Safety manual

9113

Temperature / mA converter

Version No. V7R0
6 Product Pillars
to meet your every need

Individually outstanding, unrivalled in combination

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

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

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

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

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

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

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

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<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>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>
<td></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 summarizes 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) 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 breakage, are monitored and signalled via the individual status relay and/or a collective electronic signal via the power rail. The 9113 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
- 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 analog 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) 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>
</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 sensor wiring

If a 2-wire or a 3-wire connection for RTD 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 Sensor error detection is disabled, if current input range 0...20 mA is selected or if input type Pt10, Pt20, or Pt50 is selected, the end user must ensure that the applied sensor including wiring has a failure rate qualifying it for the safety application without sensor error detection enabled.

For Pt10, Pt20 and Pt50 input types, this only relates to short-circuited sensor detection.

#### 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 parameterization - user responsibility.

#### 4.3.4 Analog output

The connected safety PLC shall be able to detect and handle the fault indications on the analog output of the 9113 converter by having a NAMUR NE43-compliant current input.

### 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 parameterization

The user is responsible for verifying the correctness of the configuration parameters. (See section 14 Safe parameterization - 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), RTD sensor signals or thermocouple sensor signals from hazardous areas to a 4...20 mA current output signal, in two separately configurable channels, within specified accuracy.

For RTD 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>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability of dangerous Failure per Hour (PFH)</td>
<td>6.10E-08</td>
</tr>
<tr>
<td>Probability of failure on demand (PFD) - 1 year proof test interval</td>
<td>3.96E-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>90.7%</td>
</tr>
<tr>
<td>Demand response time</td>
<td>Signal input: &lt; 0.5 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”</td>
<td>Output ≤ 3.6 mA or output ≥ 21 mA</td>
</tr>
</tbody>
</table>

Note 1: The 9113 contains no lifetime limiting components, therefore the PFH figures are valid for up to 12 years, according to IEC 61508.

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**

<table>
<thead>
<tr>
<th>Failure category</th>
<th>Failure rates (1/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fail Safe Detected</td>
<td>0.00E+00</td>
</tr>
<tr>
<td>Fail Safe Undetected</td>
<td>2.34E-7</td>
</tr>
<tr>
<td>Fail Dangerous Detected</td>
<td>3.67E-7</td>
</tr>
<tr>
<td>Fail Dangerous Undetected</td>
<td>6.10E-8</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 to each channel</td>
</tr>
<tr>
<td>4</td>
<td>Observe whether the output channel 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 pulse isolator. The proof test is equivalent to the functional test.

11. Procedures to repair or replace the product

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

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

12. Maintenance

No maintenance required.

13. Documentation for routing diagram

The routing diagram is shown in section 16.2.

13.1 In general

When configuring the 9113, 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

Password protection: 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 unauthorized modifications to the configuration. If the configured password is not known, please contact PR electronics support - www.prelectronics.com/contact.

Password protection is mandatory in SIL applications.

13.2.2 Sensor/cable fault information via display front 45xx

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). Sensor fault is shown independently for each channel. In case of sensor or cable fault the backlight flashes. This can be reset by pressing the 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 45xx display unit. Choose SAVE to store the current configuration in the 45xx memory. Press LOAD to read a previously stored configuration in the 45xx 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 numbers with 5 alphanumerics can be entered for both channels. Functional readout in line 2 (ch.1) and 3 (Ch.2) of the display can be selected: choose between readout of input value, output current or tag no. When selecting "ALT" the readout alternates between input value, 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 unauthorized 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. Only one channel can be simulated at a time. Leaving either of the simulation menus, or disconnecting the 45xx 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 parameterization - user responsibility

14. Safe parameterization - user responsibility

14.1 Safety-related configuration parameters

14.1.1 Parameters related only to Channel 1

<table>
<thead>
<tr>
<th>Name</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH1.TYP</td>
<td>Selected input type: PLAIN = Temperature, CURR = Current</td>
</tr>
<tr>
<td>I.RANGE</td>
<td>Selected fixed input range for current measurements (for CH1.TYPE = CURR):</td>
</tr>
<tr>
<td></td>
<td>0..20 = 0..20 mA (no sensor error detection!)</td>
</tr>
<tr>
<td></td>
<td>4..20 = 4..20 mA</td>
</tr>
<tr>
<td>CONNEC</td>
<td>Selected sensor connection type for RTD measurements:</td>
</tr>
<tr>
<td></td>
<td>(for SENSOR = Ni or Pt):</td>
</tr>
<tr>
<td></td>
<td>2W  = 2-wire</td>
</tr>
<tr>
<td></td>
<td>3W  = 3-wire</td>
</tr>
<tr>
<td></td>
<td>4W  = 4-wire</td>
</tr>
<tr>
<td></td>
<td>If 2W or 3W is selected, the end user must ensure that the applied sensor</td>
</tr>
<tr>
<td></td>
<td>wiring does not introduce failures exceeding the requirements for the</td>
</tr>
<tr>
<td></td>
<td>safety application.</td>
</tr>
<tr>
<td>UNIT</td>
<td>Selected temperature unit (for CH1.TYP = TEMP):</td>
</tr>
<tr>
<td></td>
<td>°C  = degrees Celsius</td>
</tr>
<tr>
<td></td>
<td>°F  = degrees Fahrenheit</td>
</tr>
<tr>
<td>SENSOR</td>
<td>Selected temperature sensor type (for CH1.TYPE = TEMP):</td>
</tr>
<tr>
<td></td>
<td>TC  = Thermocouple</td>
</tr>
<tr>
<td></td>
<td>Ni  = Ni RTD sensor</td>
</tr>
<tr>
<td></td>
<td>Pt  = Pt RTD sensor</td>
</tr>
</tbody>
</table>
**Pt.TYPE**

Pt sensor type (for SENSOR = Pt):
- 10 = Pt10
- 20 = Pt20
- 50 = Pt50
- 100 = Pt100
- 200 = Pt200
- 250 = Pt250
- 300 = Pt300
- 400 = Pt400
- 500 = Pt500
- 1000 = Pt1000

**Ni.TYPE**

Ni sensor type (for SENSOR = Ni):
- 50 = Ni50
- 100 = Ni100
- 120 = Ni120
- 1000 = Ni1000

**TC.TYPE**

Thermocouple type (for SENSOR = TC):
- TC.B = Thermocouple type B
- TC.E = Thermocouple type E
- TC.J = Thermocouple type J
- TC.K = Thermocouple type K
- TC.L = Thermocouple type L
- TC.N = Thermocouple type N
- TC.R = Thermocouple type R
- TC.S = Thermocouple type S
- TC.T = Thermocouple type T
- TC.U = Thermocouple type U
- TC.W3 = Thermocouple type W3
- TC.W5 = Thermocouple type W5
- TC.Lr = Thermocouple type Lr

**CJC**

CJC type for SENSOR = TC:
- INT = Internal CJC sensor measurement
- CONN = CJC connector measurement (accessory)

**O.RANGE**

Fixed output range for current output:
- 0-20 = 0...20 mA Not valid when EN.SIL = YES (Safety applications)
- 4-20 = 4...20 mA
- 20-0 = 20...0 mA Not valid when EN.SIL = YES (Safety applications)
- 20-4 = 20...4 mA

**OUT.ERR**

Fixed output value on detected sensor error:
- NONE = Sensor error detection NOT enabled, 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.
- 0 mA = Output is 0 mA at sensor error
- 3.5 mA = Output is 3.5 mA at sensor error (NE43 downscale)
- 23 mA = Output is 23 mA at sensor error (NE4 upscale)

**OUT.LO**

Selected temperature value for 0% output for CH1.TYP = 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.

**OUT.HI**

Selected temperature value for 100% output for CH1.TYP = 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.

**RESP**

Analog output response time in seconds.
- Range is 0.0 to 60.0 seconds.

**USE.CAL**

Use the applied process calibration values:
- NO = The last performed process calibration on Channel1 is not used. The channel operates with accuracy as specified.
- YES = The last performed process calibration on Channel1 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.
### 14.1.2 Parameters related only to Channel 2 (only for type 9113BB)

<table>
<thead>
<tr>
<th>Name</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH2.TYP</td>
<td>Functions as described for Channel 1 (14.1.1)</td>
</tr>
<tr>
<td>I.RANGE</td>
<td></td>
</tr>
<tr>
<td>CONNEC</td>
<td></td>
</tr>
<tr>
<td>UNIT</td>
<td></td>
</tr>
<tr>
<td>SENSOR</td>
<td></td>
</tr>
<tr>
<td>Pt.TYPE</td>
<td></td>
</tr>
<tr>
<td>Ni.TYPE</td>
<td></td>
</tr>
<tr>
<td>TC.TYPE</td>
<td></td>
</tr>
<tr>
<td>Cjc</td>
<td></td>
</tr>
<tr>
<td>O.RANGE</td>
<td></td>
</tr>
<tr>
<td>OUT.ERR</td>
<td></td>
</tr>
<tr>
<td>OUT.LO</td>
<td></td>
</tr>
<tr>
<td>OUT.HI</td>
<td></td>
</tr>
<tr>
<td>RESP</td>
<td></td>
</tr>
<tr>
<td>USE.CAL</td>
<td></td>
</tr>
</tbody>
</table>

### 14.1.3 Parameters related to both channels

<table>
<thead>
<tr>
<th>Name</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEW.PAS</td>
<td>Password for protection of the device configuration from un-authorized access. Range from 0 to 9999.</td>
</tr>
</tbody>
</table>

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

### 14.2 Verification procedure

The verification is done using the display / programming front PR 45xx 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*</td>
</tr>
<tr>
<td>6 Press OK to confirm verification of the OPEN-&gt;LOCK in the display</td>
<td>CH1.TYPE</td>
</tr>
<tr>
<td>7 Verify input type for Channel 1 and press OK</td>
<td>I.RANGE</td>
</tr>
<tr>
<td>8 Verify fixed input range and press OK (ONLY IF CH1.TYP = CURR)</td>
<td>CONNEC</td>
</tr>
<tr>
<td>9 Verify sensor connection type and press OK (ONLY IF SENSOR = Ni or Pt and CH1.TYP = TEMP)</td>
<td>UNIT</td>
</tr>
<tr>
<td>10 Verify temperature unit and press OK (ONLY IF CH1.TYP = TEMP)</td>
<td>SENSOR</td>
</tr>
</tbody>
</table>

* Open is shown briefly in the display.
<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>Verify temperature sensor type and press OK (ONLY IF CH1.TYP = TEMP) Pt.TYPE</td>
</tr>
<tr>
<td>12</td>
<td>Verify Pt sensor type and press OK (ONLY IF SENSOR = Pt and CH1.TYP = TEMP) Ni.TYPE</td>
</tr>
<tr>
<td>13</td>
<td>Verify Ni sensor type and press OK (ONLY IF SENSOR = Ni and CH1.TYP = TEMP) TC.TYPE</td>
</tr>
<tr>
<td>14</td>
<td>Verify Thermocouple type and press OK (ONLY IF SENSOR = TC and CH1.TYP = TEMP) CJC</td>
</tr>
<tr>
<td>15</td>
<td>Verify CJC type and press OK (ONLY IF SENSOR = TC and CH1.TYP = TEMP) O.RANGE</td>
</tr>
<tr>
<td>16</td>
<td>Verify fixed output range and press OK OUT.ERR</td>
</tr>
<tr>
<td>17</td>
<td>Verify fixed output value on detected sensor error and press OK (ONLY IF CH1.TYP = TEMP, or IF I.RANGE = 4-20 mA) OUT.LO</td>
</tr>
<tr>
<td>18</td>
<td>Verify temperature for 0% output and press OK (ONLY IF CH1.TYP = TEMP) OUT.HI</td>
</tr>
<tr>
<td>19</td>
<td>Verify temperature for 100% output and press OK (ONLY IF CH1.TYP = TEMP) RESP</td>
</tr>
<tr>
<td>20</td>
<td>Verify analog output response time and press OK CH2.TYP</td>
</tr>
<tr>
<td>21</td>
<td>Verify input type for Channel 2 and press OK I.RANGE</td>
</tr>
<tr>
<td>22</td>
<td>Verify fixed input range and press OK (ONLY IF CH2.TYP = CURR) CONNEC</td>
</tr>
<tr>
<td>23</td>
<td>Verify sensor connection type and press OK (ONLY IF SENSOR = Ni or Pt and CH2.TYP = TEMP) UNIT</td>
</tr>
<tr>
<td>24</td>
<td>Verify temperature unit and press OK (ONLY IF CH2.TYP = TEMP) SENSOR</td>
</tr>
<tr>
<td>25</td>
<td>Verify temperature sensor type and press OK (ONLY IF CH2.TYP = TEMP) Pt.TYPE</td>
</tr>
<tr>
<td>26</td>
<td>Verify Pt sensor type and press OK (ONLY IF SENSOR = Pt and CH2.TYP = TEMP) Ni.TYPE</td>
</tr>
<tr>
<td>27</td>
<td>Verify Ni sensor type and press OK (ONLY IF SENSOR = Ni and CH2.TYP = TEMP) TC.TYPE</td>
</tr>
<tr>
<td>28</td>
<td>Verify Thermocouple type and press OK (ONLY IF SENSOR = TC and CH2.TYP = TEMP) CJC</td>
</tr>
<tr>
<td>29</td>
<td>Verify CJC type and press OK (ONLY IF SENSOR = TC and CH2.TYP = TEMP) O.RANGE</td>
</tr>
<tr>
<td>30</td>
<td>Verify fixed output range for current output OUT.ERR</td>
</tr>
<tr>
<td>31</td>
<td>Verify fixed output value on detected sensor error and press OK (ONLY IF CH2.TYP = TEMP, or IF I.RANGE = 4-20 mA or 20-4 mA) OUT.LO</td>
</tr>
<tr>
<td>32</td>
<td>Verify temperature for 0% output and press OK (ONLY IF CH2.TYP = TEMP) OUT.HI</td>
</tr>
<tr>
<td>33</td>
<td>Verify temperature for 100% output and press OK (ONLY IF CH2.TYP = TEMP) RESP</td>
</tr>
<tr>
<td>34</td>
<td>Verify analog output response time and press OK CH1.CAL</td>
</tr>
<tr>
<td>35</td>
<td>Verify the use of applied process calibration values for Channel 1 and press OK CH2.CAL</td>
</tr>
<tr>
<td>36</td>
<td>Verify the use of applied process calibration values for Channel 2 and press OK PASSw.</td>
</tr>
<tr>
<td>37</td>
<td>Verify password and press OK SIL.OK</td>
</tr>
<tr>
<td>38</td>
<td>Verify SIL mode within 1 second</td>
</tr>
</tbody>
</table>

**Safety Manual 9113 Temperature / mA Converter**

**Version No. V7R0**
### 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 (At this time the device starts operating in SIL mode with the entered configuration parameters!)</td>
<td>CONFIG Verify OPEN-&gt;LOCK*</td>
</tr>
<tr>
<td>6 to 38</td>
<td>As step 6 to 38 for 14.2.1</td>
</tr>
</tbody>
</table>

* 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 SIL-mode OFF).
Go through the setup menu and correct the parameter(s).
Repeat step 1 to 38 (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 9113 detects a fault the output will go to Safe State, in which the output will go to “de-energized”.
If the fault is application-specific (cable error detection) the 9113 will restart when the fault has been corrected.
For device faults there are 2 ways of bringing the device out of Safe State.
1. Power cycle the device.
2. Bring the device out of SIL mode (choose “NO” in the menu point “EN.SIL”), and set it back to SIL mode again (choose “YES” in the menu point “EN.SIL” and verify the configuration).
16. User interface

16.1 Scrolling help texts in display line 3

[01] Set correct password
[02] Enter advanced setup menu?
[03] Select temperature input
  Select current input
[04] Select 0-20 mA input range
  Select 4-20 mA input range
[05] Select TC sensor type
  Select Ni sensor type
  Select Pt sensor type
[06] Select Pt10 sensor type
  Select Pt20 sensor type
  Select Pt50 sensor type
[07] Select Ni50 sensor type
  Select Ni100 sensor type
  Select Ni120 sensor type
  Select Pt100 sensor type
[08] Select Pt1000 sensor type
  Select TC-B sensor type
  Select TC-E sensor type
[09] Select TC-J sensor type
  Select TC-K sensor type
  Select TC-L sensor type
[10] Select TC-N sensor type
  Select TC-R sensor type
  Select TC-S sensor type
  Select TC-U sensor type
  Select TC-W3 sensor type
[12] Select TC-W5 sensor type
  Select TC-Lr sensor type
[13] Select 2-wire sensor connection
  Select 3-wire sensor connection
  Select 4-wire sensor connection
[14] Select Celsius as temperature unit
  Select Fahrenheit as temperature unit
[15] Select 0-20 mA output range
  Select 4-20 mA output range
[16] Select 20-0 mA output range
  Select 20-4 mA output range
[17] Enter SIL setup
  Enter simulation mode
[18] Load saved configuration into 9113
  Save 9113 configuration in 45xx
[19] Adjust LCD contrast
[20] Adjust LCD backlight
[21] Write a 5-character channel TAG
[22] Show analog input value in display
  Show analog output value in display
  Show TAG in display
[23] Enable password protection?
[24] Set new password
[25] Select language
[26] Select channel to calibrate
[27] Calibrate input low to process value?
[28] Set value for low calibration point
[29] Calibrate input high to process value?
[30] Set value for high calibration point
[31] Use process calibration values?
[32] Select channel to simulate
[33] Set the input simulation value
[34] Enable SIL configuration lock?
[35] Select internal temperature sensor
  Select CJC connector (accessory)
[36] Select Analog output response time in seconds
  Select CJC sensor error - check device temperature
  Select CJC error - check CJC connector block
[37] Is channel using process-compensated calibration data?
[38] Configuration SIL status (Open / Locked)
[39] Sensor wire breakage
[40] Sensor short circuit
[41] Input underrange
[42] Input overrange
[43] Input error - check input connections and reset power
[44] Output error - check connections and reset power
[45] Flash memory error - check configuration
[46] Invalid configuration type or version
[47] Hardware error
[48] CJC sensor error - check device temperature
[49] CJC sensor error - check device temperature
[50] CJC error - check CJC connector block
[51] No communication
16.2 Routing diagram

Power up

If SIL-locked directly to [EN,SIL]

Default state.
Line 1 shows input status.
Line 2 and 3 show analog input / output value or TAG no. and units.
Line 4 shows status for communication and whether the device is SIL-locked.
Static dot = SIL-locked and flashing dot = not SIL-locked.

Not valid for 0...20 mA input signal.

Only if input signal is temperature.
Min. and max. acc. to selected sensor type

Only if the configuration is not protected by a password.

Red text signifies safety parameters in a SIL configuration.
To default state 1.0
16.3 Routing diagram, advanced settings (ADV.SET)

MEM, DISP, CAL, SIM, PASS, LANG, RAIL, SIL

MEM
- SAVE
  - LOAD

PASS
- NO
  - EN.PASS
    - NEW.PAS

LANG
- DE, DK, ES, FR, IT, SE, UK

CAL
- CH.1
  - YES
    - NO
      - CAL.LO
        - CAL.HI
          - YES
            - NO
              - CAL.ER

RAIL
- YES
  - RAIL.ER

SIM
- CH.1
  - YES
    - NO
      - SIM.ER

SIL
- NO
  - ENSIL
    - NEW.PAS

ALT
- A.OUT
  - DISP

To default state 1.0

2.0 In the submenu simulation (SIM) you must press \( \Rightarrow \) to return to the default state 1.0.
17. Connections diagram

Power rail connections

Supply and status relay

NC = no connection

Inputs:

- RTD, 2-wire
- RTD, 3- / 4-wire
- TC, internal CJC sensor
- CJC connector

* Order separately: CJC connector 5910 / 5910Ex

Outputs:

- Current (Active output)
- 2-wire transmitter (Passive output)
- Relay
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