WAGO-I/O-SYSTEM 750

Manual

750-451

8 AI RTD

8-Channel Analog Input Module for Resistance Sensors

Version 1.1.0

WAGO Kontakttechnik GmbH & Co. KG

Hansastraße 27
D-32423 Minden

Phone: +49 (0) 571/8 87 – 0
Fax: +49 (0) 571/8 87 – 1 69

E-Mail: info@wago.com

Web: http://www.wago.com

Technical Support

Phone: +49 (0) 571/8 87 – 5 55
Fax: +49 (0) 571/8 87 – 85 55

E-Mail: support@wago.com

Every conceivable measure has been taken to ensure the accuracy and completeness of this documentation. However, as errors can never be fully excluded, we always appreciate any information or suggestions for improving the documentation.

E-Mail: documentation@wago.com

We wish to point out that the software and hardware terms as well as the trademarks of companies used and/or mentioned in the present manual are generally protected by trademark or patent.

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1 Notes about this Documentation

Note

Always retain this documentation!
This documentation is part of the product. Therefore, retain the documentation during the entire service life of the product. Pass on the documentation to any subsequent user. In addition, ensure that any supplement to this documentation is included, if necessary.

1.1 Validity of this Documentation

This documentation is only applicable to the I/O module 750-451 (8 AI RTD).

The I/O module 750-451 shall only be installed and operated according to the instructions in this manual and in the manual for the used fieldbus coupler/controller.

NOTICE

Consider power layout of the WAGO-I/O-SYSTEM 750!
In addition to these operating instructions, you will also need the manual for the used fieldbus coupler/controller, which can be downloaded at www.wago.com. There, you can obtain important information including information on electrical isolation, system power and supply specifications.

1.2 Copyright

1.3 Symbols

DANGER

Personal Injury!
Indicates a high-risk, imminently hazardous situation which, if not avoided, will result in death or serious injury.

DANGER

Personal Injury Caused by Electric Current!
Indicates a high-risk, imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

Personal Injury!
Indicates a moderate-risk, potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Personal Injury!
Indicates a low-risk, potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

NOTICE

Damage to Property!
Indicates a potentially hazardous situation which, if not avoided, may result in damage to property.

NOTICE

Damage to Property Caused by Electrostatic Discharge (ESD)!
Indicates a potentially hazardous situation which, if not avoided, may result in damage to property.

Note

Important Note!
Indicates a potential malfunction which, if not avoided, however, will not result in damage to property.

Information

Additional Information:
Refers to additional information which is not an integral part of this documentation (e.g., the Internet).

1.4 Number Notation

Table 1: Number Notation

Number Code	Example	Note
Decimal	100	Normal notation
Hexadecimal	0x64	C notation
Binary	'100' '0110.0100'	In quotation marks, nibble separated with dots (.)

1.5 Font Conventions

Table 2: Font Conventions

Font Type	Indicates
italic	Names of paths and data files are marked in italic-type. e.g.: *C:\Program Files\WAGO Software*
Menu	Menu items are marked in bold letters. e.g.: **Save**
>	A greater-than sign between two names means the selection of a menu item from a menu. e.g.: **File** > **New**
Input	Designation of input or optional fields are marked in bold letters, e.g.: **Start of measurement range**
“Value”	Input or selective values are marked in inverted commas. e.g.: Enter the value “4 mA” under **Start of measurement range**.
[Button]	Pushbuttons in dialog boxes are marked with bold letters in square brackets. e.g.: **[Input]**
[Key]	Keys are marked with bold letters in square brackets. e.g.: **[F5]**

2 Important Notes

This section includes an overall summary of the most important safety requirements and notes that are mentioned in each individual section. To protect your health and prevent damage to devices as well, it is imperative to read and carefully follow the safety guidelines.

2.1 Legal Bases

2.1.1 Subject to Changes

WAGO Kontakttechnik GmbH & Co. KG reserves the right to provide for any alterations or modifications that serve to increase the efficiency of technical progress. WAGO Kontakttechnik GmbH & Co. KG owns all rights arising from the granting of patents or from the legal protection of utility patents. Third-party products are always mentioned without any reference to patent rights. Thus, the existence of such rights cannot be excluded.

2.1.2 Personnel Qualifications

All sequences implemented on WAGO-I/O-SYSTEM 750 devices may only be carried out by electrical specialists with sufficient knowledge in automation. The specialists must be familiar with the current norms and guidelines for the devices and automated environments.

All changes to the coupler or controller should always be carried out by qualified personnel with sufficient skills in PLC programming.

2.1.3 Use of the WAGO-I/O-SYSTEM 750 in Compliance with Underlying Provisions

Fieldbus couplers, fieldbus controllers and I/O modules found in the modular WAGO-I/O-SYSTEM 750 receive digital and analog signals from sensors and transmit them to actuators or higher-level control systems. Using programmable controllers, the signals can also be (pre-) processed.

The devices have been developed for use in an environment that meets the IP20 protection class criteria. Protection against finger injury and solid impurities up to 12.5 mm diameter is assured; protection against water damage is not ensured. Unless otherwise specified, operation of the devices in wet and dusty environments is prohibited.

Operating the WAGO-I/O-SYSTEM 750 devices in home applications without further measures is only permitted if they meet the emission limits (emissions of interference) according to EN 61000-6-3. You will find the relevant information in the section “Device Description” > “Standards and Guidelines” in the manual for the used fieldbus coupler/controller.

Appropriate housing (per 2014/34/EU) is required when operating the WAGO-I/O-SYSTEM 750 in hazardous environments. Please note that a prototype test certificate must be obtained that confirms the correct installation of the system in a housing or switch cabinet.

2.1.4 Technical Condition of Specified Devices

The devices to be supplied ex works are equipped with hardware and software configurations, which meet the individual application requirements. WAGO Kontakttechnik GmbH & Co. KG will be exempted from any liability in case of changes in hardware or software as well as to non-compliant usage of devices.

Please send your request for modified and new hardware or software configurations directly to WAGO Kontakttechnik GmbH & Co. KG.

2.2 Safety Advice (Precautions)

For installing and operating purposes of the relevant device to your system the following safety precautions shall be observed:

DANGER

Do not work on devices while energized!
All power sources to the device shall be switched off prior to performing any installation, repair or maintenance work.

DANGER

Install the device only in appropriate housings, cabinets or in electrical operation rooms!
The WAGO-I/O-SYSTEM 750 and its components are an open system. As such, install the system and its components exclusively in appropriate housings, cabinets or in electrical operation rooms. Allow access to such equipment and fixtures to authorized, qualified staff only by means of specific keys or tools.

NOTICE

Replace defective or damaged devices!
Replace defective or damaged device/module (e.g., in the event of deformed contacts), since the long-term functionality of device/module involved can no longer be ensured.

NOTICE

Protect the components against materials having seeping and insulating properties!
The components are not resistant to materials having seeping and insulating properties such as: aerosols, silicones and triglycerides (found in some hand creams). If you cannot exclude that such materials will appear in the component environment, then install the components in an enclosure being resistant to the above-mentioned materials. Clean tools and materials are imperative for handling devices/modules.

NOTICE

Clean only with permitted materials!
Clean soiled contacts using oil-free compressed air or with ethyl alcohol and leather cloths.

NOTICE

Do not use any contact spray!
Do not use any contact spray. The spray may impair contact area functionality in connection with contamination.

NOTICE

Do not reverse the polarity of connection lines!
Avoid reverse polarity of data and power supply lines, as this may damage the devices involved.

NOTICE

Avoid electrostatic discharge!
The devices are equipped with electronic components that may be destroyed by electrostatic discharge when touched. Please observe the safety precautions against electrostatic discharge per DIN EN 61340-5-1/-3. When handling the devices, please ensure that environmental factors (personnel, work space and packaging) are properly grounded.

3 Device Description

The I/O module 750-451 (8 AI RTD) measures resistance at field level or evaluates platinum or nickel resistance sensors.
The resistance values are converted into temperature values. A microprocessor in the I/O module linearizes the measured resistance values and converts them into a numeric value proportional to the temperature of the selected resistance sensor.
The **WAGO-I/O-*CHECK*** commissioning tool can be used to set the required operating mode.

The I/O module has eight input channels, providing a direct connection to 2-wire resistance sensors.
The sensors are connected to Push-in CAGE CLAMP® terminals +A1/−A1 ... +A8/−A8.

The assignment of the connections is described in the “Connectors” section.
Connection examples are shown in section “Connecting Devices” > … > “Connection Example(s)”.

The operating status of the channels is indicated by a green status LED per channel.
A red error LED per channel indicates a wire break, a short circuit or that the signal is outside the measuring range.
The meaning of the LEDs is described in the “Display Elements” section.

NOTICE

Do not exceed maximum current via power jumper contacts!
The maximum current to flow through the power jumper contacts is 10 A.
Greater currents can damage the contacts.
When configuring your system, ensure that this current is not exceeded. If exceeded, insert an additional supply module.

Note

Use supply modules for ground (earth)!
The I/O module has no power jumper contacts for receiving and transmitting the earth potential. Use a supply module when an earth potential is needed for the subsequent I/O modules.

With consideration of the power jumper contacts, the individual modules can be arranged in any combination when configuring the fieldbus node. An arrangement in groups within the group of potentials is not necessary.

The I/O module 750-451 can be used with all fieldbus couplers/controllers of the WAGO-I/O-SYSTEM 750.

The field voltage and the system voltage are electrically isolated from each other.

3.1 View

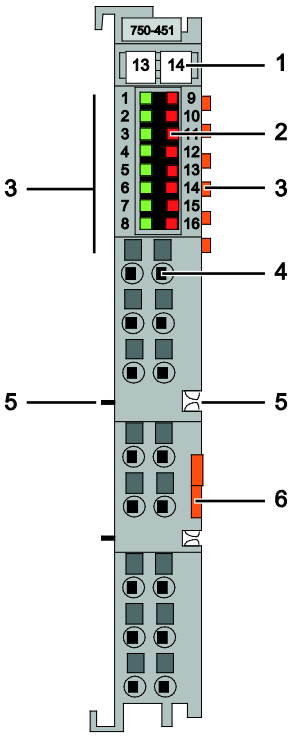


Figure 1: View

Table 3: Legend for Figure “View”

Pos.	Description	Details See Section
1	Marking possibility with Mini-WSB	---
2	Status LEDs	“Device Description” > “Display Elements”
3	Data contacts	“Device Description” > “Connectors”
4	Push-in CAGE CLAMP® connectors	“Device Description” > “Connectors”
5	Power jumper contacts	“Device Description” > “Connectors”
6	Release tab	“Mounting” > “Inserting and Removing Devices”

3.2 Connectors

3.2.1 Data Contacts/Internal Bus

Communication between the fieldbus coupler/controller and the I/O modules as well as the system supply of the I/O modules is carried out via the internal bus. It is comprised of 6 data contacts, which are available as self-cleaning gold spring contacts.

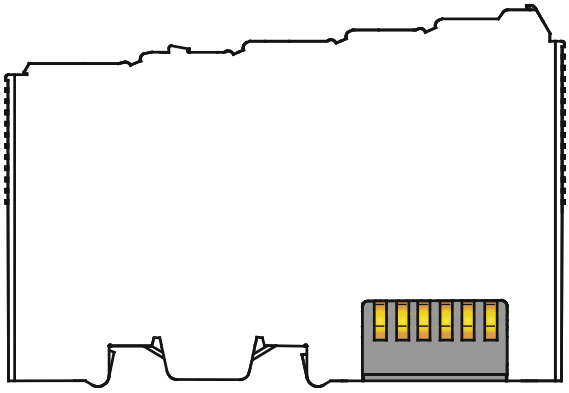


Figure 2: Data Contacts

NOTICE

Do not place the I/O modules on the gold spring contacts!
Do not place the I/O modules on the gold spring contacts in order to avoid soiling or scratching!

NOTICE

Ensure that the environment is well grounded!
The devices are equipped with electronic components that may be destroyed by electrostatic discharge. When handling the devices, ensure that the environment (persons, workplace and packing) is well grounded. Avoid touching conductive components, e.g. data contacts.

3.2.2 Power Jumper Contacts/Field Supply

⚠ CAUTION

Risk of injury due to sharp-edged blade contacts!
The blade contacts are sharp-edged. Handle the I/O module carefully to prevent injury.

The I/O module 750-451 has 2 self-cleaning power jumper contacts that supply and transmit power for the field side. The contacts on the left side of the I/O module are designed as blade contacts and those on the right side as spring contacts.

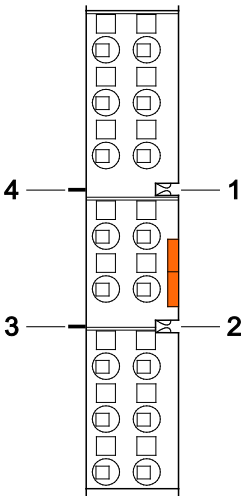


Figure 3: Power Jumper Contacts

Table 4: Legend for Figure “Power Jumper Contacts”

Contact	Type	Function
1	Spring contact	Potential transmission (U_v) for field supply
2	Spring contact	Potential transmission (0 V) for field supply
3	Blade contact	Potential feed-in (0 V) for field supply
4	Blade contact	Potential feed-in (U_v) for field supply

NOTICE

Do not exceed maximum current via power jumper contacts!
The maximum current to flow through the power jumper contacts is 10 A. Greater currents can damage the contacts.
When configuring your system, ensure that this current is not exceeded. If exceeded, insert an additional supply module.

3.2.3 Push-in CAGE CLAMP® Connectors

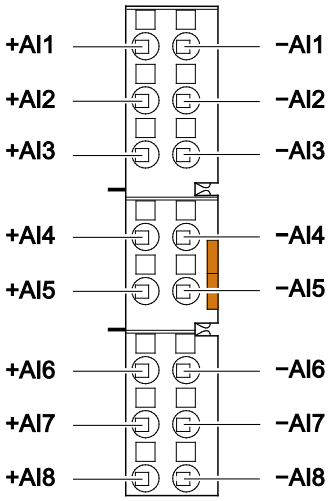


Figure 4: Push-in CAGE CLAMP® Connectors

Table 5: Legend for Figure “Push-in CAGE CLAMP® Connectors” – 8-Channel, 2-Wire

Channel	Designation	Connector	Function
1	+AI1	1	Sensor 1: +R
	−AI1	2	Sensor 1: −R
2	+AI2	3	Sensor 2: +R
	−AI2	4	Sensor 2: −R
3	+AI3	5	Sensor 3: +R
	−AI3	6	Sensor 3: −R
4	+AI4	7	Sensor 4: +R
	−AI4	8	Sensor 4: −R
5	+AI5	9	Sensor 5: +R
	−AI5	10	Sensor 5: −R
6	+AI6	11	Sensor 6: +R
	−AI6	12	Sensor 6: −R
7	+AI7	13	Sensor 7: +R
	−AI7	14	Sensor 7: −R
8	+AI8	15	Sensor 8: +R
	−AI8	16	Sensor 8: −R

3.3 Display Elements

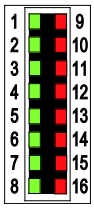


Figure 5: Display Elements

Table 6: Legend for Figure “Display Elements”

Chan-nel	Desig-nation	LED	State	Function
1	R1 status	1	OFF	Not ready for operation or no or disturbed internal bus communication, channel disabled
			Green	Ready for operation and undisturbed internal bus communication
	R1 error	9	OFF	No error and/or diagnostics disabled or channel disabled
			Red	Permissible measuring range overrange and underrange, short circuit, wire break
2	R2 status	2	(see channel 1)	
	R2 error	10	(see channel 1)	
3	R3 status	3	(see channel 1)	
	R3 error	11	(see channel 1)	
4	R4 status	4	(see channel 1)	
	R4 error	12	(see channel 1)	
5	R5 status	5	(see channel 1)	
	R5 error	13	(see channel 1)	
6	R6 status	6	(see channel 1)	
	R6 error	14	(see channel 1)	
7	R7 status	7	(see channel 1)	
	R7 error	15	(see channel 1)	
8	R8 status	8	(see channel 1)	
	R8 error	16	(see channel 1)	

3.4 Operating Elements

The I/O module 750-451 has no operating elements.

3.5 Schematic Diagram

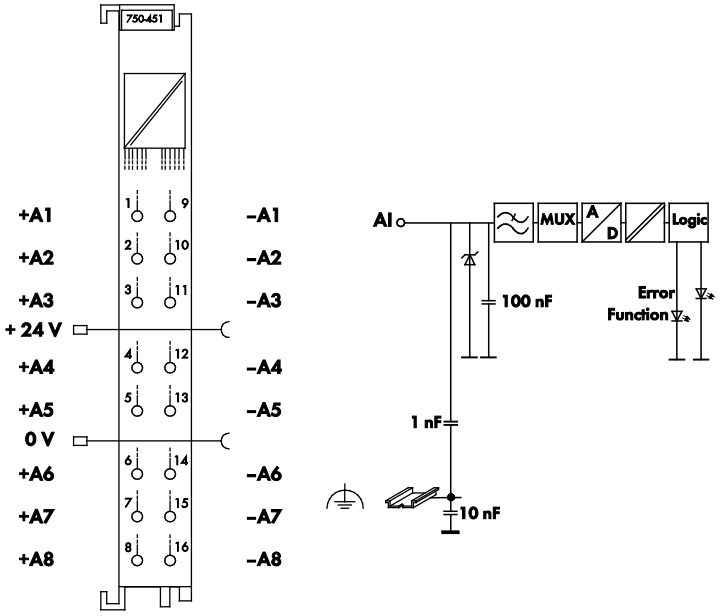


Figure 6: Schematic Diagram

3.6 Technical Data

3.6.1 Device Data

Table 7: Technical Data – Device

Width	12 mm/0.472 in.
Height (from upper edge of DIN 35 rail)	64 mm
Length	100 mm
Weight	approx. 47 g

3.6.2 Power Supply

Table 8: Technical Data – Power Supply

Power supply	Via system voltage internal bus (5 VDC)
Current consumption, system voltage $_{typ.}$ (5 VDC)	max. 110 mA
Current consumption, power jumper contacts $_{max.}$ (24 VDC)	---
Voltage via power jumper contacts	24 VDC
Current via power jumper contacts $_{max.}$	10 A
Isolation (peak value)	500 V system/field side

3.6.3 Communication

Table 9: Technical Data – Communication

Data width internal (internal data bus) 8-channel operation	8 x 16 bits data, 8 x 8 bits control/status (optional)

3.6.4 Inputs

Table 10: Technical Data – Inputs

Number of inputs	8 (parameterizable)
Sensor types	Pt100 (IEC 751, default) Pt200 (IEC 751) Pt500 (IEC 751) Pt1000 (IEC 751) Ni100 (DIN 43760) Ni120 (Minco) Ni1000 (TK5000) Ni1000 (TK6180, DIN 43760) Resistance measurement 1 (0 Ω … 5000 Ω) Resistance measurement 2 (0 Ω … 1200 Ω)
Connection types	2-wire
Measuring current	≤ 350 µA per measurement circuit
Conversion time	≤ 100 ms per channel
Resolution	16 bits
Temperature coefficient	≤ ±5 ppm/K

3.6.5 Measuring Accuracy at 25 °C

Table 11: Technical Data – Measuring Accuracy at 25 °C Ambient Temperature

Pt100 (IEC 751, default)	−200 °C… 850 °C	≤ ±0.6 K
Pt200 (IEC 751)	−200 °C … 850 °C	≤ ±0.5 K
Pt500 (IEC 751)	−200 °C … 850 °C	≤ ±0.3 K
Pt1000 (IEC 751)	−200 °C … 850 °C	≤ ±0.2 K
	−50 °C … 150 °C	≤ ±0.2 K
Ni100 (DIN 43760)	−60 °C … 250 °C	≤ ±0.4 K
Ni120 (Minco)	−80 °C … 260 °C	≤ ±0.3 K
Ni1000 (TK5000, Landis & Staefa)	−60 °C … 250 °C	≤ ±0.2 K
	−50 °C … 150 °C	≤ ±0.2 K
Ni1000 (TK6180, DIN 43760)	−60 °C … 250 °C	≤ ±0.2 K
	−50 °C … 150 °C	≤ ±0.2 K
Resistance measurement 1	0 Ω … 5000 Ω	≤ ±0.3 Ω
Resistance measurement 2	0 Ω … 1200 Ω	≤ ±0.3 Ω

3.6.6 Connection Type

Table 12: Technical Data – Field Wiring

Wire connection	Push-in CAGE CLAMP®
Cross section, solid wire	0.08 mm² … 1.5 mm² / AWG 28 … 16
Cross section, fine-stranded wire	0.25 mm² … 1.5 mm² / AWG 22 … 16
Stripped lengths	8 mm … 9 mm / 0.33 in

Table 13: Technical Data – Power Jumper Contacts

Power jumper contacts	Blade/spring contact, self-cleaning

Table 14: Technical Data – Data Contacts

Data contacts	Slide contact, hard gold plated, self-cleaning

3.6.7 Climatic Environmental Conditions

Table 15: Technical Data – Climatic Environmental Conditions

Operating temperature range	0 °C … 55 °C
Storage temperature range	−25 °C … +85 °C
Relative humidity without condensation	Max. 95 %
Resistance to harmful substances	Acc. to IEC 60068-2-42 and IEC 60068-2-43
Maximum pollutant concentration at relative humidity < 75 %	$SO_2 \leq 25$ ppm $H_2S \leq 10$ ppm
Special conditions	Ensure that additional measures for components are taken, which are used in an environment involving: – dust, caustic vapors or gases – ionizing radiation

3.7 Approvals

The following approvals have been granted to 750-451 I/O modules:

CE	Conformity Marking	
KC	Korea Certification	MSIP-REM-W43-AIM750

The following approval has been granted to the basic version of 750-451 I/O modules:

cULus	cULus	UL508

The following Ex approvals have been granted to the basic version of 750-451 I/O modules:

Ex	TÜV 14 ATEX 148929 X II 3 G Ex nA IIC T4 Gc IECEx TUN 14.0035 X Ex nA IIC T4 Gc
cULus	cULus ANSI/ISA 12.12.01 Class I, Div2 ABCD T4

Information

More information about approvals.
Detailed references to the approvals are listed in the document “Overview Approvals **WAGO-I/O-SYSTEM 750**”, which you can find via the internet under: www.wago.com > SERVICES > DOWNLOADS > Additional documentation and information on automation products > WAGO-I/O-SYSTEM 750 > System Description.

3.8 Standards and Guidelines

750-451 I/O modules meet the following standards and guidelines:

EU EMC Directive	2014/30/EU
EMC CE-Immunity to interference	EN 61000-6-2 and to EN 61131-2
EMC CE-Emission of interference	EN 61000-6-3 + A1 and to EN 61131-2

4 Process Image

4.1 Overview

Note

Representation of control/status bytes depending on the fieldbus coupler/controller!

The I/O module always makes its complete process image incl. control/status bytes available to the fieldbus coupler/controller. The **WAGO-I/O-*CHECK*** commissioning tool accesses the complete commissioning process image. The fieldbus coupler/controller uses a different process image to stage cyclic process data via the fieldbus. In the other process image, depending on the fieldbus coupler/controller, the representation of control/status bytes can be suppressed.

Table 16: Process Image

Process image			
Input*		**Output***	
Byte 0	Status byte CH1_S0	Byte 0	Control byte CH1_C0
Byte 1	Depending on the status byte: Process value or register value CH1_D0	Byte 1	Depending on the control byte: Reserved or register value CH1_D0
Byte 2	Depending on the status byte: Process value or register value CH1_D1	Byte 2	Depending on the control byte: Reserved or register value CH1_D1
Byte 3	Status byte CH2_S1	Byte 3	Control byte CH2_C1
Byte 4	Depending on the status byte: Process value or register value CH2_D0	Byte 4	Depending on the control byte: Reserved or register value CH2_D0
Byte 5	Depending on the status byte: Process value or register value CH2_D1	Byte 5	Depending on the control byte: Reserved or register value CH2_D1
…	…	…	…
Byte 21	Status byte CH8_S7	Byte 21	Control byte CH8_C7
Byte 22	Depending on the status byte: Process value or register value CH8_D0	Byte 22	Depending on the control byte: Reserved or register value CH8_D0
Byte 23	Depending on the status byte: Process value or register value CH8_D1	Byte 23	Depending on the control byte: Reserved or register value CH8_D1

*) CHx_Sx = Status byte x from channel x
CHx_Cx = Control byte x from channel x
CHx_D0 = Low-byte of the process or register value from channel x
CHx_D1 = High-byte of the process or register value from channel x

4.2 Control Bytes and Status Bytes

Control and status bytes are implemented identically for all channels. Therefore, the following description in this section is representative for all control and status bytes of the I/O module.

Table 17: Control Byte

Control byte CH1_C0, byte 0							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Reg_Com = 0	**0**	–	–	–	–	–	–
Reg_Com = 1	**0**	**Register number**					

Reg_Com	Register communication	
	0:	Register communication is switched OFF
	1:	Register communication is switched ON
0	The bit is reserved and may not be used	
–	Not used	

Table 18: Status Byte

Status byte CH1_S0, byte 0							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Reg_Com	**Err_G**	**Wire Break**	**Short Circuit**	**User Overrange**	**User Underrange**	**Overrange**	**Underrange**

Reg_Com	This bit indicates which communication mode is enabled.	
	0:	Process data communication is enabled.
	1:	Register communication is enabled.
Err_G	This bit generally indicates whether an underrange, overrange, short circuit or wire break has been detected.	
	0:	No error present.
	1:	General error present (see section “Diagnostics”).
Wire Break	This bit indicates whether a wire break has been detected.	
	0:	No wire break present.
	1:	Wire break present.
Short Circuit	This bit indicates whether the corrected raw value falls below the limiting value for short circuit detection or whether the ADC reports a reference voltage error.	
	0:	No short circuit present.
	1:	Short circuit present.
User Overrange	This bit indicates whether the limiting value specified by the user exceeds the calculated resistance or temperature value.	
	0:	Limiting value not overrange.
	1:	Limiting value overrange.
User Underrange	This bit indicates whether the limiting value specified by the user falls below the calculated resistance or temperature value.	
	0:	Limiting value not underrange.
	1:	Limiting value underrange.
Overrange	This bit indicates whether the calculated resistance or temperature value exceeds the measuring range set.	
	0:	Range not exceeded.
	1:	Range exceeded.
Underrange	This bit indicates whether the calculated resistance or temperature value falls below the measuring range set.	
	0:	There is no underrange.
	1:	There is an underrange.

Note

No short-circuit detection for resistance measurements!
For sensor types “Resistance measurement 1” and “Resistance measurement 2”, short-circuit detection is not technically possible.

4.3 Process Data

4.3.1 Overview of Sensor Types

The following table serves as an overview of all supported sensor types presented in standard format and in S5-FB250 format. The following sections provide detailed information about the individual sensor types ordered by ID. The information in the respective tables for resolution and measured values, as well as the resulting raw value ranges are based on the manufacturer scaling.

Table 19: Process Data, Overview in Standard Format and S5-FB250 Format

ID	Sensor type	Standard	Measuring range	Notation			
				Standard format		S5-FB250 format	
				Resolution	Raw value range	Resolution	Raw value range
0	Pt100	IEC 751	−200 °C … 850 °C	0.1 °C	−2000 … 8500	0.5 °C	−400 … 1700
1	Ni100	DIN 43760	−60 °C … 250 °C	0.1 °C	−600 … 2500	0.5 °C	−120 … 500
2	Pt1000	IEC 751	−200 °C … 850 °C	0.1 °C	−2000 … 8500	0.5 °C	−400 … 1700
3	Pt500	IEC 751	−200 °C … 850 °C	0.1 °C	−2000 … 8500	0.5 °C	−400 … 1700
4	Pt200	IEC 751	−200 °C … 850 °C	0.1 °C	−2000 … 8500	0.5 °C	−400 … 1700
5	Ni1000	TK6180 DIN 43760	−60 °C … 250 °C	0.1 °C	−600 … 2500	0.5 °C	−120 … 500
6	Ni120	Minco	−80 °C … 260 °C	0.1 °C	−800 … 2600	0.5 °C	−160 … 520
7	Ni1000	TK5000 (Landis + Staefa)	−60 °C … 250 °C	0.1 °C	−600 … 2500	0.5 °C	−120 … 500
8	Ni1000	TK6180 DIN 43760	−50 °C … 150 °C	0.01 °C	−5000 … 15000	0.05 °C	−1000 … 3000
9	Ni1000	TK5000 (Landis + Staefa)	−50 °C … 150 °C	0.01 °C	−5000 … 15000	0.05 °C	−1000 … 3000
10	Pt1000	IEC 751	−50 °C … 150 °C	0.01 °C	−5000 … 15000	0.05 °C	−1000 … 3000
11	Reserved for expansions						
12	Reserved for expansions						
13	Reserved for expansions						
14	Resistance measuring range 1	–	0 Ohm … 5 kOhm	0.2 Ohm	0 … 25000	4 Ohm	0 … 1250
15	Resistance measuring range 2	–	0 Ohm … 1.2 kOhm	0.05 Ohm	0 … 24000	0.5 Ohm	0 … 2400

4.3.2 Pt100 (IEC 751), ID 0

4.3.2.1 Default Format

With the setting “Pt100 (IEC 751)”, the I/O module converts the measured resistance values of Pt100 sensors (IEC 751) into temperature values and outputs the conversion results in degrees Celsius.
The temperature values are displayed at a resolution of 1 digit per 0.1 °C in one word (16-bit). Temperature values below 0 °C are represented in two's complement binary. As a result, 0 °C corresponds to the numeric value 0x0000 and 100 °C to the numeric value 0x03E8 (dec. 1000).
The maximum number range viewable in one word in two's complement representation ranges from −32768 to +32767. The number range used depends on the selected sensor type selected and the resolution of the process value. For the setting “Pt100 (IEC 751)”, the possible numerical range corresponds to the defined temperature range of −200 °C to +850 °C and ranges from −2000 to +8500 accordingly.

Table 20: ID 0, Setting Pt100 (IEC 751), Standard Format

Temperature °C	Resistance Ω	Numeric value [1]			Status byte hex.	Error LED
		Binary	Hex.	Dec.		
---	< 10.00	'1111.1000.0011.0000'	0xF830	−2000	0x50	ON
Short circuit [2]						
< –200.0	< 18.520	'1111.1000.0011.0000'	0xF830	−2000	0x41	ON
Underrange [3]						
−200.0	18.520	'1111.1000.0011.0000'	0xF830	−2000	0x00	OFF
−100.0	60.256	'1111.1100.0001.1000'	0xFC18	−1000	0x00	OFF
0.0	100.00	'0000.0000.0000.0000'	0x0000	0	0x00	OFF
100.0	138.506	'0000.0011.1110.1000'	0x03E8	1000	0x00	OFF
200.0	175.856	'0000.0111.1101.0000'	0x07D0	2000	0x00	OFF
500.0	280.978	'0001.0011.1000.1000'	0x1388	5000	0x00	OFF
750.0	360.638	'0001.1101.0100.1100'	0x1D4C	7500	0x00	OFF
800.0	375.704	'0001.1111.0100.0000'	0x1F40	8000	0x00	OFF
850.0	390.481	'0010.0001.0011.0100'	0x2134	8500	0x00	OFF
> 850.0	> 390.481	'0010.0001.0011.0100'	0x2134	8500	0x42	ON
Overrange [3]						
---	> 5010.00	'0010.0001.0011.0100'	0x2134	8500	0x60	ON
Wire break [2]						

1) Temperature values below 0 °C are represented in two's complement binary.
2) When short circuit and wire break monitoring is ON (see section “Diagnostics” > “Behavior in the Event of an Error”)
3) When underrange / overrange limit is ON (see section “Diagnostics” > “Behavior in the Event of an Error”)

4.3.2.2 S5-FB250 Format

With the setting “Pt100 (IEC 751)” and activated S5-FB250 format, the I/O module converts the measured resistance values of Pt100 sensors (IEC 751) into temperature values and outputs the conversion results.
The temperature values are displayed at a resolution of 1 digit per 0.5 °C.
The status information is depicted in bit 0 to bit 2 and the digitalized measured value in bit 3 to bit 15.

Table 21: ID 0, Setting Pt100 (IEC 751), S5-FB250 Format

Temperature °C	Resistance Ω	Numeric value [1] with status information [4]				Status byte hex.	Error LED
		Binary	XFÜ	Hex.	Dec.		
---	< 10.00	'1111.0011.1000.0	010'	0xF382	−3198	0x50	ON
Short circuit [2]							
< −200.0	< 18.520	'1111.0011.1000.0	001'	0xF381	−3199	0x41	ON
Underrange [3]							
−200.0	18.520	'1111.0011.1000.0	000'	0xF380	−3200	0x00	OFF
−100.0	60.256	'1111.1001.1100.0	000'	0xF9C0	−1600	0x00	OFF
0.0	100.00	'0000.0000.0000.0	000'	0x0000	0	0x00	OFF
100.0	138.506	'0000.0110.0100.0	000'	0x0640	1600	0x00	OFF
200.0	175.856	'0000.1100.1000.0	000'	0x0C80	3200	0x00	OFF
500.0	280.978	'0001.1111.0100.0	000'	0x1F40	8000	0x00	OFF
750.0	360.638	'0010.1110.1110.0	000'	0x2EE0	12000	0x00	OFF
800.0	375.704	'0011.0010.0000.0	000'	0x3200	12800	0x00	OFF
850.0	390.481	'0011.0101.0010.0	000'	0x3520	13600	0x00	OFF
> 850.0	> 390.481	'0011.0101.0010.0	001'	0x3521	13601	0x42	ON
Overrange [3]							
---	> 5010.00	'0011.0101.0010.0	010'	0x3522	13602	0x60	ON
Wire break [2]							

1) Temperature values below 0 °C are represented in two's complement binary.
2) When short circuit and wire break monitoring is ON (see section “Diagnostics” > “Behavior in the Event of an Error”)
3) When underrange / overrange limit is ON (see section “Diagnostics” > “Behavior in the Event of an Error”)
4) Status information:
X: Not used,
F: Short circuit, wire break,
Ü: Underrange, overrange

4.3.3 Ni100 (DIN 43760), ID 1

4.3.3.1 Default Format

With the setting “Ni100 (DIN 43760)”, the I/O module converts the measured resistance values of Ni100 sensors (DIN 43760) into temperature values and outputs the conversion results in degrees Celsius.
The temperature values are displayed at a resolution of 1 digit per 0.1 °C in one word (16-bit). Temperature values below 0 °C are represented in two's complement binary. As a result, 0 °C corresponds to the numeric value 0x0000 and 100 °C to the numeric value 0x03E8 (dec. 1000). The maximum number range viewable in one word in two's complement representation ranges from −32768 to +32767. The number range used depends on the sensor type set and the resolution of the process value. For the setting “Ni100 (DIN 43760)”, the possible numerical range corresponds to the defined temperature range of −60 °C to +250 °C and ranges from −600 to +2500 accordingly.

Table 22: ID 1, Setting Ni100 (DIN 43760), Standard Format

Temperature °C	Resistance Ω	Numeric value [1]			Status byte hex.	Error LED
		Binary	Hex.	Dec.		
---	< 10.00	'1111.1101.1010.1000'	0xFDA8	−600	0x50	ON
Short circuit [2]						
< −60.0	< 69.52	'1111.1101.1010.1000'	0xFDA8	−600	0x41	ON
Underrange [3]						
−60.0	69.52	'1111.1101.1010.1000'	0xFDA8	−600	0x00	OFF
−50.0	74.26	'1111.1110.0000.1100'	0xFE0C	−500	0x00	OFF
0.0	100.00	'0000.0000.0000.0000'	0x0000	0	0x00	OFF
50.0	129.11	'0000.0001.1111.0100'	0x01F4	500	0x00	OFF
100.0	161.78	'0000.0011.1110.1000'	0x03E8	1000	0x00	OFF
150.0	198.64	'0000.0101.1101.1100'	0x05DC	1500	0x00	OFF
200.0	240.66	'0000.0111.1101.0000'	0x07D0	2000	0x00	OFF
250.0	289.16	'0000.1001.1100.0100'	0x09C4	2500	0x00	OFF
> 250.0	> 289.16	'0000.1001.1100.0100'	0x09C4	2500	0x42	ON
Overrange [3]						
---	> 5010.00	'0000.1001.1100.0100'	0x09C4	2500	0x60	ON
Wire break [2]						

1) Temperature values below 0 °C are represented in two's complement binary.
2) When short circuit and wire break monitoring is ON (see section “Diagnostics” > “Behavior in the Event of an Error”)
3) When underrange / overrange limit is ON (see section “Diagnostics” > “Behavior in the Event of an Error”)

4.3.3.2 S5-FB250 Format

With the setting “Ni100 (DIN 43760)” and activated S5-FB250 format, the I/O module converts the measured resistance values of Ni100 sensors (DIN 43760) into temperature values and outputs the conversion results.
The temperature values are displayed at a resolution of 1 digit per 0.5 °C.
The status information is depicted in bit 0 to bit 2 and the digitalized measured value in bit 3 to bit 15.

Table 23: ID 1, Setting Ni100 (DIN 43760), S5-FB250 Format

Temperature °C	Resistance Ω	Numeric value [1] with status information [4]				Status byte hex.	Error LED
		Binary	XFÜ	Hex.	Dec.		
---	< 10.00	'1111.1100.0100.0	010'	0xFC42	−958	0x50	ON
Short circuit [2]							
< −60.0	< 69.52	'1111.1100.0100.0	001'	0xFC41	−959	0x41	ON
Underrange [3]							
−60.0	69.52	'1111.1100.0100.0	000'	0xFC40	−960	0x00	OFF
−50.0	74.26	'1111.1100.1110.0	000'	0xFCE0	−800	0x00	OFF
0.0	100.00	'0000.0000.0000.0	000'	0x0000	0	0x00	OFF
50.0	129.11	'0000.0011.0010.0	000'	0x0320	800	0x00	OFF
100.0	161.78	'0000.0110.0100.0	000'	0x0640	1600	0x00	OFF
150.0	198.64	'0000.1001.0110.0	000'	0x0960	2400	0x00	OFF
200.0	240.66	'0000.1100.1000.0	000'	0x0C80	3200	0x00	OFF
250.0	289.16	'0000.1111.1010.0	000'	0x0FA0	4000	0x00	OFF
>250.0	> 289.16	'0000.1111.1010.0	001'	0x0FA1	4001	0x42	ON
Overrange [3]							
---	> 5010.00	'0000.1111.1010.0	010'	0x0FA2	4002	0x60	ON
Wire break [2]							

1) Temperature values below 0 °C are represented in two's complement binary.
2) When short circuit and wire break monitoring is ON (see section “Diagnostics” > “Behavior in the Event of an Error”)
3) When underrange / overrange limit is ON (see section “Diagnostics” > “Behavior in the Event of an Error”)
4) Status information:
X: Not used,
F: Short circuit, wire break,
Ü: Underrange, overrange

4.3.4 Pt1000 (IEC 751), ID 2

4.3.4.1 Default Format

With the setting “Pt1000 (IEC 751)”, the I/O module converts the measured resistance values of Ni100-Pt100 sensors (IEC 751) into temperature values and outputs the conversion results in degrees Celsius.
The temperature values are displayed at a resolution of 1 digit per 0.1 °C in one word (16-bit). Temperature values below 0 °C are represented in two's complement binary. As a result, 0 °C corresponds to the numeric value 0x0000 and 100 °C to the numeric value 0x03E8 (dec. 1000). The maximum number range viewable in one word in two's complement representation ranges from −32768 to +32767. The number range used depends on the sensor type set and the resolution of the process value. For the setting “Pt1000 (IEC 751)”, the possible numerical range corresponds to the defined temperature range of −200 °C to +850 °C and ranges from −2000 to +8500 accordingly.

Table 24: ID 2, Setting Pt1000 (IEC 751), Standard Format

Temperature °C	Resistance Ω	Numeric value [1]			Status byte hex.	Error LED
		Binary	Hex.	Dec.		
---	< 10.00	'1111.1000.0011.0000'	0xF830	−2000	0x50	ON
Short circuit [2]						
< −200.0	< 185.20	'1111.1000.0011.0000'	0xF830	−2000	0x41	ON
Underrange [3]						
−200.0	185.20	'1111.1000.0011.0000'	0xF830	−2000	0x00	OFF
−100.0	602.56	'1111.1100.0001.1000'	0xFC18	−1000	0x00	OFF
0.0	1000.00	'0000.0000.0000.0000'	0x0000	0	0x00	OFF
100.0	1385.06	'0000.0011.1110.1000'	0x03E8	1000	0x00	OFF
200.0	1758.56	'0000.0111.1101.0000'	0x07D0	2000	0x00	OFF
500.0	2809.78	'0001.0011.1000.1000'	0x1388	5000	0x00	OFF
750.0	3606.38	'0001.1101.0100.1100'	0x1D4C	7500	0x00	OFF
800.0	3757.04	'0001.1111.0100.0000'	0x1F40	8000	0x00	OFF
850.0	3904.81	'0010.0001.0011.0100'	0x2134	8500	0x00	OFF
> 850.0	> 3904.81	'0010.0001.0011.0100'	0x2134	8500	0x42	ON
Overrange [3]						
---	> 5010.00	'0010.0001.0011.0100'	0x2134	8500	0x60	ON
Wire break [2]						

1) Temperature values below 0 °C are represented in two's complement binary.
2) When short circuit and wire break monitoring is ON (see section “Diagnostics” > “Behavior in the Event of an Error”)
3) When underrange / overrange limit is ON (see section “Diagnostics” > “Behavior in the Event of an Error”)

4.3.4.2 S5-FB250 Format

With the setting “Pt1000 (IEC 751)” and activated S5-FB250 format, the I/O module converts the measured resistance values of Pt1000 sensors (IEC 751) into temperature values and outputs the conversion results.
The temperature values are displayed at a resolution of 1 digit per 0.5 °C.
The status information is depicted in bit 0 to bit 2 and the digitalized measured value in bit 3 to bit 15.

Table 25: ID 2, Setting Pt1000 (IEC 751), S5-FB250 Format

Temperature °C	Resistance Ω	Numeric value [1] with status information [4]				Status byte hex.	Error LED
		Binary	XFÜ	Hex.	Dec.		
---	< 10.00	'1111.0011.1000.0	010'	0xF382	−3198	0x50	ON
Short circuit [2]							
< −200.0	< 185.20	'1111.0011.1000.0	001'	0xF381	−3199	0x41	ON
Underrange [3]							
−200.0	185.20	'1111.0011.1000.0	000'	0xF380	−3200	0x00	OFF
−100.0	602.56	'1111.1001.1100.0	000'	0xF9C0	−1600	0x00	OFF
0.0	1000.00	'0000.0000.0000.0	000'	0x0000	0	0x00	OFF
100.0	1385.06	'0000.0011.1110.1	000'	0x0640	1600	0x00	OFF
200.0	1758.56	'0000.0111.1101.0	000'	0x0C80	3200	0x00	OFF
500.0	2809.78	'0001.1111.0100.0	000'	0x1F40	8000	0x00	OFF
750.0	3606.38	'0010.1110.1110.0	000'	0x2EE0	12000	0x00	OFF
800.0	3757.04	'0011.0010.0000.0	000'	0x3200	12800	0x00	OFF
850.0	3904.81	'0011.0101.0010.0	000'	0x3520	13600	0x00	OFF
> 850.0	> 3904.81	'0011.0101.0010.0	001'	0x3521	13601	0x42	ON
Overrange [3]							
---	> 5010.00	'0011.0101.0010.0	010'	0x3522	13602	0x60	ON
Wire break [2]							

1) Temperature values below 0 °C are represented in two's complement binary.
2) When short circuit and wire break monitoring is ON (see section “Diagnostics” > “Behavior in the Event of an Error”)
3) When underrange / overrange limit is ON (see section “Diagnostics” > “Behavior in the Event of an Error”)
4) Status information:
X: Not used,
F: Short circuit, wire break,
Ü: Underrange, overrange

4.3.5 Pt500 (IEC 751), ID 3

4.3.5.1 Default Format

With the setting “Pt500 (IEC 751)”, the I/O module converts the measured resistance values of Pt500 sensors (IEC 751) into temperature values and outputs the conversion results in degrees Celsius.
The temperature values are displayed at a resolution of 1 digit per 0.1 °C in one word (16-bit). Temperature values below 0 °C are represented in two's complement binary. As a result, 0 °C corresponds to the numeric value 0x0000 and 100 °C to the numeric value 0x03E8 (dec. 1000). The maximum number range viewable in one word in two's complement representation ranges from −32768 to +32767. The number range used depends on the sensor type set and the resolution of the process value. For the setting “Pt500 (IEC 751)”, the possible numerical range corresponds to the defined temperature range of −200 °C to +850 °C and ranges from −2000 to +8500 accordingly.

Table 26: ID 3, Setting Pt500 (IEC 751), Standard Format

Temperature °C	Resistance Ω	Numeric value [1]			Status byte hex.	Error LED
		Binary	Hex.	Dec.		
---	< 10.00	'1111.1000.0011.0000'	0xF830	−2000	0x50	ON
Short circuit [2]						
< −200.0	< 92.60	'1111.1000.0011.0000'	0xF830	−2000	0x41	ON
Underrange [3]						
−200.0	92.60	'1111.1000.0011.0000'	0xF830	−2000	0x00	OFF
−100.0	301.28	'1111.1100.0001.1000'	0xFC18	−1000	0x00	OFF
0.0	500.00	'0000.0000.0000.0000'	0x0000	0	0x00	OFF
100.0	692.53	'0000.0011.1110.1000'	0x03E8	1000	0x00	OFF
200.0	879.28	'0000.0111.1101.0000'	0x07D0	2000	0x00	OFF
500.0	1404.89	'0001.0011.1000.1000'	0x1388	5000	0x00	OFF
750.0	1803.19	'0001.1101.0100.1100'	0x1D4C	7500	0x00	OFF
800.0	1878.52	'0001.1111.0100.0000'	0x1F40	8000	0x00	OFF
850.0	1952.41	'0010.0001.0011.0100'	0x2134	8500	0x00	OFF
> 850.0	> 1952.41	'0010.0001.0011.0100'	0x2134	8500	0x42	ON
Overrange [3]						
---	> 5010.00	'0010.0001.0011.0100'	0x2134	8500	0x60	ON
Wire break [2]						

1) Temperature values below 0 °C are represented in two's complement binary.
2) When short circuit and wire break monitoring is ON (see section “Diagnostics” > “Behavior in the Event of an Error”)
3) When underrange / overrange limit is ON (see section “Diagnostics” > “Behavior in the Event of an Error”)

4.3.5.2 S5-FB250 Format

With the setting “Pt500 (IEC 751)” and activated S5-FB250 format, the I/O module converts the measured resistance values of Pt500 sensors (IEC 751) into temperature values and outputs the conversion results. The temperature values are displayed at a resolution of 1 digit per 0.5 °C.
The status information is depicted in bit 0 to bit 2 and the digitalized measured value in bit 3 to bit 15.

Table 27: ID 3, Setting Pt500 (IEC 751), S5-FB250 Format

Temperatur e °C	Resistance Ω	Numeric value [1] with status information [4]				Status byte hex.	Error LED
		Binary	XFÜ	Hex.	Dec.		
---	< 10.00	'1111.0011.1000.0	010'	0xF382	−3198	0x50	ON
Short circuit [2]							
< −200.0	< 92.60	'1111.0011.1000.0	001'	0xF381	−3199	0x41	ON
Underrange [3]							
−200.0	92.60	'1111.0011.1000.0	000'	0xF380	−3200	0x00	OFF
−100.0	301.28	'1111.1001.1100.0	000'	0xF9C0	−1600	0x00	OFF
0.0	500.00	'0000.0000.0000.0	000'	0x0000	0	0x00	OFF
100.0	692.53	'0000.0011.1110.1	000'	0x0640	1600	0x00	OFF
200.0	879.28	'0000.1100.1000.0	000'	0x0C80	3200	0x00	OFF
500.0	1404.89	'0001.1111.0100.0	000'	0x1F40	8000	0x00	OFF
750.0	1803.19	'0010.1110.1110.0	000'	0x2EE0	12000	0x00	OFF
800.0	1878.52	'0011.0010.0000.0	000'	0x3200	12800	0x00	OFF
850.0	1952.41	'0011.0101.0010.0	000'	0x3520	13600	0x00	OFF
> 850.0	> 1952.41	'0011.0101.0010.0	001'	0x3521	13601	0x42	ON
Overrange [3]							
---	> 5010.00	'0011.0101.0010.0	010'	0x3522	13602	0x60	ON
Wire break [2]							

1) Temperature values below 0 °C are represented in two's complement binary.
2) When short circuit and wire break monitoring is ON (see section “Diagnostics” > “Behavior in the Event of an Error”)
3) When underrange / overrange limit is ON (see section “Diagnostics” > “Behavior in the Event of an Error”)
4) Status information:
X: Not used,
F: Short circuit, wire break,
Ü: Underrange, overrange

4.3.6 Pt200 (IEC 751), ID 4

4.3.6.1 Default Format

With the setting “Pt200 (IEC 751)”, the I/O module converts the measured resistance values of Pt200 sensors (IEC 751) into temperature values and outputs the conversion results in degrees Celsius.
The temperature values are displayed at a resolution of 1 digit per 0.1 °C in one word (16-bit). Temperature values below 0 °C are represented in two's complement binary. As a result, 0 °C corresponds to the numeric value 0x0000 and 100 °C to the numeric value 0x03E8 (dec. 1000). The maximum number range viewable in one word in two's complement representation ranges from −32768 to +32767. The number range used depends on the sensor type set and the resolution of the process value. For the setting “Pt200 (IEC 751)”, the possible numerical range corresponds to the defined temperature range of −200 °C to +850 °C and ranges from −2000 to +8500 accordingly.

Table 28: ID 4, Setting Pt200 (IEC 751), Standard Format

Temperature °C	Resistance Ω	Numeric value [1]			Status byte hex.	Error LED
		Binary	Hex.	Dec.		
---	< 10.00	'1111.1000.0011.0000'	0xF830	−2000	0x50	ON
Short circuit [2]						
< −200.0	< 37.04	'1111.1000.0011.0000'	0xF830	−2000	0x41	ON
Underrange [3]						
−200.0	37.04	'1111.1000.0011.0000'	0xF830	−2000	0x00	OFF
−100.0	120.51	'1111.1100.0001.1000'	0xFC18	−1000	0x00	OFF
0.0	200.00	'0000.0000.0000.0000'	0x0000	0	0x00	OFF
100.0	277.01	'0000.0011.1110.1000'	0x03E8	1000	0x00	OFF
200.0	351.71	'0000.0111.1101.0000'	0x07D0	2000	0x00	OFF
500.0	561.96	'0001.0011.1000.1000'	0x1388	5000	0x00	OFF
750.0	721.28	'0001.1101.0100.1100'	0x1D4C	7500	0x00	OFF
800.0	751.41	'0001.1111.0100.0000'	0x1F40	8000	0x00	OFF
850.0	780.96	'0010.0001.0011.0100'	0x2134	8500	0x00	OFF
> 850.0	> 780.96	'0010.0001.0011.0100'	0x2134	8500	0x42	ON
Overrange [3]						
---	> 5010.00	'0010.0001.0011.0100'	0x2134	8500	0x60	ON
Wire break [2]						

1) Temperature values below 0 °C are represented in two's complement binary.
2) When short circuit and wire break monitoring is ON (see section “Diagnostics” > “Behavior in the Event of an Error”)
3) When underrange / overrange limit is ON (see section “Diagnostics” > “Behavior in the Event of an Error”)

4.3.6.2 S5-FB250 Format

With the setting “Pt200 (IEC 751)” and activated S5-FB250 format, the I/O module converts the measured resistance values of Pt200 sensors (IEC 751) into temperature values and outputs the conversion results.
The temperature values are displayed at a resolution of 1 digit per 0.5 °C.
The status information is depicted in bit 0 to bit 2 and the digitalized measured value in bit 3 to bit 15.

Table 29: ID 4, Setting Pt200 (IEC 751), S5-FB250 Format

Temperature °C	Resistance Ω	Numeric value [1] with status information [4]				Status byte hex.	Error LED
		Binary	XFÜ	Hex.	Dec.		
---	< 10.00	'1111.0011.1000.0	010'	0xF382	−3198	0x50	ON
Short circuit [2]							
< −200.0	< 37.04	'1111.0011.1000.0	001'	0xF381	−3199	0x41	ON
Underrange [3]							
−200.0	37.04	'1111.0011.1000.0	000'	0xF380	−3200	0x00	OFF
−100.0	120.51	'1111.1001.1100.0	000'	0xF9C0	−1600	0x00	OFF
0.0	200.00	'0000.0000.0000.0	000'	0x0000	0	0x00	OFF
100.0	277.01	'0000.0011.1110.1	000'	0x0640	1600	0x00	OFF
200.0	351.71	'0000.1100.1000.0	000'	0x0C80	3200	0x00	OFF
500.0	561.96	'0001.1111.0100.0	000'	0x1F40	8000	0x00	OFF
750.0	721.28	'0010.1110.1110.0	000'	0x2EE0	12000	0x00	OFF
800.0	751.41	'0011.0010.0000.0	000'	0x3200	12800	0x00	OFF
850.0	780.96	'0011.0101.0010.0	000'	0x3520	13600	0x00	OFF
> 850.0	> 780.96	'0011.0101.0010.0	001'	0x3521	13601	0x42	ON
Overrange [3]							
---	> 5010.00	'0011.0101.0010.0	010'	0x3522	13602	0x60	ON
Wire break [2]							

1) Temperature values below 0 °C are represented in two's complement binary.
2) When short circuit and wire break monitoring is ON (see section “Diagnostics” > “Behavior in the Event of an Error”)
3) When underrange / overrange limit is ON (see section “Diagnostics” > “Behavior in the Event of an Error”)
4) Status information:
X: Not used,
F: Short circuit, wire break,
Ü: Underrange, overrange

4.3.7 Ni1000 (TK6180, DIN 43760), ID 5

4.3.7.1 Default Format

With the setting “Ni1000 (TK6180, DIN 43760)”, the I/O module converts the measured resistance values of Ni1000 sensors (TK6180, DIN 43760) into temperature values and outputs the conversion results in degrees Celsius.
The temperature values are displayed at a resolution of 1 digit per 0.1 °C in one word (16-bit). Temperature values below 0 °C are represented in two's complement binary. As a result, 0 °C corresponds to the numeric value 0x0000 and 100 °C to the numeric value 0x03E8 (dec. 1000). The maximum number range viewable in one word in two's complement representation ranges from −32768 to +32767. The number range used depends on the sensor type set and the resolution of the process value. For the setting “Ni1000 (TK6180, DIN 43760)”, the possible numerical range corresponds to the defined temperature range of −60 °C to +250 °C and ranges from −600 to +2500 accordingly.

Table 30: ID 5, Setting Ni1000 (TK6180, DIN 43760), Standard Format

Temperature °C	Resistance Ω	Numeric value [1]			Status byte hex.	Error LED
		Binary	Hex.	Dec.		
---	< 10.00	'1111.1101.1010.1000'	0xFDA8	−600	0x50	ON
Short circuit [2]						
< −60.0	< 695.20	'1111.1101.1010.1000'	0xFDA8	−600	0x41	ON
Underrange [3]						
−60.0	695.20	'1111.1101.1010.1000'	0xFDA8	−600	0x00	OFF
−50.0	742.60	'1111.1110.0000.1100'	0xFE0C	−500	0x00	OFF
0.0	1000.00	'0000.0000.0000.0000'	0x0000	0	0x00	OFF
50.0	1291.10	'0000.0001.1111.0100'	0x01F4	500	0x00	OFF
100.0	1617.80	'0000.0011.1110.1000'	0x03E8	1000	0x00	OFF
150.0	1986.40	'0000.0101.1101.1100'	0x05DC	1500	0x00	OFF
200.0	2406.60	'0000.0111.1101.0000'	0x07D0	2000	0x00	OFF
250.0	2891.60	'0000.1001.1100.0100'	0x09C4	2500	0x00	OFF
> 250.0	> 2891.60	'0000.1001.1100.0100'	0x09C4	2500	0x42	ON
Overrange [3]						
---	> 5010.00	'0000.1001.1100.0100'	0x09C4	2500	0x60	ON
Wire break [2]						

1) Temperature values below 0 °C are represented in two's complement binary.
2) When short circuit and wire break monitoring is ON (see section “Diagnostics” > “Behavior in the Event of an Error”)
3) When underrange / overrange limit is ON (see section “Diagnostics” > “Behavior in the Event of an Error”)

4.3.7.2 S5-FB250 Format

With the setting “Ni1000 (TK6180, DIN 43760)” and activated S5-FB250 format, the I/O module converts the measured resistance values of Ni1000 sensors (TK6180, DIN 43760) into temperature values and outputs the conversion results. The temperature values are displayed at a resolution of 1 digit per 0.5 °C.
The status information is depicted in bit 0 to bit 2 and the digitalized measured value in bit 3 to bit 15.

Table 31: ID 5, Setting Ni1000 (TK6180, DIN 43760), S5-FB250 Format

Temperature °C	Resistance Ω	Numeric value [1] with status information [4]				Status byte hex.	Error LED
		Binary	XFÜ	Hex.	Dec.		
---	< 10.00	'1111.1100.0100.0	010'	0x FC42	−958	0x50	ON
Short circuit [2]							
< −60.0	< 695.20	'1111.1100.0100.0	001'	0x FC41	−959	0x41	ON
Underrange [3]							
−60.0	695.20	'1111.1100.0100.0	000'	0xFC40	−960	0x00	OFF
−50.0	742.60	'1111.1100.1110.0	000'	0xFCE0	−800	0x00	OFF
0.0	1000.00	'0000.0000.0000.0	000'	0x0000	0	0x00	OFF
50.0	1291.10	'0000.0011.0010.0	000'	0x0320	800	0x00	OFF
100.0	1617.80	'0000.0110.0100.0	000'	0x0640	1600	0x00	OFF
150.0	1986.40	'0000.1001.0110.0	000'	0x0960	2400	0x00	OFF
200.0	2406.60	'0000.1100.1000.0	000'	0x0C80	3200	0x00	OFF
250.0	2891.60	'0000.1111.1010.0	000'	0x0FA0	4000	0x00	OFF
> 250.0	> 2891.60	'0000.1111.1010.0	001'	0x0FA1	4001	0x42	ON
Overrange [3]							
---	> 5010.00	'0000.1111.1010.0	010'	0x0FA2	4002	0x60	ON
Wire break [2]							

1) Temperature values below 0 °C are represented in two's complement binary.
2) When short circuit and wire break monitoring is ON (see section “Diagnostics” > “Behavior in the Event of an Error”)
3) When underrange / overrange limit is ON (see section “Diagnostics” > “Behavior in the Event of an Error”)
4) Status information:
X: Not used,
F: Short circuit, wire break,
Ü: Underrange, overrange

4.3.8 Ni120 (Minco), ID 6

4.3.8.1 Default Format

With the setting “Ni120 (Minco)”, the I/O module converts the measured resistance values of Ni120 sensors (Minco) into temperature values and outputs the conversion results in degrees Celsius.
The temperature values are displayed at a resolution of 1 digit per 0.1 °C in one word (16-bit). Temperature values below 0 °C are represented in two's complement binary. As a result, 0 °C corresponds to the numeric value 0x0000 and 100 °C to the numeric value 0x03E8 (dec. 1000). The maximum number range viewable in one word in two's complement representation ranges from −32768 to +32767. The number range used depends on the sensor type set and the resolution of the process value. For the setting “Ni120 (Minco)”, the possible numerical range corresponds to the defined temperature range of −80 °C to +260 °C and ranges from −800 to +2600 accordingly.

Table 32: ID 6, Setting Ni120 (Minco), Standard Format

Temperature °C	Resistance Ω	Numeric value [1]			Status byte hex.	Error LED
		Binary	Hex.	Dec.		
---	< 10.00	'1111.1100.1110.0000'	0xFCE0	−800	0x50	ON
Short circuit [2]						
< −80.0	66.60	'1111.1100.1110.0000'	0xFCE0	−800	0x41	ON
Underrange [3]						
−80.0	66.60	'1111.1100.1110.0000'	0xFCE0	−800	0x00	OFF
−50.0	86.16	'1111.1110.0000.1100'	0xFE0C	−500	0x00	OFF
0.0	120.00	'0000.0000.0000.0000'	0x0000	0	0x00	OFF
50.0	157.75	'0000.0001.1111.0100'	0x01F4	500	0x00	OFF
100.0	200.64	'0000.0011.1110.1000'	0x03E8	1000	0x00	OFF
150.0	248.95	'0000.0101.1101.1100'	0x05DC	1500	0x00	OFF
200.0	303.45	'0000.0111.1101.0000'	0x07D0	2000	0x00	OFF
250.0	366.53	'0000.1001.1100.0100'	0x09C4	2500	0x00	OFF
260.0	380.31	'0000.1010.0010.1000'	0x0A28	2600	0x00	OFF
> 260.0	> 380.31	'0000.1010.0010.1000'	0x0A28	2600	0x42	ON
Overrange [3]						
---	> 5010.00	'0000.1010.0010.1000'	0x0A28	2600	0x60	ON
Wire break [2]						

1) Temperature values below 0 °C are represented in two's complement binary.
2) When short circuit and wire break monitoring is ON (see section “Diagnostics” > “Behavior in the Event of an Error”)
3) When underrange / overrange limit is ON (see section “Diagnostics” > “Behavior in the Event of an Error”)

4.3.8.2 S5-FB250 Format

With the setting “Ni120 (Minco)” and activated S5-FB250 format, the I/O module converts the measured resistance values of Ni120 sensors (Minco) into temperature values and outputs the conversion results. The temperature values are displayed at a resolution of 1 digit per 0.5 °C.
The status information is depicted in bit 0 to bit 2 and the digitalized measured value in bit 3 to bit 15.

Table 33: ID 6, Setting Ni120 (Minco), S5-FB250 Format

Temperature °C	Resistance Ω	Numeric value [1] with status information [4]				Status byte hex.	Error LED
		Binary	XFÜ	Hex.	Dec.		
---	< 10.00	'1111.1011.0000.0	010'	0xFB02	−1278	0x50	ON
Short circuit [2]							
< −80.0	66.60	'1111.1011.0000.0	001'	0xFB01	−1279	0x41	ON
Underrange [3]							
−80.0	66.60	'1111.1011.0000.0	000'	0xFB00	−1280	0x00	OFF
−50.0	86.16	'1111.1100.1110.0	000'	0xFCE0	−800	0x00	OFF
0.0	120.00	'0000.0000.0000.0	000'	0x0000	0	0x00	OFF
50.0	157.75	'0000.0011.0010.0	000'	0x0320	800	0x00	OFF
100.0	200.64	'0000.0110.0100.0	000'	0x0640	1600	0x00	OFF
150.0	248.95	'0000.1001.0110.0	000'	0x0960	2400	0x00	OFF
200.0	303.45	'0000.1100.1000.0	000'	0x0C80	3200	0x00	OFF
250.0	366.53	'0000.1111.1010.0	000'	0x0FA0	4000	0x00	OFF
260.0	380.31	'0001.0000.0100.0	000'	0x1040	4160	0x00	OFF
> 260.0	>380.31	'0001.0000.0100.0	001'	0x1041	4161	0x42	ON
Overrange [3]							
---	> 5010.00	'0001.0000.0100.0	010'	0x1042	4162	0x60	ON
Wire break [2]							

1) Temperature values below 0 °C are represented in two's complement binary.
2) When short circuit and wire break monitoring is ON (see section “Diagnostics” > „Behavior in the Event of an Error“)
3) When underrange / overrange limit is ON (see section “Diagnostics” > „Behavior in the Event of an Error“)
4) Status information:
X: Not used,
F: Short circuit, wire break,
Ü: Underrange, overrange

4.3.9 Ni1000 (TK5000), ID 7

4.3.9.1 Default Format

With the setting “Ni1000 (TK5000)”, the I/O module converts the measured resistance values of Ni1000 sensors (TK5000) into temperature values and outputs the conversion results in degrees Celsius.
The temperature values are displayed at a resolution of 1 digit per 0.1 °C in one word (16-bit). Temperature values below 0 °C are represented in two's complement binary. As a result, 0 °C corresponds to the numeric value 0x0000 and 100 °C to the numeric value 0x03E8 (dec. 1000). The maximum number range viewable in one word in two's complement representation ranges from −32768 to +32767. The number range used depends on the sensor type set and the resolution of the process value. For the setting “Ni1000 (TK5000)”, the possible numerical range corresponds to the defined temperature range of −60 °C to +250 °C and ranges from −600 to +2500 accordingly.

Table 34: ID 7, Setting Ni1000 (TK5000), Standard Format

Temperature °C	Resistance Ω	Numeric value [1]			Status byte hex.	Error LED
		Binary	Hex.	Dec.		
---	< 10.00	'1111.1101.1010.1000'	0xFDA8	−600	0x50	ON
Short circuit [2]						
< −60.0	< 751.79	'1111.1101.1010.1000'	0xFDA8	−600	0x41	ON
Underrange [3]						
−60.0	751.79	'1111.1101.1010.1000'	0xFDA8	−600	0x00	OFF
−50.0	790.88	'1111.1110.0000.1100'	0xFE0C	−500	0x00	OFF
0.0	1000.00	'0000.0000.0000.0000'	0x0000	0	0x00	OFF
50.0	1234.98	'0000.0001.1111.0100'	0x01F4	500	0x00	OFF
100.0	1500.00	'0000.0011.1110.1000'	0x03E8	1000	0x00	OFF
150.0	1799.27	'0000.0101.1101.1100'	0x05DC	1500	0x00	OFF
200.0	2136.96	'0000.0111.1101.0000'	0x07D0	2000	0x00	OFF
250.0	2517.27	'0000.1001.1100.0100'	0x09C4	2500	0x00	OFF
> 250.0	> 2517.27	'0000.1001.1100.0100'	0x09C4	2500	0x42	ON
Overrange [3]						
---	> 5010.00	'0000.1001.1100.0100'	0x09C4	2500	0x60	ON
Wire break [2]						

1) Temperature values below 0 °C are represented in two's complement binary.
2) When short circuit and wire break monitoring is ON (see section “Diagnostics” > „Behavior in the Event of an Error“)
3) When underrange / overrange limit is ON (see section “Diagnostics” > „Behavior in the Event of an Error“)

4.3.9.2 S5-FB250 Format

With the setting “Ni1000 (TK5000)” and activated S5-FB250 format, the I/O module converts the measured resistance values of Ni1000 sensors (TK5000) into temperature values and outputs the conversion results.
The temperature values are displayed at a resolution of 1 digit per 0.5 °C.
The status information is depicted in bit 0 to bit 2 and the digitalized measured value in bit 3 to bit 15.

Table 35: ID 7, Setting Ni1000 (TK5000), S5-FB250 Format

Temperature °C	Resistance Ω	Numeric value [1] with status information [4]				Status byte hex.	Error LED
		Binary	XFÜ	Hex.	Dec.		
---	< 10.00	'1111.1100.0100.0	010'	0x FC42	−958	0x50	ON
Short circuit [2]							
< −60.0	< 751.79	'1111.1100.0100.0	001'	0x FC41	−959	0x41	ON
Underrange [3]							
−60.0	751.79	'1111.1100.0100.0	000'	0xFC40	−960	0x00	OFF
−50.0	790.88	'1111.1100.1110.0	000'	0xFCE0	−800	0x00	OFF
0.0	1000.00	'0000.0000.0000.0	000'	0x0000	0	0x00	OFF
50.0	1234.98	'0000.0011.0010.0	000'	0x0320	800	0x00	OFF
100.0	1500.00	'0000.0110.0100.0	000'	0x0640	1600	0x00	OFF
150.0	1799.27	'0000.1001.0110.0	000'	0x0960	2400	0x00	OFF
200.0	2136.96	'0000.1100.1000.0	000'	0x0C80	3200	0x00	OFF
250.0	2517.27	'0000.1111.1010.0	000'	0x0FA0	4000	0x00	OFF
> 250.0	> 2517.27	'0000.1111.1010.0	001'	0x0FA1	4001	0x42	ON
Overrange [3]							
---	> 5010.00	'0000.1111.1010.0	010'	0x0FA2	4002	0x60	ON
Wire break [2]							

1) Temperature values below 0 °C are represented in two's complement binary.
2) When short circuit and wire break monitoring is ON (see section “Diagnostics” > „Behavior in the Event of an Error“)
3) When underrange / overrange limit is ON (see section “Diagnostics” > „Behavior in the Event of an Error“)
4) Status information:
X: Not used,
F: Short circuit, wire break,
Ü: Underrange, overrange

4.3.10 Ni1000 (TK6180, DIN 43760), high-resolution, ID 8

4.3.10.1 Default Format

With the setting “Ni1000 (TK6180, DIN 43760)”, the I/O module converts the measured resistance values of Ni1000 sensors (TK6180, DIN 43760) into temperature values and outputs the conversion results in degrees Celsius.
The temperature values are displayed at a resolution of 1 digit per 0.01 °C in one word (16-bit). Temperature values below 0 °C are represented in two's complement binary. As a result, 0 °C corresponds to the numeric value 0x0000 and 100 °C to the numeric value 0x2710 (dec. 1000).
The maximum number range viewable in one word in two's complement representation ranges from −32768 to +32767. The number range used depends on the sensor type set and the resolution of the process value. For the setting “Ni1000 (TK6180, DIN 43760)”, the possible numerical range corresponds to the defined temperature range of −50 °C to +150 °C and ranges from −5000 to +15000 accordingly.

Table 36: ID 8, Setting Ni1000 (TK6180, DIN 43760), Standard Format

Temperature °C	Resistance Ω	Numeric value [1]			Status byte hex.	Error LED
		Binary	Hex.	Dec.		
---	< 10.00	'1110.1100.0111.1000'	0xEC78	−5000	0x50	ON
Short circuit [2]						
< −50.0	< 742.56	'1110.1100.0111.1000'	0xEC78	−5000	0x41	ON
Underrange [3]						
−50.0	742.56	'1110.1100.0111.1000'	0xEC78	−5000	0x00	OFF
−25.0	867.04	'1111.0110.0011.1100'	0xF63C	−2500	0x00	OFF
0.0	1000.00	'0000.0000.0000.0000'	0x0000	0	0x00	OFF
50.0	1291.10	'0001.0011.1000.1000'	0x1388	5000	0x00	OFF
100.0	1617.80	'0010.0111.0001.0000'	0x2710	10000	0x00	OFF
125.0	1796.30	'0011.0000.1101.0100'	0x30D4	12500	0x00	OFF
150.0	1986.40	'0011.1010.1001.1000'	0x3A98	15000	0x00	OFF
> 150.0	> 1986.40	'0011.1010.1001.1000'	0x3A98	15000	0x42	ON
Overrange [3]						
---	> 5010.00	'0011.1010.1001.1000'	0x3A98	15000	0x60	ON
Wire break [2]						

1) Temperature values below 0 °C are represented in two's complement binary.
2) When short circuit and wire break monitoring is ON (see section “Diagnostics” > „Behavior in the Event of an Error“)
3) When underrange / overrange limit is ON (see section “Diagnostics” > „Behavior in the Event of an Error“)

4.3.10.2 S5-FB250 Format

With the setting “Ni1000 (TK6180, DIN 43760)” and activated S5-FB250 format, the I/O module converts the measured resistance values of Ni1000 sensors (DIN 43760) into temperature values and outputs the conversion results.
The temperature values are displayed at a resolution of 1 digit per 0.05 °C.
The status information is depicted in bit 0 to bit 2 and the digitalized measured value in bit 3 to bit 15.

Table 37: ID 8, Setting Ni1000 (DIN 43760), S5-FB250 Format

Temperature °C	Resistance Ω	Numeric value [1] with status information [4]				Status byte hex.	Error LED
		Binary	XFÜ	Hex.	Dec.		
---	< 10.00	'1110.0000.1100.0	010'	0xE0C2	−7998	0x50	ON
Short circuit [2]							
< −50.0	< 742.60	'1110.0000.1100.0	001'	0xE0C1	−7999	0x41	ON
Underrange [3]							
−50.0	742.60	'1110.0000.1100.0	000'	0xE0C0	−8000	0x00	OFF
−25.0	867.04	1111.0000.0110.0	000'	0xF060	−4000	0x00	OFF
0.0	1000.00	'0000.0000.0000.0	000'	0x0000	0	0x00	OFF
50.0	1291.10	'0001.1111.0100.0	000'	0x1F40	8000	0x00	OFF
100.0	1617.80	'0101.1101.1100.0	000'	0x3E80	16000	0x00	OFF
125.0	1796.30	'0100.1110.0010.0	000'	0x4E20	20000	0x00	OFF
150.0	1986.40	'0101.1101.1100.0	000'	0x5DC0	24000	0x00	OFF
> 150.0	> 1986.40	'0101.1101.1100.0	001'	0x5DC1	24001	0x42	ON
Overrange [3]							
---	> 5010.00	'0101.1101.1100.0	010'	0x5DC2	24002	0x60	ON
Wire break [2]							

1) Temperature values below 0 °C are represented in two's complement binary.
2) When short circuit and wire break monitoring is ON (see section “Diagnostics” > „Behavior in the Event of an Error“)
3) When underrange / overrange limit is ON (see section “Diagnostics” > „Behavior in the Event of an Error“)
4) Status information:
X: Not used,
F: Short circuit, wire break,
Ü: Underrange, overrange

4.3.11 Ni1000 (TK5000), high-resolution, ID 9

4.3.11.1 Default Format

With the setting “Ni1000 (TK5000)”, the I/O module converts the measured resistance values of Ni1000 sensors (TK5000) into temperature values and outputs the conversion results in degrees Celsius.
The temperature values are displayed at a resolution of 1 digit per 0.01 °C in one word (16-bit). Temperature values below 0 °C are represented in two's complement binary. As a result, 0 °C corresponds to the numeric value 0x0000 and 100 °C to the numeric value 0x2710 (dec. 10000).
The maximum number range viewable in one word in two's complement representation ranges from −32768 to +32767. The number range used depends on the sensor type set and the resolution of the process value. For the setting “Ni1000 (TK5000)”, the possible numerical range corresponds to the defined temperature range of −50 °C to +150 °C and ranges from −5000 to +15000 accordingly.

Table 38: ID 9, Setting Ni1000 (TK5000), Standard Format

Temperature °C	Resistance Ω	Numeric value [1]			Status byte hex.	Error LED
		Binary	Hex.	Dec.		
---	< 10.00	'1110.1100.0111.1000'	0xEC78	−5000	0x50	ON
Short circuit [2]						
< −50.0	< 790.88	'1110.1100.0111.1000'	0xEC78	−5000	0x41	ON
Underrange [3]						
−50.0	790.88	'1110.1100.0111.1000'	0xEC78	−5000	0x00	OFF
−25.0	892.47	'1111.0110.0011.1100'	0xF63C	−2500	0x00	OFF
0.0	1000.00	'0000.0000.0000.0000'	0x0000	0	0x00	OFF
50.0	1234.98	'0001.0011.1000.1000'	0x1388	5000	0x00	OFF
100.0	1500.00	'0010.0111.0001.0000'	0x2710	10000	0x00	OFF
125.0	1645.10	'0011.0000.1101.0100'	0x30D4	12500	0x00	OFF
150.0	1799.27	'0011.1010.1001.1000'	0x3A98	15000	0x00	OFF
> 150.0	> 1799.27	'0011.1010.1001.1000'	0x3A98	15000	0x42	ON
Overrange [3]						
---	> 5010.00	'0011.1010.1001.1000'	0x3A98	15000	0x60	ON
Wire break [2]						

1) Temperature values below 0 °C are represented in two's complement binary.
2) When short circuit and wire break monitoring is ON (see section “Diagnostics” > „Behavior in the Event of an Error“)
3) When underrange / overrange limit is ON (see section “Diagnostics” > „Behavior in the Event of an Error“)

4.3.11.2 S5-FB250 Format

With the setting “Ni1000 (TK5000)” and activated S5-FB250 format, the I/O module converts the measured resistance values of Ni1000 sensors (TK5000) into temperature values and outputs the conversion results.
The temperature values are displayed at a resolution of 1 digit per 0.05 °C.
The status information is depicted in bit 0 to bit 2 and the digitalized measured value in bit 3 to bit 15.

Table 39: ID 9, Setting Ni1000 (TK5000), S5-FB250 Format

Temperature °C	Resistance Ω	Numeric value [1] with status information [4]				Status byte hex.	Error LED
		Binary	XFÜ	Hex.	Dec.		
---	< 10.00	'1110.0000.1100.0	010'	0x E0C2	−7998	0x50	ON
Short circuit [2]							
< −50.0	< 790.88	'1110.0000.1100.0	001'	0x E0C1	−7999	0x41	ON
Underrange [3]							
−50.0	790.88	'1110.0000.1100.0	000'	0x E0C0	−8000	0x00	OFF
−25.0	892.47	'1111.0000.0110.0	000'	0xF060	−4000	0x00	OFF
0.0	1000.00	'0000.0000.0000.0	000'	0x0000	0	0x00	OFF
50.0	1234.98	'0001.1111.0100.0	000'	0x1F40	8000	0x00	OFF
100.0	1500.00	'0011.1110.1000.0	000'	0x3E80	16000	0x00	OFF
125.0	1645.10	'0100.1110.0010.0	000'	0x4E20	20000	0x00	OFF
150.0	1799.27	'0101.1101.1100.0	000'	0x5DC0	24000	0x00	OFF
> 150.0	> 1799.27	'0101.1101.1100.0	001'	0x5DC1	24001	0x42	ON
Overrange [3]							
---	> 5010.00	'0101.1101.1100.0	010'	0x5DC2	24002	0x60	ON
Wire break [2]							

1) Temperature values below 0 °C are represented in two's complement binary.
2) When short circuit and wire break monitoring is ON (see section “Diagnostics” > „Behavior in the Event of an Error“)
3) When underrange / overrange limit is ON (see section “Diagnostics” > „Behavior in the Event of an Error“)
4) Status information:
X: Not used,
F: Short circuit, wire break,
Ü: Underrange, overrange

4.3.12 Pt1000 (IEC 751), high-resolution, ID 10

4.3.12.1 Default Format

With the setting “Pt1000 (IEC 751)”, the I/O module converts the measured resistance values of Pt1000 sensors (IEC 751) into temperature values and outputs the conversion results in degrees Celsius.
The temperature values are displayed at a resolution of 1 digit per 0.01 °C in one word (16-bit). Temperature values below 0 °C are represented in two's complement binary. As a result, 0 °C corresponds to the numeric value 0x0000 and 100 °C to the numeric value 0x2710 (dec. 10000).
The maximum number range viewable in one word in two's complement representation ranges from −32768 to +32767. The number range used depends on the sensor type set and the resolution of the process value. For the setting “Pt1000 (IEC 751)”, the possible numerical range corresponds to the defined temperature range of −50 °C to +150 °C and ranges from −5000 to +15000 accordingly.

Table 40: ID 10, Setting Pt1000 (IEC 751), Standard Format

Temperature °C	Resistance Ω	Numeric value [1]			Status byte hex.	Error LED
		Binary	Hex.	Dec.		
---	< 10.00	'1110.1100.0111.1000'	0xEC78	−5000	0x50	ON
Short circuit [2]						
< −50.0	< 803.06	'1110.1100.0111.1000'	0xEC78	−5000	0x41	ON
Underrange [3]						
−50.0	803.06	'1110.1100.0111.1000'	0xEC78	−5000	0x00	OFF
−25.0	901.92	'1111.0110.0011.1100'	0xF63C	−2500	0x00	OFF
0.0	1000.00	'0000.0000.0000.0000'	0x0000	0	0x00	OFF
25.0	1097.35	'0000.1001.1100.0100'	0x09C4	2500	0x00	OFF
50.0	1193.97	'0001.0011.1000.1000'	0x1388	5000	0x00	OFF
75.0	1289.87	'0001.1101.0100.1100'	0x1D4C	7500	0x00	OFF
100.0	1385.06	'0010.0111.0001.0000'	0x2710	10000	0x00	OFF
125.0	1479.51	'0011.0000.1101.0100'	0x30D4	12500	0x00	OFF
150.0	1573.25	'0011.1010.1001.1000'	0x3A98	15000	0x00	OFF
> 150.0	> 1573.25	'0011.1010.1001.1000'	0x3A98	15000	0x42	ON
Overrange [3]						
---	> 5010.00	'0011.1010.1001.1000'	0x3A98	15000	0x60	ON
Wire break [2]						

1) Temperature values below 0 °C are represented in two's complement binary.
2) When short circuit and wire break monitoring is ON (see section “Diagnostics” > „Behavior in the Event of an Error“)
3) When underrange / overrange limit is ON (see section “Diagnostics” > „Behavior in the Event of an Error“)

4.3.12.2 S5-FB250 Format

With the setting “Pt1000 (IEC 751)” and activated S5-FB250 format, the I/O module converts the measured resistance values of Pt1000 sensors (IEC 751) into temperature values and outputs the conversion results.
The temperature values are displayed at a resolution of 1 digit per 0.05 °C.
The status information is depicted in bit 0 to bit 2 and the digitalized measured value in bit 3 to bit 15.

Table 41: ID 10, Setting Pt1000 (IEC 751), S5-FB250 Format

Temperature °C	Resistance Ω	Numeric value [1] with status information [4]				Status byte hex.	Error LED
		Binary	XFÜ	Hex.	Dec.		
---	< 10.00	'1110.0000.1100.0	010'	0xE0C2	−7998	0x50	ON
Short circuit [2]							
< −50.0	< 803.06	'1110.0000.1100.0	001'	0xE0C1	−7999	0x41	ON
Underrange [3]							
−50.0	803.06	'1110.0000.1100.0	000'	0xE0C0	−8000	0x00	OFF
−25.0	901.92	'1111.0000.0110.0	000'	0xF060	−4000	0x00	OFF
0.0	1000.00	'0000.0000.0000.0	000'	0x0000	0	0x00	OFF
25.0	1097.35	0000.1111.1010.0	000'	0x0FA0	4000	0x00	OFF
50.0	1193.97	'0001.1111.0100.0	000'	0x1F40	8000	0x00	OFF
75.0	1289.87	'0010.1110.1110.0	000'	0x2EE0	12000	0x00	OFF
100.0	1385.06	'0011.1110.1000.0	000'	0x3E80	16000	0x00	OFF
125.0	1479.51	'0100.1110.0010.0	000'	0x4E20	20000	0x00	OFF
150.0	1573.25	0101.1101.1100.0	000'	5DC0	24000	0x00	OFF
> 150.0	> 1573.25	0101.1101.1100.0	001'	5DC1	24001	0x42	ON
Overrange [3]							
---	> 5010.00	0101.1101.1100.0	010'	5DC2	24002	0x60	ON
Wire break [2]							

1) Temperature values below 0 °C are represented in two's complement binary.
2) When short circuit and wire break monitoring is ON (see section “Diagnostics” > „Behavior in the Event of an Error“)
3) When underrange / overrange limit is ON (see section “Diagnostics” > „Behavior in the Event of an Error“)
4) Status information:
X: Not used,
F: Short circuit, wire break,
Ü: Underrange, overrange

4.3.13 Resistance Measurement 1, 0 Ohm … 5.0 kOhm, ID 14

Note

No short-circuit detection for resistance measurements!
For sensor types “Resistance measurement 1” and “Resistance measurement 2”, short-circuit detection is not technically possible.

4.3.13.1 Default Format

With the setting “Resistance measurement 1" (0 Ohm to 5.0 kOhm), the I/O module outputs the measured resistance values of the sensors directly.
The resistance values are displayed at a resolution of 1 digit per 0.2 Ω in one word (16-bit). The maximum number range viewable in one word in two's complement representation ranges from −32768 to +32767. The number range used depends on the sensor type set and the resolution of the process value. For the setting “Resistance measurement 1”, the possible numerical range corresponds to the defined measuring range of 0 Ohm to 5.0 kOhm and ranges from 0 to +25000 accordingly.

Table 42: ID 14, Setting “Resistance measurement 1”, Standard Format

Resistance Ω	Numeric value [1]			Status byte hex.	Error LED
	Binary	Hex.	Dec.		
0	'0000.0000.0000.0000'	0x0000	0	0x00	OFF
100	'0000.0001.1111.0100'	0x01F4	500	0x00	OFF
200	'0000.0011.1110.1000'	0x03E8	1000	0x00	OFF
300	'0000.0101.1101.1100'	0x05DC	1500	0x00	OFF
1000	'0001.0011.1000.1000'	0x1388	5000	0x00	OFF
2000	'0010.0111.0001.0000'	0x2710	10000	0x00	OFF
3000	'0011.1010.1001.1000'	0x3A98	15000	0x00	OFF
4000	'0100.1110.0010.0000'	0x4E20	20000	0x00	OFF
5000	'0110.0001.1010.1000'	0x61A8	25000	0x00	OFF
> 5000	'0110.0001.1010.1000'	0x61A8	25000	0x42	ON
Overrange [3]					
> 5010	'0110.0001.1010.1000'	0x61A8	25000	0x62	ON
Wire break [2]					

1) Temperature values below 0 °C are represented in two's complement binary.
2) When short circuit and wire break monitoring is ON (see section “Diagnostics” > „Behavior in the Event of an Error“)
3) When underrange / overrange limit is ON (see section “Diagnostics” > „Behavior in the Event of an Error“)

4.3.13.2 S5-FB250 Format

With the setting “Resistance measurement 1” (0 Ohm to 5.0 kOhm) and activated S5-FB250 format, the I/O module outputs the measured resistance values of the sensors directly.
The resistance values are displayed at a resolution of 1 digit per 4 Ohm. The status information is depicted in bit 0 to bit 2 and the digitalized measured value in bit 3 to bit 15.

Table 43: ID 14, Setting “Resistance measurement 1”, S5-FB250 Format

Resistance Ω	Numeric value with status information [3]				Status byte hex.	Error LED
	Binary	XFÜ	Hex.	Dec.		
0	'0000.0000.0000.0	000'	0x0000	0	0x00	OFF
100	'0000.0000.1100.1	000'	0x00C8	200	0x00	OFF
200	'0000.0001.1001.0	000'	0x0190	400	0x00	OFF
300	'0000.0010.0101.1	000'	0x0258	600	0x00	OFF
1000	'0000.0111.1101.0	000'	0x07D0	2000	0x00	OFF
2000	'0000.1111.1010.0	000'	0x0FA0	4000	0x00	OFF
3000	'0001.0111.0111.0	000'	0x1770	6000	0x00	OFF
4000	'0001.1111.0100.0	000'	0x1F40	8000	0x00	OFF
5000	'0010.0111.0001.0	000'	0x2710	10000	0x00	OFF
> 5000 Overrange [2]	'0010.0111.0001.0	001'	0x2711	10001	0x42	ON
> 5010 Wire break[1]	'0010.0111.0001.0	010'	0x2712	10002	0x60	ON

1) When short circuit and wire break monitoring is ON (see section “Diagnostics” > „Behavior in the Event of an Error“)
2) When underrange / overrange limit is ON (see section “Diagnostics” > „Behavior in the Event of an Error“)
3) Status information:
X: Not used,
F: Short circuit, wire break,
Ü: Underrange, overrange

4.3.14 Resistance Measurement 2, 0 Ohm … 1.2 kOhm, ID 15

Note

No short-circuit detection for resistance measurements!
For sensor types “Resistance measurement 1” and “Resistance measurement 2”, short-circuit detection is not technically possible.

4.3.14.1 Default Format

With the setting “Resistance measurement 2” (0 Ohm to 1.2 kOhm), the I/O module outputs the measured resistance values of the sensors directly.
The resistance values are displayed at a resolution of 1 digit per 0.05 Ω in one word (16-bit). The maximum number range viewable in one word in two's

complement representation ranges from −32768 to +32767. The number range used depends on the sensor type set and the resolution of the process value. For the setting “Resistance measurement 2”, the possible numerical range corresponds to the defined measuring range of 0 Ohm to 1.2 kOhm and ranges from 0 to +24000 accordingly.

Table 44: ID 15, Setting “Resistance measurement 2”, Standard Format

Resistance Ω	Numeric value			Status byte hex.	Error LED
	Binary	Hex.	Dec.		
0	'0000.0000.0000.0000'	0x0000	0	0x00	OFF
100	'0000.0111.1101.0000'	0x7D0	2000	0x00	OFF
200	'0000.1111.1010.0000'	0x0FA0	4000	0x00	OFF
300	'0001.0111.0111.0000'	0x1770	6000	0x00	OFF
400	'0001.1111.0100.0000'	0x1F40	8000	0x00	OFF
500	'0010.0111.0001.0000'	0x2710	10000	0x00	OFF
750	'0011.1010.1001.1000'	0x3A98	15000	0x00	OFF
1000	'0100.1110.0010.0000'	0x4E20	20000	0x00	OFF
1200	'0101.1101.1100.0000'	0x5DC0	24000	0x00	OFF
> 1200 Overrange [2]	'0101.1101.1100.0000'	0x5DC0	24000	0x42	ON
> 5010 Wire break[1]	'0101.1101.1100.0000'	0x5DC0	24000	0x60	ON

1) When short circuit and wire break monitoring is ON (see section “Diagnostics” > „Behavior in the Event of an Error“)
2) When underrange / overrange limit is ON (see section “Diagnostics” > „Behavior in the Event of an Error“)

4.3.14.2 S5-FB250 Format

With the setting “Resistance measurement 2” (0 Ohm to 1.2 kOhm) and activated S5-FB250 format, the I/O module outputs the measured resistance values of the sensors directly.
The resistance values are displayed at a resolution of 1 digit per 0.5 Ohm. The status information is depicted in bit 0 to bit 2 and the digitalized measured value in bit 3 to bit 15.

Table 45: ID 15, Setting “Resistance measurement 2”, S5-FB250 Format

Resistance Ω	Numeric value with status information [3]				Status byte hex.	Error LED
	Binary	XFÜ	Hex.	Dec.		

0	'0000.0000.0000.0	000'	0x0000	0	0x00	OFF
100	'0000.0110.0100.0	000'	0x0640	1600	0x00	OFF
200	'0000.1100.1000.0	000'	0x0C80	3200	0x00	OFF
300	'0001.0010.1100.0	000'	0x12C0	4800	0x00	OFF
400	'0001.1001.0000.0'	000'	0x1900	6400	0x00	OFF
500	'0001.1111.0100.0	000'	0x1F40	8000	0x00	OFF
750	'0010.1110.1110.0	000'	0x2EE0	12000	0x00	OFF
1000	'0011.1110.1000.0	000'	0x3E80	16000	0x00	OFF
1200	'0100.1011.0000.0	000'	0x4B00	19200	0x00	OFF
> 1200	'0100.1011.0000.0	001'	0x4B01	19201	0x42	ON
Overrange [2]						
> 5010	'0100.1011.0000.0	010'	0x4B02	19202	0x60	ON
Wire break [1]						

1) When short circuit and wire break monitoring is ON (see section “Diagnostics” > „Behavior in the Event of an Error“)
2) When underrange / overrange limit is ON (see section “Diagnostics” > „Behavior in the Event of an Error“)
3) Status information:
X: Not used,
F: Short circuit, wire break,
Ü: Underrange, overrange

5 Mounting

5.1 Mounting Sequence

Fieldbus couplers/controllers and I/O modules of the WAGO-I/O-SYSTEM 750/753 are snapped directly on a carrier rail in accordance with the European standard EN 50022 (DIN 35).

The reliable positioning and connection is made using a tongue and groove system. Due to the automatic locking, the individual devices are securely seated on the rail after installation.

Starting with the fieldbus coupler/controller, the I/O modules are mounted adjacent to each other according to the project design. Errors in the design of the node in terms of the potential groups (connection via the power contacts) are recognized, as the I/O modules with power contacts (blade contacts) cannot be linked to I/O modules with fewer power contacts.

⚠ CAUTION

Risk of injury due to sharp-edged blade contacts!
The blade contacts are sharp-edged. Handle the I/O module carefully to prevent injury.

NOTICE

Insert I/O modules only from the proper direction!
All I/O modules feature grooves for power jumper contacts on the right side. For some I/O modules, the grooves are closed on the top. Therefore, I/O modules featuring a power jumper contact on the left side cannot be snapped from the top. This mechanical coding helps to avoid configuration errors, which may destroy the I/O modules. Therefore, insert I/O modules only from the right and from the top.

Note

Don't forget the bus end module!
Always plug a bus end module 750-600 onto the end of the fieldbus node! You must always use a bus end module at all fieldbus nodes with WAGO-I/O-SYSTEM 750 fieldbus couplers/controllers to guarantee proper data transfer.

5.2 Inserting and Removing Devices

NOTICE

Perform work on devices only if they are de-energized!
Working on energized devices can damage them. Therefore, turn off the power supply before working on the devices.

5.2.1 Inserting the I/O Module

1. Position the I/O module so that the tongue and groove joints to the fieldbus coupler/controller or to the previous or possibly subsequent I/O module are engaged.

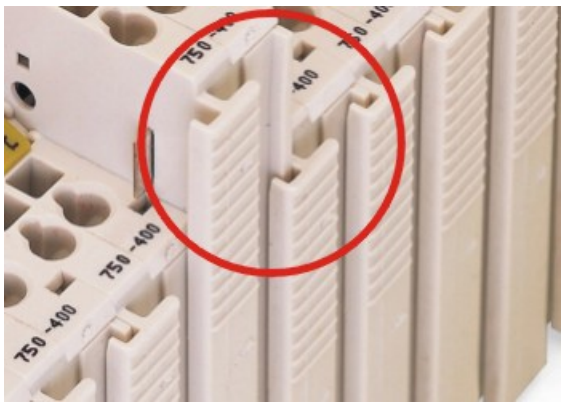


Figure 7: Insert I/O Module (Example)

2. Press the I/O module into the assembly until the I/O module snaps into the carrier rail.

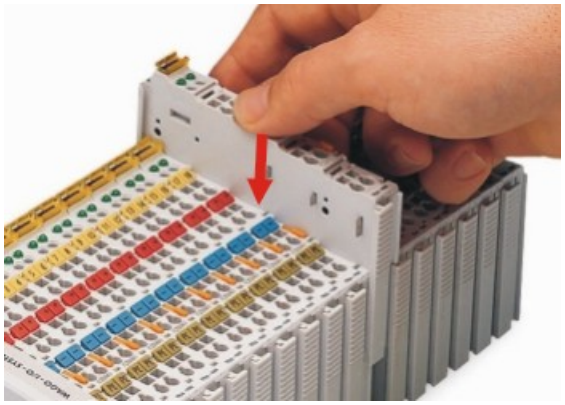


Figure 8: Snap the I/O Module into Place (Example)

With the I/O module snapped in place, the electrical connections for the data contacts and power jumper contacts (if any) to the fieldbus coupler/controller or to the previous or possibly subsequent I/O module are established.

5.2.2 Removing the I/O Module

1. Remove the I/O module from the assembly by pulling the release tab.

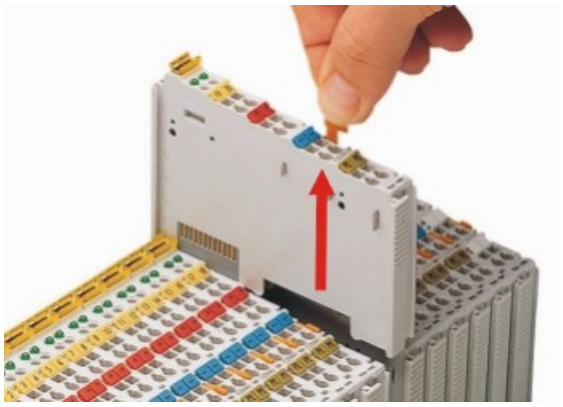


Figure 9: Removing the I/O Module (Example)

Electrical connections for data or power jumper contacts are disconnected when removing the I/O module.

6 Connect Devices

6.1 Connecting a Conductor to the Push-in CAGE CLAMP®

The Push-in CAGE CLAMP® connection is appropriate for solid, stranded and finely stranded conductors.

Note

Only connect one conductor to each Push-in CAGE CLAMP® connection!
Only one conductor may be connected to each Push-in CAGE CLAMP® connection.
Do not connect more than one conductor at one single connection!

If more than one conductor must be routed to one connection, these must be connected in an up-circuit wiring assembly, for example using WAGO feed-through terminals.

Terminate both solid and stranded or ferruled conductors by simply pushing them in - no tool required. For all other types of conductors, Push-in CAGE CLAMP® must be opened for connection with an operating tool with a 2.5 mm blade (order no. 210-719).

1. To open the Push-in CAGE CLAMP® insert the actuating tool into the opening above the connection.

2. Insert the conductor into the corresponding connection opening.

3. To close the Push-in CAGE CLAMP® simply remove the tool - the conductor is then clamped firmly in place.

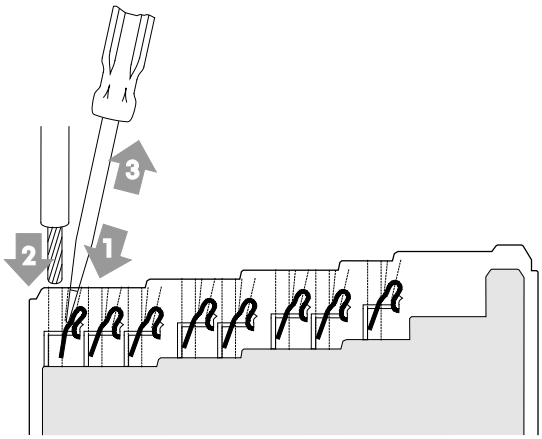


Figure 10: Connecting a Conductor to a Push-in CAGE CLAMP®

6.2 Connection Examples

6.2.1 8 × 2-wire

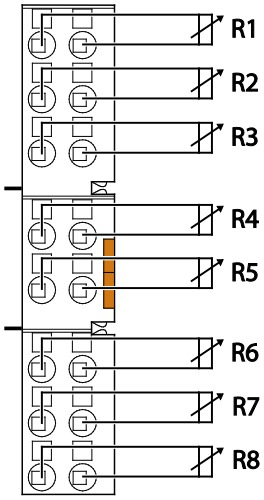


Figure 11: Connection Example, 750-451, 8-Channel, 8 × 2-Wire

7 Commissioning

7.1 Parameterization via Register Communication

The operating mode and the parameters for the 750-451 I/O module can be set directly using the register communication.

The values for channel 1 are set via control and status bytes CH1_C0/CH1_S0 for the addressing and via data bytes CH1_D0 and CH1_D1 for the transmission of the values to be set.

Note

Enter password!
Before writing to the user register 32 and following, “0x1235” must be written to the password register 31.
The number of user registers depends on the I/O module used.

Bits 0 ... 5 of the control byte receive the register number.
Via bit 6 (R/W) of the control byte, the access direction (read/write) is set.
To switch ON register communication, bit 7 (Reg_Com) is set to “1” in the control byte.

Note

No access to process data during register communication!
During register communication, process data cannot be accessed! Resulting process data that may be displayed will be invalid!

The values to be set are written to output data bytes CH1_D0 und CH1_D1.
Via the input data bytes CH_1D0 and CH1_D1, the set values can be read from the I/O module.

Note

Checking of the values set!
After writing the register, the set values can be checked by reading out the register.

The corresponding bits of the control byte are mirrored in bits 0 ... 5 and 7 of the status byte.

Note

Do not forget: reset password!
After writing to the registers, password register 31 must be reset with “0x0000” Otherwise write access to these registers is possible until the supply voltage is disconnected.

Channels 2 … 8 are set similar to channel 1 (see chapter “Process Image” > “Overview”):

- Channel 2 via control and status bytes CH2_C1/CH2_S1 and data bytes CH2_D0 and CH2_D1
- Channel 3 via control and status bytes CH3_C2/CH3_S2 and data bytes CH3_D0 and CH3_D1
- Channel 4 via control and status bytes CH4_C3/CH4_S3 and data bytes CH4_D0 and CH4_D1
- Channel 5 via control and status bytes CH5_C4/CH5_S4 and data bytes CH5_D0 and CH5_D1
- Channel 6 via control and status bytes CH6_C5/CH6_S5 and data bytes CH6_D0 and CH6_D1
- Channel 7 via control and status bytes CH7_C6/CH7_S6 and data bytes CH7_D0 and CH7_D1
- Channel 8 via control and status bytes CH8_C7/CH8_S7 and data bytes CH8_D0 and CH8_D1

7.1.1 Register Assignment

Table 46: Register 6

Register	Function	Memory	Access	Default setting
6	**Diagnostics**	**RAM**	**R**	**–**
Bit 0: Underrange				
0	The resistance or temperature value calculated by the I/O module is above the lower temperature/resistance limit.			
1	The resistance or temperature value calculated by the I/O module is below the lower temperature/resistance limit.			
Bit 1: Overrange				
0	The resistance or temperature value calculated by the I/O module is below the upper temperature/resistance limit.			
1	The resistance or temperature value calculated by the I/O module is above the upper temperature/resistance limit.			
Bit 2: User limiting value underrange				
0	The resistance or temperature value calculated by the I/O module is above the lower temperature/resistance limit parameterized by the user.			
1	The resistance or temperature value calculated by the I/O module is below the lower temperature/resistance limit parameterized by the user.			
Bit 3: User limiting value overrange				
0	The resistance or temperature value calculated by the I/O module is below the upper temperature/resistance limit parameterized by the user.			
1	The resistance or temperature value calculated by the I/O module is above the upper temperature/resistance limit parameterized by the user.			
Bit 4: Short circuit				
0	”Indicate short circuit” is OFF or there is no short circuit.			
1	”Indicate short circuit” is ON and there is a short circuit.			
Bit 5: Wire break				
0	”Indicate wire break” is OFF or there is no wire break.			
1	”Indicate wire break” is ON and there is a wire break.			
Bit 6: Group error				
0	There is no error or bit 0, bit 1, bit 4 and/or bit 5 is/are not set.			
1	General error			
Bit 7 … 15: free				

Table 47: Register 32

Register	Function	Memory	Access	Default setting
32	**Mode setting**	**EEPROM**	**R/W**	**0x0008**
Bit 0: Number notation				
0*	Numeric values appear in two's complement.			
1	Numeric values appear in amount / sign format.			
Bit 1: S5-FB250 output format				
0*	Numeric values appear in standard format.			
1	Numeric values appear in S5-FB250 format.			
Bit 2: Watchdog timer (internal data bus)				
0*	The Watchdog timer is enabled.			
1	The Watchdog timer is not enabled. The status LEDs light up continuously.			
Bit 3 … 4: Notch filter setting				
0*	The Notch filter is not enabled (100 Hz).			
1	Notch filter (50 Hz)			
2	Notch filter (60 Hz)			
3	Notch filter (50/60 Hz)			

*) Default setting

Table 48: Register 35

Register	Function	Memory	Access	Default setting
35	**Channel configuration**	**EEPROM**	**R/W**	**0xFF10**

Bit 0 … 3: Sensor				
Value	**Sensor type**	**Standard**	**Measuring range**	**Resolution**
0*	Pt100	IEC 751	–200 °C … 850 °C	0.1 °C
1	Ni100	DIN 43760	–60 °C … 250 °C	0.1 °C
2	Pt1000	IEC 751	–200 °C … 850 °C	0.1 °C
3	Pt500	IEC 751	–200 °C … 850 °C	0.1 °C
4	Pt200	IEC 751	–200 °C … 850 °C	0.1 °C
5	Ni1000	TK 61180 DIN 43760	–60 °C … 250 °C	0.1 °C
6	Ni120	Minco	–80 °C … 260 °C	0.1 °C
7	Ni1000	TK 5000 (Landis+Staefa)	–60 °C … 250 °C	0.1 °C
8	Ni1000	TK 6180 DIN 43760	–50 °C … 150 °C	0.01 °C
9	Ni1000	TK 5000 (Landis+Staefa)	–50 °C … 150 °C	0.01 °C
10	Pt1000	IEC 751	–50 °C … 150 °C	0.01 °C
11	Reserved for expansions			
12	Reserved for expansions			
13	Reserved for expansions			
14	Resistance measurement 1		0 Ohm … 5 kOhm	0.2 Ohm
15	Resistance measurement 2		0 Ohm … 1.2 kOhm	0.05 Ohm

Bit 4 … 5: Selection of the operating mode	
0	Channel disabled
1*	2-wire
Bit 6: Selection of the calibration data	
0*	Manufacturer calibration
1	User calibration
Bit 7: Activation of user scaling	
0*	User scaling disabled
1	User scaling enabled
Bit 8: Diagnosis, underrange	
0	Diagnostics disabled
1*	Diagnostics enabled
Bit 9: Diagnosis, overrange	
0	Diagnostics disabled
1*	Diagnostics enabled
Bit 10: Diagnosis, user limiting value underrange	
0	Diagnostics disabled
1*	Diagnostics enabled

Register	Function	Memory	Access	Default setting
35	**Channel configuration**	**EEPROM**	**R/W**	**0xFF10**
Bit 11: Diagnosis, user limiting value overrange				
0	Diagnostics disabled			
1*	Diagnostics enabled			
Bit 12: Diagnosis, short circuit				
0	Diagnostics disabled			
1*	Diagnostics enabled			
Bit 13: Diagnosis, wire break				
0	Diagnostics disabled			
1*	Diagnostics enabled			
Bit 14: Group error				
0	Diagnostics disabled			
1*	Diagnostics enabled			
Bit 15: Global enable and disable diagnostic functions				
0	Diagnostics disabled			
1*	Diagnostics enabled			

*) Default setting

Table 49: Register 36

Register	Function		Memory	Access	Default setting
36	**Line resistance**		**EEPROM**	**R/W**	**0x0000**
Bit 0 … 15: Line resistance					
0 … 65535	Value range (raw), decimal, 16-bit unsigned integer				
0 … FFFF	Value range (raw), hexadecimal, 16-bit unsigned integer				
0 … 65.535	Value range (scaled), decimal, 16-bit unsigned integer				
	Resolution:	1/1000			
	Unit	Ohm			
	Equation:	R = R(raw) – Reg37			

Table 50: Register 37

Register	Function		Memory	Access	Default setting
37	**User calibration Offset**		**EEPROM**	**R/W**	**0x0000**
Bit 0 … 15: User scaling Offset					
–32768 … 32767	Value range (raw), decimal, 16-bit integer				
8000 … 7FFF	Value range (raw), hexadecimal, 16-bit integer				
–262144 … 262136	Value range (scaled), decimal, 16-bit integer				
FFFC0000 … 03FFF8	Value range (scaled), hexadecimal, 16-bit integer				
	Resolution:	8			
	Unit	–			
	Equation:	Raw value(corr) = ((raw value(ADC) × Reg38) / 32768) × (Reg37 × 8)			
The user calibration is enabled if bit 6 in register 35 is not set.					

Table 51: Register 38

Register	Function	Memory	Access	Default setting
38	**User calibration Gain**	**EEPROM**	**R/W**	**0x8000**
Bit 0 … 15: User calibration Gain				
0 … 65535	Value range (raw), decimal, 16-bit unsigned integer			
0000 … FFFF	Value range (raw), hexadecimal, 16-bit unsigned integer			
0 …	Value range (scaled), decimal, 16-bit unsigned integer			
	Resolution:	1/32768		
	Unit	–		
	Equation:	Raw value(corr) = ((raw value(ADC) × Reg38) / 32768) × (Reg37 × 8)		
The user calibration is enabled if bit 6 in register 35 is set.				

Table 52: Register 39

Register	Function	Memory	Access	Default setting
39	**User scaling Offset**	**EEPROM**	**R/W**	**0x0000**
Bit 0 … 15: User scaling Offset				
–32768 … 32767	Value range (raw), decimal, 16-bit integer			
8000 … 7FFF	Value range (raw), hexadecimal, 16-bit integer			
–262144 … 262136	Value range (scaled), decimal, 16-bit integer			
FFFC0000 … 03FFF8	Value range (scaled), hexadecimal, 16-bit integer			
	Resolution:	1/32768		
	Unit	–		
	Equation*:	y2 = ((y1 × Reg40) / 256**) + Reg39		
User scaling is enabled if bit 7 is set in register 35.				

*) y1= unscaled process value
y2= scaled process value
**) Gain Divisor = set to 256 by default, cannot be changed

Table 53: Register 40

Register	Function	Memory	Access	Default setting
40	**User scaling Gain**	**EEPROM**	**R/W**	**0x0100**
Bit 0 … 15: User scaling Gain				
0 … 65535	Value range (raw), decimal, 16-bit unsigned integer			
0000 … FFFF	Value range (raw), hexadecimal, 16-bit unsigned integer			
0 … 65535	Value range (scaled), decimal, 16-bit unsigned integer			
0000 … FFFF	Value range (scaled), hexadecimal, 16-bit unsigned integer			
	Resolution:	1		
	Unit	–		
	Equation*:	y2 = ((y1 × Reg40) / 256**) + Reg39		
User scaling is enabled if bit 7 is set in register 35.				

*) y1= unscaled process value
y2= scaled process value
**) Gain Divisor = set to 256 by default, cannot be changed

Table 54: Register 41

Register	Function	Memory	Access	Default setting
41	**User scaling Divisor**	**EEPROM**	**R**	**0x0100*****
Bit 0 … 15: User scaling Divisor				
0 … 65535	Value range (raw), decimal, 16-bit unsigned integer			
0000 … FFFF	Value range (raw), hexadecimal, 16-bit unsigned integer			
0 … 65535	Value range (scaled), decimal, 16-bit unsigned integer			
0000 … FFFF	Value range (scaled), hexadecimal, 16-bit unsigned integer			
	Resolution:	1		
	Unit	–		
	Equation*:	y2 = ((y1 × Reg40) / 256**) + Reg39		
User scaling is enabled if bit 7 is set in register 35.				

*) y1= unscaled process value
y2= scaled process value
**) Gain Divisor = set to 256 by default, cannot be changed
***) This value cannot be changed

Table 55: Register 42

Register	Function	Memory	Access	Default setting
42	**Lower user limit value**	**EEPROM**	**R/W**	**0x8000**
Bit 0 … 15: Lower user limit value				
–32768 … 32767	Value range (raw), decimal, 16-bit integer			
8000 … 7FFF	Value range (raw), hexadecimal, 16-bit integer			
Value range depending on the sensor type set (see chapter “Process Data” “Overview of Sensor Types”)	Value range (scaled), decimal, 16-bit unsigned integer			
	Value range (scaled), hexadecimal, 16-bit unsigned integer			
	Resolution:	1		
	Unit	–		
This register contains the lower user limit value. The resistance/temperature value calculated by the I/O module is compared to the limiting value entered by the user. If the resistance/temperature value calculated by the I/O module falls below the value entered here, the I/O modules signals a limiting value underrange. The scaling of the value to be entered here depends on the sensor type set.				
Diagnostics for the lower user limit value is enabled if bit 10 in register 35 is set.				

Table 56: Register 43

Register	Function	Memory	Access	Default setting
43	**Upper user limit value**	**EEPROM**	**R/W**	**0x7FFF**
Bit 0 … 15: Upper user limit value				
–32768 … 32767	Value range (raw), decimal, 16-bit integer			
8000 … 7FFF	Value range (raw), hexadecimal, 16-bit integer			
Value range depending on the sensor type set (see chapter “Process Data” > “Overview of Sensor Types”)	Value range (scaled), decimal, 16-bit unsigned integer			
	Value range (scaled), hexadecimal, 16-bit unsigned integer			
	Resolution:	1		
	Unit	–		
This register contains the upper user limit value. The resistance/temperature value calculated by the I/O module is compared to the limiting value entered by the user. If the resistance/temperature value calculated by the I/O module exceeds the value entered here, the I/O modules signals a limiting value overrange. The scaling of the value to be entered here depends on the sensor type set.				
Diagnostics for the upper user limit value is enabled if bit 11 in register 35 is set.				

7.1.2 Control and Status Bytes during Register Communication

The following tables show the assignment of the control and status bytes for register communication. Control and status bytes are implemented identically for all channels. Therefore, the following description in this chapter is representative for all control and status bytes of the I/O module.

With the bits 0 ... 5 and 7 in the respective status byte, register communication is acknowledged by the I/O module.

Table 57: Control Byte CH1_C0 During Register Communication

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Reg_Com	**R/W**	**Register number**					
Register number	Register number of the selected function (see chapter “Startup” > “Register Assignment”)						
R/W	0:	Read access					
	1:	Write access					
Reg_Com	1:	Register communication					

Table 58: Status Byte CH1_S0 During Register Communication

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Reg_Com	**R/W**	**Register number**					
Register number	Register number of the selected function (see chapter “Startup” > “Register Assignment”), mirrored from control byte CH1_C0						
R/W	0:	Read access (acknowledgement)					
Reg_Com	1:	Register communication, mirrored from control byte CH1_C0					

7.2 Parameterization with WAGO-I/O-*CHECK*

The WAGO-I/O-*CHECK* software from WAGO Kontakttechnik GmbH & Co. KG can be used to conveniently and completely configure and parameterize the I/O module. You have the following options:

- Graphical representation of the bus node
- Display of the measured values
- Settings for the application
- Configuration of the I/O module operating modes
- Parameterization of module settings, configuration of channel and scaling settings, calibration of measurement channels
- Monitoring

Note

WAGO-I/O-*CHECK*

You can obtain the WAGO-I/O-*CHECK* software on a CD under Item No. 759-302. This CD contains all the application program files and an explanation. You can find a description at the internet page at http://www.wago.com

Note

Save your settings before you start the parameterization!
Before you start the parameterization, you should backup your current settings to a parameter file. This way, in case the parameters are wrong, you can always fall back on the original values.

In order to open specific parameterization dialogs for the I/O module, proceed as follows:

1.Right click on the I/O module.

2. Select the **Settings** menu item (see following figure

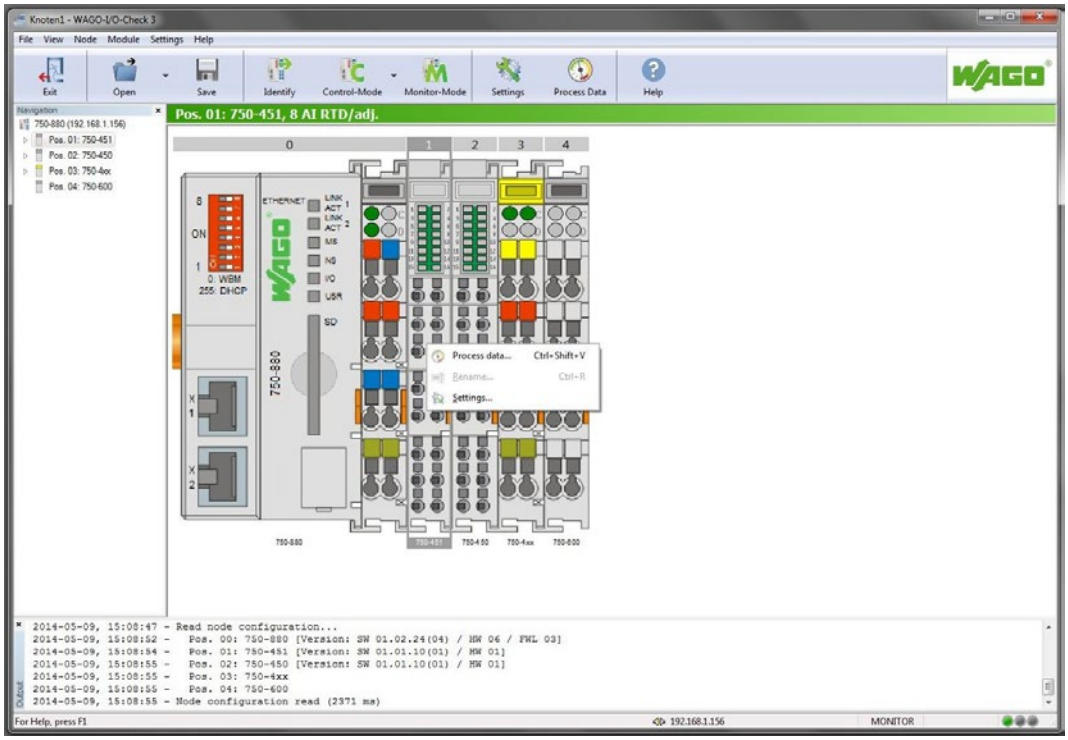


Figure 12: WAGO-I/O-*CHECK* User Interface

The configuration dialog appears, which forms the basis for the following description. This forms the basis for the subsequent explanation.

7.2.1 Parameterization Dialog

The parameterization dialog is divided into the following areas:

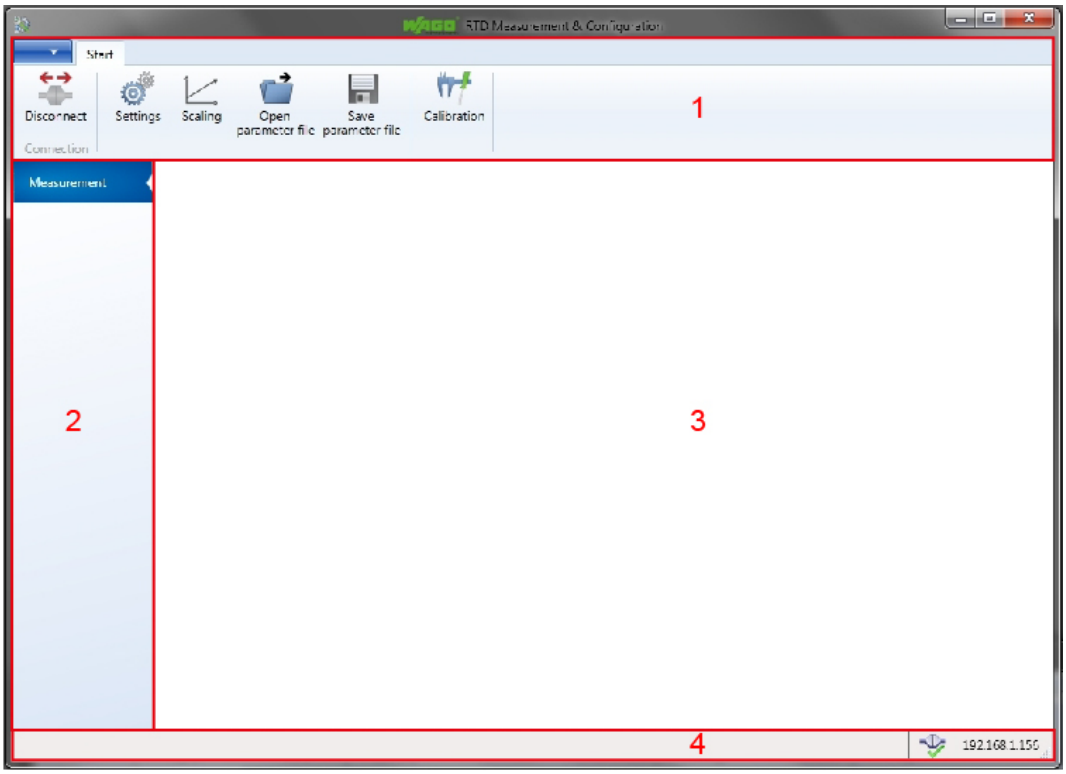


Figure 13: Parameterization Dialog for the I/O Module

1 Toolbar

2 Navigation bar

3 Application area

4 Status bar

These areas will be explained in more detail in the following sections.

7.2.1.1 Toolbar

The toolbar is divided into the following areas in the parameterization dialog for the I/O module:

- Main menu
- Application menu

7.2.1.1.1 Main Menu

The toolbar in the main menu contains the following buttons:

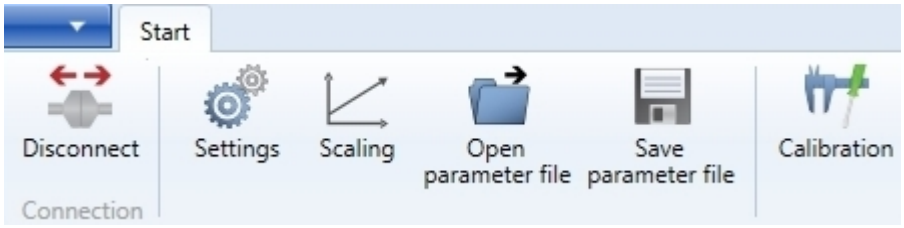
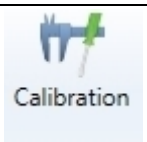


Figure 14: Buttons in the Main Menu

Table 59: Buttons on the Main Menu

Button	Function	Description
	**[Disconnect]**	Interrupts an existing connection to the I/O module
	**[Connect]**	Establishes a connection to the I/O module
	**[Settings]**	Opens the dialog for parameterization of the module and channel settings
	**[Scaling]**	Opens the dialog for configuring the scaling settings
	**[Open parameter file]**	Opens an existing parameter file, WAGO-I/O-*CHECK* displays the standard dialog for opening files.
	**[Save parameter file]**	Saves all read parameters to a parameter file with the exception of the calibration settings, WAGO-I/O-*CHECK* displays the standard dialog for saving files.
	**[Calibration]**	Opens the dialog for calibrating measurement channels

7.2.1.1.2 Application Menu

The application menu is called up via the blue button to the left in the toolbar, and contains the following buttons:

Figure 15: Buttons in the Application Menu

Table 60: Buttons in the Application Menu

Button	Function	Description
Help	**[Help]**	Opens the manual for I/O module 750-451 in PDF format
About	**[About]**	Opens the information dialog
Exit	**[Exit]**	Closes the parameterization dialog

7.2.1.2 Navigation Area

The navigation area in the parameterization dialog contains one button.

- “Measured values” menu item

Clicking on one of the buttons in the main menu opens a new window that also contains a navigation area.

The navigation area in the “Settings” menu item contains new buttons.

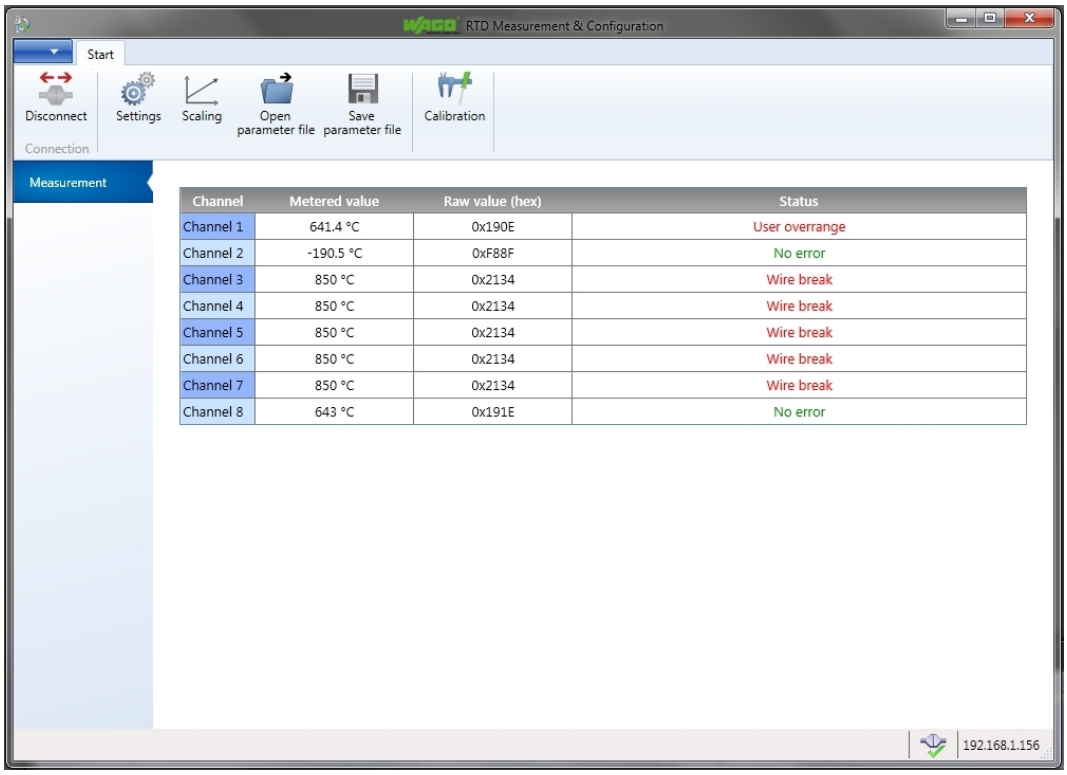
- “Module” menu item
- “Channel 1” menu item
- “Channel 2” menu item
- “Channel 3” menu item
- “Channel 4” menu item
- “Channel 5” menu item
- “Channel 6” menu item
- “Channel 7” menu item
- “Channel 8” menu item

The navigation area in the “Scaling” and “Calibration” menu items contains eight buttons.

- “Channel 1” menu item
- “Channel 2” menu item
- “Channel 3” menu item
- “Channel 4” menu item
- “Channel 5” menu item
- “Channel 6” menu item
- “Channel 7” menu item
- “Channel 8” menu item

7.2.1.3 Application Area

All channels of the I/O module are displayed individually in an overview. The overview provides information about the number of channels of the I/O module used. You can read the measured value, raw value and error status for each channel.



Channel	Metered value	Raw value (hex)	Status
Channel 1	641.4 °C	0x190E	User overrange
Channel 2	-190.5 °C	0xF88F	No error
Channel 3	850 °C	0x2134	Wire break
Channel 4	850 °C	0x2134	Wire break
Channel 5	850 °C	0x2134	Wire break
Channel 6	850 °C	0x2134	Wire break
Channel 7	850 °C	0x2134	Wire break
Channel 8	643 °C	0x191E	No error

Figure 16: Display of Measured Values in the Application Area

7.2.1.3.1 “Settings” Menu Item

In this menu item, you can parameterize the module settings under “Module” in the navigation area on the left side.

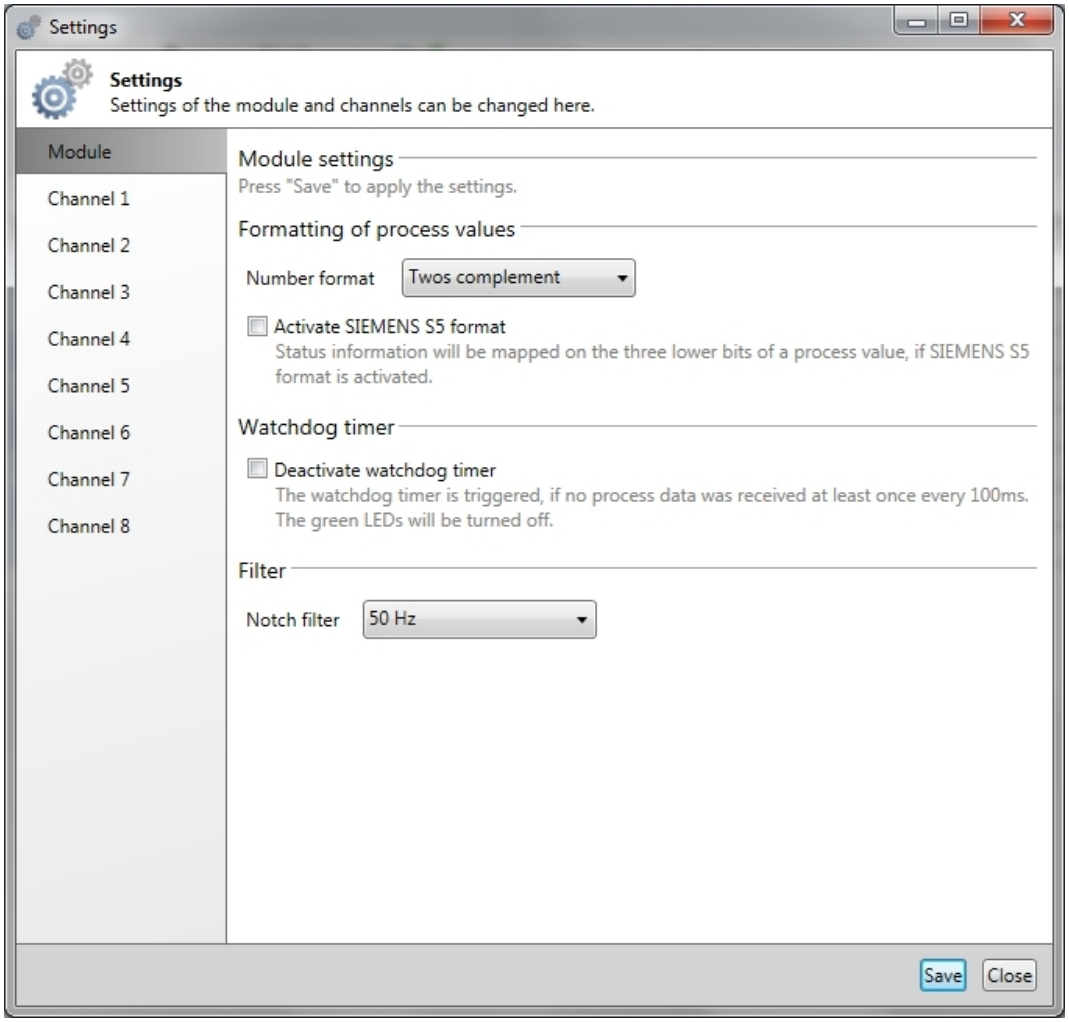


Figure 17: “Settings” > “Module” Menu Item

Table 61: “Settings” > “Module” Menu Item

Option	Description			
Formatting of process values				
Number format	Two's complement representation			
	Amount/sign representation			
Use SIEMENS S5 format	☑	The SIEMENS S5 format is enabled. Display of status indicators in the bottom three bits:		
		Bit 0: Overflow. Set for overrange/underrange (if overrange/underrange is enabled)	Bit 1: Error. Set for wire break/short circuit (if “Indicate wire break/short circuit” is enabled).	Bit 2: Always 0.
	☐	The SIEMENS S5 format is disabled. No display of status indicators.		
Watchdog Timer				
Disable Watchdog timer	☑	The “Disable Watchdog timer” option is enabled. The green LEDs illuminate continuously.		
	☐	The “Disable Watchdog timer” option is disabled. If no process data is exchange with the bus coupler for 100 ms, the green LEDs go out.		
Filter selection				
disabled	The Notch filter is disabled.			
50 Hz	The Notch filter is disabled (50 Hz)			
60 Hz	The Notch filter is disabled (60 Hz)			
50/60 Hz	The Notch filter is disabled (50/60 Hz)			

Note

Changing the process value resolution in Siemens S5 format!
The resolution of the process value is changed by enabling SIEMENS S5 format. Specific information about resolutions is available in chapter "Process Data" > “Overview of Sensor Types”.

The settings for each individual channel can be made under the “Channel 1” to “Channel 8” menu items in the navigation area. The setting options for each channel are identical. Therefore, the description of "Channel 1" menu item is representative of all channels.

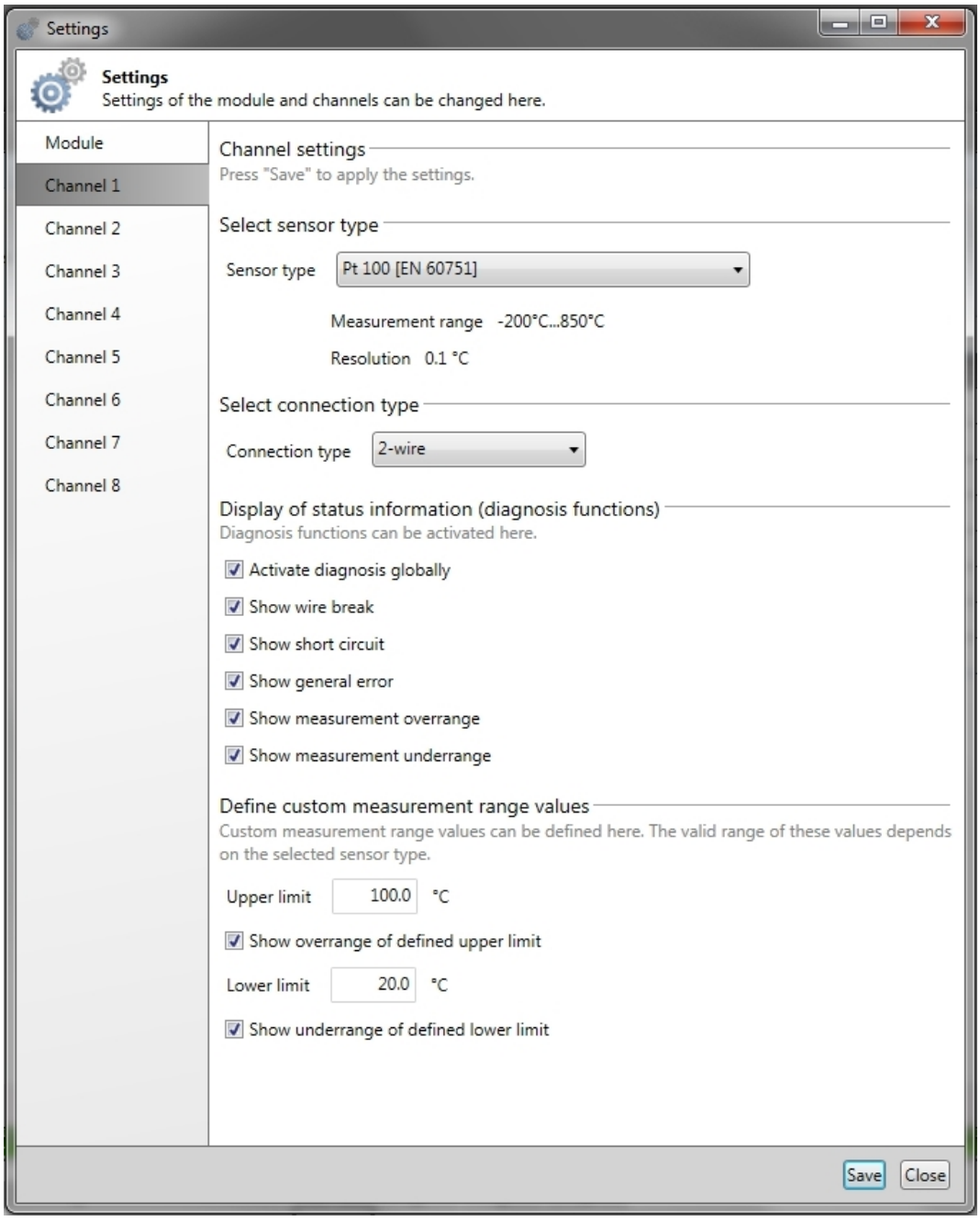


Figure 18: “Settings” Menu Item

Table 62: “Settings” Menu Item

Option	Description		
Sensor type selection			
Sensor type	Ni100 [DIN 43760]		These sensor types can be selected per channel.
	Ni120 [Minco]		
	Ni1000 [TK 61180, DIN 43760]	−50 C … 150 °C	
		−60 °C … 250 °C	
	Ni1000 [TK 5000 (Landis+Staefa)]	−50 °C … 150 °C	
		−60 °C … 250 °C	
	Pt100 [IEC 751]		
	Pt200 [IEC 751]		
	Pt500 [IEC 751]		
	Pt1000 [IEC 751]	−200 C … 850 °C	
		−50 C … 150 °C	
	Resistance measurement 1		
	Resistance measurement 2		
Connection type selection			
Connection type	Disabled		The channel is disabled.
	2-wire		The channel uses 2-wire connection technology.
Display of status information (diagnostic functions)			
Global enable diagnostic functions	☑		The diagnostic functions are enabled globally and are indicated in the status byte. At least one of the following diagnostic functions must also be individually enabled again.
	☐		The diagnostic functions are disabled globally.
Indicate wire break	☑		The “Wire break” diagnostic function is enabled and indicated in the status byte.
	☐		The “Wire break” diagnostic function is not indicated.
Indicate short circuit	☑		The “Short circuit” diagnostic function is enabled and indicated in the status byte.
	☐		The “Short circuit” diagnostic function is not indicated.
Indicate group error	☑		The “Group error (general error)” diagnostic function is enabled and indicated in the status byte.
	☐		The “Group error” diagnostic function is not indicated.
Indicate measuring range overflow	☑		The “Measuring range overflow” diagnostic function is enabled and indicated in the status byte.
	☐		The “Measuring range overflow” diagnostic function is not indicated.
Indicate measuring range underflow	☑		The “Measuring range underflow” diagnostic function is enabled and indicated in the status byte.
	☐		The “Measuring range underflow” diagnostic function is not indicated.

Specifying your own limits	
Upper limiting value	You can specify the upper limiting value you require. The information is given in °C or Ohm depending on the sensor type set.
Indicate overflow of the specified upper limiting value	☑ The “Limiting value overrange” diagnostic function is enabled and indicated in the status byte. The overrange of the value entered by you under “Upper limiting value” is indicated.
	☑ The “Limiting value overrange” diagnostic function is not indicated.
Lower limiting value	You can specify the lower limiting value you require. The information is given in °C or Ohm depending on the sensor type set.
Indicate underflow of the specified lower limiting value	☑ The “Limiting value underrange” diagnostic function is enabled and indicated in the status byte. The underrange of the value entered by you under “Lower limiting value” is indicated.
	☑ The “Limiting value underrange” diagnostic function is not indicated.

Note

No short-circuit detection for resistance measurements!

For sensor types “Resistance measurement 1” and “Resistance measurement 2”, short-circuit detection is not technically possible.

7.2.1.3.2 “Scaling” Menu Item

In this menu item, you can parameterize the scaling settings.

Note

Select the required channel!
Before proceeding with the following scaling settings, first select the required channel in the navigation area!

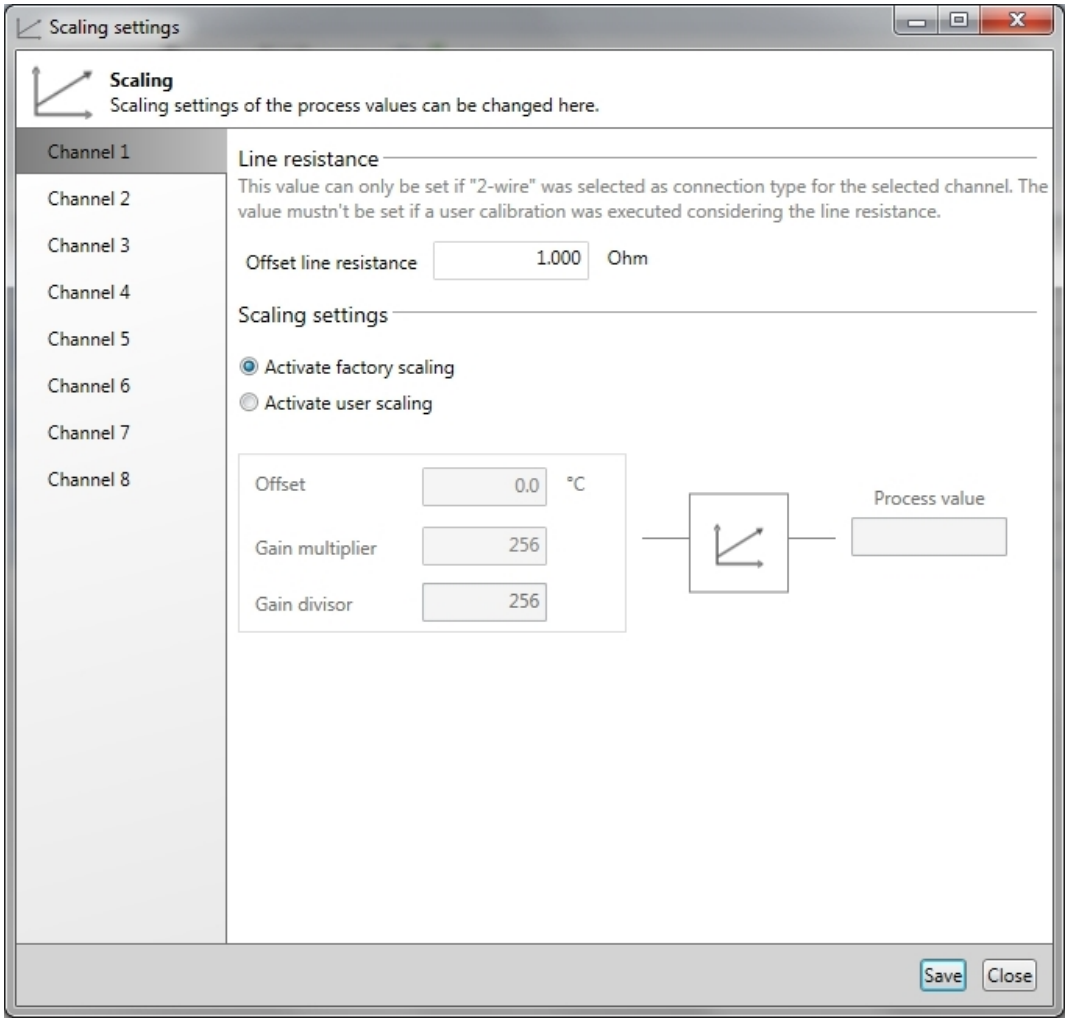


Figure 19: “Scaling” Menu Item

Table 63: “Scaling” > “Channel 1 …8” Menu Item

Option	Description
Line resistance	
Offset line resistance	Enter the line resistance to be observed when calculating the measured values.

Table 63: “Scaling” > “Channel 1 …8” Menu Item

Option	Description
Scaling settings	
Enable manufacturer scaling	☑ Manufacturer scaling is enabled. Manufacturer-side scaling is applied. The gain multiplier, gain divisor and offset cannot be entered individually.
	☐ Manufacturer scaling is disabled.
Enable user scaling	☑ User scaling is enabled. By enabling user scaling, the gain multiplier and offset can be specified individually.
	☐ User scaling is disabled.
Offset	The offset value moves the zero point of the unscaled process value (offset on the y axis).
Gain multiplier	The gain multiplier changes the slope factor of the unscaled process value.
Gain divisor	The gain divisor determines the resolution of the gain multiplier. The gain divisor is 256 by default.
Process value	The process value is the resistance or temperature value resulting from the temperature or resistance measurement. The process value is given in °C or Ohm depending on the sensor type set.

The user has the option of scaling the measured values calculated by the I/O module. A linear equation is applied to the sensor-specific measurement variable:

- y2 = ((y1 × Reg40) / Reg41) + Reg39

The variables are assigned as follows:

- y2= scaled process value
- y1= unscaled process value
- Reg40= gain multiplier
- Reg41= gain divisor = set to 256 by default
- Reg39= scaling offset

The gain multiplier and scaling offset values are required for user scaling. After entering both factors, you receive a scaled process value as the result. The gain divisor determines the resolution of the gain multiplier. The gain divisor is set to 256 by default.

7.2.1.3.3 Application Examples of Scaling

- **Example with the “Pt100 (IEC 751)” setting**

  How to calculate the scaled process value is described below. The equation for calculating the scaled process value with the “Sensor type Pt100 (IEC 751)” setting in standard format with corresponding variables is:

  ((Unscaled process value × gain multiplier) / 256) + scaling offset = scaled process value in °C

Example:
((20 °C × 512) / 256) + 20 = 60 °C

Other example calculations for the “Pt100 (IEC 751)” sensor type in standard format are available in the table below.

Table 64: Examples of a Scaled Process Value, Standard Format, Pt100 (IEC 751)

Gain multiplier	Scaling offset in °C	Scaled process value		
		at 20 °C*	at 30 °C*	at 40.2 °C*
256 (1**)	0	20 °C	30 °C	40.2 °C
256 (1**)	10	30 °C	40 °C	50.2 °C
384 (1.5**)	15	45 °C	60 °C	75.3 °C
512 (2**)	20	60 °C	80 °C	100.4 °C
640 (2.5**)	20	70 °C	95 °C	120.5 °C

*) Unscaled process value
**) Multiplier (= gain multiplier/gain divisor)

Other example calculations for the “Pt100 (IEC 751)” sensor type in S5-FB250 format are available in the table below.

Table 65: Examples of a Scaled Process Value, S5-FB250 Format, Pt100 (IEC 751)

Gain multiplier	Scaling offset in °C	Scaled process value		
		at 20 °C*	at 30 °C*	at 40.2 °C*
256 (1**)	0	20 °C	30 °C	40 °C
256 (1**)	10	30 °C	40 °C	50 °C
384 (1.5**)	15	45 °C	60 °C	75.5 °C
512 (2**)	20	60 °C	80 °C	100.5 °C
640 (2.5**)	20	70 °C	95 °C	120.5 °C

*) Unscaled process value
**) Multiplier (= gain multiplier/gain divisor)

- **Example with "Resistance measurement 2" setting**

  The equation for calculating the scaled process value with the “Sensor type Resistance measurement 2” setting in standard format with corresponding variables is:

  ((Unscaled process value × gain multiplier) / 256) + scaling offset = scaled process value in Ohm

  Example:
  ((100°Ohm × 384) / 256) + 15 = 165 Ohm

Other example calculations for the “Resistance measurement 2” sensor type in standard format are available in the table below.

Table 66: Examples of a Scaled Process Value, Standard Format, Resistance measurement 2

Gain multiplier	Scaling offset in Ohm	Scaled process value		
		at 100 Ohm*	at 155 Ohm*	at 300.2 Ohm*
256 (1**)	0	100 Ohm	155 Ohm	300.2 Ohm
256 (1**)	10	110 Ohm	165 Ohm	310.2 Ohm
384 (1.5**)	15	165 Ohm	247.5 Ohm	465.3 Ohm
512 (2**)	20	220 Ohm	330 Ohm	620.4 Ohm
640 (2.5**)	20	270 Ohm	407.5 Ohm	770.5 Ohm

*) Unscaled process value
**) Multiplier (= gain multiplier/gain divisor)

Other example calculations for the “Resistance measurement 2” sensor type in S5-FB250 format are available in the table below.

Table 67: Examples of a scaled process value, S5-FB250 Format, Resistance measurement 2

Gain multiplier	Scaling offset in Ohm	Scaled process value		
		at 100 Ohm*	at 155 Ohm*	at 300.2 Ohm*
256 (1**)	0	100 Ohm	155 Ohm	300.0 Ohm
256 (1**)	10	110 Ohm	165 Ohm	310.0 Ohm
384 (1.5**)	15	165 Ohm	247.5 Ohm	465.5 Ohm
512 (2**)	20	220 Ohm	330 Ohm	620.5 Ohm
640 (2.5**)	20	270 Ohm	407.5 Ohm	770.5 Ohm

*) Unscaled process value
**) Multiplier (= gain multiplier/gain divisor)

7.2.1.3.4 “Open Parameter File” Menu Item

In this menu item, you can open and load an existing parameter file. Please proceed as follows:

1. Click the **[Open parameter file]** button in the main menu.
2. A standard Windows dialog appears to select the source directory.
3. Select the parameter file you want to open.
4. Click **[Open]** in the standard Windows dialog.
5. The parameter file is opened.

7.2.1.3.5 “Save Parameter File” Menu Item

Note

Important note!
Please note that the calibration settings are not saved in the parameter file.

In this menu item, you can save the changes you selected and made to a parameter file. Please proceed as follows:

1. Click the **[Save parameter file]** button in the main menu.
2. A standard Windows dialog appears to select the target directory.
3. Select the target directory to which the new parameter file should be saved.
4. Click **[Save]** in the standard Windows dialog.
5. The parameter file is saved to the target directory you selected.

7.2.1.3.6 “Calibration” Menu Item

In this menu item, you can calibrate the channels of the I/O module.

Note

Select the required channel!
Before proceeding with the following calibration settings, first select the required channel in the navigation area!

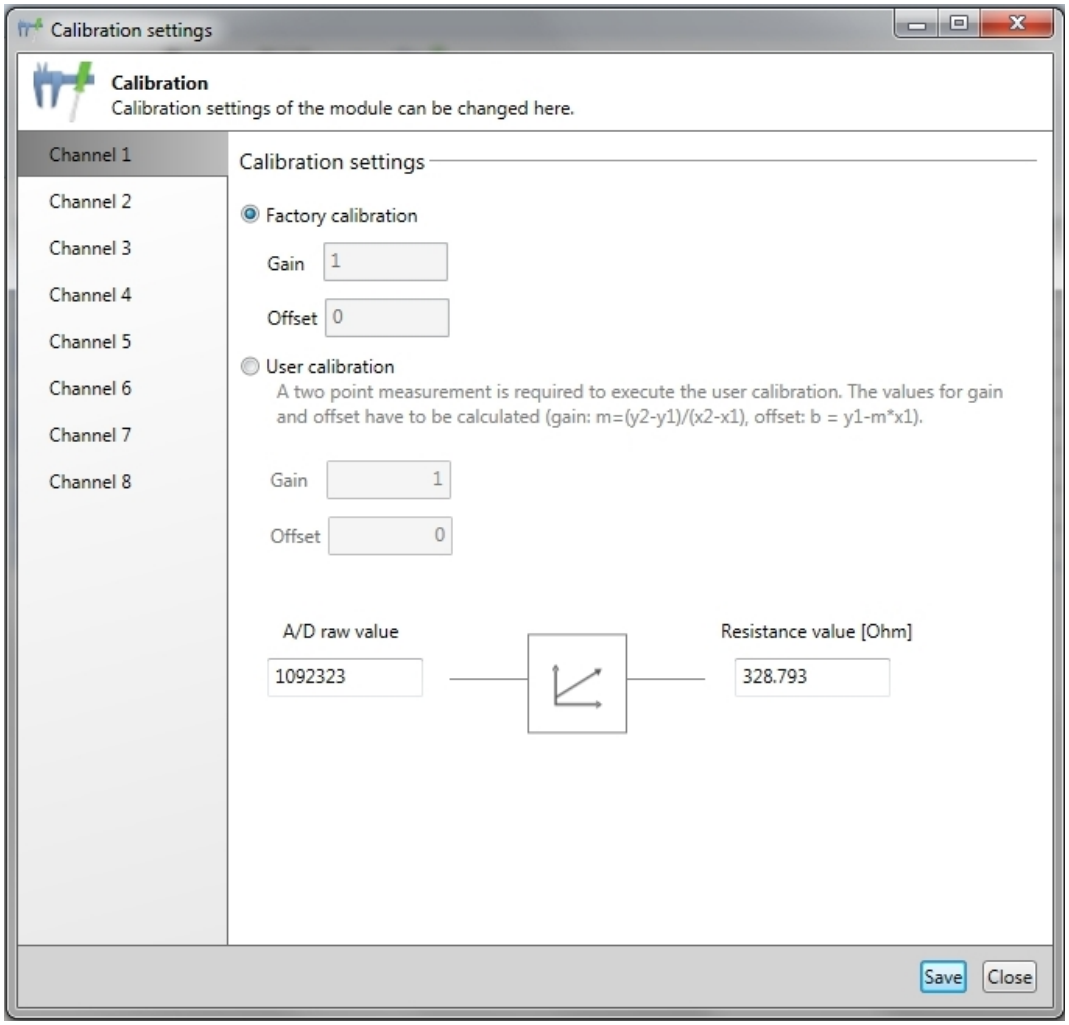


Figure 20: “Calibration” Menu Item

Table 68: “Calibration” Menu Item

Option	Description	
Calibration settings		
Manufacturer calibration	☑	Manufacturer calibration is enabled. Manufacturer-side calibration is applied. The gain and offset values cannot be entered individually.
	☐	Manufacturer calibration is disabled.
	Gain	The gain value changes the slope factor of the A/D raw value.
	Offset	The offset value moves the zero point of the A/D raw value (offset on the y axis).
User calibration	☑	User calibration is enabled. By enabling user scaling, the gain and offset values can be specified individually.
	☐	User calibration is disabled.
A/D raw value	Analog/digital converter raw value. This is a 24-bit value.	
Resistance value [Ohm]	This is the output value after calculating the gain and offset values and conversion from A/D raw value. The output is in Ohm.	

User calibration allows you to calibrate the I/O module individually. The following calculation formulas apply when calculating both required factors:

- Calibration gain: $m = (y2 - y1) / (x2 - x1)$
- Calibration offset: $b = y1 - m \times x1$

The variables are assigned as follows:

- m= Calibration gain
- b= Calibration offset
- x1= Actual value 1 (A/D raw value)
- x2= Actual value 2 (A/D raw value)
- y1= Setpoint 1
- y2= Setpoint 2

7.2.1.3.7 Application Example of Calibration

For the calibration, a 2-point measurement with reference resistances is carried out.

Example:

Measurement 1: y1= 100 Ohm
Measurement 2: y2= 4000 Ohm

Both values of the reference resistances are first converted into corresponding A/D raw values. The following calculation formula is used:

A/D raw value = (Measure resistance × ((2^24) − 1)) / 5050

Example:

y1 = (100 Ohm × ((2^24) − 1)) / 5050 = 332222
y2 = (4000 Ohm × ((2^24) − 1)) / 5050 = 13288883

For each of the two calibration points, you should record as many A/D raw values as possible (at least 10).

Example:

A/D raw values recorded at 100 Ohm (10 measured values total):
A/D raw value 1: 333887
A/D raw value 2: 333895
A/D raw value 3: 333893
A/D raw value 4: 333895
A/D raw value 5: 333892
A/D raw value 6: 333882
A/D raw value 7: 333881
A/D raw value 8: 333900
A/D raw value 9: 333900
A/D raw value 10: 333895

A/D raw values recorded at 4000 Ohm (10 measured values total):
A/D raw value 1: 13287113
A/D raw value 2: 13287092
A/D raw value 3: 13287087
A/D raw value 4: 13287107
A/D raw value 5: 13287073
A/D raw value 6: 13287107
A/D raw value 7: 13287094
A/D raw value 8: 13287132
A/D raw value 9: 13287098
A/D raw value 10: 13287131

In the next step, determine the average for each of the two reference resistances from the recorded A/D raw values. By calculating the average, you get the x1 and x2 values.

Example:

At 100 Ohm, x1 is = 333892
At 4000 Ohm, x2 is = 13287103

You can now use all calculated values in the calculation formulas and get the calibration gain and calibration offset.
The calibration gain is the slope factor and the calibration offset gives you the factor for displacement on the y axis.

Example:

Calibration gain:
(13288883 − 332222)) / (13287103 − 333892) = 1.000266343

Calibration offset:
332222 − 1.000266343 × 333892 = −1759

7.2.1.4 Status Bar

The following information is displayed in the status bar:

- Status indicator
- Online status
- IP address or COM interface

7.3 Configuration and Parameterization using a GSD File with PROFIBUS DP and PROFINET IO

A GSD (device master data) file can be used to configure the parameters of the I/O module 750-451.

Note

Description of parameterization/configuration per GSD in the appendix!
Other methods are available for parameterization depending on the fieldbus coupler/controller. Detailed information is available in the appendix.

8 Diagnostics

8.1 Error Response

The behavior of the I/O module in the event of an error depends on the configuration of the wire break / short circuit monitoring, underrange / overrange monitoring and limiting value underrange / overrange monitoring. You can enable or disable these diagnostics in register 35.
The I/O module always only allows one error to be displayed. One bit is assigned to each fault condition in the status byte. If a fault condition is detected, the respective status byte is set. For this reason, the fault conditions are prioritized. If there are multiple errors, the error with the highest priority is displayed.
The following prioritization applies:

Table 69: PriorityLevels of Diagnostic Functions

Priority level	Diagnostic function
High	Wire break
High	Short circuit
Medium	Underrange
Medium	Overrange
Low	User limiting value underrange
Low	User limiting value overrange

Table 70: Behavior in the Event of an Error Dependent on the Configuration

Configuration		Behavior for range violation	Behavior for wire break / short circuit
Wire break/ short circuit monitoring	Underrange / overrange monitoring		
OFF	OFF	Process value is saturated, no change in status byte, error LED OFF	Process value is saturated, no change in status byte, error LED OFF
OFF	ON	Process value is saturated, error bit (bit 0: Underrange or bit 1: Overrange), general error (Err_G) (bit 6) is set, error LED ON	Process value is saturated, error bit (bit 0: Underrange for short circuit or bit 1: Overrange for wire break), general error (Err_G) (bit 6) is set, error LED on

Table 70: Behavior in the Event of an Error Dependent on the Configuration

Configuration		Behavior for range violation	Behavior for wire break / short circuit
Wire break/ short circuit monitoring	Underrange / overrange monitoring		
ON	OFF	Process value is saturated, no change in status byte, error LED ON	Process value is saturated, error bit (bit 4 for short circuit or bit 5 for wire break), general error (Err_G) (bit 6) is set, error LED ON
ON	ON	Process value is saturated, error bit (bit 0: Underrange or bit 1: Overrange), general error (Err_G) (bit 6) is set, error LED ON	Process value is saturated, error bits (bit 4 for short circuit or bit 5 for wire break), general error (Err_G) (bit 6) is set, error LED ON

Note

No short-circuit detection for resistance measurements!
For sensor types “Resistance measurement 1” and “Resistance measurement 2”, short-circuit detection is not technically possible.

The limiting values for detecting an underrange/overrange, short circuit/wire break or limiting value underrange/overrange and the output process values are specified in the process image tables.

A general error indicates that an error is present without defining it in more detail. This includes all fault conditions from register 6 (see chapter “Startup” > “Register Assignment”). A general error is then also indicated when several fault conditions specified in register 6 occur simultaneously. The requirement for displaying a general fault condition is that at least one of the relevant bits 0 … 5 of the status byte is set.

9 Appendix

9.1 Configuration and Parameterization using a GSD File with PROFIBUS DP and PROFINET IO

9.1.1 Configuration 8 AI RTD

9.1.1.1 PROFIBUS DP (750-333, 750-833) Fieldbus Coupler PROFINET IO (750-370) Fieldbus Coupler

When using the aforementioned PROFIBUS-DP and PROFINET-IO fieldbus couplers, the process image size is configured by selecting the corresponding PI module type.

Table 71: Configuration

PI module type	Representatives of the module type	PI data type	Instances	
			Inp.	Outp.
75x-451 8AI, RTD	75x-451	Integer16[8]	1	1
75x-451 8AI, RTD, EM		{Unsigned8, Integer16}[8]		

9.1.1.2 PROFINET IO (750-375, 750-377) Fieldbus Coupler

When using the aforementioned PROFINET-IO fieldbus couplers, the process image size is configured by selecting the corresponding PI module / submodule type.

Table 72: Configuration

PI module type	Representatives of the module type	PI submodule type	Process image length	PI data type	Instances	
					Inp.	Outp.
75x-451 8AI, RTD	75x-451	**INT8[8] I**	16 bytes	Integer16[8]	1	1
		{UINT8, INT8}[8] I/O	24 bytes	{Unsigned8, Integer16}[8]		

9.1.2 Parameterization 8 AI RTD

Apart from the user limits, the GSD file can be used to provide the I/O module on the PROFIBUS DP and PROFINET IO fieldbus coupler with all operating parameters.

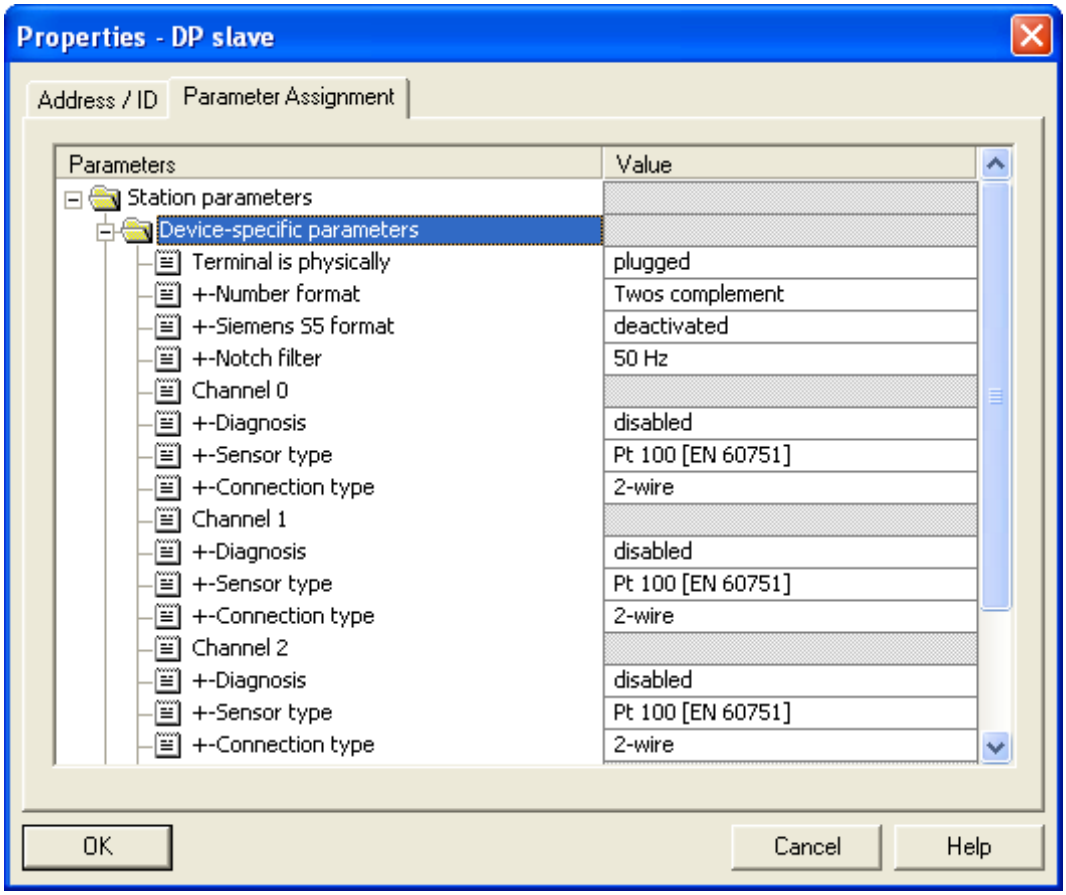


Figure 21: Example of the PROFIBUS DP Fieldbus Coupler Parameterization Dialog

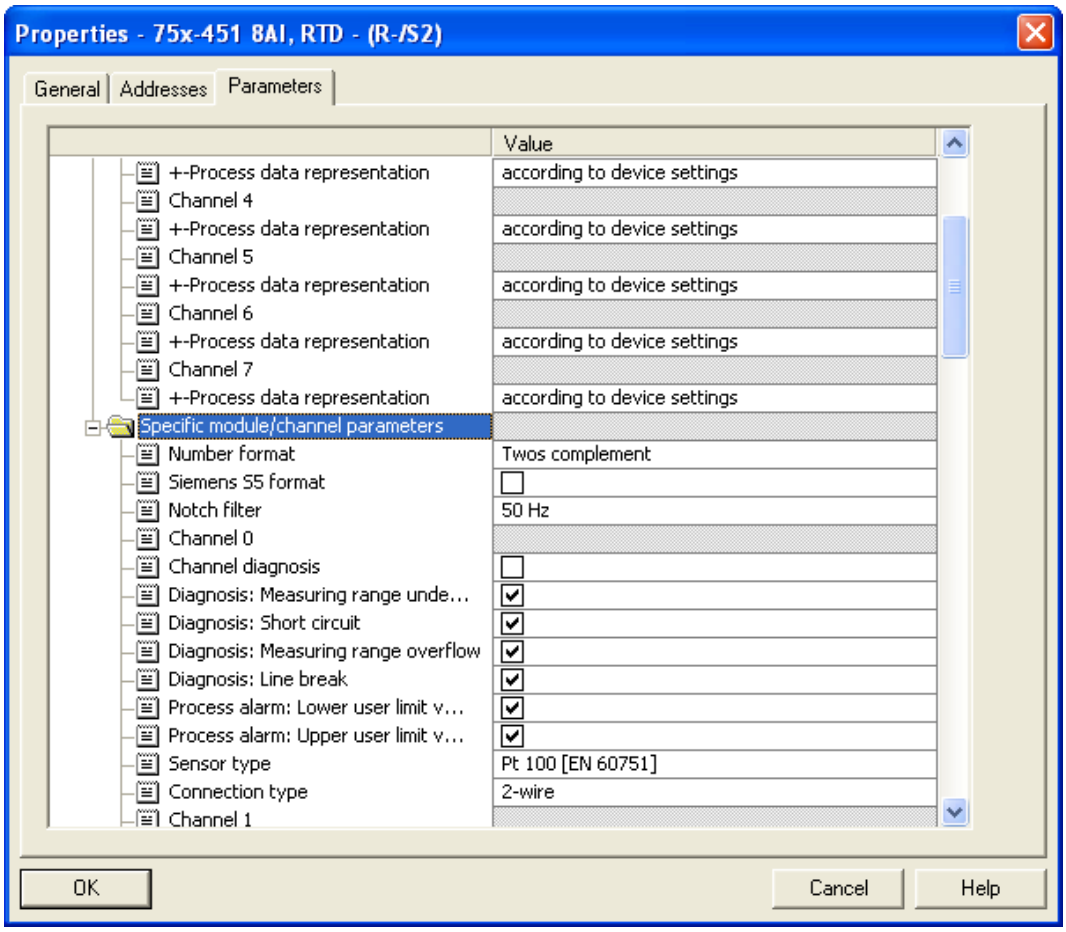


Figure 22: Example of the 750-370 Fieldbus Coupler Parameterization Dialog

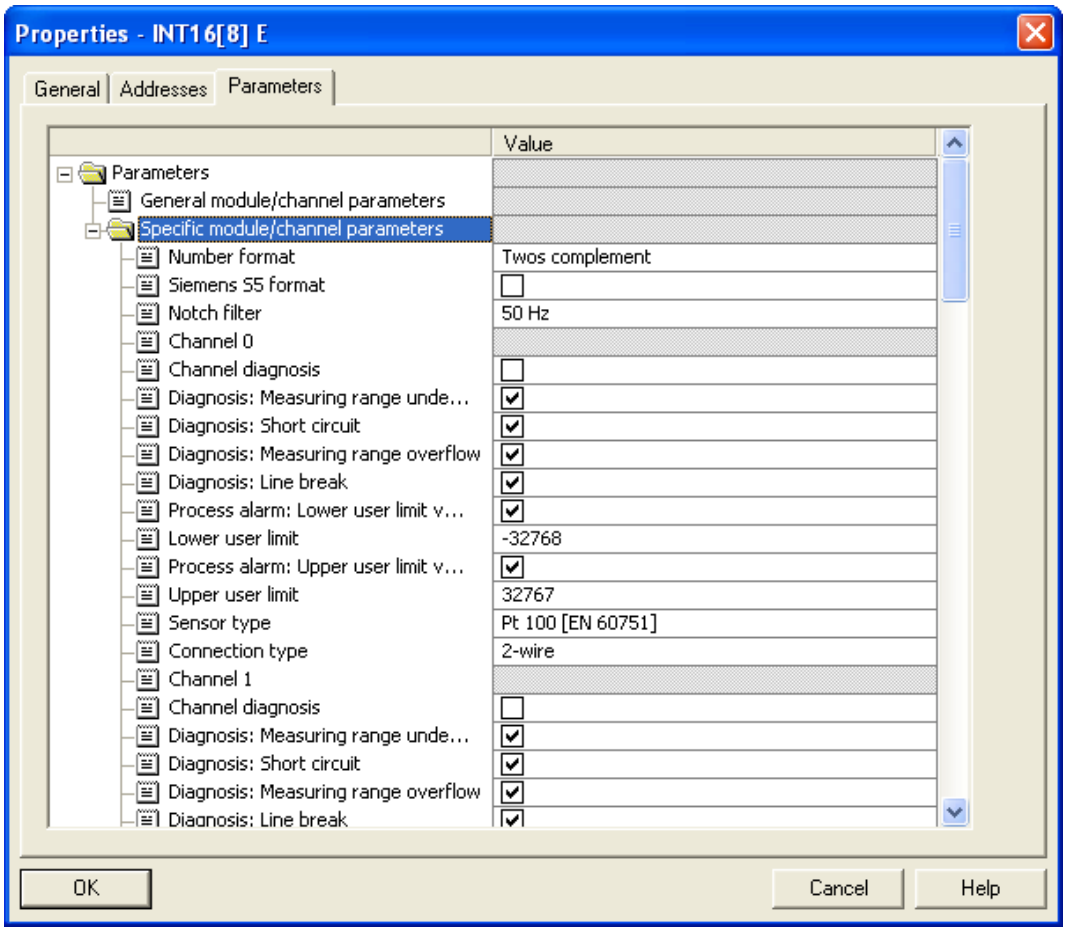


Figure 23: Example of the 750-375 and 750-377 Fieldbus Coupler Parameterization Dialog

9.1.2.1 All PROFIBUS DP and PROFINET IO Fieldbus Couplers

The following assignment applies to the parameters of the I/O module when using PROFIBUS-DP and PROFINET-IO fieldbus couplers.

Table 73: Specific Module / Channel Parameters for 75x-451

GSD File		**WAGO-I/O-*CHECK***	
Description	**Value**	**Selection box**	**Value**
Number format	Twos complement *)	Number format	Twos complement *)
	Sign magnitude		Sign magnitude
SIEMENS S5 format	*Checkbox* deactivated *)	SIEMENS S5 format	*Checkbox* deactivated *)
	activated		activated
Sensor type	Pt 100 [EN 60751] *)	Sensor type	Pt 100 [EN 60751] *)
	Ni 100 [DIN 43760]		Ni 100 [DIN 43760]
	Pt 1000 [EN 60751]		Pt 1000 [EN 60751]
	Pt 500 [EN 60751]		Pt 500 [EN 60751]
	Pt 200 [EN 60751]		Pt 200 [EN 60751)
	Ni 1000 [TK 6180, DIN 43760]		Ni 1000 [TK 6180, DIN 43760]
	Ni 120 [Minco]		Ni 120 [Minco]
	Ni 1000 [TK 5000, DIN 43760]		Ni 1000 [TK 5000 (Landis + Staefa)]

Table 73: Specific Module / Channel Parameters for 75x-451

GSD File		WAGO-I/O-*CHECK*	
Description	**Value**	**Selection box**	**Value**
	Ni 1000 [TK 6180, DIN 43760] HR		
	Ni 1000 [TK 5000, DIN 43760] HR		
	Pt 1000 [EN 60751] HR		
	Resistor 0R … 5K (linear)		Resistance measurement 1
	Resistor 0R … 1K2 (linear)		Resistance measurement 2
Connection type	deactivated	Connection type	deactivated
	2-wire*)		2-wire*)

*) Default setting

9.1.2.2 PROFIBUS DP (750-333, 750-833) Fieldbus Coupler

The aforementioned fieldbus couplers allow module-specific parameterization of behavior at diagnosis.

Table 74: General Module / Channel Parameters

Parameter	Value	Explanation
Diagnosis Channel x (x = 0…7)		The fieldbus coupler signals a diagnosis if the I/O module reports the events: • Measuring range overflow • Measuring range underflow • Short circuit • Line break
	0 (disabled)*)	Diagnostics reported by the I/O module do not lead to the signaling of a diagnosis by the fieldbus coupler.
	1 (enabled)	Diagnostics reported by the I/O module lead to the signaling of a diagnosis by the fieldbus coupler.

*) Default setting

9.1.2.3 PROFINET IO (750-370, 750-375, 750-377) Fieldbus Coupler

The aforementioned fieldbus couplers allow module-specific parameterization of behavior at diagnosis.

Table 75: General Module / Channel Parameters

Parameter	Value	Explanation
Channel diagnosis Channel x (x = 0…7)	0 (false)*)	Any errors that may occur on the respective signal channel do not cause transmission of a diagnostic alarm nor entry in the diagnostics database of the station proxy.
	1 (true)	Any errors that may occur on the respective signal channel and the error type explicitly released entail transmission of a diagnostic alarm. The respective error leads to an entry in the diagnostics database of the station proxy.
Diagnosis: Measuring range underflow Channel x (x = 0…7)	0 (false)	An undershot on the respective signal channel does not lead to transmission of a diagnostic alarm nor entry in the diagnostics database of the station proxy.
	1 (true)*)	Provided that the channel diagnostics of the respective signal channel has been activated, an undershoot leads to transmission of a diagnostic alarm and entry in the diagnostics database of the station proxy.
Diagnosis: Short circuit Channel x (x = 0…7)	0 (false)	A short circuit on the respective signal channel does not lead to transmission of a diagnostic alarm nor to entry in the diagnostics database of the station proxy.
	1 (true)*)	Provided that the channel diagnostics of the respective signal channel has been activated, a short circuit leads to transmission of a diagnostic alarm and entry in the diagnostics database of the station proxy.
Diagnosis: Measuring range overflow Channel x (x = 0…7)	0 (false)	An overrange on the respective signal channel does not lead to transmission of a diagnostic alarm nor entry in the diagnostics database of the station proxy.
	1 (true)*)	Provided that the channel diagnostics of the respective signal channel has been activated, an overrange leads to transmission of a diagnostic alarm and entry in the diagnostics database of the station proxy.
Diagnosis: Wire break Channel x (x = 0…7)	0 (false)	A wire break on the respective signal channel does not lead to transmission of a diagnostic alarm nor to entry in the diagnostics database of the station proxy.
	1 (true)*)	Provided that the channel diagnostics of the respective signal channel has been activated, a wire break leads to transmission of a diagnostic alarm and entry in the diagnostics database of the station proxy.

Table 75: General Module / Channel Parameters

Parameter	Value	Explanation
Process alarm: Lower user limit value undershot Channel x (x = 0…7)	0 (false)	Falling below the lower user limit on the respective signal channel does not lead to transmission of a process alarm. The lower user limit is set in another attribute.
	1 (true)*)	Provided that the channel diagnostics of the respective signal channel has been activated, falling below the lower user limit leads to transmission of a process alarm. No entry in the diagnostics database of the station proxy is made. The lower user limit is set in another attribute.
Process alarm: Upper user limit value exceeded Channel x (x = 0…7)	0 (false)	Exceeding the upper use limit on the respective signal channel does not lead to transmission of a process alarm. The upper user limit is set in another attribute.
	1 (true)*)	Provided that the channel diagnostics of the respective signal channel has been activated, exceeding the upper user limit leads to transmission of a process alarm. No entry in the diagnostics database of the station proxy is made. The upper user limit is set in another attribute.

*) Default settings

10 Use in Hazardous Environments

The **WAGO-I/O-SYSTEM 750** (electrical equipment) is designed for use in Zone 2 hazardous areas.

The following sections include both the general identification of components (devices) and the installation regulations to be observed. The individual subsections of the “Installation Regulations” section must be taken into account if the I/O module has the required approval or is subject to the range of application of the ATEX directive.

10.1 Marking Configuration Examples

10.1.1 Marking for Europe According to ATEX and IEC-Ex

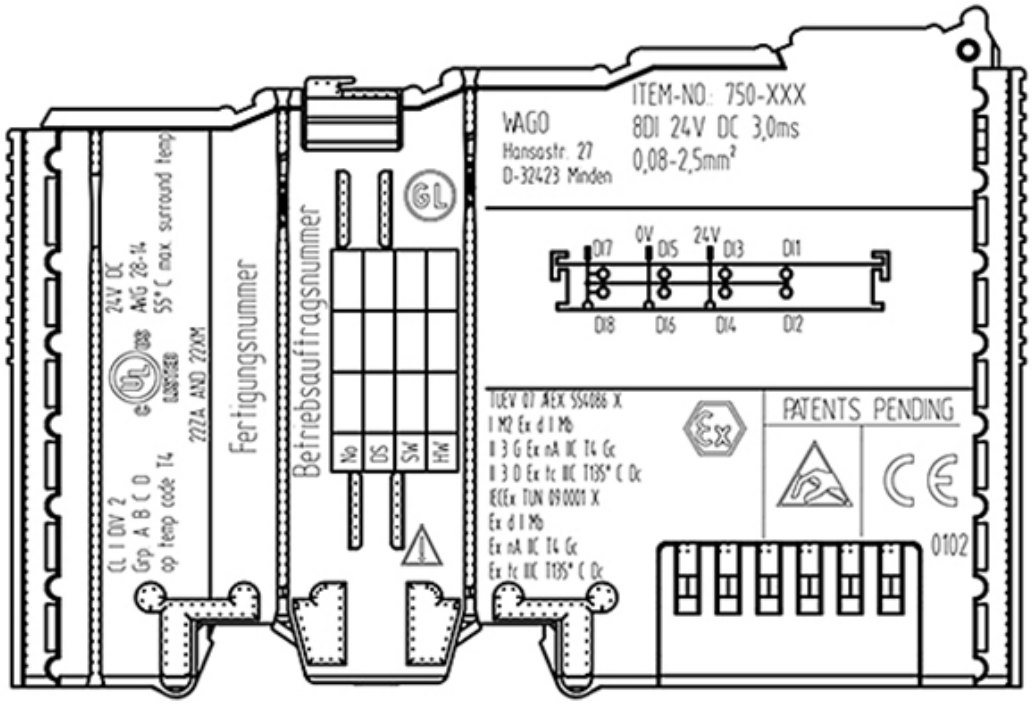


Figure 24: Side Marking Example for Approved I/O Modules According to ATEX and IECEx

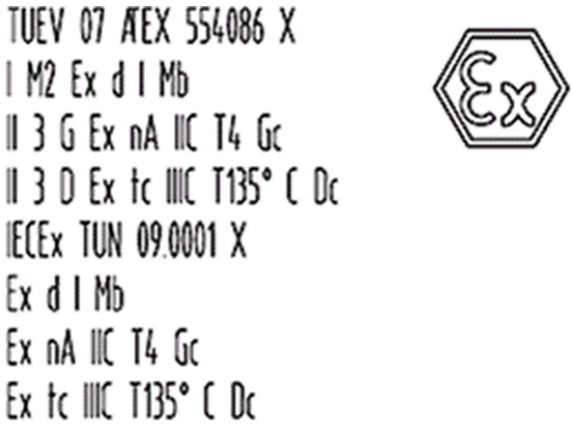


Figure 25: Text Detail – Marking Example for Approved I/O Modules According to ATEX and IECEx.

Table 76: Description of Marking Example for Approved I/O Modules According to ATEX and IECEx

Marking	Description
TÜV 07 ATEX 554086 X IECEx TUN 09.0001 X	Approving authority and certificate numbers
Dust	
II	Equipment group: All except mining
3D	Category 3 (Zone 22)
Ex	Explosion protection mark
tc Dc	Type of protection and equipment protection level (EPL):protection by enclosure
IIIC	Explosion group of dust
T 135°C	Max. surface temperature of the enclosure (without a dust layer)
Mining	
I	Equipment group: Mining
M2	Category: High level of protection
Ex	Explosion protection mark
d Mb	Type of protection and equipment protection level (EPL): Flameproof enclosure
I	Explosion group for electrical equipment for mines susceptible to firedamp
Gases	
II	Equipment group: All except mining
3G	Category 3 (Zone 2)
Ex	Explosion protection mark
nA Gc	Type of protection and equipment protection level (EPL): Non-sparking equipment
nC Gc	Type of protection and equipment protection level (EPL): Sparking apparatus with protected contacts. A device which is so constructed that the external atmosphere cannot gain access to the interior
IIC	Explosion group of gas and vapours
T4	Temperature class: Max. surface temperature 135°C

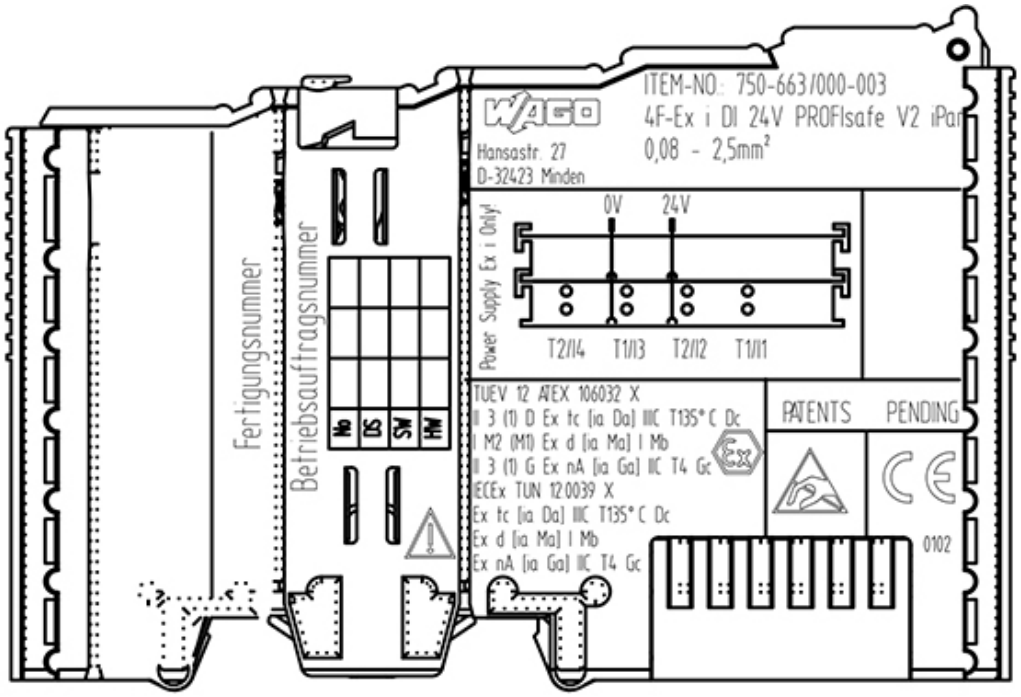


Figure 26: Side Marking Example for Approved Ex i I/O Modules According to ATEX and IECEx.

TUEV 12 ATEX 106032 X
II 3 (1) D Ex tc [ia Da] IIIC T135° C Dc
I M2 (M1) Ex d [ia Ma] I Mb
II 3 (1) G Ex nA [ia Ga] IIC T4 Gc
IECEx TUN 12.0039 X
Ex tc [ia Da] IIIC T135° C Dc
Ex d [ia Ma] I Mb
Ex nA [ia Ga] IIC T4 Gc

Figure 27: Text Detail – Marking Example for Approved Ex i I/O Modules According to ATEX and IECEx.

Table 77: Description of Marking Example for Approved Ex i I/O Modules According to ATEX and IECEx

Marking	Description
TÜV 07 ATEX 554086 X IECEx TUN 09.0001X TÜV 12 ATEX 106032 X IECEx TUN 12.0039 X	Approving authority and certificate numbers
Dust	
II	Equipment group: All except mining
3(1)D	Category 3 (Zone 22) equipment containing a safety device for a category 1 (Zone 20) equipment
3(2)D	Category 3 (Zone 22) equipment containing a safety device for a category 2 (Zone 21) equipment
Ex	Explosion protection mark
tc Dc	Type of protection and equipment protection level (EPL): protection by enclosure
[ia Da]	Type of protection and equipment protection level (EPL): associated apparatus with intrinsic safety circuits for use in Zone 20
[ib Db]	Type of protection and equipment protection level (EPL): associated apparatus with intrinsic safety circuits for use in Zone 21
IIIC	Explosion group of dust
T 135°C	Max. surface temperature of the enclosure (without a dust layer)
Mining	
I	Equipment Group: Mining
M2 (M1)	Category: High level of protection with electrical circuits which present a very high level of protection
Ex d Mb	Explosion protection mark with Type of protection and equipment protection level (EPL): Flameproof enclosure
[ia Ma]	Type of protection and equipment protection level (EPL): associated apparatus with intrinsic safety electrical circuits
I	Explosion group for electrical equipment for mines susceptible to firedamp

Table 77: Description of Marking Example for Approved Ex i I/O Modules According to ATEX and IECEx

Gases	
II	Equipment group: All except mining
3(1)G	Category 3 (Zone 2) equipment containing a safety device for a category 1 (Zone 0) equipment
3(2)G	Category 3 (Zone 2) equipment containing a safety device for a category 2 (Zone 1) equipment
Ex	Explosion protection mark
nA Gc	Type of protection and equipment protection level (EPL): Non-sparking equipment
[ia Ga]	Type of protection and equipment protection level (EPL): associated apparatus with intrinsic safety circuits for use in Zone 0
[ia Gb]	Type of protection and equipment protection level (EPL): associated apparatus with intrinsic safety circuits for use in Zone 1
IIC	Explosion group of gas and vapours
T4	Temperature class: Max. surface temperature 135°C

10.1.2 Marking for America According to NEC 500

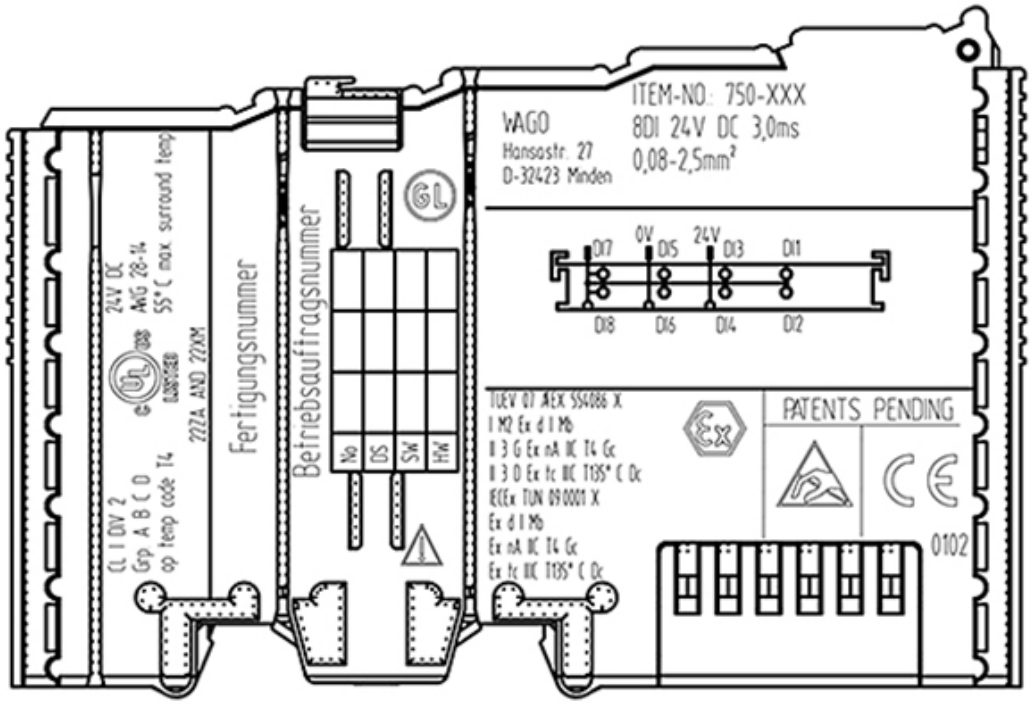


Figure 28: Side Marking Example for I/O Modules According to NEC 500

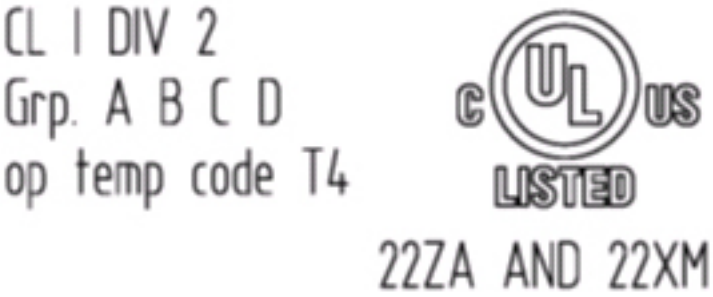


Figure 29: Text Detail – Marking Example for Approved I/O Modules According to NEC 500

Table 78: Description of Marking Example for Approved I/O Modules According to NEC 500

Marking	Description
CL I	Explosion protection group (condition of use category)
DIV 2	Area of application
Grp. ABCD	Explosion group (gas group)
Op temp code T4	Temperature class

10.2 Installation Regulations

For the installation and operation of electrical equipment in hazardous areas, the valid national and international rules and regulations which are applicable at the installation location must be carefully followed.

10.2.1 Special Conditions for Safe Use (TÜV 14 ATEX 148929 X)

1. The modules of the WAGO-I/O-SYSTEM 750-*** have to been erected in such a way, that corresponding to EN 60079-15 a degree of protection of at least IP 54 according to EN 60529 is achieved.
2. Measures have to been taken, external to the modules, to provide a transient protection that ensures that the rated voltage, connected to the power supply terminals, is not exceeded by more than 40 %.
3. The connecting and disconnecting of the non-intrinsically safe circuits is only permitted if no explosive atmosphere exists. This although applies for the all switches, interfaces (Fieldbus, Ethernet, Serial) and the SD-card.
4. The ambient temperature range is: $0\ °C \leq T_{amb} \leq +60\ °C$
   The ambient temperature range for modules with suffix extension /025-**** is: $-20\ °C \leq T_{amb} \leq +60\ °C$

10.2.2 Special Conditions for Safe Use (ATEX Certificate TÜV 12 ATEX 106032 X)

1. For use as Gc- or Dc-apparatus (in zone 2 or 22) the Field bus Independent I/O Modules WAGO-I/O-SYSTEM 750-*** Ex i shall be erected in an enclosure that fulfils the requirements of the applicable standards (see the marking) EN 60079-0, EN 60079-11, EN 60079-15 and EN 60079-31.
   For use as group I electrical apparatus M2 the apparatus shall be erected in an enclosure that ensures a sufficient protection according to EN 60079-0 and EN 60079-1 and the degree of protection IP64.
   The compliance of these requirements and the correct installation into an enclosure or a control cabinet of the devices shall be certified by an ExNB.
2. Measures have to be taken outside of the device that the rating voltage is not being exceeded of more than 40 % because of transient disturbances.
3. The connecting and disconnecting of the non-intrinsically safe circuits is only permitted during installation, for maintenance or for repair purposes. The temporal coincidence of explosion hazardous atmosphere and installation, maintenance resp. repair purposes shall be excluded.
4. For the type the following shall be considered: The Interface circuits shall be limited to overvoltage category I/II (non mains/mains circuits) as defined in EN 60664-1.

10.2.3 Special Conditions for Safe Use (IEC-Ex Certificate TUN 14.0035X)

1. The modules of the WAGO-I/O-SYSTEM 750-*** have to been erected in such a way, that corresponding to IEC 60079-15 a degree of protection of at least IP 54 according to IEC 60529 is achieved.
2. Measures have to been taken, external to the modules, to provide a transient protection that ensures that the rated voltage, connected to the power supply terminals, is not exceeded by more than 40 %.
3. The connecting and disconnecting of the non-intrinsically safe circuits is only permitted if no explosive atmosphere exists. This although applies for the all switches, interfaces (Fieldbus, Ethernet, Serial) and the SD-card.
4. The ambient temperature range is: 0 °C ≤ Tamb ≤ +60 °C
   The ambient temperature range for modules with suffix extension /025-**** is: -20 °C ≤ Tamb ≤ +60 °C

10.2.4 Special Conditions for Safe Use (IEC-Ex Certificate IECEx TUN 12.0039 X)

1. For use as Gc- or Dc-apparatus (in zone 2 or 22) the Field bus independent I/O Modules WAGO-I/O-SYSTEM 750-*** Ex i shall be erected in an enclosure that fulfils the requirements of the applicable standards (see the marking) IEC 60079-0, IEC 60079-11, IEC 60079-15, IEC 60079-31.
   For use as group I electrical apparatus M2 the apparatus shall be erected in an enclosure that ensures a sufficient protection according to IEC 60079-0 and IEC 60079-1 and the degree of protection IP64.
   The compliance of these requirements and the correct installation into an enclosure or a control cabinet of the devices shall be certified by an ExCB.
2. Measures have to be taken outside of the device that the rating voltage is not being exceeded of more than 40 % because of transient disturbances.
3. The connecting and disconnecting of the non-intrinsically safe circuits is only permitted during installation, for maintenance or for repair purposes. The temporal coincidence of explosion hazardous atmosphere and installation, maintenance resp. repair purposes shall be excluded.
4. For the type the following shall be considered: The Interface circuits shall be limited to overvoltage category I/II (non mains/mains circuits) as defined in IEC 60664-1.

10.2.5 Special Conditions for Safe Use according to ANSI/ISA 12.12.01

A. “This equipment is suitable for use in Class I, Division 2, Groups A, B, C, D or non-hazardous locations only.”
B. “This equipment is to be fitted within tool-secured enclosures only.”
C. “WARNING Explosion hazard - substitution of components may impair suitability for Class I, Div. 2.”
D. “WARNING – Do not disconnect equipment unless power has been switched off or the area is known to be non-hazardous” has to be placed near each operator accessible connector and fuse holder.
E. When a fuse is provided, the following information shall be provided: “A switch suitable for the location where the equipment is installed shall be provided to remove the power from the fuse.”
F. For devices with EtherCAT/Ethernet connectors “Only for use in LAN, not for connection to telecommunication circuits.”
G. “WARNING - Use Module 750-642 only with antenna module 758-910.”
H. For Couplers/Controllers and Economy bus modules only: The instructions shall contain the following: “The configuration interface Service connector is for temporary connection only. Do not connect or disconnect unless the area is known to be non-hazardous. Connection or disconnection in an explosive atmosphere could result in an explosion.”
I. Modules containing fuses only: “WARNING - Devices containing fuses must not be fitted into circuits subject to over loads, e.g. motor circuits.”
J. Modules containing SD card reader sockets only: “WARNING - Do not connect or disconnect SD-Card while circuit is live unless the area is known to be free of ignitable concentrations of flammable gases or vapors.”
K. The modules 750-439, 750-538, 750-633, 750-663/000-003 shall only be supplied with 750-606 or 750-625/000-001.
L. Module 750-538 only “In Hazardous Locations, Non-Incendive only when installed per Control Drawing No. 750-538”.

Information

Additional Information

Proof of certification is available on request.
Also take note of the information given on the operating and assembly instructions.
The manual, containing these special conditions for safe use, must be readily available to the user.

List of Figures

List of Tables

WAGO Kontakttechnik GmbH & Co. KG
Postfach 2880 • D-32385 Minden
Hansastraße 27 • D-32423 Minden
Phone: 05 71/8 87 – 0
Fax: 05 71/8 87 – 1 69
E-Mail: info@wago.com
Internet: http://www.wago.com