

# Special Documentation

## **Proline Promass 200**

## **FOUNDATION Fieldbus**

Heartbeat Verification application package





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# 1 Certification

BESCHEINIGUNG ◆ ATTESTATION ◆ 证明书 ◆ СВИДЕТЕЛЬСТВО ◆ CONSTANCIA ◆ ATTESTAZIONE



Industrie Service

## ATTESTATION

The Certification Body of  
 TÜV SÜD Industrie Service GmbH  
 Business Area Plant Engineering

certifies that the product

### Proline Promass 200 with Heartbeat Technology™

manufactured by

**Endress + Hauser AG**  
**Kägenstraße 7**  
**4153 Reinach BL**  
**Switzerland**

complies with the following requirements:

Heartbeat Technology™ is a test method integrated in the measuring device for the diagnostics and verification of flowmeters when used in a particular application throughout the useful lifetime of the measuring device. Testing is based on internal factory-traceable references which are redundantly reproduced in the device. Heartbeat Technology™ includes Heartbeat Diagnostics and Heartbeat Verification.

**Test specifications:**

- DIN EN IEC 61508-2:2011-02, Appendix C
- DIN EN IEC 61508-3:2011-02, Section 6
- DIN EN ISO 9001:2008, (Section 7.6 a), Control of monitoring and measuring equipment

**Test results:**

Heartbeat Verification verifies the function of Proline Promass 200 on demand within the specified measuring tolerance with a total test coverage ("TTC") of TTC > 95%.

Heartbeat Technology™ complies with the requirements for traceable verification according to DIN EN ISO 9001:2008 – Section 7.6 a) "Control of monitoring and measuring equipment". In accordance with this standard, the user is responsible for providing a definition of the verification interval that satisfies the particular requirements.

This Attestation is based on report no.: TR.2065342.004.14 dated October 16, 2014.  
 Attestation no.: PC/209/03/144/06/14

Munich, October 16, 2014

Jörg Steimer  
 Certification Body Plant Engineering



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## 2 About this document

### 2.1 Document function

This manual is a Special Documentation and does not replace the Operating Instructions included in the scope of supply. It is a part of the Operating Instructions and serves as a reference for using the Heartbeat Technology function integrated in the measuring device.





### 2.2 Content and scope

This document contains descriptions of the additional parameters and technical data of the application package and detailed explanations regarding:









- Application-specific parameters
- Advanced technical specifications



### 2.3 Symbols used

#### 2.3.1 Safety symbols

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

#### 2.3.2 Symbols for certain types of information


Symbol	Meaning
	<b>Tip</b> Indicates additional information.
	Reference to documentation
	Reference to page
	Reference to graphic
	Notice or individual step to be observed
	Series of steps
	Result of a step
	Operation via local display

Symbol	Meaning
	Operation via operating tool
	Write-protected parameter

### 2.3.3 Symbols in graphics

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


## 2.4 Documentation

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

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

This documentation is an integral part of the following Operating Instructions:

Measuring device	Documentation code
Promass 8A2B**-...	BA01827D
Promass 8E2C**-...	BA01639D
Promass 8F2B**-...	BA01315D

 This Special Documentation is available:

- On the CD-ROM supplied with the device (depending on the device version ordered)
- In the Download Area of the Endress+Hauser Internet site: [www.endress.com](http://www.endress.com) → Downloads

## 2.5 Registered trademarks

**FOUNDATION™ Fieldbus**

Registration-pending trademark of the FieldComm Group, Austin, Texas, USA

## 3 Product features and availability

### 3.1 Product features

Heartbeat Technology offers diagnostic functionality by means of continuous self-monitoring as well as in-situ verification of flowmeters in the application.

The test scope achieved using these diagnostic and verification tests is referred to as the **Total Test Coverage** (TTC). The TTC is calculated using the following formula for random errors (calculation based on FMEDA as per IEC 61508):

$$TTC = (\lambda_{TOT} - \lambda_{du}) / \lambda_{TOT}$$


$\lambda_{TOT}$ : Rate of all theoretically possible failures

$\lambda_{du}$ : Rate of undetected dangerous failures

Only the dangerous undetected failures are not diagnosed by the device diagnostics. If these failures occur, they can distort the measured value that is displayed or interrupt the output of measured values.

Heartbeat Technology checks the device function within the specified measuring tolerance with a defined TTC.

The TTC is at least 95%.

 The current value for the TTC depends on the configuration and integration of the measuring device. The values indicated above were determined under the following conditions:


- Integration of the measuring device for measured value output via 4 to 20mA HART output
- Simulation operation not active
- Error behavior, current output set to **Minimum alarm** or **Maximum alarm** and evaluation unit recognizes both alarms
- Settings for diagnostic behavior correspond to factory settings

### 3.2 Availability of the application package

The **Heartbeat Verification + Monitoring** application package can be ordered with the device or enabled subsequently with an activation code. Detailed information on the order code is available from your Endress+Hauser Sales Center or on the website [www.endress.com](http://www.endress.com).

The availability of the Heartbeat Verification + Monitoring application package with the **EB** option can be checked as follows:

- Order code with breakdown of the device features on the delivery note
- On the Web using the Device Viewer ([www.endress.com/deviceviewer](http://www.endress.com/deviceviewer)): enter the serial number from the nameplate and check whether the feature is displayed
- In the operating menu Expert → System → Administration: The **Software option overview** parameter displays the packages that are currently activated.

 **Measuring devices with device firmware and lower**

A device firmware upgrade is required on devices with an earlier firmware version.

Contact your Endress+Hauser service organization.

#### 3.2.1 Order code

If ordering directly with the device or subsequently as a retrofit kit:

The availability of the application package can be checked as follows:

- Order code with breakdown of the device features on the delivery note
- On the Web using the Device Viewer ([www.endress.com/deviceviewer](http://www.endress.com/deviceviewer)): enter the serial number from the nameplate and check whether the feature is displayed
- In the operating menu Expert → System → Administration: The **Software option overview** parameter indicates whether the application package is enabled.

### 3.2.2 Activation

The **Heartbeat Verification + Monitoring** application package must be enabled in the device if the package is ordered subsequently as a retrofit kit. The retrofit kit contains an activation code that must be entered via the operating menu:

Expert → System → Administration

- ▶ Enter the activation code.
  - ↳ The application package is available.  
The **Software option overview** parameter displays the packages that are currently activated.

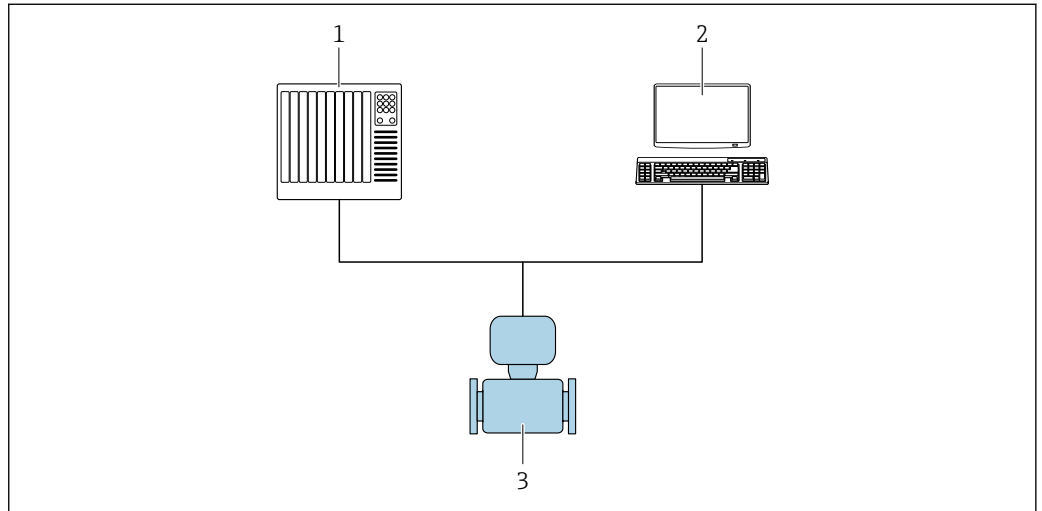
### 3.2.3 Access

Heartbeat Technology is compatible with all the system integration options. Interfaces with digital communication are required to access the data saved in the device. The speed of data transmission depends on the type of communication interface used.



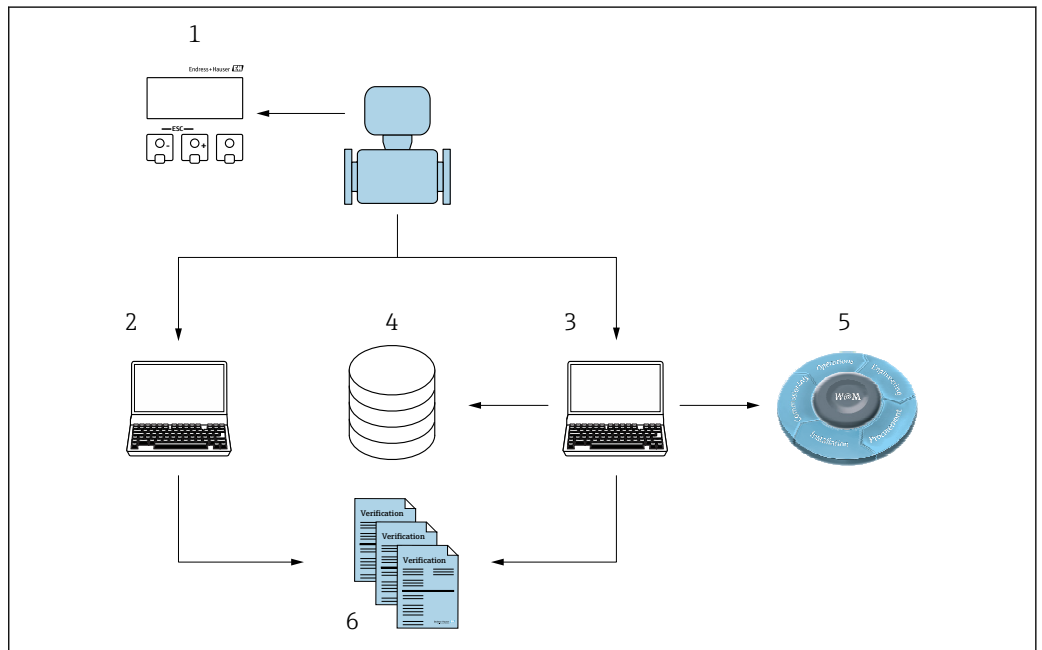
## 4 System integration

The **Heartbeat Technology** features are available via the local display module and the digital interfaces. The features can be used via an asset management system and the automation infrastructure (e. g. PLC).



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- 1 PLC
- 2 Asset Management System
- 3 Measuring device



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- 1 Local display
- 2 Web browser
- 3 FieldCare
- 4 Data archive
- 5 W@M Portal
- 6 Verification report

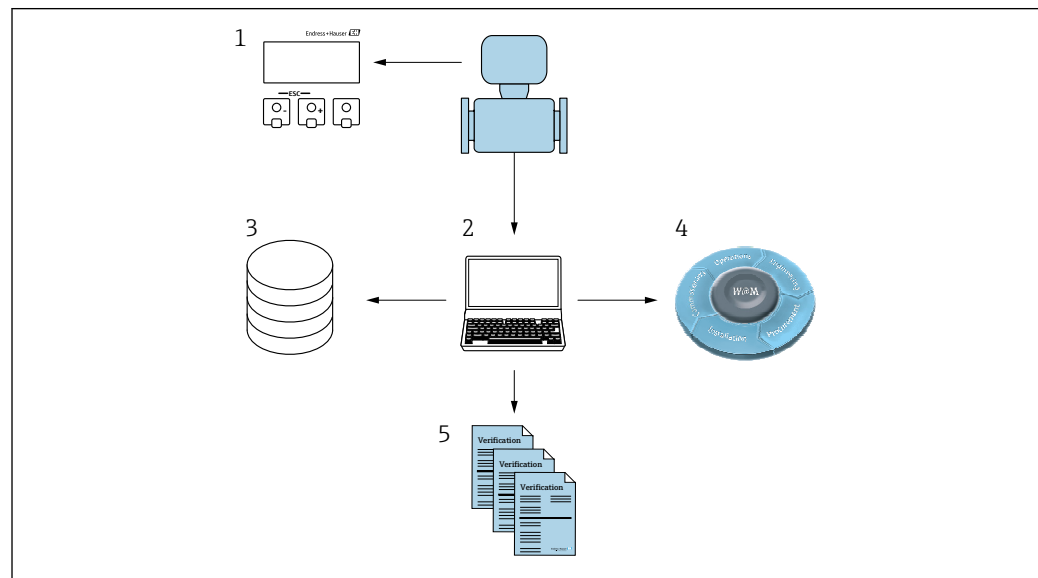
Run the **Heartbeat Verification** via one of the following interfaces:

- System integration interface of a higher-level system
- Local display
- Common Data Interface (CDI)

To start a verification and signal the result (Passed or Failed) the device must be accessed externally from a higher-level system via the system integration interface. It is not possible to start the verification via an external status signal and relay the results to a higher-level system via the status output.

The detailed results of the verification (8 data records) are saved in the device and provided in the form of a verification report.

 For more information on "System integration", see the Operating Instructions (documentation code)



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- 1 Local display
- 2 FieldCare
- 3 Data archive
- 4 W@M
- 5 Verification report

Verification reports can be created using the FieldCare plant asset management software from Endress+Hauser. With the Flow Verification DTM, FieldCare also offers the possibility of archiving the verification results to create traceable documentation.

The Flow Verification DTM also enables trend analysis – i.e. the ability to monitor, compare and track the verification results of all the verifications performed on the device.

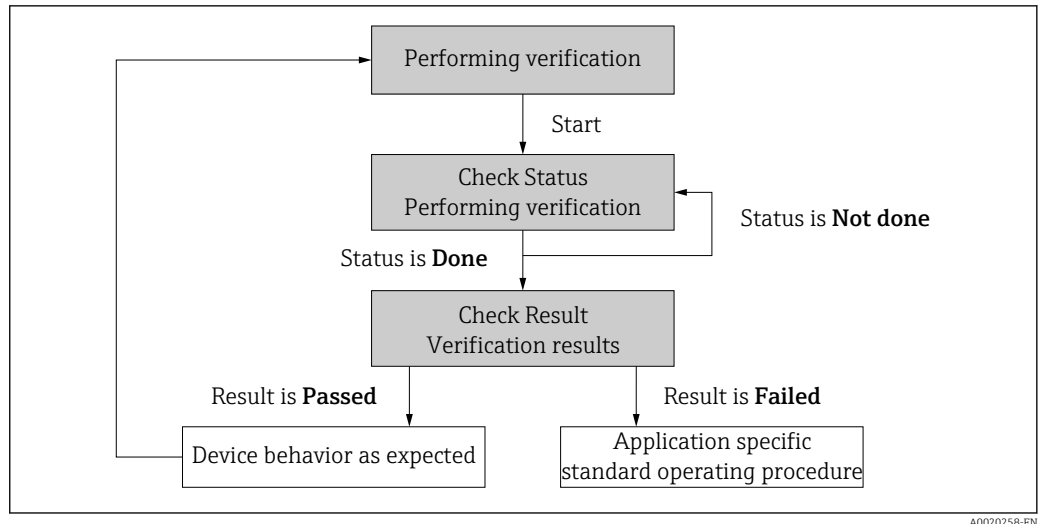
## 4.1 Automated data exchange

- Instrument check via self-monitoring
- Start verification and status verification

The verification function integrated in the measuring device can be activated by a control system and the results can be checked.

 For more information on "System integration", see the Operating Instructions (documentation code)

The following procedure must be implemented for this purpose:



Verification result: The overall result of the verification is indicated in the **Overall result** parameter. Different, application-specific measures must be performed by system routines depending on the result, e.g. a "Maintenance Required" alert is triggered if **Failed** is displayed as the result.

## 4.2 Data exchange performed by the user (asset management system)

### Heartbeat Monitoring

Configuration of the monitoring function: specify which diagnostic parameters are output continuously via the system integration interface.

### Heartbeat Verification

- Start the verification
- Upload, archive and document the verification results including detailed results

## 4.3 Data management

The results of a **Heartbeat Verification** are saved as a non-volatile parameter set in the measuring device memory:

- 8 storage locations available for parameter data sets
- New verification results overwrite old data following the FIFO<sup>1)</sup> principle

The results can be documented in the form of a verification report using the the Endress+Hauser asset management software, FieldCare.

FieldCare also offers additional capabilities with the Flow Verification DTM:

- Archiving of verification results
- Export of data from these archives
- Trend analysis of verification results (line recorder function)

### 4.3.1 Data management via Flow Verification DTM







A verification can be performed and a verification report printed via the DeviceDTM.

A special DTM for **Heartbeat Verification** (Flow Verification DTM) is also available in addition to the DeviceDTM. The Flow Verification DTM offers advanced capabilities for managing and visualizing the results.

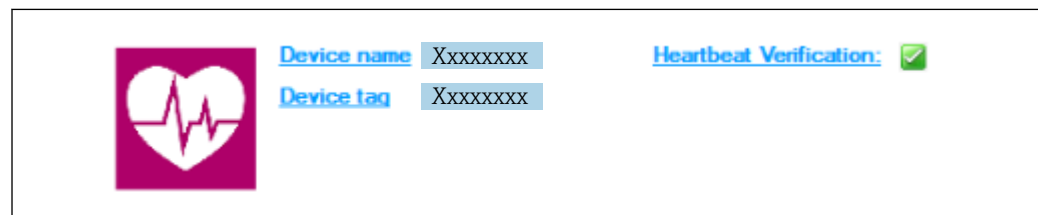
1) First In – First Out

### Basic functions

The following basic functions are available:

	Read data records from the device
	Create a new archive
	Open saved archive files
	Save data sets to an existing archive file or initial saving of data sets to a new archive file
	Save the data sets under a new file name; a new archive file is created in this case
	Create a verification report in PDF format

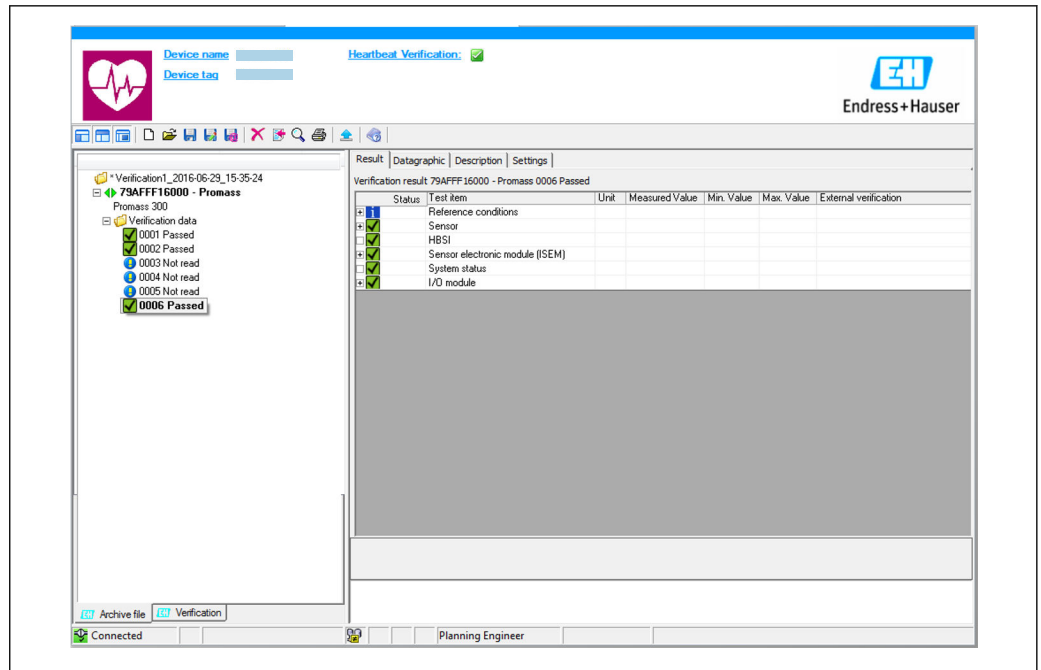
### Header



- Top display area of the DTM
- Contains the following information:
  - Measuring device
  - Device tag
- Indicates whether verification is active:

### Reading out data

Start uploading the data from the measuring device to the asset management software.



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### 1 Sample graphic

- ▶ Click an individual data set.
  - ↳ Selected data sets, which are saved in the measuring device, are transmitted to the asset management software and visualized.

### Verification results

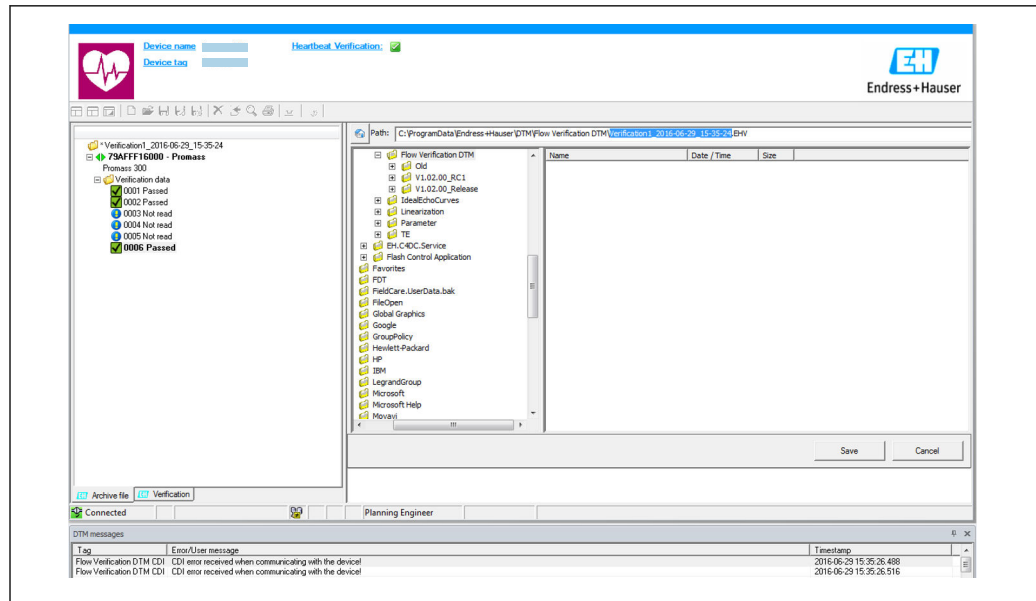
Details for the verification results are displayed in the data area.

The data area is split into 3 tabs:

- Result – status, test group and detailed results including limit values
- Data graphic – visualization of results as a trend curve
- Description – additional descriptions and information entered by the user



### Saving to an archive file

Save the data to an archive after upload.




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## 2 Sample graphic

- ▶ Click the icons  or .
- ↳ A file with the extension ".EHV" is generated. This file is used to archive the data. It can be read and interpreted by every asset management system with an installed Flow Verification DTM and is therefore also suitable for analysis by a third party (e.g. Endress+Hauser service organization).

## Opening the archive file

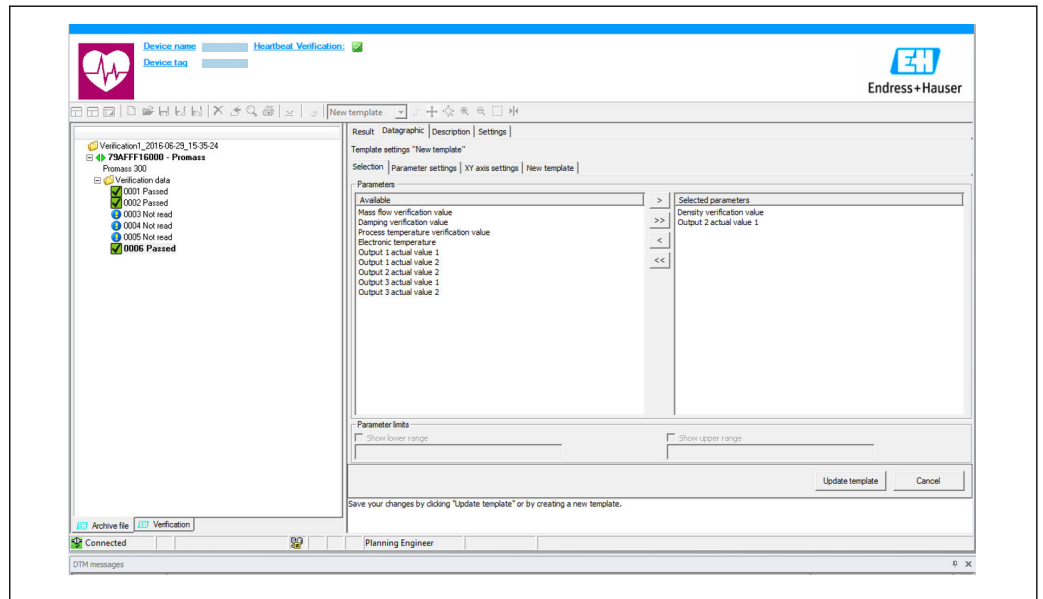
Open archive files already available.

- ▶ Click the  icon.
- ↳ The archive data are uploaded to the Flow Verification DTM.

## Configuring visualization and trending

The verification data can be visualized in the Graphic tab in the data area. The data saved in the archive are visualized as a graph over time. For this purpose, any of the data available can be selected.

### Selecting the measured variables

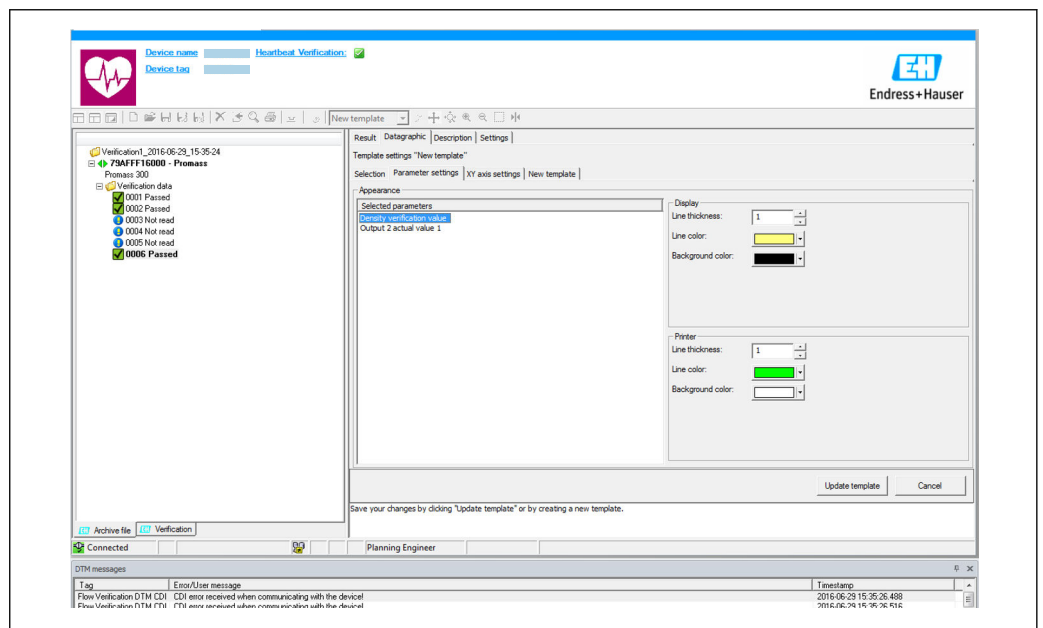


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#### 3 Sample graphic

- ▶ Select the measured variables using the list displayed.

### Visualizing a graph

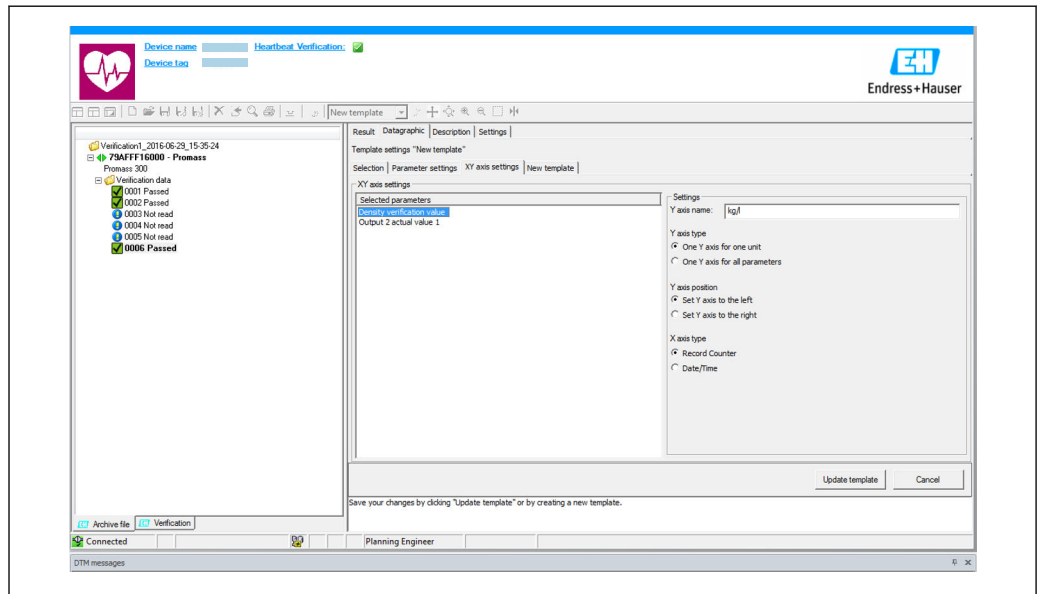


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#### 4 Sample graphic

- ▶ Assign properties for visualization of the graph.

### Configuring the Y-axis

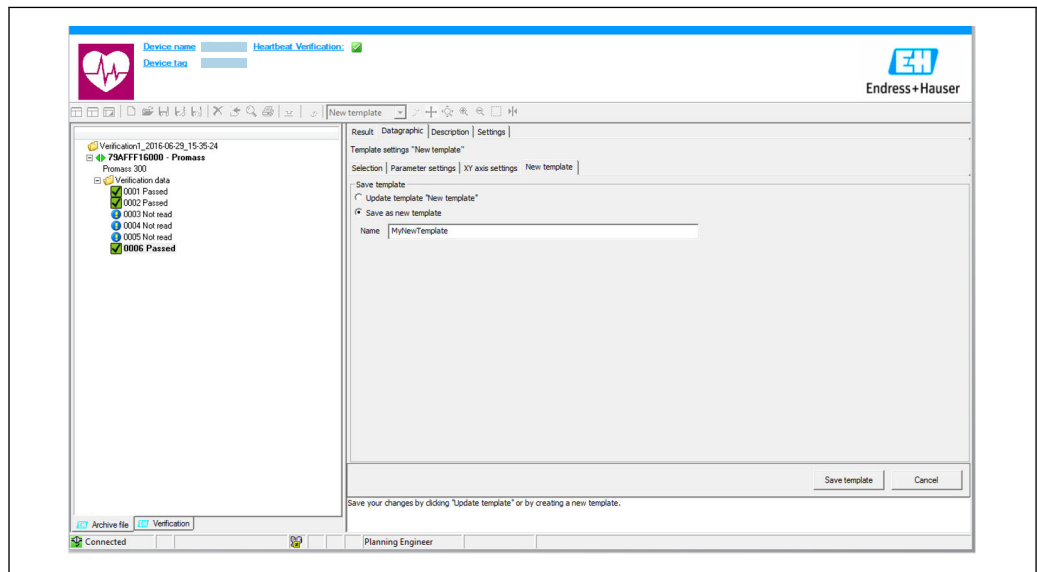


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#### 5 Sample graphic

- Assign the measured variables of the Y-axis.

### Update template or create new template



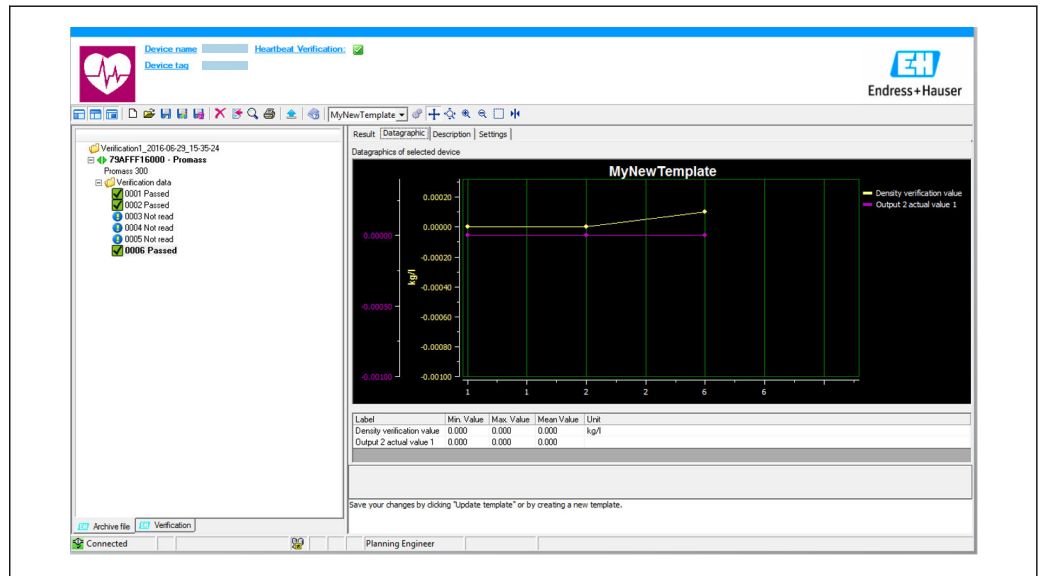
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#### 6 Sample graphic

- Add a selected parameter configuration to the template or save under a new template name.



## Showing the visualization trend




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### 7 Sample graphic

- ▶ Display the template.
  - ↳ The template shows the data in chronological order. The data points are referenced by the verification ID (X-axis), the Y-axis displays the parameters defined in the configuration.

## Creating a verification report

1. Click the  icon.
2. Select the data set.
  - ↳ A verification report is generated.

## 5 Heartbeat Verification

Heartbeat Verification checks the device function within the specified measuring tolerance on demand with a total test coverage (TTC) of > 95%. The result of the verification is "Passed" or "Failed". The verification data are saved in the device and, optionally, are archived on a PC with the FieldCare asset management software. A verification report is generated automatically on the basis of these data to ensure the traceable documentation of the verification results.

Therefore Heartbeat Verification also supports the documentation of proof tests as per IEC 61511-1. For details, see the Functional Safety Manual.

Heartbeat Technology offers two ways to perform Heartbeat Verification:

- Internal verification  
Verification is performed by the device without manual checking of external measured variables.
- External verification  
Verification includes the entry of external measured variables.

### 5.1 Performance characteristics

**Heartbeat Verification** is performed on demand and complements the self-monitoring function, which is performed constantly, with other tests.

The internal verification checks the following inputs and outputs:

- 4-20 mA current output, passive
- Pulse/frequency output, passive
- 4-20 mA current input, passive
- 4-20 mA current output
- Pulse/frequency output

External verification supports verification of the following output modules:

- 4-20 mA current output, passive
- Pulse/frequency output, passive
- 4-20 mA current output
- Pulse/frequency output

The verification is based on references that are incorporated in the measuring device, traceable from the factory and redundant in the device. **Heartbeat Verification** confirms on demand the device function with the total test coverage (TTC).

Confirmed by TÜV Industry Service: **Heartbeat Technology** meets the requirement for traceable verification according to DIN EN ISO 9001: 2008 Chapter 7.6 a) Control of monitoring and measuring equipment.

### 5.2 Commissioning

The configuration (factory reference) required as part of **Heartbeat Verification** is recorded during calibration at the factory and is permanently stored in the measuring device. When verifying in the application, the current situation of the measuring device is compared against this factory reference.

- ▶ When commissioning the measuring device:  
Perform an initial verification to save the results as the initial situation in the measuring device life cycle.

#### 5.2.1 Recording reference data

It is possible to manually record reference data relating to the operator and the location. These reference data appear on the verification report.

**Navigation**

"Setup" menu → Advanced setup → Heartbeat setup → Heartbeat base settings

**Navigation**

"Expert" menu → Diagnostics → Heartbeat → Heartbeat base settings


▶ Heartbeat base settings

**Parameter overview with brief description**

Parameter	Description	User entry
Plant operator	Enter the plant operator.	Max. 32 characters such as letters, numbers or special characters (e.g. @, %, /)
Location	Enter the location.	Max. 32 characters such as letters, numbers or special characters (e.g. @, %, /)

## 5.3 Operation



### 5.3.1 General notes

 The Heartbeat Verification function can be used without restriction on a custody-transfer (CT) measuring device in the custody transfer mode.

**Initial verification**

- ▶ When commissioning the measuring device:  
Perform an initial verification to save the results as the initial situation in the measuring device life cycle.

Initial verification can be performed in 2 ways:

- Internal verification →  20
- External verification →  23

**Device behavior and interpretation**

**Result Passed**

- All test results are within the specifications.
- If the calibration factor and zero point match the factory settings, there is a high degree of certainty that the measuring device complies with the specification for flow and density.
- Verification generally delivers the result Passed in most applications.

**Result Failed**

One or more test results are outside the specifications.

1. Repeat verification.
  - ↳ If the result of the second verification is Passed, the result of the first can be ignored.

2. In order to identify possible variations, compare the current process conditions with those of a previous verification.
3. Ensure defined and stable process conditions to rule out process-specific influences as much as possible.
4. Repeat verification.
5. If the verification repeatedly delivers a Failed result, take the following measures:
6. Calibrate the measuring device.
  - ↳ The calibration has the advantage that the "as found" measuring device state is recorded and the actual measured error is determined.
7. Take remedial action on the basis of the verification results and the diagnostic information of the measuring device.
  - ↳ The cause of the error can be narrowed down if the test group that Failed the verification is identified.

### 5.3.2 Internal verification

The internal verification is performed automatically by the device and without manual checking of external measured variables.


#### Diagnostic behavior

Signals indicating that internal verification is being performed:

- Local display: Status display "In process"
- Duration of test approx. 5 s

#### Performing internal verification

##### Before verification starts

 The entry for the date and time is saved in addition to the current operating time and the results of the verification and also appears in the verification report.

The **Year** parameter, **Month**, **Day**, **Hour**, **AM/PM** and **Minute** are used to manually record the data at the time of verification.

1. Enter date and time.


##### Select the verification mode


2. In the **Verification mode** parameter, select the **Internal verification** option.


##### Start the verification test




3. In the **Start verification** parameter, select the **Start** option.
  - ↳ While the verification is being performed, the progress of the verification is indicated as a % (bar graph indicator) in the **Progress** parameter.

##### Displaying the verification status and result

The current status of the internal verification is indicated in the **Status** parameter (→  22):

- Done  
The verification test is finished.
- Busy  
The verification test is running.
- Not done  
A verification has not yet been performed on this measuring device.
- Failed  
A precondition for performing the verification has not been met, the verification cannot start (e. g. due to unstable process parameters) →  19.














The result of the verification is displayed in the **Overall result** parameter (→  22):

- **Passed**  
All the verification tests were successful.
  - **Not done**  
A verification has not yet been performed on this measuring device.
  - **Failed**  
One or more verification tests were not successful →  19.
-  ▪ The overall result of the last verification can always be accessed in the menu.
- **Navigation:**  
Diagnostics → Heartbeat → Verification results
  - Detailed information on the result of the verification (test groups and test status) is also provided in the verification report in addition to the overall result .
  - If the device does not pass the verification, the results are saved nonetheless and indicated in the verification report.
  - This helps users to perform a targeted search for the cause of the error →  19.










### "Performing verification" wizard

#### Navigation

"Diagnostics" submenu → Heartbeat → Performing verification

► Performing verification	
Year	→  22
Month	→  22
Day	→  22
Hour	→  22
AM/PM	→  22
Minute	→  22
Verification mode	→  22
Start verification	→  22
Progress	→  22
Measured values	→  28
Output values	→  28
Status	→  22
Overall result	→  22

## Parameter overview with brief description

Parameter	Prerequisite	Description	User entry / Selection / User interface	Factory setting
Year	 Can be edited if Heartbeat Verification is not active.	Entry for date and time (field 1): enter the year verification is performed.	9 to 99	10
Month	 Can be edited if Heartbeat Verification is not active.	Entry for date and time (field 2): enter the month verification is performed.	<ul style="list-style-type: none"> <li>▪ January</li> <li>▪ February</li> <li>▪ March</li> <li>▪ April</li> <li>▪ May</li> <li>▪ June</li> <li>▪ July</li> <li>▪ August</li> <li>▪ September</li> <li>▪ October</li> <li>▪ November</li> <li>▪ December</li> </ul>	January
Day	 Can be edited if Heartbeat Verification is not active.	Entry for date and time (field 3): enter the day verification is performed.	1 to 31	1
Hour	 Can be edited if Heartbeat Verification is not active.	Entry for date and time (field 4): enter the hour verification is performed.	0 to 23	12
AM/PM	 Can be edited if Heartbeat Verification is not active.  In the <b>Date/time format</b> parameter (2812), the <b>dd.mm.yy hh:mm am/pm</b> option or the <b>mm/dd/yy hh:mm am/pm</b> option is selected.	Entry for date and time (field 5): enter the morning or afternoon.	<ul style="list-style-type: none"> <li>▪ AM</li> <li>▪ PM</li> </ul>	AM
Minute	 Can be edited if Heartbeat Verification is not active.	Entry for date and time (field 6): enter the minute verification is performed.	0 to 59	0
Verification mode	 Can be edited if Heartbeat Verification is not active.	Select verification mode.  Internal verification Verification is performed automatically by the device and without manual checking of external measured variables.	Internal verification	Internal verification
Start verification	–	Start verification.  Start the verification with the <b>Start</b> option.	<ul style="list-style-type: none"> <li>▪ Cancel</li> <li>▪ Pulse output</li> <li>▪ Frequency output</li> <li>▪ Start verification</li> </ul>	Cancel
Progress	–	Shows the progress of the process.	0 to 100 %	0 %
Status	–	Displays the current status of the verification.	<ul style="list-style-type: none"> <li>▪ Done</li> <li>▪ Busy</li> <li>▪ Failed</li> <li>▪ Not done</li> </ul>	–
Overall result	–	Displays the overall result of the verification.   Detailed description of the classification of the results: →  30	<ul style="list-style-type: none"> <li>▪ Failed</li> <li>▪ Not used</li> <li>▪ Passed</li> <li>▪ Check not done</li> </ul>	–

### 5.3.3 External verification

External verification is similar to the internal verification function but additionally outputs a number of different measured variables. During the verification process, these measured variables are recorded manually with the help of external measuring equipment and entered into the measuring device (e.g. actual value at current output). The value entered is checked and verified by the measuring device to ensure that it complies with the factory specifications. A status of (Passed or Failed) follows, accordingly, and is documented as an individual result of the verification and evaluated in the overall result.

Permanently predefined output signals are simulated during external verification of the outputs. These output signals do not represent the current measured value. To measure the simulated signals, it can be necessary to set the higher-level process control system to a safe state beforehand. In order to perform a verification, the pulse/frequency/switch output must be enabled and assigned to a measured variable.

#### Measured variables for external verification

Output current (current output)

- Simulation of the measured values for every output physically present on the device
- Simulation "Low value" and "High value"
- Measurement of the two values
- Entry of the two measured values in the verification screen

Output frequency (pulse/frequency output)

- Simulation of the measured values for every output physically present on the device
- Simulation value pulse output: Simulated frequency depending on the pulse width configured
- Simulation value frequency output: Maximum frequency



For more information on simulation, see the Operating Instructions.

#### Determining the terminal assignment for the outputs

The terminal assignment depends on the specific device version.

To determine the device-specific terminal assignment:  
See the adhesive label in the terminal cover



For detailed information on the terminal assignment, see the Operating Instructions for the device

#### Measuring equipment requirements

##### *Recommendations for the measuring equipment*

DC current measuring uncertainty	±0.2 %
DC current resolution	10 µA
DC voltage measuring uncertainty	±0.1 %
DC voltage resolution	1 mV
Frequency measuring uncertainty	±0.1 %
Frequency resolution	1 Hz
Temperature coefficient	0.0075 %/°C

### Connecting the measuring equipment in the measuring circuit

#### **⚠ WARNING**

#### **Danger to persons from non-approved equipment in the hazardous area!**


- ▶ Only use intrinsically safe measuring equipment in hazardous zones.
- ▶ Measure intrinsically safe circuits with approved equipment only.
- ▶ Outputs (passive) for the hazardous area may only be connected to suitable intrinsically safe circuits.

#### *Determining the terminal assignment for the outputs*

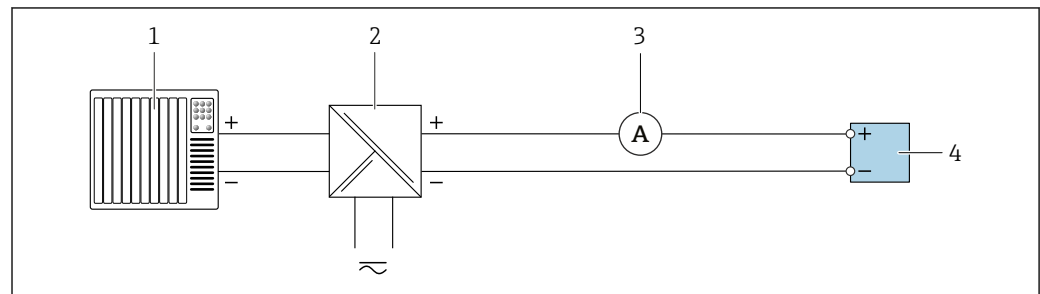
The terminal assignment depends on the specific device version.

To determine the device-specific terminal assignment:

See the adhesive label in the terminal cover

 For detailed information on the terminal assignment, see the Operating Instructions for the device

#### *Passive current output*



A0034446

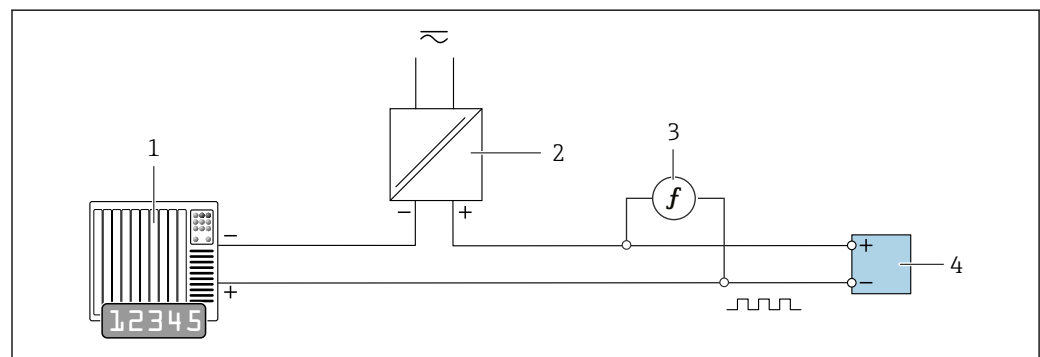
#### 8 External verification of passive current output

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

#### External verification of passive current output

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

#### *Passive pulse/frequency/switch output*



A0034445

#### 9 External verification of passive pulse/frequency output

- 1 Automation system with pulse/frequency input (e.g. PLC)
- 2 Power supply unit
- 3 Frequency meter
- 4 Transmitter



External verification of passive pulse/frequency output

1. Connect the power supply unit
2. Connect the frequency meter in parallel to the pulse/frequency output of the transmitter

### Diagnostic behavior

Signals indicating that external verification is being performed:

Local display: A warning signal is displayed and C

Verification is currently active in the device.



For detailed information on the diagnostics, see the Operating Instructions .

### Performing external verification

A full internal verification is performed in the course of the verification. The validity of the entered and measured values of the outputs is checked. Additional internal verification of the outputs does not take place.

#### NOTICE

**External verification is not possible if no connection has been established and the ammeter is looped in during verification.**

- ▶ Establish a connection before external verification starts.
- ▶ Loop in ammeter before external verification starts.

### Before verification starts



The entry for the date and time is saved in addition to the current operating time and the results of the verification and also appears in the verification report.

The **Year** parameter, **Month**, **Day**, **Hour**, **AM/PM** and **Minute** are used to manually record the data at the time of verification.

1. Enter date and time.



The entry for the date and time is saved in addition to the current operating time and the results of the verification and also appears in the verification report.

### Select the verification mode

2. In the **Verification mode** parameter, select the **External verification** option.

### Further parameter settings

3. In the **External device information** parameter, enter a unique ID (e. g. serial number) for the measuring equipment used (max. 32 characters).
4. In the **Start verification** parameter, select one of the available options (e. g. the **Output 1 low value** option).
5. In the **Measured values** parameter, enter the value displayed on the external measuring equipment.
6. Repeat steps 4 and 5 until all the output options are checked.
7. Adhere to the sequence indicated and enter the measured values.

The duration of the process and number of outputs depend on the device configuration.


The value displayed in the **Output values** parameter (→ 28) indicates the value simulated by the device at the selected output. → 24 .


### Start the verification test


8. In the **Start verification** parameter, select the **Start** option.
  - ↳ While the verification is being performed, the progress of the verification is indicated as a % (bar graph indicator) in the **Progress** parameter.



### Displaying the verification status and result

The current status of the internal verification is indicated in the **Status** parameter (→  22):

- Done  
The verification test is finished.
- Busy  
The verification test is running.
- Not done  
A verification has not yet been performed on this measuring device.
- Failed  
A precondition for performing the verification has not been met, the verification cannot start (e. g. due to unstable process parameters) →  19.

The result of the verification is displayed in the **Overall result** parameter (→  22):







- Passed  
All the verification tests were successful.
- Not done  
A verification has not yet been performed on this measuring device.
- Failed  
One or more verification tests were not successful →  19.

-  ■ The overall result of the last verification can always be accessed in the menu.
- Navigation:  
Diagnostics → Heartbeat → Verification results
- Detailed information on the result of the verification (test groups and test status) is also provided in the verification report in addition to the overall result .
- If the device does not pass the verification, the results are saved nonetheless and indicated in the verification report.
- This helps users to perform a targeted search for the cause of the error →  19.

### "Performing verification" wizard







#### Navigation






"Diagnostics" submenu → Heartbeat → Performing verification

▶ Performing verification	
Year	→  27
Month	→  27
Day	→  27
Hour	→  27
AM/PM	→  27
Minute	→  27

Verification mode	→ ⓘ 28
External device information	→ ⓘ 28
Start verification	→ ⓘ 28
Status	→ ⓘ 28
Measured values	→ ⓘ 28
Output values	→ ⓘ 28
Overall result	→ ⓘ 28

**Parameter overview with brief description**

Parameter	Prerequisite	Description	User entry / Selection / User interface	Factory setting
Year	 Can be edited if Heartbeat Verification is not active.	Entry for date and time (field 1): enter the year verification is performed.	9 to 99	10
Month	 Can be edited if Heartbeat Verification is not active.	Entry for date and time (field 2): enter the month verification is performed.	<ul style="list-style-type: none"> <li>▪ January</li> <li>▪ February</li> <li>▪ March</li> <li>▪ April</li> <li>▪ May</li> <li>▪ June</li> <li>▪ July</li> <li>▪ August</li> <li>▪ September</li> <li>▪ October</li> <li>▪ November</li> <li>▪ December</li> </ul>	January
Day	 Can be edited if Heartbeat Verification is not active.	Entry for date and time (field 3): enter the day verification is performed.	1 to 31	1
Hour	 Can be edited if Heartbeat Verification is not active.	Entry for date and time (field 4): enter the hour verification is performed.	0 to 23	12
AM/PM	 Can be edited if Heartbeat Verification is not active.  In the <b>Date/time format</b> parameter (2812), the <b>dd.mm.yy hh:mm am/pm</b> option or the <b>mm/dd/yy hh:mm am/pm</b> option is selected.	Entry for date and time (field 5): enter the morning or afternoon.	<ul style="list-style-type: none"> <li>▪ AM</li> <li>▪ PM</li> </ul>	AM
Minute	 Can be edited if Heartbeat Verification is not active.	Entry for date and time (field 6): enter the minute verification is performed.	0 to 59	0

Parameter	Prerequisite	Description	User entry / Selection / User interface	Factory setting
Verification mode	 Can be edited if Heartbeat Verification is not active.	Select verification mode. External verification Similar to internal verification but with the entry of external measured variables: <b>Measured values</b> parameter.	External verification	Internal verification
External device information	With the following conditions: <ul style="list-style-type: none"> <li>▪ In the <b>Verification mode</b> parameter (→  22), the <b>External verification</b> option is selected.</li> <li>▪ Can be edited if verification status is not active.</li> </ul>	Record measuring equipment for external verification.	Free text entry	–
Start verification		Start verification. To carry out a complete verification, select the selection parameters individually. Once the external measured values have been recorded, verification is started using the <b>Start</b> option.	<ul style="list-style-type: none"> <li>▪ Cancel</li> <li>▪ Pulse output</li> <li>▪ Frequency output</li> <li>▪ Start verification</li> </ul>	Cancel
Measured values	One of the following options is selected in the <b>Start verification</b> parameter (→  22): <ul style="list-style-type: none"> <li>▪ Output 1 low value</li> <li>▪ Output 1 high value</li> <li>▪ Output 2 low value</li> <li>▪ Output 2 high value</li> <li>▪ Frequency output 1</li> <li>▪ Pulse output 1</li> </ul>	Displays the references for the external measured variables. Pulse/frequency output: Output frequency in [Hz]	Signed floating-point number	0
Output values	–	Displays the references for the external measured variables. Pulse/frequency output: Output frequency in [Hz].	Signed floating-point number	0
Progress	–	Shows the progress of the process.	0 to 100 %	0 %
Status	–	Displays the current status of the verification.	<ul style="list-style-type: none"> <li>▪ Done</li> <li>▪ Busy</li> <li>▪ Failed</li> <li>▪ Not done</li> </ul>	–
Overall result	–	Displays the overall result of the verification.  Detailed description of the classification of the results: →  30	<ul style="list-style-type: none"> <li>▪ Failed</li> <li>▪ Not used</li> <li>▪ Passed</li> <li>▪ Check not done</li> </ul>	–

### 5.3.4 Verification results

Access to the verification results:

In the operating menu via the local display, operating tool

– Diagnostics → Heartbeat → Verification results

– Expert → Diagnostics → Heartbeat → Verification results

#### Navigation




"Diagnostics" submenu → Heartbeat → Verification results





**Navigation**

"Expert" menu → Diagnostics → Heartbeat → Verification results

► Verification results		
Date/time		→ ⓘ 29
Verification ID		→ ⓘ 29
Operating time		→ ⓘ 29
Overall result		→ ⓘ 29
Sensor		→ ⓘ 29
Main electronic module		→ ⓘ 29
I/O module		→ ⓘ 30

**Parameter overview with brief description**

Parameter	Prerequisite	Description	User interface	Factory setting
Date/time	The verification has been performed.	Date and time.	dd.mmmm.yyyy; hh:mm	1 January 2010; 12:00
Verification ID	The verification has been performed.	Displays consecutive numbering of the verification results in the measuring device.	0 to 65535	0
Operating time	The verification has been performed.	Indicates how long the device has been in operation up to the verification.	Days (d), hours (h), minutes (m), seconds (s)	-
Overall result	-	Displays the overall result of the verification.  Detailed description of the classification of the results: → ⓘ 30	<ul style="list-style-type: none"> <li>▪ Failed</li> <li>▪ Not used</li> <li>▪ Passed</li> <li>▪ Check not done</li> </ul>	-
Sensor	In the <b>Overall result</b> parameter, the <b>Failed</b> option is displayed.	Displays the result for the sensor.  Detailed description of the classification of the results: → ⓘ 30	<ul style="list-style-type: none"> <li>▪ Failed</li> <li>▪ Not used</li> <li>▪ Passed</li> <li>▪ Check not done</li> </ul>	Check not done
Main electronic module	In the <b>Overall result</b> parameter, the <b>Failed</b> option is displayed.	Displays the result for the sensor electronics module (ISEM).  Detailed description of the classification of the results: → ⓘ 30	<ul style="list-style-type: none"> <li>▪ Failed</li> <li>▪ Not used</li> <li>▪ Passed</li> <li>▪ Check not done</li> </ul>	Check not done

Parameter	Prerequisite	Description	User interface	Factory setting
I/O module	In the <b>Overall result</b> parameter, the <b>Failed</b> option is displayed.	Displays the result for I/O module monitoring of the I/O module. <ul style="list-style-type: none"> <li>For pulse output: Accuracy of pulses (for external verification only)</li> <li>For frequency output: Accuracy of frequency (for external verification only)</li> </ul>  Detailed description of the classification of the results: →  30	<ul style="list-style-type: none"> <li>Failed</li> <li>Not used</li> <li>Passed</li> <li>Check not done</li> </ul>	Check not done
System status	In the <b>Overall result</b> parameter, the <b>Failed</b> option is displayed.	Displays the system condition. Tests the measuring device for active errors.  Detailed description of the classification of the results: →  30	<ul style="list-style-type: none"> <li>Failed</li> <li>Not used</li> <li>Passed</li> <li>Not done</li> </ul>	Not done


## Classification of results


### Individual results

Result	Description
Failed	At least one individual test in the test group was outside the specifications.
Not used	The result is used for internal purposes.
Passed	All individual tests in the test group complied with the specifications. The result is also "Passed" if the result of an individual test is "Check not done" and the result of all other tests is "Passed".
Not done	No test has been performed for this test group.

### Overall results

Result	Description
Failed	At least one test group was outside the specifications.
Not used	The result is used for internal purposes.
Passed	All verified test groups complied with the specifications (result "Passed"). The overall result is also "Passed" if the result for an individual test group is "Check not done" and the result for all other test groups is "Passed".
Not done	No verification was performed for any of the test groups (result for all test groups is "Check not done").

 If a result is classified as **Check not done**, the output concerned has not been used.


 **Heartbeat Verification** confirms the device function within the specified measuring tolerance on demand with a TTC <sup>2)</sup> > 95 %. Based on redundant references in the device which are traceable from the factory, **Heartbeat Technology** meets all the requirements concerning traceable device verification according to DIN EN ISO 9001:2008.

2) Total Test Coverage

*Test groups*

Test group	Description
Sensor	Electrical components of the sensor (signals, circuits and cables)
Main electronics module	Electronics module for control and conversion of the sensor signals
I/O electronics module	Results of the input and output modules installed on the measuring device. During internal verification, the actual current at the output is relayed back and compared with the set point.

For more information on the test groups and individual tests .

-  The results for a test group (e.g. sensor) contain the result of several individual tests. All the individual tests must be passed for the test group to pass.

The same applies to the overall result: All the test groups must pass for the overall result to be "passed". Information on the individual tests is provided in the verification report and the detailed verification results which can be accessed with the Flow Verification DTM.

**Limit values***I/O module*

Input; Output	Internal verification	External verification
Pulse output	Only external verification is possible.	Simulation: 1 pulse/s, pulse width 100 ms, with 1000 pulses $\pm 10$ pulses
Frequency output	Only external verification is possible.	$\pm 0.1$ %

**5.3.5 Detailed verification results**

The process conditions at the time of verification and the individual test group results can be accessed with the Flow Verification DTM.

- Process conditions: "VerificationDetailedResults → VerificationActualProcessConditions"
- Verification results: "VerificationDetailedResults → VerificationSensorResults"

**Process conditions**

To increase the comparability of the results, the process conditions that apply at the time of verification are recorded.

Process conditions	Description, value range
Mass flow	Current measured value for mass flow
Density	Current measured value for density
Damping	Current measured value for measuring tube damping
Process temperature	Current measured value for medium temperature (if available)
Electronic temperature	Current measured value for the electronic temperature in the transmitter

**Individual test group results**

The individual test group results listed below provide information on the results of the individual tests within a test group.

*Sensor*

Parameter/individual test	Description	Result/limit value	Interpretation/cause/remedial measures
Measuring tube temperature sensor	Condition of the measuring tube temperature sensor: Intact/not intact (short-circuit/open circuit)	No value range <ul style="list-style-type: none"> <li>■ Passed</li> <li>■ Failed</li> </ul>	<ul style="list-style-type: none"> <li>▶ Check connecting cable between sensor and transmitter</li> <li>▶ Replace sensor</li> </ul>
Carrier tube temperature sensor (Not Promass E)	Condition of the carrier tube temperature sensor: Intact/not intact (short-circuit/open circuit)	No value range <ul style="list-style-type: none"> <li>■ Passed</li> <li>■ Failed</li> </ul>	<ul style="list-style-type: none"> <li>▶ Check connecting cable between sensor and transmitter</li> <li>▶ Replace sensor</li> </ul>
Sensor coil symmetry	Monitoring of the signal amplitude between the inlet and outlet sensor	No value range <ul style="list-style-type: none"> <li>■ Passed</li> <li>■ Failed</li> </ul>	<p>Indication of mechanical damage or electronic interference</p> <ul style="list-style-type: none"> <li>▶ Check connecting cable between sensor and transmitter</li> <li>▶ Replace sensor</li> </ul>
Lateral mode frequency	Monitoring of the oscillation frequency of the measuring tube/tubes	No value range <ul style="list-style-type: none"> <li>■ Passed</li> <li>■ Failed</li> </ul>	<ul style="list-style-type: none"> <li>▶ Check whether the sensor is outside the operational range</li> <li>▶ Check for damage on the measuring tube, e.g. as a result of corrosion</li> <li>▶ Check connecting cable between sensor and transmitter</li> <li>▶ Replace sensor</li> </ul>




*HBSI*

Parameter/individual test	Description	Result/limit value	Interpretation/cause/remedial measures
HBSI	Monitoring of the relative change of the entire sensor, with all its electrical, mechanical and electromechanical components incorporated in the sensor housing (including the measuring tube, electrodynamic sensors, excitation system, cables etc.), in % of the reference value.	No value range <ul style="list-style-type: none"> <li>■ Passed</li> <li>■ Failed</li> </ul>	<ul style="list-style-type: none"> <li>▶ Deviations of the HBSI value indicate corrosion, abrasion or other damage, such as shock/impact. If the result is "Failed", the sensor is seriously impaired and must be checked.</li> </ul>

*System condition*


Parameter/individual test	Description	Result/limit value	Interpretation/cause/remedial measures
System condition	System condition monitoring	No value range <ul style="list-style-type: none"> <li>■ Passed</li> <li>■ Failed</li> <li>■ Not done</li> </ul>	<p><b>Causes</b> System error during verification.</p> <p><b>Corrective action</b></p> <ul style="list-style-type: none"> <li>▶ Check diagnostic event in the <b>Event logbook</b> submenu.</li> </ul>

*I/O modules*

Parameter/individual test	Description	Result/limit value	Interpretation/cause/remedial measures
Output 1 to n	Checking of all the input and output modules installed at the measuring device →  18	No value range <ul style="list-style-type: none"> <li>■ Passed</li> <li>■ Failed</li> <li>■ Not done</li> </ul> <p> Limit values →  31</p>	<p><b>Causes</b></p> <ul style="list-style-type: none"> <li>■ Output values out of specification.</li> <li>■ I/O modules defective.</li> </ul> <p><b>Corrective action</b></p> <ul style="list-style-type: none"> <li>▶ Check cabling.</li> <li>▶ Check connections.</li> <li>▶ Check load (current output).</li> <li>▶ Replace the I/O module.</li> </ul>



### 5.3.6 Verification report

The results of the verification can be documented in the form of a verification report via the FieldCare operating tool →  11. The verification report is created on the basis of the data records saved in the measuring device after verification. As the verification results are automatically and uniquely identified with a verification ID and the operating time, they are suitable for the traceable documentation of the verification of flowmeters.

#### First page

Measuring point identification, identification of the verification results and confirmation of completion:

- System operator
  - Customer reference
- Device information
  - Information on the place of operation (tag) and the current configuration of the measuring point
  - Management of the information in the device
  - Display on the verification report
- Calibration
  - Information on the calibration factor and zero point setting for the sensor
  - These values must correspond to those from the last calibration or repeat calibration in order to comply with factory specifications
- Verification information
  - The operating time and verification ID are used to uniquely assign the verification results for the traceable documentation of the verification
  - Storage and display of the manual date and time entry as well as the current operating time in the device
  - Verification mode: internal or external verification
- Overall verification result
  - Overall result of the verification passed if all of the individual results are passed


#### Second page

Details on the individual results for all test groups:

- System operator
- Test groups
  - Sensor
  - Main electronics module
  - System condition
  - I/O module

As a prerequisite for the validity of the verification report, the **Heartbeat Verification** feature must be activated on the measuring device concerned and must have been performed by an operator tasked to carry out this job by the customer. Alternatively, an Endress+Hauser service technician or a service provider authorized by Endress+Hauser can be tasked with performing the verification.

## Verification report



People for Process Automation


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**Plant operator:**

---

**Device information**

Location	Location 14
Device tag	M-745
Module name	ProXX
Nominal diameter	DNxx
Device name	ProXX
Order code	8F3B25-725
Serial number	1234567890
Firmware version	01.01.00



**Calibration**

Calibration factor	2.10
Compensated calibration factor	10

**Verification information**

Operating time (counter)	12d15h32min12s
Date/time (manually recorded)	02.10.2017/12:00
Verification ID	17
Verification mode	External verification

**Overall verification result\***

<input checked="" type="checkbox"/> Passed	Details see next page
--	-----------------------

\*Result of the complete device functionality test via Heartbeat Technology

**Confirmation**

Heartbeat Verification verifies the function of the flowmeter within the specified measuring tolerance, over the useful lifetime of the device, with a total test coverage > 94 %, and complies with the requirements for traceable verification according to DIN EN ISO 9001:2008 – Section 7.6 a. (attested by TÜV-SÜD Industrieservices GmbH)

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**Notes**

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Date

Operator's signature


Inspector's signature

www.endress.com


Device DTM

Page 1

A0031154-EN

 10 Example of a verification report (Page 1)

The remaining pages of the verification report list the individual test groups and the individual test group results.

 Individual test groups and description of individual tests:

Verification Report Promass

**Endress+Hauser** 

People for Process Automation

---

**Plant Operator:**

---

**Device Identification and Verification Identification**

Serial number	452633345
Device tag	M-745
Verification ID	17



<b>Sensor</b>	<b>✔ Passed</b>
Pickup coil	✔ Passed
Measuring tube temperature sensor	✔ Passed
Carrier tube temperature sensor	✔ Passed
Pickup coil symmetry	✔ Passed
Frequency lateral mode	✔ Passed
Sensor circuit leakage	✔ Passed
<b>Main electronic module</b>	<b>✘ Failed</b>
Supply voltage	✔ Passed
Zero point tracking	✘ Failed
Reference clock	✔ Passed
Reference temperature	✔ Passed
<b>System status</b>	<b>✔ Passed</b>
<b>I/O module</b>	<b>✔ Passed</b>
Output 1	✔ Passed*
Output 2	🔍 Check not done*

\*External verification

**Information about the External Verification**

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Fluke 2354, Cal: 10.0.2012, F. Maier

www.endress.com

Page 2

 11 Example of a verification report (Page 2)

 Data administration with FieldCare (Flow Verification DTM): →  11


### 5.3.7 Interpreting and using the verification results

**Heartbeat Verification** uses the self-monitoring function of the Proline flowmeters to check the measuring device functionality. During the verification process, the system checks whether the measuring device components comply with the factory specifications. Both the sensor and the electronics modules are included in the tests.

Compared to flow calibration, which incorporates the entire measuring device and assesses the flow measuring performance directly (primary measured variable), **Heartbeat Verification** checks the function of the measuring chain from the sensor to the outputs.

Here, the function checks device-internal parameters that are correlated with flow measurement (secondary measured variables, comparative values). The check is based on reference values that were recorded during the factory calibration.

If a verification is passed, this confirms that the comparison values that are checked are within the factory specification and that the measuring device is working correctly. At the same time, the zero point and calibration factor of the sensor are documented and traceable in the verification report. To ensure that the measuring device complies with the factory specification, these values must correspond to those of the last calibration or repeat calibration.

-  Confirmation of compliance with the flow specifications with a total test coverage of 100 % is only possible by verifying the primary measured variable (flow) by recalibrating or by proving the value.
- **Heartbeat Verification** confirms the device function within the specified measuring tolerance on demand with a TTC<sup>3)</sup> > 95 %.

Recommended course of action if the result of a verification is **Failed**:


If the result of a verification is **Failed**, it is advisable to begin by repeating the verification. This applies in particular if the individual tests of the **Sensor** test group are concerned, as a process-related influence is then possible.

In this case, it is advisable to compare the current process conditions to those of a previous verification to identify any deviations. To inhibit process-related influences as much as possible, the ideal solution is to establish defined and stable process conditions and then to repeat the verification.

Stabilize or stop flow, ensure that process temperature is stable, drain the sensor if possible.

Recommended remedial action if the result of the verification is **Failed**:

- Calibrate the measuring device  
The calibration has the advantage that the "as found" measuring device state is recorded and the actual measured error is determined.
- Direct remedial measures  
Take remedial action on the basis of the verification results and the diagnostic information of the measuring device. Narrow down the possible cause of the error by identifying the test group that **failed** the verification.

 For detailed information on the diagnostics, see the Operating Instructions .

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3) Total Test Coverage







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