

# X20ST4492

## Information:

B&R makes every effort to keep data sheets as current as possible. From a safety point of view, however, the current version of the data sheet must always be used.

The certified, currently valid data sheet can be downloaded from the B&R website [www.br-automation.com](http://www.br-automation.com).

## Information:

This data sheet must be used with mapp Safety.

B&R safety technology can still be used in Safety Releases  $\leq 1.10$ , however. Documentation for this is available for download on the B&R website [www.br-automation.com](http://www.br-automation.com).

For additional information about mapp Safety, additional technical descriptions (e.g. connection examples and error detection) as well as generally valid contents (intended use, etc.), see section Safety technology in Automation Help.

## Organization of notices

### Safety notices

Contain **only** information that warns of dangerous functions or situations.

| Signal word     | Description   |
|-----------------|---|
| <b>Danger!</b>  | Failure to observe these safety guidelines and notices will result in death, severe injury or substantial damage to property. |
| <b>Warning!</b> | Failure to observe these safety guidelines and notices can result in death, severe injury or substantial damage to property.  |
| <b>Caution!</b> | Failure to observe these safety guidelines and notices can result in minor injury or damage to property.                      |
| <b>Notice!</b>  | Failure to observe these safety guidelines and notices can result in damage to property.                                      |

Table 1: Organization of safety notices

### General notices

Contain **useful** information for users and instructions for avoiding malfunctions.

| Signal word         | Description  |
|---------------------|--|
| <b>Information:</b> | Useful information, application tips and instructions for avoiding malfunctions. |

Table 2: Organization of general notices

## 1 General information

The module is equipped with 2 safe analog input pairs for J, K, N, S, R, C and T thermocouple sensors and 1 safe analog input pair for PT100/PT1000 resistance temperature measurement.

Thermocouple sensors require a measurement of the terminal temperature. The module's PT100/PT1000 sensors are used for temperature compensation.

The safe temperature module is suitable for safely acquiring temperatures for safety-related applications up to PL e or SIL 3.

This module is designed for X20 16-pin terminal blocks.

- 2 safe analog input pairs for thermocouples
- For sensor types J, K, N, S, R, C, T, raw value measurement
- 1 safe analog input pair for resistance temperature measurement
- For PT100 and PT1000
- Configurable sensor type per channel
- 24-bit digital converter resolution
- Galvanically isolated analog channel pairs
- Input filter configurable
- Integrated terminal temperature compensation
- 2x PT1000 sensor integrated in the terminal (X20TB5E)
- 2x external PT1000 sensor can be connected (X20TB5F)

## 2 Order data


| Order number | Short description  | Figure  |
|--------------|--|---|
|              | <b>Analog input modules</b>  |  |
| X20ST4492    | X20 safe temperature input module, 2x 2 safe analog inputs for thermocouples, Type: J, K, N, S, R, C, T, resolution 0.1°C, 1x 2 safe analog inputs for PT100/PT1000 sensors, channel pairs galvanically isolated, integrated compensation of terminal temperature, integrated temperature sensor in terminal block X20TB5E, configurable input filter and switching thresholds |   |
|              | <b>Required accessories</b>  |   |
|              | <b>Bus modules</b>   |   |
| X20BM33      | X20 bus module, for X20 SafeIO modules, internal I/O power supply connected through  |   |
| X20BM36      | X20 bus module, for X20 SafeIO modules, with node number switch, internal I/O power supply connected through   |   |
|              | <b>Terminal blocks</b>   |   |
| X20TB5E      | X20 terminal block, 16-pin, safety-keyed, 2x PT1000 integrated for terminal temperature compensation   |   |
| X20TB5F      | X20 terminal block, 16-pin, safety-keyed   |   |

Table 3: X20ST4492 - Order data

### 3 Technical data

| Order number   | X20ST4492   |
|--|---|
| Short description  |   |
| I/O module   | 2x 2 safe analog inputs for thermocouples, 1x 2 safe analog inputs for PT100/PT1000 sensors, channel pairs galvanically isolated, integrated terminal temperature compensation, integrated temperature sensor in terminal block X20TB5E |
| General information  |   |
| B&R ID code  | 0xB419  |
| System requirements  |   |
| Automation Studio  | 3.0.81.15 or later  |
| Automation Runtime   | 3.00 or later   |
| SafeDESIGNER   | 2.81 or later   |
| Safety Release   | 1.4 or later  |
| mapp Technology Package <sup>1)</sup>                            | mapp Safety 5.7.0 or later  |
| Status indicators  | I/O function per channel, operating state, module status  |
| Diagnostics  |   |
| Module run/error   | Yes, using LED status indicator and software  |
| Inputs   | Yes, using LED status indicator and software  |
| Blackout mode  |   |
| Scope  | Module  |
| Function   | Module function   |
| Standalone mode  | No  |
| Max. I/O cycle time  | 2 ms  |
| Power consumption  |   |
| Bus  | 0.25 W  |
| Internal I/O   | 1.2 W   |
| Additional power dissipation caused by actuators (resistive) [W] | -   |
| Electrical isolation   |   |
| Channel - Bus  | Yes   |
| Channel - Channel  | No  |
| Channel pair - Channel pair                                      | Yes   |
| Certifications   |   |
| CE   | Yes   |
| Functional safety  | cULus FSPC E361559<br>Energy and industrial systems<br>Certified for functional safety<br>ANSI UL 1998:2013   |
| Functional safety  | IEC 61508:2010, SIL 3<br>EN 62061:2013, SIL 3<br>EN ISO 13849-1:2015, Cat. 4 / PL e<br>IEC 61511:2004, SIL 3  |
| Functional safety  | EN 50156-1:2004   |
| ATEX   | Zone 2, II 3G Ex nA nC IIA T5 Gc<br>IP20, Ta (see X20 user's manual)<br>FTZÜ 09 ATEX 0083X  |
| UL   | cULus E115267<br>Industrial control equipment   |
| HazLoc   | cCSAus 244665<br>Process control equipment<br>for hazardous locations<br>Class I, Division 2, Groups ABCD, T5   |
| DNV GL   | Temperature: <b>A</b> (0 - 45°C)<br>Humidity: <b>B</b> (up to 100%)<br>Vibration: <b>A</b> (0.7 g)<br>EMC: <b>B</b> (bridge and open deck)  |
| LR   | ENV1  |
| KR   | Yes   |
| ABS  | Yes   |
| EAC  | Yes   |
| KC   | Yes   |
| Safety characteristics   |   |
| Note   | The following characteristic values apply only to the use of input channel pairs.<br>Assessing the channels from a safety point of view when they are used individually is not possible. <sup>2)</sup>                                  |
| EN ISO 13849-1:2015  |   |
| Category   | Cat. 4  |
| PL   | PL e  |
| DC   | >94%  |
| MTTFD  | 2200 years  |
| Mission time   | Max. 20 years   |

Table 4: X20ST4492 - Technical data

| Order number  | X20ST4492  |
|---|--|
| IEC 61508:2010,<br>IEC 61511:2004,<br>EN 62061:2013           |  |
| SIL CL  | SIL 3  |
| SFF   | >90%   |
| PFH / PFH <sub>d</sub>  |  |
| Module  | <1*10 <sup>-9</sup>  |
| openSAFETY wired  | Negligible   |
| openSAFETY wireless   | <1*10 <sup>-14</sup> * Number of openSAFETY packets per hour |
| PFD   | <1*10 <sup>-4</sup>  |
| Proof test interval (PT)                                      | 20 years   |
| I/O power supply  |  |
| Nominal voltage   | 24 VDC   |
| Voltage range   | 24 VDC -15% / +20%   |
| Thermocouple temperature inputs                               |  |
| Quantity  | 2 safe input channel pairs                                   |
| Variant   | Type thermocouple  |
| Digital converter resolution                                  | 24-bit   |
| Filter time   | Configurable between 1 and 66.7 ms                           |
| Output format   | SAFEINT  |
| Measurement range   |  |
| Sensor temperature  |  |
| Type J: Fe-CuNi   | -210.0 to 1200.0°C   |
| Type K: NiCr-Ni   | -270.0 to 1372.0°C   |
| Type N: NiCrSi-NiSi   | -270.0 to 1300.0°C   |
| Type S: PtRh10-Pt   | -50.0 to 1768.0°C  |
| Type R: PtRh13-Pt   | -50.0 to 1768.0°C  |
| Type C: WRe5-WRe26  | 0 to 2320.0°C  |
| Type T: Cu-CuNi   | -270.0 to 400.0°C  |
| Voltage   | ±65 mV   |
| Max. internal resistance of source during voltage measurement | 20 Ω   |
| Terminal temperature compensation                             | Internal / External  |
| Sensor standard   | EN 60584   |
| Resolution  |  |
| Sensor temperature  | 1 LSB = 0.1°C  |
| Voltage   | 1 LSB = 2 µV   |
| Conversion procedure  | Sigma-delta  |
| Linearization method  | Internal   |
| Permissible input signal                                      | Max. ±1 V  |
| Input filter  | First-order low-pass filter / cutoff frequency 500 Hz        |
| Basic accuracy <sup>3)</sup>                                  |  |
| Type J: Fe-CuNi   | 1.41°C   |
| Type K: NiCr-Ni   | 1.81°C   |
| Type N: NiCrSi-NiSi   | 1.73°C   |
| Type S: PtRh10-Pt   | 3.10°C   |
| Type R: PtRh13-Pt   | 3.10°C   |
| Type C: WRe5-WRe26  | 3.48°C   |
| Type T: Cu-CuNi   | 0.74°C   |
| Voltage   | 78 µV  |
| Max. gain drift <sup>4)</sup>                                 | 0.013 %/°C   |
| Max. offset drift   |  |
| Type J: Fe-CuNi   | 0.0297°C per °C  |
| Type K: NiCr-Ni   | 0.0427°C per °C  |
| Type N: NiCrSi-NiSi   | 0.0471°C per °C  |
| Type S: PtRh10-Pt   | 0.1637°C per °C  |
| Type R: PtRh13-Pt   | 0.1455°C per °C  |
| Type C: WRe5-WRe26  | 0.1068°C per °C  |
| Type T: Cu-CuNi   | 0.0335°C per °C  |
| Voltage   | 1.69 µV per °C   |
| Terminal temperature compensation                             |  |
| Accuracy of internal terminal temperature                     | 15°C at static temperatures and during safe operation        |
| Common-mode rejection   |  |
| DC  | >70 dB   |
| 50 Hz   | >70 dB   |
| Common-mode range   | ±4 V within channel pair, ±50 V between 2 channel pairs      |
| Crosstalk between channels                                    | ≤70 dB   |
| Insulation voltage between channel and bus                    | 500 VDC  |

Table 4: X20ST4492 - Technical data

| Order number                                     | X20ST4492  |
|--|--|
| Safety-related accuracy per channel              |  |
| Type J: Fe-CuNi                                  | 35.25°C  |
| Type K: NiCr-Ni                                  | 47.62°C  |
| Type N: NiCrSi-NiSi                              | 51.81°C  |
| Type S: PtRh10-Pt                                | 150.90°C   |
| Type R: PtRh13-Pt                                | 134.54°C   |
| Type C: WRe5-WRe26                               | 111.36°C   |
| Type T: Cu-CuNi                                  | 30.82°C  |
| Voltage  | 2080 µV  |
| <b>Resistance measurement temperature inputs</b> |  |
| Quantity   | 1 safe input channel pair  |
| Variant  | Type PT100/PT1000  |
| Measurement range                                |  |
| PT100  | -200.0 to 850.0°C  |
| PT1000   | -200.0 to 850.0°C  |
| Basic accuracy <sup>3)</sup>                     |  |
| PT100  | 1.89°C   |
| PT1000   | 0.53°C   |
| Measurement current                              | 262 µA ±5%   |
| Max. gain drift <sup>4)</sup>                    | 0.004 %/°C   |
| Max. offset drift                                |  |
| PT100  | 0.0525°C per °C  |
| PT1000   | 0.0053°C per °C  |
| Temperature sensor resolution                    |  |
| PT100  | 1 LSB = 0.1°C  |
| PT1000   | 1 LSB = 0.1°C  |
| Input filter                                     |  |
| Cutoff frequency                                 | 500 Hz first-order   |
| Max. line length                                 | 50 m   |
| Max. line resistance                             | 5 Ω  |
| Safety-related accuracy per channel              |  |
| PT100  | 12.60°C  |
| PT1000   | 8.93°C   |
| <b>Operating conditions</b>                      |  |
| Mounting orientation                             |  |
| Horizontal                                       | Yes  |
| Vertical   | Yes  |
| Installation elevation above sea level           | 0 to 2000 m, no limitation   |
| Degree of protection per EN 60529                | IP20   |
| <b>Ambient conditions</b>                        |  |
| Temperature                                      |  |
| Operation  |  |
| Horizontal mounting orientation                  | 0 to 60°C  |
| Vertical mounting orientation                    | 0 to 50°C  |
| Derating   | See section "Derating".  |
| Storage  | -40 to 85°C  |
| Transport  | -40 to 85°C  |
| Relative humidity                                |  |
| Operation  | 5 to 95%, non-condensing   |
| Storage  | 5 to 95%, non-condensing   |
| Transport  | 5 to 95%, non-condensing   |
| <b>Mechanical properties</b>                     |  |
| Note   | Order 1x safety-keyed terminal block separately.<br>Order 1x safety-keyed bus module separately. |
| Pitch  | 25 <sup>+0.2</sup> mm  |

Table 4: X20ST4492 - Technical data

- 1) The system requirements of the mapp Technology Package must be observed (see Automation Help).
- 2) In addition, the danger notices in the technical data sheet and section "Safety technology" in Automation Help must be observed.
- 3) At 25°C
- 4) Based on the measured value

## Derating

Starting at a temperature of 55°C (horizontal mounting orientation), dummy modules must be connected next to the X20ST4492.

| Module                             | X20ST4492 |
|------------------------------------|-----------|
| <b>Derating bonus</b>              |           |
| Dummy module on the left           | +0°C      |
| Dummy module on the right          | +2.5°C    |
| Dummy module on the left and right | +5°C      |

Table 5: Derating bonus

## Danger!

Operation outside the technical data is not permitted and can result in dangerous states.

## Information:

For additional information about installation, see section "Installation notes for X20 modules" in Automation Help.

## 4 LED status indicators

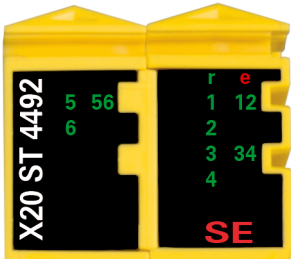
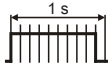
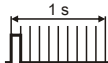


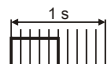
| Figure   | LED        | Color  | Status  | Description  |
|--|------------|--|---|--|
|                               | r          | Green  | Off   | No power to module   |
|  |            |  | Single flash  | Mode "Reset"   |
|  |            |  | Double flash  | Updating firmware  |
|  |            |  | Blinking  | Mode PREOPERATIONAL  |
|  |            |  | On  | Mode RUN   |
|  | e          | Red  | Off   | Module not supplied with power or everything OK  |
|  |            |  | Pulsating   | Bootloader mode  |
|  |            |  | Triple flash  | Updating safety-related firmware   |
|  |            |  | On  | Error or I/O component not provided with voltage   |
|  | e + r      | Solid red / Single green flash                             |   | Invalid firmware   |
|  | 1 to 6     | Input state of the corresponding analog input              |   |  |
|  |            | Red  | On  | Warning/Error on the input channel   |
|  |            |  | Blinking  | Open circuit on corresponding channel  |
|  |            |  | All on  | Error on all channels, connection to the SafeLOGIC controller not OK or startup not yet completed                        |
|  |            | Green  | On  | Channel being used and signal OK   |
|  |            |  | Blinking  | Channel outside of the limits configured in SafeDESIGNER   |
|  |            |  | Off   | Channel not used   |
|  | 12, 34, 56 | Input state of the corresponding analog input channel pair |   |  |
|  |            | Red  | On  | Warning/Error on this channel pair   |
|  |            |  | All on  | Error on all channels, connection to the SafeLOGIC controller not OK or startup not yet completed                        |
|  |            | Green  | On  | Signal on channel pair OK  |
|  |            |  | Off   | Signal on channel pair not OK  |
|  | SE         | Red  | Off   | Mode RUN or I/O component not provided with voltage  |
|  |            |  |    | Boot phase, missing X2X Link or defective processor  |
|  |            |  |   | Safety PREOPERATIONAL state<br>Modules that are not used in the SafeDESIGNER application remain in state PREOPERATIONAL. |
|  |            |  |  | Safe communication channel not OK  |
|  |            |  |  | The firmware for this module is a non-certified pilot customer version.  |
|  |            |  |  | Boot phase, faulty firmware  |
|  |            |  | On  | Safety state active for the entire module (= state "FailSafe")   |
| The "SE" LEDs separately indicate the status of safety processor 1 ("S" LED) and safety processor 2 ("E" LED). |            |  |   |  |

Table 6: Status indicators

### Danger!

Constantly lit "SE" LEDs indicate a defective module that must be replaced immediately. It is your responsibility to ensure that all necessary repair measures are initiated after an error occurs since subsequent errors can result in a hazard!

## 5 Pinout

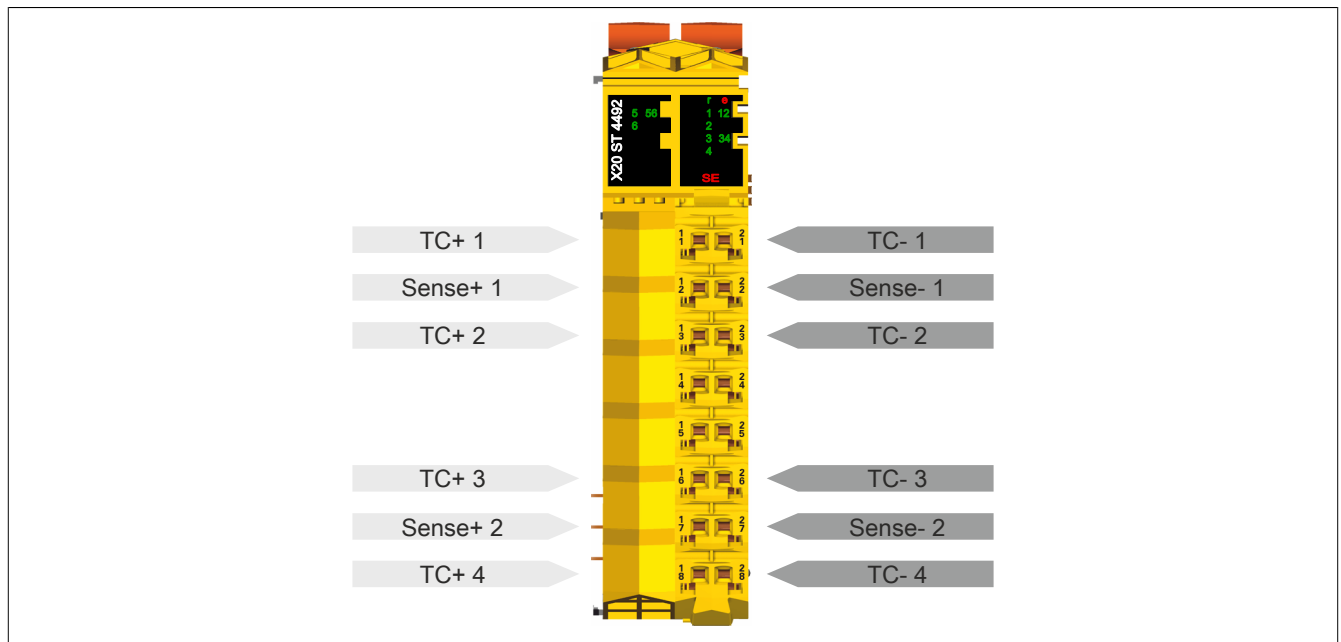


Figure 1: X20ST4492 - Pinout



## 6 Input circuit diagram

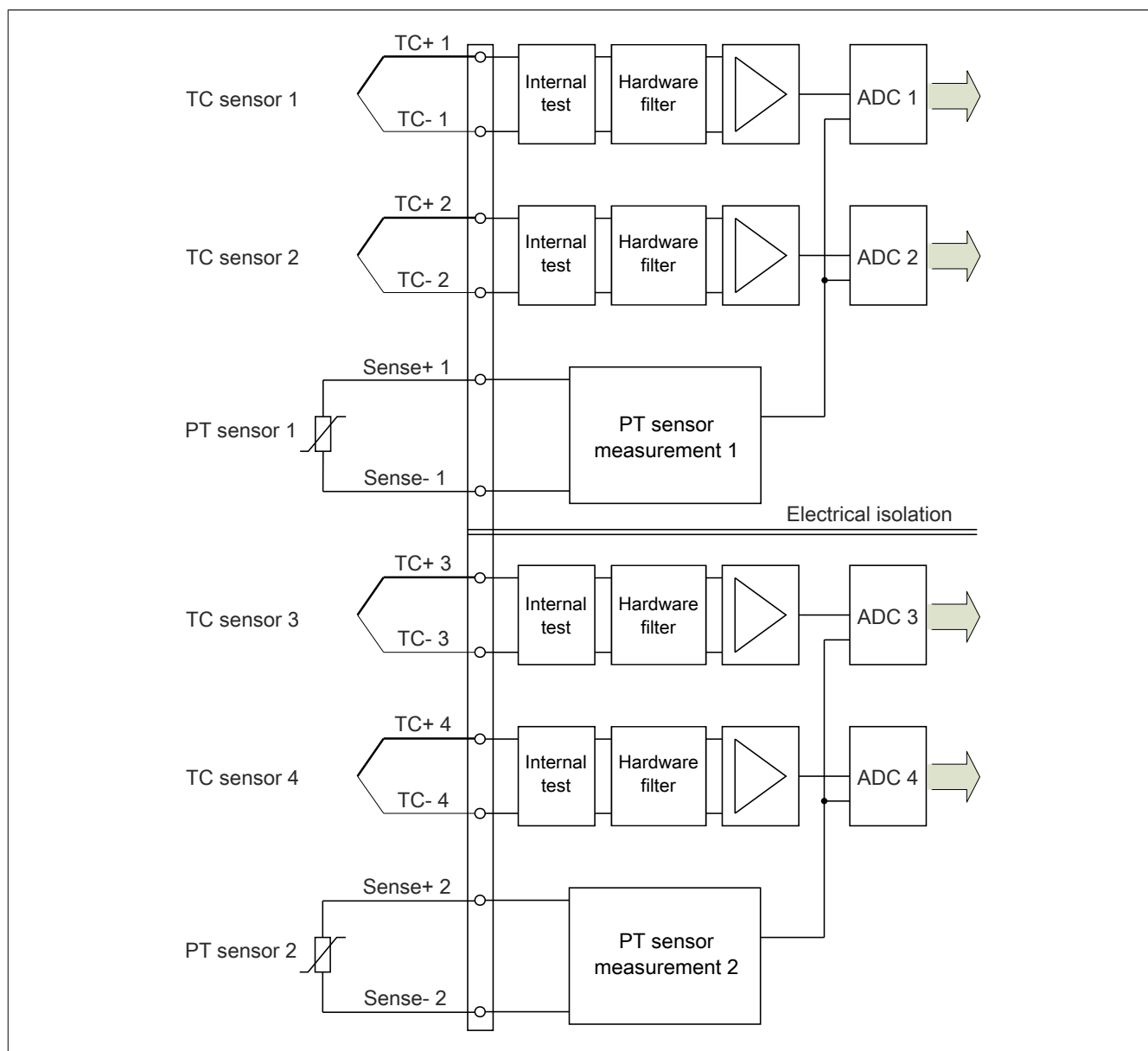


Figure 2: Input circuit diagram

## 7 Register description

### 7.1 Parameters in the I/O configuration

#### Group: Function model

| Parameter      | Description  | Default value | Unit |
|----------------|--|---------------|------|
| Function model | This parameter is reserved for future functional expansions. | Default       | -    |

Table 7: I/O configuration parameters: Function model

#### Group: General

| Parameter         | Description  | Default value                           | Unit |   |
|-------------------|--|---|------|---|
| Module supervised | System behavior when a module is missing   | On                                      | -    |   |
|                   |  |   |      |   |
|                   | Parameter value  | Description                             |      |   |
|                   | On   | A missing module triggers service mode. |      |   |
|                   | Off  | A missing module is ignored.            |      |   |
| Blackout mode     | This parameter enables blackout mode (see section Blackout mode in Automation Help under: Hardware → X20 system → Additional information → Blackout mode).   |   | Off  | - |
|                   |  |   |      |   |
|                   | Parameter value  | Description                             |      |   |
|                   | On   | Blackout mode is enabled.               |      |   |
|                   | Off  | Blackout mode is disabled.              |      |   |
| SafeDOMAIN ID     | In applications with multiple SafeLOGIC controllers, this parameter defines the module's association with a particular SafeLOGIC controller. <ul style="list-style-type: none"><li>Permissible values: 1 to 1000</li></ul> | Assigned automatically                  | -    |   |
| SafeNODE ID       | Unique safety address of the module <ul style="list-style-type: none"><li>Permissible values: 2 to 1023</li></ul>  | Assigned automatically                  | -    |   |

Table 8: I/O configuration parameters: General

## 7.2 Parameters in SafeDESIGNER

### Group: Basic

| Parameter  | Description  | Default value | Unit |                 |             |           |   |          |  |         |   |       |  |
|--|--|---------------|------|-----------------|-------------|-----------|---|----------|--|---------|---|-------|--|
| Min. required firmware revision  | This parameter is reserved for future functional expansions.   | Basic release | -    |                 |             |           |   |          |  |         |   |       |  |
| Availability   | This parameter can be used to configure the module as "optional". Optional modules do not have to be present, i.e. the SafeLOGIC controller will not indicate that these modules are not present. However, this parameter does not influence the module's signal or status data.   | Permanent     | -    |                 |             |           |   |          |  |         |   |       |  |
| <table><tr><th>Parameter value</th><th>Description</th></tr><tr><td>Permanent</td><td><p>This module is mandatory for the application.</p><p>The module must be in OPERATIONAL mode after startup, and safe communication with the SafeLOGIC controller must be established without errors (SafeModuleOK = SAFETRUE). Processing of the safety application on the SafeLOGIC controller is delayed after startup until this state is achieved for all modules with "Availability = Permanent".</p><p>After startup, module problems are indicated by a quickly blinking "MXCHG" LED on the SafeLOGIC controller. An entry is also made in the logbook.</p></td></tr><tr><td>Optional</td><td><p>The module is not required for the application.</p><p>The module is not taken into account during startup, which means the safety application is started regardless of whether the modules with "Availability = Optional" are in OPERATIONAL mode or if safe communication is properly established between these modules and the SafeLOGIC controller.</p><p>After startup, module problems are NOT indicated by a quickly blinking "MXCHG" LED on the SafeLOGIC controller. An entry is NOT made in the logbook.</p></td></tr><tr><td>Startup</td><td><p>This module is optional. The system determines how the module will proceed during startup.</p><p>If it is determined that the module is physically present during startup (regardless of whether it is in OPERATIONAL mode or not), then the module behaves as if "Availability = Permanent" is set.</p><p>If it is determined that the module is not physically present during startup, then the module behaves as if "Availability = Optional" is set.</p></td></tr><tr><td>Never</td><td><p>The module is not required for the application.</p><p>The module is not taken into account during startup, which means the safety application is started regardless of whether the modules with "Availability = Never" are physically present.</p><p>Unlike when "Availability = Optional" is configured, the module is not started with "Availability = Never", which optimizes system startup behavior.</p><p>After startup, module problems are NOT indicated by a quickly blinking "MXCHG" LED on the SafeLOGIC controller. An entry is NOT made in the logbook.</p></td></tr></table> |  |               |      | Parameter value | Description | Permanent | <p>This module is mandatory for the application.</p> <p>The module must be in OPERATIONAL mode after startup, and safe communication with the SafeLOGIC controller must be established without errors (SafeModuleOK = SAFETRUE). Processing of the safety application on the SafeLOGIC controller is delayed after startup until this state is achieved for all modules with "Availability = Permanent".</p> <p>After startup, module problems are indicated by a quickly blinking "MXCHG" LED on the SafeLOGIC controller. An entry is also made in the logbook.</p> | Optional | <p>The module is not required for the application.</p> <p>The module is not taken into account during startup, which means the safety application is started regardless of whether the modules with "Availability = Optional" are in OPERATIONAL mode or if safe communication is properly established between these modules and the SafeLOGIC controller.</p> <p>After startup, module problems are NOT indicated by a quickly blinking "MXCHG" LED on the SafeLOGIC controller. An entry is NOT made in the logbook.</p> | Startup | <p>This module is optional. The system determines how the module will proceed during startup.</p> <p>If it is determined that the module is physically present during startup (regardless of whether it is in OPERATIONAL mode or not), then the module behaves as if "Availability = Permanent" is set.</p> <p>If it is determined that the module is not physically present during startup, then the module behaves as if "Availability = Optional" is set.</p> | Never | <p>The module is not required for the application.</p> <p>The module is not taken into account during startup, which means the safety application is started regardless of whether the modules with "Availability = Never" are physically present.</p> <p>Unlike when "Availability = Optional" is configured, the module is not started with "Availability = Never", which optimizes system startup behavior.</p> <p>After startup, module problems are NOT indicated by a quickly blinking "MXCHG" LED on the SafeLOGIC controller. An entry is NOT made in the logbook.</p> |
| Parameter value  | Description  |               |      |                 |             |           |   |          |  |         |   |       |  |
| Permanent  | <p>This module is mandatory for the application.</p> <p>The module must be in OPERATIONAL mode after startup, and safe communication with the SafeLOGIC controller must be established without errors (SafeModuleOK = SAFETRUE). Processing of the safety application on the SafeLOGIC controller is delayed after startup until this state is achieved for all modules with "Availability = Permanent".</p> <p>After startup, module problems are indicated by a quickly blinking "MXCHG" LED on the SafeLOGIC controller. An entry is also made in the logbook.</p>          |               |      |                 |             |           |   |          |  |         |   |       |  |
| Optional   | <p>The module is not required for the application.</p> <p>The module is not taken into account during startup, which means the safety application is started regardless of whether the modules with "Availability = Optional" are in OPERATIONAL mode or if safe communication is properly established between these modules and the SafeLOGIC controller.</p> <p>After startup, module problems are NOT indicated by a quickly blinking "MXCHG" LED on the SafeLOGIC controller. An entry is NOT made in the logbook.</p>   |               |      |                 |             |           |   |          |  |         |   |       |  |
| Startup  | <p>This module is optional. The system determines how the module will proceed during startup.</p> <p>If it is determined that the module is physically present during startup (regardless of whether it is in OPERATIONAL mode or not), then the module behaves as if "Availability = Permanent" is set.</p> <p>If it is determined that the module is not physically present during startup, then the module behaves as if "Availability = Optional" is set.</p>  |               |      |                 |             |           |   |          |  |         |   |       |  |
| Never  | <p>The module is not required for the application.</p> <p>The module is not taken into account during startup, which means the safety application is started regardless of whether the modules with "Availability = Never" are physically present.</p> <p>Unlike when "Availability = Optional" is configured, the module is not started with "Availability = Never", which optimizes system startup behavior.</p> <p>After startup, module problems are NOT indicated by a quickly blinking "MXCHG" LED on the SafeLOGIC controller. An entry is NOT made in the logbook.</p> |               |      |                 |             |           |   |          |  |         |   |       |  |

Table 9: SafeDESIGNER parameters: Basic

**Group: Safety response time**

| Parameter                        | Description   | Default value   | Unit        |     |   |    |  |  |  |
|----------------------------------|---|-----------------|-------------|-----|---|----|--|--|--|
| Manual configuration             | This parameter makes it possible to manually and individually configure the safety response time for the module.  | No              | -           |     |   |    |  |  |  |
|                                  | The parameters for the safety response time are generally set in the same way for all stations involved in the application. For this reason, these parameters are configured for the SafeLOGIC controller in SafeDESIGNER. For application situations in which individual safety functions require optimal response time behavior, the parameters for the safety response time can be configured individually on the respective module.   |                 |             |     |   |    |  |  |  |
|                                  |   |                 |             |     |   |    |  |  |  |
|                                  |   |                 |             |     |   |    |  |  |  |
|                                  | <table><tr><th>Parameter value</th><th>Description</th></tr><tr><td>Yes</td><td>Data from the module's "Safety response time" group is used to calculate the safety response time for the module's signals.</td></tr><tr><td>No</td><td>The parameters for the safety response time are taken from the "Safety response time" group on the SafeLOGIC controller.</td></tr></table>  | Parameter value | Description | Yes | Data from the module's "Safety response time" group is used to calculate the safety response time for the module's signals. | No | The parameters for the safety response time are taken from the "Safety response time" group on the SafeLOGIC controller. |  |  |
| Parameter value                  | Description   |                 |             |     |   |    |  |  |  |
| Yes                              | Data from the module's "Safety response time" group is used to calculate the safety response time for the module's signals.   |                 |             |     |   |    |  |  |  |
| No                               | The parameters for the safety response time are taken from the "Safety response time" group on the SafeLOGIC controller.  |                 |             |     |   |    |  |  |  |
| Safe data duration               | <p>This parameter specifies the maximum permissible data transmission time between the SafeLOGIC controller and SafeIO module.</p> <p>For additional information about the actual data transmission time, see section Diagnostics and service -&gt; Diagnostics tools -&gt; Network analyzer -&gt; Editor -&gt; Calculation of safety runtime in Automation Help.</p> <p>The following formula can be used as the lower limit:</p> <p>"Value of the Network Analyzer" * 2 + SafeLOGIC cycle time * 2</p> <p>The stability of the system cannot be ensured for smaller values.</p> <ul style="list-style-type: none"><li>Permissible values: 2000 to 10,000,000 µs (corresponds to 2 ms to 10 s)</li></ul> | 20000           | µs          |     |   |    |  |  |  |
| Additional tolerated packet loss | <p>This parameter specifies the number of additional tolerated lost packets during data transfer.</p> <ul style="list-style-type: none"><li>Permissible values: 0 to 10</li></ul>   | 1               | Packets     |     |   |    |  |  |  |
| Node guarding packets            | <p>This parameter specifies the maximum number of packets used for node guarding.</p> <ul style="list-style-type: none"><li>Permissible values: 1 to 255</li></ul> <p><b>Note</b></p> <ul style="list-style-type: none"><li>The larger the configured value, the greater the amount of asynchronous data traffic.</li><li>This setting is not critical to safety functionality. The time for safely cutting off actuators is determined independently of this.</li></ul>  | 5               | Packets     |     |   |    |  |  |  |

Table 10: SafeDESIGNER parameters: Safety response time

**Group: Module configuration**

| Parameter         | Description  | Default value  | Unit        |            |  |            |  |  |  |
|-------------------|--|--|-------------|------------|--|------------|--|--|--|
| Dual-channel mode | This value sets the channels being used for dual-channel evaluation.   | Channel 12   | -           |            |  |            |  |  |  |
|                   |  |  |             |            |  |            |  |  |  |
|                   | <table><tr><th>Parameter value</th><th>Description</th></tr><tr><td>Channel 12</td><td>Channels 1 and 2 as well as Channels 3 and 4 are used for dual-channel evaluation.</td></tr><tr><td>Channel 13</td><td>Channels 1 and 3 as well as Channels 2 and 4 are used for dual-channel evaluation.</td></tr></table> | Parameter value  | Description | Channel 12 | Channels 1 and 2 as well as Channels 3 and 4 are used for dual-channel evaluation. | Channel 13 | Channels 1 and 3 as well as Channels 2 and 4 are used for dual-channel evaluation. |  |  |
|                   | Parameter value  | Description  |             |            |  |            |  |  |  |
|                   | Channel 12   | Channels 1 and 2 as well as Channels 3 and 4 are used for dual-channel evaluation. |             |            |  |            |  |  |  |
| Channel 13        | Channels 1 and 3 as well as Channels 2 and 4 are used for dual-channel evaluation.   |  |             |            |  |            |  |  |  |
|                   |  |  |             |            |  |            |  |  |  |
|                   |  |  |             |            |  |            |  |  |  |
| Input filter      | <div>This parameter sets the filter time of A/D converters.<ul style="list-style-type: none"><li>Permissible values: 1 ms, 2 ms, 10 ms, 16.7 ms, 20 ms, 33.3 ms, 40 ms, 66.7 ms</li></ul></div>  | 1  | ms          |            |  |            |  |  |  |

Table 11: SafeDESIGNER parameters: Module configuration

**Group: SafeTemperatureInputxx**

| Parameter                                      | Description   | Default value | Unit |
|--|---|---------------|------|
| Sensor type<br>(for SafeTemperatureInput01-04) | This parameter can be used to specify the type of sensor connected.<br><ul style="list-style-type: none"> <li>Permissible values: Type J, Type K, Type N, Type S, Type R, Type C, Type T, Voltage [μV]</li> </ul> | Type J        | -    |
| Sensor type<br>(for SafeTemperatureInput05-06) | This parameter can be used to specify the type of sensor connected.<br><ul style="list-style-type: none"> <li>Permissible values: PT100, PT1000</li> </ul>  | PT1000        | -    |

Table 12: SafeDESIGNER parameters: SafeTemperatureInputxx

**Danger!**

The use or configuration of an incorrect TC sensor type **CANNOT** be detected by the module. The temperature value acquired by the module is incorrect.

Make sure during validation that the correct TC sensor type is installed and configured.

**Information:**

The use or configuration of an incorrect PT sensor type is detected by the module. The module will switch to the FAILSAFE state.

**Group: SafeTemperatureexxy**

| Parameter                    | Description  | Default value | Unit          |
|------------------------------|--|---------------|---------------|
| Limit threshold equivalent x | This parameter specifies the limit value for the "Dual-channel evaluation" function for the maximum temperature difference between the two channels.<br><ul style="list-style-type: none"> <li>Permissible values during temperature measurement: Corresponds to the thermocouple type</li> <li>Permissible values during voltage measurement: -2,147,483,648 to +2,147,483,647</li> </ul> | 1000          | 0.1°C<br>2 μV |
| Discrepancy time x           | This parameter specifies the maximum time for the "Dual-channel evaluation" function in which the difference between both analog input values is permitted to exceed the limit value.<br><ul style="list-style-type: none"> <li>Permissible values: 0 to 10,000 ms (corresponds to 0 to 10 s)</li> </ul>   | 0             | ms            |

Table 13: SafeDESIGNER parameters: SafeTemperatureexxy

Parameters "Limit threshold equivalent x" and "Discrepancy time x" together form a parameter set. Channels "SafeThresholdSelector\_xxyy\_Bit1" and "SafeThresholdSelector\_xxyy\_Bit2" are available in the SafeDESIGNER application to determine which parameter set in the module is enabled, i.e. it is possible to change the parameter set at runtime.

## 7.3 Channel list

| Channel name  | Access via Automation Studio   | Access via SafeDESIGNER | Data type | Description   |       |             |        |  |        |   |        |   |        |                                      |        |                                       |        |                                       |        |   |        |  |        |  |        |                                      |
|---|--|-------------------------|-----------|---|-------|-------------|--------|--|--------|---|--------|---|--------|--------------------------------------|--------|---------------------------------------|--------|---------------------------------------|--------|---|--------|--|--------|--|--------|--------------------------------------|
| ModuleOk  | Read   | -                       | BOOL      | Indicates whether the module is physically present in the slot and configured   |       |             |        |  |        |   |        |   |        |                                      |        |                                       |        |                                       |        |   |        |  |        |  |        |                                      |
| SerialNumber  | Read   | -                       | UDINT     | Module serial number  |       |             |        |  |        |   |        |   |        |                                      |        |                                       |        |                                       |        |   |        |  |        |  |        |                                      |
| ModuleID  | Read   | -                       | UINT      | Module ID   |       |             |        |  |        |   |        |   |        |                                      |        |                                       |        |                                       |        |   |        |  |        |  |        |                                      |
| HardwareVariant   | Read   | -                       | UINT      | Hardware variant  |       |             |        |  |        |   |        |   |        |                                      |        |                                       |        |                                       |        |   |        |  |        |  |        |                                      |
| FirmwareVersion   | Read   | -                       | UINT      | Firmware version of the module  |       |             |        |  |        |   |        |   |        |                                      |        |                                       |        |                                       |        |   |        |  |        |  |        |                                      |
| UDID_low  | (Read) <sup>1)</sup>   | -                       | UDINT     | UDID, lower 4 bytes   |       |             |        |  |        |   |        |   |        |                                      |        |                                       |        |                                       |        |   |        |  |        |  |        |                                      |
| UDID_high   | (Read) <sup>1)</sup>   | -                       | UINT      | UDID, upper 2 bytes   |       |             |        |  |        |   |        |   |        |                                      |        |                                       |        |                                       |        |   |        |  |        |  |        |                                      |
| SafetyFWversion1  | (Read) <sup>1)</sup>   | -                       | UINT      | Firmware version - Safety processor 1   |       |             |        |  |        |   |        |   |        |                                      |        |                                       |        |                                       |        |   |        |  |        |  |        |                                      |
| SafetyFWversion2  | (Read) <sup>1)</sup>   | -                       | UINT      | Firmware version - Safety processor 2   |       |             |        |  |        |   |        |   |        |                                      |        |                                       |        |                                       |        |   |        |  |        |  |        |                                      |
| SafetyFWcrc1  | (Read) <sup>1)</sup>   | -                       | UINT      | CRC of the firmware header on safety processor 1  |       |             |        |  |        |   |        |   |        |                                      |        |                                       |        |                                       |        |   |        |  |        |  |        |                                      |
| SafetyFWcrc2  | (Read) <sup>1)</sup>   | -                       | UINT      | CRC of the firmware header on safety processor 2  |       |             |        |  |        |   |        |   |        |                                      |        |                                       |        |                                       |        |   |        |  |        |  |        |                                      |
| Bootstate   | (Read) <sup>1)</sup>   | -                       | UINT      | Startup state of the module.<br>Notes: <ul style="list-style-type: none"><li>Some of the boot states do not occur during normal startup or are cycled through so quickly that they are not visible externally.</li><li>The boot states usually cycle through in ascending order. There are cases, however, in which a previous value is captured.</li></ul> <table><tr><th>Value</th><th>Description</th></tr><tr><td>0x0003</td><td>Startup communication processor OK, no communication with the safety processors (check 24 V supply voltage!)</td></tr><tr><td>0x0010</td><td>FAILSAFE. At least one of the safety processors is in the safe state.</td></tr><tr><td>0x0020</td><td>Internal communication with safety processors started</td></tr><tr><td>0x0024</td><td>Firmware update of safety processors</td></tr><tr><td>0x0040</td><td>Firmware of safety processors started</td></tr><tr><td>0x0440</td><td>Firmware of safety processors running</td></tr><tr><td>0x0840</td><td>Waiting for openSAFETY "Operational" (loading the SafeDESIGNER application or no valid application available; waiting for acknowledgments such as module replacement)</td></tr><tr><td>0x1040</td><td>Evaluating the configuration according to the SafeDESIGNER application</td></tr><tr><td>0x3440</td><td>Stabilizing cyclic openSAFETY data exchange.<br/><b>Note:</b><br/>If the boot state remains here, SafeDESIGNER parameters "(Default) Safe data duration" and "(Default) Additional tolerated packet loss" must be checked.</td></tr><tr><td>0x4040</td><td>RUN. Final state, startup completed.</td></tr></table> | Value | Description | 0x0003 | Startup communication processor OK, no communication with the safety processors (check 24 V supply voltage!) | 0x0010 | FAILSAFE. At least one of the safety processors is in the safe state. | 0x0020 | Internal communication with safety processors started | 0x0024 | Firmware update of safety processors | 0x0040 | Firmware of safety processors started | 0x0440 | Firmware of safety processors running | 0x0840 | Waiting for openSAFETY "Operational" (loading the SafeDESIGNER application or no valid application available; waiting for acknowledgments such as module replacement) | 0x1040 | Evaluating the configuration according to the SafeDESIGNER application | 0x3440 | Stabilizing cyclic openSAFETY data exchange.<br><b>Note:</b><br>If the boot state remains here, SafeDESIGNER parameters "(Default) Safe data duration" and "(Default) Additional tolerated packet loss" must be checked. | 0x4040 | RUN. Final state, startup completed. |
| Value   | Description  |                         |           |   |       |             |        |  |        |   |        |   |        |                                      |        |                                       |        |                                       |        |   |        |  |        |  |        |                                      |
| 0x0003  | Startup communication processor OK, no communication with the safety processors (check 24 V supply voltage!)   |                         |           |   |       |             |        |  |        |   |        |   |        |                                      |        |                                       |        |                                       |        |   |        |  |        |  |        |                                      |
| 0x0010  | FAILSAFE. At least one of the safety processors is in the safe state.  |                         |           |   |       |             |        |  |        |   |        |   |        |                                      |        |                                       |        |                                       |        |   |        |  |        |  |        |                                      |
| 0x0020  | Internal communication with safety processors started  |                         |           |   |       |             |        |  |        |   |        |   |        |                                      |        |                                       |        |                                       |        |   |        |  |        |  |        |                                      |
| 0x0024  | Firmware update of safety processors   |                         |           |   |       |             |        |  |        |   |        |   |        |                                      |        |                                       |        |                                       |        |   |        |  |        |  |        |                                      |
| 0x0040  | Firmware of safety processors started  |                         |           |   |       |             |        |  |        |   |        |   |        |                                      |        |                                       |        |                                       |        |   |        |  |        |  |        |                                      |
| 0x0440  | Firmware of safety processors running  |                         |           |   |       |             |        |  |        |   |        |   |        |                                      |        |                                       |        |                                       |        |   |        |  |        |  |        |                                      |
| 0x0840  | Waiting for openSAFETY "Operational" (loading the SafeDESIGNER application or no valid application available; waiting for acknowledgments such as module replacement)  |                         |           |   |       |             |        |  |        |   |        |   |        |                                      |        |                                       |        |                                       |        |   |        |  |        |  |        |                                      |
| 0x1040  | Evaluating the configuration according to the SafeDESIGNER application   |                         |           |   |       |             |        |  |        |   |        |   |        |                                      |        |                                       |        |                                       |        |   |        |  |        |  |        |                                      |
| 0x3440  | Stabilizing cyclic openSAFETY data exchange.<br><b>Note:</b><br>If the boot state remains here, SafeDESIGNER parameters "(Default) Safe data duration" and "(Default) Additional tolerated packet loss" must be checked. |                         |           |   |       |             |        |  |        |   |        |   |        |                                      |        |                                       |        |                                       |        |   |        |  |        |  |        |                                      |
| 0x4040  | RUN. Final state, startup completed.   |                         |           |   |       |             |        |  |        |   |        |   |        |                                      |        |                                       |        |                                       |        |   |        |  |        |  |        |                                      |
| Diag1_Temp  | (Read) <sup>1)</sup>   | -                       | INT       | Module temperature in °C  |       |             |        |  |        |   |        |   |        |                                      |        |                                       |        |                                       |        |   |        |  |        |  |        |                                      |
| oS_PropDelayStat<br>(hardware upgrade 2.3.0.0 or later) | (Read) <sup>1)</sup>   | -                       | UDINT     | Propagation delay statistics (average value of the data transmission time).<br>The unit depends on parameter "Process data transfer rate" of the SafeLOGIC controller. <ul style="list-style-type: none"><li>If the value of the parameter is "High", the unit is 100 µs.</li><li>If the value of the parameter is "Low", the unit is 1 ms.</li></ul><br>This value corresponds to the measurement of the forward and return channels and thus twice the theoretical runtime that is determined by the Network Analyzer.  |       |             |        |  |        |   |        |   |        |                                      |        |                                       |        |                                       |        |   |        |  |        |  |        |                                      |
| SafeModuleOK  | Read   | Read                    | SAFEBOOL  | Indicates whether the safe communication channel is OK  |       |             |        |  |        |   |        |   |        |                                      |        |                                       |        |                                       |        |   |        |  |        |  |        |                                      |
| SafeTemperatureOKxxyy                                   | Read   | Read                    | SAFEBOOL  | Status of dual-channel temperature evaluation xx/yy   |       |             |        |  |        |   |        |   |        |                                      |        |                                       |        |                                       |        |   |        |  |        |  |        |                                      |
| TestActive  | Read   | Read                    | BOOL      | Indication of an active channel test  |       |             |        |  |        |   |        |   |        |                                      |        |                                       |        |                                       |        |   |        |  |        |  |        |                                      |
| EquivalentThresholdxxyy                                 | (Read) <sup>1)</sup>   | -                       | UINT      | Limit value "Limit threshold equivalent" currently in use (see "SafeDESIGNER parameters: SafeTemperaturexxyy")  |       |             |        |  |        |   |        |   |        |                                      |        |                                       |        |                                       |        |   |        |  |        |  |        |                                      |
| DiscrepancyTimeThresholdxxyy                            | (Read) <sup>1)</sup>   | -                       | UINT      | Limit value "Discrepancy time" currently in use (see "SafeDESIGNER parameters: SafeTemperaturexxyy")  |       |             |        |  |        |   |        |   |        |                                      |        |                                       |        |                                       |        |   |        |  |        |  |        |                                      |
| SafeTemperaturexxyy                                     | Read   | Read                    | SAFEINT   | (Temperature channel xx + Temperature channel yy)/2   |       |             |        |  |        |   |        |   |        |                                      |        |                                       |        |                                       |        |   |        |  |        |  |        |                                      |
| TemperatureOKxx   | Read   | Read                    | BOOL      | Status of temperature evaluation xx   |       |             |        |  |        |   |        |   |        |                                      |        |                                       |        |                                       |        |   |        |  |        |  |        |                                      |
| Temperature_A   | Read   | -                       | INT       | Temperature of the temperature channel selected with "TempChannel_Select_A"   |       |             |        |  |        |   |        |   |        |                                      |        |                                       |        |                                       |        |   |        |  |        |  |        |                                      |

Table 14: Channel list

| Channel name                    | Access via Automation Studio             | Access via SafeDESIGNER | Data type | Description  |  |                                 |
|---------------------------------|--|-------------------------|-----------|--|--|---------------------------------|
| TempChannel_Select_A            | Write                                    | -                       | USINT     | Selection of the temperature to be transferred on channel "Temperature_A". |  |                                 |
|                                 |  |                         |           | Value  | Description                              |                                 |
|                                 |  |                         |           | 0  | The value from channel 2 is transferred. |                                 |
|                                 |  |                         |           | 1  | The value from channel 1 is transferred. |                                 |
|                                 |  |                         |           | 2  | The value from channel 2 is transferred. |                                 |
|                                 |  |                         |           | 3  | The value from channel 3 is transferred. |                                 |
|                                 |  |                         |           | 4  | The value from channel 4 is transferred. |                                 |
|                                 |  |                         |           | 5  | The value from channel 5 is transferred. |                                 |
|                                 |  |                         |           | 6  | The value from channel 6 is transferred. |                                 |
| ≥7                              | The value from channel 2 is transferred. |                         |           |  |  |                                 |
| SafeThresholdSelector_xxyy_Bit1 | -  | Write                   | SAFEBOOL  |  |  |                                 |
| SafeThresholdSelector_xxyy_Bit2 | -  | Write                   | SAFEBOOL  | **_Bit1  | **_Bit2                                  | Parameters currently being used |
|                                 |  |                         |           | 0  | 0  | Parameter set 1                 |
|                                 |  |                         |           | 1  | 0  | Parameter set 2                 |
|                                 |  |                         |           | 0  | 1  | Parameter set 3                 |
|                                 |  |                         |           | 1  | 1  | Parameter set 4                 |
| SafeReleasexxyy                 | -  | Write                   | SAFEBOOL  | Release signal - Channel xxyy  |  |                                 |

Table 14: Channel list

1) This data is accessed in Automation Studio using library ASIOACC.

## Danger!

The validity of analog signals is represented by the associated status signals. These binary status signals (data type SAFEBOOL) must also be evaluated each time the analog signals are used. A binary status signal with the status FALSE indicates an invalid value in the analog signal. In these situations, the analog signal is no longer permitted to be used for safety-related assessments.

## 8 Minimum cycle time

The minimum cycle time specifies the time up to which the bus cycle can be reduced without communication errors occurring.

| Minimum cycle time |
|--------------------|
| 200 µs             |

## 9 I/O update time

The time needed by the module to generate a sample is specified by the I/O update time.

| Configured filter | Maximum I/O update time |
|-------------------|-------------------------|
| 1 ms              | 32 ms                   |
| 2 ms              | 40 ms                   |
| 10 ms             | 86 ms                   |
| 16.7 ms           | 132 ms                  |
| 20 ms             | 152 ms                  |
| 33.3 ms           | 240 ms                  |
| 40 ms             | 284 ms                  |
| 66.7 ms           | 372 ms                  |

## 10 Version history

| Version | Date          | Comment   |
|---------|---------------|---|
| 2.10    | May 2021      | Chapter 3 "Technical data": <ul style="list-style-type: none"> <li>Updated display of system requirements.</li> <li>Safety characteristics: Updated footnote.</li> </ul>  |
| 2.08    | November 2020 | <ul style="list-style-type: none"> <li>Chapter 3 "Technical data": <ul style="list-style-type: none"> <li>Thermocouple temperature inputs: Added number of channels.</li> <li>Resistance measurement temperature inputs: Added number of channels.</li> </ul> </li> <li>Editorial changes.</li> </ul>   |
| 2.07    | August 2020   | <ul style="list-style-type: none"> <li>Chapter 3 "Technical data": <ul style="list-style-type: none"> <li>General information: Added additional power dissipation caused by actuators (resistive) [W].</li> <li>Updated certifications.</li> </ul> </li> <li>Editorial changes.</li> </ul>  |
| 2.06    | May 2020      | <ul style="list-style-type: none"> <li>Chapter 1 "General information": Updated description.</li> <li>Chapter 3 "Technical data": <ul style="list-style-type: none"> <li>Added footnote for system requirements.</li> <li>Updated certifications.</li> <li>Thermocouple temperature inputs: Added variant.</li> <li>Resistance measurement temperature inputs: Added variant.</li> </ul> </li> <li>Chapter 7.3 "Channel list": Added channel "oS_PropDelayStat".</li> </ul> |
| 2.05    | February 2020 | Editorial changes.  |
| 2.04    | November 2019 | <ul style="list-style-type: none"> <li>Chapter 3 "Technical data": <ul style="list-style-type: none"> <li>Updated certifications.</li> <li>Resistance measurement temperature inputs: Updated basic accuracy.</li> <li>Resistance measurement temperature inputs: Updated max. offset drift.</li> <li>Resistance measurement temperature inputs: Updated safety-related accuracy per channel.</li> </ul> </li> <li>Editorial changes.</li> </ul>                            |
| 2.03    | August 2019   | Chapter 7.3 "Channel list": Updated description of channel "TempChannel_Select_A".  |
| 2.02    | May 2019      | First edition for mapp Safety   |

Table 15: Version history



## 11 EC declaration of conformity

This document was originally written in the German language. The German edition therefore represents the original documentation in accordance with the 2006/42/EC Machinery Directive. Documents in other languages should be interpreted as translations of the original documentation.

### **Product manufacturer:**

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The place of jurisdiction, in accordance with article 17 of the European Convention on Courts of Jurisdiction and Enforcement, is A-4910, Austria.

Ried im Innkreis, Austria, commercial register court: Ried im Innkreis, Austria

Commercial register number: FN 111651 v.

The place of fulfillment in accordance with article 5 of the European Convention on Courts of Jurisdiction and Enforcement is A-5142 Eggelsberg, Austria.

VATIN: ATU62367156

The EC declarations of conformity for B&R products can be downloaded from the B&R website ([www.br-automation.com](http://www.br-automation.com)).