), −200 to 900 °C (−328 to 1652 °F) (DIN43710, GOST)</td>
<td>± (0.15% oMR + 0.5 K (0.9 °F)) from −100 °C (−148 °F)</td>
<td></td>
</tr>
</tbody>
</table>
### Input:

<table>
<thead>
<tr>
<th>Type</th>
<th>Range</th>
<th>Maximum measured error of measuring range (oMR):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typ U (Cu-CuNi), -200 to 600 °C (–328 to 1 112 °F) (DIN43710)</td>
<td>± (0.15% oMR + 0.5 K (0.9 °F)) from −100 °C (–148 °F)</td>
<td></td>
</tr>
<tr>
<td>Typ S (Pt10Rh-Pt), 0 to 1 768 °C (32 to 3 214 °F) (IEC584)</td>
<td>± (0.15% oMR + 3.5 K (6.3 °F)) for 0 to 100 °C (32 to 212 °F)</td>
<td></td>
</tr>
<tr>
<td>Typ R (Pt13Rh-Pt), −50 to 1 768 °C (−58 to 3 214 °F) (IEC584)</td>
<td>± (0.15% oMR + 1.5 K (2.7 °F)) for 100 to 1 768 °C (212 to 3 214 °F)</td>
<td></td>
</tr>
</tbody>
</table>

**Resolution**

16 bit

**Temperature drift**

Temperature drift: ≤ 0.1%/10 K (18 °F)

### Current output

<table>
<thead>
<tr>
<th>Linearity</th>
<th>0.1% of full scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resolution</td>
<td>13 bit</td>
</tr>
<tr>
<td>Temperature drift</td>
<td>Temperature drift: ≤ 0.1%/10 K (18 °F)</td>
</tr>
<tr>
<td>Output Ripple</td>
<td>10 mV at 500 Ω for frequencies ≤ 50 kHz</td>
</tr>
</tbody>
</table>

### Voltage output

<table>
<thead>
<tr>
<th>Linearity</th>
<th>0.1% of full scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resolution</td>
<td>13 bit</td>
</tr>
<tr>
<td>Temperature drift</td>
<td>Temperature drift: ≤ 0.1%/10 K (18 °F)</td>
</tr>
</tbody>
</table>

### 12.5 Installation

#### 12.5.1 Mounting location
Panel, cut-out 92 x 92 mm (3.62x3.62 in) (see 'Mechanical construction').

#### 12.5.2 Orientation
Horizontal +/- 45° in every direction

### 12.6 Environment

#### 12.6.1 Ambient temperature range
−20 to 60 °C (−4 to 140 °F)

#### 12.6.2 Storage temperature
−30 to 70 °C (−22 to 158 °F)

#### 12.6.3 Altitude
Non-Ex version: < 3 000 m (9 840 ft) over MSL
Ex version: < 2 000 m (6 562 ft) over MSL
**12.6.4 Climate class**
To IEC 60654-1, Class B2

**12.6.5 Degree of protection**
IP 65/NEMA 4
Device casing IP 20

**12.6.6 Shock and vibration resistance**
2 Hz (+3/-0) to 13.2 Hz: ±1 mm (±0.04 in)
13.2 to 100 Hz: 0.7 g

**12.6.7 Electromagnetic compatibility (EMC)**
CE compliance
Electromagnetic compatibility in accordance with all the relevant requirements of the IEC/EN 61326 series and NAMUR Recommendation EMC (NE21). For details refer to the EU Declaration of Conformity.
Maximum measured error <1% of measuring range.
Interference immunity as per IEC/EN 61326 series, industrial requirements.
Interference emission as per IEC/EN 61326 series, Class A equipment.

**12.6.8 Electrical protection class**
IEC 60529 (IP code)/NEMA 250

**12.6.9 Condensation**
Front: permitted
Device casing: not permitted

**12.7 Mechanical construction**

**12.7.1 Design, dimensions**

![Dimensions of the process indicator in mm (in)](image)
12.7.2 **Weight**
500 g (17.64 oz)

12.7.3 **Materials**
- Housing front: ABS plastic
- Housing casing: ABS GF plastic

12.7.4 **Terminals**
Plug-in screw terminals, clamping range 1.5 mm² (16 AWG) solid, 1 mm² (18 AWG) strand with wire ferrule
12.8 Operability

12.8.1 Local operation

Display elements

1. Device status LEDs: green - device ready for operation; red - device or sensor malfunction
2. Bar graph with overrange and underrange
3. 7-digit 14-segment display
4. Unit and text field 9x77 dot matrix
5. Relay status indicator: if power is supplied to a relay, the symbol is displayed
6. Status indicator for digital inputs
7. Symbol for "device operation locked"

- Display range
  - -99999 to +99999 for measured values
  - 0 to 9999999 for counter values
- Signalization
  - Relay activation
  - Overrange/underrange

Operating elements

Jog/shuttle dial

12.8.2 Remote operation

Configuration

The device can be configured with the ReadWin 2000 PC software.

Interface

CDI interface at device; connection to PC via USB box (see "Accessories")
RS232 interface at device; connection with serial interface cable (see "Accessories")
12.9Certificates and approvals

12.9.1CE mark
The product meets the requirements of the harmonized European standards. As such, it complies with the legal specifications of the EC directives. The manufacturer confirms successful testing of the product by affixing to it the CE-mark.

12.9.2Ex approval
Information about currently available Ex versions (ATEX, FM, CSA, etc.) can be supplied by your Endress+Hauser sales organization on request. All explosion protection data are given in a separate documentation which is available upon request.

12.9.3Other standards and guidelines
The manufacturer confirms compliance with all the relevant external standards and guidelines.

12.10Supplementary documentation
- System components and data manager - solutions to complete your measuring point: FA00016K/09
- Ex-related additional documentation: ATEX II(1)GD: XA00053R/09/a3

13Appendix

13.1Flow conversion

Conversion of various units to m³/h

**Liter**
- 1 l/s = 3.6 m³/h
- 1 l/min = 0.06 m³/h
- 1 l/h = 0.001 m³/h

**Hectoliter**
- 1 hl/s = 360 m³/h
- 1 hl/min = 6 m³/h
- 1 hl/h = 0.1 m³/h

**Cubic meter**
- 1 m³/s = 3600 m³/h
- 1 m³/min = 60 m³/h

**Megaliter**
- 1 Ml/s = 3600000 m³/h
- 1 Ml/min = 60000 m³/h
- 1 Ml/h = 1000 m³/h

**US gallon**
- 1 USgal/s = 13.6274 m³/h
- 1 USgal/min = 0.2271 m³/h
- 1 USgal/h = 0.003785 m³/h

**US mega-gallon**
- 1 USMgal/s = 13 627 481.6155 m³/h
- 1 USMgal/min = 2 271 246.936 m³/h
- 1 USMgal/h = 0.37854118 m³/h

**US barrel**
- 1 US bl/s = 429.264 m³/h
- 1 US bl/min = 7.1544 m³/h
- 1 US bl/h = 0.1192 m³/h

**Imperial gallon**
- 1 Imp. gal/s = 16.3659 m³/h
- 1 Imp. gal/min = 0.2728 m³/h
- 1 Imp. gal/h = 0.004546 m³/h

**US kilogallon**
- 1 US kgal/s = 13 627.4444 m³/h
- 1 US kgal/min = 0.2271 m³/h
- 1 US kgal/h = 0.003785 m³/h

**Cubic inch**
- 1 in³/s = 0.05899 m³/h
- 1 in³/min = 0.00098322 m³/h
- 1 in³/h = 0.00016387 m³/h

**Cubic foot**
- 1 ft³/s = 101.9406 m³/h
- 1 ft³/min = 1.699 m³/h
- 1 ft³/h = 0.0283 m³/h
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