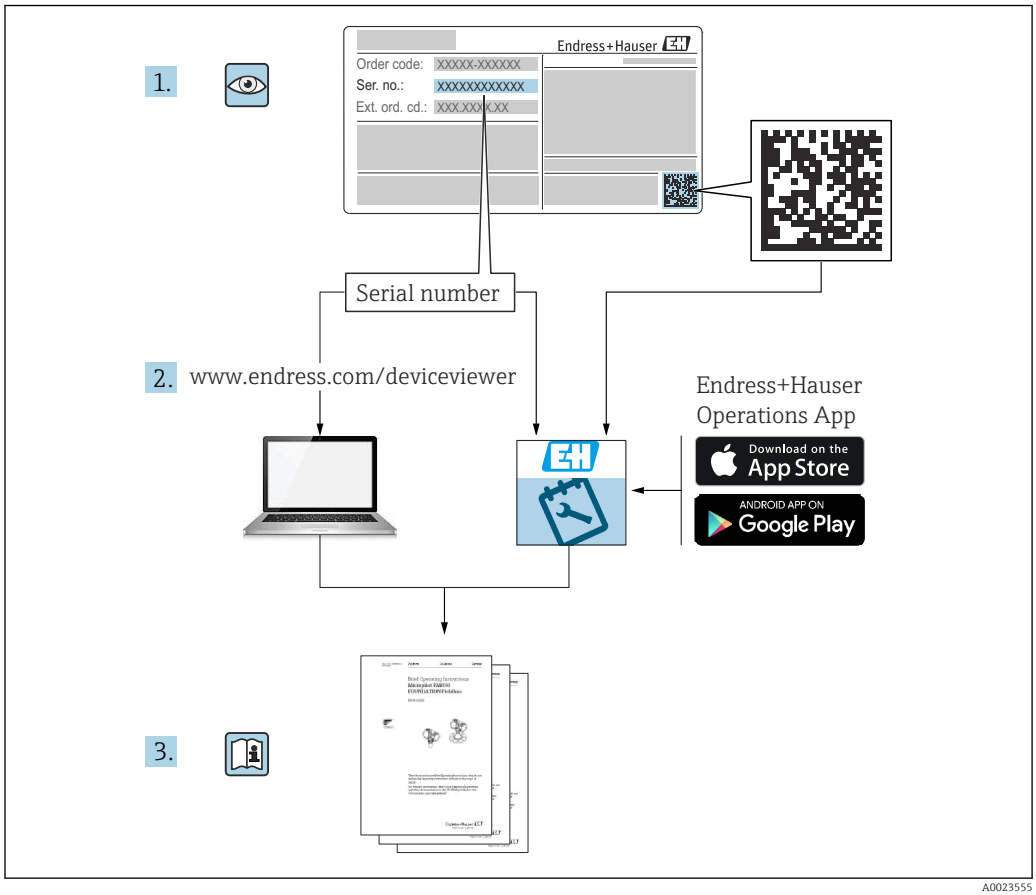
FY01050P/00/EN/01.21
71543538
2021-08-02

02.00.zz (Device firmware)

Functional Safety Manual
Deltabar S FMD77

Pressure and differential pressure measurement, level and flow measurement with 4-20 mA output signal

Endress+Hauser
People for Process Automation


1.
Endress+Hauser
Order code: XXXXX-XXXXXX
Ser. no.: XXXXXXXXXXX
Ext. ord. cd.: XXX XXX XX
Serial number
2. www.endress.com/deviceviewer
Endress+Hauser
Operations App
Download on the App Store
ANDROID APP ON Google Play
3.
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1 Declaration of Conformity

SIL_00458_01.21

Endress+Hauser
People for Process Automation

Declaration of Conformity

Functional Safety according to IEC 61508
Based on NE 130 Form B.1

Endress+Hauser SE+Co. KG, Hauptstraße 1, 79689 Maulburg

being the manufacturer, declares that the product

Deltabar S FMD77

is suitable for the use in safety-instrumented systems according to IEC 61508. The instructions of the corresponding functional safety manual must be followed.

This declaration of compliance is exclusively valid for the listed products and accessories in delivery status.

Maulburg, 07/07/2021
Endress+Hauser SE+Co. KG

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1.1 Safety-related characteristic values

In various applications, the operation of pressure or differential pressure transmitters at overpressure (outside the measuring range, < MWP) or low pressure is not critical.

The state of the processes must be assessed and the various parameters must be taken into consideration.

- Low pressure or overpressure not dangerous → message E727 pressure overrange = Warning
- Low pressure or overpressure dangerous → message E727 pressure overrange = Alarm

Depending on the configuration profile selected for the messages, different parameters must be considered when assessing the facility:

- Message E727 pressure overrange = Alarm → parameter profile A applies
- Message E727 pressure overrange = Warning → parameter profile B applies

Parameter profiles A and B depend on the alarm settings and not on the firmware version. For firmware versions up to and including firmware version 02.20.04, message E727 was set, as a rule, to "Alarm" for SIL locking with increased security during parameter entry. With firmware version 02.30.zz and higher, the settings for message E727 remain unchanged.

SIL_00458_01.21

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General

Device designation and permissible types [1]	FMD77-# x # ## # # # # # E # x = A,B,C,D,E,F FMD77-# x # ## # # # # # # E x = A,B,C,D,E,F Parameter profile A with message E727 (pressure overrange) configured as an alarm		
Safety-related output signal	4...20 mA		
Fault signal	≤ 3,6 mA ; ≥ 21,0 mA		
Process variable/function	Pressure, differential pressure, level and flow measurement		
Safety function(s)	MIN , MAX , RANGE		
Device type acc. to IEC 61508-2	☐ Type A	☒ Type B	
Operating mode	☒ Low Demand Mode	☐ High Demand Mode	☐ Continuous Mode
Valid hardware version	As of 02.00, Manufacturing date after 01.10.2018		
Valid software version	As of 02.0y; 02.30.zz recommended		
Safety manual	FY01050P		
Type of evaluation (check only one box)	☒	Complete HW/SW evaluation parallel to development incl. FMEDA and change request acc. to IEC 61508-2, 3	
	☐	Evaluation of "proven in use" performance for HW/SW incl. FMEDA and change request acc. to IEC 61508-2, 3	
	☐	Evaluation of HW/SW field data to verify „prior use" acc. to IEC 61511	
	☐	Evaluation by FMEDA acc. to IEC 61508-2 for devices w/o software	
Evaluation through – report/certificate no.	TÜV SÜD Rail GmbH Z10 020351 0010		
Test documents	Development documents	Test reports	Data sheets

SIL - Integrity

Systematic safety integrity		☐ SIL 2 capable	☒ SIL 3 capable
Hardware safety integrity	Single channel use (HFT = 0)	☒ SIL 2 capable	☐ SIL 3 capable
	Multi channel use (HFT ≥ 1)	☐ SIL 2 capable	☒ SIL 3 capable

FMEDA

Safety function	MIN	MAX	RANGE
λ_{DU} [2),3)]	58 FIT	58 FIT	58 FIT
λ_{DD} [2),3)]	367 FIT	50 FIT	0 FIT
λ_{SU} [2),3)]	431 FIT	431 FIT	431 FIT
λ_{SD} [2),3)]	50 FIT	367 FIT	417 FIT
SFF	94 %	94 %	94 %
PFD_{avg} (T_1 = 1 year) [3)] (single channel architecture)	2.5×10^{-4}	2.5×10^{-4}	2.5×10^{-4}
PFH	5.8×10^{-8} 1/h	5.8×10^{-8} 1/h	5.8×10^{-8} 1/h
PTC [4)]	A: 50 % / B: 99 %	A: 50 % / B: 99 %	A: 50 % / B: 99 %
λ_{total} [2,3)]	906 FIT	906 FIT	906 FIT
Diagnostic test interval [5)]	5 min (RAM,ROM...), 1 s (Measurement)	5 min (RAM,ROM...), 1 s (Measurement)	5 min (RAM,ROM...), 1 s (Measurement)
Fault reaction time [6)]	5 min (RAM,ROM...), 10 s (Measurement)	5 min (RAM,ROM...), 10 s (Measurement)	5 min (RAM,ROM...), 10 s (Measurement)

Comments

-

Declaration

☒	Our internal company quality management system ensures information on safety-related systematic faults which become evident in the future

[1)] Valid order codes and order code exclusions are maintained in the E+H ordering system
[2)] FIT = Failure In Time, number of failures per 10^9 h
[3)] Valid for average ambient temperature up to +40 °C (+104 °F)
For continuous operation at ambient temperature close to +60 °C (+140 °F), a factor of 2.1 should be applied
[4)] PTC = Proof Test Coverage
[5)] All diagnostic functions are performed at least once within the diagnostic test interval
[6)] Maximum time between error recognition and error response

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Endress+Hauser
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General			
Device designation and permissible types [1]	FMD77-# x # ## # # # # # E # x = A,B,C,D,E,F FMD77-# x # ## # # # # # # E x = A,B,C,D,E,F Parameter profile B with message E727 (pressure overrange) configured as a warning		
Safety-related output signal	4...20 mA		
Fault signal	≤ 3,6 mA ; ≥ 21,0 mA		
Process variable/function	Pressure, differential pressure, level and flow measurement		
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FMEDA			
Safety function	MIN	MAX	RANGE
λ_{DU} [2),3)]	78 FIT	78 FIT	78 FIT
λ_{DD} [2),3)]	347 FIT	50 FIT	0 FIT
λ_{SU} [2),3)]	431 FIT	431 FIT	431 FIT
λ_{SD} [2),3)]	50 FIT	347 FIT	397 FIT
SFF	91 %	91 %	91 %
PFD_{avg} (T_1 = 1 year) [3)] (single channel architecture)	3.4×10^{-4}	3.4×10^{-4}	3.4×10^{-4}
PFH	7.8×10^{-8} 1/h	7.8×10^{-8} 1/h	7.8×10^{-8} 1/h
PTC [4)]	A: 50 % / B: 99 %	A: 50 % / B: 99 %	A: 50 % / B: 99 %
λ_{total} [2,3)]	906 FIT	906 FIT	906 FIT
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Comments
-

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[4)] PTC = Proof Test Coverage
[5)] All diagnostic functions are performed at least once within the diagnostic test interval
[6)] Maximum time between error recognition and error response

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2 About this document

2.1 Document function

This supplementary Safety Manual applies in addition to the Operating Instructions, Technical Information and ATEX Safety Instructions. The supplementary device documentation must be observed during installation, commissioning and operation. The requirements specific for the protection function are described in this Safety Manual.

General information on functional safety (SIL) is available at:
- www.endress.com/SIL
- WP01032F, Whitepaper "Functional Safety in practice"

2.2 Symbols used

2.2.1 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.

2.2.2 Symbols for certain types of information and graphics

Tip
Indicates additional information

Reference to documentation

Reference to graphic

▶
Notice or individual step to be observed

1., 2., 3.
Series of steps

Result of a step

1, 2, 3, ...
Item numbers

A, B, C, ...
Views

2.3 Supplementary device documentation

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

The following document types are available in the Downloads section of the Endress+Hauser website (www.endress.com/downloads):

2.3.1 Further applicable documents

- TI00382P
- BA00270P
- KA00218P
- KA01018P
- BA00274P (Description of Device Functions)
- FY01038P

2.3.2 Technical Information (TI)

Planning aid
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.

2.3.3 Operating Instructions (BA)

Your reference guide
These Operating Instructions contain all the information that is required in 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.

2.3.4 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.

2.3.5 Functional Safety Manual for diaphragm seal (FY)

This document is a supplement to the Functional Safety Manuals for pressure transmitters or differential pressure transmitters if these transmitters are fitted with diaphragm seals. It provides an overview of the safety-related characteristic values of the diaphragm seals and explains how they must be combined with the values of the basic units. The document also contains instructions and conditions that apply for the devices fitted with diaphragm seals.

2.3.6 Certificate

The associated certificate is available in the Endress+Hauser W@M Device Viewer or can be found in the declaration of conformity of the applicable Functional Safety Manual. This certificate must be valid at the time of delivery of the device.

3 Design

3.1 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 firmware 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.

Any exemptions from possible combinations of features are saved in the Endress +Hauser ordering system.

Valid device versions for safety-related use:

3.1.1 Order codes

Deltabar S FMD77

Feature: 010 "Approval"
Version: all

Feature: 020 "Output; Operation"
Version:
- A: 4-20mA HART; extern. + LCD
- B: 4-20mA HART; inside + LCD
- C: 4-20mA HART; inside
- D: 4-20mA HART; Li=0 extern. + LCD
- E: 4-20mA HART; Li=0 inside + LCD
- F: 4-20mA HART; Li=0 inside

Feature: 030 "Housing; Cover sealing; Cable entry"
Version: all

Feature: 040 "Nominal range; Cell material; PN"
Version: all

Feature: 050 "Calibration; Unit"
Version: all

Feature: 060 "Membrane material"
Version: all

Feature: 070 "Process connection, LP side; Seal"
Version: all

Feature: 080 "Process connection, high-pressure side"
Version: all

Feature: 090 "Fill fluid"
Version: all

Feature: 100 "Additional option 1"
Version: E; SIL

Feature: 110 "Additional option 2"
Version: E; SIL

Valid firmware version: from 02.00.zz (→ nameplate of the device)

Valid hardware version (electronics): from 02.00.ww, date of manufacture after 1 October 2018 (→ device nameplate)

3.2 Identification marking

SIL-certified devices are marked with the SIL logo SIL on the nameplate.

3.3 Safety function

The device's safety functions are:
- Minimum, maximum or range monitoring
- Absolute pressure measurement
- Gauge pressure measurement
- Differential pressure measurement

The assessment of the functional safety of a device includes the basic unit with the main electronics, sensor electronics and sensor up to the sensor diaphragm and the process connection mounted directly on the device. The process adapter, diaphragm seal and mounted/enclosed accessories were not taken into account in the rating. The requirements for the operation of diaphragm seals in safety instrumented functions are described in the Functional Safety Manual (FY01038P) pertaining to the device.

3.3.1 Safety-related output signal

The device's safety-related signal is the 4 to 20 mA analog output signal as per NAMUR NE43. All safety measures refer to this signal exclusively. The device additionally communicates for information only via HART and contains all HART features with additional device information. HART communication is not part of the safety function. The behavior of the output current in the event of a fault depends on the settings for the alarms and warnings. The safety-related output signal is fed to a downstream logic unit, e.g. a programmable logic controller or a limit signal transmitter, where it is monitored to determine whether:

- it exceeds and/or drops below a predefined limit value
- a fault has occurred, e.g. failure current (≤3.6 mA, ≥21.0 mA, signal cable open circuit or short-circuit).

NOTICE

In an alarm condition

▶ Ensure that the equipment under control achieves or maintains a safe state.

The following dangerous undetected failures can occur in the devices:
- An incorrect output signal that deviates from the real measured value by more than 1 %, but is still in the 4 to 20 mA or 3.8 to 20.5 mA range
- A settling time that is delayed by more than the specified settling time plus tolerance

For fault monitoring, the logic unit must be able to detect both HI alarms (≥21 mA) and LO alarms (≤3.6 mA).

The transmitter output is not safety-oriented during the following activities:
- Configuration changes
- Multidrop
  - with SW version < 02.20 if the "Bus address (345)" parameter is set to ≠ "0".
  - with SW version ≥ 02.20 if the "Current mode (052)" parameter is set to "Fixed" (local display and FieldCare) or "Disabled" (HART handheld terminal).
- Simulation
- Proof testing

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

3.3.2 Redundant configuration of multiple sensors

With redundant configuration with HFT = 1 (e.g. 1oo2 or 2oo3 architecture), the device meets the requirements for SIL 3.

The common cause factors ß and $ß_D$ indicated in the table below are minimum values for the device. These values should be used when calculating the failure probability of redundantly connected devices according to IEC 61508-6. The plant-specific assessment

can return higher values depending on the particular installation and the use of other components (e.g. Ex barrier).

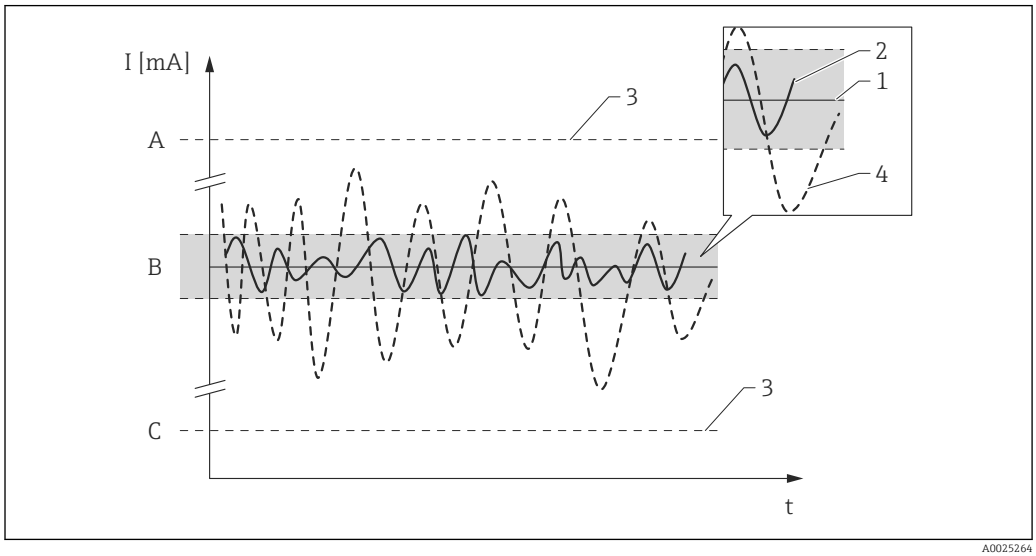
Minimum value ß with homogeneous redundant use	5 %
Minimum value $ß_D$ with homogeneous redundant use	2 %

3.4 Basic conditions for use in safety-related applications

The measuring system must be used correctly for the specific application, taking into account the medium properties and ambient conditions. Carefully follow instructions pertaining to critical process situations and installation conditions from the Operating Instructions. The application-specific limits must be observed. The specifications in the Operating Instructions and the Technical Information must not be exceeded.

3.4.1 Safety-related failures according to IEC / EN 61508

Safety-related error	**Explanation**	**Implications for the safety related output signal**	**Implications for measuring uncertainty (see item number in graphic below)**	
No device error	Safe: SD No error	None	1	Is within the specification (see TI, BA, ...)
λ_S	Safe failure	Causes the output signal to signal the failsafe mode	3	No implications
λ_S	Safe failure	Is within the defined error range	2	May be outside specifications
λ_{DD}	Dangerous detected: Dangerous failure which can be detected (diagnostic at the device)	Causes the output signal to signal the failsafe mode	3	No implications
λ_{DU}	Dangerous undetected: Dangerous failure which cannot be detected	May be outside the defined error range	4	May be outside the defined error range



A Hi-Alarm ≥ 21 mA
B Error range ± 1 %
C Lo-Alarm ≤ 3.6 mA

3.4.2 Safety measured error

The total deviations with regard to the safety-related current output are composed of:
- Measured errors under reference operating conditions: as per Technical Information
- Measured errors due to process/installation/ambient conditions: as per Technical Information
- Measured errors due to ambient conditions (EMC): ±0.5 % based on the span of the safety-related current output
  Strong, pulse-like EMC interference on the power supply line can result in transient (< 1 s) deviations in the output signal (≥ ±1 % based on the span of the safety related current output). Therefore, filtering with a time constant ≥ 1 s should be performed in the downstream logic unit.
- Measured errors due to random component failures (SIL error range): ±1 % based on the span of the safety-related current output

3.4.3 Restrictions for safety-related operation

- Device warm-up time: after device warm-up, the safety functions are available after a 30 Sekunden initialization period.
- If the device is operated locally without a display and without an operating tool or without a HART communicator, it cannot be safely configured because the user cannot perform a visual check. In both these situations, communication via HART alone is not sufficient.
- The device must be locked after parameter configuration.
- When the device is used as a subsystem of a safety function, the "Hold measured value" setting in the "Output fail mode (388)" parameter and the Multidrop mode may not be selected as this option does not guarantee a failsafe alarm.
- A complete function test of the safety-related functions must be carried out during commissioning.
- The maximum interval for proof testing (proof test interval) is 5 Jahre.
- Faulty devices must be replaced as soon as possible to minimize the possibility of multiple errors occurring. The failure probabilities indicated in this Functional Safety Manual are based on a medium time to repair (MTTR) of 8 Stunden.

3.5 Dangerous undetected failures in this scenario

An incorrect output signal that deviates from the real measured value by more than 1 %, but is still in the 4 to 20 mA range, is considered a dangerous, undetected failure.

3.6 Useful lifetime of electric components

The established failure rates of electrical components apply within the useful lifetime as per IEC 61508-2:2010 section 7.4.9.5 note 3.

According to DIN EN 61508-2:2011 section 7.4.9.5 (national footnote N3) appropriate measures taken by the operator can extend the useful lifetime.

4 Commissioning (installation and configuration)

4.1 Requirements for 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.
- Personnel must be authorized by the plant owner/operator.
- Be familiar with federal/national regulations.
- Before starting work: personnel must read and understand the instructions in the manual and supplementary documentation as well as the certificates (depending on the application).
- Personnel must follow instructions and comply with general policies.

The operating personnel must fulfill the following requirements:

- Personnel are instructed and authorized according to the requirements of the task by the facility's owner-operator.
- Personnel follow the instructions in this manual.

4.2 Installation

The mounting and wiring of the device and the permitted orientations are described in the Operating Instructions pertaining to the device.

Correct installation is a prerequisite for safe operation of the device.

4.3 Commissioning

The commissioning of the device is described in the Operating Instructions pertaining to the device.

Prior to operating the device in a safety instrumented system, verification must be performed by carrying out a test sequence as described in Section **6 Proof testing**.

4.4 Operation

The operation of the device is described in the Operating Instructions pertaining to the device.

4.5 Device configuration for safety-related applications

4.5.1 Calibration of the measuring point

For more information, see the Operating Instructions.

4.5.2 Configuration methods

Increased security during parameter entry

The following conditions are permitted and recommended for devices without a local display that are to be used in process control safety systems:
- Via the FieldCare/DeviceCare operating program and DTM with firmware version ≥ 02.10
- Via the Field Communicator handheld terminal and Device Description with device revision ≥ 21

This parameter configuration method is a software function implemented in the device and comprises automated parameter confirmation and device locking.

Parameter configuration via local display

1. Reset parameters to factory setting: reset code "7864" (see the associated Operating Instructions, "Resetting to factory setting (reset)" section). Check default values, number formats and parameter descriptions with the "Device parameter configuration report".
2. Configure the device.
3. Enter the settings for the following parameters according to the report, since these settings are queried for safe device configuration.

Parameter	Available in the operating mode			Group
	Pressure	Level, level selection "Level easy pressure"	Flow [1]	
ACK. ALARM MODE	X	X	X	MESSAGES
CALIB. OFFSET	X	X	X	POSITION ADJUST.
MEASURING MODE	X	X	X	MEASURING MODE
EMPTY PRESSURE		X		BASIC SETUP
EMPTY CALIB.		X		BASIC SETUP
FULL PRESSURE		X		BASIC SETUP
FULL CALIB.		X		BASIC SETUP
MAX. FLOW			X	BASIC SETUP
MAX PRESS. FLOW			X	BASIC SETUP
LOW FLOW CUT-OFF			X	EXTENDED SETUP
SET.L.FL.CUT-OFF			X	EXTENDED SETUP
LINEAR/SQROOT			X	EXTENDED SETUP
SET LRV	X	X	X	BASIC SETUP
SET URV	X	X	X	BASIC SETUP
DAMPING VALUE	X	X	X	BASIC SETUP
OUTPUT FAIL MODE [2]	X	X	X	OUTPUT
SET MIN. CURRENT [2]	X	X	X	OUTPUT

Parameter	Available in the operating mode			Group
	Pressure	Level, level selection "Level easy pressure"	Flow [1]	
SET MAX. ALARM [2]	X	X	X	OUTPUT
E727 P.OVERRANGE [2]	X	X	X	OUTPUT

1) Not for options with 160/250 bar (2320/3625 psi) measuring range
2) From firmware version ≥2.30

The EMPTY PRESSURE and FULL PRESSURE parameters are only displayed for the "Dry" CALIBRATION MODE. If you have performed a wet calibration, you must subsequently select the "Dry" option via the CALIBRATION MODE parameter. You can read out the corresponding values for the EMPTY PRESSURE and FULL PRESSURE parameters here.

4. Switch the device off and then on again. This ensures that the parameter settings are saved.
5. Check the safety function.
6. Select the "SAFETY CONFIRM." group (menu path: (GROUP SELECTION→) OPERATING MENU → SAFETY CONFIRM.)
7. Select the "Lock" option. Select the "Lock" option via the SAFETY LOCK parameter. The status "Locked" or "Unlocked" is indicated on the fourth line of the display.
8. Enter the password via the SAFETY PASSWORD parameter (password: 7452)

For firmware version ≤02.20.04

- If the correct password is entered, the following parameters are reset to the factory values (→ Step 10 for factory values):
  - CURRENT CHARACT.
  - OUTPUT FAIL MODE
  - ALT. CURR. OUTPUT
  - SET MAX. ALARM
  - SET MIN. CURRENT
  - SIMULATION
  - ALARM DELAY
  - ALARM DISPLAY TIME
  - SELECT ALARM TYPE
- Any simulation which may be running is ended
- The configurable messages ("Error"-type messages) 115, 120, 620, 715, 717, 718, 720, 726 and 727 are automatically set to "Alarm" ("Messages" section of the relevant Operating Instructions)

For firmware version ≥02.30.zz

- Any simulation which may be running is ended
- No parameters are reset

Log the following confirmed settings according to the "Device parameter configuration report".

9. Via the DIGIT SETS parameter, the user can check whether the characters and digits are displayed correctly on the user interface. "0123456789.-" is shown if everything is displayed correctly. Options: Valid: Select this option if the string of characters and digits is displayed correctly. Not valid: Select this option if the string of characters and digits is not displayed correctly. In this case, operation in the safe measuring mode is not possible. The confirmation sequence is cancelled.

10. Only for firmware version ≤02.20.04: Via the OUTPUT CURRENT parameter, the user can check whether the following parameters are correctly reset to the factory values. If reset correctly, the OUTPUT CURRENT parameter displays "LinMaxNorm/22/3.8/0s".

Factory values:
- CURRENT CHARACT.: Linear
- OUTPUT FAIL MODE: Max. alarm
- ALT. CURR. OUTPUT: Normal
- SET MAX. ALARM: 22 mA
- SET MIN. CURRENT: 3.8 mA
- ALARM DELAY: 0.0 s
- ALARM DISPLAY TIME: 0.0 s

Options:
- Valid: Select this option if the factory values displayed correspond to the desired values. The device continues to interrogate the safety-related parameters.
- Not valid: Select this option if the factory values displayed do not correspond to the desired values. In this case, operation in the safe measuring mode is not possible. The SAFETY LOCK parameter displays the status "Unlocked". The confirmation sequence is cancelled.

11. Depending on the selected operating mode, the following parameters must be confirmed:

For firmware version ≤02.20.04
- ACK. ALARM MODE
- CALIB. OFFSET
- MEASURING MODE
- EMPTY PRESSURE (only Level operating mode)
- EMPTY CALIB. (only Level operating mode)
- FULL PRESSURE (only Level operating mode)
- FULL CALIB. (only Level operating mode)
- MAX. FLOW (only Flow operating mode)
- MAX PRESS. FLOW (only Flow operating mode)
- LOW FLOW CUT-OFF (only Flow operating mode)
- SET.L.FL.CUT-OFF (only Flow operating mode)
- LINEAR/SQROOT (only Flow operating mode)
- SET LRV
- SET URV
- DAMPING VALUE

For firmware version ≥02.30.zz
- ACK. ALARM MODE
- CALIB. OFFSET
- MEASURING MODE
- EMPTY PRESSURE (only Level operating mode)
- EMPTY CALIB. (only Level operating mode)
- FULL PRESSURE (only Level operating mode)
- FULL CALIB. (only Level operating mode)
- MAX. FLOW (only Flow operating mode)
- MAX. FLOW (only Flow operating mode)
- LOW FLOW CUT-OFF (only Flow operating mode)
- SET.L.FL.CUT-OFF (only Flow operating mode)
- LINEAR/SQROOT (only Flow operating mode)
- SET LRV
- SET URV
- DAMPING VALUE
- OUTPUT FAIL MODE

- SET MIN. CURRENT
- SET MAX. ALARM
- E727 P.OVERRANGE

The value saved is indicated on the fourth line of the local display.

Options:
- Valid: Select this option if the entered value or the desired value is displayed. The device continues to interrogate the safety-related parameters.
- Not valid: Select this option if an incorrect value or a value that was not entered is displayed. In this case, operation in the safe measuring mode is not possible. The SAFETY LOCK parameter displays the status "Unlocked". The confirmation sequence is cancelled.

12. Once the safety-related parameters have been successfully interrogated, the password "7452" must be entered again via the CONF. PASSWORD parameter. Afterwards, the device is locked for the safe measuring mode. The SAFETY LOCK parameter displays the status "Locked". This locking has the highest priority and can only be disabled via the SAFETY LOCK and SAFETY PASSWORD parameters.

Parameter configuration via Field Communicator 375/475 handheld terminal

1. Go to "Main Menu" → "HART Communication" → "HART-Application" → "Online". The device is then found automatically and opened online. Ensure that the device bus address = 0.
2. Ensure that the connection has been made with the correct device. This can be done using the "Measuring point" parameter, the extended order number or the serial number.
3. Reset parameters to factory setting: reset code "7864" (see the associated Operating Instructions, "Resetting to factory setting (reset)" section). Check default values, number formats and parameter descriptions with the "Device parameter configuration report".
4. Configure the device.
5. Enter the settings for the following parameters according to the report, since these settings are queried for safe device configuration.

Parameter	Available in the operating mode			Group
	Pressure	Level, level selection "Level easy pressure"	Flow [1)]	
ACK. ALARM MODE	X	X	X	MESSAGES
CALIB. OFFSET	X	X	X	POSITION ADJUST.
MEASURING MODE	X	X	X	MEASURING MODE
EMPTY PRESSURE		X		BASIC SETUP
EMPTY CALIB.		X		BASIC SETUP
FULL PRESSURE		X		BASIC SETUP
FULL CALIB.		X		BASIC SETUP
MAX. FLOW			X	BASIC SETUP
MAX PRESS. FLOW			X	BASIC SETUP
LOW FLOW CUT-OFF			X	EXTENDED SETUP
SET.L.FL.CUT-OFF			X	EXTENDED SETUP
LINEAR/SQROOT			X	EXTENDED SETUP
SET LRV	X	X	X	BASIC SETUP
SET URV	X	X	X	BASIC SETUP

Parameter	Available in the operating mode			Group
	Pressure	Level, level selection "Level easy pressure"	Flow [1]	
DAMPING VALUE	X	X	X	BASIC SETUP
OUTPUT FAIL MODE [2]	X	X	X	OUTPUT
SET MIN. CURRENT	X	X	X	OUTPUT
SET MAX. ALARM	X	X	X	OUTPUT
E727 P.OVERRANGE	X	X	X	OUTPUT

1) Not for options with 160/250 bar (2320/3625 psi) measuring range
2) From firmware version ≥2.30

The EMPTY PRESSURE and FULL PRESSURE parameters are only displayed for the "Dry" CALIBRATION MODE. If you have performed a wet calibration, you must subsequently select the "Dry" option via the CALIBRATION MODE parameter. You can read out the corresponding values for the EMPTY PRESSURE and FULL PRESSURE parameters here.

6. Switch the device off and then on again. This ensures that the parameter settings are saved.
7. Check the safety function.
8. Close the Field Communicator 375/475 handheld terminal. Then connect to the device again.
9. Select the "SAFETY CONFIRM." group (menu path: (GROUP SELECTION→) OPERATING MENU → SAFETY CONFIRM.)
10. Select the "Lock" option. Select the "Lock" option via the SAFETY LOCK parameter. The status "Locked" or "Unlocked" is indicated on the fourth line of the display.
11. Enter the password via the SAFETY PASSWORD parameter (password: 7452)

For firmware version ≤02.20.04

- If the correct password is entered, the following parameters are reset to the factory values (→ Step 10 for factory values):
  - CURRENT CHARACT.
  - OUTPUT FAIL MODE
  - ALT. CURR. OUTPUT
  - SET MAX. ALARM
  - SET MIN. CURRENT
  - SIMULATION
  - ALARM DELAY
  - ALARM DISPLAY TIME
  - SELECT ALARM TYPE
- Any simulation which may be running is ended
- The configurable messages ("Error"-type messages) 115, 120, 620, 715, 717, 718, 720, 726 and 727 are automatically set to "Alarm" ("Messages" section of the relevant Operating Instructions)

For firmware version ≥02.30.zz

- Any simulation which may be running is ended
- No parameters are reset

Log the following confirmed settings according to the "Device parameter configuration report".

12. Via the DIGIT SETS parameter, the user can check whether the characters and digits are displayed correctly on the user interface. "0123456789.-" is shown if everything is displayed correctly. Options: Valid: Select this option if the string of characters and digits is displayed correctly. Not valid: Select this option if the string of characters and digits is not displayed correctly. In this case, operation in the safe measuring mode is not possible. The confirmation sequence is cancelled.
13. Only for firmware version ≤02.20.04: Via the OUTPUT CURRENT parameter, the user can check whether the following parameters are correctly reset to the factory values. If reset correctly, the OUTPUT CURRENT parameter displays "LinMaxNorm/22/3.8/0s".

Factory values:
- CURRENT CHARACT.: Linear
- OUTPUT FAIL MODE: Max. alarm
- ALT. CURR. OUTPUT: Normal
- SET MAX. ALARM: 22 mA
- SET MIN. CURRENT: 3.8 mA
- ALARM DELAY: 0.0 s
- ALARM DISPLAY TIME: 0.0 s

Options:
- Valid: Select this option if the factory values displayed correspond to the desired values. The device continues to interrogate the safety-related parameters.
- Not valid: Select this option if the factory values displayed do not correspond to the desired values. In this case, operation in the safe measuring mode is not possible. The SAFETY LOCK parameter displays the status "Unlocked". The confirmation sequence is cancelled.

14. Depending on the selected operating mode, the following parameters must be confirmed:

For firmware version ≤02.20.04
- ACK. ALARM MODE
- CALIB. OFFSET
- MEASURING MODE
- EMPTY PRESSURE (only Level operating mode)
- EMPTY CALIB. (only Level operating mode)
- FULL PRESSURE (only Level operating mode)
- FULL CALIB. (only Level operating mode)
- MAX. FLOW (only Flow operating mode)
- MAX PRESS. FLOW (only Flow operating mode)
- LOW FLOW CUT-OFF (only Flow operating mode)
- SET.L.FL.CUT-OFF (only Flow operating mode)
- LINEAR/SQROOT (only Flow operating mode)
- SET LRV
- SET URV
- DAMPING VALUE

For firmware version ≥02.30.zz
- ACK. ALARM MODE
- CALIB. OFFSET
- MEASURING MODE
- EMPTY PRESSURE (only Level operating mode)
- EMPTY CALIB. (only Level operating mode)
- FULL PRESSURE (only Level operating mode)
- FULL CALIB. (only Level operating mode)
- MAX. FLOW (only Flow operating mode)
- MAX. FLOW (only Flow operating mode)
- LOW FLOW CUT-OFF (only Flow operating mode)
- SET.L.FL.CUT-OFF (only Flow operating mode)

- LINEAR/SQROOT (only Flow operating mode)
- SET LRV
- SET URV
- DAMPING VALUE
- OUTPUT FAIL MODE
- SET MIN. CURRENT
- SET MAX. ALARM
- E727 P.OVERRANGE

The value saved is indicated on the fourth line of the local display.

Options:
- Valid: Select this option if the entered value or the desired value is displayed. The device continues to interrogate the safety-related parameters.
- Not valid: Select this option if an incorrect value or a value that was not entered is displayed. In this case, operation in the safe measuring mode is not possible. The SAFETY LOCK parameter displays the status "Unlocked". The confirmation sequence is cancelled.

15. Once the safety-related parameters have been successfully interrogated, the password "7452" must be entered again via the CONF. PASSWORD parameter. Afterwards, the device is locked for the safe measuring mode. The SAFETY LOCK parameter displays the status "Locked". This locking has the highest priority and can only be disabled via the SAFETY LOCK and SAFETY PASSWORD parameters.
16. Switch the device off and then on again. This ensures that the parameter settings for the current output, alarm response and locking are saved. Read out the parameters again and compare them to the data recorded in the "Device parameter configuration report".

The "Offline" operating function is not permitted for the configuration of an application with functional safety. Please ensure that no messages (e.g. Device disconnected) are displayed during the parameter configuration.

Parameter configuration via FieldCare operating program

1. The connection can be established in the following two ways: 1) Select the "HART Communication" connection wizard. The device will then be found automatically and opened online. Ensure that the device bus address = 0. 2) In the tree structure, select "Create projects" → "Add device" → "HART communication" and then select "Create network". The device is opened online. Ensure that the device bus address = 0.
2. Ensure that the connection has been made with the correct device. This can be done using the "Measuring point" parameter, the extended order number or the serial number.
3. Reset parameters to factory setting: reset code "7864" (see the associated Operating Instructions, "Resetting to factory setting (reset)" section). Check default values, number formats and parameter descriptions with the "Device parameter configuration report".
4. Configure the device.
5. Enter the settings for the following parameters according to the report, since these settings are queried for safe device configuration.

Parameter	Available in the operating mode			Group
	Pressure	Level, level selection "Level easy pressure"	Flow [1)]	
ACK. ALARM MODE	X	X	X	MESSAGES
CALIB. OFFSET	X	X	X	POSITION ADJUST.
MEASURING MODE	X	X	X	MEASURING MODE

Parameter	Available in the operating mode			Group
	Pressure	Level, level selection "Level easy pressure"	Flow [1]	
EMPTY PRESSURE		X		BASIC SETUP
EMPTY CALIB.		X		BASIC SETUP
FULL PRESSURE		X		BASIC SETUP
FULL CALIB.		X		BASIC SETUP
MAX. FLOW			X	BASIC SETUP
MAX PRESS. FLOW			X	BASIC SETUP
LOW FLOW CUT-OFF			X	EXTENDED SETUP
SET.L.FL.CUT-OFF			X	EXTENDED SETUP
LINEAR/SQROOT			X	EXTENDED SETUP
SET LRV	X	X	X	BASIC SETUP
SET URV	X	X	X	BASIC SETUP
DAMPING VALUE	X	X	X	BASIC SETUP
OUTPUT FAIL MODE [2]	X	X	X	OUTPUT
SET MIN. CURRENT	X	X	X	OUTPUT
SET MAX. ALARM	X	X	X	OUTPUT
E727 P.OVERRANGE	X	X	X	OUTPUT

1) Not for options with 160/250 bar (2320/3625 psi) measuring range
2) From firmware version ≥2.30

The EMPTY PRESSURE and FULL PRESSURE parameters are only displayed for the "Dry" CALIBRATION MODE. If you have performed a wet calibration, you must subsequently select the "Dry" option via the CALIBRATION MODE parameter. You can read out the corresponding values for the EMPTY PRESSURE and FULL PRESSURE parameters here.

6. Switch the device off and then on again. This ensures that the parameter settings are saved.
7. Check the safety function.
8. Close FieldCare. Then connect to the device again.
9. Select the "SAFETY CONFIRM." group (menu path: (GROUP SELECTION→) OPERATING MENU → SAFETY CONFIRM.)
10. Select the "Lock" option. Select the "Lock" option via the SAFETY LOCK parameter. The status "Locked" or "Unlocked" is indicated on the fourth line of the display.
11. Enter the password via the SAFETY PASSWORD parameter (password: 7452)

For firmware version ≤02.20.04
- If the correct password is entered, the following parameters are reset to the factory values (→ Step 10 for factory values):
  - CURRENT CHARACT.
  - OUTPUT FAIL MODE
  - ALT. CURR. OUTPUT
  - SET MAX. ALARM
  - SET MIN. CURRENT
  - SIMULATION
  - ALARM DELAY
  - ALARM DISPLAY TIME
  - SELECT ALARM TYPE
- Any simulation which may be running is ended
- The configurable messages ("Error"-type messages) 115, 120, 620, 715, 717, 718, 720, 726 and 727 are automatically set to "Alarm" ("Messages" section of the relevant Operating Instructions)

For firmware version ≥02.30.zz
- Any simulation which may be running is ended
- No parameters are reset

Log the following confirmed settings according to the "Device parameter configuration report".

12. Via the DIGIT SETS parameter, the user can check whether the characters and digits are displayed correctly on the user interface. "0123456789.-" is shown if everything is displayed correctly. Options: Valid: Select this option if the string of characters and digits is displayed correctly. Not valid: Select this option if the string of characters and digits is not displayed correctly. In this case, operation in the safe measuring mode is not possible. The confirmation sequence is cancelled.
13. Only for firmware version ≤02.20.04: Via the OUTPUT CURRENT parameter, the user can check whether the following parameters are correctly reset to the factory values. If reset correctly, the OUTPUT CURRENT parameter displays "LinMaxNorm/22/3.8/0s".

Factory values:
- CURRENT CHARACT.: Linear
- OUTPUT FAIL MODE: Max. alarm
- ALT. CURR. OUTPUT: Normal
- SET MAX. ALARM: 22 mA
- SET MIN. CURRENT: 3.8 mA
- ALARM DELAY: 0.0 s
- ALARM DISPLAY TIME: 0.0 s

Options:
- Valid: Select this option if the factory values displayed correspond to the desired values. The device continues to interrogate the safety-related parameters.
- Not valid: Select this option if the factory values displayed do not correspond to the desired values. In this case, operation in the safe measuring mode is not possible. The SAFETY LOCK parameter displays the status "Unlocked". The confirmation sequence is cancelled.

14. Depending on the selected operating mode, the following parameters must be confirmed:

For firmware version ≤02.20.04
- ACK. ALARM MODE
- CALIB. OFFSET
- MEASURING MODE
- EMPTY PRESSURE (only Level operating mode)
- EMPTY CALIB. (only Level operating mode)

- FULL PRESSURE (only Level operating mode)
- FULL CALIB. (only Level operating mode)
- MAX. FLOW (only Flow operating mode)
- MAX PRESS. FLOW (only Flow operating mode)
- LOW FLOW CUT-OFF (only Flow operating mode)
- SET.L.FL.CUT-OFF (only Flow operating mode)
- LINEAR/SQROOT (only Flow operating mode)
- SET LRV
- SET URV
- DAMPING VALUE

For firmware version ≥02.30.zz
- ACK. ALARM MODE
- CALIB. OFFSET
- MEASURING MODE
- EMPTY PRESSURE (only Level operating mode)
- EMPTY CALIB. (only Level operating mode)
- FULL PRESSURE (only Level operating mode)
- FULL CALIB. (only Level operating mode)
- MAX. FLOW (only Flow operating mode)
- MAX. FLOW (only Flow operating mode)
- LOW FLOW CUT-OFF (only Flow operating mode)
- SET.L.FL.CUT-OFF (only Flow operating mode)
- LINEAR/SQROOT (only Flow operating mode)
- SET LRV
- SET URV
- DAMPING VALUE
- OUTPUT FAIL MODE
- SET MIN. CURRENT
- SET MAX. ALARM
- E727 P.OVERRANGE

The value saved is indicated on the fourth line of the local display.

Options:
- Valid: Select this option if the entered value or the desired value is displayed. The device continues to interrogate the safety-related parameters.
- Not valid: Select this option if an incorrect value or a value that was not entered is displayed. In this case, operation in the safe measuring mode is not possible. The SAFETY LOCK parameter displays the status "Unlocked". The confirmation sequence is cancelled.

15. Once the safety-related parameters have been successfully interrogated, the password "7452" must be entered again via the CONF. PASSWORD parameter. Afterwards, the device is locked for the safe measuring mode. The SAFETY LOCK parameter displays the status "Locked". This locking has the highest priority and can only be disabled via the SAFETY LOCK and SAFETY PASSWORD parameters.
16. Switch the device off and then on again. This ensures that the parameter settings for the current output, alarm response and locking are saved. Read out the parameters again and compare them to the data recorded in the "Device parameter configuration report".

- The "Offline" operating function and FDT-Up-Download are not permitted for the configuration of an application with functional safety.
- Note the status when entering and displaying the parameters. This is indicated by icons/symbols and refers to possible errors during parameter entry, when updating parameters and when connecting to the device. More information can be found in the FieldCare help.

Standard parameter configuration

Parameter configuration via local display

1. Reset parameters to factory setting: reset code "7864" (see the associated Operating Instructions, "Resetting to factory setting (reset)" section). Check default values, number formats and parameter descriptions with the "Device parameter configuration report".

After this reset, the following operating steps may no longer be performed:
- Position adjustment or onsite configuration of measuring range without local display
- Download
- Configuration backup with HistoROM®/M-DAT
- Reset, except for reset code "7864"
- Current trim
- Sensor recalibration

2. Via the DIGIT SETS parameter, check whether the characters and digits are displayed correctly on the user interface. "0123456789.-" is shown if everything is displayed correctly. Menu path: (GROUP SELECTION →) OPERATING MENU → DISPLAY
3. Configure the device parameters and keep a manual log of the settings. For parameter configuration, see the associated Operating Instructions. Switch the device off and then on again. This ensures that the parameter settings have been saved.

Observe the prescribed parameters in accordance with the "Device parameter configuration form". The permitted parameter settings must also be taken into consideration.

4. Check the safety function.
5. Read out the prescribed parameters and compare them to the "Device parameter configuration report".
6. Lock the device via the software and/or hardware (see the associated Operating Instructions).
7. Read out and keep a record of the CONFIG RECORDER parameter. Menu path: (GROUP SELECTION→) OPERATING MENU → TRANSMITTER INFO → TRANSMITTER DATA

- If the device is in a fault state, i.e. an alarm is output and the current output adopts the set value, the cause of the fault must first be eliminated.
- "Level" operating mode, "Level easy pressure" level selection: The EMPTY PRESSURE and FULL PRESSURE parameters are only displayed for the "Dry" CALIBRATION MODE.
  If you have performed a wet calibration, you must subsequently select the "Dry" option via the CALIBRATION MODE parameter. You can read out the corresponding values for the EMPTY PRESSURE and FULL PRESSURE parameters here.
- The sensor can only be recalibrated by Endress+Hauser Service. All parameters, except the parameters for a sensor recalibration, are reset by the "7864" reset code. Therefore, the parameters have to be checked prior to locking via the SAFETY CONFIRM. menu.

Parameter configuration via Field Communicator 375/475 handheld terminal

1. Go to "Main Menu" → "HART Communication" → "HART-Application" → "Online". The device is then found automatically and opened online. Ensure that the device bus address = 0.
2. Ensure that the connection has been made with the correct device. This can be done using the "Measuring point" parameter, the extended order number or the serial number.

3. Reset parameters to factory setting: reset code "7864" (see the associated Operating Instructions, "Resetting to factory setting (reset)" section). Check default values, number formats and parameter descriptions with the "Device parameter configuration report".

After this reset, the following operating steps may no longer be performed:
- Position adjustment or onsite configuration of measuring range without local display
- Download
- Configuration backup with HistoROM®/M-DAT
- Reset, except for reset code "7864"
- Current trim
- Sensor recalibration

4. Via the DIGIT SETS parameter, check whether the characters and digits are displayed correctly on the user interface. "0123456789.-" is shown if everything is displayed correctly. Menu path: (GROUP SELECTION →) OPERATING MENU → DISPLAY
5. Configure the device parameters and keep a manual log of the settings. For parameter configuration, see the associated Operating Instructions. Switch the device off and then on again. This ensures that the parameter settings have been saved.

Observe the prescribed parameters in accordance with the "Device parameter configuration form". The permitted parameter settings must also be taken into consideration.

6. Check the safety function. Close the Field Communicator handheld terminal. Then connect to the device again.
7. Read out the prescribed parameters and compare them to the "Device parameter configuration report".
8. Lock the device via the software and/or hardware (see the associated Operating Instructions).
9. Read out and keep a record of the CONFIG RECORDER parameter. Menu path: (GROUP SELECTION→) OPERATING MENU → TRANSMITTER INFO → TRANSMITTER DATA

- If the device is in a fault state, i.e. an alarm is output and the current output adopts the set value, the cause of the fault must first be eliminated.
- "Level" operating mode, "Level easy pressure" level selection: The EMPTY PRESSURE and FULL PRESSURE parameters are only displayed for the "Dry" CALIBRATION MODE.
  If you have performed a wet calibration, you must subsequently select the "Dry" option via the CALIBRATION MODE parameter. You can read out the corresponding values for the EMPTY PRESSURE and FULL PRESSURE parameters here.
- The sensor can only be recalibrated by Endress+Hauser Service. All parameters, except the parameters for a sensor recalibration, are reset by the "7864" reset code. Therefore, the parameters have to be checked prior to locking via the SAFETY CONFIRM. menu.

Parameter configuration via FieldCare operating program

1. The connection can be established in the following two ways: 1) Select the "HART Communication" connection wizard. The device will then be found automatically and opened online. Ensure that the device bus address = 0. 2) In the tree structure, select "Create projects" → "Add device" → "HART communication" and then select "Create network". The device is opened online. Ensure that the device bus address = 0.
2. Ensure that the connection has been made with the correct device. This can be done using the "Measuring point" parameter, the extended order number or the serial number.

3. Reset parameters to factory setting: reset code "7864" (associated Operating Instructions, "Resetting to factory setting (reset)" section). Check default values, number formats and parameter descriptions with the "Device parameter configuration report".

After this reset, the following operating steps may no longer be performed:
- Position adjustment or onsite configuration of measuring range without local display
- Download
- Configuration backup with HistoROM®/M-DAT
- Reset, except for reset code "7864"
- Current trim
- Sensor recalibration

4. Via the DIGIT SETS parameter, check whether the characters and digits are displayed correctly on the user interface. "0123456789.-" is shown if everything is displayed correctly. Menu path: (GROUP SELECTION →) OPERATING MENU → DISPLAY
5. Configure the device parameters and keep a manual log of the settings. For parameter configuration, see the associated Operating Instructions. Switch the device off and then on again. This ensures that the parameter settings have been saved.

Observe the prescribed parameters in accordance with the "Device parameter configuration form". The permitted parameter settings must also be taken into consideration.

6. Check the safety function. Close FieldCare. Then connect to the device again.
7. Read out the prescribed parameters and compare them to the "Device parameter configuration report".
8. Lock the device via the software and/or hardware (see the associated Operating Instructions)
9. Read out and keep a record of the CONFIG RECORDER parameter. Menu path: (GROUP SELECTION→) OPERATING MENU → TRANSMITTER INFO → TRANSMITTER DATA

- If the device is in a fault state, i.e. an alarm is output and the current output adopts the set value, the cause of the fault must first be eliminated.
- "Level" operating mode, "Level easy pressure" level selection: The EMPTY PRESSURE and FULL PRESSURE parameters are only displayed for the "Dry" CALIBRATION MODE.
  If you have performed a wet calibration, you must subsequently select the "Dry" option via the CALIBRATION MODE parameter. You can read out the corresponding values for the EMPTY PRESSURE and FULL PRESSURE parameters here.
- The sensor can only be recalibrated by Endress+Hauser Service. All parameters, except the parameters for a sensor recalibration, are reset by the "7864" reset code. Therefore, the parameters have to be checked prior to locking via the SAFETY CONFIRM. menu.

4.5.3 Locking/unlocking a SIL device

⚠ WARNING

Changes to the measuring system or parameters can affect the safety function.

▶ After entering all the parameters and checking the safety function, the operation of the device must be locked.

Procedure with increased security during parameter entry

Locking

With the "Increased security during parameter entry" method, the device is locked by a password at the end of the locking sequence.

Locking by password has the highest priority and can only be disabled via the SAFETY LOCK and SAFETY PASSWORD parameters.

Unlocking

1. Select the "SAFETY CONFIRM." group (menu path: (GROUP SELECTION→) OPERATING MENU → SAFETY CONFIRM.)
2. Select the "Unlock" option via the SAFETY LOCK parameter.
3. Enter the password "7452" via the SAFETY PASSWORD parameter. If the password entered is correct, the SAFETY LOCK or SAFETY LOCKSTATE parameter displays the status "Unlocked".

Procedure for standard device configuration

If you are using the "Standard device configuration" method, the device must be locked via the software and/or hardware (see the associated Operating Instructions).

The damping setting via DIP switch 2 (damping: on/off) is independent of software and/or hardware locking. The switch position must therefore comply with the factory setting: on (damping on). The damping value can be set to 0 s where needed.

Unlocking a SIL device

When SIL locking is active on a device, the device is protected against unauthorized operation by means of a locking code and, as an additional option, by means of 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.

4.6 Parameters and default settings for SIL mode

4.6.1 "Increased security during parameter entry" method

The device checks whether certain operating steps have been performed beforehand or whether invalid parameters have been configured. If this is the case, a message appears to this effect and this method is then no longer possible.

The "Increased security during parameter entry" method is no longer possible after the following operating steps:
- Position adjustment performed or measuring range set on site without using the local display.
- Following a download
- After a configuration backup using HistoROM®/M-DAT
- After a reset, except after the reset code "7864"
- After performing sensor recalibration
- Following current trimming
- For the LEVEL SELECTION parameter, the "Level easy height" or "Level standard" option was selected (permitted setting for LEVEL SELECTION is "Level easy pressure").

The "Increased security during parameter entry" method is only possible again if a reset (code "7864") is performed, thereby resetting all the parameters to the as-delivered state.

4.6.2 "Standard device configuration" method

The reset (code "7864") must be performed to use the "Standard device configuration" method.

4.6.3 Permitted parameter settings

Only certain settings are permitted for some parameters. If one of these parameters is set to an invalid setting, the "Increased security during parameter entry" method is not possible. This method is possible again as soon as the parameter is set to the permitted setting.

Parameter and menu path	Permitted setting
▪ BUS ADDRESS (345) ▪ CURRENT MODE (052) [1] Menu path: (GROUP SELECTION →) OPERATING MENU → TRANSMITTER INFO → HART DATA	▪ 0 ▪ Signaling (local display and FieldCare) or enabled (HART handheld terminal)
"Pressure" MEASURING MODE: PRESS. ENG. UNIT (060) Menu path: (GROUP SELECTION →) OPERATING MENU → SETTINGS → BASIC SETUP or configuration via FieldCare using the Quick Setup	All units, except "User unit".
"Flow" MEASURING MODE [2]: ▪ UNIT FLOW (391) ▪ NORM FLOW UNIT (661) ▪ STD. FLOW UNIT (660) ▪ MASS FLOW UNIT (571) Menu path: (GROUP SELECTION →) OPERATING MENU → SETTINGS → BASIC SETUP or configuration via FieldCare using the Quick Setup	All units, except "User unit".
"Level" MEASURING MODE, "Level easy pressure" LEVEL SELECTION: ▪ EMPTY PRESSURE ▪ FULL PRESSURE ▪ EMPTY CALIB. ▪ FULL CALIB. ▪ SET LRV ▪ SET URV Menu path: (GROUP SELECTION →) OPERATING MENU → SETTINGS → BASIC SETUP or configuration via FieldCare using the Quick Setup	The parameters must meet the following conditions: ▪ The pressure values for SET LRV and SET URV must be within the sensor measuring range. ▪ The turndown, which is determined by the difference between the pressure values for SET LRV and SET URV, must not be larger than the maximum turndown (factory setting 100:1). ▪ The value for FULL PRESSURE - EMPTY PRESSURE must not fall below the minimum span (1 % of sensor measuring range).
"Level" MEASURING MODE, "Level easy pressure" LEVEL SELECTION: ADJUST DENSITY (007) Menu path: (GROUP SELECTION →) OPERATING MENU → SETTINGS → EXTENDED SETUP	Same value as PROCESS DENSITY (025)
▪ CURRENT CHARACT. (694), (695), (696), (764) [3] ▪ OUTPUT FAIL MODE (388) [3] ▪ SET MAX. ALARM (342) ▪ SET MIN. CURRENT (343) ▪ ALT. CURR. OUTPUT (597) [3] Menu path: (GROUP SELECTION →) OPERATING MENU → OUTPUT	▪ Linear ▪ Max. alarm (110 %): can be set from 21 to 23 mA or Min. alarm [4] (−10 %): 3.6 mA ▪ 22 mA [3] or 21 to 23 mA ▪ 3.8 mA [3] or 4 mA ▪ Normal/NE43

Parameter and menu path	Permitted setting
▪ ALARM DELAY (336) [3] ▪ ALARM DISPL. TIME (480) [3] Menu path: (GROUP SELECTION →) OPERATING MENU → DIAGNOSIS MESSAGES	▪ 0.0 s ▪ 0.0 s
SIMULATION (413) Menu path: (GROUP SELECTION →) OPERATING MENU → SIMULATION	SIMULATION = None [5]

1) Only above firmware version ≥02.20
2) Not for options with measuring range e.g. 160/250 bar [2320/3625 psi])
3) For firmware versions ≤02.20.04, settings are reset to permitted default values once the SIL password is entered.
4) For firmware versions ≤02.20.04, the "Min. alarm" setting is only possible with the "Standard configuration" method.
5) With the "Increased security during parameter entry" method, any simulation running is terminated automatically once the correct password has been entered.

- If the device is in a fault state, i.e. an alarm is output and the current output assumes the set value, the cause of the fault must first be eliminated.
- When operating via the DTM, locking via the SAFETY LOCK menu is only possible in the online mode.
- The sensor can only be recalibrated by Endress+Hauser Service. All parameters, except the parameters for a sensor recalibration, are reset by the "7864" reset code. Therefore, the parameters have to be checked prior to locking via the SAFETY CONFIRM. menu.

4.6.4 Check

⚠ CAUTION

A change to the measuring system or parameters can affect the safety function.

- ▶ Once all of the parameters have been entered, the safety function must be checked before performing the locking sequence! This can be done, for example, via the "Simulation" parameter or by approaching the limit pressure (see the parameter description for "Simulation" in the associated Operating Instructions).
- ▶ When the device is part of a safety function, the entire safety function must be checked following any change to the device, e.g. a change in the orientation of the device or the parameter configuration.

5 Operation

5.1 Device behavior during power-up

Once switched on, the device runs through a diagnostic phase of approx. 30 s. During this time, the current output is first set to approx. 12 mA, then to 4 mA, before the current that is output actually corresponds to the current measured value. Communication via HART is not possible during the diagnostic phase.

5.2 Behavior of device in the event of an alarm and warnings

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

⚠ CAUTION

In some cases, (e.g. failure of power supply, a cable open circuit and faults in the current output itself, where the error current ≥ 21 mA cannot be reached), output currents ≤ 3.6 mA occur irrespective of the configured failure current. In some other cases, (e.g. cabling short circuit), output currents ≥ 21.0 mA occur irrespective of the configured failure current.

- For alarm monitoring, the downstream logic unit must be able to recognize failure currents of the upper level for signal on alarm (≥ 21 mA) and the lower level for signal on alarm (≤ 3.6 mA).

5.3 Alarm and warning messages

5.3.1 List of alarm and warning messages

Additional information is provided by the alarm and warning messages in the form of error codes and associated plain text messages.

Parameter	Description	Factory setting		Parameterization method with increased security during parameter entry		
		FW 02.20	FW ≥ 02.30.zz	Permitted SIL setting	FW ≤ 02.20 [1]	FW ≥ 02.30.zz
115	Sensor over pressure	Warning	Warning	Warning or alarm	Alarm	As per client setting (default: warning)
120	Sensor low pressure	Warning	Warning	Warning or alarm	Alarm	
620	Current output out of range	Warning	Warning	Warning or alarm	Alarm	
715	Sensor over temperature	Warning	Warning	Warning or alarm	Alarm	
720	Sensor under temperature	Warning	Warning	Warning or alarm	Alarm	
717	Transmitter over temp.	Warning	Warning	Warning or alarm	Alarm	
718	Transmitter under temp.	Warning	Warning	Warning or alarm	Alarm	
726	Sens. temp. error overrange	Warning	Alarm	Alarm	Alarm	Alarm
727	Sens. pres. error overrange [2]	Warning	Warning	Warning or alarm	Alarm	As per client setting (default: warning)
Alarm current	Output fail mode	MAX	MAX	MIN. or MAX	MAX	As per client setting (default: MAX.)

1) Settings are automatically changed from warning to alarm via the parameterization method
2) The setting influences the parameters for functional safety

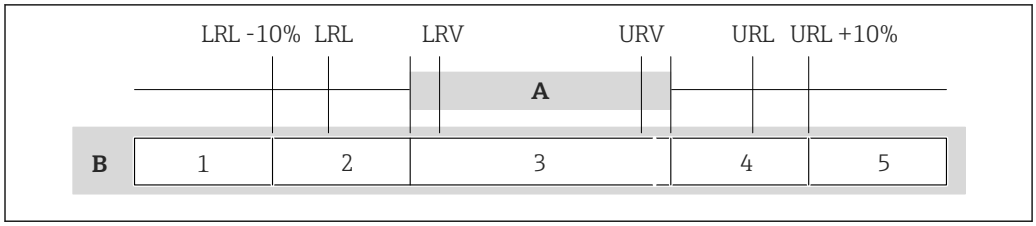
⚠ WARNING

In the case of devices with firmware version ≤ 02.20.04, certain messages in the SAFETY CONFIRM. menu (increased security during parameter entry) are automatically set from warning to alarm.

Do not use the SAFETY CONFIRM. sequence if the pressure in the applications is outside the set current or measuring range.

- Standard device configuration and software/hardware locking is recommended in such applications.

5.3.2 Device response in event of overranging



A Range of current signal for measured value transmission (NE43) 3.8 to 20.5 mA
B Output current range ≤3.6 to ≥21.0 mA
LRL Lower range limit
LRV Lower range value
URV Upper range value
URL Upper range limit

Process pressure range	Acting process pressure	Message [1]	
1	Process pressure below sensor measuring range limit	E120	(LRL - 10%)
		E727	(<< LRL - 10%)
2	Process pressure/current below set range limit	E620	< LRV
3	Process pressure within set measuring range	None	(3.8 to 20.5 mA
4	Process pressure/current above set range limit	E620	> URV
5	Process pressure above sensor measuring range limit	E115	(URL + 10%)
		E727	(>> URL + 10%)

1) The output current depends on the message setting as alarm or warning

6 Proof testing

The safety-related functionality of the device in the SIL mode must be verified during commissioning, when changes are made to safety-related parameters, and also at appropriate time intervals. This enables this functionality to be verified within the entire safety instrumented system. The time intervals must be specified by the operator.

⚠ CAUTION

The safety function is not guaranteed during a proof test.
Suitable measures must be taken to guarantee process safety during the test.

- The safety-related output signal 4 to 20 mA must not be used for the protective system during the test.
- The operator specifies the testing interval and this must be taken into account when determining the probability of failure PFDavg of the sensor system.

The individual proof test coverages (PTC) that can be used for calculation are specified for the proof tests described below.

Two possible ways to perform proof tests to detect dangerous undetected failures are described below. They differ with regard to the percentage coverage rate.

6.1 Test sequence A

Proof testing procedure

1. Bypass safety PLC or take other suitable measures to prevent alarms from being triggered in error.
2. Disable locking
3. Set the current output of the transmitter to HI alarm via a HART command or via the local display and check whether the analog current signal reaches this value (e.g. simulate an alarm via the "SIMULATION MODE" and SIM. ERROR NO. parameters). This test detects problems due to non-standard voltages (e.g. due to a loop current supply voltage that is too low or due to increased line resistance) and checks for possible failures in the transmitter electronics.
4. Set the current output of the transmitter to LO alarm via a HART command or via the local display and check whether the analog current signal reaches this value (e.g. set the ALARM RESPONSE parameter to "Min. alarm" or simulate an alarm via the "SIMULATION MODE" and "SIM. ERROR NO. parameters). This test detects any faults associated with quiescent currents.
5. Restore the full functionality of the current loops.
6. Remove the bypass for the safety PLC or restore normal operation by some other means.
7. After the proof test has been carried out, the results must be documented and retained in a suitable manner.

This check detects 50 % of the dangerous undetected failures.

6.2 Test sequence B

Proof testing procedure

1. Carry out steps 1 to 4 of test sequence A.
2. Compare the displayed pressure measured value with the applied pressure and check the current output. Appropriate procedures, measuring equipment and references must be used for this test. For the lower range value (4 mA value) and upper range value (20 mA value), compare the applied pressure with the measured pressure. If the measured pressure differs from the pressure applied to the device, the reference pressure present must be reassigned to the 4 mAvalue and the 20 mA value.

For the 4 mA value, see the corresponding Operating Instructions (BA), Description of Device Functions
- For pressure measurement: SET LRV (245) and GET LRV (309)
- For level measurement: SET LRV (013) ("Level easy pressure" level selection)
- For flow measurement: SET LRV (637)

For the 20 mA value, see the corresponding Operating Instructions (BA), Description of Device Functions
- For pressure measurement: SET URV (246) and GET URV (310)
- For level measurement: SET URV (012) ("Level easy pressure" level selection)
- For flow measurement: SET URV (638).

Compare the displayed pressure measured value with the applied pressure again and check the current output. If there are any deviations, contact Endress+Hauser Service.

3. Carry out steps 5 to 7 of test sequence A.

This check detects 99 % of the dangerous undetected failures.

NOTICE

Regarding test sequence B, Step 2: After this procedure, the current value is output correctly. The displayed value, e.g. on the local display, and the digital value via HART may differ from the actual pressure applied.

▶ If the display value and digital value are also to be corrected, please contact Endress +Hauser Service

6.3 Verification criterion

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 safety instrumented system.

- The purpose of proof-testing is to detect dangerous undetected device failures (λ_{DU}).
- This test does not cover the impact of systematic faults on the safety function, which must be assessed separately.
- Systematic faults can be caused, for example, by process material properties, operating conditions, build-up or corrosion.
- As part of the visual inspection, for example, ensure that all of the seals and cable entries provide adequate sealing and that the device is not visibly damaged.

7 Repair and error handling

7.1 Maintenance

Maintenance instructions and instructions regarding recalibration may be found in the Operating Instructions pertaining to the device.

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

7.2 Repair

Repair means restoring functional integrity by replacing defective components.

Only original Endress+Hauser spare parts may be used here.

The repair must be documented. This includes:

- Serial number of the device
- Date of the repair
- Type of repair
- Person who performed the repair

Components may be repaired/replaced by the customer's specialist staff if original Endress +Hauser spare parts (which can be ordered by the end customer) are used, and if the relevant installation instructions are followed.

A proof test must always be performed after every repair.

Installation Instructions are supplied with the original spare part and can also be accessed in the Download Area at www.endress.com

Send in replaced components to Endress+Hauser for fault analysis.

When returning the defective component, always enclose the "Declaration of Hazardous Material and Decontamination" with the note "Used as SIL device in a safety instrumented system.

Information on returns: http://www.endress.com/support/return-material

7.3 Modification

- **Modifications to SIL devices by the user are not permitted as they can impair the functional safety of the device**
- Modifications to SIL devices on site at the user's plant are possible following approval by the Endress+Hauser manufacturing center
- Modifications to SIL devices must be performed by staff who have been authorized to perform this work by Endress+Hauser
- Only **original spare parts** from Endress+Hauser must be used for modifications
- All modifications must be documented in the Endress+Hauser W@M Device Viewer
- All modifications require a modification nameplate or the replacement of the original nameplate.

7.4 Decommissioning

When decommissioning, the requirements according to IEC 61508-1:2010 section 7.17 must be observed.

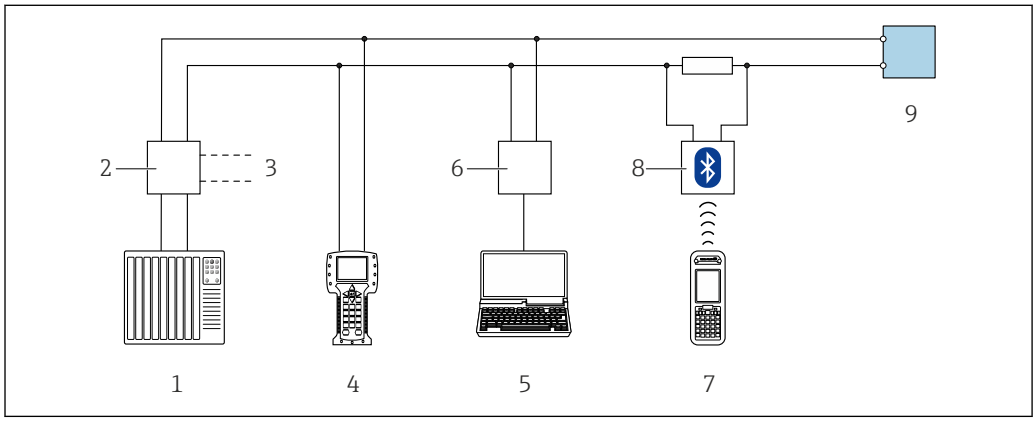
7.5 Disposal

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 Endress+Hauser for disposal under the applicable conditions.

8 Appendix

8.1 Structure of the measuring system

8.1.1 System components



1 *PLC (programmable logic controller)*
2 *2 transmitter power supply units, e.g. RN221N (with communication resistor)*
3 *Connection for Commubox FXA191, FXA195 and Field Communicator*
4 *HART handheld terminal, e.g. Field Communicator*
5 *Computer with operating tool*
6 *Commubox FXA191 (RS232) or FXA195 (USB), FXA291*
7 *Field Xpert*
8 *VIATOR Bluetooth modem with connecting cable*
9 *Transmitter*

An analog signal (4 to 20 mA) that is in proportion to the pressure is generated in the transmitter. This is sent to a downstream logic unit (e.g. PLC, limit signal transmitter, etc.) where it is monitored to determine whether it is below or above a specified limit value.

For fault monitoring, the logic unit must be able to detect both HI alarms (≥ 21.0 mA) and LO alarms (≤ 3.6 mA).

8.1.2 Description of use as a protective system

The differential pressure transmitter is used for the following measuring tasks:
- Flow measurement (volume flow or mass flow) in conjunction with primary devices in gases, vapors and liquids
- Level, volume or mass measurements in liquids
- Differential pressure monitoring, e.g. of filters and pumps

8.1.3 Installation conditions

The installation conditions for various measurements are described in the Technical Information for the device.

Correct installation is a prerequisite for safe operation of the device.

8.1.4 Measurement function

The measuring principle and the measurement functions are described in the Technical Information for the device

8.2 Commissioning or proof test report

The following device-specific test report acts as a print/master template and can be replaced or supplemented any time by the customer's own SIL reporting and testing system.

8.2.1 Pressure device parameter configuration form

Operation via: ❑ Handheld terminal ❑ FieldCare/DeviceCare ❑ On site

Device designation: _____ Serial number: _____

Measuring point: _____ Upper range limit (URL sensor): _____

Parameter name	Direct access	Menu path: Expert	Factory setting [1]	Permitted settings	Set point	Actual value	Tested
Digit set	840	→ Display			012345 67890.-		
Calib. offset	319	→ Position adjustment	0.0	[2]			
Measuring mode	389		Pressure		Pressure		
Set LRV	245	→ Quick Setup / Basic Setup	0.0 or as per order	[2]			
Set URV	246		URL sensor or as per order	[2]			
Damping value	247		2 s	0 to 999 s			
Press. eng. unit	060	→ Basic setup	mbar/bar or as per order [3]	All except "user unit"			
Current charact.	695	→ Output	Linear	Linear			
Output fail mode	388		Max. alarm	Max. alarm Min. alarm			
Alt. curr. output	597		Normal	Normal			
Set max. alarm	342		22 mA	21 to 23 mA			
Set min. current	343		3.8 mA	3.8 mA or 4 mA			
Simulation	413	→ Simulation	None	None			
Ack. alarm mode	401	→ Messages	Off	Off/On			
Error No. Select alarm type The following messages must be set to "Alarm":	595/600						
115 Sensor over pressure			Warning	Alarm o. warning			
120 Sensor low pressure			Warning	Alarm o. warning			
715 Sensor over temperature			Warning	Alarm o. warning			
717 Transmitter over temp.			Warning	Alarm o. warning			
718 Transmitter under temp.			Warning	Alarm o. warning			
720 Sensor under temperature			Warning	Alarm o. warning			
726 Sens. temp. error overrange			Warning/alarm [4]	Alarm			
727 Sens. pres. error overrange [5]			Warning	Alarm o. warning			
620 Current output out of range			Warning	Alarm o. warning			
Alarm delay	336		0.0 s	0.0 s			
Alarm display time	480		0.0 s	0.0 s			

Parameter name	Direct access	Menu path: Expert	Factory setting [1]	Permitted settings	Set point	Actual value	Tested
Current mode [6]	052	→ HART Data	Signaling [7] or Enabled [8]	Signaling [9] or Enabled [10]			
Bus address	345		0	0			
After locking: Config. counter	352	→ Transmitter data					

1) After performing a reset with reset code "7864"
2) Within the lower and upper range limit
3) Depending on the "Press. Sens Hilim (485)" parameter
4) Alarm setting from firmware ≥ 02.30.zz
5) Influence on SFF
6) Only from software version ≥ 02.20
7) Local display and FieldCare
8) HART handheld terminal
9) Local display and FieldCare
10) HART handheld terminal

Date Signature Signature of tester

8.2.2 Level device parameter configuration form [1)]

Operation via: ❑ Handheld terminal ❑ FieldCare/DeviceCare ❑ On site

Device designation: _____ Serial number: _____

Measuring point: _____ Upper range limit (URL sensor): _____

Parameter name	Direct access	Menu path: Expert	Factory setting [1)]	Permitted settings	Specified value	Actual value	Checked
Digits set	840	→ Display			012345 67890.-		
Calib. offset	319	→ Position adjustment	0.0	[2)]			
Measuring mode	389		Pressure		Level		
Level selection	020		Level easy pressure	Level easy pressure			
Empty calib.	010	→ Basic setup	0.0 % or as per order				
Empty pressure	011		0.0 or as per order	[2)]			
Full calib.	004		100 % or as per order				
Full pressure	005		URL sensor or as per order	[2)]			
Set LRV	013		0.0 % or as per order				
Set URV	012		100 % or as per order				
Damping value	247		2 s	0 to 999 s			
Press. eng. unit	060		mbar/bar or as per order [3)]	All except "user unit"			
Output unit	023		% or as per order				
Adjust density	007	→ Extended setup	1.0 kg/dm³	= Process density (025)			
Current charact.	695	→ Output	Linear	Linear			
Output fail mode	388		Max. alarm	Max. alarm Min. alarm			
Alt. curr. output	597		Normal	Normal			
Set max. alarm	342		22 mA	22 mA			
Set min. current	343		3.8 mA	3.8 mA			
Simulation	413	→ Simulation	None	None			
Ack. alarm mode	401	→ Messages	Off	Off/On			
Error No. Select alarm type The following messages must be set to "Alarm":	595/600						
115 Sensor over pressure			Warning	Alarm o. warning			
120 Sensor low pressure			Warning	Alarm o. warning			
715 Sensor over temperature			Warning	Alarm o. warning			
717 Transmitter over temp.			Warning	Alarm o. warning			

1) Not for options with measuring range e.g. 160/250 bar [2320/3625 psi])

Parameter name	Direct access	Menu path: Expert	Factory setting [1]	Permitted settings	Specified value	Actual value	Checked
718 Transmitter under temp.			Warning	Alarm o. warning			
720 Sensor under temperature			Warning	Alarm o. warning			
726 Sens. temp. error overrange			Warning/alarm [4]	Alarm			
727 Sens. pres. error overrange [5]			Warning	Alarm o. warning			
620 Current output out of range			Warning	Alarm o. warning			
Alarm delay	336		0.0 s	0.0 s			
Alarm display time	480		0.0 s	0.0 s			
Current mode [6]	052	→ HART Data	Signaling [7] or Enabled [8]	Signaling [9] or Enabled [10]			
Bus address	345		0	0			
After locking: Config. counter	352	→ Transmitter data					

1) After performing a reset with reset code "7864"
2) Within the lower and upper range limit
3) Depending on the "Press. Sens Hilim (485)" parameter
4) Alarm setting from firmware ≥ 02.30.zz
5) Influence on SFF
6) Only as of software version ≥ 02.20
7) Local display and FieldCare
8) HART handheld terminal
9) Local display and FieldCare
10) HART handheld terminal

Date Signature Signature of tester

8.2.3 Flow device parameter configuration form [2)]

Operation via: ❑ Handheld terminal ❑ FieldCare/DeviceCare ❑ On site

Device designation: _____ Serial number: _____

Measuring point: _____ Upper range limit (URL sensor): _____

Parameter name	Direct access	Menu path: Expert	Factory setting [1)]	Permitted settings	Set point	Actual value	Tested
Character string	840	→ Display			012345 67890.-		
Calib. offset	319	→ Position adjustment	0.0	[2)]			
Measuring mode	389		Pressure		Level		
Max. flow	311	→ Quick Setup / Basic Setup	1.0 s or as per order				
Max pressure	634		URL sensor or as per order	[2)]			
Damping value	247		2.0 s or as per order	0 to 999 s			
Press. eng. unit	060		mbar/bar or as per order [3)]	All except "user units"			
Flow type	640	→ Basic setup	Volume operat. cond. or as per order				
Unit flow (as per order) [4)]	391		m^3/s	All except "user unit"			
Norm flow unit (as per order) [4)]	661		Nm^3/s				
Std. flow unit (as per order) [4)]	660		Sm^3/s				
Mass flow unit (as per order) [4)]	571		kg/s				
Low flow cut-off	442	→ Quick Setup / Basic Setup / Extended Setup	Off	Off / On			
Set l.fl. cut-off	323		5 %	0 to 50 % of max. flow			
Set LRV [5)]	637		0.0 or as per order				
Set URV [5)]	638		Max. flow or as per order				
Set LRV [6)]	245		0.0 or as per order	[2)]			
Set URV [6)]	246		URL sensor or as per order	[2)]			
Current charact.	695	→ Output	Linear	Linear			
Output fail mode	388	→ Quick Setup / Output	Max. alarm	Max. alarm Min. alarm			
Alt. curr. output	597		Normal	Normal			
Set max. alarm	342	→ Output	22 mA	21 to 23 mA			
Set min. current	343	→ Quick Setup/ Output	3.8 mA	3.8 mA or 4 mA			
Linear/sqroot	390	→ Output	Flow (sqroot)	Differential pressure / flow (sqroot)			
Simulation	413	→ Simulation	None	None			
Ack. alarm mode	401	→ Messages	Off	Off/On			

2) Not for options with measuring range e.g. 160/250 bar [2320/3625 psi])

Parameter name	Direct access	Menu path: Expert	Factory setting [1]	Permitted settings	Set point	Actual value	Tested
Error No. Select alarm type The following messages must be set to "Alarm":	595/600						
115 Sensor over pressure			Warning	Alarm o. warning			
120 Sensor low pressure			Warning	Alarm o. warning			
715 Sensor over temperature			Warning	Alarm o. warning			
717 Transmitter over temp.			Warning	Alarm o. warning			
718 Transmitter under temp.			Warning	Alarm o. warning			
720 Sensor under temperature			Warning	Alarm o. warning			
726 Sens. temp. error overrange			Warning/alarm [7]	Alarm			
727 Sens. pres. error overrange [8]			Warning	Alarm o. warning			
620 Current output out of range			Warning	Alarm o. warning			
Alarm delay	336		0.0 s	0.0 s			
Alarm display time	480		0.0 s	0.0 s			
Current mode [9]	052	→ HART Data	Signaling [10] or Enabled [11]	Signaling [12] or Enabled [13]			
Bus address	345		0	0			
after locking: Config. counter	352	→ Transmitter data					

1) After performing a reset with reset code "7864"
2) Within the lower and upper range limit
3) Depending on the "Press. Sens Hilim (485)" parameter
4) Only one entry is possible. This depends on the settings in the "Flow-meas. type (640)" parameter.
5) For Linear/sqroot = flow (sqroot)
6) For Linear/sqroot = differential pressure
7) Alarm setting from firmware ≥ 02.30.zz
8) Influence on SFF
9) Only from software version ≥ 02.20
10) Local display and FieldCare
11) HART handheld terminal
12) Local display and FieldCare
13) HART handheld terminal

Date Signature Signature of tester

8.3 Parameter description

8.3.1 Parameter description of the SAFETY CONFIRM. group - "Pressure" measuring mode

For other parameter descriptions, e.g. level, see the corresponding Operating Instructions.

The numbers in brackets indicate the identification numbers of the parameters on the local display.

Parameter name	Description
SAFETY LOCKSTATE	Displays the device status with regard to the safe measuring mode. **Possibilities:** ▪ Unlocked ▪ Lock **Prerequisites:** Operating tool or Field Communicator 375/475 handheld terminal
SAFETY LOCK (836)	This parameter offers the following functions: ▪ Check and lock the device for the safe measuring mode ▪ Remove lock for the safe measuring mode ▪ Local display: Displays the device status with regard to the safe measuring mode.
SAFETY PASSWORD (838)	The password must be entered in the following situations: ▪ Prior to querying safety-related parameters ▪ When unlocking the safe measuring mode
DIGITS SET (841)	This parameter is used to check whether the characters and digits are displayed correctly on the user interface. If the characters and digits are displayed correctly, this parameter displays the character string "0123456789.-". **Options:** ▪ Valid Select this option if the string of characters and digits is displayed correctly. ▪ Not valid Select this option if the string of characters and digits is not displayed correctly. In this case, operation in the safe measuring mode is not possible.
OUTPUT CURRENT (875)	Only for firmware version ≤ 2.20 For displaying and querying the settings for the CURR. CHARACT., OUTPUT FAIL MODE, ALT. CURR. OUTPUT, SET MAX. ALARM, SET MIN. CURRENT, ALARM DELAY, ALARM DISPLAY TIME parameters. Once you have entered the password correctly for the SAFETY PASSWORD parameter, the following parameters - among others - are reset to the factory setting: ▪ CURRENT CHARACT.= Linear ▪ OUTPUT FAIL MODE = Max. alarm ▪ ALT. CURR. OUTPUT = Normal ▪ SET MAX. ALARM = 22 mA ▪ SET MIN. CURRENT = 3.8 mA ▪ ALARM DELAY = 0 s ▪ ALARM DISPLAY TIME = 0 s The OUTPUT CURRENT parameter displays these factory values as "LinMaxNorm22/3.8/0s". **Options:** ▪ Valid Select this option if the factory values displayed correspond to the desired values. ▪ Not valid Select this option if the factory values displayed do not correspond to the desired values. In this case, operation in the safe measuring mode is not possible.

Parameter name	Description
OUTPUT FAIL MODE (57)	Only for firmware version ≥ 2.30 For displaying and querying the set output fail mode. **Possibilities:** ▪ Max. alarm (110 %) ▪ Min. alarm (−10 %) **Options:** ▪ Valid Select this option if the selected and desired value is displayed ▪ Not valid Select this option if an incorrect value or a value that was not selected is displayed. In this case, operation in the safe measuring mode is not possible.
SET MIN. CURRENT (56)	Only for firmware version ≥ 2.30 For displaying and querying the lower current limit. **Possibilities:** ▪ 3.8 mA ▪ 4 mA **Options:** ▪ Valid Select this option if the selected and desired value is displayed ▪ Not valid Select this option if an incorrect value or a value that was not selected is displayed. In this case, operation in the safe measuring mode is not possible.
SET MAX. ALARM (54)	Only for firmware version ≥ 2.30 For displaying and querying the set current value for the maximum alarm current. **Possibilities:** 21 to 23 mA **Options:** ▪ Valid Select this option if the selected and desired value is displayed ▪ Not valid Select this option if an incorrect value or a value that was not selected is displayed. In this case, operation in the safe measuring mode is not possible.
E727 P.OVERRANGE (58)	Only for firmware version ≥ 2.30 For displaying and querying the set behavior in the event of this error. This setting affects the SIL characteristic values. **Possibilities:** ▪ Alarm (A): output current adopts a defined value ▪ Warning (W): output current in saturation (3.8 or 20.5 mA) **Options:** ▪ Valid Select this option if the selected and desired value is displayed ▪ Not valid Select this option if an incorrect value or a value that was not selected is displayed. In this case, operation in the safe measuring mode is not possible.

Parameter name	Description
ACK. ALARM MODE (844)	For displaying and querying the option selected for the ACK. ALARM MODE parameter (MESSAGES group). **Possibilities:** ▪ On ▪ Off **Options:** ▪ Valid Select this option if the selected and desired value is displayed ▪ Not valid Select this option if an incorrect value or a value that was not selected is displayed. In this case, operation in the safe measuring mode is not possible. NOTICE **If you selected the "On" option for the ACK. ALARM MODE parameter and an alarm occurs, proceed as follows:** ▶ Rectify the cause of the alarm. ▶ Unlock the device via the SAFETY LOCK and SAFETY PASSWORD parameters. ▶ Acknowledge the alarm via the ACK. ALARM parameter. ▶ Select the "Lock" option for the SAFETY LOCK parameter. ▶ Enter the password for the SAFETY PASSWORD parameter. ▶ Confirm the values and option selected for the parameters queried. ▶ Lock the device via the password.
CALIB. OFFSET (847)	For displaying and querying the value entered or calculated for the CALIB. OFFSET parameter (POSITION ADJUSTMENT group). **Options:** ▪ Valid Select this option if the selected and desired value is displayed ▪ Not valid Select this option if an incorrect value or a value that was not selected is displayed. In this case, operation in the safe measuring mode is not possible. You can also perform position adjustment by means of the POS. ZERO ADJUST or POS. INPUT VALUE parameters. The CALIB. OFFSET parameter then displays the calculated value.
MEASURING MODE (845)	For displaying and querying the set measuring mode. **Possibilities:** ▪ Pressure ▪ Level **Options:** ▪ Valid (for "Pressure" measuring mode) Select this option if the selected and desired value is displayed ▪ Not valid (for "Level" measuring mode) Select this option if an incorrect value or a value that was not selected is displayed. In this case, operation in the safe measuring mode is not possible.
SET LRV (852)	For displaying and querying the value entered or calculated for the SET LRV parameter (BASIC SETUP or QUICK SETUP group). **Options:** ▪ Valid Select this option if the selected and desired value is displayed ▪ Not valid Select this option if an incorrect value or a value that was not selected is displayed. In this case, operation in the safe measuring mode is not possible. You can also configure the lower-range value via the GET LRV parameter and a pressure present at the device. The SET LRV parameter displays the pressure value that has been assigned to the lower-range value.

Parameter name	Description
SET URV (853)	For displaying and querying the value entered or calculated for the SET URV parameter (BASIC SETUP or QUICK SETUP group). **Options:** ▪ Valid Select this option if the selected and desired value is displayed ▪ Not valid Select this option if an incorrect value or a value that was not selected is displayed. In this case, operation in the safe measuring mode is not possible. You can also configure the upper-range value via the GET URV parameter and a pressure present at the device. The SET URV parameter displays the pressure value that has been assigned to the upper-range value.
DAMPING VALUE (855)	For displaying and querying the value entered for the DAMPING VALUE parameter (BASIC SETUP or QUICK SETUP group). **Options:** ▪ Valid Select this option if the selected and desired value is displayed ▪ Not valid Select this option if an incorrect value or a value that was not selected is displayed. In this case, operation in the safe measuring mode is not possible. Changing the "Damping" DIP switch on the electronic insert does not have any effect on the damping time when operation for the safe measuring mode is locked via SAFETY LOCK (836), SAFETY PASSWORD (838) and CONF. PASSWORD (856). A change only takes effect once operation has been unlocked.
CONF. PASSWORD (856)	Once the safety-related parameters have been successfully interrogated, the password "7452" must be entered again via the CONF. PASSWORD parameter. Afterwards, the device is locked for the safe measuring mode. The SAFETY LOCKSTATE parameter displays the status "Locked".

8.4 Version history

FY01050P

- Firmware version: from 02.00.zz (zz: any double number)
- Hardware version: from 02.00.ww (ww: any double number), date of manufacture after 1 October 2018
- Changes:
  Certificate renewed
- Predecessor: SD00189P
  Deltabar S FMD77, FMD78, PMD75

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