

Special Documentation

Proline Promag 10

Heartbeat Verification + Monitoring application package
IO-Link



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1 Certification

Certification is issued by an independent certification body.

The following requirements are certified:

- Inspection method
- Test principles
- Test results with total test coverage (TTC) specified
- Traceable verification as per DIN EN ISO 9001:2015, Clause 7.1.5/7.1.2 a)



Requirements according to DIN EN ISO 9001

Heartbeat Technology™ also meets the requirements for traceable verification according to DIN EN ISO 9001: 2015 - Clause 7.1.5/7.1.5.2 a) "Control of monitoring and measuring equipment". According to the standard, the user is responsible for specifying the verification interval in accordance with requirements.

Further information on documentation → 6

2 About this document

2.1 Document function

This manual is 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

2.3.1 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 potentially dangerous situation. Failure to avoid this situation can result in serious or fatal injury.

CAUTION

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

NOTICE

This symbol alerts you to a potentially harmful situation. Failure to avoid this situation can result in damage to the product or something in its vicinity.

2.3.2 Symbols for certain types of information

Symbol	Meaning
	Permitted Procedures, processes or actions that are permitted.
	Preferred Procedures, processes or actions that are preferred.
	Forbidden Procedures, processes or actions that are forbidden.
	Tip Indicates additional information.
	Reference to documentation
	Reference to page
	Reference to graphic
	Notice or individual step to be observed
	Series of steps

Symbol	Meaning
	Result of an individual step
 A0028662	Operation via local display
 A0028663	Operation via operating tool
 A0028665	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:

- *Device Viewer* (www.endress.com/deviceviewer): Enter the serial number from the nameplate
- *Endress+Hauser Operations app*: Enter serial number from nameplate or scan matrix code on nameplate.



This Special Documentation is available:

In the Download Area of the Endress+Hauser Internet site: www.endress.com → Downloads

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

Measuring instrument	Documentation code
Promag D 10	BA02490D
Promag H 10	BA02300D
Promag P 10	BA02491D
Promag W 10	BA02492D

Certification	Documentation code
Manufacturer declaration Promag 10	HE_01407

2.5 Registered trademarks



IO-Link®

Is a registered trademark. It may only be used in conjunction with products and services by members of the IO-Link Community or by non-members who hold an appropriate license. For more specific guidelines on use, refer to the IO-Link Community rules on:

www.io-link.com.

3 Product features and availability

3.1 Product features

Heartbeat Technology offers diagnostic functionality through continuous self-monitoring, the transmission of additional measured variables to an external Condition Monitoring system and the in situ verification of flowmeters in the application.

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

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

λ_{TOT} : Rate of all theoretically possible failures

λ_{du} : Rate of undetected dangerous failures

Only the dangerous undetected failures that are not captured by the device diagnostics can falsify the measured value that is output or interrupt the output of measured values.

Heartbeat Technology checks the device function within the specified measuring tolerance with a defined total test coverage. The defined total test coverage is indicated in the product-specific TÜV certificate (TÜV = Technical Inspection Association).



The current value for the total test coverage depends on the configuration and integration of the measuring instrument. It is determined under the following basic conditions:

- Simulation operation not active
- Settings for diagnostic behavior correspond to factory settings

3.2 Availability of the application package

The application package can be ordered together with the device or can be activated subsequently with an activation code. Detailed information on the order code is available via the Endress+Hauser website www.endress.com or from your local Endress+Hauser Sales Center.

3.2.1 Order code

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

Order code for "Application package", option EB "Heartbeat Verification + Monitoring"

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

- Order code with breakdown of the device features on the delivery note
- Open the Device Viewer via the website www.endress.com/deviceviewer: Enter the serial number on the nameplate and check whether the order code is displayed
- In the operating menu System → Software configuration : 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:

System → Device management

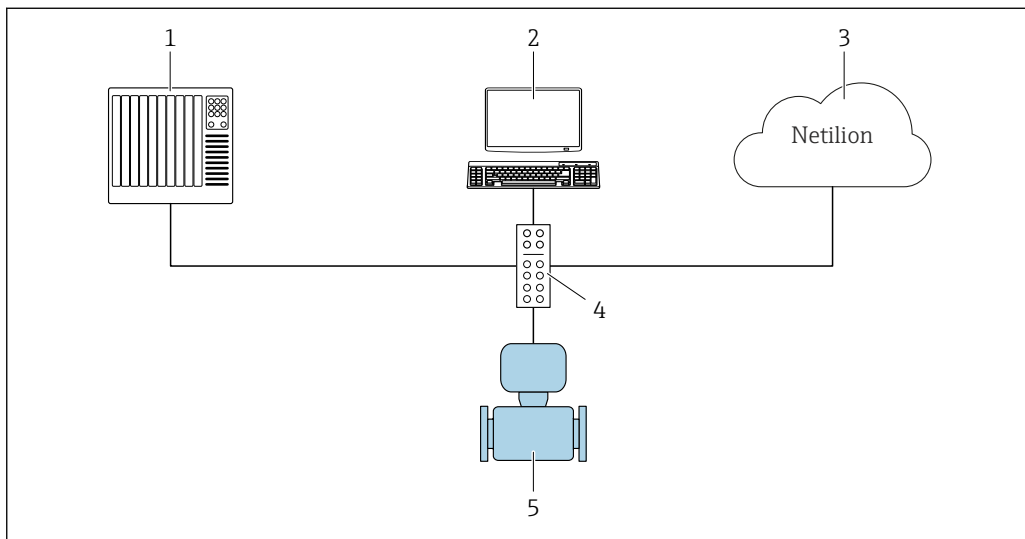
- ▶ Enter the activation code.
 - ↳ The application package is available.
The **Software option overview** parameter displays the packages that are currently activated.

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

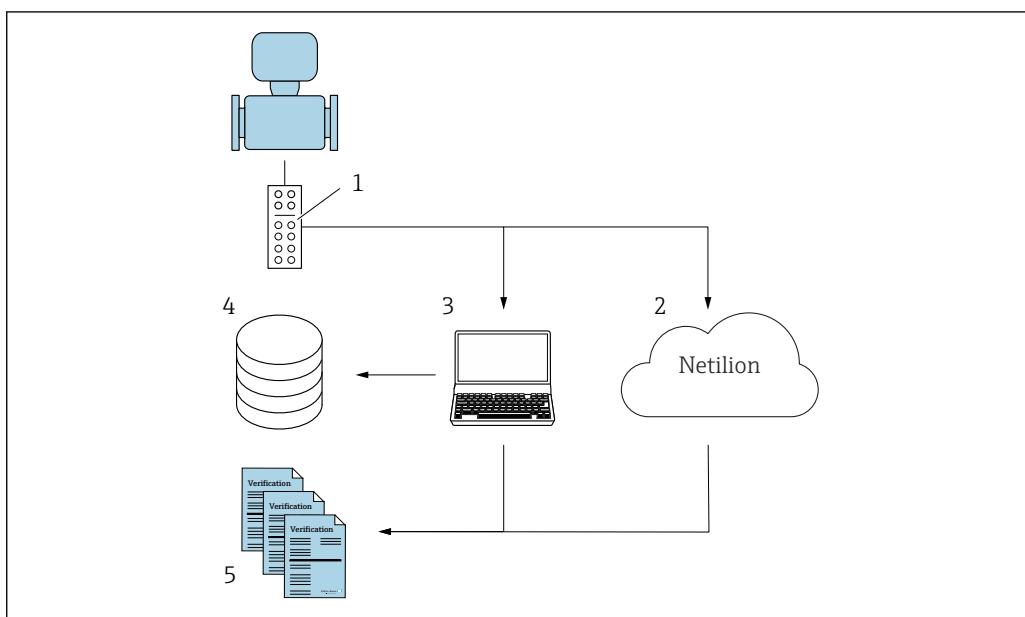
The **Heartbeat Technology** features are available via the digital interfaces. The features can be used via an asset management system, the automation infrastructure (e.g. PLC) or the Netilion cloud platform.



 1 *General screen layout*

- 1 PLC
- 2 Asset management system
- 3 Netilion cloud platform
- 4 IO-Link master
- 5 Measuring instrument

4.1 Performing verification and creating a verification report



- 1 *IO-Link master*
- 2 *Netilion cloud platform*
- 3 *FieldCare*
- 4 *Data archive (via Flow Verification DTM)*
- 5 *Verification report*

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

- System integration interface of a higher-level system
- Bluetooth
- Common Data Interface CDI

The device must be accessed externally from a higher-level system via the system integration interface in order to start a verification and relay the verification result (Passed or Failed).

The detailed results of the verification (3 data record) are saved in the device and provided in the form of a verification report.

Verification reports can be generated with the help of the CDI DTM, or Endress+Hauser's FieldCare plant asset management software.

With the Flow Verification DTM, FieldCare also offers the possibility of data management and of archiving the verification results to create traceable documentation.

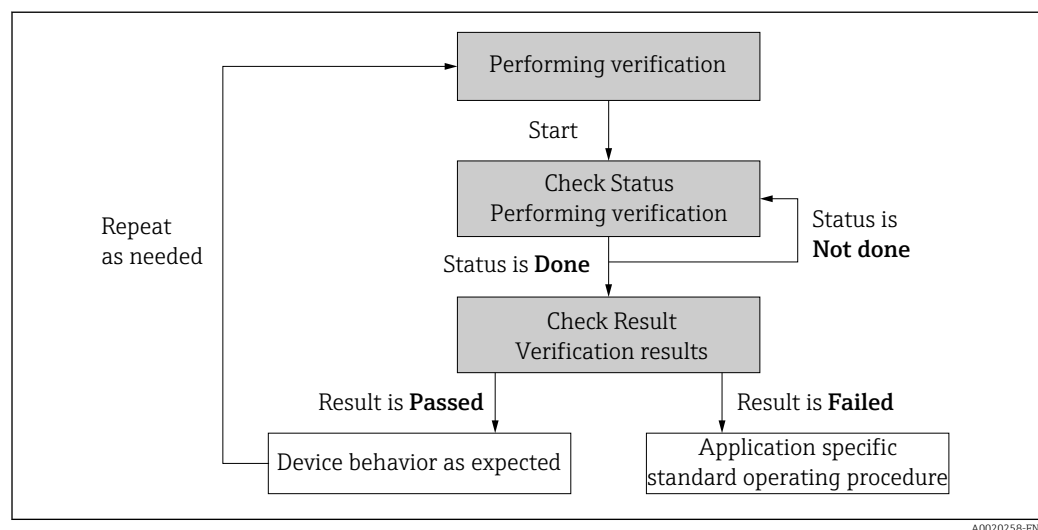
The Flow Verification DTM also enables trend analysis – i.e. the ability to monitor, compare and track the verification results of all the verifications performed on the device. This can be used for evaluation purposes, for example to extend recalibration intervals .

Data exchange can take place automatically or be triggered by a user.

4.2 Integration in the PLC system

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

The following procedure must be implemented for this purpose:



A0020258-EN

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

4.3 Data availability for the user

The data from the **Heartbeat Monitoring** function and the **Heartbeat Verification** function can be made available in different ways.

4.3.1 IO-Link Engineering Tool

Heartbeat Verification

- Start verification
- Read out the last verification result.

Heartbeat Monitoring

The user can read the monitoring measured variables in the operating menu.

4.3.2 Asset management system

Heartbeat Verification

- Start verification in the operating menu.
- Read out, archive and document the verification results including detailed results with flow verification DTM and devices DTM.

Heartbeat Monitoring

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

4.3.3 PLC system

Heartbeat Verification

- Start verification
- The user can read the verification result (pass/fail) in the system.

Heartbeat Monitoring

Configuration of the monitoring function: specify which monitoring parameters are output continuously via the system integration interface (acyclic query).



ISDU = 9038 or 0x234E



For detailed on the IO-Link, see the "IO-Link" Special Documentation for the device
→ 6.

4.4 Data management

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

- Availability of 3 storage locations for parameter data sets
- New verification results overwrite old data following the FIFO ¹⁾ principle

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

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)

4.4.1 Data management via Device Type Manager (DTM)

Using the device DTM, you can operate the device and perform a **Heartbeat Verification**. The verification results can be displayed and a verification report created.



The Commubox FXA291 is required for connection between the device and the computer/laptop.

1) First In – First Out

5 Heartbeat Verification

Heartbeat Verification checks the device function within the specified measuring tolerance on demand. The result of the verification is "Passed" or "Failed".

The verification data are saved in the device and optionally archived on a PC with the Asset Management Software DeviceCare or FieldCare on a PC. Based on this data, a verification report is generated automatically to ensure that traceable documentation of the verification results is available.

Heartbeat Technology offers the following option for Heartbeat Verification:

Standard verification →  14

Verification is performed by the measuring instrument without manual checking of external measured variables.

5.1 Traceability according to ISO 9001

Heartbeat Verification performs a verification of the measuring instrument on demand, within the specified measuring tolerance and with confirmed total test coverage. This method fulfills the requirement for traceable verification according to ISO 9001:2015, Section 7.1.5.2 Measurement traceability.

The certificate issued by an independent body (TÜV SÜD Industrieservices GmbH) is available via: *Device Viewer* (www.endress.com/deviceviewer): Enter serial number from nameplate.

5.2 Performance characteristics

Heartbeat Verification is performed on demand and complements self-monitoring, which is permanently performed, with extended checks (electronic power loss, coil circuit measurement, surge circuit, electrode signal integrity).

The test is based on device-internal, factory-traceable references that are implemented redundantly in the device. **Heartbeat Verification** confirms the device function on request with the specified total test coverage.

Assessed by an independent body: **Heartbeat Technology** meets the requirement for traceable verification according to DIN EN ISO 9001: 2015 Clause 7.1.5.2 a) Control of monitoring and measuring equipment.

5.3 Commissioning

 Recommendation: During the process of commissioning the measuring instrument, an initial verification (and all additional verifications during the life cycle) is performed under process or reference conditions →  11.

Results are archived as the baseline in the measuring instrument life cycle until the 3rd verification. From the 4th verification onwards, you are recommended to print out verification reports or upload data using the Flow Verification DTM to ensure the integrity and traceability of the previous verifications.

5.3.1 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

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

▶ Heartbeat base settings

Plant operator

→ 13

Location

→ 13

Partially filled pipe

→ 13

Parameter overview with brief description

Parameter	Description	User entry / Selection
Plant operator	Enter plant operator.	Max. 32 characters, such as letters, numbers or special characters (e.g. @, %, /)
Location	Enter the location where the measuring device is mounted. Information appears in the verification report.	Max. 32 characters, such as letters, numbers or special characters (e.g. @, %, /)
Partially filled pipe	Indicate, if the measuring tube is partially filled during the verification process in order to avoid evaluating the EPD electrode cable.	■ No ■ Yes

5.4 Operation

5.4.1 General information

Initial verification

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

Initial verification is carried out in accordance with the standard verification → 14

Device behavior and interpretation

Result is "Passed"

All test results are within the specifications.

If the calibration factor and the zero point match the most recent calibration values, there is a high degree of certainty that the measuring instrument complies with the specification for flow.

Result is "Failed"

One or more test results are out of specification.

If the result of the verification is "Failed", take the following measures:

1. Establish defined and stable process conditions.
 - ↳ Ensure a constant process temperature.
Avoid two-phase flow, pulsating flow, pressure shocks and very high flow rates.

2. Repeat verification.

↳ Result is "Passed"

If the result of the repeat verification is "Passed", the result of the first verification can be ignored. In order to identify possible deviations, compare the current process conditions with the process conditions of a previous verification.

If the result of the verification is "Failed" again, take the following measures:

1. Take remedial action on the basis of the verification results and the diagnostic information of the measuring instrument.

↳ The cause of the error can be narrowed down if the test group that "Failed" the verification is identified.

2. Provide Endress+Hauser Service with the verification result with the current process conditions.

3. Check the calibration or calibrate the measuring instrument.

↳ The calibration has the advantage that the "as found" measuring instrument state is recorded and the actual measurement error is determined.

5.4.2 Standard verification

Standard verification is performed automatically by the device and without manual checking of external measured variables. The outputs and inputs are not verified during standard verification. This can only be performed with extended verification.

Diagnostic behavior

The device signals that standard verification is in progress: **△C302 Device verification active** diagnostic message

- Factory setting for diagnostic behavior: warning
- The device continues to measure.
- The last good value is output intermittently for 10 seconds.
- Test duration: approx. 60 seconds.
- All measured values during the verification are added to the totalizers.

The diagnostic behavior can be reconfigured by the user if necessary: If set to alarm, measured value output is interrupted, and the signal outputs and totalizers adopt the defined alarm condition.



For detailed information on diagnostics and troubleshooting and for diagnostics information and associated remedial action, see the Operating Instructions → 6.

Performing standard verification

Before verification starts



The date and time are saved with the current operating time and the verification results and also appear in the verification report.

Select the verification mode

1. In the **Verification mode** parameter, select the **Standard verification** option.

Starting the verification test

2. 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 status and verification result

The current status of standard verification is displayed in the **Status** parameter (→  16):

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

The verification result is displayed in the **Overall result** parameter (→  16):

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



- The most recent verification result can be retrieved at any time in the menu.
- Navigation:
Diagnostics → Heartbeat Technology → Verification results
- Detailed information on the verification result (test groups and test status) are shown in the verification report in addition to the overall verification 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 →  13.

"Performing verification" submenu

Navigation

"Diagnostics" menu → Heartbeat Technology → Performing verification

► Performing verification	
Plant operator	→  16
Location	→  16
Partially filled pipe	→  16
Start verification	→  16
Status	→  16
Date/time	→  16
Progress	→  16
Verification result	→  16

Parameter overview with brief description

Parameter	Description	User entry / User interface / Selection
Plant operator	Enter plant operator.	Max. 32 characters, such as letters, numbers or special characters (e.g. @, %, /)
Location	Enter the location where the measuring device is mounted. Information appears in the verification report.	Max. 32 characters, such as letters, numbers or special characters (e.g. @, %, /)
Status	Shows the status of the record process of the reference values.	■ Done ■ Busy ■ Failed ■ Not done
Partially filled pipe	Indicate, if the measuring tube is partially filled during the verification process in order to avoid evaluating the EPD electrode cable.	■ No ■ Yes
Start verification	Start verification.	■ Cancel ■ Start
Status	Shows the actual status.	■ Done ■ Busy ■ Failed ■ Not done
Date/time	Shows the date and time.	Date and time
Progress	Shows the progress of the process.	0 to 100 %
Verification result	Shows the overall result of the verification.	■ Not supported ■ Passed ■ Not done ■ Failed

5.4.3 Verification results

Access to the verification results:

Using the local display or operating tool

The following parameters can be viewed in the operating menu and in the Heartbeat Technology verification report:

Navigation

"Diagnostics" submenu → Heartbeat → Verification results

► Verification results		
Date/time	→	 17
Verification ID	→	 17
Operating time	→	 17
Verification result	→	 17
Sensor	→	 17
Sensor electronic module (ISEM)	→	 17

I/O module	→ 17
System status	→ 17

Parameter overview with brief description

Parameter	Prerequisite	Description	User interface
Date/time	–	Displays the date and time of the verification.	Date and time
Verification ID	–	Shows the verification ID that identifies the dataset. It is also displayed in the verification report.	0 to 65 535
Operating time	–	Indicates how long the device has been in operation.	Days (d), hours (h), minutes (m), seconds (s)
Verification result	–	Shows the overall result of the verification.	■ Not supported ■ Passed ■ Not done ■ Failed
Sensor	In the Overall result parameter, the Failed option was displayed.	Shows the overall result for the “sensor” test group.	■ Not supported ■ Passed ■ Not done ■ Failed
Sensor electronic module (ISEM)	In the Overall result parameter, the Failed option was displayed.	Shows the overall result for the “sensor electronic module” test group.	■ Not supported ■ Passed ■ Not done ■ Failed
I/O module	In the Overall result parameter, the Failed option was displayed.	Shows the overall result for the “I/O module” test group.	■ Not supported ■ Passed ■ Not done ■ Failed
System status	In the Overall result parameter, the Failed option was displayed.	Shows the result of the system condition monitoring.	■ Not supported ■ Passed ■ Not done ■ Failed

Classification of individual tests

Individual results

Result	Description
Failed	At least one individual test in the test group was out of specification.
Passed	All individual tests in the test group complied with the specifications. The result is also "Passed" if the result for an individual test is "Check not done" and the verification result for all other test groups is "Passed".
Not done	No test has been performed for this test group. For example, because this parameter is not available in the current device configuration.
Not supported	The result is used for internal purposes.

Overall verification results

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

 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. 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 ISO 9001: 2015 Clause 7.1.5.2 a).

Test groups

Test group	Description
Sensor	Electrical components of the sensor (signals, circuits and cables)
Sensor electronics module (ISEM)	Electronics module for control and conversion of the sensor signals
I/O module	Results of the input and output modules installed on the measuring instrument
System condition	Test for active measuring instrument errors of "alarm"-type diagnostic behavior

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 in the detailed verification results, which can be accessed with the Flow Verification DTM.

5.4.4 Detailed verification results

Individual test group results and detailed verification results can be viewed in the verification report and retrieved using the Flow Verification DTM.

This also applies to the process conditions determined at the time of verification.

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 action
Shot time symmetry	Monitoring of symmetry in the exciter circuit for coil current shot times while both field polarities are changed.	No value range - Passed - Failed - Not done	- EMC interference - Defective H-bridge in the amplifier
Holding voltage symmetry	Monitoring of symmetry in holding voltages of exciter circuit for setting the coil current for both field polarities.	No value range - Passed - Failed - Not done	- EMC interference - Defective H-bridge in the amplifier
Coil current loss	Monitoring of the coil current path for leak current. Comparison of incoming and outgoing currents.	No value range - Passed - Failed - Not done	Sensor short-circuit. Check entire sensor system: - Check for moisture (e.g. condensation) - Check for faulty sensor and cable connections or interfaces - Check coils - Check insulation resistance
Coil current stability	Monitoring the correct adjustment of the coil current.	No value range - Passed - Failed - Not done	EMC interference
Coil resistance	Monitoring of the coil resistance.	No value range - Passed - Failed - Not done	- Faulty connections: check the outer connection parts, clamp connections and connecting cables - Process temperature too high - Coil in the sensor is defective
Electrode circuit 1	Monitoring of the impedance in electrode circuit 1.	No value range - Passed - Failed - Not done	Electrode cable is defective  The test is not performed if the measuring tube is empty Status indicated: "Not done"
Electrode circuit 2	Monitoring of the impedance in electrode circuit 2.	No value range - Passed - Failed - Not done	Electrode cable is defective  The test is not performed if the measuring tube is empty Status indicated: "Not done"
EPD electrode circuit	Monitoring of the impedance in the EPD circuit.	No value range - Passed - Failed - Not done	EPD cable is defective  The test is not performed if the measuring tube is empty Status indicated: "Not done"

Sensor electronics module (ISEM)

Parameter/individual test	Description	Result/limit value	Interpretation/cause/remedial action
Supply voltage	All the relevant supply voltages are checked. Monitoring of the supply voltage for the sensor electronics module guarantees that the system is functioning correctly.	No value range - Passed - Failed - Not done	Sensor electronics module (ISEM) defective Replace sensor electronics module (ISEM)
Linearity and reference voltage	- Monitoring of flowmeter circuit with regard to gain and linearity. - Monitoring of reference voltages in flowmeter circuit and exciter circuit	No value range - Passed - Failed - Not done	Sensor electronics module (ISEM) defective Replace sensor electronics module (ISEM)
Offset electrode signal amplifier	Monitoring of flow measurement amplifier with regard to zero point.	No value range - Passed - Failed - Not done	Sensor electronics module (ISEM) defective Replace sensor electronics module (ISEM)
Hold voltage feedback	The configured hold voltage is fed back to ensure the secure and constant functioning of the hold voltage.	No value range - Passed - Failed - Not done	Sensor electronics module (ISEM) defective Replace sensor electronics module (ISEM)

Parameter/individual test	Description	Result/limit value	Interpretation/cause/remedial action
Overvoltage feedback	The overvoltage is fed back to ensure the secure and constant functioning of the overvoltage.	No value range - Passed - Failed - Not done	Sensor electronics module (ISEM) defective
Electronic current loss	Monitoring of the coil current path for leak current.	No value range - Passed - Failed - Not done	Sensor electronics module (ISEM) defective
Coil current measurement	Monitoring of low-side current measurement.	No value range - Passed - Failed - Not done	Sensor electronics module (ISEM) defective
Overvoltage circuit	Monitoring of overvoltage.	No value range - Passed - Failed - Not done	Sensor electronics module (ISEM) defective
Electrode signal integrity	Monitoring of input stage, sensor and electrode cable.	No value range - Passed - Failed - Not done	One of the electrode signals is missing. This can be due to the following: - Sensor electronics module (ISEM) defective - Faulty connection to the sensor - Electrode short-circuit or open circuit - Sensor is defective

System condition

Parameter/individual test	Description	Result/limit value	Interpretation/cause/remedial measures
System condition	System condition monitoring	No value range - Passed - Failed - Not done	Causes System error during verification Corrective action ▶ Check diagnostic event in the Event logbook submenu.

I/O modules

Parameter/individual test	Description	Result/limit value	Interpretation/cause/remedial action
Output 1 to n	Check all the input and output modules installed at the measuring instrument  Only possible with extended verification ¹⁾ . →  12	No value range - Passed - Failed - Not done  Limit values	Causes - Output values out of specification - I/O module defective Corrective action ▶ Check the wiring. ▶ Check connections. ▶ Check load (current output). ▶ Replace the I/O module.

1) Only possible for devices with current, pulse and frequency outputs

Process conditions

To improve the comparability of the results, the current process conditions are recorded at the time of verification.

These process conditions are documented as process conditions on the last page of the verification report.

Process conditions	Description
Current potential difference	Current measured value for potential difference
Current potential of electrode 1	Current measured value for potential of electrode 1
Current potential of electrode 2	Current measured value for potential of electrode 2
Current potential of pipe GND electrode	Current measured value for potential of pipe GND electrode
Process temperature verification value	Current measured value for medium temperature (if available)
Electronics temperature	Current measured value for the electronics temperature in the transmitter

5.4.5 Structure and content of the verification report

The results of the verification can be documented in the form of a verification report via the web server, asset management system and Netilion →  11. The verification report is created on the basis of the data records saved in the measuring instrument 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.

The verification report contains the following pages and information:

First page: identification

Devices, measuring points and verification-related information:

- System operator
 - Person who performed the verification.
 - Record the plant operator in the report: →  12
- Device information
 - Information on the place of operation of the device
 - Device identification and configuration
 - Record the place of operation: →  12
- Calibration
 - Information on the calibration factor and zero point setting for the sensor
 - Note: These values must correspond to those from the last calibration or repeat calibration in order to comply with factory specifications.
- Verification information (information on completion of the verification):
 - 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 measuring instrument
 - Verification mode: standard verification or extended verification
- Verification result
 - Verification result "Passed" or "Failed". The result "Failed" is displayed if one or more parameters on the next page also has/have the "Failed" status.

Second page: test results

"Passed" or "Failed" results for all individual tests (parameters) by test group:

Test groups →  18

Third page (and subsequent pages): measured values and visualization

Displays the parameters along with the quantitative test value, unit, limit values, and visualization:

- Test item with value: displays all test groups with parameters that have a quantitative test value →  18
- Unit: unit of the parameter
- Current: the value recorded during the verification
- Min.: the lower limit value of the parameter
- Max.: the upper limit value of the parameter
- Visualization: The measured value is displayed as a filled dot within the bar graph, between the lower limit (left) and the upper limit (right).

Last page: process conditions

Measured process conditions during the verification. These process conditions do not affect the verification result:

- Process conditions: all measured process conditions are displayed →  20
- Unit: unit of the measured parameter
- Current: the value recorded during the verification

As a prerequisite for the validity of the verification report, the **Heartbeat Verification** feature must be activated on the relevant measuring instrument 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.



Comments from the person carrying out the verification appear in the "Information about the Extended Verification" field. It is also recommended for information on the type and serial number of the external testing device used to carry out the extended verification.



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

5.4.6 Interpreting and using the verification results

Heartbeat Verification uses the self-monitoring function of the Proline flowmeters to check the measuring instrument functionality. During the verification process, the system checks whether the measuring instrument 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 instrument 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.

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.

Ideally, ensure defined and stable process conditions in order to rule out process-specific influences as much as possible. When repeating the verification, it is advisable to compare the current process conditions to those of the previous verification in order to identify any deviations.



The process conditions for the previous verification are documented on the last page of the verification report or can be called up using the Flow Verification DTM
→  18.

Additional remedial action if the result of a verification is "Failed"

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



For detailed information on diagnostics and troubleshooting and for diagnostics information and associated remedial action, see the Operating Instructions →  6.

6 Heartbeat Monitoring

With Heartbeat Monitoring, additional measured values are output continuously and monitored and interpreted in an external Condition Monitoring system, enabling early detection of changes to the measuring instrument and in the process. The information obtained in this way helps users to manage measures relating to maintenance or process optimization.

6.1 Commissioning

After commissioning, the parameters, in the case of digital communication, they are typically continuously available.

6.1.1 Description of the monitoring parameters

The following monitoring parameters can be assigned to the various outputs of the measuring instrument for continuous transmission to a Condition Monitoring system.

 Some measured variables are only available via the SmartBlue app if the **Heartbeat Verification + Monitoring** application package is enabled in the measuring device.

Parameter	Description	Value range
Noise parameter ¹⁾ .	Degree to which the differential signal from both working electrodes is dispersed	0 to $+3.0 \cdot 10^{+38}$
Coil current shot time ¹⁾	Rise time of coil current for buildup of magnetic field	2 to 500 ms

1) Only available if the "Heartbeat Monitoring" function is enabled in the measuring instrument

 For information on using the parameters and interpreting the measurement results, see →  25.

6.1.2 Displaying the monitoring results

Display via the device-integrated web server or via FDI packages

The current values of all monitoring parameters can be accessed via navigating to the following: Expert → Sensor → Testpoints

Navigation

"Diagnostics" submenu → Heartbeat → Monitoring results



Parameter overview with brief description

Parameter	Description	User interface
Noise	Indicates the degree to which the differential signal from both measuring electrodes is dispersed.	0 to $3.0 \cdot 10^{+38} \mu V$
Coil current shot time	Indicates the rise time of the coil current for the buildup of the magnetic field.	2 to 500 ms

6.2 Operation

The benefits of **Heartbeat Monitoring** are in direct correlation with the recorded data selection and their interpretation. Good data interpretation is critical for deciding whether a problem has occurred and when and how maintenance should be scheduled or performed (good knowledge of the application is required). The elimination of process effects that cause misleading warnings or interpretation must also be ensured. For this reason it is important to compare the recorded data against a process reference.

With Heartbeat Monitoring it is possible to display and output additional monitoring-specific measured values for monitoring in an external Condition Monitoring system during continuous operation.

Condition Monitoring focuses on measured variables that indicate a change in the performance of the device brought about by process-specific influences. There are two difference categories of process-specific influences:

- Temporary process-specific influences that impact the measuring function directly and therefore result in a higher level of measurement uncertainty than would normally be expected (e.g. measurement of multiphase fluids). These process-specific influences generally do not affect the integrity of the device but do impact measuring performance temporarily.
- Process-specific influences which only impact the integrity of the sensor over the medium term but which also bring about a gradual change in the measuring performance.

Devices with **Heartbeat Monitoring** offer a range of parameters that are particularly suitable for monitoring specific, application-related influences:

- Corrosive or abrasive fluids
- Multi-phase fluids (gas content in liquid fluids)
- Wet gases
- Applications in which the sensor is exposed to a programmed amount of wear.

The results of Condition Monitoring must always be interpreted in the context of the application.

6.2.1 Possible interpretation of the monitoring parameters

This section describes the interpretation of certain monitoring parameters in connection with the process and the application.

Monitoring parameter	Possible reasons for deviation
Noise	A change can be an indicator of multi-phase fluids (gas content in liquid fluids or a change in the solids content of the fluid) or changing electrical conductivity. This value allows conclusions to be drawn about the process.
Coil current shot time	At constant process temperatures, a change can indicate a possible buildup of magnetite or an increase in the magnetite content of the medium. Strong external magnetic fields influence this value too.



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