9116 Universal converter

No. 9116V101-IN (1031)
Product version: 9116-001

PR electronics A/S offers a wide range of analogue and digital signal conditioning modules for industrial automation. The product range includes Isolators, Displays, Ex Interfaces, Temperature Transmitters, and Universal Modules. You can trust our products in the most extreme environments with electrical noise, vibrations and temperature fluctuations, and all products comply with the most exacting international standards. »Signals the Best« is the epitome of our philosophy – and your guarantee for quality.

PR electronics A/S offre une large gamme de produits pour le traitement des signaux analogiques et numériques dans tous les domaines industriels. La gamme de produits s’étend des transmetteurs de température aux afficheurs, des isolateurs aux interfaces SI, jusqu’aux modules universels. Vous pouvez compter sur nos produits même dans les conditions d’utilisation sévères, p.ex. bruit électrique, vibrations et fluctuations de température. Tous nos produits sont conformes aux normes internationales les plus strictes. Notre devise »SIGNALS the BEST« c’est notre ligne de conduite - et pour vous l’assurance de la meilleure qualité.

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</table>
WARNING
The following operations should only be carried out on a disconnected device and under ESD-safe conditions:
- General mounting, connection and disconnection of wires.
- Troubleshooting the device.

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

WARNING
Do not open the front plate of the device as this will cause damage to the connector for the display / programming front PR 4501. This device contains no DIP-switches or jumpers.

SYMBOL IDENTIFICATION

Triangle with an exclamation mark: Read the manual before installation and commissioning of the device in order to avoid incidents that could lead to personal injury or mechanical damage.

The CE mark proves the compliance of the device with the essential requirements of the directives.

The double insulation symbol shows that the device is protected by double or reinforced insulation.

Ex devices have been approved according to the ATEX directive for use in connection with installations in explosive areas. See installation drawings in appendix.

SAFETY INSTRUCTIONS

DEFINITIONS
Hazardous voltages have been defined as the ranges: 75...1500 Volt DC, and 50...1000 Volt AC.
Technicians are qualified persons educated or trained to mount, operate, and also troubleshoot technically correct and in accordance with safety regulations. Operators, being familiar with the contents of this manual, adjust and operate the knobs or potentiometers during normal operation.
RECEIPT AND UNPACKING
Unpack the device without damaging it and check whether the device type corresponds to the one ordered. The packing should always follow the device until this has been permanently mounted.

ENVIRONMENT
Avoid direct sunlight, dust, high temperatures, mechanical vibrations and shock, as well as rain and heavy moisture. If necessary, heating in excess of the stated limits for ambient temperatures should be avoided by way of ventilation. The device must be installed in pollution degree 2 or better. The device is designed to be safe at least under an altitude up to 2 000 m.

MOUNTING
Only technicians who are familiar with the technical terms, warnings, and instructions in the manual and who are able to follow these should connect the device. Should there be any doubt as to the correct handling of the device, please contact your local distributor or, alternatively,

PR electronics A/S
www.prelectronics.com

The use of stranded wires is not permitted for mains wiring except when wires are fitted with cable ends.

Descriptions of input / output and supply connections are shown in the block diagram and on the side label.

The device is provided with field wiring terminals and shall be supplied from a Power Supply having double / reinforced insulation. A power switch shall be easily accessible and close to the device. The power switch shall be marked as the disconnecting unit for the device.

For installation on Power Rail 9400 the power is supplied by Power Control Unit 9410.

Year of manufacture can be taken from the first two digits in the serial number.

CALIBRATION AND ADJUSTMENT
During calibration and adjustment, the measuring and connection of external voltages must be carried out according to the specifications of this manual. The technician must use tools and instruments that are safe to use.
NORMAL OPERATION
Operators are only allowed to adjust and operate devices that are safely fixed in panels, etc., thus avoiding the danger of personal injury and damage. This means there is no electrical shock hazard, and the device is easily accessible.

Cleansing
When disconnected, the device may be cleaned with a cloth moistened with distilled water.

Liability
To the extent the instructions in this manual are not strictly observed, the customer cannot advance a demand against PR electronics A/S that would otherwise exist according to the concluded sales agreement.

HOW TO DEMOUNT SYSTEM 9000

Picture 1:  
By lifting the bottom lock, the device is detached from the power rail.
EC DECLARATION OF CONFORMITY

As manufacturer
PR electronics A/S
Lerbakken 10
DK-8410 Rønde

hereby declares that the following product:
Type: 9116
Name: Universal converter

is in conformity with the following directives and standards:
The EMC Directive 2004/108/EC and later amendments
EN 61326-1: 2006

For specification of the acceptable EMC performance level, refer to the electrical specifications for the device.
The Low Voltage Directive 2006/95/EC and later amendments
EN 61010-1: 2001
The ATEX Directive 94/9/EC and later amendments
EN 61241-0: 2006, EN 61241-11: 2006, EN 60079-0: 2006,
ATEX certificate: KEMA 07ATEX0149 X

Notified body
KEMA Quality B.V. (0344)
Utrechtseweg 310, 6812 AR Arnhem
P.O. Box 5185, 6802 ED Arnhem
The Netherlands

Rønde, 15 January 2010

Kim Rasmussen
Manufacturer’s signature
UNIVERSAL CONVERTER
9116

• Input for RTD, TC, Ohm, potentiometer, mA and V
• Supply for 2-wire transmitters
• Active / passive mA output and relay output
• Can be supplied separately or installed on power rail, PR 9400
• SIL 2-certified via Full Assessment

Advanced features
• Configuration and monitoring by way of detachable display front (PR 4501); process calibration, signal and relay simulation.
• Advanced relay configuration, e.g. setpoint, window, delay, sensor error indication and power monitoring.
• Copying of the configuration from one device to others of the same type via PR 4501.
• Reduced Uo Ex data < 8.3 V for active input signals.
• TC inputs with internal or external CJC for higher accuracy.
• The device automatically detects whether it must supply an active or a passive current signal.

Application
• 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.
• Conversion and scaling of temperature, voltage, potentiometer and linear resistance signals.
• Power supply and signal isolator for 2-wire transmitters.
• Monitoring of error events and cable breakage via the individual status relay and/or a collective electronic signal via the power rail.
• The 9116 has been designed, developed and certified for use in SIL 2 applications according to the requirements of IEC 61508.

Technical characteristics
• 1 green and 1 red front LED indicate operation status and malfunction. 1 yellow LED indicates relay status.
• 2.6 kVAC galvanic isolation between input, output and supply.
### APPLICATIONS

#### Input signals:
- Potentiometer
- RTD and lin. R
- Connection, wires
- TC

* Order separately: CJC connector 5910Ex

#### Output signals:
- Analogue, 0/4...20 mA and relay

#### Power rail
- Status relay signal
- Rail, +24 VDC
- Rail, Gnd.
- No connection
- No connection

#### Power connection:
- Gnd.
- Supply +19.2...31.2 VDC
- Device status
- N.C.

### Zones

- **Zone 0, 1, 2, 20, 21, 22 / Cl. I/II/III, div. 1 gr. A-G**
- **Zone 2 / Cl. 1, div. 2, gr. A-D or safe area**
Functionality
The simple and easily understandable menu structure and the explanatory help texts guide you effortlessly and automatically through the configuration steps, thus making the product very easy to use. Functions and configuration options are described in the section "Configuration / operating the function keys”.

Application
• Communications interface for modification of operational parameters in 9116.
• Can be moved from one 9116 device to another and download the configuration of the first unit to subsequent units.
• Fixed display for visualisation of process data and status.

Technical characteristics
• LCD display with 4 lines; Line 1 (H=5.57 mm) shows input status, line 2 (H=3.33 mm) toggles between input value and tag. no. Line 3 (H=3.33 mm) shows output value and UNIT. Line 4 shows status for relay and communication and whether the device is SIL-locked. Static dot = SIL-locked and flashing dot = not SIL-locked.
• Programming access can be blocked by assigning a password. The password is saved in the device in order to ensure a high degree of protection against unauthorised modifications to the configuration.

Mounting / installation
• Click 4501 onto the front of 9116.
Order
9116B1 = Universal converter - Uo 28 VDC (max. loop voltage)
9116B2 = Universal converter - Uo 22 VDC (max. loop voltage)
4501 = Display / programming front
5910Ex = CJC connector
9400 = Power rail

Electrical specifications
Specifications range: -20°C to +60°C
Storage temperature: -20°C to +85°C

Common specifications:
Supply voltage, DC: 19.2...31.2 VDC
Max. consumption: ≤ 3.5 W
Fuse: 1.25 A SB / 250 VAC
Isolation voltage, test / operation: 2.6 kVAC / 250 VAC
Communications interface: Programming front 4501
Signal / noise ratio: Min. 60 dB (0...100 kHz)
Response time (0...90%, 100...10%):
  Temperature input, programmable: 1...60 s
  mA / V input, programmable: 0.4...60 s
Calibration temperature: 20...28°C

Accuracy, the greater of the general and basic values:

<table>
<thead>
<tr>
<th>General values</th>
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<tbody>
<tr>
<td>Input type</td>
</tr>
<tr>
<td>All</td>
</tr>
</tbody>
</table>
### Basic values

<table>
<thead>
<tr>
<th>Input type</th>
<th>Basic accuracy</th>
<th>Temperature coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>mA</td>
<td>≤ ±16 µA</td>
<td>≤ ±1.6 µA / °C</td>
</tr>
<tr>
<td>Volt</td>
<td>≤ ±20 µV</td>
<td>≤ ±2 µV / °C</td>
</tr>
<tr>
<td>Pt100, Pt200, Pt 1000</td>
<td>≤ ±0.2°C</td>
<td>≤ ±0.02°C / °C</td>
</tr>
<tr>
<td>Pt500, Ni100, Ni120, Ni 1000</td>
<td>≤ ±0.3°C</td>
<td>≤ ±0.03°C / °C</td>
</tr>
<tr>
<td>Pt50, Pt400, Ni50</td>
<td>≤ ±0.4°C</td>
<td>≤ ±0.04°C / °C</td>
</tr>
<tr>
<td>Pt250, Pt300</td>
<td>≤ ±0.6°C</td>
<td>≤ ±0.06°C / °C</td>
</tr>
<tr>
<td>Pt20</td>
<td>≤ ±0.8°C</td>
<td>≤ ±0.08°C / °C</td>
</tr>
<tr>
<td>Pt10</td>
<td>≤ ±1.4°C</td>
<td>≤ ±0.14°C / °C</td>
</tr>
<tr>
<td>TC type: E, J, K, L, N, T, U</td>
<td>≤ ±1°C</td>
<td>≤ ±0.1°C / °C</td>
</tr>
<tr>
<td>TC type: R, S, W3, W5, LR</td>
<td>≤ ±2°C</td>
<td>≤ ±0.2°C / °C</td>
</tr>
<tr>
<td>TC type: B 160...400°C</td>
<td>≤ ±4.5°C</td>
<td>≤ ±0.45°C / °C</td>
</tr>
<tr>
<td>TC type: B 400...1820°C</td>
<td>≤ ±2°C</td>
<td>≤ ±0.2°C / °C</td>
</tr>
</tbody>
</table>

**EMC immunity influence** ................................................. < ±0.5% of span

Extended EMC immunity:
NAMUR NE 21, A criterion, burst ................................. < ±1% of span

Auxiliary supplies for 9116B1:
2-wire supply (terminal 54...52) .................................. 28...16.5 VDC / 0...20 mA

Auxiliary supplies for 9116B2:
2-wire supply (terminal 54...52) .................................. 22...16.5 VDC / 0...20 mA

Wire size (max....min.) ........................................... AWG 26...14 / 0.13...2.08 mm² stranded wire

Screw terminal torque ............................................ 0.5 Nm

Relative humidity ................................................... < 95% RH (non-cond.)

Dimen., without display front (HxWxD) ........ 109 x 23.5 x 104 mm

Dimensions, with display front (HxWxD) ....... 109 x 23.5 x 116 mm

Protection degree .................................................. IP20

Weight ........................................................................ 185 g / 200 g with 4501
Isolation:
Input to any .......................................................... 300 VAC double/reinforced isolation
Output relay to analogue output ..................... 150 VAC double/reinforced or
300 VAC basic isolation
Analogue output to supply .......................... 300 VAC double/reinforced isolation
Status relay to supply ................................. 150 VAC double/reinforced or
300 VAC basic isolation

RTD, linear resistance and potentiometer input:

<table>
<thead>
<tr>
<th>Input type</th>
<th>Min. value</th>
<th>Max. value</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pt100</td>
<td>-200°C</td>
<td>+850°C</td>
<td>IEC60751</td>
</tr>
<tr>
<td>Ni100</td>
<td>-60°C</td>
<td>+250°C</td>
<td>DIN 43760</td>
</tr>
<tr>
<td>Linear resist.</td>
<td>0 Ω</td>
<td>10000 Ω</td>
<td>-</td>
</tr>
<tr>
<td>Potentiometer</td>
<td>10 Ω</td>
<td>10000 Ω</td>
<td>-</td>
</tr>
</tbody>
</table>

Input for RTD types:
Pt10*, Pt20*, Pt50*, Pt100, Pt200, Pt250, Pt300, Pt400, Pt500, Pt1000
Ni50, Ni100, Ni120, Ni1000

Effect of sensor cable resistance
(3- / 4-wire), RTD................................................. < 0.002 Ω / Ω
Sensor error detection, RTD .......................... Programmable ON / OFF
Short circuit detection, RTD .......................... Yes
Cable resistance per wire (max.), RTD...... 50 Ω
Sensor current, RTD........................................... Nom. 0.2 mA
* No short circuit detection for Pt10, Pt20 and Pt50
* No short circuit detection for Lin. R_0%≤ app. 18 Ω

TC input:

<table>
<thead>
<tr>
<th>Type</th>
<th>Min. value</th>
<th>Max. value</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>+0°C</td>
<td>+1820°C</td>
<td>IEC 60584-1</td>
</tr>
<tr>
<td>E</td>
<td>-100°C</td>
<td>+1000°C</td>
<td>IEC 60584-1</td>
</tr>
<tr>
<td>J</td>
<td>-100°C</td>
<td>+1200°C</td>
<td>IEC 60584-1</td>
</tr>
<tr>
<td>K</td>
<td>-180°C</td>
<td>+1372°C</td>
<td>IEC 60584-1</td>
</tr>
<tr>
<td>L</td>
<td>-200°C</td>
<td>+900°C</td>
<td>DIN 43710</td>
</tr>
<tr>
<td>N</td>
<td>-180°C</td>
<td>+1300°C</td>
<td>IEC 60584-1</td>
</tr>
<tr>
<td>R</td>
<td>-50°C</td>
<td>+1760°C</td>
<td>IEC 60584-1</td>
</tr>
<tr>
<td>S</td>
<td>-50°C</td>
<td>+1760°C</td>
<td>IEC 60584-1</td>
</tr>
<tr>
<td>T</td>
<td>-200°C</td>
<td>+400°C</td>
<td>IEC 60584-1</td>
</tr>
<tr>
<td>U</td>
<td>-200°C</td>
<td>+600°C</td>
<td>DIN 43710</td>
</tr>
<tr>
<td>W3</td>
<td>0°C</td>
<td>+2300°C</td>
<td>ASTM E988-90</td>
</tr>
<tr>
<td>W5</td>
<td>0°C</td>
<td>+2300°C</td>
<td>ASTM E988-90</td>
</tr>
<tr>
<td>LR</td>
<td>-200°C</td>
<td>+800°C</td>
<td>GOST 3044-84</td>
</tr>
</tbody>
</table>
Cold junction compensation (CJC):
  via external sensor in connector 5910  20...28°C ≤ ±1°C
  -20...20°C and 28...70°C ≤ ±2°C
via internal CJC sensor.........................  ±(2.0°C + 0.4°C * Δt)
Δt = internal temperature - ambient temperature
Sensor error detection ........................... Programmable ON or OFF
(sensor error current)
when detecting ................................... Nom. 2 µA
else......................................................... 0 µA

**Current input:**
Measurement range.............................. 0...20 mA
Programmable measurement ranges......... 0...20 and 4...20 mA
Input resistance.................................... Nom. 20 Ω + PTC 50 Ω
Sensor error detection:
  Loop break 4...20 mA ............................ Yes
  NB: Only when input is selected as 4...20 mA

**Voltage input:**
Measurement range.............................. 0...10 VDC
Programmable measurement ranges........ 0...1 / 0.2...1 / 0...5 / 1...5 / 0...10 and 2...10 VDC
Input resistance.................................... Nom. >10 MΩ

**Current output:**
Signal range (span).............................. 0...20 mA
Programmable signal ranges ................. 0...20 / 4...20 / 20...0 and 20...4 mA
Load (max.)............................................. 20 mA / 600 Ω / 12 VDC
Load stability....................................... ≤ 0.01% of span / 100 Ω
Sensor error reaction........................... 0 / 3.5 / 23 mA / none
NAMUR NE 43 Upscale/Downscale ........... 23 mA / 3.5 mA
Output limitation:
  on 4...20 and 20...4 mA signals ............. 3.8...20.5 mA
  on 0...20 and 20...0 mA signals ............. 0...20.5 mA
Current limit........................................... ≤ 28 mA

**2-wire 4...20 mA output:**
Signal range ....................................... 4...20 mA
Load stability...................................... ≤ 0.01% of span / 100 Ω
Load resistance .................................. ≤ (Vsupply -3.5) / 0.023 A [Ω]
External 2-wire supply range ............... 3.5...26 VDC
Effect of external 2-wire supply
  voltage variation ............................... < 0.005% of span / V
Configuration of sensor error check

<table>
<thead>
<tr>
<th>Device</th>
<th>Configuration</th>
<th>Sensor error detection</th>
</tr>
</thead>
<tbody>
<tr>
<td>9116</td>
<td>ERR.ACT=NONE - OUT.ERR=NONE.</td>
<td>OFF</td>
</tr>
<tr>
<td></td>
<td>Else:</td>
<td>ON</td>
</tr>
</tbody>
</table>

Relay output in safe area:

- Relay functions: Setpoint, Window, Sensor error, Power and Off
- Hysteresis, in % of span / display range: 0.1...25 / 1...25
- On and Off delay: 0...3600 s
- Sensor error reaction: Break / Make / Hold
- Max. voltage: 250 VAC / 30 VDC
- Max. current: 2 AAC / 2 ADC
- Max. AC power: 500 VA / 60 W

Status relay in safe area:

- Max. voltage: 125 VAC / 110 VDC
- Max. current: 0.5 AAC / 0.3 ADC
- Max. AC power: 62.5 VA / 32 W

Marine approval:

- Det Norske Veritas, Ships & Offshore: Pending

GOST R approval:

- VNIIFTRI, Cert No.: Pending

SIL certification:

- exida, Cert No.: PREI 070902 P0002 C05

Observed authority requirements:

- Standard:
  - EN 61326-1
  - EN 61010-1
  - EN 60079-0, -11, -15 , -26
  - IEC 60079-0, -11, -15 and -26
  - IEC 60079-0, -11
  - FM 3600, 3611, 3810
  - CSA E60079-0, -15
  - CSA 22.2 -25, -142, -213
  - ANSI/ISA-12.00.01 / 12.12.02
  - UL 61010-1

- SIL: IEC 61508

of span = of the currently selected measurement range
### Visualisation in 4501 of:

**Input signal outside range**

Outside range readout (IN.LO, IN.HI):
If the valid range of the A/D converter or the polynomial is exceeded.

<table>
<thead>
<tr>
<th>Input</th>
<th>Range</th>
<th>Readout</th>
<th>Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOLT</td>
<td>0...1 V / 0.2...1 V</td>
<td>IN.LO</td>
<td>&lt; -25 mV</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IN.HI</td>
<td>&gt; 1.2 V</td>
</tr>
<tr>
<td></td>
<td>0...10 V / 2...10 V</td>
<td>IN.LO</td>
<td>&lt; -25 mV</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IN.HI</td>
<td>&gt; 12 V</td>
</tr>
<tr>
<td>CURR</td>
<td>0...20 mA / 4...20 mA</td>
<td>IN.LO</td>
<td>&lt; -1.05 mA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IN.HI</td>
<td>&gt; 25.05 mA</td>
</tr>
<tr>
<td>LIN.R</td>
<td>0...800 Ω</td>
<td>IN.LO</td>
<td>&lt; -10 Ω</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IN.HI</td>
<td>&gt; 900 Ω</td>
</tr>
<tr>
<td></td>
<td>0...10 kΩ</td>
<td>IN.LO</td>
<td>&lt; -10 Ω</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IN.HI</td>
<td>&gt; 11 kΩ</td>
</tr>
<tr>
<td>POTM</td>
<td>0 - 100%</td>
<td>IN.LO</td>
<td>&lt; -0.5 %</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IN.HI</td>
<td>&gt; 100.5 %</td>
</tr>
<tr>
<td>TEMP</td>
<td>TC / RTD</td>
<td>IN.LO</td>
<td>&lt; temperature range -2°C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IN.HI</td>
<td>&gt; temperature range +2°C</td>
</tr>
</tbody>
</table>

Display readout below . / above max. (-1999, 9999):

<table>
<thead>
<tr>
<th>Input</th>
<th>Range</th>
<th>Readout</th>
<th>Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All</td>
<td>-1999</td>
<td>Display readout &lt; -1999</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9999</td>
<td>Display readout &gt; 9999</td>
</tr>
</tbody>
</table>

### Sensor error detection

Sensor error detection (SE.BR, SE.SH):

<table>
<thead>
<tr>
<th>Input</th>
<th>Range</th>
<th>Readout</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>CURR</td>
<td>Loop break (4...20 mA)</td>
<td>SE.BR</td>
<td>&lt;= 3.6 mA; &gt; = 21 mA</td>
</tr>
<tr>
<td>POTM</td>
<td>All, SE.BR on all 3-wire</td>
<td>SE.BR</td>
<td>Sensor broken</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SE.SH</td>
<td>Sensor shorted</td>
</tr>
<tr>
<td>LIN.R</td>
<td>All</td>
<td>SE.BR</td>
<td>Sensor broken or wire resistance too high</td>
</tr>
<tr>
<td></td>
<td>For Lin. R_0% ≥ app. 18 Ω</td>
<td>SE.SH</td>
<td>Sensor shorted</td>
</tr>
<tr>
<td>TEMP</td>
<td>All</td>
<td>SE.BR</td>
<td>Sensor broken or wire resistance too high</td>
</tr>
<tr>
<td></td>
<td>Pt100 to Pt1000 and Ni50 to Ni1000</td>
<td>SE.SH</td>
<td>Sensor shorted</td>
</tr>
</tbody>
</table>
## Hardware error

<table>
<thead>
<tr>
<th>Error search</th>
<th>Readout</th>
<th>Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>CJC sensor error - check device temperature</td>
<td>CJ.ER</td>
<td>Defect internal CJC sensor or CJC temperature out of allowed range **</td>
</tr>
<tr>
<td>CJC connector error - check CJC connector block</td>
<td>CJ.CE</td>
<td>Defect (or missing) CJC connector or temperature out of allowed range **</td>
</tr>
<tr>
<td>Input error - check input connection and reset power</td>
<td>IN.ER</td>
<td>Signal levels on input beyond limits or connected to wrong terminals*</td>
</tr>
<tr>
<td>Output error - check output connections and reset power</td>
<td>AO.ER</td>
<td>Error in analogue output current (SIL mode only)*</td>
</tr>
<tr>
<td>No communication</td>
<td>NO.CO</td>
<td>No communication with (4501)</td>
</tr>
<tr>
<td>Flash memory error - check configuration</td>
<td>FL.ER CO.ER</td>
<td>FLASH error (configuration invalid)***</td>
</tr>
<tr>
<td>Invalid configuration type or version</td>
<td>TY.ER</td>
<td>Configuration read from EEPROM has invalid type or rev. no.</td>
</tr>
<tr>
<td>Hardware error</td>
<td>RA.ER</td>
<td>RAM error*</td>
</tr>
<tr>
<td>Hardware error</td>
<td>IF.ER</td>
<td>Internal Flash error*</td>
</tr>
<tr>
<td>Hardware error</td>
<td>SW.ER</td>
<td>SW monitor error*</td>
</tr>
<tr>
<td>Hardware error</td>
<td>AD.ER</td>
<td>A/D converter error*</td>
</tr>
<tr>
<td>Hardware error</td>
<td>AO.SU</td>
<td>Analogue output supply error*</td>
</tr>
<tr>
<td>Hardware error</td>
<td>CA.ER</td>
<td>Factory calibration error*</td>
</tr>
<tr>
<td>Hardware error</td>
<td>CM.ER</td>
<td>Main CPU error*</td>
</tr>
<tr>
<td>Hardware error</td>
<td>RE.ER</td>
<td>Relay readback error*</td>
</tr>
<tr>
<td>Hardware error</td>
<td>II.ER</td>
<td>Initialization check error*</td>
</tr>
<tr>
<td>Hardware error</td>
<td>RS.ER</td>
<td>Reset error*</td>
</tr>
<tr>
<td>Hardware error</td>
<td>IC.ER</td>
<td>Input communication error*</td>
</tr>
<tr>
<td>Hardware error</td>
<td>M1.ER</td>
<td>Main CPU to Ch.1 error*</td>
</tr>
<tr>
<td>Hardware error</td>
<td>MC.ER</td>
<td>Main CPU config. error*</td>
</tr>
<tr>
<td>Hardware error</td>
<td>MF.ER</td>
<td>Main CPU Flash error*</td>
</tr>
<tr>
<td>Hardware error</td>
<td>MR.ER</td>
<td>Main CPU Ram error*</td>
</tr>
<tr>
<td>Hardware error</td>
<td>MS.ER</td>
<td>Main CPU supply error*</td>
</tr>
<tr>
<td>Hardware error</td>
<td>MP.ER</td>
<td>Main CPU ProgFlow error*</td>
</tr>
<tr>
<td>Hardware error</td>
<td>MI.ER</td>
<td>Main CPU initialization check error*</td>
</tr>
<tr>
<td>Hardware error</td>
<td>DE.ER</td>
<td>Device error*</td>
</tr>
<tr>
<td>Hardware error</td>
<td>FC.ER</td>
<td>Invalid code checksum in 4501</td>
</tr>
</tbody>
</table>
All error indications in the display flash once per second (1 Hz), and the corresponding help text is shown. If the error is a sensor error, the display backlight flashes as well - this is acknowledged (stopped) by pushing the OK button.

* Error is acknowledged by resetting the device power
** Error can be disregarded by selecting input type different than TC.
*** Error is acknowledged by stepping through the basic setup.
CONNECTIONS

Inputs:

- **RTD, 2-wire**
  - 41 42 43 44
  - ![Diagram of RTD, 2-wire connection]

- **Resistance, 2-wire**
  - 41 42 43 44
  - ![Diagram of Resistance, 2-wire connection]

- **Resistance, 3- / 4-wire**
  - 41 42 43 44
  - ![Diagram of Resistance, 3- / 4-wire connection]

- **Potentiometer**
  - 41 42 43 44
  - ![Diagram of Potentiometer connection]

- **Current**
  - 51 52 53 54
  - ![Diagram of Current connection]

- **Voltage**
  - 51 52 53 54
  - ![Diagram of Voltage connection]

- **2-wire transmitter**
  - 51 52 53 54
  - ![Diagram of 2-wire transmitter connection]

- **TC, internal CJC sensor**
  - 41 42 43 44
  - ![Diagram of TC, internal CJC sensor connection]

- **CJC connector**
  - 41 42
  - ![Diagram of CJC connector connection]

* Order separately: CJC connector 5910Ex.

Outputs:

- **Current (Active output)**
  - 11 12 13 14
  - ![Diagram of Current (Active output) connection]

- **2-wire transmitter (Passive output)**
  - 11 12 13 14
  - ![Diagram of 2-wire transmitter (Passive output) connection]

- **Relay**
  - 11 12 13 14
  - ![Diagram of Relay connection]
**Signal error and cable fault indications without display front**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Green LED</th>
<th>Relay: Yellow LED</th>
<th>Error: Red LED</th>
<th>Status relay, N.C.</th>
<th>Power rail signal status</th>
</tr>
</thead>
<tbody>
<tr>
<td>No supply</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>De-energized</td>
<td>Closed</td>
</tr>
<tr>
<td>Device failure</td>
<td>OFF</td>
<td></td>
<td>ON</td>
<td>De-energized</td>
<td>Closed</td>
</tr>
<tr>
<td>Device OK</td>
<td>Flashing</td>
<td></td>
<td></td>
<td>Energized</td>
<td>Open</td>
</tr>
<tr>
<td>Signal OK</td>
<td>Flashing</td>
<td></td>
<td>OFF</td>
<td>Energized</td>
<td>Open</td>
</tr>
<tr>
<td>Output relay energized</td>
<td>Flashing</td>
<td>ON</td>
<td>OFF</td>
<td>Energized</td>
<td>Open</td>
</tr>
<tr>
<td>Output relay energized w. wire short/break</td>
<td>Flashing</td>
<td>ON</td>
<td>Flashing</td>
<td>De-energized</td>
<td>Closed (if enabled)</td>
</tr>
<tr>
<td>Output relay de-energized w. wire short/break</td>
<td>Flashing</td>
<td>OFF</td>
<td>Flashing</td>
<td>De-energized</td>
<td>Closed (if enabled)</td>
</tr>
<tr>
<td>Output relay de-energized</td>
<td>Flashing</td>
<td>OFF</td>
<td>OFF</td>
<td>Energized</td>
<td>Open</td>
</tr>
</tbody>
</table>
CONFIGURATION / OPERATING THE FUNCTION KEYS

Documentation for routing diagram.

In general
When configuring the 9116, 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 accept 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.

Further explanations
Password protection: Programming access can be blocked by assigning a password. The password is saved in the converter 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.

Selection of units
After choosing the input signal type you can choose which process units should be shown in the display (see table). By selection of temperature input the process value is always displayed in Celsius or Fahrenheit. This is selected in the menu point after selection of temperature input.

CJC
In the CJC menu you can choose between CJC connector and internal cold junction compensation. The CJC connector (PR 5910Ex) must be ordered separately.
Signal and sensor error information via display front 4501

Sensor error (see limits in the table) is displayed as SE.BR (sensor break) or SE.SH (sensor short). Signals outside the selected range (not sensor error, see table for limits) are displayed as IN.LO indicating low input signal or IN.HI indicating high input signal. The error indication is displayed as text in line 1 and at the same time the backlight flashes. Line 4 of the display is a status line which shows whether the device is SIL-locked (static dot = SIL-locked and flashing dot = not SIL-locked) as well as relay status and COM (running circle) indicating correct functioning of 4501.

Signal and sensor error indication without display front

Status of the unit can also be read from the 3 LEDs in the front of the device.
- Green flashing LED indicates normal operation.
- No light in the green LED indicates lack of supply voltage or error in the device.
- Steady red LED indicates fatal error.
- Flashing red LED indicates sensor error.

Relay functions

5 different settings of relay function can be selected.
- **Setpoint:** The unit works as a single trip amplifier
- **Window:** The relay has a window that is defined by a low and a high setpoint. On both sides of the window the relay has the same status.
- **Error function:** The relay is activated by sensor error.
- **Power:** The relay is activated as long as the power is on.
- **Off:** The relay is deactivated.

**Increasing/decreasing:** The relay can be set to activate at increasing or decreasing input signal.

**Delay:** An ON and an OFF delay can be set in the range 0...3600 s.

**Hysteresis:** A hysteresis can be set at 0.1...25% of the span or between 1 and 25% of display range.

**Window:** The window function is selected by choosing “window” in the menu and defining a high and a low setpoint.
- See the graphic depiction of the window functions on page 30.

**Setpoint:** The setpoint function is selected by choosing ”setpoint” in the menu and entering the desired limit. The device then works as a single limit switch.
- See the graphic depiction of the window functions on page 31.
An activated relay means that the contact is closed if the contact function "normally open" is selected, and the contact is open if the contact function "normally closed" is selected.

The delay time for activation and deactivation can be set independently of each other in the menus ON.DEL and OFF DEL respectively.

**Advanced functions**

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

**Display setup:** Here you can adjust the brightness contrast and the backlight. Setup of TAG numbers with 5 alphanumerics. Input value is always shown in line 2. Selection of functional readout in line 3 of the display - choose between readout of analogue output or tag no or alternating display.

**Two-point process calibration:** The device can be process-calibrated in 2 points to fit a given input signal. A low input signal (not necessarily 0%) is applied and the actual value is entered via 4501. Then a high signal (not necessarily 100%) is applied and the actual value is entered via 4501. If you accept to use the calibration, the device will work according to this new adjustment. If you later reject this menu point or choose another type of input signal the device will return to factory calibration.

**Process simulation function:** In the menu point “EN.SIM” it is possible to simulate an input signal by means of the arrow keys and thus control the output signal up or down, or the relay state OFF and ON. You must exit the menu by pressing \(\bigcirc\) (no time-out). The simulation function exits automatically, if the 4501 is detached.

**Password:** Here you can choose a pass word between 0000 and 9999 in order to protect the device against unauthorised modifications to the configuration. The device is delivered default without password.

**Memory:** In the memory menu you can save the configuration of the device in the 4501, and then move the 4501 onto another device of the same type and download the configuration in the new device.
**Language:** In the menu "lang.setup" 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.

**Power rail:** In the menu "RAIL" you can choose if sensor errors are transmitted to the central surveillance in the PR 9410 power control unit.

**Safety integrity level:** See Safety Manual for details.

---

**Safety Integrity Level (SIL):** See Safety Manual for details.
Fast setpoint adjustment and relay test

Increase setpoint
Decrease setpoint
Save and exit the menu
and simultaneously = change relay state

Error indication, example

Red text signifies safety parameters in a SIL configuration. See safety manual for details.

Routing diagram ADV.SET

Continued on the page

9116 - Product Version 9116-001
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
- Accept the chosen value and proceed to the next menu
- Hold OK Back to previous menu / return to menu 1.0 without saving

1.0 = Default state. Line 1 shows input status. Line 2 shows input value and TAG NO. Line 3 shows output value and units. Line 4 shows status for relay and communication and whether the device is SIL-locked. Static dot = SIL-locked and flashing dot = not SIL-locked.

1.1 = Only if password-protected.
1.2 = Only if FastSet is activated and the relay function is setpoint.
1.3 = Only if input types support sensor error check. Not valid for these input signals: 0...20 mA and voltage.
1.4 = Only if input signal is temperaure.
1.5 = Only if the configuration is not protected by a password.

Selectable UNITS:

- °C, °F, %, m, cm, mm, um, ft, in, mils, yd, m3, l
- s, min, mm/s, m/min, m/h, in/s, Pa, N, N, in/h, ft/s, ft/min, bar, mbar, ft/h, kJ, m/s2, Wh, mV
- rpm, Hz, t, kg, g, N, Pa, MPa, kPa, hPa, mA, A, V, mol
- MWh, kWh, S, W, Wh, Wh, kV, kW, W, V, [blank]

Continued on the next page
2.0 In the submenu simulation (SIM) you must press \( \text{OK} \) to return to the default state 1.0.
SCROLLING HELP TEXTS IN DISPLAY LINE 3

[01] Set correct password
[02] Enter Advanced setup menu?
[03] Select Temperature input
Select Potentiometer input
Select Linear resistance input
Select Current input
Select Voltage input
[04] Select 0.0-1 V input range
Select 0.2-1 V input range
Select 0-5 V input range
Select 1-5 V input range
Select 0-10 V input range
Select 2-10 V input range
[05] Select 0-20 mA input range
Select 4-20 mA input range
Select 2-Wire sensor connection
Select 3-Wire sensor connection
Select 4-Wire sensor connection
[07] Set Resistance value low
[08] Set Resistance value high
[09] Select Celsius as temperature unit
Select Fahrenheit as temperature unit
[10] Select TC sensor type
Select Ni sensor type
Select Pt sensor type
[12] Select Decimal point position
[13] Set Display range low
[14] Set Display range high
[15] Select Relay setpoint in % of input range
Select Relay setpoint in display units
[16] Select Pt100 sensor type
Select Pt50 sensor type
Select Pt100 sensor type
Select Pt200 sensor type
Select Pt250 sensor type
Select Pt300 sensor type
Select Pt400 sensor type
Select Pt500 sensor type
Select Pt1000 sensor type
[17] Select Ni50 sensor type
Select Ni100 sensor type
Select Ni120 sensor type
Select Ni1000 sensor type
[18] Select TC-B sensor type
Select TC-E sensor type
Select TC-J sensor type
Select TC-K sensor type
Select TC-L sensor type
Select TC-N sensor type
Select TC-R sensor type
Select TC-S sensor type
Select TC-T sensor type
Select TC-U sensor type
Select TC-W3 sensor type
Select TC-W5 sensor type
Select TC-Lr sensor type
[19] Select OFF function - relay is permanently off
Select POWER function - relay indicates power status OK
Select ERROR function - relay indicates sensor error only
Select WINDOW function - relay is controlled by 2 setpoints
Select SETPOINT function - relay is controlled by 1 setpoint
[20] Select Normally Closed contact
Select Normally Open contact
[21] Set Relay setpoint
[22] Select Action on decreasing signal
Select Action on increasing signal
[23] Set Relay hysteresis
[24] Select No error action - undefined status at error
Select Open relay contact at error
Select Close relay contact at error
Select Hold relay status at error
[25] Set Relay ON delay in seconds
[26] Set Relay OFF delay in seconds
[27] Select Contact is Closed Inside Window
Select Contact is Open Inside Window
[28] Select Relay window setpoint low
[29] Set Relay window setpoint high
[30] Set Relay window hysteresis
[31] Select Internal temperature sensor
Select CJC connector (Accessory)
[32] Select Open relay contact at error
Select Close relay contact at error
[33] Select 0-20 mA output range
Select 4-20 mA output range
Select 20-0 mA output range
Select 20-4 mA output range
[34] Select No error action - output undefined at error
Select Downscale at error
Select Namur NE43 downscale at error
Select Namur NE43 upscale at error
[35] Select Analogue output response time in seconds.
[36] Set Temperature for analogue output low
[37] Set Temperature for analogue output high
[38] Enter SIL setup
Enter Simulation mode
Enter Rail setup
Perform Process Calibration
Enter Language setup
Enter Password setup
Enter Display setup
Perform Memory operations
[39] Load saved configuration into module
Save configuration in display front
Adjust LCD contrast
Adjust LCD backlight
Write a 5-character channel TAG
Show Analog output value in display
Show TAG on display
Calibrate Input low to process value?
Calibrate Input high to process value?
Enable input simulation?
Set the input simulation value
Relay simulation - use \ to toggle relay
Enable Password protection?
Set New password
Enable Fastset functionality?
Relay setpoint - press \ to save
Relay setpoint - Read only
[40] Select Language
[41] Use process calibration values?
Set value for low calibration point
Set value for high calibration point
Enable Rail status signal output?
Enable SIL configuration lock?
0...20 mA is not a valid output range for SIL operation
is channel using process-compensated calibration data?

Configuration SIL status (Open / Locked)

Sensor short circuit

Sensor wire breakage

Display underrange

Display overrange

Input underrange

Input overrange

Input error - check input connections and reset power

Output error - check connentions and reset power

Flash memory error - check configuration

Invalid configuration type or version

Hardware error

CJC sensor error - check device temperature

CJC error - check CJC connector block

No communication

... Utiliza el canal datos de calibration compensados por proceso...
Graphic depiction of window
Graphic depiction of setpoint
APPENDIX

IECEx Installation drawing
ATEX Installation drawing
FM Installation drawing
Safety manual
IECEx Installation drawing

**9116**
For safe installation of 9116B the following must be observed. The module shall only be installed by qualified personnel who are familiar with the national and international laws, directives and standards that apply to this area.

Year of manufacture can be taken from the first two digits in the serial number.

**4501**
For Installation in Zone 2 / Division 2 the following must be observed.
The 4501 programming module is to be used solely with PR electronics modules. It is important that the module is undamaged and has not been altered or modified in any way. Only 4501 modules free of dust and moisture shall be installed.

IECEx Certificate: .................................................................................. KEM 10.0022X
Marking: ................................................................................................. Ex nA nC IIC T4 Gc
[Ex ia Ga] IIC/IIA/IIIA
[Ex ia Da] IIIC

Standards

### Hazardous area
Zone 0, 1, 2, 20, 21 and 22
- Non hazardous area or Zone 2

### Status relay, terminal (33,34)
**Non hazardous area installation**
- Voltage max: 125 VAC / 110 VDC
- Power max: 62.5 VA / 32 W
- Current max: 0.5 A AC / 0.3 ADC

### Zone 2 installation:
- Voltage max: 32 VAC / 32 VDC
- Power max: 16 VA / 32 W
- Current max: 0.5 A AC / 1 A DC

### Relay output, terminal (13,14)
**Non hazardous area installation**
- Voltage max: 250VAC / 30VDC
- Power max: 500VA / 60W
- Current max: 2A AC / 2ADC

### Zone 2 installation
- Voltage max: 32 VAC / 30 VDC
- Power max: 64 VA / 60 W
- Current max: 2 A AC / 2 ADC

(terminal 11,12,13,14)
(terminal 31,32,33,34)
(terminal 91,92,93,94,95)
Um*: 253 V; max. 400 Hz
Terminal 51-52, 51-53

Ui 30 V  
Ii 120 mA  
Pi 900 mW  
Ci 3 nF  
Li 1 μH

Uo 28 V  
P0 650 mW  
Ii 120 mA  
Pi 900 mW  
Ci 3 nF  
Li 1 μH

Terminal 51-54, 52-54

Module 9116B1

<table>
<thead>
<tr>
<th>Group</th>
<th>Co</th>
<th>Lo</th>
<th>Lo/Ro</th>
</tr>
</thead>
<tbody>
<tr>
<td>IIC</td>
<td>80 nF</td>
<td>4 mH</td>
<td>54 μH/G</td>
</tr>
<tr>
<td>IIB</td>
<td>640 nF</td>
<td>16 mH</td>
<td>218 μH/G</td>
</tr>
<tr>
<td>IIA</td>
<td>2.1 μF</td>
<td>32 mH</td>
<td>436 μH/G</td>
</tr>
</tbody>
</table>

Module 9116B2

<table>
<thead>
<tr>
<th>Group</th>
<th>Co</th>
<th>Lo</th>
<th>Lo/Ro</th>
</tr>
</thead>
<tbody>
<tr>
<td>IIC</td>
<td>0.16 μF</td>
<td>4 mH</td>
<td>54 μH/G</td>
</tr>
<tr>
<td>IIB</td>
<td>1.13 μF</td>
<td>16 mH</td>
<td>218 μH/G</td>
</tr>
<tr>
<td>IIA</td>
<td>4.15 μF</td>
<td>32 mH</td>
<td>436 μH/G</td>
</tr>
</tbody>
</table>

Installation notes:

For installation in Zone 2, the module must be installed in an outer enclosure having an IP protection of at least IP54 according to type of protection Ex-n or Ex-e.

For installation on Power Rail in Zone 2, only Power Rail type 9400 supplied by Power Control Unit type 9410 is allowed.

In type of protection "intrinsic safety iD" the parameters for intrinsic safety for gas group IIB are applicable.

Do not separate connectors when energized and an explosive gas mixture is present.

Do not mount or remove modules from the Power Rail when an explosive gas mixture is present.

If the sensor circuits or loop supply circuits have been installed in a type of protection other than "Intrinsic Safety", the module shall not be reinstalled in type of protection "Intrinsic Safety"
Status relay, terminal (33,34)
Non hazardous area installation
Voltage max: 125 VAC / 110 VDC
Power max: 62.5 VA / 32 W
Current max: 0.5 A AC / 0.3 ADC

Zone 2 installation:
Voltage max: 32 VAC / 32 VDC
Power max: 16 VA / 32 W
Current max: 0.5 A AC / 1 A DC

Relay output, terminal (13,14)
Non hazardous area installation
Voltage max: 250 VAC / 30 VDC
Power max: 500 VA / 60 W
Current max: 2 A AC / 2A DC

Zone 2 installation
Voltage max: 32 V AC / 32 VDC
Power max: 64 VA / 60 W
Current max: 2 A AC / 2 ADC

Hazardous area
Zone 0,1,2, 20, 21, 22
Non Hazardous area
or Zone 2

\(-20 \leq T_a \leq +60^\circ C\)

- 4-20 mA Loop-powered transmitter

Module 9116B1/2
Terminal 54-52

<table>
<thead>
<tr>
<th>Term.</th>
<th>Group</th>
<th>Co</th>
<th>Lo</th>
<th>Lo/Ro</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uo</td>
<td>IIC</td>
<td>80 nF</td>
<td>4 mH</td>
<td>54 \mu H/\Omega</td>
</tr>
<tr>
<td>Io</td>
<td>IIIB</td>
<td>640 nF</td>
<td>16 mH</td>
<td>218 \mu H/\Omega</td>
</tr>
<tr>
<td>Po</td>
<td>IIA</td>
<td>2.1 \mu F</td>
<td>32 mH</td>
<td>436 \mu H/\Omega</td>
</tr>
</tbody>
</table>

Module 9116B2
Term. 54-52, 51-52

<table>
<thead>
<tr>
<th>Term.</th>
<th>Group</th>
<th>Co</th>
<th>Lo</th>
<th>Lo/Ro</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uo</td>
<td>IIC</td>
<td>0.16 \mu F</td>
<td>4 mH</td>
<td>54 \mu H/\Omega</td>
</tr>
<tr>
<td>Io</td>
<td>IIIB</td>
<td>1.13 \mu F</td>
<td>16 mH</td>
<td>218 \mu H/\Omega</td>
</tr>
<tr>
<td>Po</td>
<td>IIA</td>
<td>4.15 \mu F</td>
<td>32 mH</td>
<td>436 \mu H/\Omega</td>
</tr>
</tbody>
</table>

Revision date: 2010-02-12
Version Revision: V5 R0
Prepared by: PB
Page: 3/4
Hazardous area  
Zone 0, 1, 2, 20, 21, 22  
Non Hazardous area  
or Zone 2

\[-20 \leq T_a \leq +60^\circ C\]

**Status relay, terminal (33,34)**

**Non hazardous area installation**
- Voltage max: 125 VAC / 110 VDC
- Power max: 62.5 VA / 32 W
- Current max: 0.5 A AC / 0.3 ADC

**Zone 2 installation:**
- Voltage max: 32 VAC/ 32 VDC
- Power max: 16 VA / 32 W
- Current max: 0.5 A AC / 1 A DC

**Relay output, terminal (13,14)**

**Non hazardous area installation**
- Voltage max: 250VAC / 30VDC
- Power max: 500VA / 60W
- Current max: 2A AC / 2ADC

**Zone 2 installation**
- Voltage max: 32 VAC / 32 VDC
- Power max: 64 VA / 60 W
- Current max: 2 A AC / 2 ADC

<table>
<thead>
<tr>
<th>Module 9116B 1/2</th>
<th>Terminal 51-52</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ui</td>
<td>30 V</td>
</tr>
<tr>
<td>li</td>
<td>120 mA</td>
</tr>
<tr>
<td>Pi</td>
<td>800 mH</td>
</tr>
<tr>
<td>Ci</td>
<td>3 nF</td>
</tr>
<tr>
<td>Li</td>
<td>2 μH</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 9116B 1/2</th>
<th>Group</th>
<th>Co</th>
<th>Lo</th>
<th>Lo/ Ro</th>
</tr>
</thead>
<tbody>
<tr>
<td>Term. 52-51, 51-52</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uo</td>
<td>IIIC</td>
<td>0.4 μF</td>
<td>100 mH</td>
<td>25mH/Ω</td>
</tr>
<tr>
<td>lo</td>
<td>IIB</td>
<td>2.3 μF</td>
<td>100 mH</td>
<td>100mH/Ω</td>
</tr>
<tr>
<td>Po</td>
<td>IIA</td>
<td>9.5 μF</td>
<td>100 mH</td>
<td>200mH/Ω</td>
</tr>
</tbody>
</table>

Revision date: 2010-02-12  
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Prepared by: PB  
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ATEX Installation drawing

9116
For safe installation of 9116B the following must be observed. The module shall only be installed by qualified personnel who are familiar with the national and international laws, directives and standards that apply to this area.
Year of manufacture can be taken from the first two digits in the serial number.

4501
For installation in Zone 2 / Division 2 the following must be observed.
The 4501 programming module is to be used solely with PR electronics’ modules. It is important that the module is undamaged and has not been altered or modified in any way. Only 4501 modules free of dust and moisture shall be installed.

ATEX Certificate: ...........................................................................KEMA 10 ATEX 0053 X
Marking: ...........................................................................II 3 G Ex nA nC T4
II (1) G [Ex ia] IIIC/IIB/IIA
II (1) D [Ex iaD]

Standards

Status relay, terminal (33,34)
Non hazardous area installation
Voltage max: 125 VAC / 110 VDC
Power max: 62.5 VA / 32 W
Current max: 0.5 A AC / 0.3 ADC

Zone 2 installation:
Voltage max: 32 VAC/ 32 VDC
Power max: 16 VA / 32 W
Current max: 0.5 A AC / 1 A DC

Relay output, terminal (13,14)
Non hazardous area installation
Voltage max: 250 VAC / 30 VDC
Power max: 500 VA / 60 W
Current max: 2 A AC / 2 ADC

Zone 2 installation
Voltage max: 32 V AC / 30 VDC
Power max: 64 VA / 60 W
Current max: 2 A AC / 2 ADC

(terminal 11,12,13,14)
(terminal 31,32,33,34)
(terminal 91,92,93,94,95)
U_{m}: 253 V; max 400 Hz

Revision date: 2010-02-12
Version Revision: V5 R0
Prepared by: PB
Page: 1/4
### Installation notes:

For installation in Zone 2, the module must be installed in an outer enclosure having an IP protection of at least IP54 conforming to the requirements of EN60079-15.

For installation on Power Rail in Zone 2, only Power Rail type 9400 supplied by Power Control Unit type 9410 (Type Examination Certificate KEMA 07ATEX0152 X) is allowed.

In type of protection “intrinsic safety ID” the parameters for intrinsic safety for gas group IIB are applicable.

Do not separate connectors when energized and an explosive gas mixture is present.

Do not mount or remove modules from the Power Rail when an explosive gas mixture is present.

If the sensor circuits or loop supply circuits have been installed in a type of protection other than “Intrinsic Safety”, the module shall not be reinstalled in type of protection “Intrinsic Safety”
**Hazardous area**

- Zone 0, 1, 2, 20, 21, 22

**Non Hazardous area**

- or Zone 2

---

**Status relay, terminal (33,34)**

**Non hazardous area installation**

- Voltage max: 125 VAC / 110 VDC
- Power max: 62.5 VA / 32 W
- Current max: 0.5 A AC / 0.3 ADC

**Zone 2 installation**:

- Voltage max: 32 VAC / 32 VDC
- Power max: 16 VA / 32 W
- Current max: 0.5 A AC / 1 A DC

**Relay output, terminal (13,14)**

**Non hazardous area installation**

- Voltage max: 250 VAC / 30 VDC
- Power max: 500 VA / 60 W
- Current max: 2 A AC / 2 ADC

**Zone 2 installation**

- Voltage max: 64 VA / 60 W
- Current max: 2 A AC / 2 ADC

---

**Module 9116B 1/2**

<table>
<thead>
<tr>
<th>Terminal 54-52</th>
<th>U</th>
<th>I</th>
<th>Pi</th>
<th>Ci</th>
<th>L1</th>
</tr>
</thead>
<tbody>
<tr>
<td>U1</td>
<td>30 V</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I1</td>
<td>120 mA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pi</td>
<td>900 mW</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ci</td>
<td>3 nF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L1</td>
<td>2 µH</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

**Module 9116B1**

<table>
<thead>
<tr>
<th>Group</th>
<th>Co</th>
<th>Lo</th>
<th>Lo/Ro</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uo</td>
<td>28 V</td>
<td>80 nF</td>
<td>4 mH</td>
</tr>
<tr>
<td>lo</td>
<td>93 mA</td>
<td>640 nF</td>
<td>16 mH</td>
</tr>
<tr>
<td>Po</td>
<td>650 mW</td>
<td>2.1 µF</td>
<td>32 mH</td>
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</table>

**Module 9116B2**

<table>
<thead>
<tr>
<th>Group</th>
<th>Co</th>
<th>Lo</th>
<th>Lo/Ro</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uo</td>
<td>21.4 V</td>
<td>0.16 µF</td>
<td>4 mH</td>
</tr>
<tr>
<td>lo</td>
<td>93 mA</td>
<td>1.13 µF</td>
<td>16 mH</td>
</tr>
<tr>
<td>Po</td>
<td>650 mW</td>
<td>4.15 µF</td>
<td>32 mH</td>
</tr>
</tbody>
</table>

---

**Revision date:** 2010-02-12

**Prepared by:** PB

**Page:** 3/4

---

**TERNALEN 54-52**

- Terminal 54-52
- Module 9116B 1/2
- Power Rail

---

**Installation in non-Ex area**

- Voltage max: 253 VAC / 250 VDC
- Power max: 64 VA / 32 W
- Current max: 2 A AC / 2 ADC

---

**Installation in hazardous area**

- Voltage max: 125 VAC / 110 VDC
- Power max: 62.5 VA / 32 W
- Current max: 0.5 A AC / 0.3 ADC

---

**Installation in hazardous area or Zone 2**

- Voltage max: 32 VAC / 32 VDC
- Power max: 16 VA / 32 W
- Current max: 0.5 A AC / 1 A DC

---

**Installation in hazardous area and Zone 2**

- Voltage max: 64 VA / 60 W
- Current max: 2 A AC / 2 ADC

---

**Diagram and Table**

- 4-20 mA Loop-powered transmitter
- Status relay, terminal (33,34)
- Relay output, terminal (13,14)
- Non hazardous area installation
- Zone 2 installation
- Relay output, terminal (13,14)
- Non hazardous area installation
- Zone 2 installation
- Module 9116B1
- Module 9116B2
- Revision date: 2010-02-12
- Prepared by: PB
- Page: 3/4

---

**Additional Information**

- Zone 2 installation
- Current max: 2 A AC / 2 ADC
- Power max: 64 VA / 60 W
- Non hazardous area installation
- Voltage max: 250 VAC / 30 VDC
- Power max: 500 VA / 60 W
- Current max: 2 A AC / 2 ADC

---

**9116QA01**

LERBAKKEN 10, 8410 ROENDE DENMARK

---

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Hazardous area
Zone 0,1,2, 20, 21, 22

-20 ºC ≤ Ta ≤ +60ºC

Status relay, terminal (33,34)
Non hazardous area installation
Voltage max: 125 VAC / 110 VDC
Power max: 62.5 VA / 32 W
Current max: 0.5 A AC / 0.3 ADC

Zone 2 installation:
Voltage max: 32 VAC/ 32 VDC
Power max: 16 VA / 32 W
Current max: 0.5 A AC / 1 A DC

Relay output, terminal (13,14)
Non hazardous area installation
Voltage max: 250 VAC / 30 VDC
Power max: 500 VA / 60 W
Current max: 2 A AC / 2 ADC

Zone 2 installation:
Voltage max: 32 V AC / 30 VDC
Power max: 64 VA / 60 W
Current max: 2 A AC / 2 ADC

(terminal 11,12,13,14)
(terminal 31,32,33,34)
(terminal 91,92,93,94,95)
Um, 253 V max. 400 Hz

Module 9116B 1/2
Terminal 51-52

<table>
<thead>
<tr>
<th>Uii</th>
<th>30 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>lii</td>
<td>120 mA</td>
</tr>
<tr>
<td>Pi</td>
<td>900 mW</td>
</tr>
<tr>
<td>Gi</td>
<td>3 nF</td>
</tr>
<tr>
<td>Li</td>
<td>2 μH</td>
</tr>
</tbody>
</table>

Module 9116B 1/2
Term. 52-51, 51-52

<table>
<thead>
<tr>
<th>Group</th>
<th>Co</th>
<th>Lo</th>
<th>Lo/ Ro</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uo</td>
<td>16.6 V</td>
<td>lIC</td>
<td>0.4 μF</td>
</tr>
<tr>
<td>lo</td>
<td>0.2 mA</td>
<td>lIB</td>
<td>2.3 μF</td>
</tr>
<tr>
<td>Po</td>
<td>0.8 mW</td>
<td>lIA</td>
<td>9.5 μF</td>
</tr>
</tbody>
</table>
For safe installation of 9116B the following must be observed. The module shall only be installed by qualified personnel who are familiar with the national and international laws, directives and standards that apply to this area.

Year of manufacture can be taken from the first two digits in the serial number.

For Installation in Zone 2 / Division 2 the following must be observed. The 4501 programming module is to be used solely with PR electronics modules. It is important that the module is undamaged and has not been altered or modified in any way. Only 4501 modules free of dust and moisture shall be installed.

### Hazardous Classified Location

Class I / II / III, Division 1, Group A,B,C,D,E,F,G
Class I Zone 0 / 1 / 2 Group IIC, IIB, IIA or
Class I Zone 20 / 21

Simple Apparatus or
Intrinsic safe apparatus
with entity parameters:

\[
\begin{align*}
V_{\text{max}} (U_i) & \geq V_t (U_o) \\
I_{\text{max}} (I_i) & \geq I_t (I_o) \\
P_i & \geq P_t (P_o) \\
C_a & \geq C_{\text{cable}} + C_i \\
L_a & \geq L_{\text{cable}} + L_i
\end{align*}
\]

### Unclassified Location

or

### Hazardous Classified Location

Class I, Division 2 Group A,B,C,D T4
Class I, Zone 2, Group IIC, IIB, IIA T4

### Status relay, terminal (33,34)

Non hazardous area installation
Voltage max: 125 VAC / 110 VDC
Power max: 62.5 VA / 32 W
Current max: 0.5 A AC / 0.3 ADC

Zone 2 installation:
Voltage max: 32 VAC/ 32 VDC
Power max: 16 VA / 32 W
Current max: 0.5 A AC / 1 A DC

### Relay output, terminal (13,14)

Non hazardous area installation
Voltage max: 250 VAC / 30 VDC
Power max: 500 VA / 60 W
Current max: 2 A AC / 2 ADC

Zone 2 installation
Voltage max: 32 V AC / 30 VDC
Power max: 64 VA / 60 W
Current max: 2 A AC / 2 ADC

(terminal 11,12,13,14)
(terminal 31,32,33,34)
(terminal 91,92,93,94,95)
\[U_m: 253 \text{ V max. 400 Hz}\]
Installation notes:

1) The installation shall be in accordance with the National Electrical Code NFPA 70, Article 500 or 505.
2) For installation in Zone 2 or Division 2, the module must be installed in a suitable outer enclosure having an IP protection of at least IP54.
3) The module is galvanically isolated and does not require grounding.
4) Install in pollution degree 2 or better.
5) Use 60 / 75 °C copper conductors with wire size AWG: (26-14).
6) Warning: Substitution of components may impair intrinsic safety.
7) Warning: To prevent ignition of the explosive atmospheres, disconnect power before servicing and do not separate connectors when energized and an explosive gas mixture is present.
8) In type of protection “intrinsic safety iD” the parameters for intrinsic safety for gas group IIB are applicable.
9) Warning: Do not mount or remove modules from the Power Rail when an explosive gas mixture is present.
### Hazardous Classified Location

Class I / II / III, Division 1, Group A,B,C,D,E,F,G
Class I Zone 0 / 1 / 2 Group IIC, IIB, IIa or
Class I Zone 20 / 21

\[-20 ^\circ C \leq T_a \leq +60 ^\circ C\]

#### Module 9116B1/2

<table>
<thead>
<tr>
<th>Term.</th>
<th>54-52; 51-52</th>
</tr>
</thead>
<tbody>
<tr>
<td>(U_i, V_{\text{max}})</td>
<td>30 V</td>
</tr>
<tr>
<td>(I_i, I_{\text{max}})</td>
<td>120 mA</td>
</tr>
<tr>
<td>(P_i)</td>
<td>900 mW</td>
</tr>
<tr>
<td>(C_i)</td>
<td>3 nF</td>
</tr>
<tr>
<td>(L_i)</td>
<td>2 (\mu) H</td>
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</table>

#### Module 9116B1

<table>
<thead>
<tr>
<th>Group</th>
<th>Co</th>
<th>Lo</th>
<th>Lo/Ro</th>
</tr>
</thead>
<tbody>
<tr>
<td>(U_o, V_{\text{c}})</td>
<td>(28 \text{ V})</td>
<td>(80 \text{ nF})</td>
<td>(4 \text{ mH} 54 \mu\text{H}/\Omega)</td>
</tr>
<tr>
<td>(I_o, I_{\text{sc}})</td>
<td>(93 \text{ mA})</td>
<td>(640 \text{ nF})</td>
<td>(16 \text{ mH} 218 \mu\text{H}/\Omega)</td>
</tr>
<tr>
<td>(P_o)</td>
<td>(650 \text{ mW})</td>
<td>(2.1 \text{ \mu F})</td>
<td>(32 \text{ mH} 436 \mu\text{H}/\Omega)</td>
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</table>

#### Module 9116B2

<table>
<thead>
<tr>
<th>Group</th>
<th>Co</th>
<th>Lo</th>
<th>Lo/Ro</th>
</tr>
</thead>
<tbody>
<tr>
<td>(U_o, V_{\text{c}})</td>
<td>(21.4 \text{ V})</td>
<td>(0.16 \text{ \mu F})</td>
<td>(4 \text{ mH} 54 \mu\text{H}/\Omega)</td>
</tr>
<tr>
<td>(I_o, I_{\text{sc}})</td>
<td>(93 \text{ mA})</td>
<td>(1.13 \text{ \mu F})</td>
<td>(16 \text{ mH} 218 \mu\text{H}/\Omega)</td>
</tr>
<tr>
<td>(P_o)</td>
<td>(650 \text{ mW})</td>
<td>(4.15 \text{ \mu F})</td>
<td>(32 \text{ mH} 436 \mu\text{H}/\Omega)</td>
</tr>
</tbody>
</table>

### Unclassified Location

#### Hazardous Classified Location

Class I, Division 2 Group A,B,C,D T4
Class I, Zone 2, Group IIC, IIB, IIa T4

#### Status relay, terminal (33,34)

Non hazardous area installation
Voltage max: 125 VAC / 110 VDC
Power max: 62.5 VA / 32 W
Current max: 0.5 A AC / 0.3 ADC

Zone 2 installation:
Voltage max: 32 VAC / 32 VDC
Power max: 16 VA / 32 W
Current max: 0.5 A AC / 1 A DC

#### Relay output, terminal (13,14)

Non hazardous area installation
Voltage max: 250 VAC / 30 VDC
Power max: 500 VA / 60 W
Current max: 2 A AC / 2 ADC

Zone 2 installation
Voltage max: 32 VAC / 32 VDC
Power max: 64 VA / 60 W
Current max: 2 A AC / 2 ADC

\((\text{terminal 11,12,13,14})\)
\((\text{terminal 31,32,33,34})\)
\((\text{terminal 91,92,93,94,95})\)

\(U_{\text{in}}: 253 \text{ V max. 400 Hz}\)
**Hazardous Classified Location**

Class I / II / III, Division 1, Group A,B,C,D,E,F,G
Class I Zone 0 / 1 / 2 Group IIC, IIB, IIA or
Class I Zone 20 / 21

**Unclassified Location**

**or**

**Hazardous Classified Location**

Class I, Division 2 Group A,B,C,D  T4
Class I, Zone 2, Group IIC, IIB, IIA T4

-20 °C ≤ Ts ≤ +60°C

**Status relay, terminal (33,34)**

Non hazardous area installation
Voltage max: 125 VAC / 110 VDC
Power max: 62.5 VA / 32 W
Current max: 0.5 A AC / 0.3 ADC

Zone 2 installation:
Voltage max: 32 VAC / 32 VDC
Power max: 16 VA / 32 W
Current max: 0.5 A AC / 1 A DC

**Relay output, terminal (13,14)**

Non hazardous area installation
Voltage max: 250 VAC / 30 VDC
Power max: 500 VA / 60 W
Current max: 2 A AC / 2 ADC

Zone 2 installation
Voltage max: 32 VAC / 32 VDC
Power max: 64 VA / 60 W
Current max: 2 A AC / 2 ADC

**Voltage max:** 253 V max. 400 Hz

**Current max:**
0/4-20 mA
-20 ºC ≤ Ta ≤ +60ºC

**Terminal 11,12,13,14**

**Terminal 31,32,33,34**

**Terminal 91,92,93,94,95**

**Power Rail**

**Module 9116B 1/2**

<table>
<thead>
<tr>
<th>Terminal 51-52</th>
<th>Ul, Vmax</th>
<th>30 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>li, Imax</td>
<td>120 mA</td>
<td></td>
</tr>
<tr>
<td>Pi</td>
<td>900 mW</td>
<td></td>
</tr>
<tr>
<td>Ci</td>
<td>3 nF</td>
<td></td>
</tr>
<tr>
<td>Li</td>
<td>2 μH</td>
<td></td>
</tr>
</tbody>
</table>

**Module 9116B 1/2**

<table>
<thead>
<tr>
<th>Term. 52-51, 51-52</th>
<th>Group</th>
<th>Co</th>
<th>Lo</th>
<th>Lo/Ro</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uo, Voc</td>
<td>16.6 V</td>
<td>IIC or A,B</td>
<td>0.4 μF</td>
<td>100 mH</td>
</tr>
<tr>
<td>lo, Isc</td>
<td>0.2 mA</td>
<td>IIIB or C,E,F</td>
<td>2.3 μF</td>
<td>100 mH</td>
</tr>
<tr>
<td>Po</td>
<td>0.8 mW</td>
<td>IIA or D,G</td>
<td>9.5 μF</td>
<td>100 mH</td>
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</tbody>
</table>
SAFETY MANUAL

UNIVERSAL CONVERTER
9116

This safety manual is valid for the following product versions:
9116-001
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<th>Section</th>
<th>Page</th>
</tr>
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<td>26</td>
</tr>
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<td>27</td>
</tr>
</tbody>
</table>
1 Observed standards

<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC 61508</td>
<td>Functional Safety of electrical / electronic / programmable electronic safety-related systems</td>
</tr>
<tr>
<td>IEC 61326-3-1:2008</td>
<td>Immunity requirements for safety-related systems</td>
</tr>
</tbody>
</table>

2 Acronyms and abbreviations

<table>
<thead>
<tr>
<th>Acronym / Abbreviation</th>
<th>Designation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Element</td>
<td></td>
<td>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”</td>
</tr>
<tr>
<td>PFD</td>
<td>Probability of Failure on Demand</td>
<td>This is the likelihood of dangerous safety function failures occurring on demand.</td>
</tr>
<tr>
<td>PFH</td>
<td>Probability of dangerous Failure per Hour</td>
<td>The term “Probability” is misleading, as IEC 61508 defines a Rate.</td>
</tr>
<tr>
<td>SFF</td>
<td>Safe Failure Fraction</td>
<td>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.</td>
</tr>
<tr>
<td>SIF</td>
<td>Safety Integrity Function</td>
<td>Function that provides fault detection (to ensure the necessary safety integrity for the safety functions)</td>
</tr>
<tr>
<td>SIL</td>
<td>Safety Integrity Level</td>
<td>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.</td>
</tr>
</tbody>
</table>

3 Purpose of the product

Conversion and scaling of temperature (Pt, Ni and TC), voltage, potentiometer, linear resistance and current signals from hazardous area.

The device 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 faults, are monitored and signalled via the individual status relay and/or a collective electronic signal via the power rail.

The 9116 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
Relay output pulse length, min. .......... 70 ms
Loop supply ........................................ >16.5 V @ 20 mA
External loop supply voltage.............. 5...26 VDC + external drop
(Mounting area.................................. Zone 2 / Division 2 or safe area
Mounting environment......................... Pollution degree 2 or better

4.2 Safety accuracy

The analogue output and relay output corresponds to the applied input within the safety accuracy.
Safety accuracy ................................... ±2%

4.2.1 Minimum span

For temperature measurements, the selected range (OUT.HI - OUT.LO), and for linear resistance measurements the selected range (R 100% - R 0%), shall be larger or equal to the values below:

<table>
<thead>
<tr>
<th>Input type</th>
<th>Minimum span for safety accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pt100, Pt200, Pt1000</td>
<td>28°C</td>
</tr>
<tr>
<td>Pt500, Ni100, Ni120, Ni1000</td>
<td>43°C</td>
</tr>
<tr>
<td>Pt50, Pt400, Ni50</td>
<td>57°C</td>
</tr>
<tr>
<td>Pt250, Pt300</td>
<td>85°C</td>
</tr>
<tr>
<td>Pt20</td>
<td>142°C</td>
</tr>
<tr>
<td>Pt10</td>
<td>283°C</td>
</tr>
<tr>
<td>TC: E, J, K, L, N, T, U</td>
<td>91°C</td>
</tr>
<tr>
<td>Linear resistance, R 100% ≤ 800 Ω</td>
<td>53 Ω</td>
</tr>
<tr>
<td>Linear resistance, R 100% &gt; 800 Ω</td>
<td>667 Ω</td>
</tr>
</tbody>
</table>

4.2.2 Range limitations

TC type B shall not be used below +400°C

4.3 Associated equipment

4.3.1 RTD or linear resistance sensor wiring

If a 2-wire or a 3-wire connection for RTD or linear resistance is selected,
the end user must ensure that the applied sensor wiring does not introduce failures exceeding the requirements for the safety application.

4.3.2 Sensor errors
If the loop supply is used to supply a current input signal, the sensor error indication shall be enabled on the safety output(s).
If sensor error detection is disabled, or if any of the configurations below are used, the user must ensure that the applied sensor, including wiring, has a failure rate that qualifies it for the safety application without sensor error detection enabled:
- Input is current, 0-20 mA
- Input is voltage
- Input is linear resistance and R_0% < 18 Ω (no short circuit detection)
- Input it Pt10, Pt20 or Pt50 (no short circuit detection)
- Input is potentiometer (no short circuit detection on arm)

4.3.3 Process calibration
If a process calibration is taken into SIL-mode operation, it is mandatory that the accuracy of the device (and sensor, if applicable) are tested by the end user after SIL-mode is entered, in addition to the normal functional test. Refer to section 14 - Safe parameterisation - user responsibility.

4.3.4 Analogue output
The connected safety PLC shall be able to detect and handle the fault indications on the analogue output of the 9116 converter by having a NAMUR NE43-compliant current input.

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

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 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.

4.6 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 function
Conversion of current signals (0...20 mA or 4...20 mA), voltage signals, potentiometer, linear resistance, RTD sensor signals or thermocouple sensor signals from hazardous areas to a 4...20 mA current output signal, and/or an output relay, within specified accuracy.
For RTD and linear resistance input sensors, cable resistances of up to 50 Ω per wire can be compensated if 3- or 4-wire connection is configured.

For thermocouple sensors, cold junction temperature errors can be compensated, either by an internally mounted temperature sensor, or by an accessory connector with a built-in temperature sensor. The selection of CJC measurement must be done and verified by the end user.

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

<table>
<thead>
<tr>
<th>RTD, TC, LinR and Potentiometer input, Current output</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability of dangerous Failure per Hour (PFH)</td>
<td>4.30E-08</td>
</tr>
<tr>
<td>Probability of failure on demand (PFD) - 1 year proof test interval</td>
<td>2.82E-04</td>
</tr>
<tr>
<td>Proof test interval (10% of loop PFD)</td>
<td>4 years</td>
</tr>
<tr>
<td>Safe Failure Fraction</td>
<td>93%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RTD, TC, LinR and Potentiometer input, Relay output</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability of dangerous Failure per Hour (PFH)</td>
<td>6.20E-08</td>
</tr>
<tr>
<td>Probability of failure on demand (PFD) - 1 year proof test interval</td>
<td>4.03E-04</td>
</tr>
<tr>
<td>Proof test interval (10% of loop PFD)</td>
<td>3 years</td>
</tr>
<tr>
<td>Safe Failure Fraction</td>
<td>90%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Voltage input, Current output</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability of dangerous Failure per Hour (PFH)</td>
<td>5.60E-08</td>
</tr>
<tr>
<td>Probability of failure on demand (PFD) - 1 year proof test interval</td>
<td>3.66E-04</td>
</tr>
<tr>
<td>Proof test interval (10% of loop PFD)</td>
<td>3 years</td>
</tr>
<tr>
<td>Safe Failure Fraction</td>
<td>93%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Voltage input, Relay output</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability of dangerous Failure per Hour (PFH)</td>
<td>7.60E-08</td>
</tr>
<tr>
<td>Probability of failure on demand (PFD) - 1 year proof test interval</td>
<td>4.89E-04</td>
</tr>
<tr>
<td>Proof test interval (10% of loop PFD)</td>
<td>2 years</td>
</tr>
<tr>
<td>Safe Failure Fraction</td>
<td>91%</td>
</tr>
</tbody>
</table>
### Current input, Current output

<table>
<thead>
<tr>
<th>Probability of dangerous Failure per Hour (PFH)</th>
<th>4.20E-08</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability of failure on demand (PFD) - 1 year proof test interval</td>
<td>2.77E-04</td>
</tr>
<tr>
<td>Proof test interval (10% of loop PFD)</td>
<td>5 years</td>
</tr>
<tr>
<td>Safe Failure Fraction</td>
<td>95%</td>
</tr>
</tbody>
</table>

### Current input, Relay output

<table>
<thead>
<tr>
<th>Probability of dangerous Failure per Hour (PFH)</th>
<th>6.20E-08</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability of failure on demand (PFD) - 1 year proof test interval</td>
<td>4.00E-04</td>
</tr>
<tr>
<td>Proof test interval (10% of loop PFD)</td>
<td>3 years</td>
</tr>
<tr>
<td>Safe Failure Fraction</td>
<td>93%</td>
</tr>
</tbody>
</table>

### Common Safety Parameters

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demand response time</td>
<td>Signal input: &lt; 0.5 seconds</td>
</tr>
<tr>
<td></td>
<td>Potentiometer and linear resistance input: &lt; 0.65 seconds</td>
</tr>
<tr>
<td></td>
<td>Temperature input: &lt; 1.1 seconds</td>
</tr>
<tr>
<td>Demand mode</td>
<td>High</td>
</tr>
<tr>
<td>Demand rate</td>
<td>3000 seconds</td>
</tr>
<tr>
<td>Mean Time To Repair (MTTR)</td>
<td>24 hours</td>
</tr>
<tr>
<td>Diagnostic test interval</td>
<td>30 seconds</td>
</tr>
<tr>
<td>Hardware Fault Tolerance (HFT)</td>
<td>0</td>
</tr>
<tr>
<td>Component Type</td>
<td>B</td>
</tr>
<tr>
<td>SIL capability</td>
<td>SIL 2</td>
</tr>
<tr>
<td>Description of the “Safe State”, analogue output</td>
<td>Output ≤ 3.6 mA or Output ≥ 21 mA</td>
</tr>
<tr>
<td>Description of the “Safe State”, relay output</td>
<td>Contact open (relay de-energized)</td>
</tr>
<tr>
<td>Relay lifetime (Note²)</td>
<td>100 000 times</td>
</tr>
</tbody>
</table>

Note¹: The 9116 contains no lifetime limiting components, therefore the PFH figures are valid for up to 12 years, according to IEC 61508.

Note²: 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 rates (1/h) for RTD, TC, LinR and Potentiometer input, Current output

<table>
<thead>
<tr>
<th>Event</th>
<th>Rate (1/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fail Safe Detected</td>
<td>0.000E-0</td>
</tr>
<tr>
<td>Fail Safe Undetected</td>
<td>2.78E-07</td>
</tr>
<tr>
<td>Fail Dangerous Detected</td>
<td>3.52E-07</td>
</tr>
<tr>
<td>Fail Dangerous Undetected</td>
<td>4.30E-08</td>
</tr>
</tbody>
</table>

### Failure rates (1/h) for RTD, TC, LinR and Potentiometer input, Relay output

<table>
<thead>
<tr>
<th>Event</th>
<th>Rate (1/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fail Safe Detected</td>
<td>0.000E-0</td>
</tr>
<tr>
<td>Fail Safe Undetected</td>
<td>3.59E-07</td>
</tr>
<tr>
<td>Fail Dangerous Detected</td>
<td>2.30E-07</td>
</tr>
<tr>
<td>Fail Dangerous Undetected</td>
<td>6.20E-08</td>
</tr>
</tbody>
</table>

### Failure rates (1/h) for Voltage input, Current output

<table>
<thead>
<tr>
<th>Event</th>
<th>Rate (1/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fail Safe Detected</td>
<td>0.000E-0</td>
</tr>
<tr>
<td>Fail Safe Undetected</td>
<td>3.95E-07</td>
</tr>
<tr>
<td>Fail Dangerous Detected</td>
<td>4.79E-07</td>
</tr>
<tr>
<td>Fail Dangerous Undetected</td>
<td>5.60E-08</td>
</tr>
</tbody>
</table>

### Failure rates (1/h) for Voltage input, Relay output

<table>
<thead>
<tr>
<th>Event</th>
<th>Rate (1/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fail Safe Detected</td>
<td>0.000E-0</td>
</tr>
<tr>
<td>Fail Safe Undetected</td>
<td>4.80E-07</td>
</tr>
<tr>
<td>Fail Dangerous Detected</td>
<td>3.53E-07</td>
</tr>
<tr>
<td>Fail Dangerous Undetected</td>
<td>7.60E-08</td>
</tr>
</tbody>
</table>

### Failure rates (1/h) for Current input, Current output

<table>
<thead>
<tr>
<th>Event</th>
<th>Rate (1/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fail Safe Detected</td>
<td>0.000E-0</td>
</tr>
<tr>
<td>Fail Safe Undetected</td>
<td>4.44E-07</td>
</tr>
<tr>
<td>Fail Dangerous Detected</td>
<td>5.54E-07</td>
</tr>
<tr>
<td>Fail Dangerous Undetected</td>
<td>4.20E-08</td>
</tr>
</tbody>
</table>

### Failure rates (1/h) for Current input, Relay output

<table>
<thead>
<tr>
<th>Event</th>
<th>Rate (1/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fail Safe Detected</td>
<td>0.000E-0</td>
</tr>
<tr>
<td>Fail Safe Undetected</td>
<td>6.36E-07</td>
</tr>
<tr>
<td>Fail Dangerous Detected</td>
<td>3.20E-07</td>
</tr>
<tr>
<td>Fail Dangerous Undetected</td>
<td>6.20E-08</td>
</tr>
</tbody>
</table>
10 Periodic proof test procedure

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

This test will detect approximately 95% of possible “du” (dangerous undetected) failures in the device. 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 device 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 9116, 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 accept 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 device 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 **Sensor/cable fault information via display front 4501**
When the function is enabled and supported by selected input type, sensor or cable faults are displayed as SE.BR (sensor break) or SE.SH (cable short-circuited).
In case of sensor or cable fault the backlight flashes. This can be reset by pressing the $\text{-reset}$ key. When the sensor or cable fault has been remedied, the device will return to normal operation.

13.3 **Advanced functions (ADV.SET)**
The device gives access to a number of advanced functions which can be reached by answering “Yes” to the point “ADV.SET”.

13.3.1 **Memory (MEM)**
In the memory menu a non-SIL configuration can be either saved or loaded from the local memory of the 4501 display unit. Choose SAVE to store the current configuration in the 4501 memory. Press LOAD to read a previously stored configuration in the 4501 memory and store it in the device. It is only possible to load a configuration stored from the same type of device and from the same version, or earlier.

13.3.2 **Display setup (DISP)**
The brightness contrast and the backlight can be adjusted.
Tag number with 5 alphanumerics can be entered.
Functional readout in line 3 of the display can be selected: choose between readout of output current or tag no. When selecting "ALT" the readout alternates between output current and tag no.

13.3.3 **Password (PASS)**
Here you can choose a password between 0000 and 9999 in order to protect the device against unauthorised modifications to the configuration. The device is delivered default without password.

13.3.4 **Language (LANG)**
In this menu 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.

13.3.5 **Process calibration (CAL)**
A process calibration can be made by the end user. A known process signal must be applied for both low and high end of the input measurement range. The known input of the applied low end signal must be entered in the CAL.LO menu and confirmed by pressing OK before removing or changing the applied signal to the high end signal. The known input of the applied high end signal must be entered in the CAL.HI menu and confirmed by pressing OK before removing. It is possible to enable or disable the use of the latest process calibration.

13.3.6 **Power rail (RAIL)**
In this menu it can be chosen if sensor errors are transmitted to the central surveillance in the PR 9410 power control device.
13.3.7 Simulation (SIM)

It is possible to override the actual measured input signal by a simulated value. In the REL.SIM menu it is possible to simulate the relay state with out affecting the analogue output, by pressing \( \wedge \). Leaving the simulation menus, or disconnecting the 4501 device, will disable the simulation mode and bring the output back to correspond to the actual measured value. Simulation is not possible in SIL-mode.

13.3.8 Safety integrity level (SIL)

See section 14 - Safe parameterisation - user responsibility

14 Safe parameterisation - user responsibility

14.1 Safety-related configuration parameters

14.1.1 Common parameters

<table>
<thead>
<tr>
<th>Name</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>IN.TYPE</td>
<td>Selected input type:TEMP = Temperature CURR = Current VOLT = Voltage</td>
</tr>
<tr>
<td></td>
<td>LIN.R = Linear resistance POTM = Potentiometer</td>
</tr>
<tr>
<td>I.RANGE</td>
<td>Selected fixed input range for current measurements (for IN.TYPE = CURR):</td>
</tr>
<tr>
<td></td>
<td>0_20 = 0...20 mA (no sensor error detection!) 4_20 = 4...20 mA</td>
</tr>
<tr>
<td>V.RANGE</td>
<td>Selected fixed input range for voltage measurements (for IN.TYPE = VOLT)</td>
</tr>
<tr>
<td>SENSOR</td>
<td>Selected temperature sensor type (for IN.TYPE = TEMP):</td>
</tr>
<tr>
<td></td>
<td>TC = Thermocouple Ni = Ni RTD sensor Pt = Pt RTD sensor</td>
</tr>
<tr>
<td>Pt.TYPE</td>
<td>Pt sensor type (for SENSOR = Pt):</td>
</tr>
<tr>
<td>---------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>10 = Pt10</td>
<td></td>
</tr>
<tr>
<td>20 = Pt20</td>
<td>(No short circuit detection!)</td>
</tr>
<tr>
<td>50 = Pt50</td>
<td></td>
</tr>
<tr>
<td>100 = Pt100</td>
<td></td>
</tr>
<tr>
<td>200 = Pt200</td>
<td></td>
</tr>
<tr>
<td>250 = Pt250</td>
<td></td>
</tr>
<tr>
<td>300 = Pt300</td>
<td></td>
</tr>
<tr>
<td>400 = Pt400</td>
<td></td>
</tr>
<tr>
<td>500 = Pt500</td>
<td></td>
</tr>
<tr>
<td>1000 = Pt1000</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ni.TYPE</th>
<th>Ni sensor type (for SENSOR = Ni):</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 = Ni50</td>
<td></td>
</tr>
<tr>
<td>100 = Ni100</td>
<td></td>
</tr>
<tr>
<td>120 = Ni120</td>
<td></td>
</tr>
<tr>
<td>1000 = Ni1000</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TC.TYPE</th>
<th>Thermocouple type (for SENSOR = TC):</th>
</tr>
</thead>
<tbody>
<tr>
<td>TC.B = Thermocouple type B</td>
<td></td>
</tr>
<tr>
<td>TC.E = Thermocouple type E</td>
<td></td>
</tr>
<tr>
<td>TC.J = Thermocouple type J</td>
<td></td>
</tr>
<tr>
<td>TC.K = Thermocouple type K</td>
<td></td>
</tr>
<tr>
<td>TC.L = Thermocouple type L</td>
<td></td>
</tr>
<tr>
<td>TC.N = Thermocouple type N</td>
<td></td>
</tr>
<tr>
<td>TC.R = Thermocouple type R</td>
<td></td>
</tr>
<tr>
<td>TC.S = Thermocouple type S</td>
<td></td>
</tr>
<tr>
<td>TC.T = Thermocouple type T</td>
<td></td>
</tr>
<tr>
<td>TC.U = Thermocouple type U</td>
<td></td>
</tr>
<tr>
<td>TC.W3 = Thermocouple type W3</td>
<td></td>
</tr>
<tr>
<td>TC.W5 = Thermocouple type W5</td>
<td></td>
</tr>
<tr>
<td>TC.Lr = Thermocouple type Lr</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CJC</th>
<th>CJC type for SENSOR = TC:</th>
</tr>
</thead>
<tbody>
<tr>
<td>INT = Internal CJC sensor measurement</td>
<td></td>
</tr>
<tr>
<td>CONN = CJC connector measurement (accessory)</td>
<td></td>
</tr>
</tbody>
</table>
| CONNEC | Selected sensor connection type for RTD or linear resistance measurements (for SENSOR = Ni or Pt or IN.TYPE = LIN.R):  
2W = 2-wire  
3W = 3-wire  
4W = 4-wire  
If 2W or 3W is selected, the end user must ensure that the applied sensor wiring does not introduce failures exceeding the requirements for the safety application. |
|---|---|
| R 0% | 0% input range for linear resistance measurements (for IN.TYPE = LIN.R).  
This value must be < (R 100% - minimum span), refer to 4.2.1 |
| R 100% | 100% input range for linear resistance measurements (for IN.TYPE = LIN.R)  
This value must be > (R 0% + minimum span), refer to 4.2.1 |
| UNIT | Selected temperature unit for IN.TYPE = TEMP  
°C = degrees Celsius  
°F = degrees Fahrenheit  
For IN.TYPE ≠ TEMP selectable units refer to routing diagram |
| DISP.LO | 0% display value on 4501. Can be used as base for relay setpoints (for IN.TYPE ≠ TEMP) |
| DISP.HI | 100% display value on 4501. Can be used as base for relay setpoints (for IN.TYPE ≠ TEMP) |
| NEW.PAS | Password for protection of the device configuration from unauthorized access. Range from 0 to 9999. |
### 14.1.2 Parameters related to Relay Output

| REL.UNI | Relay Units (for IN.TYPE ≠ TEMP):  
|         | PERC = Relay setpoint in percent of input range.  
|         | DISP = Relay setpoints and hysteresis values relates to DISP.LO and DISP.HI (display units) |
| REL.FUN | Relay Function:  
|         | OFF (Note³) = Relay is always OFF  
|         | POW (Note³) = Relay is always ON if power is applied  
|         | ERR = Relay is activated when sensor error is present  
|         | WIND = Relay is activated when input signal is between SETP.LO and SETP.HI values  
|         | SETP = Relay is activated when input signal reaches SETP value |
| CONTAC. | Relay contact function:  
|         | N.C. = Normally Closed relay contact (for REL.FUN = SETP)  
|         | N.O. = Normally Open relay contact (for REL.FUN = SETP)  
|         | O.I.W = Relay contact Open Inside Window (for REL.FUN = WIND)  
|         | C.I.W = Relay contact Closed Inside Window (for REL.FUN = WIND) |
| SETP.   | Relay setpoint value in REL.UNI units for IN.TYPE ≠ TEMP or in UNIT for IN.TYPE = TEMP. (for REL.FUN = SETP) |
| SETP.LO | Relay setpoint low value in REL.UNI units for IN.TYPE ≠ TEMP or in UNIT for IN.TYPE = TEMP. (for REL.FUN = WIND) |
| SETP.HI | Relay setpoint high value in REL.UNI units for IN.TYPE ≠ TEMP or in UNIT for IN.TYPE = TEMP. (for REL.FUN = WIND) |
| ACT.DIR | Relay action for increasing or decreasing input signal (for REL.FUN = SETP):  
|         | DECR = Relay activates when input signal ≤ SETP.  
|         | INCR = Relay activates when input signal ≥ SETP. |
| HYST   | Hysteresis value in REL.UNI units for IN.TYPE ≠ TEMP or in UNIT for IN.TYPE = TEMP. (for REL.FUN = SETP or WIND) |
ERR.ACT | Relay sensor error action (for REL.FUN = SETP, WIND or ERR): Only relevant if IN.TYPE = TEMP, CURR and I.RANGE = 4-20, POTM or LIN.R and R 0% is ≥ 18. NONE (Note3) = Sensor error detection NOT enabled (Note4), relay state at sensor error is undefined. (NOT for REL.FUN = ERR) OPEN = Relay contact is open at sensor error CLOS = Relay contact is closed at sensor error HOLD (Note3) = Relay contact holds the state as before sensor error occurred. (NOT for REL.FUN = ERR)

ON.DEL | Relay ON delay from SETP or SETP.LO/HI is crossed in units of seconds (for REL.FUN = SETP or WIND)

OFF.DEL | Relay OFF delay from SETP +/- HYST or SETP.LO/HI +/- HYST is crossed in units of seconds (for REL.FUN = SETP or WIND)

Note3: Value not allowed if the relay is used in a safety application (EN.SIL = YES) and IN.TYPE = CUR and loop supply is used to supply a current input signal. Note4: Error detection is enabled if OUT.ERR ≠ none, but relay state at sensor error is undefined.

14.1.3. Parameters related to analogue output

<table>
<thead>
<tr>
<th>Name</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>O.RANGE</td>
<td>Fixed output range for current output:</td>
</tr>
<tr>
<td></td>
<td>0-20 = 0...20 mA</td>
</tr>
<tr>
<td></td>
<td>Value not allowed when EN.SIL = YES (Safety applications)</td>
</tr>
<tr>
<td></td>
<td>4-20 = 4...20 mA</td>
</tr>
<tr>
<td></td>
<td>20-0 = 20...0 mA</td>
</tr>
<tr>
<td></td>
<td>Value not allowed when EN.SIL = YES (Safety applications)</td>
</tr>
<tr>
<td></td>
<td>20-4 = 20...4 mA</td>
</tr>
<tr>
<td>OUT.ERR</td>
<td>Fixed output value on detected sensor error:</td>
</tr>
<tr>
<td></td>
<td>NONE (Note5) = Sensor error detection NOT enabled (Note6), output at sensor error is undefined. The end user must ensure that the applied sensor including wiring has a failure rate qualifying it for the safety application without the detection enabled.</td>
</tr>
<tr>
<td></td>
<td>0 mA = Output is 0 mA at sensor error</td>
</tr>
<tr>
<td></td>
<td>3.5 mA = Output is 3.5 mA at sensor error (NE43 downscale)</td>
</tr>
<tr>
<td></td>
<td>23 mA = Output is 23 mA at sensor error (NE4 upscale)</td>
</tr>
</tbody>
</table>
### Table 1: Settings

<table>
<thead>
<tr>
<th>Setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OUT.LO</strong></td>
<td>Selected temperature value for 0% output for IN.TYPE = TEMP in units defined by the UNIT parameter (°C or °F). Range is defined by the selected temperature sensor (SENSOR and TC.TYPE, Ni.TYPE or Pt.TYPE), but value must be less than OUT.HI - minimum span.</td>
</tr>
<tr>
<td><strong>OUT.HI</strong></td>
<td>Selected temperature value for 100% output for IN.TYPE = TEMP in units defined by the UNIT parameter (°C or °F). Range is defined by the selected temperature sensor (SENSOR and TC.TYPE, Ni.TYPE or Pt.TYPE), but must be larger than OUT.LO + minimum span.</td>
</tr>
<tr>
<td><strong>RESP</strong></td>
<td>Analogue output response time in seconds. Range is 0.0 to 60.0 seconds.</td>
</tr>
</tbody>
</table>
| **USE.CAL** | Use the applied process calibration values:  
NO = The last performed process calibration is not used. The channel operates with accuracy as specified.  
YES = The last performed process calibration is in operation. The required accuracy must be verified by user.  
End user must verify by test that the applied process calibration does not introduce failures exceeding the requirements for the safety application. |

**Note 5:** Value not allowed if analogue output is used in a safety application (EN.SIL = YES) and IN.TYPE = CURR and loop supply is used to supply a current input signal.

**Note 6:** Error detection is enabled if ERR.ACT ≠ NONE, but analogue output value is undefined.

### 14.2 Verification procedure

The verification is done using the display / programming front PR 4501 and following the procedure described below.
### 14.2.1 If no password is set

<table>
<thead>
<tr>
<th>Action</th>
<th>Display shows</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Press OK</td>
<td>ADV.SET</td>
</tr>
<tr>
<td>2. Set (ADV.SET) to Yes and press OK</td>
<td>SETUP</td>
</tr>
<tr>
<td>3. Set SETUP to SIL and press OK</td>
<td>EN.SIL</td>
</tr>
<tr>
<td>4. Set EN.SIL to YES and press OK</td>
<td>NEW.PAS</td>
</tr>
<tr>
<td>5. Set password to a number between 0 and 9999 and press OK (At this time the device starts operating in SIL mode with the entered configuration parameters!)</td>
<td>CONFIG Verify OPEN-&gt;LOCK (Note&lt;sup&gt;7&lt;/sup&gt;)</td>
</tr>
<tr>
<td>6. Press OK to confirm verification of the OPEN-&gt;LOCK in the display</td>
<td>IN.TYPE</td>
</tr>
<tr>
<td>7. Verify input type and press OK</td>
<td>I.RANGE</td>
</tr>
<tr>
<td>8. Verify fixed input current range and press OK (ONLY if IN.TYPE = CURR)</td>
<td>CONNEC</td>
</tr>
<tr>
<td>9. Verify sensor connection type and press OK (ONLY if IN.TYPE = TEMP and SENSOR = Ni or Pt or IN.TYPE = LIN.R)</td>
<td>UNIT</td>
</tr>
<tr>
<td>10. Verify temperature unit and press OK (ONLY if IN.TYPE = TEMP)</td>
<td>SENSOR</td>
</tr>
<tr>
<td>11. Verify temperature sensor type and press OK (ONLY if IN.TYPE = TEMP)</td>
<td>Pt.TYPE</td>
</tr>
<tr>
<td>12. Verify Pt sensor type and press OK (ONLY if IN.TYPE = TEMP and SENSOR = Pt)</td>
<td>Ni.TYPE</td>
</tr>
<tr>
<td>13. Verify Ni sensor type and press OK (ONLY if IN.TYPE = TEMP and SENSOR = Ni)</td>
<td>TC.TYPE</td>
</tr>
<tr>
<td>14. Verify Thermocouple type and press OK (ONLY if IN.TYPE = TEMP and SENSOR = TC)</td>
<td>CJC</td>
</tr>
</tbody>
</table>

Note<sup>7</sup>: Open is shown briefly in the display.
<table>
<thead>
<tr>
<th>Action</th>
<th>Display shows</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 Verify CJC type and press OK (ONLY if IN.TYPE = TEMP and SENSOR = TC)</td>
<td>V.RANGE</td>
</tr>
<tr>
<td>16 Verify fixed input voltage range and press OK (ONLY if IN.TYPE = VOLT)</td>
<td>R 0%</td>
</tr>
<tr>
<td>17 Verify input resistance 0% range and press OK (ONLY if IN.TYPE = LIN.R)</td>
<td>R 100%</td>
</tr>
<tr>
<td>18 Verify input resistance 100% range and press OK (ONLY if IN.TYPE = LIN.R)</td>
<td>UNIT</td>
</tr>
<tr>
<td>19 Verify display units for 4501 and press OK (ONLY if IN.TYPE ≠ TEMP)</td>
<td>DEC.P</td>
</tr>
<tr>
<td>20 Verify display decimal point for 4501 and press OK (ONLY if IN.TYPE ≠ TEMP)</td>
<td>DISP.LO</td>
</tr>
<tr>
<td>21 Verify display value for 4501 at 0% input and press OK (ONLY if IN.TYPE ≠ TEMP)</td>
<td>DISP.HI</td>
</tr>
<tr>
<td>22 Verify display value for 4501 at 100% input and press OK (ONLY if IN.TYPE ≠ TEMP)</td>
<td>REL.UNI</td>
</tr>
<tr>
<td>23 Verify relay setpoint units and press OK (ONLY if IN.TYPE ≠ TEMP)</td>
<td>REL.FUN</td>
</tr>
<tr>
<td>24 Verify relay function and press OK</td>
<td>CONTAC.</td>
</tr>
<tr>
<td>25 Verify relay contact function and press OK (ONLY if REL.FUN ≠ OFF or POW)</td>
<td>SETP.</td>
</tr>
<tr>
<td>26 Verify relay setpoint and press OK (ONLY if REL.FUN = SETP)</td>
<td>SETP.LO</td>
</tr>
<tr>
<td>27 Verify low setpoint value and press OK (ONLY if REL.FUN = WIND)</td>
<td>SETP.HI</td>
</tr>
<tr>
<td>28 Verify high setpoint value and press OK (ONLY if REL.FUN = WIND)</td>
<td>ACT.DIR</td>
</tr>
<tr>
<td>Action</td>
<td>Display shows</td>
</tr>
<tr>
<td>-----------------------------------------------------------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>29 Verify relay activation direction and press OK</td>
<td>HYST</td>
</tr>
<tr>
<td>(ONLY if REL.FUN = SETP)</td>
<td></td>
</tr>
<tr>
<td>30 Verify relay setpoint hysteresis and press OK</td>
<td>ERR.ACT</td>
</tr>
<tr>
<td>(ONLY if REL.FUN = SETP or WIND)</td>
<td></td>
</tr>
<tr>
<td>31 Verify relay action on sensor error and press OK</td>
<td>ON.DEL</td>
</tr>
<tr>
<td>(ONLY if REL.FUN = SETP, WIND or ERR and the selected input type and</td>
<td></td>
</tr>
<tr>
<td>range support sensor error detection, refer to section 4.3.2)</td>
<td></td>
</tr>
<tr>
<td>32 Verify relay ON delay and press OK</td>
<td>OFF.DEL</td>
</tr>
<tr>
<td>(ONLY if REL.FUN = SETP or WIND)</td>
<td></td>
</tr>
<tr>
<td>33 Verify relay OFF delay and press OK</td>
<td>O.RANGE</td>
</tr>
<tr>
<td>(ONLY if REL.FUN = SETP or WIND)</td>
<td></td>
</tr>
<tr>
<td>34 Verify fixed output range for current output</td>
<td>OUT.ERR</td>
</tr>
<tr>
<td>35 Verify fixed output value on detected sensor error and press OK</td>
<td>OUT.LO</td>
</tr>
<tr>
<td>(ONLY if IN.TYPE \neq VOLT, or IN.TYPE = CURR and I.RANGE \neq 0-20 mA)</td>
<td></td>
</tr>
<tr>
<td>36 Verify temperature for 0% output and press OK</td>
<td>OUT.HI</td>
</tr>
<tr>
<td>(ONLY if IN.TYPE = TEMP)</td>
<td></td>
</tr>
<tr>
<td>37 Verify temperature for 100% output and press OK</td>
<td>RESP</td>
</tr>
<tr>
<td>(ONLY if IN.TYPE = TEMP)</td>
<td></td>
</tr>
<tr>
<td>38 Verify analogue output response time and press OK</td>
<td>CH1.CAL</td>
</tr>
<tr>
<td>39 Verify the use of applied process calibration values and press OK</td>
<td>PASSW.</td>
</tr>
<tr>
<td>40 Verify password and press OK</td>
<td>SIL.OK</td>
</tr>
<tr>
<td>41 Verify SIL mode within 1 second</td>
<td></td>
</tr>
</tbody>
</table>
14.2.2 If password is set

<table>
<thead>
<tr>
<th>Action</th>
<th>Display shows</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Press OK</td>
<td>PASSW</td>
</tr>
<tr>
<td>2 Enter password and press OK</td>
<td>ADV.SET</td>
</tr>
<tr>
<td>3 Set ADV.SET to Yes and press OK</td>
<td>SETUP</td>
</tr>
<tr>
<td>4 Set SETUP to SIL and press OK</td>
<td>EN.SIL</td>
</tr>
<tr>
<td>5 Set EN.SIL to YES and press OK</td>
<td>CONFIG Verify OPEN-&gt;LOCK</td>
</tr>
<tr>
<td></td>
<td>(Note8)</td>
</tr>
<tr>
<td>6 to 41 As step 6 to 41 for 14.2.1</td>
<td>As step 6 to 41 for 14.2.1</td>
</tr>
</tbody>
</table>

Note8: Open is shown briefly in the display

14.2.3 If any parameter is found to be incorrect during verification
Remove SIL-mode (by entering the password and selecting EN.SIL = NO).
Go through the setup menu and correct the parameter(s).
Repeat step 1 to 36 (with correct parameters).

14.3 Functional test
The user is responsible to make a functional test after verification of the safety parameters. The procedure for periodic proof test described in section 10 shall be used.
In addition, if a process calibration is taken into SIL-mode operation (refer to section 13.3 - Advanced functions), it is mandatory that the accuracy of the device (and sensor, if applicable) are tested.

15 Fault reaction and restart condition
When the 9116 detects a fault the outputs will go to Safe State, in which the outputs will be “de-energised”.
If the fault is application-specific (cable error detection) the 9116 will restart when the fault has been corrected.
Power cycle the device for bringing it out of Safe State.
16 User interface

[01] Set correct password
[02] Enter Advanced setup menu?
[03] Select Temperature input
  Select Potentiometer input
  Select Linear resistance input
  Select Current input
  Select Voltage input
[04] Select 0.0-1 V input range
  Select 0.2-1 V input range
  Select 0-5 V input range
  Select 1-5 V input range
  Select 0-10 V input range
  Select 2-10 V input range
[05] Select 0-20 mA input range
  Select 4-20 mA input range
[06] Select 2-Wire sensor connection
  Select 3-Wire sensor connection
  Select 4-Wire sensor connection
[07] Select Resistance value low
[08] Select Resistance value high
[09] Select Celsius as temperature unit
  Select Fahrenheit as temperature unit
[10] Select TC sensor type
  Select Ni sensor type
  Select Pt sensor type
[12] Select Decimal point position
[13] Set Display range low
[14] Set Display range high
[15] Select Relay setpoint in % of input range
  Select Relay setpoint in display units
[16] Select Pt10 sensor type
  Select Pt20 sensor type
  Select Pt50 sensor type
  Select Pt100 sensor type
  Select Pt200 sensor type
  Select Pt250 sensor type
  Select Pt300 sensor type
  Select Pt400 sensor type
  Select Pt500 sensor type
  Select Pt1000 sensor type
[17] Select Ni50 sensor type
  Select Ni100 sensor type
  Select Ni20 sensor type
  Select Ni1000 sensor type
[18] Select TC-B sensor type
  Select TC-E sensor type
  Select TC-J sensor type
  Select TC-K sensor type
  Select TC-L sensor type
  Select TC-N sensor type
  Select TC-R sensor type
  Select TC-S sensor type
  Select TC-T sensor type
  Select TC-U sensor type
  Select TC-W3 sensor type
  Select TC-W5 sensor type
  Select TC-Lr sensor type
[19] Select OFF function - relay is permanently off
  Select POWER function - relay indicates power status OK
  Select ERROR function - relay indicates sensor error only
  Select WINDOW function - relay is controlled by 2 setpoints
  Select SETPOINT function - relay is controlled by 1 setpoint
[20] Select Normally Closed contact
  Select Normally Open contact
[21] Set Relay setpoint
[22] Select Action on decreasing signal
  Select Action on increasing signal
[23] Set Relay hysteresis
[24] Select No error action - undefined status at error
  Select Hold relay contact at error
  Select Close relay contact at error
[25] Set Relay ON delay in seconds
[26] Set Relay OFF delay in seconds
[27] Select Contact is Closed Inside Window
  Select Contact is Open Inside Window
[28] Set Relay window setpoint low
[29] Set Relay window setpoint high
[30] Set Relay window hysteresis
[31] Select Internal temperature sensor
  Select CJC connector (Accessory)
[32] Select Open relay contact at error
  Select Close relay contact at error
[33] Select 0-20 mA output range
  Select 4-20 mA output range
  Select 20-0 mA output range
  Select 20-4 mA output range
[34] Select No error action - output undefined at error
  Select Downscale at error
  Select Namur NE43 downscale at error
  Select Namur NE43 upscale at error
[35] Select Analogue output response time in seconds.
[36] Select Temperature for analogue output low
[37] Select Temperature for analogue output high
[38] Enter SIL setup
  Enter Simulation mode
  Enter Rail setup
  Perform Process Calibration
  Enter Language setup
  Enter Password setup
  Enter Display setup
  Perform Memory operations
[39] Load saved configuration into module
  Save configuration in display front
[40] Adjust LCD contrast
[41] Adjust LCD backlight
[42] Write a 5-character channel TAG
[43] Show Analog output value in display
  Show TAG on display
  Alternate shown information in display
[44] Calibrate Input low to process value?
[45] Calibrate Input high to process value?
[46] Enable input simulation?
[47] Set the input simulation value
[48] Relay simulation - use ~ to toggle relay
[49] Enable Password protection?
[50] Set New password
[51] Enable Fastset functionality?
[52] Relay setpoint - press \* to save
[58] Relay setpoint - Read only
[59] Select Language
[60] Use process calibration values?
[61] Set value for low calibration point
[62] Set value for high calibration point
[63] Enable Rail status signal output?
[64] Enable SIL configuration lock?
0...20 mA is not a valid output range for SIL operation
[65] is channel using process-compensated calibration data?
[66] Configuration SIL status (Open / Locked)
[67] Sensor short circuit
[68] Sensor wire breakage
[69] Display underrange
[70] Display overrange
[71] Input underrange
[72] Input overrange
[73] Input overrange
[74] Input error - check input connections and reset power
[75] Output error - check input connections and reset power
[76] Flash memory error - check configuration
[77] Invalid configuration type or version
[78] Hardware error
[79] CJC sensor error - check device temperature
[80] CJC error - check CJC connector block
[81] No communication
16.2 Routing diagram

Fast setpoint adjustment and relay test
- Increase setpoint
- Decrease setpoint
- Save and exit the menu
- and simultaneously = change relay state

Error indication, example

Routing diagram ADV.SET

Continued on the page
Routing diagram ADV.SET
### 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
- ✖ Accept the chosen value and proceed to the next menu

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

---

1.0 = Default state. Line 1 shows input status. Line 2 toggles between process value and UNIT. Line 3 shows output and TAG No. Line 4 shows status for relay and communication and whether the device is SIL-locked. Static dot = SIL-locked and flashing dot = not SIL-locked.

1.1 = Only if password-protected.

1.2 = Only if FastSet is activated and the relay function is setpoint.

1.3 = Only if input types support sensor error check. Not valid for these input signals: 0...20 mA and voltage.

1.4 = Only if input signal is temperature.

1.5 = Only if the configuration is not protected by a password.

---

### Selectable Units:

<table>
<thead>
<tr>
<th>°C</th>
<th>°F</th>
<th>min</th>
<th>t</th>
<th>GW</th>
<th>m³/h</th>
</tr>
</thead>
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16.3 Routing diagram - Advanced settings (ADV.SET)

Top default state 1.0

2.0 In the submenu simulation (SIM) you must press OK to return to the default state 1.0.

Verify SIL configuration

Red text signifies safety parameters in a SIL configuration.
17 Connections diagram

**Power Rail connections**

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Error signal +24 V

NC = no connection

**Supply and status relay**

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Gnd. N.C.

+24 V

**Inputs:**

- **RTD, 2-wire**
  - 41 42 43 44
  - ![Resistance](image1)

- **Resistance, 2-wire**
  - 41 42 43 44
  - ![Resistance](image2)

- **Resistance, 3- / 4-wire**
  - 41 42 43 44
  - ![Resistance](image3)

- **RTD, 3- / 4-wire**
  - 41 42 43 44
  - ![Resistance](image4)

- **TC, internal CJC sensor**
  - 41 42 43 44
  - ![Resistance](image5)

- **CJC connector**
  - 41 42 CJC 44
  - ![Resistance](image6)

  *Order separately: CJC connector 5910Ex.*

**Outputs:**

- **Current** (Active output)
  - 11 12 13 14
  - ![Resistance](image7)

- **2-wire transmitter** (Passive output)
  - 11 12 13 14
  - ![Resistance](image8)

- **Relay**
  - 11 12 13 14
  - ![Resistance](image9)

Version No. V1R0
Displays  Programmable displays with a wide selection of inputs and outputs for display of temperature, volume and weight, etc. Feature linearisation, scaling, and difference measurement functions for programming via PReset software.

Ex interfaces  Interfaces for analogue and digital signals as well as HART® signals between sensors / I/P converters / frequency signals and control systems in Ex zone 0, 1 & 2 and for some modules in zone 20, 21 & 22.

Isolation  Galvanic isolators for analogue and digital signals as well as HART® signals. A wide product range with both loop-powered and universal isolators featuring linearisation, inversion, and scaling of output signals.

Temperature  A wide selection of transmitters for DIN form B mounting and DIN rail modules with analogue and digital bus communication ranging from application-specific to universal transmitters.

Universal  PC or front programmable modules with universal options for input, output and supply. This range offers a number of advanced features such as process calibration, linearisation and auto-diagnosis.