GB

Operating instructions
IO-Link input module for temperature measurement
AL2384

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1 Preliminary note

You will find instructions, technical data, approvals and further information using the QR code on the unit / packaging or at documentation.ifm.com.

1.1 Symbols used

✓	Requirement
▶	Instructions
▷	Reaction, result
[...]	Designation of keys, buttons or indications
→	Cross-reference
!	Important note Non-compliance may result in malfunction or interference.
i	Information Supplementary note

1.2 Warnings

Warnings indicate the possibility of personal injury and damage to property. This enables safe product handling. Warnings are graded as follows:

WARNING

Warning of serious personal injury

▷ If the warning is not observed, fatal and serious injuries are possible.

CAUTION

Warning of minor to moderate personal injury

▷ If the warning is not observed, minor to moderate injuries are possible.

ATTENTION

Warning of damage to property

▷ If the warning is not observed, damage to property is possible.

2 Safety instructions

- The unit described is a subcomponent for integration into a system.
  - The system architect is responsible for the safety of the system.
  - The system architect undertakes to perform a risk assessment and to create documentation in accordance with legal and normative requirements to be provided to the operator and user of the system. This documentation must contain all necessary information and safety instructions for the operator, the user and, if applicable, for any service personnel authorised by the architect of the system.
- Read this document before setting up the product and keep it during the entire service life.
- The product must be suitable for the corresponding applications and environmental conditions without any restrictions.
- Only use the product for its intended purpose (→ Intended use).
- If the operating instructions or the technical data are not adhered to, personal injury and/or damage to property may occur.
- The manufacturer assumes no liability or warranty for any consequences caused by tampering with the product or incorrect use by the operator.
- Installation, electrical connection, set-up, operation and maintenance of the product must be carried out by qualified personnel authorised by the machine operator.
- Protect units and cables against damage.
- Store the product in its original packaging.

3 Intended use

The device has 4 input ports for temperature measurements to which the following sensors can be connected:

- Pt100 2-wire
- Pt100 3-wire
- Pt100 4-wire
- Pt1000 2-wire
- Pt1000 3-wire
- Pt1000 4-wire
- type J thermocouple
- type K thermocouple

The device is specially designed for the use of non-grounded and exposed thermocouples.

The device must not be used in the food and beverage industry (use of cleaning agents under high pressure and at high temperatures).

For the UL scope of validity:

The device is exclusively for use in industrial machinery in compliance with the NFPA79 electrical standard.

▶ The connected thermocouples must not be used to measure hazardous live parts.

▶ The device is intended for indoor use only.

▶ The device can be operated in wet location.

4 Function

4.1 IO-Link

IO-Link is a communication system for connecting intelligent sensors and actuators to automation systems. IO-Link is standardised in the IEC 61131-9 standard.

General information on IO-Link at io-link.ifm

Input Output Device Description (IODD) with all parameters, process data and detailed descriptions of the device at documentation.ifm.com

IO-Link offers the following advantages:

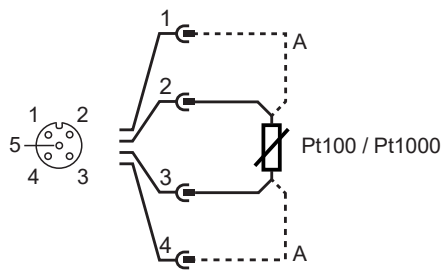
- Interference-free transmission of all data and process values
- Parameter setting in the running process or presetting outside the application
- Parameters for identifying the connected devices in the system
- Additional parameters and diagnostic functions
- Automatic backup and restore of parameter sets in case of device replacement (data storage)
- Logging of parameter sets, process values and events
- Device description file (IODD - Input Output Device Description) for easy project planning
- Standardised electrical connection
- Remote maintenance

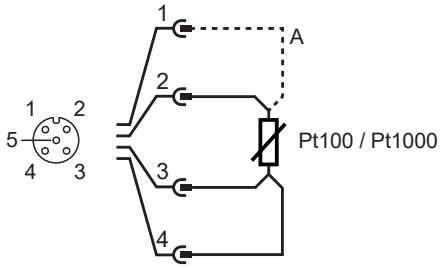
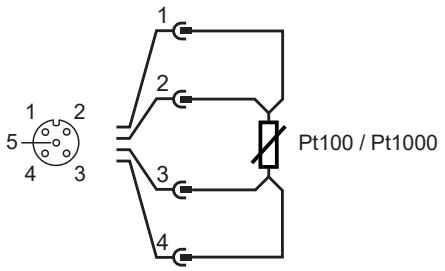
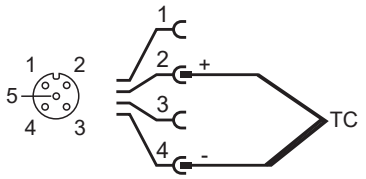
4.2 Port modes

Each of the four ports can be operated in 9 different port modes. The port mode must match the connected sensor type.

The port mode is set using the parameter [Port modes].

In port mode 00, the port is disabled.

Port mode	Sensor type	Measuring range	Wiring
00 (default – port - off)	—	—	—
01	Pt100 2-wire	-195…+510 °C	 A: bridge (to be connected externally)
04	Pt1000 2-wire	-195…+310 °C	

Port mode	Sensor type	Measuring range	Wiring
02	Pt100 3-wire	-195…+510 °C	 A: bridge (to be connected externally)
05	Pt1000 3-wire	-195…+310 °C	
03	Pt100 4-wire	-195…+510 °C	
06	Pt1000 4-wire	-195…+310 °C	
07	Type J thermocouple	-210…+1200 °C	
08	Type K thermocouple	-200…+1370 °C	

All port modes operate with an accuracy of 0.3% over the entire measuring range.

Only use thermocouples that are ungrounded and exposed.

Recommendation for port modes 01 and 04:

▶ Use the EVCB32 cable to make installation easier, as the contacts 1 – 2 and 3 – 4 are bridged internally.

4.3 Zero-point calibration

Zero-point calibration can be set for each port using the parameter [Temperature zero point calibration].
Value range: -100…100 (default: 0)

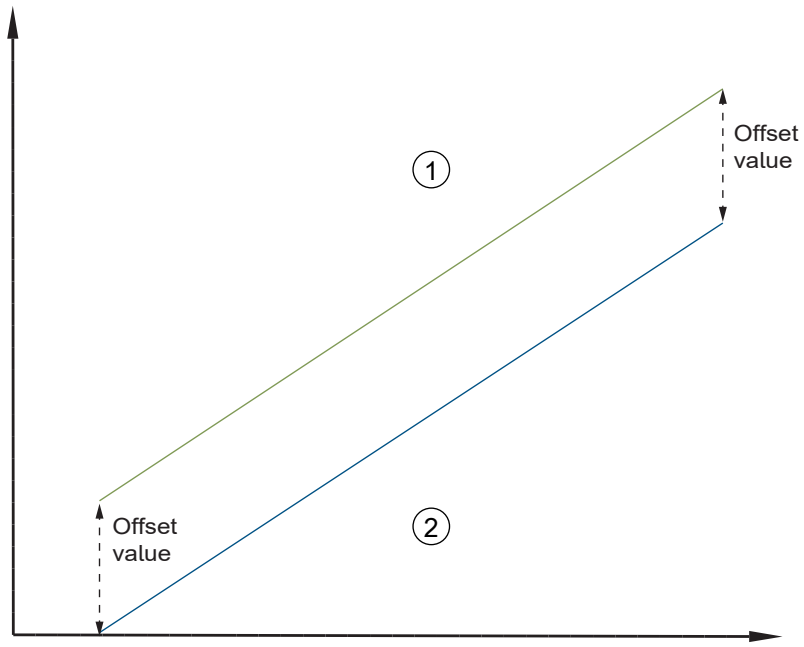


Fig. 1: Zero-point calibration

1 Measured value after offset
2 Measured value before offset

4.4 Cold junction compensation

This function is only available for port modes 07 and 08 (type J / K thermocouple).

As thermocouples can only determine temperature differences, the temperature of a reference junction, also known as cold junction, must be known in order to calculate the temperature. For each port, the IO-Link module internally measures the corresponding cold junction temperature. You can also configure a cold junction offset for each port to compensate for the temperature difference between the cold junction and the thermocouple junction.

The following parameters for cold junction compensation are available for each port:

Parameter	Value	Description
[Cold junction Switch]	• On (default) • Off	Switches the cold junction compensation on and off.
[Cold junction temperature]	-50…100	This parameter displays the cold junction temperature measured by the IO-Link module in °C. If the port mode has a setting other than TCJ or TCK, the [Cold junction Switch] value is [NoData].
[Cold junction Offset]	-10…10 (default: 0)	The configured value is added to the measured [Cold junction temperature] in °C.

Calculation of the temperature:

If cold junction compensation is switched off ([Cold junction Switch] = off), the cold junction temperature and the cold junction offset will not be included in the temperature calculation.

If cold junction compensation is switched on ([Cold junction Switch] = on), the temperature is calculated as follows:

Temperature = measured value of thermocouple + cold junction temperature + cold junction offset

Example:

- measured value of thermocouple: 10 mV (≙ 185.96 °C)
- cold junction temperature: 26.4 °C (≙ 1.35 mV)
- cold junction offset: 10 °C (≙ 0.52 mV)

ϑ = 219.66 °C (10 mV + 1.35 mV + 0.52 mV = 11.87 mV ≙ 219.66 °C)

4.5 Rejection filter

This function is only available for port modes 01...06 (Pt100 / Pt1000).

The [Rejection filter] is only set when configuring the port mode parameter.

A rejection filter that suppresses certain AC voltage frequencies can be set for each port using the parameter [Rejection filter].

Values:

- Filter OFF (default: 0)
- Filter 50 and 60 Hz
- Filter 50 Hz
- Filter 60 Hz

4.6 Averaging IIR filter

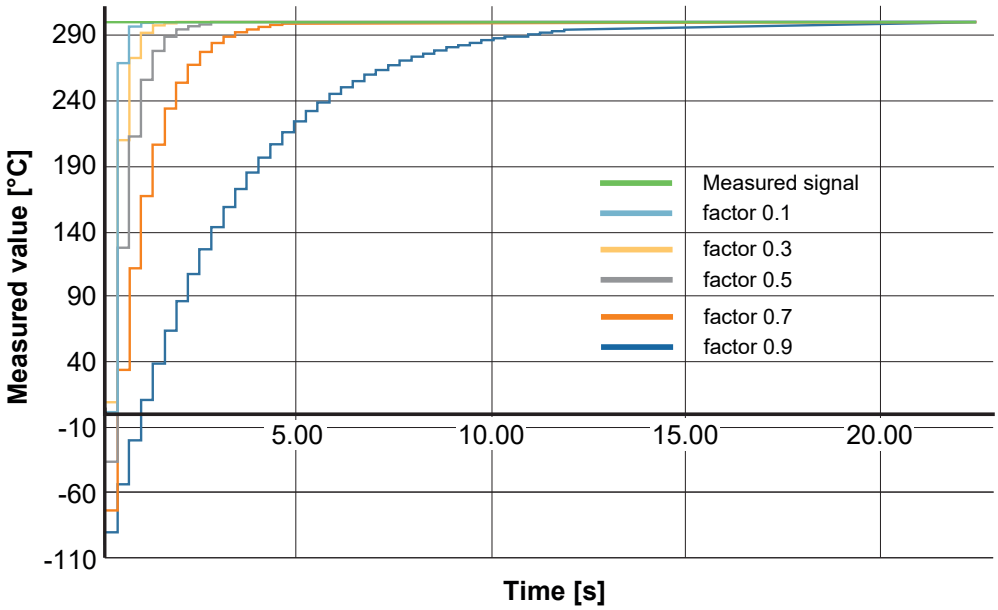
A filter factor for signal stabilisation can be set for each port using the parameter [Averaging IIR factor].

Lower factor values have a shorter settling time of the filter. Higher factor values enable more precise averaging, but have a longer settling time of the filter.

Value range: 0…9

The configured value is multiplied by the coefficient 0.1.

Example for settling time Pt1000 in 2-wire port mode:



If [Averaging IIR factor] = 0, the IIR filter is switched off.

4.7 SSC configuration

4.7.1 Switch point logic and switch point mode

Each of the 4 ports has 2 switching signal channels (SSC). The following parameters can be configured for each SSC using [SSCx.y Config]:

Parameter	Value	Description
[Logic]	• High active (default) • Low active	Switch point logic
[Mode]	• Deactivated • Single point • Window • Two point (default)	Switch point mode
[Hyst]	1…100 (default: Auto)	Auto - internal hysteresis. Value in °C.

If the respective switching threshold is exceeded or not reached, the output signal becomes [active] or [inactive].

In [Single point] and [Window mode], the hysteresis [Hyst] also affects the switching threshold.

The output signals of the [Low active] and [High active] switch point logics act mutually inverted.

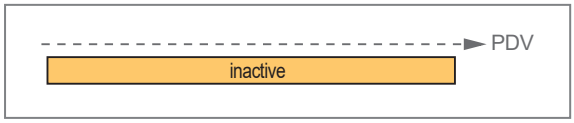


Fig. 2: Switch-point logic high active

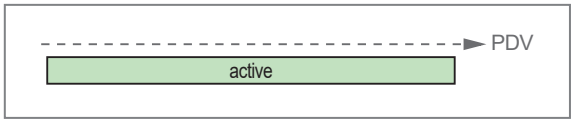


Fig. 3: Switch-point logic low active

Single-point mode

Only one switch point (SP1) is set manually.

The reset point (SP1-Hyst) results from the setpoint and the set hysteresis.

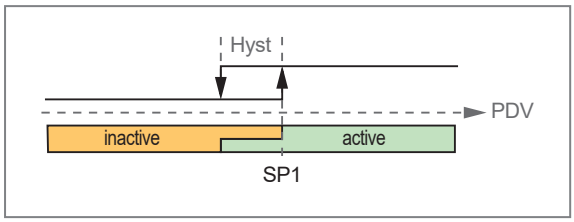


Fig. 4: Switch-point logic high active

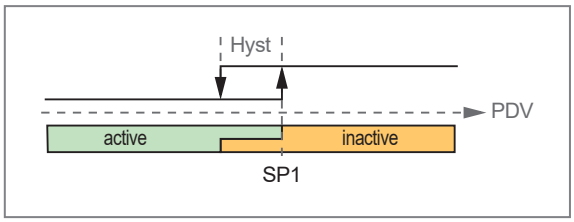


Fig. 5: Switch-point logic low active

Window mode

SP1 and SP2 can have the same value.

([High active logic]) The output is active within the switching limits (SP1) and (SP2). The output is inactive when the process value leaves the window area and the set hysteresis is exceeded: SP1+Hyst or SP2-Hyst.

([Low active logic]) The output is inactive within the switching limits (SP1) and (SP2). The output is active when the process value leaves the window area and the set hysteresis is exceeded: SP1+Hyst or SP2-Hyst.

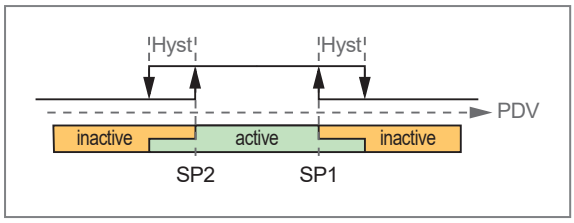


Fig. 6: Switch-point logic high active

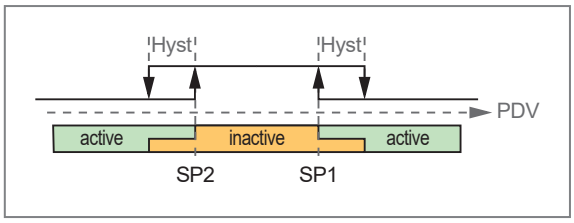


Fig. 7: Switch-point logic low active

The position of the setpoints is freely selectable; SP1 can be below or above SP2.

Two-point mode

SP1 and SP2 can have the same value.

A setpoint (SP1) and a reset point (SP2) are set manually.

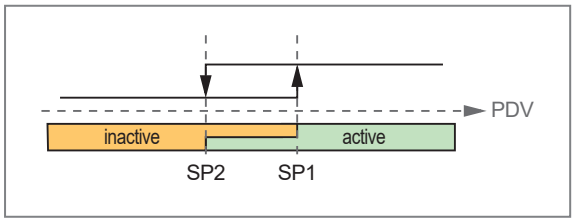


Fig. 8: Switch-point logic high active

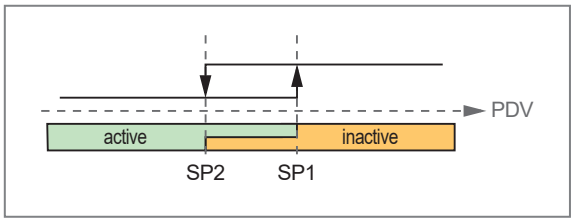


Fig. 9: Switch-point logic low active

The position of the setpoints is freely selectable; SP1 can be below or above SP2.

4.7.2 Setpoints

The following parameters can be configured for each SSC using [SSCx.y Param]:

Parameter	Values	Description
[SP1]	-210…1370 (default: 100)	Setpoint 1 (not in switch point mode [Deactivated])
[SP2]	-210…1370 (default: 25)	Setpoint 2 (only in switch point modes [Window] and [Two point])

The teach function can be used to set the setpoints to current and calculated measured values.
Teach function (→ 🗋 11)

4.7.3 Teach function

The teach function enables switch point setting to the current measured value. The parameter [Teach Select] is used to specify the SSC for teaching.

Parameter	Value	Description
[Teach Select]	1 (default)	Teach SSC1.1
	2	Teach SSC1.2
	11	Teach SSC2.1
	12	Teach SSC2.2
	21	Teach SSC3.1
	22	Teach SSC3.2
	31	Teach SSC4.1

Parameter	Value	Description
[Teach Select]	32	Teach SSC4.2

The IO-Link system command [Teach SP1] or [Teach SP2] starts the teach operation: First, the current measured value is set off against the configured zero-point calibration, cold junction compensation and IIR filter values, and from this, the teach point (TP) is determined. Then, the corresponding setpoint is set depending on the selected switch point mode:

Switch point mode	IO-Link system command	Setpoint calculation
[Single point]	[Teach SP1]	SP1 = TP_{SP1} – Hyst
[Window]	[Teach SP1]	SP1 = TP_{SP1}
	[Teach SP2]	SP2 = TP_{SP2}
[Two point]	[Teach SP1]	SP1 = TP_{SP1}
	[Teach SP2]	SP2 = TP_{SP2}

The parameter [Teach Result] shows the current status of the teach operation:

Parameter	Value	Description
[Teach Result]	0 (default)	Idle Default status after • device start • reset • change of SSC via [Teach Select]
	1	SP1 success SP1 has been taught successfully.
	2	SP2 success SP2 has been taught successfully.
	3	SP1, SP2 success SP1 and SP2 have been taught successfully.
	4	Wait for command No use
	5	Busy Setpoint is calculated and validated.
	7	Error Value is outside the measuring range.

Teaching is not possible in the following cases:

- Port is disabled (port mode 00)
- Switch point mode [Deactivated] is selected
- [Teach SP2], if switch point mode [Single point] is selected
- Error case

4.7.4 Counter function

[SSC Counter] displays the counter value of the respective SSC. The counter is incremented by 1 each time the setpoint is exceeded (change of the SSC bit from 0 to 1).

Value range of the counter: 0…2.147.483.647 (default: 0)

The counter is also incremented if the SSC status changes due to changes to the SSC parameters [Logic], [Mode], [Hyst], [SP1] or [SP2].

The IO-Link system commands [Back-to-box] and [Reset-to-Zero] reset the counts of all SSCs to 0.

The IO-Link system command [Application Reset] does NOT reset the SSC counts.

5 Installation

▶ Disconnect the power of the machine before installation.

▶ For installation choose a flat mounting surface.

▶ Fasten the module onto the mounting surface using M5 mounting screws and washers. Tightening torque 1.8 Nm.

6 Electrical connection

The unit must be connected by a qualified electrician.

Observe the national and international regulations for the installation of electrical equipment.

Voltage supply according to SELV, PELV.

For the UL scope of validity:

▷ Device supply according to Limited Energy in conformity with chapter 9.4, UL61010-1.

▷ The cabling of the device must only be used in an indoor environment.

▷ To connect the device, only use UL-certified cables belonging to category CYJV or PVVA with a minimum temperature of 65 °C and AWG 24 – AWG 16.

6.1 Connecting the device

▶ Disconnect power.

▶ Connect the unit as follows:

M12 plug, A-coded, IO-Link (X1)

1: L+ (US)
2: not used
3: L- (US)
4: IO-Link

M12 connector, A-coded, ports (X1.0...X1.3)

1: R+: Pt100 / Pt1000
2: MP+: Pt100 / Pt1000; type J / type K thermocouple
3: R-: Pt100 / Pt1000
4: MP-: Pt100 / Pt1000; type J / type K thermocouple
5: FE

Connection examples: Port modes

6.1.1 IO-Link connection

The IO-Link port must be connected according to the IO-Link specification.

6.1.2 Mounting the connector

The threaded connections in the device correspond to the M12 standard. To ensure compliance with the specified protection rating, only cables that comply with this standard may be used. In the case of self-assembled cables, the system manufacturer is responsible for the protection rating.

▶ Use connectors with gold-plated contacts.

▶ During installation, place the connectors vertically so that the coupling nut will not damage the thread.

▶ Observe the coding of the connectors during installation.

If connector in the device:

▶ Tighten the cable sockets according to the torque specifications indicated by the cable vendor. Maximum permissible tightening torque: 0.8 Nm

If sockets in the device:

▶ Tighten the cable plug using 1.0 ± 0.1 Nm.

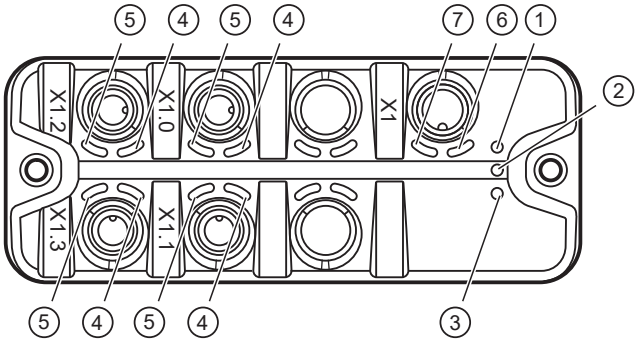
▶ Cover unused sockets with protective caps (article number E73004). Tightening torque: 0.6...0.8 Nm

▶ Provide all outgoing cables with suitable strain relief after a maximum of 200 mm. Observe the minimum bending radius of the cables (→ information from the cable manufacturer).

6.1.2.1 Maximum cable length

- Without IO-Link communication: 30 m on each side
- With IO-Link communication: 20 m on the master side

7 Operating and display elements



1:	LED INT	Internal error
2:	LED 1	Not used
3:	LED 2	Not used
4:	LED port status 1	Port status
5:	LED port status 2	Port status
6:	LED	IO-Link communication
7:	LED US	Supply voltage

7.1 LEDs

LED	Colour	Status	Designation
INT	Red	On	Internal error
		Off	No internal error Device in operating mode
1	—	—	Not used
2	—	—	Not used
US	Green	On	Voltage supply ≥ 18 V
		Off	Voltage supply < 16 V
	Green	On	IO-Link communication active
		Off	IO-Link communication not active
Port status	Yellow	LED port status 1 off LED port status 2 off	Port is disabled (port mode 00)
		LED port status 1 on LED port status 2 on	Input signal in measuring range
		LED port status 1 on LED port status 2 flashing	Input signal too low
		LED port status 1 flashing LED port status 2 on	Input signal too high
		LED port status 1 flashing LED port status 2 flashing	No sensor / port error

8 Troubleshooting

LED	LED status	IO-Link event code	Error	Troubleshooting
INT	On	No IO-Link connection	Internal error	Contact ifm support. Contact at www.ifm.com
Port status 1 and 2	Flashing	0x8CBA	No sensor signal	Check/correct sensor type, port mode and connections. → Function → Electrical connection
Port status 1 and 2	Flashing	0x5010	Port error	Contact ifm support. Contact at www.ifm.com

9 Maintenance, repair and disposal

The unit is maintenance-free.

▶ After use, dispose of the unit in an environmentally friendly way in accordance with the applicable national regulations.

Cleaning the unit:

▶ Disconnect the unit from the voltage supply.

▶ Clean the unit from dirt using a soft, chemically untreated and dry micro-fibre cloth.