

PERFORMANCE  
MADE  
SMARTER

# Safety manual **9106**

## **HART transparent repeater**



TEMPERATURE | I.S. INTERFACES | COMMUNICATION INTERFACES | MULTIFUNCTIONAL | ISOLATION | DISPLAY

Version No. V3R0

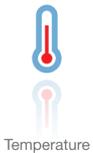
**PR**  
electronics

# 6 Product Pillars

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With our innovative, patented technologies, we make signal conditioning smarter and simpler. Our portfolio is composed of six product areas, where we offer a wide range of analog and digital devices covering over a thousand applications in industrial and factory automation. All our products comply with or surpass the highest industry standards, ensuring reliability in even the harshest of environments and have a 5-year warranty for greater peace of mind.



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Our range of temperature transmitters and sensors provides the highest level of signal integrity from the measurement point to your control system. You can convert industrial process temperature signals to analog, bus or digital communications using a highly reliable point-to-point solution with a fast response time, automatic self-calibration, sensor error detection, low drift, and top EMC performance in any environment.



I.S. Interface

We deliver the safest signals by validating our products against the toughest safety standards. Through our commitment to innovation, we have made pioneering achievements in developing I.S. interfaces with SIL 2 Full Assessment that are both efficient and cost-effective. Our comprehensive range of analog and digital intrinsically safe isolation barriers offers multifunctional inputs and outputs, making PR an easy-to-implement site standard. Our backplanes further simplify large installations and provide seamless integration to standard DCS systems.



Communication

We provide inexpensive, easy-to-use, future-ready communication interfaces that can access your PR installed base of products. All the interfaces are detachable, have a built-in display for readout of process values and diagnostics, and can be configured via push-buttons. Product specific functionality includes communication via Modbus and Bluetooth and remote access using our PR Process Supervisor (PPS) application, available for iOS and Android.



Multifunction

Our unique range of single devices covering multiple applications is easily deployable as your site standard. Having one variant that applies to a broad range of applications can reduce your installation time and training, and greatly simplify spare parts management at your facilities. Our devices are designed for long-term signal accuracy, low power consumption, immunity to electrical noise and simple programming.



Isolation

Our compact, fast, high-quality 6 mm isolators are based on microprocessor technology to provide exceptional performance and EMC-immunity for dedicated applications at a very low total cost of ownership. They can be stacked both vertically and horizontally with no air gap separation between units required.



Display

Our display range is characterized by its flexibility and stability. The devices meet nearly every demand for display readout of process signals and have universal input and power supply capabilities. They provide a real-time measurement of your process value no matter the industry and are engineered to provide a user-friendly and reliable relay of information, even in demanding environments.

# Safety manual

## HART transparent repeater

### 9106

This safety manual is valid for the following product versions:  
9106-002

1. Observed standards .....	4
2. Acronyms and abbreviations .....	4
3. Purpose of the product .....	4
4. Assumptions and restrictions for use of the product .....	5
4.1 Basic safety specifications .....	5
4.2 Safety accuracy .....	5
4.3 Analog output .....	5
4.4 Failure rates .....	5
4.5 Installation in hazardous areas .....	5
4.6 Installation in SIL 3 applications .....	5
4.7 FMEDA Report .....	5
4.8 Useful lifetime .....	5
5. Functional specification of the safety functions .....	6
6. Functional specification of the non-safety functions .....	6
7. Safety parameters .....	6
8. Hardware and software configuration .....	6
9. Failure category SIL 2 / SIL 3 .....	6
10. Periodic proof test procedure .....	7
11. Procedures to repair or replace the product .....	7
12. Maintenance .....	7
13. Connections diagram .....	8

## 1. Observed standards

Standard	Description
IEC 61508	Functional Safety of electrical / electronic / programmable electronic safety-related systems
IEC 61508-2:2010	Part 2: Requirements for electrical / electronic / programmable electronic safety-related systems

## 2. Acronyms and abbreviations

Acronym / Abbreviation	Designation	Description
Element		Term defined by IEC 61508 as "part of a subsystem comprising a single component or any group of components that performs one or more element safety functions".
PFD	Probability of Failure on Demand	This is the likelihood of dangerous safety function failures occurring on demand.
PFH	Probability of dangerous Failure per Hour	The term "Probability" is misleading, as IEC 61508 defines a Rate.
SFF	Safe Failure Fraction	Safe Failure Fraction summarises the fraction of failures which lead to a safe state and the fraction of failures which will be detected by diagnostic measures and lead to a defined safety action.
SIF	Safety Integrity Function	Function that provides fault detection (to ensure the necessary safety integrity for the safety functions).
SIL	Safety Integrity Level	The international standard IEC 61508 specifies four discrete safety integrity levels (SIL 1 to SIL 4). Each level corresponds to a specific probability range regarding the failure of a safety function.

## 3. Purpose of the product

HART transparent, galvanic isolation and repetition of passive and active 4...20 mA current signals from hazardous area to non-classified area.

The module can be mounted in non-classified area or in zone 2 / Div. 2 and receive current signals from zone 0, 1, 2, 20, 21, 22 and mines or Class I/II/III, Div. 1, Group. A-G.

Error events, including cable breakage, are monitored and signalled via the individual status relay and/or a collective electronic signal via the power rail.

The display and programming module 45xx can be used to show the actual process values, and alter the set point for high and low limit.

The 9106 has been designed, developed and certified for use in SIL applications according to the requirements of IEC 61508.

## 4. Assumptions and restrictions for use of the product

### 4.1 Basic safety specifications

Operational temperature range . . . . .	-20...+60°C
Storage temperature range. . . . .	-20...+85°C
Power supply type. . . . .	Double or reinforced
Supply voltage . . . . .	19.2...31.2 VDC
Loop supply 9106B1 . . . . .	16V @ 20mA
Loop supply 9106B2 . . . . .	15V @ 20mA
Max external output supply voltage . . . . .	26 VDC
Mounting area . . . . .	Zone 2 / Division 2 or safe area
Mounting environment . . . . .	Pollution degree 2 or better

### 4.2 Safety accuracy

The analog output corresponds to the applied input within the safety accuracy.

Safety accuracy . . . . .  $\pm 2\%$

### 4.3 Analog output

The connected safety PLC shall be able to detect and handle the fault indications from the analog output of the 9106 Repeater by having a NAMUR NE43-compliant input circuit.

### 4.4 Failure rates

The basic failure rates from the Siemens standard SN 29500 are used as the failure rate database.

Failure rates are constant, wear-out mechanisms are not included.

External power supply failure rates are not included.

### 4.5 Installation in hazardous areas

The IECEx Installation drawing, ATEX Installation drawing and FM Installation drawing shall be followed if the products are installed in or connected to hazardous areas.

### 4.6 Installation in SIL 3 applications

The independence of the safety functions enables the use of the two channels in a 9106 HART transparent repeater device, in a SIL 3 safety function when both inputs are connected in series.

The safety PLC or equivalent connected to the output shall be able to detect and handle the fault indications from both analog outputs of the 9106 Repeater by having NAMUR NE43-compliant input circuits and must be able to compare the two channels.

### 4.7 FMEDA Report

The FMEDA report "PR 9106-9107 06-03-19 R025 FMEDA V2 R1" is issued by exida.

The report can be downloaded from the PR website [www.prelectronics.com](http://www.prelectronics.com).

It is easily found by entering 9106 in the search field. From the results, open the corresponding link e.g. "9106B HART transparent repeater" and locate the FMEDA report in the Supplementary documentation folder to the right.

### 4.8 Useful lifetime

It is assumed that early failures are detected to a huge percentage during the installation period, therefore the assumption of a constant failure rate based on the bathtub curve are valid during the useful lifetime.

According to IEC/EN 61508-2, a useful lifetime, based on general experience, should be assumed.

Experience has shown that the useful lifetime often lies within a range of 8 to 12 years.

However, it can be significantly less if elements are operated near to their specification limits. As such, when site experience indicates a deviation from the useful lifetime indicated, then a number based on plant experience should be used.

## 5. Functional specification of the safety functions

Galvanic isolation of an active or passive 4...20 mA current signal from hazardous areas to an active or passive 4...20 mA output signal in non-classified area or zone 2 / Div. 2, within the specified accuracy.

An undetected dangerous failure is defined as if the output does not correspond to the applied input within  $\pm 2\%$  accuracy, and is not in safe state, while operating in SIL mode.

## 6. Functional specification of the non-safety functions

The status relay (terminal 33 and 34), error signal on power rail (terminal 91) and LED outputs are not suitable for use in any Safety Instrumented Function. The display value and any possible parameterisation by the 45xx add-on module does not affect the safety function of the 9106.

Also the HART transparency of the module is not a safety function.

## 7. Safety parameters

All figures for probability of failures are specified in the FMEDA report issued by Exida, see section 4.7.

Connection diagram	Ex input SIL 2
Demand rate	Note <sup>1</sup>
Mean Time To Repair (MTTR)	24 hours
Component Type	A (HFT=0)
SIL capability	SIL 2
Description of the "Safe State"	Output $\leq 3.6$ mA or Output $\geq 21$ mA

Connection diagram	Ex input SIL 3
Demand rate	Note <sup>1</sup>
Mean Time To Repair (MTTR)	24 hours
Component Type	A (HFT=0), see Note <sup>2</sup>
SIL capability	SIL 3, see Note <sup>3</sup>
Description of the "Safe State"	Output $\leq 3.6$ mA or Output $\geq 21$ mA

Note<sup>1</sup>: Depends on detection time in external controller. If detection time is xx seconds, the Demand Rate shall be 100 times xx seconds.

Note<sup>2</sup>: Simple device (type A) where microprocessors and software have no effect on safety output.

Note<sup>3</sup>: The use of 9106 in SIL 3 applications requires that the connected PLC is suitable for SIL 3 applications. see paragraph 4.6.

## 8. Hardware and software configuration

All configurations of software and hardware versions are fixed from factory, and cannot be changed by end-user or reseller. This manual only covers products labelled with the product version (or range of versions) specified on the front page.

## 9. Failure category SIL 2 / SIL 3

All failure rates and failure categories are specified in the FMEDA report issued by exida, see section 4.7.

## 10. Periodic proof test procedure

Step	Action
1	Bypass the safety PLC or take other appropriate action to avoid a false trip
2	Connect a simulator identical to the input setup
3	Apply input value corresponding to 0/100% output range to each channel
4	Observe whether the output channel acts as expected
5	Restore the input terminals to full operation
6	Remove the bypass from the safety PLC or otherwise restore normal operation

This test will detect approximately 95% of possible "du" (dangerous undetected) failures in the module.

## 11. Procedures to repair or replace the product

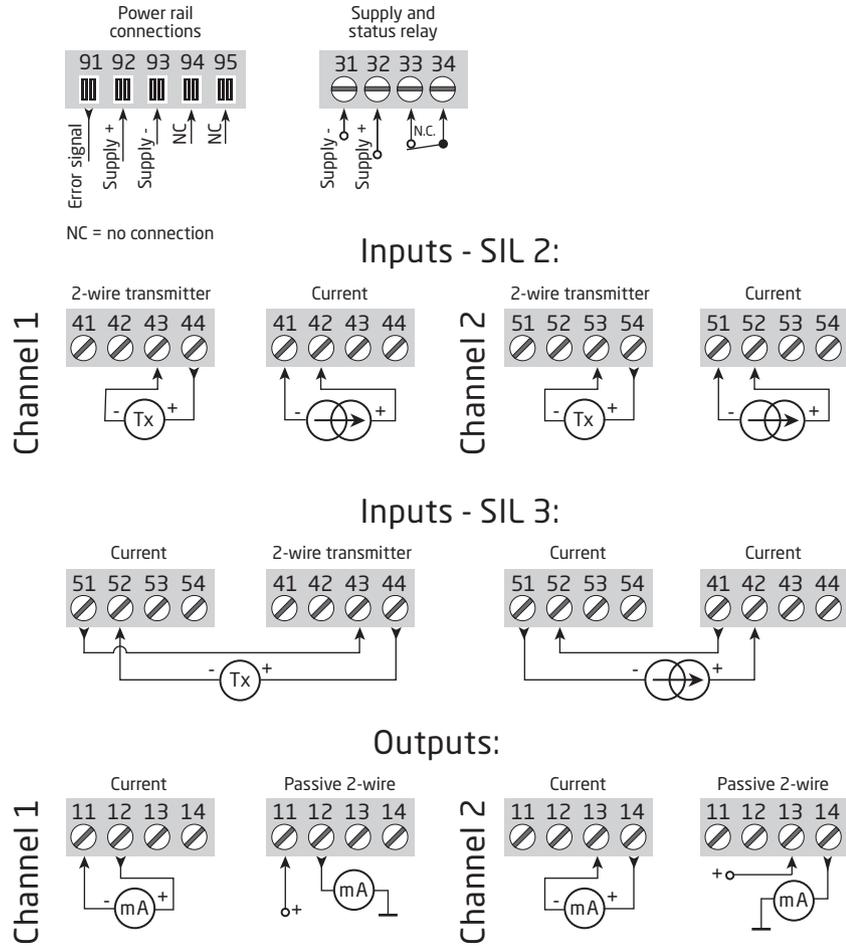
Any failures that are detected and that compromise functional safety should be reported to the sales department at PR electronics A/S.

Repair of the module and replacement of circuit breakers must be done by PR electronics A/S only.

## 12. Maintenance

No maintenance required.

# 13. Connections diagram



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All our devices are backed by expert service and a 5-year warranty. With each product you purchase, you receive personal technical support and guidance, day-to-day delivery, repair without charge within the warranty period and easily accessible documentation.

We are headquartered in Denmark, and have offices and authorized partners the world over. We are a local

business with a global reach. This means that we are always nearby and know your local markets well. We are committed to your satisfaction and provide PERFORMANCE MADE SMARTER all around the world.

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Our innovative, patented technologies are derived from our extensive R&D facilities and from having a great understanding of our customers' needs and processes. We are guided by principles of simplicity, focus, courage and excellence, enabling some of the world's greatest companies to achieve PERFORMANCE MADE SMARTER.