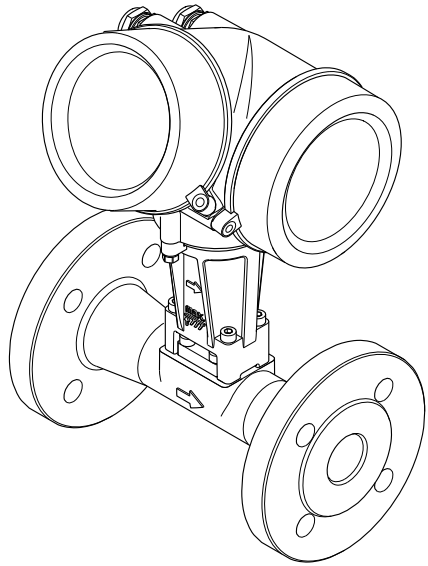
SD02025D/06/EN/01.18
71384796

Valid as of version
01.03.zz (Device firmware)

Special Documentation
Proline Prowirl 200

Functional Safety Manual



Endress+Hauser
People for Process Automation

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1 Declaration of conformity

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Endress+Hauser
People for Process Automation

Declaration of Conformity

Functional Safety according to IEC 61508:2010
Supplement 1 / NE130 Form B.1

Endress+Hauser Flowtec AG, Kägenstrasse 7, CH-4153 Reinach

declares as manufacturer, that the Flowmeter

Proline Prowirl 200

is suitable for the use in safety-instrumented systems according to IEC61508:2010.

In safety instrumented systems according IEC 61508 and IEC 61511, the instructions of the Safety Manual have to be followed.

Reinach, 06. September. 2017

Endress+Hauser Flowtec AG

Marcel Ziltener
Director Controlling & Human Resources

i.V.
Michael Karolzak
Senior Expert Functional Safety

1/1

A0034950-EN

1.1 Safety-related characteristic values

General	
Device designation and permitted versions	7D2C (Prowirl D 200) 7F2C (Prowirl F 200) 7O2C (Prowirl O 200) 7R2C (Prowirl R 200)
	Order code for "Output": ▪ Option A "4-20mA HART" ▪ Option B "4-20mA HART, pul./freq./switch output" ▪ Option C "4-20mA HART, 4-20mA"
	Order code for "Additional approval": Option LA "SIL"
Safety-related output signal	4 to 20 mA
Error current	≤ 3.6 mA or ≥ 21 mA
Assessed measured variable/function	Volume flow monitoring
Safety function(s)	Min., Max., Range
Device type according to IEC 61508-2	☐ Type A ☑ Type B
Operating mode	☑ Low Demand Mode ☑ High Demand Mode ☐ Continuous Mode [1]
Valid hardware version	From delivery date 01.01.2018
Valid firmware version	01.03.zz (HART; from delivery date 01.01.2018)
Safety manual	SD02025D
Type of assessment (only 1 version can be selected)	☑ Complete HW/SW assessment in the context of development including FMEDA and change process according to IEC 61508-2, 3
	☐ Assessment of evidence for proven-in-use HW/SW including FMEDA and change process according to IEC 61508-2, 3
	☐ Analysis of HW/SW field data for evidence of "prior use" according to IEC 61511
	☐ Assessment by FMEDA according to IEC 61508-2 for devices without software
Assessment by (including report no. + FMEDA data source)	TÜV Rheinland Industrie Service GmbH – Certificate No. 968/EZ 645.00/14
Test documents	Development documents, test reports, data sheets

1) No continuous operation in accordance with IEC 61508: 2011 (Section 3.5.16).

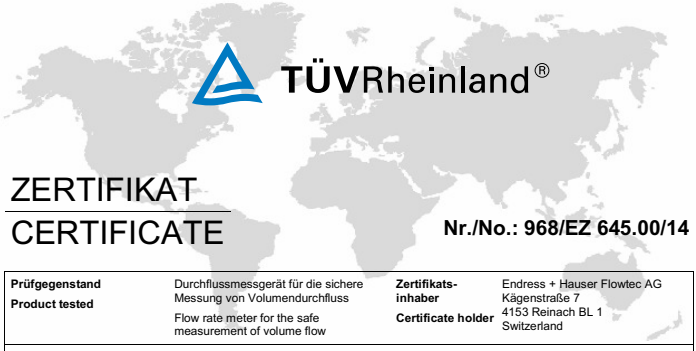
SIL integrity			
Systematic safety integrity		☐ SIL 2 capable	☑ SIL 3 capable
Hardware safety integrity	Single-channel service (HFT = 0)	☑ SIL 2 capable	☐ SIL 3 capable
	Multi-channel service (HFT ≥ 1)	☐ SIL 2 capable	☑ SIL 3 capable

FMEDA [1]		
Safety function(s)	Min., Max., Range	
	Option A, B	Option C
λ_{DU} [2]	58 (59) FIT	70 (70) FIT
λ_{DD} [2]	1050 (1067) FIT	1456 (1474) FIT
λ_{SU} [2]	1395 (1403) FIT	1301 (1309) FIT
λ_{SD} [2]	384 (385) FIT	380 (381) FIT
SFF - Safe Failure Fraction	98 %	98 %
PFD_{avg} for T_1 = 1 year [3] (single-channel architecture)	$2.6 \cdot 10^{-4}$	$3.1 \cdot 10^{-4}$
PFD_{avg} for T_1 = 5 years [3] (single-channel architecture)	$1.3 \cdot 10^{-3}$	$1.5 \cdot 10^{-3}$
PFH	$5.8 \cdot 10^{-8} \cdot 1/h$	$7.0 \cdot 10^{-8} \cdot 1/h$
PTC [4]	to 98 %	
$MTBF_{tot}$ [5]	39 years	36 years
Diagnostic test interval [6]	30 min	
Fault response time [7]	30 s	
Process safety time [8]	50 h	
Recommended test interval T_1	5 years	
$MTTF_d$ [9]	103 years	75 years

1) Values in brackets apply to remote version.
2) FIT = Failure In Time, number of failures per 10^9 h.
3) Valid for averaged ambient temperatures up to 40 °C (104 °F) in accordance with general standard for devices with SIL capability.
4) PTC = Proof Test Coverage (diagnostic coverage achieved by device failure detection during manual proof testing).
5) This value takes into account all failure types of the electronic components as per Siemens SN29500.
6) All diagnostic functions are carried out at least once during this time.
7) Maximum time between fault detection and fault response.
8) The process safety time amounts to the diagnostic test interval * 100 (calculation as per IEC 61508).
9) $MTTF_d$ as per ISO 13849/IEC 62061 also includes soft errors (sporadic bit errors in data memories).

Note
The measuring device has been developed for use in "low demand" and "high demand" mode.
Explanation
☑Our in-house quality management system saves information on safety-related systematic errors that will become known in the future.

2 SIL certificate



TÜVRheinland®

ZERTIFIKAT
CERTIFICATE

Nr./No.: 968/EZ 645.00/14

Prüfgegenstand **Product tested**	Durchflussmessgerät für die sichere Messung von Volumendurchfluss Flow rate meter for the safe measurement of volume flow	**Zertifikats-inhaber** **Certificate holder**	Endress + Hauser Flowtec AG Kägenstraße 7 4153 Reinach BL 1 Switzerland
Typbezeichnung **Type designation**	Prowirl 200 with the IO-Modules: "IO211 Ex-i, 212 Ex-d" (Option A, B) or "IO216 Ex-i, 217 Ex-d" (Option C) or "IO218 Ex-i, 219 Ex-d" (Option D)	**Hersteller** **Manufacturer**	wie Zertifikatsinhaber see certificate holder
Prüfgrundlagen **Codes and standards forming the basis of testing**	IEC 61508 Parts 1-7:2010		
Bestimmungsgemäße Verwendung **Intended application**	Das Gerät erfüllt die Anforderungen der Prüfgrundlagen (HW Sicherheitsintegrität SIL 2 und systematische Sicherheitsintegrität SIL 3 nach IEC 61508) und kann in Anwendungen bis SIL 2 (HFT = 0) bzw. SIL 3 (HFT = 1) nach IEC 61508 für die Sicherheitsfunktion Messung von Volumendurchfluss an der ersten 4-20mA Stromschnittstelle eingesetzt werden. The device complies with the requirements of the relevant standards (HW Safety Integrity SIL 2 and Systematic Capability SIL 3 acc. to IEC 61508) and can be used in applications up to SIL 2 (HFT = 0) resp. SIL 3 (HFT = 1) acc. to IEC 61508 for the safety function measurement of volume flow rate at the first 4-20mA current interface.		
Besondere Bedingungen **Specific requirements**	Die Hinweise in der zugehörigen Installations- und Betriebsanleitung sind zu beachten. The instructions of the associated Installation and Operating Manual shall be considered.		
Dieses Zertifikat ist gültig bis 25.02.2019. This certificate is valid until 2019-02-25.			

TÜVRheinland CERTIFIED
Functional Safety Type Approved
www.tuv.com ID 0600000000

Der Ausstellung dieses Zertifikates liegt eine Prüfung zugrunde, deren Ergebnisse im Bericht Nr. 968/EZ 645.00/14 vom 25.02.2014 dokumentiert sind.

Der Inhaber eines für den Prüfgegenstand gültigen Genehmigungs-Ausweises ist berechtigt, die mit dem Prüfgegenstand übereinstimmenden Erzeugnisse mit dem abgebildeten Prüfzeichen zu versehen.

The issue of this certificate is based upon an examination, whose results are documented in Report No. 968/EZ 645.00/14 dated 2014-02-25.

The holder of a valid licence certificate for the product tested is authorized to affix the test mark shown opposite to products, which are identical with the product tested.

TÜV Rheinland Industrie Service GmbH
Bereich Automation
Funktionale Sicherheit
Am Grauen Stein, 51105 Köln

Köln, 2014-02-25

Certification Body for FS-Products

Dr.-Ing. Thorsten Gantevoort

TÜV Rheinland Industrie Service GmbH, Am Grauen Stein, 51105 Köln / Germany
Tel.: +49 221 806-1790, Fax: +49 221 806-3539, E-Mail: industrie.service@de.tuv.com

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3 About this document

3.1 Document function

The document is part of the Operating Instructions and serves as a reference for application-specific parameters and notes.

- General information about functional safety: **SIL**
- General information about SIL is available:
  In the Downloads area of the Endress+Hauser website: www.de.endress.com/SIL

3.2 Using this document

3.2.1 Information on the document structure

Additional information regarding:
- The arrangement of the parameters, along with a short description, according to the **Operation** menu, **Setup** menu, **Diagnostics** menu: Operating Instructions → 10
- Operating concept: Operating Instructions → 10

3.3 Symbols used

3.3.1 Safety symbols

Symbol	Meaning
DANGER	**DANGER!** This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.
WARNING	**WARNING!** This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in serious or fatal injury.
CAUTION	**CAUTION!** This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or medium injury.
NOTICE	**NOTE!** This symbol contains information on procedures and other facts which do not result in personal injury.

3.3.2 Symbols for certain types of information

Symbol	Meaning
	Tip Indicates additional information.
	Reference to documentation

Symbol	Meaning
	Reference to page
	Reference to graphic
▶	Notice or individual step to be observed
1., 2., 3...	Series of steps
	Result of a step
	Operation via local display
	Operation via operating tool
	Write-protected parameter

3.3.3 Symbols in graphics

Symbol	Meaning
1, 2, 3 ...	Item numbers
A, B, C, ...	Views
A-A, B-B, C-C, ...	Sections

3.4 Supplementary device documentation

For an overview of the scope of the associated Technical Documentation, refer to the following:

- The *W@M Device Viewer* : Enter the serial number from the nameplate (www.endress.com/deviceviewer)
- The *Endress+Hauser Operations App*: Enter the serial number from the nameplate or scan the 2-D matrix code (QR code) on the nameplate.

3.4.1 Standard documentation

Operating Instructions

Measuring device	Documentation code
Prowirl D 200	BA01685D
Prowirl F 200	BA01686D
Prowirl O 200	BA01687D
Prowirl R 200	BA01688D

Description of Device Parameters

Measuring device	Documentation code
Prowirl 200	GP01109D

Technical Information

Measuring device	Documentation code
Prowirl D 200	TI01332D
Prowirl F 200	TI01333D
Prowirl O 200	TI01334D
Prowirl R 200	TI01335D

3.4.2 Supplementary device-dependent documentation

Safety Instructions

Contents	Documentation code
ATEX/IECEx Ex d, Ex tb	XA01635D
ATEX/IECEx Ex ia, Ex tb	XA01636D
ATEX/IECEx Ex ic, Ex ec	XA01637D
$_{C}CSA_{US}$ XP	XA01638D
$_{C}CSA_{US}$ IS	XA01639D
NEPSI Ex d	XA01643D
NEPSI Ex i	XA01644D
NEPSI Ex ic, Ex nA	XA01645D
INMETRO Ex d	XA01642D
INMETRO Ex i	XA01640D
INMETRO Ex nA	XA01641D
EAC Ex d	XA01684D
EAC Ex nA	XA01685D

Special documentation

Contents	Documentation code
Information on the Pressure Equipment Directive	SD01614D

Contents	Documentation code
Heartbeat Technology	SD02029D
Wet steam detection	SD02032D
Wet steam measurement	SD02035D

Installation Instructions

Contents	Comment
Installation instructions for spare part sets and accessories	For an overview of the accessories available for order, see the Operating Instructions for the device → 🖹 10

4 Permitted devices types

The details pertaining to functional safety in this manual relate to the device versions listed below and are valid as of the specified software and hardware versions. Unless otherwise specified, all subsequent versions can also be used for safety functions. A modification process according to IEC 61508 is applied for any device modifications.

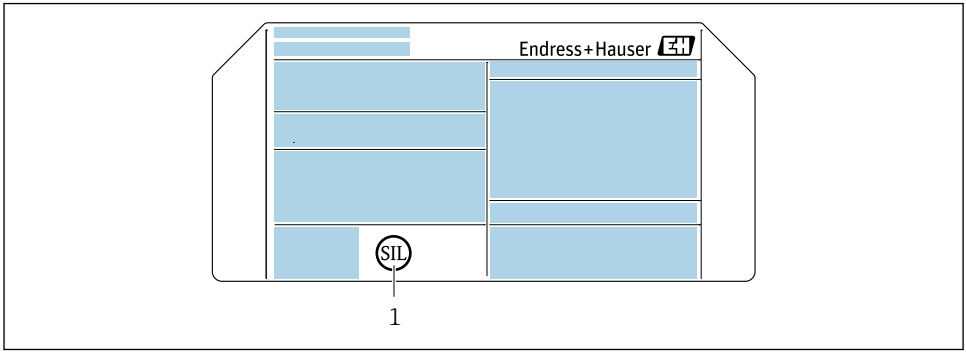
Feature	Designation	Option selected
–	Order code	7D2C (Prowirl D 200) 7F2C (Prowirl F 200) 7O2C (Prowirl O 200) 7R2C (Prowirl R 200)
000	Nominal diameter	D: DN 15 to 150 (½ to 6") F: DN 15 to 300 (½ to 12") O: DN 15 to 300 (½ to 12") R: DN 25 to 250 (1 to 10")
010	Approval	All
020	Output; input [1) 2)]	Option A "4-20mA HART" Option B "4-20mA HART, pul./freq./switch output" Option C "4-20mA HART, 4-20mA"
030	Display; operation	All
040	Housing	All
045	Cable, remote version	All
050	Electrical connection	All

Feature	Designation	Option selected
060	Sensor version; DSC sensor; measuring tube [3]	Option AA "volume; 316L; 316L −40 to +260 °C (−40 to +500 °F)" Option AB "volume; Alloy C22; 316L −40 to +260 °C (−40 to +500 °F)" Option AC "volume; Alloy C22; Alloy C22 −40 to +260 °C (−40 to +500 °F)" Option BA "volume high-temperature; 316L; 316L −200 to +400 °C (−328 to +750 °F)" Option BB "volume high-temperature; Alloy C22; 316L −200 to +400 °C (−328 to +750 °F)" Option BD "volume high-temperature; Alloy 718; 316L −200 to +400 °C (−328 to +750 °F)" [4]
061	DSC sensor seal	All
065	Pressure component	All
070	Process connection	All
080	Calibration flow	All
480	Device model	All
500	Display operating language	All
520	Sensor option	All
530	Customer-specific configuration	All
540	Application Package	All
570	Service	All
580	Test, certificate	All
590	Additional approval	Option LA "SIL" [5]
610	Accessory mounted	All
620	Accessory enclosed	All
850	Firmware version	Firmware with SIL capability, e. g. 01.03.zz (HART)
895	Marking	All

1) In devices with 2 outputs, only current output 1 (terminals 1 and 2) is suitable for safety functions. Output 2 (terminals 3 and 4) can be connected for non-safety related purposes where needed.
2) Option D is only available for the "mass flow" measured variable. As the Prowirl 200 is certified only for the "Volume flow monitoring" safety function, this output version is not available.
3) SIL is available only with the order code for "Sensor version", option "volume" and option "volume high-temperature".
4) Sensor versions are not available for the "mass" option, as the device is certified only for the "volume flow monitoring" safety function.
5) An additional selection of any further versions is possible.

- Valid hardware version: From delivery date 01.01.2018
- Valid firmware version: From 01.03.zz (HART; from delivery date 01.01.2018)

4.1 SIL label on the transmitter nameplate



1 SIL logo

5 Safety function

5.1 Definition of the safety function

The measuring device's permitted safety functions are:
- Monitoring of a maximum or minimum volume flow for liquid or gaseous media
- Monitoring of a volume flow range for liquid or gaseous media

5.1.1 Safety-related output signal

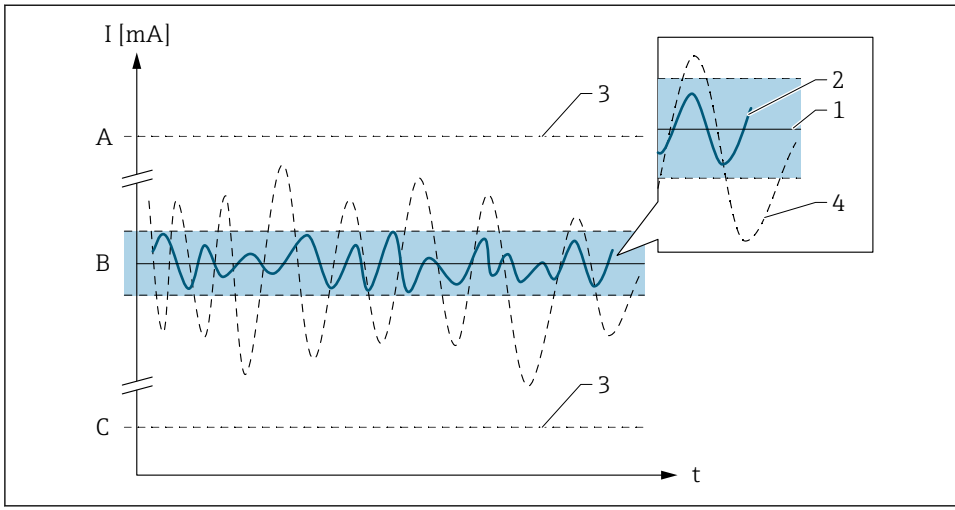
The measuring device's safety-related signal is the 4–20 mA analog output signal. All safety measures refer to this signal exclusively.

In devices with 2 outputs (*order code for "Output, input", option B "4-20mA HART, pulse/ frequency/switch output" or option C "4-20mA HART, 4-20mA"*) only current output 1 (terminals 1 and 2) is suitable for safety functions. Output 2 (terminals 3 and 4) can be connected for non-safety related purposes where needed.

The safety-related output signal is fed to a downstream automation system where it is monitored for the following:
- Overshooting and/or undershooting of a specified limit value for the volume flow
- The occurrence of a fault: e.g. error current (≤ 3.6 mA, ≥ 21 mA), interruption or short-circuit of the signal line

The safety-related errors are broken down in accordance with IEC/EN 61508 into different categories and implications for the safety-related output signal.

Safety related error	Explanation	Item no.→ 🖹 15	Implication for safety-related output signal
No device error	Safe: No error	1	Within specification
λ_{SD}	Safe detected: Safe, detectable failure present	3	Device assumes a signal on alarm
λ_{SU}	Safe undetected: Safe, undetectable failure present	2	Is within the specified tolerance range
λ_{DD}	Dangerous detected: Dangerous but detectable failure present (diagnosis in device)	3	Device assumes a signal on alarm
λ_{DU}	Dangerous undetected: Dangerous, undetectable failure present	4	May be outside the specified tolerance range



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A Error current ≥ 21 mA
B Measuring uncertainty in accordance with Technical Information
C Error current ≤ 3.6 mA

5.2 Restrictions for use in safety-related applications

1. The measuring device must be used correctly for the specific application, taking into account the medium properties and ambient conditions.
2. Carefully follow safety instructions pertaining to critical process situations and installation conditions, which can be found in the device documentation.

3. Observe application-specific limits.
4. Do not exceed technical specifications of measuring device.

Information on the safety-related signal → 14

For detailed information on the technical specifications, see the device documentation.→ 10.

5.2.1 Dangerous undetected failures in this scenario

An incorrect output signal that deviates from the value specified in the Operating Instructions but is still in the range of 4 to 20 mA, is considered a dangerous, undetected failure.

Information on measured error→ 18

For detailed information on the maximum measured error, see the Operating Instructions. → 10

5.2.2 Useful lifetime of electric components

The established failure rates of electrical components apply for a useful lifetime of 12 years as per IEC 61508-2: 2010, section 7.4.9.5, note 3.

The device's year of manufacture is coded in the first character of the serial number (→ table below).

Example: serial number **E**5ABBF02000 → year of manufacture 2011

ASCII character	Meaning	ASCII character	Meaning	ASCII character	Meaning
D	2010	K	2015	R	2020
E	2011	L	2016	S	2021
F	2012	M	2017	T	2022
H	2013	N	2018	V	2023
J	2014	P	2019	W	2024

5.2.3 Suitability of the measuring device

1. Carefully select the nominal diameter of the measuring device in accordance with the application's expected flow rates.
   ↳ The maximum flow rate during operation must not exceed the specified maximum value for the sensor.
2. In safety-related applications, it is advisable to select the limit value for monitoring a minimum flow such that this limit is at least twice the smallest specified flow that can still be measured, with the actual medium and the selected nominal diameter.
   ↳ For further information, see the Technical Information.→ 🖹 11
3. To achieve the best possible measuring performance in the lower measuring range (comparable with measuring performance under reference operating conditions), the density and viscosity that match the medium must be configured. The Applicator can be used to determine the exact properties of the medium.
   ↳ For further information on reference conditions and the Applicator, see the Technical Information. → 🖹 11
4. If there is a difference in diameter between the process connection pipe and the internal diameter of the flange, this difference must be corrected with the **Mating pipe diameter** parameter.
   ↳ For further information, see the Operating Instructions. → 🖹 10

NOTICE

Use the measuring device according to the specifications.

- ▶ Pay attention to the medium properties and the environmental conditions.
- ▶ Carefully follow instructions pertaining to critical process situations and installation conditions.

Detailed information on:

- Installation
- Electrical connection
- Medium properties
- Environment
- Process

Operating Instructions and Technical Information → 10

⚠ CAUTION

For liquids that readily boil or in the case of suction lines:

- ▶ Ensure that the vapor pressure is not undershot and that the liquid does not start to boil.
- ▶ Please ensure that there is never any outgassing of the gases naturally contained in many liquids. Sufficiently high system pressure prevents the occurrence of these effects.
- ▶ In order to guarantee correct measurement, ensure that no cavitation occurs.
- ▶ Avoid applications that cause buildup, corrosion or abrasion at the bluff body.

Further information on the suitability of the measuring device for safety-related operation is available from your Endress+Hauser sales center.

5.2.4 Information on measured errors

When the measured value is transmitted via the 4–20 mA current output, the measuring device's relative measured error is made up of the contribution of the digitally determined measured value and the accuracy of the analog current output. These contributions, which are listed in the device documentation, apply under reference operating conditions and can depend on the sensor version ordered. If process or ambient conditions are different, there are additional contributions, e.g. temperature or pressure, which are also listed.

For further information on calculating the measured error, see the Technical Information. → 11

Guidelines for minimal measured errors:

1. In the event of high process pressure:
   Set the typical process pressure in the measuring device.
2. Limit value monitoring: Depending on the process dynamics, the current value of the unfiltered 4–20 mA output signal can temporarily exceed the specified error range.
   The device can optionally provide damping of the current output via a parameter that only affects the measured value output.
   ↳ Device-internal diagnostics or the outputting of an error current (≤ 3.6 mA , ≥ 21 mA) are not affected by this damping.

5.2.5 Power supply to the 4–20 mA current output

Overvoltages at the 4–20 mA current output - caused by a fault in the supply unit, for example - can result in a leak current in the device's input protection unit. This may lead to falsification of the output signal by more than the specified error or the minimum error current (3.6 mA) can no longer be set due to the leak current.

▶ Use a 4–20 mA power supply unit with either voltage limitation or voltage monitoring.

NOTICE

The safety-related connection values depend on the Ex approval.

▶ Pay attention to the safety-related connection values.

For detailed information on the connection values, see the Safety Instructions.→ 11

5.2.6 HART communication

The measuring device also communicates via HART in the SIL mode. This comprises all the HART features with additional device information.

NOTICE

The measuring device's safety-related signal is the 4–20 mA analog output signal.

All safety measures refer to this signal exclusively.

▶ Please note the following: → 14.

NOTICE

When the SIL locking code is entered, the device parameters that affect the safety-related output signal are locked and write-protected. It is still possible to read the parameters.

When SIL locking is enabled, restrictions apply on all communication options, such as the service interface (CDI), HART protocol and local display.

▶ Deactivation of the SIL mode → 27.

6 Use in protective systems

6.1 Device behavior during operation

6.1.1 Device behavior during power-up

Once switched on, the device runs through a start-up phase. The current output is set to error current during this time. This current is ≤ 3.6 mA in the initial seconds of this start-up phase.

No communication with the device is possible via the interfaces during the start-up phase. After the start-up phase the device switches to the normal mode (measuring operation).

6.1.2 Behavior of device during operation

The device outputs a current value which corresponds to the measured value to be monitored. This value must be monitored and processed further in an attached automation system.

6.1.3 Device behavior in safety function demand mode

Depending on the setting of the **Failure mode** parameter, the current is as follows in demand mode:
- For **Min.** option: ≤ 3.6 mA
- For **Max.** option: ≥ 21 mA

6.1.4 Device behavior in event of alarms and warnings

The output current on alarm can be set to a value ≤ 3.6 mA or ≥ 21 mA.

In some cases (e.g. a cable open circuit or faults in the current output itself, where it is not possible to set the error current ≥ 21 mA) output currents of ≤ 3.6 mA occur irrespective of the configured error current.

In some other cases (e.g. short circuit of cabling), output currents of ≥ 21 mA occur irrespective of the configured error current.

For alarm monitoring, the downstream automation system must be able to recognize both maximum alarms (≥ 21 mA) and minimum alarms (≤ 3.6 mA).

6.1.5 Alarm and warning messages

Additional information is provided by the alarm and warning messages output in the form of diagnostic events and associated event texts.

NOTICE

A diagnostic message is displayed even though the diagnostic event is no longer active in the unlocked SIL mode.

When SIL mode is activated, additional diagnostics are activated. If a diagnostic event is pending and the locked SIL mode is deactivated, the diagnostic message remains as long as the error is still present.
- ▶ In this case, the device must be disconnected briefly from the power supply (e. g. by unplugging the terminals).
- ▶ When the device is then restarted, a self-check is carried out, and the diagnostics event is reset where applicable.

This behavior occurs in the case of the following diagnostic messages:
Diagnostic message **803 Current loop**

6.2 Parameter configuration for safety-related applications

6.2.1 Calibration of the measuring point

The measuring point is calibrated via the operating interfaces. A wizard guides you systematically through all the submenus and parameters that have to be set for configuring the measuring device.

For detailed information on the operating options, see the Operating Instructions.→ 10

After the operating language has been selected, the following can be configured:
- Selection and configuration of the medium
- Configuration of the current outputs
- Configuration of the pulse/frequency output and switch output
- Configuration of the local display
- Configuration of the output behavior
- Configuration of the low flow cutoff

For the further configuration of the measuring device in special applications, a wide range of other configuration parameters are available via the **Diagnostics** menu and **Expert** menu.

For detailed information on configuring the measuring device, see the Operating Instructions and Description of Device Parameters → 10

To activate the SIL mode, the device must run through a confirmation sequence. While running through this sequence, critical parameters are either set automatically by the device to standard values or transferred to the local display/operating tool to enable verification of the setting. On completion of parameter configuration, the SIL mode of the device must be enabled with a SIL locking code.

Availability of the SIL mode function

NOTICE

The SIL confirmation sequence is only visible on the local display and in the operating tools for devices with the order code for "Additional approval", option LA "SIL".
- ▶ For this reason, the SIL mode can also only be activated on these measuring devices.
- ▶ If the LA "SIL" option was ordered for the flowmeter ex works, this option is available when the measuring device is delivered to the customer. Access is via the operating interfaces of the measuring device.
- ▶ If the order option cannot be accessed in the measuring device, the function cannot be retrofitted during the life cycle of the device. If you have any questions please contact your Endress+Hauser service or sales organization.

Ways to check function availability in the measuring device:
Using the serial number:
W@M Device viewer [1] → Order code for *"Additional approval"*, option LA *"SIL"*

1) www.endress.com/deviceviewer

Detailed information concerning the SIL label:
- Permitted device types
- SIL label on the transmitter nameplate → 14

Overview of the SIL mode

The SIL mode enables the following steps:

1. Makes sure that the preconditions are met.
   ↳ The measuring device checks whether the user has correctly configured a predefined set of parameters for the safety function.
   If the result is positive, the device continues with the activation of the SIL mode.
   If the result is negative, the sequence is not permitted or is aborted, and the device does not continue with the activation of the SIL mode.
2. Automatically switches a predefined set of parameters to the default values specified by the manufacturer.
   ↳ This parameter set ensures that the flowmeter works in the safety mode.
3. Guides the user through the preconfigured parameters for checking.
   ↳ This ensures that the user actively checks all the important pre-settings.
4. Activates write protection for all the relevant parameters in the SIL mode.

All this ensures that the parameter settings that are required for the safety function are configured correctly. (These settings cannot be circumvented either deliberately or by accident.)

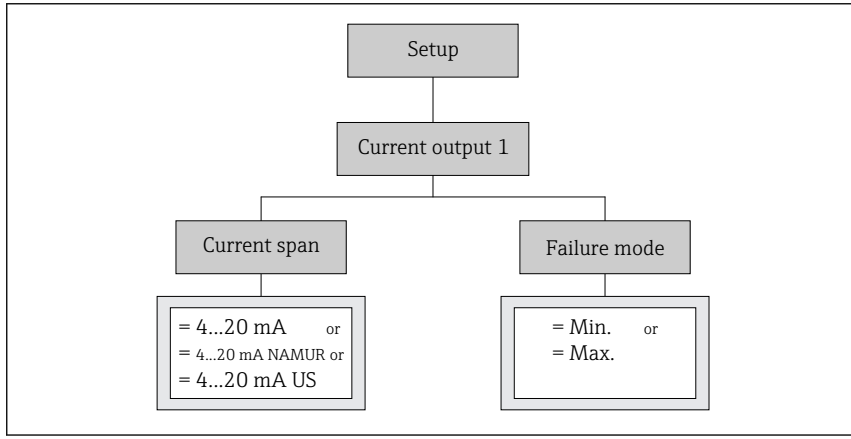
6.2.2 Locking a SIL device

When locking a SIL device, all safety-related parameter settings are shown to the operator individually and must be confirmed explicitly. Parameter settings not permitted in the locked SIL mode are reset to their default values where necessary. A SIL locking code is then entered to lock the device software to ensure that parameters cannot be changed. Non-safety-related parameters remain unchanged.

NOTICE

Once the SIL device has been locked, the process-related parameters are write protected, and thereby locked, for security reasons.
It is still possible to read the parameters. When SIL locking is enabled, restrictions apply on all communication options, such as the service interface, HART protocol and local display.
► Follow the specified locking sequence.

1. Check preconditions.
   ↳



2. In the **Setup** menu → **Advanced setup** submenu, select the **SIL confirmation** wizard.
3. Select **Set write protection** parameter.
4. Enter the SIL locking code **7452**.
   ↳ The device first checks the preconditions listed under item 1.

NOTICE

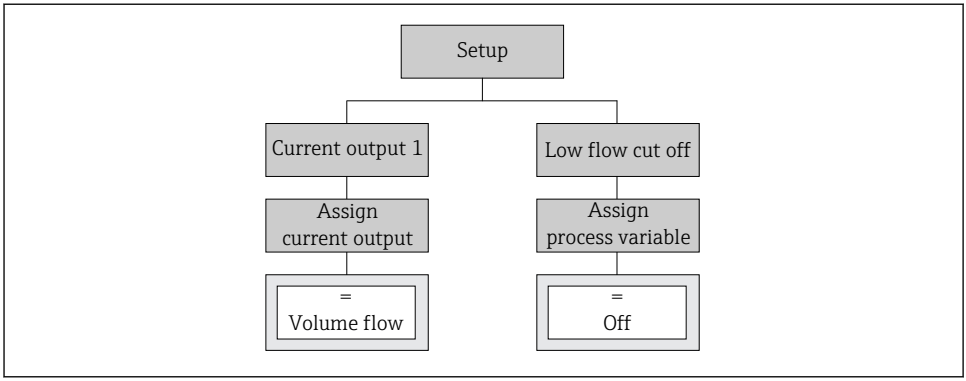
If these preconditions are not met, the message "SIL preparation = failed" appears on the display along with the parameter that failed to meet the preconditions under 1.
The SIL confirmation sequence is not continued.
► Check preconditions.

If the preconditions are met, the message **SIL preparation = finished** appears on the display.

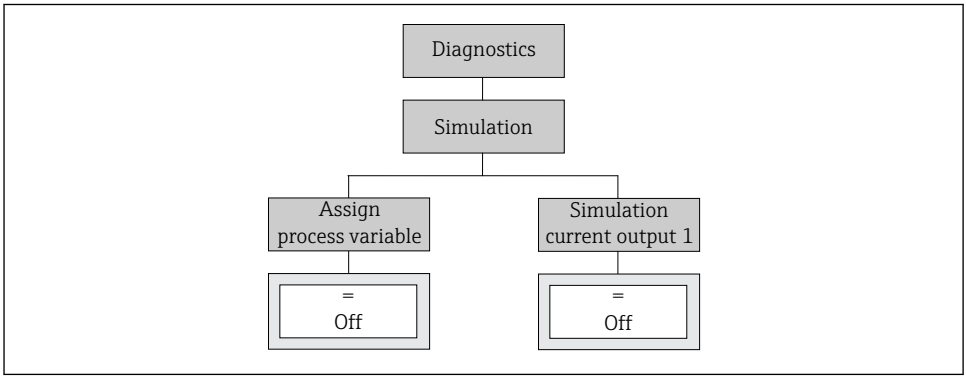
Once the preconditions have been met, the device automatically switches the following parameters to safety-oriented settings:

NOTICE

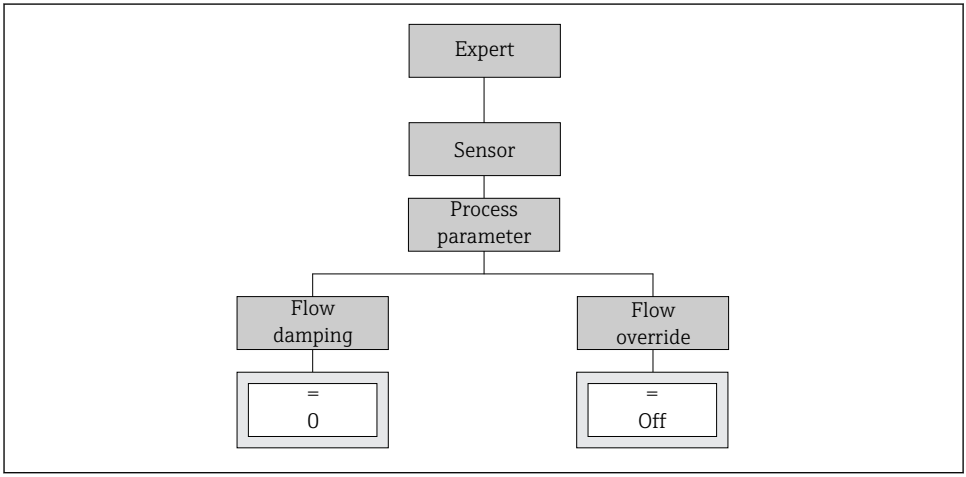
If the measuring device has been configured for the "mass flow" measured variable, the Assign current output in the SIL confirmation sequence is automatically switched to Volume flow.
The 4 mA value and 20 mA value are reset to the factory setting.
► Cancel the SIL confirmation sequence.
► Check the settings of the current output and change them if necessary.



A0021070-EN

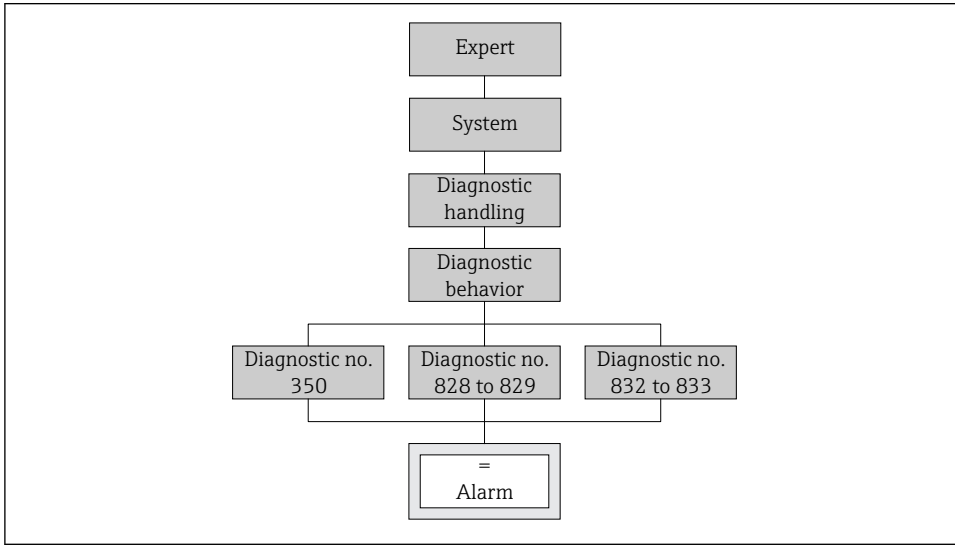


A0021506-EN



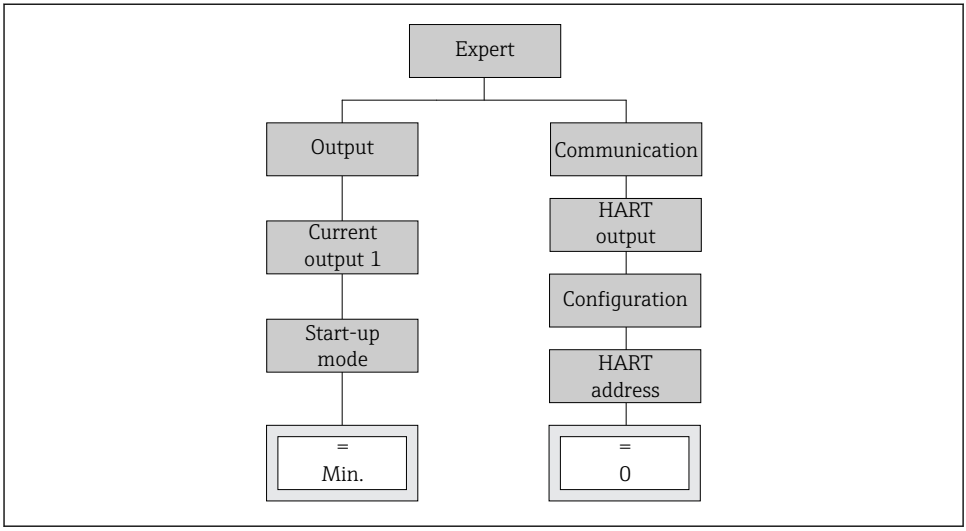
A0021521-EN

The diagnostic behavior is set in such a way that the measuring device is set to the safe state when an error occurs. This means that the diagnostic messages listed in the graphic are set to alarm and the current output adopts the configured failsafe mode→ 19.



A0021522-EN

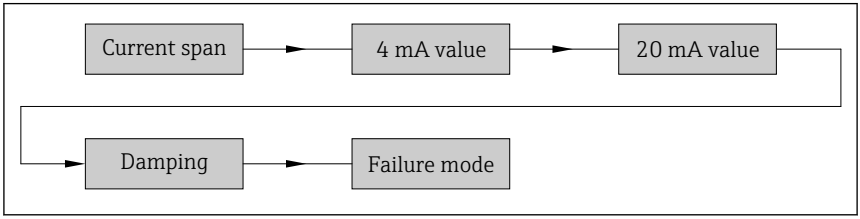
- diagnostic message **350 Pre-amplifier defective**
- diagnostic message **828 Ambient temperature too low**
- diagnostic message **829 Ambient temperature too high**
- diagnostic message **832 Electronic temperature too high**
- diagnostic message **833 Electronic temperature too low**



A0021523-EN

To check that values are displayed correctly, the following string appears on the device display or operating tool: **0123456789+-.**

5. The user must confirm that the values are displayed correctly.
   ↳ The device displays the current settings for the following parameters one after another for the user to confirm each of them:



A0021100-EN

For detailed information on the parameters in the graphic, see the Operating Instructions.→ 10

6. At the end of the verification, the SIL locking code **7452** must be entered in the **Set write protection** parameter again to confirm that all the parameter values have been defined correctly.
   ↳ If the SIL locking code has been entered correctly, the message **"End of sequence"** appears on the display.
7. Press the E key to confirm.

The SIL mode is now activated.

Recommendation:

1. Check the write protection switch (WP) in the connection compartment.
2. Set this switch to the **ON** position where necessary.
   ↳ Hardware write protection enabled.
3. Restart the device on completion of the SIL confirmation sequence.

NOTICE

If the SIL confirmation sequence is aborted before the "End of sequence" message is displayed, the SIL device is not locked. The safety-oriented parameter settings have been made but the SIL device has not been locked.

▶ Perform SIL device locking again.

6.2.3 Unlocking a SIL device

A device in the locked SIL mode is protected against unauthorized operation by means of a SIL locking code and, where applicable, by means of a user-specific release code and a hardware write protection switch. The device must be unlocked in order to change parameters, for proof-tests as well as to reset self-holding diagnostic messages.

NOTICE

Unlocking the device deactivates diagnostic functions, and the device may not be able to carry out its safety function in the unlocked SIL mode.

▶ Therefore, independent measures must be taken to ensure that there is no risk of danger while the SIL device is unlocked.

Unlocking procedure:

1. Check the write protection switch (WP) in the connection compartment.
2. Set this switch to the **OFF** position where necessary.
   ↳ Hardware write protection disabled.
3. Enter the user-specific release code if necessary.
4. In the **Setup** menu → **Advanced setup** submenu, select the **Deactivate SIL** wizard.
5. Select **Reset write protection** parameter.
6. Enter the SIL locking code **7452**.
   ↳ If the SIL locking code has been entered correctly, the message **"End of sequence"** appears on the display.
7. Press the E key to confirm.

The SIL mode is now deactivated.

6.3 Proof-testing

NOTICE

The safety function is not guaranteed during a proof test.

Nevertheless, process safety must be guaranteed during proof testing.

- ▶ The safety-related output signal 4 to 20 mA may not be used for the protective system.
- ▶ Take alternative monitoring measures if necessary.

6.3.1 Proof testing the safety function of the entire system

1. Check the functional integrity of the safety function at appropriate intervals.
2. The operator specifies the testing interval and this must be taken into account when determining the probability of failure PFD_{avg} of the sensor system.
   ↳ In the case of a single-channel system architecture, the average probability of failure (PFD_{avg}) of the sensor is derived from the proof-test interval T_i, the failure rate for dangerous undetected failures λ_{du}, the proof test coverage PTC and the assumed mission time by close approximation as follows:

$$PFD_{avg} \approx \lambda_{du} \times (PTC/2 \times T_i + (1 - PTC) / 2 \times MT)$$

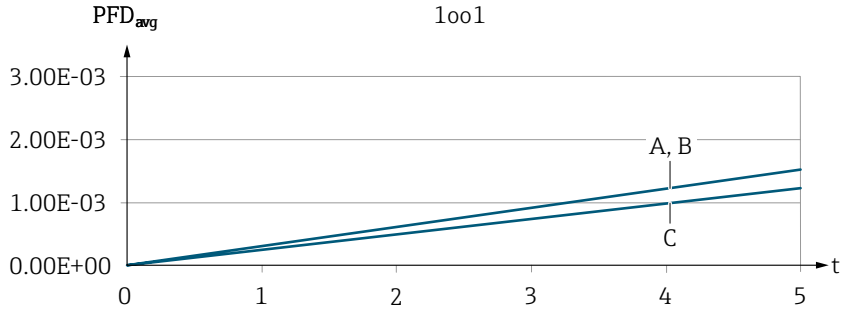
A0023571

MT Mission time
PTC Proof test coverage
Ti Test interval

3. The operator also specifies the procedure for proof-testing.
   ↳ **NOTE!**
   In accordance with IEC 61511, an independent proof test of the subsystems→ 🖹 29, e.g. sensor, is permitted as an alternative to testing the safety function of the entire system.

Average probability of failure and useful lifetime

PFD_{avg} for a single-channel system:



t	*Mission time in years*
A, B, C	*Output versions*
PFD_{avg}	*Average probability of dangerous failure on demand*
1oo1	*Single-channel architecture*

6.3.2 Proof testing the sensor subsystem

If there are no operator-specific requirements for the proof test, the following alternative is available for testing the sensor subsystem [2)] depending on the **"volume flow"** measured variable used for the safety function..

Proof test	Description	PTC
1 → 🖹 30	Device restart and testing of current output 1	75 %
2 → 🖹 32	Device restart and external Heartbeat Verification (includes testing of current output 1)	85 %
3 → 🖹 34	Testing with a secondary standard	98 %
4 → 🖹 35	Testing with a secondary standard and testing of current output 1	99 %

Other recommendations

It is advisable to perform a visual inspection on site.

- ▶ As part of the visual inspection of the transmitter, ensure that all of the electronics compartment cover seals and cable entries are providing adequate sealing.

2) In accordance with IEC 61508, the sensor is synonymous with the entire flowmeter.

NOTICE

The safety function is not guaranteed during a proof test.

Nevertheless, process safety must be guaranteed during proof testing.

- ▶ The safety-related output signal 4 to 20 mA may not be used for the protective system.
- ▶ Take alternative monitoring measures if necessary.

Proof test 1: Device restart and testing of current output 1

Test method

- Part 1 - Device restart
- Part 2 - Testing of current output 1

Preparation

Byassing of safety function of process control system, to prevent accidental activation of the safety function.

- ▶ Deactivate the locked SIL mode → 27.

Test sequence - Part 1: Device restart

1. Force a restart of the device by disconnecting and reapplying the terminal voltage.
2. Alternatively:
   Open the **Device reset** parameter.
   - ↳ Navigation: Setup → Advanced setup → Administration
3. Select **Restart device** option.

The restart resets every parameter for which data is contained in the volatile memory (RAM) to the factory setting (e. g. measured value data). The device configuration remains unchanged.

NOTICE

The "To factory defaults" option and the "To delivery settings" option reset the device configuration to the factory setting!

If one of these two options is selected, the measuring device must be reconfigured.

- ▶ In the **Device reset** parameter, select only the **Restart device** option.

Evaluating the results - Part 1: Device restart

- ▶ Test restart of device.
  - ↳ After a successful startup, the local display switches automatically from the startup display to the operational display. If the device restarts and no diagnostic message is displayed, this step has been completed successfully.
    If nothing appears on the local display or if a diagnostic message is displayed, refer to the section on "Diagnostics and troubleshooting" in the Operating Instructions for the device.

Test step - Part 2 - Testing of current output 1

The **Simulation** submenu (Diagnostics → Simulation) enables you to simulate, without a real flow situation, various process variables in the process and the device alarm mode and to verify downstream signal chains (switching valves or closed-control loops).

Performing the test

For proof testing, use only the **Current output simulation** parameter (→ 32) and the **Value current output** parameter (→ 32), as these are the only parameters approved for testing the safety-related characteristics.

1. In the **Value current output** parameter, select the defined default values one after the other.
2. Compare current at output 1 with this default value.

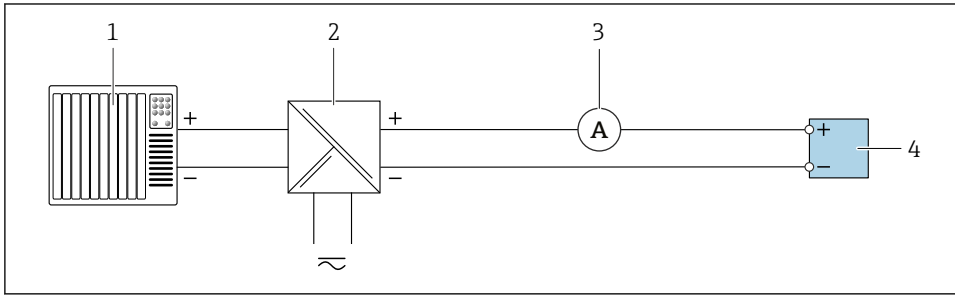
Comparing the current values

The current values are compared using one of the following methods:

1. Measure the current of the DUT at the logic subsystem (process control system or safety-related PLC).
2. Alternatively:
   Measure the current at the DUT using an external, traceably calibrated ammeter.

Connecting the measuring equipment in the measuring circuit and external testing of the passive current output

Requirements for the measuring equipment:
- DC current measuring uncertainty ±0.2 %
- DC current resolution10 µA



1 *External verification of passive current output*

1 Automation system with current input (e.. g. PLC)
2 Power supply unit
3 Ammeter
4 Transmitter

1. Connect the ammeter to the transmitter by looping it in series into the circuit.
2. Connect the power supply unit.

Evaluation of results - Part 2: Testing of current output 1

The amount of deviation between the measured current and the set point must not exceed the measured error specified for the safety function. The deviation should not exceed ±1 % / ±300 µA.

▶ Note data relating to measured error→ 18.

Connecting the test

1. Re-activate the locked SIL mode→ 22.
2. Deactivate bypassing of safety function of process control system.
3. Document results of proof test in accordance with the safety management guidelines applicable to the system.

NOTICE

At least 75 % of dangerous, undetected failures are detected using these test sequences (PTC = 0.75). The influence of systematic errors on the safety function is not fully covered by the test. Systematic faults can be caused, for example, by medium properties, operating conditions, build-up or corrosion.

▶ If one of the test criteria from the test sequences described above is not fulfilled, the device may no longer be used as part of a protective system.
▶ Take measures to reduce systematic errors.

Parameter overview with brief description

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
Current output 1 to n simulation	–	Switch the simulation of the current output on and off.	On	Off
Value current output 1 to n	In the **Current output 1 to n simulation** parameter, the **On** option is selected.	Enter the current value for simulation.	▪ 1. Default value: Select 4.0 mA. ▪ 2. Default value: Select 20.0 mA.	3.59 mA

Proof test 2: Device restart and external Heartbeat Verification

Test method

- Part 1 - Device restart
- Part 2 - External Heartbeat Verification

Preparation

Byassing of safety function of process control system, to prevent accidental activation of the safety function.

▶ Deactivate the locked SIL mode → 27.

Test sequence - Part 1: Device restart

1. Force a restart of the device by disconnecting and reapplying the terminal voltage.
2. Alternatively:
   Open the **Device reset** parameter.
   ↳ Navigation: Setup → Advanced setup → Administration
3. Select **Restart device** option.

The restart resets every parameter for which data is contained in the volatile memory (RAM) to the factory setting (e. g. measured value data). The device configuration remains unchanged.

NOTICE

The "To factory defaults" option and the "To delivery settings" option reset the device configuration to the factory setting!
If one of these two options is selected, the measuring device must be reconfigured.
► In the **Device reset** parameter, select only the **Restart device** option.

Evaluating the results - Part 1: Device restart

► Test restart of device.
↳ After a successful startup, the local display switches automatically from the startup display to the operational display. If the device restarts and no diagnostic message is displayed, this step has been completed successfully.
If nothing appears on the local display or if a diagnostic message is displayed, refer to the section on "Diagnostics and troubleshooting" in the Operating Instructions for the device.

Test sequence - Part 2 - External Heartbeat Verification

The **Heartbeat Verification** application package must be available in order to run this test sequence.

For detailed information on the availability of the application package and how to perform the external verification, see Special Documentation.→ 11

► Perform external verification of the device using Heartbeat Verification in accordance with the information in the associated Special Documentation.

This includes a device verification with testing of the current output by comparing with an external reference.

Evaluation of results - Part 2 - External Heartbeat Verification

1. Verify if the result of the verification is **Pass** or **Fail**.
   ↳ If the result of the external Heartbeat Verification is **Pass**, the test has been completed successfully.
2. To document the test, print the verification report.

Connecting the test

1. Re-activate the locked SIL mode→ 📄 22.
2. Deactivate bypassing of safety function of process control system.
3. Document results of proof test in accordance with the safety management guidelines applicable to the system.

NOTICE

At least 85 % of dangerous, undetected failures are detected using these test sequences (PTC = 0.85). The influence of systematic errors on the safety function is not fully covered by the test. Systematic faults can be caused, for example, by medium properties, operating conditions, build-up or corrosion.

- ▶ If one of the test criteria from the test sequences described above is not fulfilled, the device may no longer be used as part of a protective system.
- ▶ Take measures to reduce systematic errors.

Proof test 3: Testing with a secondary standard

Test method:
Check measured value for liquid and gaseous volume flow by comparing with a secondary standard

Test sequence

The measured values (3 to 5 measuring points) are checked with a secondary standard on an installed device (mobile calibration rig or calibrated reference device) or on a factory calibration rig following device removal.

The measured values of the secondary standard and the device under test (DUT) are compared using one of the following methods:

Comparison by reading off the digital measured value

- ▶ Compare the digital measured value of the secondary standard against the measured value display of the DUT at the logic subsystem (process control system or safety-related PLC).

Comparison of the measured value by measuring the current

Requirements for the measuring equipment:
- DC current measuring uncertainty ±0.2 %
- DC current resolution10 µA

1. Measure the current at the DUT using an external, traceably-calibrated ammeter.
2. Measure the current of the DUT at the logic subsystem (process control system or safety-related PLC).

Evaluation of the results

The amount of deviation between the measured flow rate and the set point must not exceed the measured error specified for the safety function.

► Carefully follow the information in the section on "Restrictions for use in safety-related applications – information on measured errors" → 15.

NOTICE

At least 98 % of dangerous, undetected failures are detected using these test sequences (PTC = 0.98). The influence of systematic errors on the safety function is not fully covered by the test. Systematic faults can be caused, for example, by medium properties, operating conditions, build-up or corrosion.

► If one of the test criteria from the test sequences described above is not fulfilled, the device may no longer be used as part of a protective system.
► Take measures to reduce systematic errors.

Detailed information on:
- Orientation
- Medium properties
- Operating conditions

Operating Instructions→ 10

Proof test 4: Testing with a secondary standard and testing of current output 1

Test method

- Part 1: Testing with a secondary standard
- Part 2 - Testing of current output 1

Preparation

Byassing of safety function of process control system, to prevent accidental activation of the safety function.

► Deactivate the locked SIL mode → 27.

Test sequence - Part 1: Testing with a secondary standard

The measured values (3 to 5 measuring points) are checked with a secondary standard on an installed device (mobile calibration rig or calibrated reference device) or on a factory calibration rig following device removal.

The measured values of the secondary standard and the device under test (DUT) are compared using one of the following methods:

Comparison by reading off the digital measured value

► Compare the digital measured value of the secondary standard against the measured value display of the DUT at the logic subsystem (process control system or safety-related PLC).

Comparison of the measured value by measuring the current

Requirements for the measuring equipment:
- DC current measuring uncertainty ±0.2 %
- DC current resolution10 µA

1. Measure the current at the DUT using an external, traceably-calibrated ammeter.
2. Measure the current of the DUT at the logic subsystem (process control system or safety-related PLC).

Evaluation of results - Part 1: Testing with a secondary standard

The amount of deviation between the measured flow rate and the set point must not exceed the measured error specified for the safety function.

▶ Carefully follow the information in the section on "Restrictions for use in safety-related applications – information on measured errors" → 🖹 15.

Test step - Part 2 - Testing of current output 1

The **Simulation** submenu (Diagnostics → Simulation) enables you to simulate, without a real flow situation, various process variables in the process and the device alarm mode and to verify downstream signal chains (switching valves or closed-control loops).

Performing the test

For proof testing, use only the **Current output simulation** parameter (→ 🖹 32) and the **Value current output** parameter (→ 🖹 32), as these are the only parameters approved for testing the safety-related characteristics.

1. In the **Value current output** parameter, select the defined default values one after the other.
2. Compare current at output 1 with this default value.

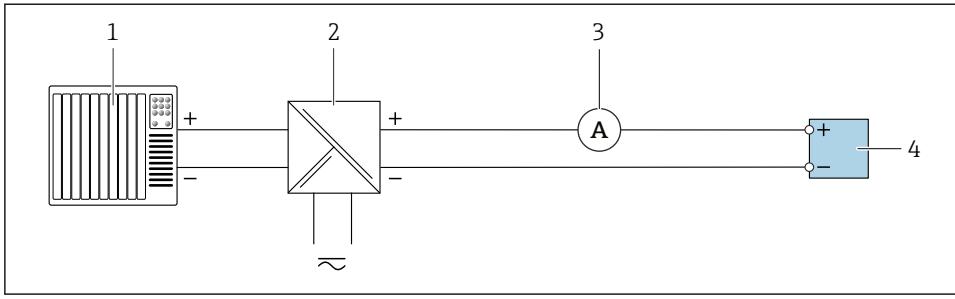
Comparing the current values

The current values are compared using one of the following methods:

1. Measure the current of the DUT at the logic subsystem (process control system or safety-related PLC).
2. Alternatively:
   Measure the current at the DUT using an external, traceably calibrated ammeter.

Connecting the measuring equipment in the measuring circuit and external testing of the passive current output

Requirements for the measuring equipment:
- DC current measuring uncertainty ±0.2 %
- DC current resolution10 µA



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2 *External verification of passive current output*

1 Automation system with current input (e.. g. PLC)
2 Power supply unit
3 Ammeter
4 Transmitter

1. Connect the ammeter to the transmitter by looping it in series into the circuit.
2. Connect the power supply unit.

Evaluation of results - Part 2: Testing of current output 1

The amount of deviation between the measured current and the set point must not exceed the measured error specified for the safety function. The deviation should not exceed ±1 % / ±300 µA.

► Note data relating to measured error→ 18.

Connecting the test

1. Re-activate the locked SIL mode→ 22.
2. Deactivate bypassing of safety function of process control system.
3. Document results of proof test in accordance with the safety management guidelines applicable to the system.

NOTICE

At least 99 % of dangerous, undetected failures are detected using these test sequences (PTC = 0.99). The influence of systematic errors on the safety function is not fully covered by the test. Systematic faults can be caused, for example, by medium properties, operating conditions, build-up or corrosion.

- ▶ If one of the test criteria from the test sequences described above is not fulfilled, the device may no longer be used as part of a protective system.
- ▶ Take measures to reduce systematic errors.

Detailed information on:
- Orientation
- Medium properties
- Operating conditions

Operating Instructions→ 10

Parameter overview with brief description

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
Current output 1 to n simulation	–	Switch the simulation of the current output on and off.	On	Off
Value current output 1 to n	In the **Current output 1 to n simulation** parameter, the **On** option is selected.	Enter the current value for simulation.	▪ 1. Default value: Select 4.0 mA. ▪ 2. Default value: Select 20.0 mA.	3.59 mA

6.3.3 Heartbeat Technology

Heartbeat Technology continuously diagnoses whether failures have occurred. The scope of the diagnostics in the SIL mode corresponds to the SFF.

Heartbeat Technology also allows operators to create documented proof that diagnostic checks have been carried out and thereby supports the documentation of proof testing in accordance with IEC 61511-1, Section 16.3.3, "Documentation of proof testing and inspections".

NOTICE

The SIL mode needs to be disabled temporarily in order to perform heartbeat verification.

- ▶ On completion of the verification, the SIL mode must be enabled again .

The **Heartbeat Verification** application package is available as an order option and can be retrofitted on all measuring devices.

Please contact your Endress+Hauser service or sales organization to retrofit the device.

Performing proof test with **Heartbeat Verification**→ 32

7 Life cycle

7.1 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.

7.2 Installation

7.2.1 Installation and electrical connection

Detailed information on:
- Installation
- Electrical connection
- Medium properties
- Environment
- Process

Operating Instructions and Technical Information → 10

7.2.2 Orientation

For detailed information on the orientation, see the Operating Instructions. → 10

7.3 Commissioning

For detailed information on commissioning, see the Operating Instructions. → 10

7.4 Operation

For detailed information on the operating options, see the Operating Instructions.→ 10

7.5 Maintenance

For detailed information on maintenance, see the Operating Instructions. → 10

Alternative monitoring measures must be taken to ensure process safety during configuration, proof-testing and maintenance work on the device.

7.6 Repair

Repair means restoring functional integrity by replacing defective components. Components of the same type must be used for this purpose. It is recommended to document the repair. This includes specifying the device serial number, the repair date, the type of repair and the individual who performed the repair.

For detailed information on returns, see the Operating Instructions. → 10

7.6.1 Replacing device components

The following components may be replaced by the customer's technical staff if genuine spare parts are used and the appropriate installation instructions are followed:
- Calibrated sensor component
- Transmitter without a sensor
- Display module
- Main electronics module
- I/O-Module
- Terminals for I/O modules
- Electronics compartment cover
- Seal sets for electronics compartment cover
- Securing clamps for electronics compartment cover
- Pressure compensation vent
- Cable glands

Installation Instructions: see the Download Area at www.endress.com.

The replaced component must be sent to Endress+Hauser for the purpose of fault analysis if the device has been operated in a protective system and a device error cannot be ruled out. In this case, always enclose the "Declaration of Hazardous Material and Decontamination" with the note "Used as SIL device in protection system" when returning the defective device. Please also refer to the "Return" section in the Operating Instructions ..

7.7 Modification

Modifications are changes to devices with SIL capability already delivered or installed.
- ▶ Modifications to devices with SIL capability are usually performed in the Endress+Hauser manufacturing center.
- ▶ Modifications to devices with SIL capability onsite at the user's plant are possible following approval by the Endress+Hauser manufacturing center. In this case, the modifications must be performed and documented by an Endress+Hauser service technician.
- ▶ Modifications to devices with SIL capability by the user are not permitted.

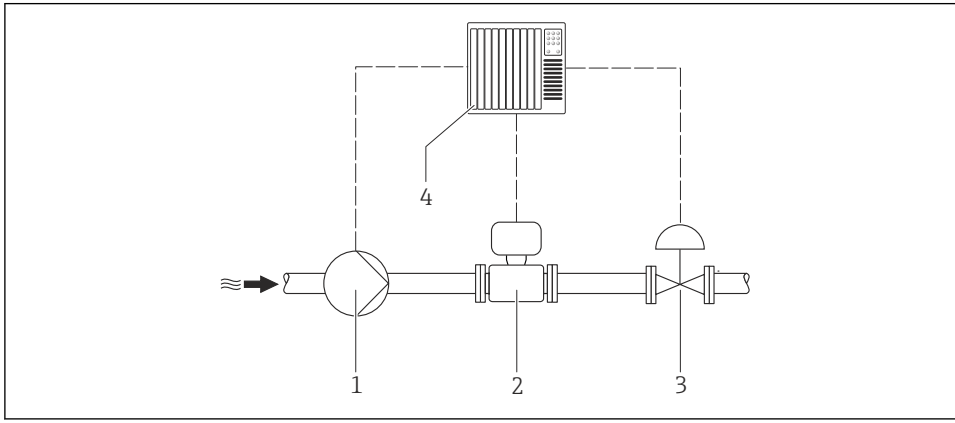
7.8 Decommissioning

For detailed information on decommissioning, see the Operating Instructions for the device → 10

8 Appendix

8.1 Structure of the measuring system

8.1.1 System components



3 System components

1 Pump
2 Measuring device
3 Valve
4 Automation system

An analog signal (4–20 mA) proportional to the volume flow is generated in the transmitter. This is sent to a downstream automation system where it is monitored to determine whether it falls below or exceeds a specified limit value. The safety function (volume flow monitoring) is implemented in this way.

8.1.2 Description of use of protective system

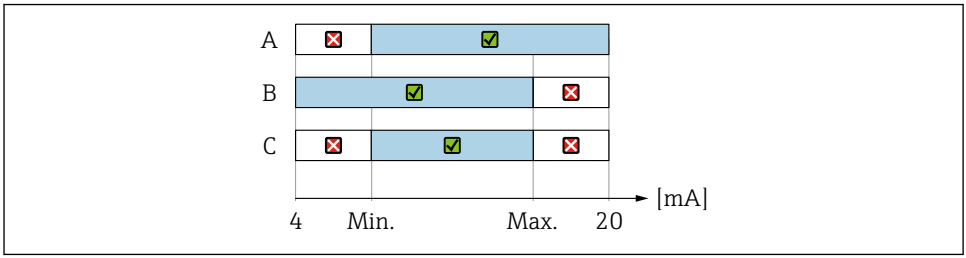
The measuring device can be used in protective systems to monitor the following (Min., Max. and range):
Volume flow

NOTICE

The device must be correctly mounted to guarantee safe operation.

► Observe the mounting instructions.

For detailed information on mounting, see the Operating Instructions → 10



4 *Monitoring options in protective systems*

A Min. alarm
B Max. alarm
C Range monitoring

☒ = *Safety function is triggered*

☑ = *Permitted operating status*

8.2 Verification or calibration

The SIL mode must be disabled in order to verify the measuring point with Heartbeat Technology or calibrate the measuring point.

NOTICE

To use the device in a safety function again following a verification or calibration, the configuration of the measuring point must be checked and the SIL mode must be enabled again.

► Activation of the SIL mode → 22.

8.3 Notes on the redundant use of multiple sensors

This section provides additional information regarding the use of homogeneously redundant sensors e.g. 1oo2 or 2oo3 architectures.

The common cause factors β and β_D indicated below are minimum values for the device. These must be used when designing the sensor subsystem:
- Minimum value β for homogeneously redundant use: 2 %
- Minimum value β_D for homogeneously redundant use: 1 %

The device meets the requirements for SIL 3 in homogeneously redundant applications. When installing identical sensors, i.e. the same type and nominal diameter, the sensors must not be connected directly flange to flange but at different locations in the pipe. This is to prevent the sensors from affecting each other acoustically.

NOTICE

Note the following if a fault is detected in one of the redundantly operated devices during the proof test:

► Check the other devices to see if the same fault occurs there.

8.4 Version history

SD02025D/06/EN/01.18		
Release date	**Order code for "Firmware version"**	**Firmware version**
01.2018	Option 72	01.03.zz
Firmware changes	**Hardware version**	**Associated Operating Instructions**
▪ Support for "mass (integrated pressure/ temperature measurement)" order option ▪ Upgrade to **Heartbeat Technology** application package ▪ Permanent activation of **natural gas, air and industrial gases** application packages ▪ Extension of low flow cut off ▪ Extension of measuring range for steam ▪ Extension of two-phase measurement	▪ Valid for hardware from delivery date 10.2013 ▪ All previous changes to the hardware since 10.2013 do not result in any changes to the safety-related characteristics→ 🖹 5.	▪ BA01685D/06/EN/ 01.18 ▪ BA01686D/06/EN/ 01.18 ▪ BA01687D/06/EN/ 01.18 ▪ BA01688D/06/EN/ 01.18

It is possible to flash the firmware to the current version or the previous version using the service interface.

For the compatibility of the firmware version with the previous version, the installed device description files and operating tools, observe the information about the device in the "Manufacturer's information" document.

The manufacturer's information is available:
- In the Download Area of the Endress+Hauser web site: www.endress.com → Downloads
- Specify the following details:
  - Product root: e.g. 7F2C
    The product root is the first part of the order code: see the nameplate on the device.
  - Text search: Manufacturer's information
  - Media type: Documentation – Technical Documentation

www.addresses.endress.com

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