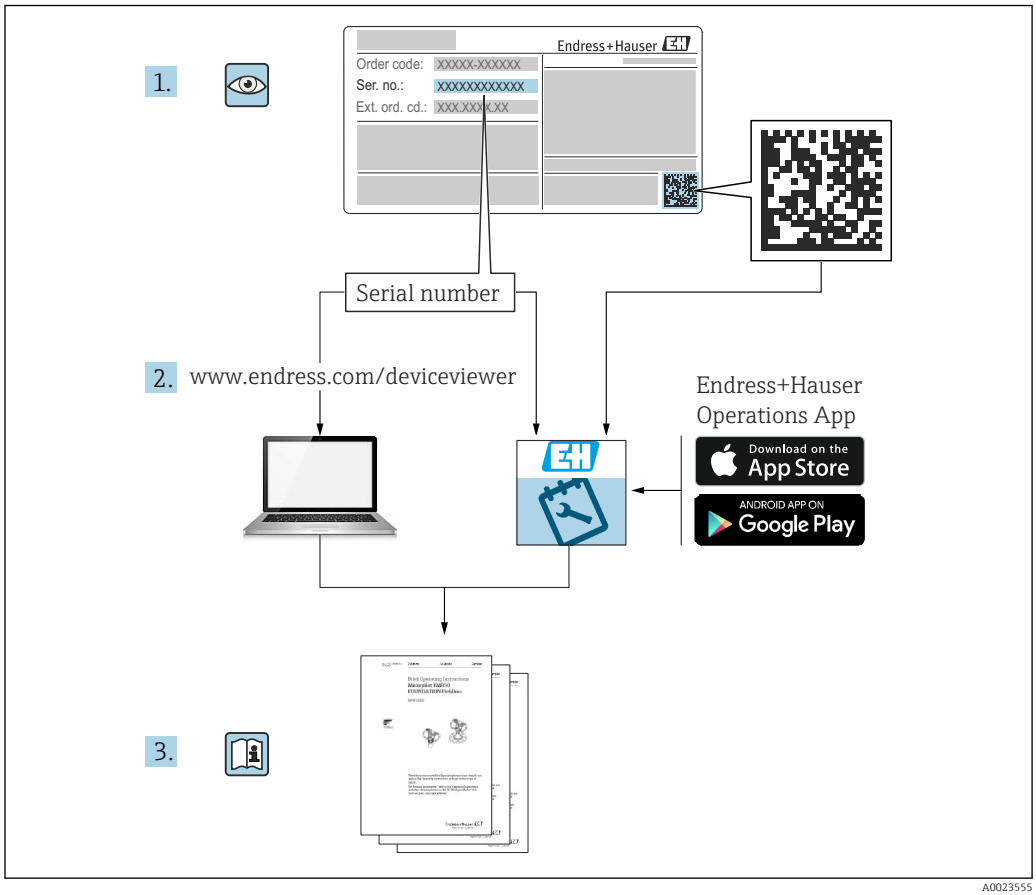
FY01098K/09/EN/02.24-00
71663787
2024-05-31

Functional Safety Manual
RIA15 process indicator

Loop-powered Ex ia process indicator as a field device or panel-mounted instrument for 4 to 20 mA signals or HART® protocol

Endress+Hauser
People for Process Automation


1.
Endress+Hauser
Order code: XXXXX-XXXXXX
Ser. no.: XXXXXXXXXXX
Ext. ord. cd.: XXX XXX XXX
Serial number
2. www.endress.com/deviceviewer
Endress+Hauser
Operations App
Download on the App Store
ANDROID APP ON Google Play
3.
A0023555

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1 Manufacturer's declaration

SIL_00514_01.23

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Herstellererklärung - Manufacturer Declaration
Funktionale Sicherheit - Functional Safety (IEC 61508:2010)
Beiblatt 1 / NE130 Formblatt B1 – Supplement 1 / NE130 From B.1

Endress+Hauser Wetzer GmbH+Co. KG Obere Wank 1, 87484 Nesselwang

erklärt als Hersteller, dass der folgende schleifengespeister Anzeiger für 4 ... 20 mA ,
oder 4 ... 20 mA mit HART® Kommunikation
declares as manufacturer, that the following loop-powered process indicator for 4 to 20mA
or 4 to 20mA with HART® communication

RIA15-SIL

in sicherheitsrelevanten Anwendungen SIL2 (HFT=0) nach IEC61508:2010 eingesetzt werden kann.
is suitable for use in saftey relevant applications up to SIL2 (HFT=0) according to IEC 61508:2010.

Für einen Einsatz in sicherheitsrelevanten Anwendungen entsprechend IEC 61508 sind die Angaben des Handbuchs zur Funktionalen Sicherheit zu beachten.
In safety relevant applications according to IEC 61508, the instructions of the Safety Manual have to be followed.

Nesselwang, 14.09.2023
Endress+Hauser Wetzer GmbH+Co. KG

ppa. Harald Müller
Director Technology

i.V. Robert Zeller
Head of Department R&D-Components

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1.1 Safety-related characteristic values

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Allgemein			
Gerätebezeichnung und zulässige Ausführungen	RIA15 (Bestellmerkmal "Weitere Zulassungen": Option LA "SIL")		
Sicherheitsbezogene Ausgangssignale	4...20mA		
Fehlerstrom	≤ 3,6 mA oder ≥ 21,0 mA		
Bewertete Messgröße / Funktion	Messwert Anzeige		
Sicherheitsfunktion(en)	weiterleiten des Messsignals		
Gerätetyp gem. IEC 61508-2	☑ Typ A	☐ Typ B	
Betriebsart	☑ Low Demand Mode	☑ High Demand	☐ Continuous Mode
Gültige Hardware-Version	V01.00 oder höher		
Gültige Firmware-Version	n/a		
Sicherheitshandbuch	FY01098K/09		
Art der Bewertung (nur eine Variante wählbar)	☐	Vollständige entwicklungsbegleitende HW/SW Bewertung inkl. FMEDA und Änderungsprozess nach IEC 61508-2, 3	
	☐	Bewertung über Nachweis der Betriebsbewährung HW/SW inkl. FMEDA und Änderungsprozess nach IEC 61508-2, 3	
	☐	Auswertung von Felddaten HW/SW zum Nachweis "Frühere Verwendung" gem. IEC 61511	
	☑	Bewertung durch FMEDA gem. IEC 61508-2 für Geräte ohne Software	
Bewertung durch / Zertifikatsnummer	Internes Assessment		
Prüfungsunterlagen	Entwicklungsdokumente, Testreports, Datenblätter		

SIL - Integrität			
Systematische Sicherheitsintegrität		☑ SC 2 fähig	☐ SC 3 fähig
Hardware Sicherheitsintegrität	Einkanaliger Einsatz (HFT = 0)	☑ SIL 2 fähig	☐ SIL 3 fähig
	Mehrkanaliger Einsatz (HFT ≥ 1)	☑ SIL 2 fähig	☐ SIL 3 fähig

FMEDA	RIA15
Sicherheitsfunktion(en)	weiterleiten des Messsignals
λ_{DU} [1),2)]	10 FIT
λ_{DD} [1),2)]	0 FIT
λ_S [1),2)]	21 FIT
SFF - Safe Failure Fraction	68%
PFD_{avg} für T1 = 1 Jahr [2)] (einkanalige Architektur)	$4.4 \cdot 10^{-5}$
PFD_{avg} für T1 = 5 Jahre [2)] (einkanalige Architektur)	$2.2 \cdot 10^{-4}$
PFH	$1.0 \cdot 10^{-8} \cdot 1/h$
PTC [3)]	99 %
Fehlerreaktionszeit [4)]	n/a
Diagnose-Testintervall [5)]	n/a
Prozesssicherheitszeit [6)]	n/a
MTTF [7)]	414 years

Erklärung	
☑	Unser firmeninternes Qualitätsmanagement stellt die Information von zukünftig bekanntwerdenden sicherheitsrelevanten systematischen Fehlern sicher.

[1)] FIT = Failure In Time, Anzahl der Ausfälle pro 10^9 h
[2)] Gültig für gemittelte Umgebungstemperaturen bis zu +40 °C (+104 °F)
Bei einer durchschnittlichen Dauereinsatztemperatur nahe +60 °C (+140 °F) sollte ein Faktor von 2,1 berücksichtigt werden
[3)] PTC = Proof Test Coverage (Diagnoseaufdeckungsgrad von Gerätefehlern bei manueller Wiederholungsprüfung)
[4)] Maximale Zeit zwischen Fehlererkennung und Fehlerreaktion
[5)] In dieser Zeit werden alle online Diagnosefunktionen mindestens 1x ausgeführt (32 min inkl. Speichertest)
[6)] Die Prozesssicherheitszeit beträgt: Diagnose-Testintervall x 100 (Berechnung nach IEC 61508)
[7)] MTTF (Mean Time To Failure) Dieser Wert berücksichtigt alle Ausfallarten der Elektronikkomponenten gemäß Siemens SN29500

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General				
Device designation and permissible types	RIA15 (Order code for "Additional approval": Option LA "SIL")			
Safety-related output signal	4...20mA			
Fault current	≤ 3,6 mA or ≥ 21,0 mA			
Process variable/function	measurement indication			
Safety function(s)	forwarding the measurement signal			
Device type acc. to IEC 61508-2	☑ Type A	☐ Type B		
Operating mode	☑ Low Demand Mode	☑ High Demand	☐ Continuous Mode	
Valid Hardware-Version	01.00 or higher			
Valid Software-Version	n/a			
Safety manual	FY01098K/09			
Type of evaluation (check only one box)	☐ Complete HW/SW evaluation parallel to development incl. FMEDA and change request acc. to IEC 61508-2, 3			
	☐ Evaluation of "Proven-in-use" performance for HW/SW incl. FMEDA and change request acc. to IEC 61508-2, 3			
	☐ Evaluation of HW/SW field data to verify „prior use" acc. to IEC 61511			
	☑ Evaluation by FMEDA acc. to IEC61508-2 for devices w/o software			
Evaluation through / certificate no.	internal assessment			
Test documents	development documents, test reports, data sheets			
SIL - Integrity				
Systematic safety integrity		☑ SIL 2 capable	☐ SIL 3 capable	
Hardware safety integrity	Single channel use (HFT = 0)	☑ SIL 2 capable	☐ SIL 3 capable	
	Multi-channel use (HFT ≥ 1)	☑ SIL 2 capable	☐ SIL 3 capable	

FMEDA	RIA15
Safety function	forwarding the measurement signal
λ_{DU} [1) 2)]	10 FIT
λ_{DD} [1) 2)]	0 FIT
λ_S [1) 2)]	21 FIT
SFF - Safe Failure Fraction	68%
PFD_{avg} T1 = 1 year [2)]	$4.4 \cdot 10^{-5}$
PFD_{avg} T1 = 5 years [2)]	$2.2 \cdot 10^{-4}$
PFH	$1.0 \cdot 10^{-8}$ 1/h
PTC [3)]	99 %
Fault reaction time [4)]	n/a
Diagnostic test interval [5)]	n/a
Process safety time [6)]	n/a
MTTF [7)]	414 years

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

1) FIT = Failure In Time, Number of failures per 10^9 h
2) Valid for average ambient temperature up to +40 °C (+104 °F)
For continuous operation at ambient temperature close to +60 °C (+140 °F), a factor of 2 should be applied
3) PTC = Proof Test Coverage
4) Maximum time between error recognition and error response
5) All online diagnostic functions are performed at least once within the Diagnostic test interval (32 min incl. memory test)
6) The Process safety time is: Diagnostic test interval x 100 (calculated acc. to IEC 61508)
7) MTTF (Mean Time To Failure) is the predicted elapsed time between inherent failures of a system during operation in accordance to Siemens SN29500

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2 About this document

2.1 Document function

This Safety Manual applies in addition to the Operating Instructions, Technical Information and Ex-specific Safety Instructions. The supplementary device documentation

must be observed during installation, commissioning and operation. The requirements specific to the protection function are described in this Safety Manual.

General information on functional safety (SIL) is available at:
www.endress.com/SIL

2.2 Symbols used

2.2.1 Safety symbols

DANGER
This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.

WARNING
This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in serious or fatal injury.

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

NOTICE
This symbol contains information on procedures and other facts which do not result in personal injury.

2.2.2 Symbols for certain types of information and graphics

Tip
Indicates additional information

Reference to documentation

Reference to graphic

▶
Notice or individual step to be observed

1., 2., 3.
Series of steps

Result of a step

1, 2, 3, ...
Item numbers

A, B, C, ...
Views

2.3 Supplementary device documentation

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

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

2.3.1 Further applicable documents

Technical Information (TI)

Planning aid
The document contains all the technical data on the device and provides an overview of the accessories and other products that can be ordered for the device.

Brief Operating Instructions (KA)

Guide that takes you quickly to the 1st measured value
The Brief Operating Instructions contain all the essential information from incoming acceptance to initial commissioning.

Operating Instructions (BA)

Your reference guide
These Operating Instructions contain all the information that is required in various phases of the life cycle of the device: from product identification, incoming acceptance and storage, to mounting, connection, operation and commissioning through to troubleshooting, maintenance and disposal.

Safety Instructions (XA)

Depending on the approval, the following Safety Instructions (XA) are supplied with the device. They are an integral part of the Operating Instructions.

The nameplate indicates the Safety Instructions (XA) that are relevant to the device.

Functional Safety Manual (FY)

Depending on the SIL approval, the Functional Safety Manual (FY) is an integral part of the Operating Instructions and applies in addition to the Operating Instructions, Technical Information and ATEX Safety Instructions.

The different requirements that apply for the protective function are described in the Functional Safety Manual (FY).

3 Design

3.1 Permitted devices types

The details pertaining to functional safety in this manual relate to the device versions listed below and are valid as of the specified firmware version.

Unless otherwise specified, all subsequent versions can also be used for safety functions.

A modification process according to IEC 61508 is applied for any device modifications.

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

Valid device versions for safety-related use:

3.1.1 Ordering features

RIA15-

Feature: 010 "Approval"
Version: all

Feature: 020 "Housing"
Version: all

Feature: 030 "Input"
Version: all

Feature: 550 "Calibration"
Version: all

Feature: 570 "Service"
Version: all

Feature: 580 "Test, Certificate"
Version: all

Feature: 590 "Additional Approval"
Version: LA
Version **"LA"** must be selected for use as a safety function as per IEC 61508. All other versions are permitted in addition to **"LA"**.

Feature: 610 "Accessory Mounted"
Version: all

Feature: 620 "Accessory Enclosed"
Version: all

Feature: 895 "Marking"
Version: all

3.2 Identification marking

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

3.3 Safety function

The device's safety function is:
Transmit the measuring signal without distortion

3.3.1 Safety-related measuring signal

The safety-related measuring signal is the 4 to 20 mA signal (NE 43), which is transmitted without distortion.

The display function (current signal/HART communication) of the device is **not** part of the safety function.

NOTICE

In an alarm condition

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

3.4 Basic conditions for use in safety-related applications

The measuring system must be used correctly for the specific application, taking into account the installation and ambient conditions. Carefully follow instructions pertaining to critical process situations and installation conditions from the Operating Instructions. The

application-specific limits must be observed. The specifications in the Operating Instructions and the Technical Information must not be exceeded.

3.4.1 Safety-related failures according to IEC/EN 61508

No device error
- No failure
- No effect on the safety-related measuring signal

λS (Safe)
- Safe failure
- No effect on the safety-related measuring signal:

λ_{DD} (Dangerous detected)
- Dangerous failure which can be detected
- Affects the safety-related measuring signal: low alarm or high alarm

λ_{DU} (Dangerous undetected)
- Dangerous failure which cannot be detected
- Affects the safety-related measuring signal: can distort the measuring signal

3.4.2 Restrictions for safety-related use

- The 0 to 20 mA transmission range must not be used in safety-related applications.
- Take the voltage drop at the RIA15 into account when supplying the current loop. See BA, TI, KA.
- If there is no low voltage detection in the current loop, a voltage drop of at least 3 V at the RIA15 without backlight function must be taken into account when designing the current loop.

3.5 Dangerous undetected failures in this scenario

An incorrect measuring signal that deviates from the value specified in this manual, but is still in the range of 4 to 20 mA, is considered a "dangerous, undetected failure".

3.6 Useful lifetime of electrical components

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

In accordance with DIN EN 61508-2:2011 section 7.4.9.5, national footnote N3, appropriate measures taken by the manufacturer and operator can extend the useful lifetime.

This device does not contain any electronic components as per the "EMCRH Electrical & Mechanical Component Reliability Handbook" Third Edition (exida.com) that have a useful lifetime less than 50 years.

However, the useful lifetime can be significantly shorter if the device is operated at higher temperatures.

4 Commissioning (installation and configuration)

4.1 Requirements for personnel

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

- Trained, qualified specialists must have a relevant qualification for this specific function and task.
- Personnel must be authorized by the plant owner/operator.
- Be familiar with federal/national regulations.
- Before starting work: personnel must read and understand the instructions in the manual and supplementary documentation as well as the certificates (depending on the application).
- Personnel must follow instructions and comply with general policies.

The operating personnel must fulfill the following requirements:

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

4.2 Installation

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

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

4.3 Commissioning

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

Before operating the device in a safety instrumented system, perform a verification using a test sequence → 12.

4.4 Operation

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

4.5 Device configuration for safety-related applications

4.5.1 Configuration of the measured value display

Refer to the Operating Instructions for information on configuration. The settings do not have a modifying effect and do not affect the current signal. The additional voltage drop in the current loop must be taken into account when switching to HART® communication.

4.5.2 Device protection

The device must be protected (to lock operation).

5 Operation

5.1 Device behavior when switched on

The measured value is displayed when current flows in the range of 4 to 20 mA.

5.2 Safe states

Safe state/measuring signal:

- Measured value not distorted
- I ≤ 3.6 mA (Low alarm)
- I ≥ 21 mA (High alarm)

6 Proof testing

NOTICE

- ▶ The functional integrity of the device must be verified during commissioning, in the event of changes and at appropriate intervals. The time intervals must be specified by the operator.

⚠ CAUTION

The safety function is not guaranteed during a proof test

Suitable measures must be taken to guarantee process safety during the test.

- ▶ The safety-related output signal 4 to 20 mA must not be used for the safety instrumented system during testing.
- ▶ A completed test must be documented; the template provided in the Appendix can be used for this purpose. (See Section 8.2)
- ▶ The operator specifies the test interval and this must be taken into account when determining the probability of failure PFD_{avg} of the sensor system.

If no operator-specific proof-testing requirements have been defined, the following is a possible alternative for testing the device. The individual proof test coverages (PTC) that can be used for calculation are specified for the test sequences described below.

NOTICE

- ▶ If there is a fault in the current loop before testing starts, the cause of the fault must be first eliminated.

Proof testing and optimization of subsystems

The NAMUR worksheet NA106 "Flexible proof testing of field devices in safety instrumented systems" describes how the test activities can be optimized for safety instrumented systems with regard to interruptions in operation while maintaining the required safety integrity of the installed PCS safety instrumented systems.

Proof testing of the device can be performed as follows:
Test sequence: Verification of the measurement accuracy in the range of 4 to 20 mA

Note the following for the test sequences:

- The device must be checked in the closed current loop with the measuring instruments installed.
- The accuracy of the measuring instrument used must meet the required accuracy of the application.

6.1 Test sequence

Preparation

1. Device identification:
Check device tag, device name, serial number and hardware version

2. Visual inspection:
- Wiring
- Housing/housing cover
- Mechanical and electrical installation

Proof test procedure

1. Simulation of a high alarm (≥ 21 mA) in the current loop.

2. Check the accuracy of the measuring signal in the current loop using appropriate measuring equipment, e.g. read out the measured value at the safety control.

3. A deviation in the measuring signal from the expected accuracy means that the device has failed the proof test.

This test detects 99 % of dangerous, undetected failures (proof test coverage, PTC = 0.99). If these three points are covered by the test sequence of the sensor used, the check can be carried out in combination with the sensor.

6.2 Verification criterion

If the test criteria from the test sequence described above is not satisfied, the device may no longer be used as part of a safety instrumented system.
- The purpose of proof-testing is to detect dangerous undetected device failures (λ_{DU}).
- The impact of systematic failures on the safety function is not covered by this test and must be assessed separately.
- Systematic faults can be caused by operating conditions and the installation, for example.

7 Repair and error handling

7.1 Maintenance

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

7.2 Repair

Repair means restoring functional integrity by replacing defective components.

Only original Endress+Hauser spare parts may be used for this purpose.

Document the repair with the following information:
- Serial number of the device
- Date of the repair
- Type of repair
- Person who performed the repair

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

A proof test must always be performed after every repair.

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

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

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

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

7.3 Modification

Modifications are changes to SIL devices that are already delivered or installed:
- **Modifications to SIL devices by the user are not permitted because they can impair the functional safety of the device**
- Modifications to SIL devices may be performed onsite at the user's plant following approval by the Endress+Hauser manufacturing center
- Modifications to SIL devices must be performed by personnel authorized to do so by Endress+Hauser
- Only **original spare parts** from Endress+Hauser may be used for modifications
- All modifications must be documented in the Endress+Hauser Device Viewer (www.endress.com/deviceviewer)
- All modifications require a change nameplate or replacement of the original nameplate.

7.4 Decommissioning

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

7.5 Disposal

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

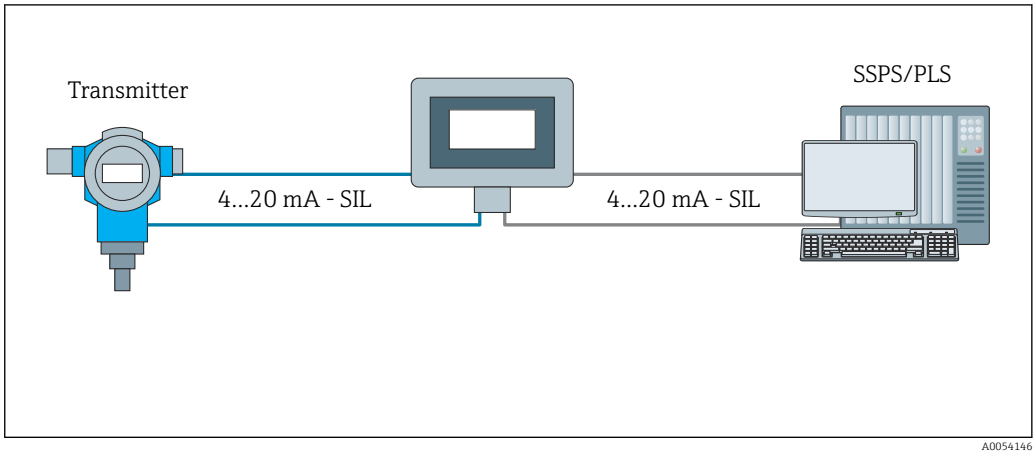
8 Appendix

8.1 Structure of the measuring system

The RIA15 loop-powered indicator is used to display a measuring signal proportional to the current signal of a 4 to 20 mA current loop or alternatively to display a measured value scanned via HART® communication.

The display function (current signal/HART® communication) of the device is not part of the safety function.

The safety-related measuring signal is the 4 to 20 mA signal (NE 43), which is transmitted without distortion.



8.2 Commissioning or proof test report

8.2.1 Test report – Page 1

Company/contact person	/
Tester	

Device information	
Plant	Measuring point/TAG no.:
Device type/Order code	
Serial number	Hardware version

Verification information
Date/time
Performed by

Verification result		
Overall result	☐ Passed	☐ Failed

Comment:

Date	Signature of customer	Signature Tester

8.2.2 Test report – Page 2

Type of safety function
☐ Safe measurement

Proof testing
☐ Test sequence

This report is based on the specifications in the Functional Safety Manual: FY01098K

Proof test report			
Test step	Target value	Actual value	Pass
1. Simulation of a high alarm (≥ 21 mA) in the current loop			☐ Passed ☐ Failed
2. High alarm, measurement accuracy complies with technical data			☐ Passed ☐ Failed

Comment:

8.3 Version history

Version of manual	Changes	Valid as of firmware version	Reference to NE 53 customer information
FY01098K/09/EN/01.23	First version	01.05.01	-
FY01098K/09/EN/02.24	Addition of the note in Section 6.1 Test sequence	01.05.01	-

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