

SAFETY MANUAL

PULSE ISOLATOR

9202

This safety manual is valid for the following product versions:

9202-002

9202-003

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1. Observed standards

Standard	Description
IEC 61508	Functional Safety of electrical / electronic / programmable electronic safety-related systems
IEC 61508-2:2000	Part 2: Requirements for electrical / electronic / programmable electronic safety-related systems
IEC 61508-3:1998	Part 3: Software requirements
IEC 61326-3-1:2008	Immunity requirements for 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

Pulse isolator for transmission of signals to the safe area from NAMUR sensors and mechanical switches installed in the hazardous area.

The module can be mounted in the safe area and in zone 2 / div. 2 and receive signals from zone 0, 1, 2, 20, 21 and 22 / Class I/II/III, Div. 1, Gr. 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 9202 has been designed, developed and certified for use in SIL 2 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, min. Double or reinforced

Supply voltage 19.2...31.2 VDC

Output pulse length, min. 40 µs

Mounting area Zone 2 / Division 2 or safe area

Mounting environment Pollution degree 2 or better

4.2 Associated equipment

4.2.1 Relay output

The relay output shall only be connected to equipment which has a current limiting function of 2 A.

4.2.2 Opto output

The opto output signals are fed to SIL 2 compliant inputs of a safety PLC specified to receive a frequency of 5 kHz and a pulse length down to 40 microseconds or the field device signal pulse length minus 60 microseconds.

4.2.3 Field device

The field device must provide a minimum pulse length of 100 microseconds.

4.3 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.

4.4 Safe parameterisation

The user is responsible for verifying the correctness of the configuration parameters. (See section 14 Safe parameterisation - user responsibility).

Manual override may not be used for safety applications.

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 hazardous areas.

5. Functional specification of the safety functions

Pulse isolator as well as supply of NAMUR sensors and mechanical switches with cable error detection installed in the hazardous area. Cable error detection only works with NAMUR sensors or with the use of external resistors R_S and R_P . See connections diagram at page 13 (switch, cable fault) .

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.

7. Safety parameters

	Relay	Opto
Probability of dangerous Failure per Hour (PFH)	4.66E-8	3.62E-8
	Note ¹ , Note ²	
Probability of failure on demand (PFD) - 1 year proof test interval	2.04E-4	1.58E-4
Proof test interval (10% of loop PFD)	4 years	5 years
Safe Failure Fraction	90%	91%
Demand response time, opto output	<125 μ s	
Demand response time, relay output	<10 ms	
Demand mode	High	
Demand rate	1000 s	
Mean Time To Repair (MTTR)	8 hours	
Diagnostic test interval	10 seconds	
Hardware Fault Tolerance (HFT)	0	
Component Type	B	
SIL capability	SIL 2	
Description of the "Safe State", opto output	High impedance	
Description of the "Safe State", relay output	De-energised	
Relay lifetime (Note ²)	100 000 times	

Note¹: The 9202 contains no lifetime limiting components, therefore the PFH figures are valid for up to 12 years, according to IEC 61508.

Note²: The maximum frequency for Pulse Isolator 9202 with relay output is 20 Hz. The user must calculate the product lifetime with regard to the relay lifetime.

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

Failure category	Failure rates (1/h)	
	Relay	Opto
Fail Safe Detected	0.000E+00	0.000E+00
Fail Safe Undetected	2.897E-07	2.755E-07
Fail Dangerous Detected	1.303E-07	1.356E-07
Fail Dangerous Undetected	4.658E-08	3.618E-08

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	Perform an ON / OFF signal for 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 pulse isolator. The proof test is equivalent to the functional test.

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. Documentation for routing diagram

The routing diagram is shown in section 16.2.

13.1 In general

When configuring the 9202, you will be guided through all parameters and you can choose the settings which fit the application. For each menu there is a scrolling help text which is automatically shown in line 3 on the display.

Configuration is carried out by use of the 3 function keys:

- ⬆ will increase the numerical value or choose the next parameter
- ⬇ will decrease the numerical value or choose the previous parameter
- Ⓞ will save the chosen value and proceed to the next menu

When configuration is completed, the display will return to the default state 1.0.

Pressing and holding Ⓞ will return to the previous menu or return to the default state (1.0) without saving the changed values or parameters.

If no key is activated for 1 minute, the display will return to the default state (1.0) without saving the changed values or parameters.

13.2 Further explanations

13.2.1 Password protection

Access to the configuration can be blocked by assigning a password. The password is saved in the module in order to ensure a high degree of protection against unauthorised modifications to the configuration. Default password 2008 allows access to all configuration menus.

Password protection is mandatory in SIL applications.

13.2.2 Cable fault information via display front 4501

Cable fault (see limits in the table) is displayed as CA.BR (cable break) or CA.SH (cable short-circuited). Cable fault is shown independently for each channel but the configuration is common for both channels. In case of cable fault the backlight flashes. This can be reset by pressing the Ⓞ key. When the cable fault has been remedied, the module will return to normal operation.

13.4 Advanced functions

The unit gives access to a number of advanced functions which can be reached by answering "Yes" to the point "adv.set".

13.4.1 Display setup

Here you can adjust the brightness contrast and the backlight. Setup of tag numbers with 5 alphanumerics. Selection of functional readout in line 2 and 3 of the display - choose between readout of digital output or tag no. When selecting "ALT" the readout toggles between digital output and tag no.

13.4.2 Password

Here you can choose a password between 0000 and 9999 in order to protect the unit against unauthorised modifications to the configuration. The unit is delivered default without password.

13.4.3 Language

In the menu "LANG" you can choose between 7 different language versions of help texts that will appear in the menu. You can choose between UK, DE, FR, IT, ES, SE and DK.

13.4.4 Power rail

In the menu "RAIL" you can choose if errors in the module are transmitted to the central surveillance in the PR 9410 power control unit.

13.4.5 Safety integrity level

See Safe parameterisation - user responsibility

14 Safe parameterisation - user responsibility

14.1 Safety-related configuration parameters

Parameters	Value	Description
CH1.FUN	DIR / INV	Direct / inverted channel function
CH2.FUN.	DIR / INV	Direct / inverted channel function
PASSW	0 - 9999	New password

The above safety-related configuration parameters are marked in red text in the routing diagrams and must be verified by the user in a SIL-configuration.

14.2 Verification procedure

The verification is done using the display / programming front PR 4501 by following the procedure described below.

14.2.1 If no password is set

	Action	Display shows
1	Press OK	ADV.SET
2	Set (ADV.SET) to Yes and press OK	DISP SETUP
3	Step down to (SIL SETUP) and press OK	EN.SIL
4	Set (EN SIL) to YES and press OK	NEW.PASS
5	Set password to a number between 0 and 9999 and press OK (At this time the module starts operating in SIL mode with the entered configuration parameters!)	Verify⇒OPEN "briefly" ⇒LOCK*
6	Verify Channel 1 function and press OK	CH1.FUN
7	Verify Channel 2 function and press OK	CH2:FUN
8	Verify password and press OK	PASSW
9	Verify SIL and press OK	

* Open is shown briefly in the display.

14.2.2 If password is set

	Action	Display shows
1	Press OK	PASSW
2	Enter password and press OK	ADV.SET
3	Set (ADV.SET) to Yes and press OK	DISP SETUP
4	Step down to (SIL SETUP) and press OK	EN.SIL
5	Set (EN SIL) to YES and press OK (At this time the module starts operating in SIL mode with the entered configuration parameters!)	Verify⇒OPEN "briefly" ⇒LOCK*
6	Verify Channel 1 function and press OK	CH1.FUN
7	Verify Channel 2 function and press OK	CH2:FUN
8	Verify password and press OK	PASSW
9	Verify SIL and press OK	

* Open is shown briefly in the display

14.3 Functional test

The user is responsible to make a functional test after verification of safety parameters. The procedure for periodic proof test described in section 10 shall be used.

15 Fault reaction and restart condition

When the 9202 detects a fault the output will go to Safe State, in which the opto output will go to "high impedance" or the relay output will go to "de-energised". If the fault is application-specific (cable error detection) the 9202 will restart when the fault has been corrected.

For device faults there are 2 ways of bringing the module out of Safe State.

1. Power cycle the module.
2. Bring the module out of SIL mode (choose "NO" in the menu point "EN.SIL"), and set it back to SIL mode again (choose "YES" in the menu point "EN.SIL" and verify the configuration).

16 User interface

16.1 Scrolling help texts in display line 3

- [01] Set correct password [PASS]
- [02] Enter advanced setup [ADV.SET]
- [03] Enable cable short circuit error indication [CA.SH]
- [04] Enable cable breakage error indication? [CA.BR]
- [05] Enable rail status signal output? [RAIL.ER]
- [06] Enter language setup [SETUP]
- [6/1] Enter password setup [SETUP]
- [6/2] Enter display setup [SETUP]
- [6/3] Enter rail setup [SETUP]
- [6/4] Enter SIL setup [SETUP]
- [07] Select direct channel function [CH1.FUN] [CH2.FUN]
Select inverted channel function [CH1.FUN] [CH2.FUN]
- [09] Adjust LCD contrast [CONTRA]
- [10] Adjust LCD backlight [LIGHT]
- [11] Write a 5-character channel ["TAGON] ["TAGON]
- [12] Show output state in display [DISP]
Show TAG in display
Alternate shown information in display
- [13] Configuration SIL status (Open / Locked) [CONFIG]
- [14] Enable SIL configuration lock [EN.SIL]
- [15] Enable password protection [EN.PASS]
- [16] Set new password [NEW.PAS]
- [17] Select language [LANGUA]
- [18] Cable short circuit [¹CA.SH] [²OFF]
- [19] Cable breakage [¹ON] [²CA.BR]

16.2 Routing diagram

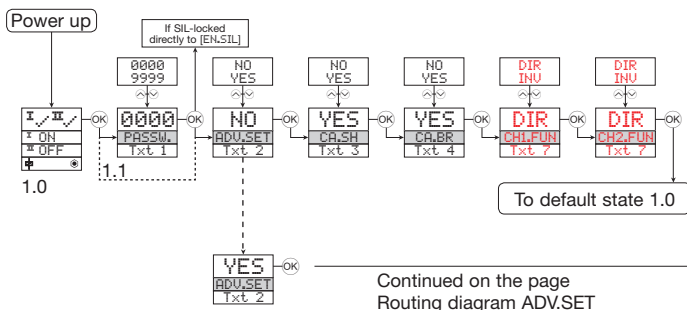
If no key is activated for 1 minute, the display will return to the default state 1.0 without saving configuration changes.

⤴ Increase value / choose next parameter

⤵ Decrease value / choose previous parameter

⊗ Save the chosen value and proceed to the next menu

Hold ⊗ Back to previous menu / return to menu 1.0 without saving



Continued on the page
Routing diagram ADV.SET

1.0 = Default state

Line 1 shows status for channel 1 and channel 2.

Line 2 shows status for sensor 1.

Line 3 shows status for sensor 2.

Line 4 indicates whether the module is SIL-locked.

1.1 = Only if password-protected

1.2 = If password has been set.

Line 1 symbols:

ⓘ✓ = OK. Flashing ⓘ! = error

Line 2 and 3 symbols:

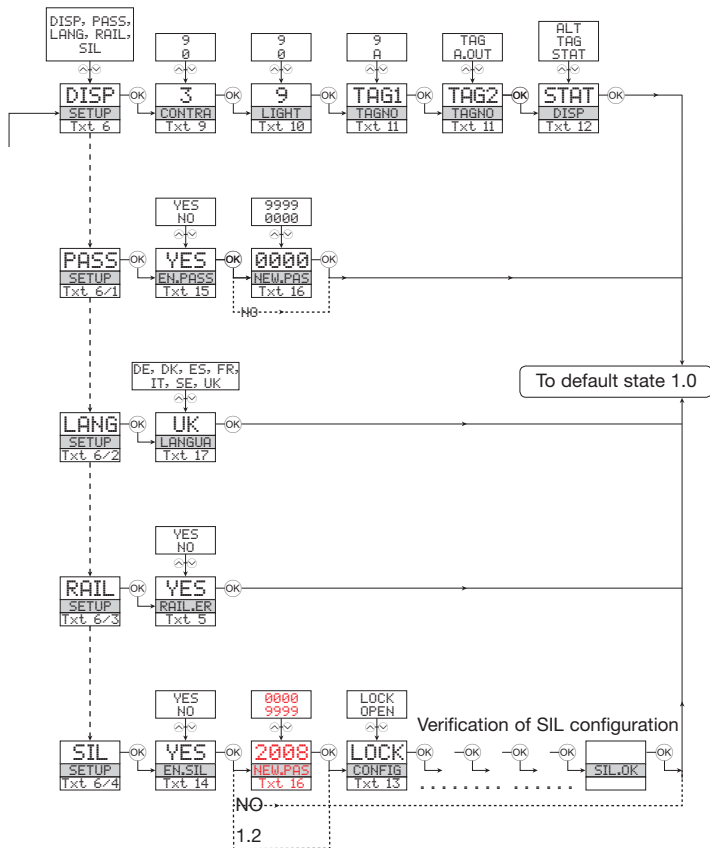
Input frequency > 1 Hz = ⓘ □ □ □

Line 4 symbols:

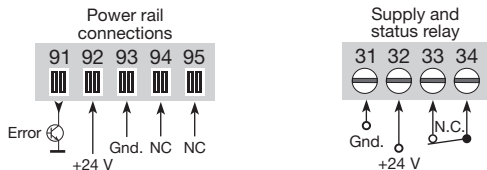
Static dot = SIL-locked

Flashing dot = not SIL-locked

16.3 Routing diagram - Advanced settings (ADV.SET)

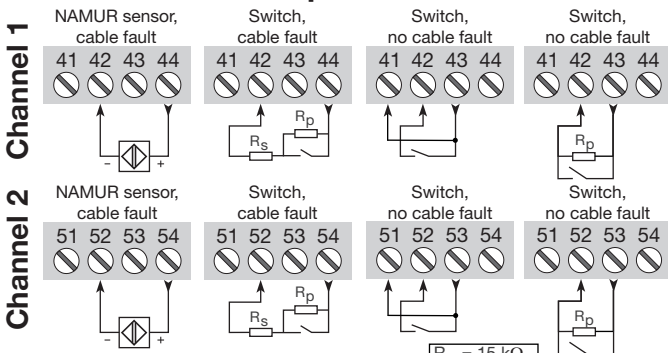


17. Connections diagram



NC = no connection

Inputs:



Outputs:

