Non-contact Thermometer
SA-80T-4IO
User's Manual

Thank you for purchasing the non-contact thermometer SA-80T-4IO.

This manual contains the information necessary for using the SA-80T-4IO. Read this manual thoroughly before using this product to ensure correct use of this product with full understanding of its functions and performance. After you have finished reading this manual, store it safely for future reference.

- Support for the China RoHS directive



For details on the support for the China RoHS (the Administrative Measure on the Control of Pollution Caused by Electronic Information Products), see the following website.
http://www.optex-fa.com/rohs_cn/

- Specifications are subject to change without notice
- For more information, questions and comments regarding product, please contact us at the information below.

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Safety Precautions

Safety precautions for ensuring safe operation of this product are displayed as follows with the following symbols.
Precautions listed here describe important information about safety. Make sure to follow them accordingly.

Safety Symbols

⚠WARNING	Indicates that any improper operation or handling may result in moderate or minor injury, and in rare cases, serious injury or death. Also indicates a risk of serious property damage.
⚠CAUTION	Indicates that any improper operation or handling may result in minor injury or property damage.

⚠WARNING	
	Do not disassemble, repair, modify, deform under pressure, or attempt to incinerate this product. Doing so may cause injury or fire.
	This product is not explosion-proof and should not be used around flammable or explosive gases or liquids. Doing so may cause ignition resulting in an explosion or fire.
	Do not use air dusters or any spray that uses flammable gas around the product or on the inside of the product. Doing so may cause ignition resulting in an explosion or fire.
	Do not install this product in any of the following locations. Doing so may cause a fire, damage, or a malfunction. 1. Locations where dust, salt, iron powders, or vapor (steam) is present. 2. Locations subjected to corrosive gases or flammable gases. 3. Locations where oil or chemical splashes may occur. 4. Locations where heavy vibrations or impacts may occur. 5. Locations where the ambient temperature exceeds the rated range. 6. Locations subject to rapid temperature changes (or where condensation occurs). 7. Locations with strong electric or magnetic fields. 8. Outdoor locations or locations subject to direct light.
	This is a class A product. In a domestic environment this product may cause radio interference, in which case the user may be required to take adequate measures.
	This product is not intended for use with nuclear power, railways, aviation, vehicles, medical equipment, food-handling equipment, or any application where particular safe-ty measures are required. Absolutely do not use this product for any of these fields.
	This product cannot be used in applications that directly or indirectly detect human bodies for the purpose of ensuring safety. Do not use this product as a detection device for protecting the human body.
	Do not let the thermometer touch the measured object. This product is a non-contact thermometer. Touching high-temperature object may cause deformation of the meter, irreparable damage or incorrect measurement.
	Do not let the lens touch with a hard or sharp-edged object. Do not insert foreign objects into the lens. These may cause incorrect measurement.
	Keep the thermometer away from sudden change in ambient temperature. Sudden temperature change may cause incorrect measurement. Start measurement when temperature has become stable after leaving the meter for a while.
	What to do in the event of a malfunction such as smoke being emitted from the product: If you detect any malfunction including emission of smoke, abnormal smells or sounds, or the body becoming very hot, immediately stop operating the product and turn off the product power. Failure to do so may cause a fire. Repairing the product is dangerous and should in no way be performed by the customer. Contact an OPTEX FA sales representative for repairs.

⚠CAUTION

- Make sure to turn the power off before wiring the cable or connecting/disconnecting the connector. Connecting or disconnecting while powered may damage this product or cause electric shock.
- Avoid using the transient state while the power is on (10 min.). Output could become unstable, causing unexpected operation.
- Do not place wires with this product near a high voltage cable or power line. Doing so may cause malfunction or damage by induction.
- Do not bend the cable when below the freezing point. This may cause the cable to break.
- Do not drop this product or subject this product to strong impacts. Doing so may damage this product.
- Follow the instructions in this manual or the specified instruction manual for correct wiring, when wiring this product. Incorrect wiring may cause a damage or malfunction of this product.
- When disconnecting the connector, be careful not to touch the terminals inside the connector, and do not allow foreign objects to enter the connector.
- Install this product as far away as possible from high-voltage equipment, power equipment, equipment that generates large switching surges, inverter motors, welders, or any equipment that can be a source of noise.
- When connecting or disconnecting the cable, make sure to hold it by the connector portion, and do not apply excessive force to the cable.

NOTICE

- After carefully considering the intended use, required specifications, and usage conditions, install and use this product within the specified and rated ranges.
- Information about the hardware, software, and system included in this manual is subject to change without notice.
- When using this product, it is the responsibility of the customer to ensure the necessary safety designs in hardware, software, and systems in order to prevent any threat to life, physical health, and property that may be caused by product malfunction or failure.
- Do not use this product for the development of weapons of mass destruction, for military use, or for any other military application. If this product is to be exported, comply with all applicable export laws and regulations, including the Foreign Exchange and Foreign Trade Act and the Export Administration Regulations, and carry out the necessary procedures pursuant to the provisions therein.
- For more details on conformity to the Restriction of Hazardous Substances Directive for this product, please contact an OPTEX FA sales representative. Before using this product, fully examine the applicable environmental laws and regulations, and operate this product in conformity with such laws and regulations. OPTEX FA does not assume any responsibility for damages or losses occurring as a result of non-compliance with applicable laws and regulations.
- Measurement characteristics and values may vary depending on the state of the target object and variations among individual products.
- This product is not an instrument with a scale or display, but outputs temperature degree Celsius or Fahrenheit. In Japan, set the temperature output to Celsius if using a display unit to indicate the temperature when selling this product or presenting it for sale.

1 General Description

SA-80T-4IO is a non-contact thermometer with IO-Link communication. It measures the temperature of targets in the range of 0 to +400 °C, 32 to 752 °F.

2 Included Items

- SA-80T-4IO
- Instruction manual
- Mounting nuts x2
- Mounting bracket

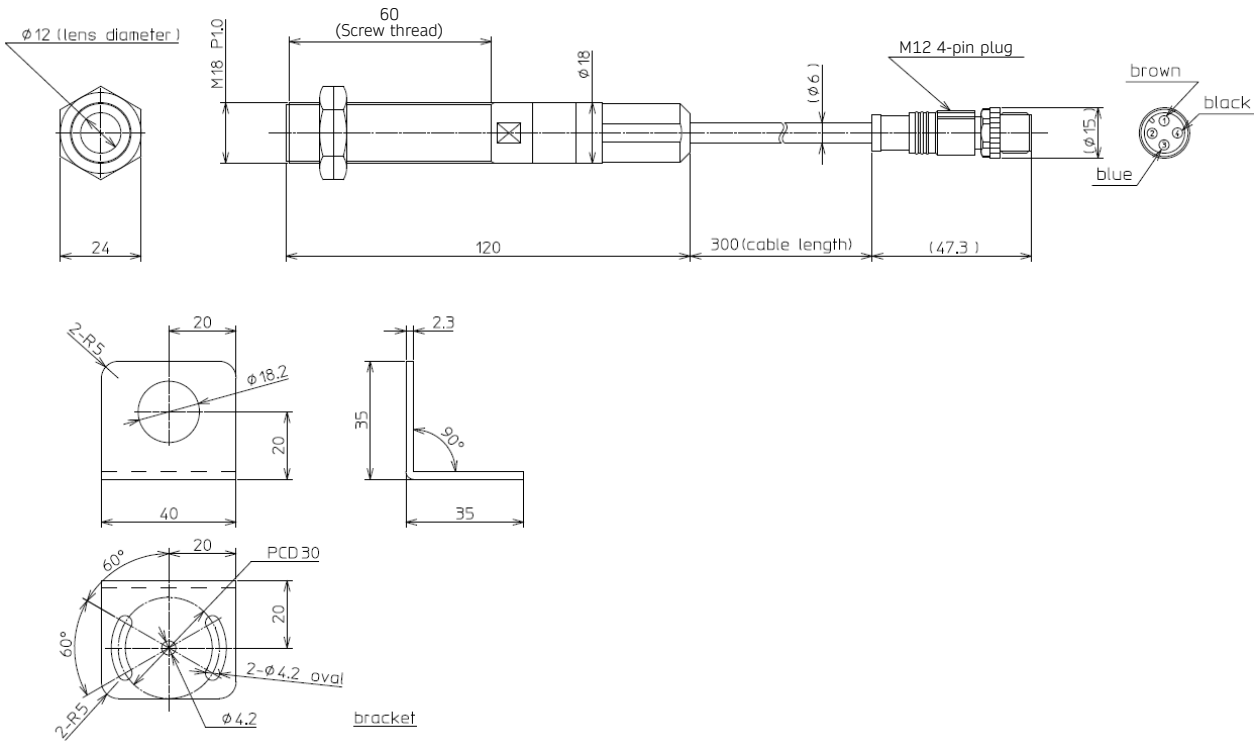
3 Connector cables (optional)

M12 4-pin connector cables（straight, open-end)

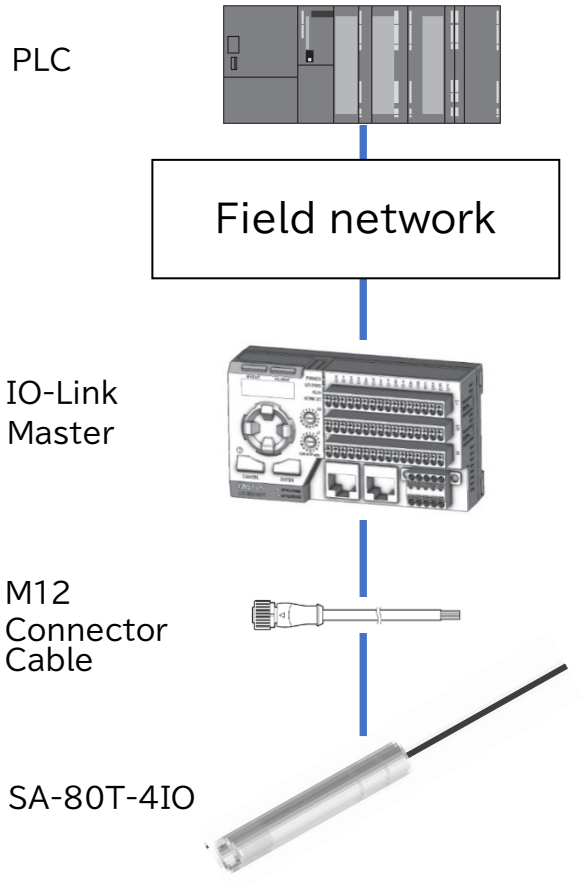
Model:

- YF2A14-020VB3XLEAX: 2 m length
- YF2A14-050VB3XLEAX: 5 m length
- YF2A14-100VB3XLEAX: 10 m length

4 External Dimensions



5 System Structure



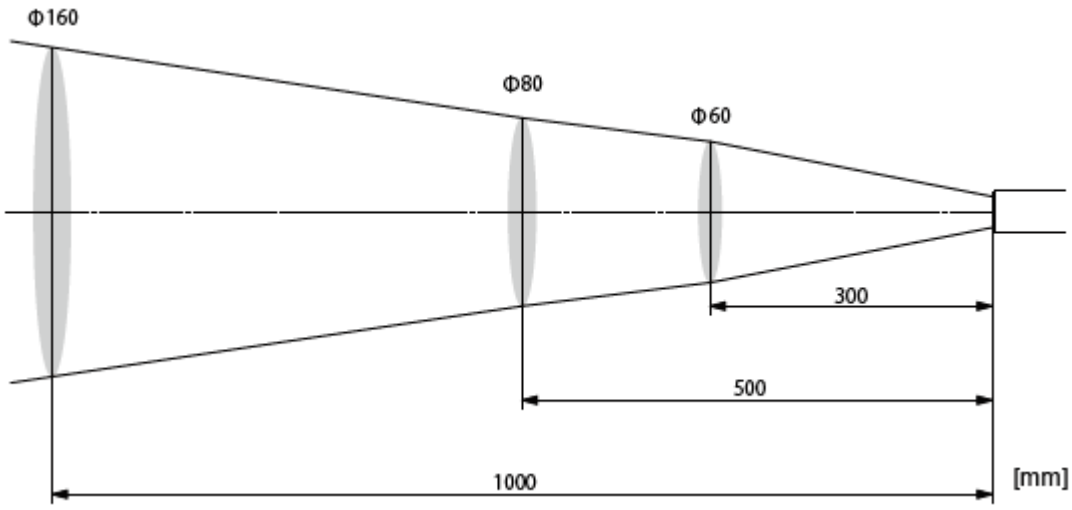
6 Specifications

Item		Specification
Measurement range		0 to 400 °C (32 to 752 °F)
Field of view		ø80 mm/500 mm
Optics		Silicon lens
Sensing element/spectral response		Thermopile/8 to 14 µm
Response time		100 ms/90 % response
Accuracy		0 to 200 °C (32 to 392 °F): ±2 °C (±3.6 °F), 201 to 400 °C (393.8 to 752 °F): ±1 % of measured value * Measurement conditions: ε = 1.0, ambient temperature: 23 ± 5°C (73.4 ±9 °F), distance at 250 mm, target size: ø100 mm
Repeatability		±1 °C (±1.8 °F) of reading value
Emissivity adjustment		0.1 to 1.2
Supply voltage		18 to 30 VDC ±10 %
Current consumption		Max. 50 mA
Communication interface		IO-Link
Total cable extension		20 m
Environmental resistance	Degree of protection	IP67
	Ambient temperature	0 to 70 °C (32 to 158 °F)
	Ambient humidity	35 to 85 % RH (no condensation)
	Storage temperature	-20 to 70 °C (-4 to 158 °F)
	Vibration resistance	10 to 55 Hz, 1.5 mm amplitude, 2 hours each for XYZ directions
Applicable regulations	EMC	EMC Directive (2014/30/EU)
	Environment	RoHS Directive (2011/65/EU), China RoHS (MIIT Order No.32)
Applicable standard		EN 61326-1
Materials		SUS/AL
Weight		Approx. 180 g

■ IO-Link specifications

Item	Specifications
Host communication interface	IO-Link (operates as device)
Minimum cycle time	3 ms
Baud rate	COM2 (38.4 kbps)
IO-Link revision	1.1
Communication function operation power supply	IO-Link power supply (supplied from the IO-Link master)
Process input data byte count	4 bytes
Process output data byte count	0 byte

7 Field of View



The fields of view stated above are measurement diameters with an optical response of 90%.

The size of the measurement target must be sufficiently larger than the measurement diameters shown in the above diagram.

8 Installation

The screw thread on the product is M18 x P1.0. Use the included mounting nuts to securely install this product in a ø18mm or larger hole.

Using an item such as an L-shaped metal fitting sold on the market makes it easy to adjust the angle, etc.

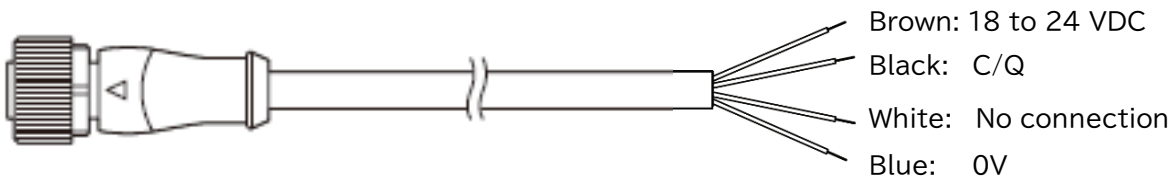
Note the following when installing this product.

- This product should be installed perpendicular to the measurement target.
- Avoid mechanical shock to this product.
- Make sure there are no heat sources around the location of this product and measurement target. Highly reflective measurement targets may cause an error in measurement.
- Do not install this product in a location where the ambient temperature is +70°C or higher or where this product will be exposed to direct hot air.

9 Connection

■ Wiring to the IO-Link Master

Use the M12 4-pin connector cable to connect the IO-Link master and this product.



10 Measurement

1. Ensure that the connection is correct before applying power to this product.

2. Check that this product operates properly on the IO-Link master.

* There may be some errors in the measured temperature when the temperature of this product is unstable, such as immediately after this product is installed.

■ Emissivity (ε)

The emissivity is the rate of the energy emitted from the surface of the object. All objects possess a particular emissivity that changes according to the object's surface conditions and temperature. Setting the emissivity of the measurement target on this product allows for more precise measurements.

Objects with a low emissivity (e.g. the surfaces of shiny metallic objects) reflect the surrounding temperature since they are highly reflective. For such targets, nearby heat sources other than the measurement target will lead to incorrect measurements due to these temperatures being reflected. In these situations, countermeasures such as blocking all heat sources other than the measurement target should be implemented. Taking into consideration usage convenience, the emissivity can be set up to 1.20 on this product.

11 Maintenance

■ Lens

Dust, dirt, and scratches on the lens can cause incorrect measurements. In case of dirty lenses, please remove the dust on the lens with a blower for lens cleaning, etc. If the dust or dirt cannot be removed with a blower, lightly wipe the lens with a cotton swab or special lens cleaning cloth using a small quantity of ethyl alcohol.

■ Housing

If the housing becomes excessively dirty, wipe it with a soft cloth using a small quantity of ethyl alcohol.

■ Calibration

OPTEX FA recommends having calibration performed annually. Contact an OPTEX FA sales representative.

12 Process Data

The process data exchanged by this product with the IO-Link master via IO-Link cyclic communication is shown below.

IO-Link process data is transmitted in big-endian format, so the following table is also expressed in this format.

By default, OPTEX FA's IO-Link master UR-MS and UR-ES series convert IO-Link process data to little-endian format before transmitting it to the field network. When using these products, refer to the following table by reversing the byte order.

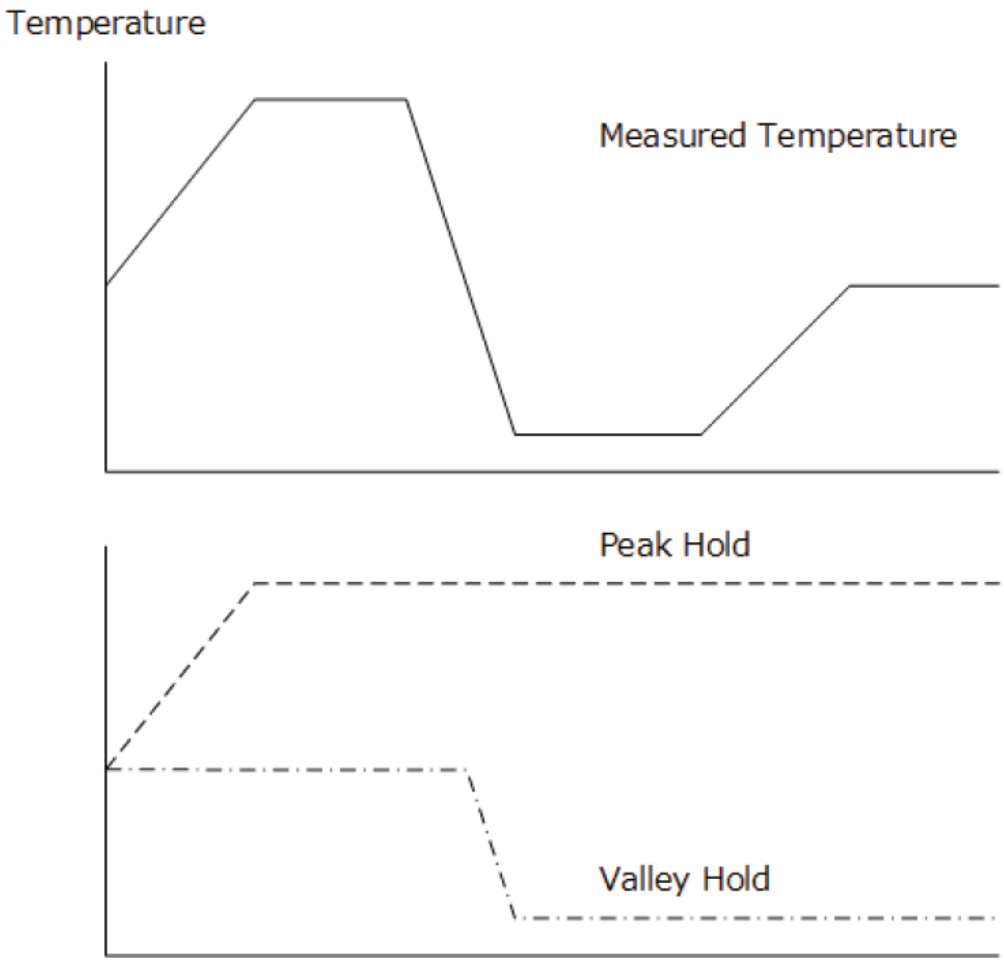
Process data	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Process input data	+0	Upper eight bits of the measured temperature							
	+1	Lower eight bits of the measured temperature in units of 0.1 (corresponding to [Select process data]). If °F is selected with [Select process data], the measured temperature unit also becomes °F.							
	+2	Details corresponding to [Select process data]							
	+3	Details corresponding to [Select process data]							Alarm Output

■ Details corresponding to [Select process data]

Process input data is assigned as follows according to [Select process data].

Value	Details
0: Peak temperature hold	Highest temperature during measurement
1: Valley temperature hold	Lowest temperature during measurement
2: Internal temperature	Temperature of this product

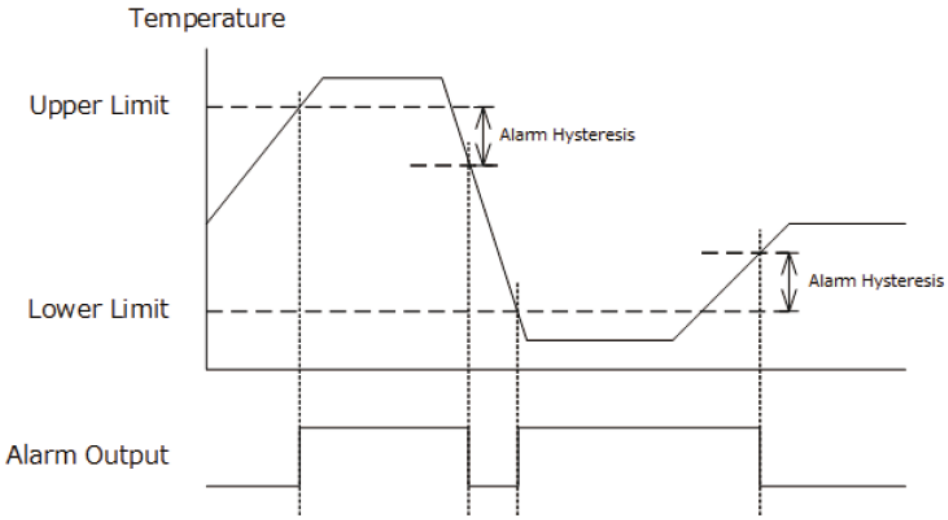
The [Select process data] options “Peak temperature hold” and “Valley temperature hold” operate as shown in the following diagrams.



Use the [System command] “Reset hold” to reset the held temperatures.

■ Alarm output

Upper limit/lower limit/hysteresis



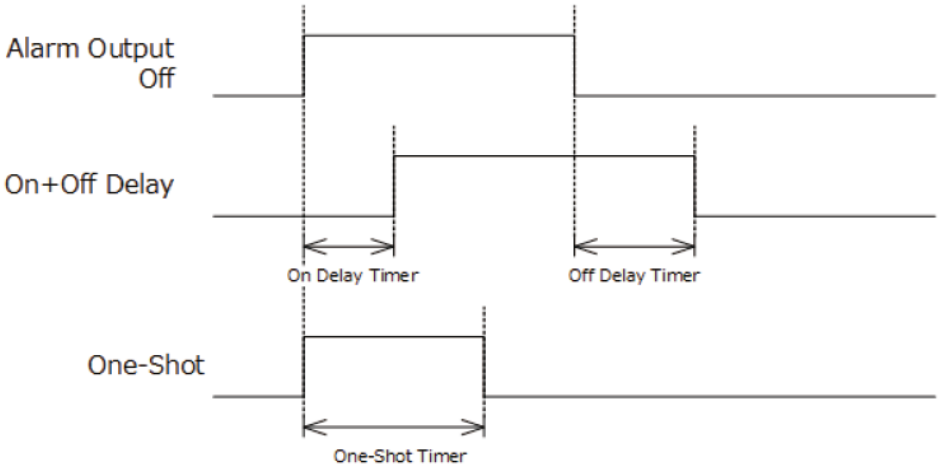
Alarm output turns on when the measured temperature exceeds the upper alarm limit.

This output turns off when the measured temperature falls below (upper alarm limit minus alarm hysteresis).

Alarm output turns on when the measured temperature falls below the lower alarm limit.

This output turns off when the measured temperature exceeds (lower alarm limit plus alarm hysteresis).

Alarm timer



When [Alarm timer function] is set to [Delay], the output is delayed for the time set with [On delay time] and [Off delay time] as shown with “Delay” in the above diagram.

When [Alarm timer function] is set to [One-shot], output is generated just for the time set with [One-shot time] as shown with “One-shot” in the above diagram.

13 Service Data

The service data of this product that can be read/written via IO-Link ISDU handling is shown below.

W: Write only, R/W: Read/Write, R: Read only

Name	Index number	Subindex number	Read/Write	Data byte count
System command	2	0	W	1
Device lock	12	0	R/W	2
Emissivity	64	0	R/W	2
Response Time	65	0	R/W	1
Emissivity teaching	66	0	R/W	2
Upper alarm limit	67	0	R/W	2
Lower alarm limit	68	0	R/W	2
Timer function	128	0	R/W	1
One-shot time	129	0	R/W	1
On delay time	130	0	R/W	1
Off delay time	131	0	R/W	1
Select alarm	132	0	R/W	1
Alarm hysteresis	133	0	R/W	1
Estimated days until maintenance is required	160	0	R	2
Time until maintenance event	161	0	R/W	4
Operating time	162	0	R	4
Select process data	192	0	R/W	1
Teaching status	193	0	R	1

■ System command

Index number	Subindex number	Read/Write	Data byte count	Default value
2	0	W	1	—

Value	Details
130	Initializes the settings.
160	Resets the peak temperature hold or valley temperature hold selected with [Select process data].

■ Device lock

Index number	Subindex number	Read/Write	Data byte count	Default value
12	0	R/W	2	0

Value	Details
0	Unlocks the data storage function.
1	Locks the parameters.
2	Locks the data storage function.
3	Locks the parameters and the data storage function.

■ Emissivity

Index number	Subindex number	Read/Write	Data byte count	Default value
64	0	R/W	2	0.950

Value	Details
0.100 to 1.200	Sets the emissivity of the measurement target. The value is set in units of 0.001.

■ Response time

Index number	Subindex number	Read/Write	Data byte count	Default value
65	0	R/W	1	1.0

Value	Details
0.1 to 10.0	Applies moving average processing to the measured temperature. A longer response time increases the delay before the measured temperature is obtained, but the measured value will be more stable. The response time is set in units of 0.1 seconds.

■ Emissivity teaching

Index number	Subindex number	Read/Write	Data byte count	Default value
66	0	R/W	2	—

Value	Details
0.0 to 400.0 (°C) 32.0 to 752.0 (°F)	Calculates the emissivity so that the measured temperature equals the set temperature. When this value is read, the current measured temperature is returned.

If the target temperature is known but the emissivity of the measurement target is not, the ratio can be calculated and set with the following procedure.

1. Ready the measurement target for measurement. Ensure that the ambient temperature is stable. (Wait approximately 10 minutes after power on.)
2. Write the target temperature in index 66, [Emissivity teaching].
3. Wait 100 ms.
4. Read index 66, [Emissivity teaching]. The procedure has been successful if the measured temperature is close to the target temperature.

An error result is stored in index 193, [Teaching status], when:

- The automatically calculated emissivity is not in the range of 0.1 to 1.2.
- The target temperature of the measurement target is close to the ambient temperature, making it difficult to detect the difference between these temperatures.

  As an example, with an emissivity of 0.95 and an ambient temperature of 25°C, calculation is possible if the difference between the ambient and target temperatures is 5°C or more.

■ Alarm output: Upper limit

Index number	Subindex number	Read/Write	Data byte count	Default value
67	0	R/W	2	400 (°C)
				752 (°F)

Value	Details
0.0 to 400.0 (°C) 32.0 to 752.0 (°F)	Alarm output turns on when the measured temperature exceeds the set temperature. Once this output turns on, it remains on until the temperature falls below the temperature set with [Alarm hysteresis] from the upper alarm limit. This item is enabled when [Select alarm] is set to “Upper limit only” or “Upper limit and lower limit.” The value is set in units of 0.1. The unit corresponds to [Select process data].

For details, refer to “Upper limit/lower limit/hysteresis.”

■ Alarm output: Lower limit

Index number	Subindex number	Read/Write	Data byte count	Default value
68	0	R/W	2	0 (°C)
				32 (°F)

Value	Details
0.0 to 400.0 (°C) 32.0 to 752.0 (°F)	Alarm output turns on when the measured temperature falls below the set temperature. Once this output turns on, it remains on until the temperature exceeds the temperature set with [Alarm hysteresis] from the upper alarm limit. This item is enabled when [Select alarm] is set to “Lower limit only” or “Upper limit and lower limit.” The value is set in units of 0.1. The unit corresponds to [Select process data].

For details, refer to “Upper limit/lower limit/hysteresis.”

■ Timer function

Index number	Subindex number	Read/Write	Data byte count	Default value
128	0	R/W	1	0: No timer

Value	Details
0: No timer	Sets no timer for alarm output.
1: Delay	Sets the delay timer for alarm output.
2: One-shot	Sets the one-shot for alarm output.

For details, refer to “Alarm timer.”

■ One-shot time

Index number	Subindex number	Read/Write	Data byte count	Default value
129	0	R/W	1	1.0

Value	Details
0.1 to 10.0	Sets the length of time that alarm output is on. This item is enabled when [Timer function] is set to “One-shot.”

For details, refer to “Alarm timer.”

■ On delay time

Index number	Subindex number	Read/Write	Data byte count	Default value
130	0	R/W	1	1.0

Value	Details
0.0 to 10.0	Sets the length of time until alarm output turns on. This item is enabled when [Timer function] is set to “Delay.”

■ Off delay time

Index number	Subindex number	Read/Write	Data byte count	Default value
131	0	R/W	1	1.0

Value	Details
0.0 to 10.0	Sets the length of time until alarm output turns off. This item is enabled when [Timer function] is set to “Delay.”

■ Select alarm

Index number	Subindex number	Read/Write	Data byte count	Default value
132	0	R/W	1	3: Enable both

Value	Details
0: Disable	Turns alarm output off.
1: Enable only upper limit	Alarm output turns on when the measured temperature exceeds the [Alarm upper limit].
2: Enable only lower limit	Alarm output turns on when the measured temperature falls below the [Alarm lower limit].
3: Enable both	Alarm output turns on when the measured temperature exceeds the [Alarm upper limit] or falls below the [Alarm lower limit].

■ Alarm hysteresis

Index number	Subindex number	Read/Write	Data byte count	Default value
133	0	R/W	1	2.0 (°C)
				3.6 (°F)

Value	Details
0.0 to 10.0 (°C)	Applies hysteresis to the upper/lower limit temperature at which the alarm turns off after it has turned on.
0.0 to 18.0 (°F)	

■ Estimated days until maintenance is required

Index number	Subindex number	Read/Write	Data byte count	Default value
160	0	R	2	—

Value	Details
	Returns the number of days until maintenance is required.

■ Time until maintenance event

Index number	Subindex number	Read/Write	Data byte count	Default value
161	0	R/W	4	0

Value	Details
0 to 88000	Returns the remaining time, in units of 1 hour, until the next maintenance event. When this time reaches 0, a “Maintenance required” notification event occurs. After this event occurs, reset this value.

■ Operating time

Index number	Subindex number	Read/Write	Data byte count	Default value
162	0	R	4	—

Value	Details
	Returns the operating time, in units of 1 hour.

■ Select process data

Index number	Subindex number	Read/Write	Data byte count	Default value
192	0	R/W	1	0: Peak temperature hold (°C)

Value	Details
0: Peak temperature hold (°C)	Highest temperature during measurement. The value is displayed in units of 0.1°C.
1: Valley temperature hold (°C)	Lowest temperature during measurement. The value is displayed in units of 0.1°C.
2: Internal temperature (°C)	Temperature of this product. The value is displayed in units of 0.1°C.
3: Peak temperature hold (°F)	Highest temperature during measurement. The value is displayed in units of 0.1°F.
4: Valley temperature hold (°F)	Lowest temperature during measurement. The value is displayed in units of 0.1°F.
5: Internal temperature (°F)	Temperature of this product. The value is displayed in units of 0.1°F.

■ Teaching status

Index number	Subindex number	Read/Write	Data byte count	Default value
193	0	R	1	0

Value	Details
Bit 0	The emissivity calculated by emissivity teaching is out of range.
Bit 1	Calculation is not possible because the difference between the internal temperature and the temperature of the measurement target is small.

14 Events

Name	Event code	Type	Description
Maintenance required	6144	Notification	The referential time for calibration or the user-specified time for cleaning has been reached.
Memory rewriting limit	6145	Error	Setting value memory has exceeded the limit of write cycle. This indicates the end of this product's service life, so we recommend you replace it as soon as possible.
Calibration value reading failure	20497	Error	It is no longer possible to read the normal calibration value. If this event occurs again, after turning power off and on, consider recalibration or repair of this product.
High temperature warning	16912	Warning	The internal temperature of this product has exceeded +70°C.
Low temperature warning	16928	Warning	The internal temperature of this product has fallen below 0°C.

15 Troubleshooting

Problem	Cause	Solution
Cannot perform measurement.	The supply voltage is not being applied.	Check the power connection wires and connect them securely.
	The supply voltage is low.	Check the supply voltage.
The measured value is incorrect.	The lens is dirty.	Clean the lens.
	The field of view is off center.	Adjust the installation position of this product while checking the measured value.
	The temperature of a high-temperature object located nearby is affecting the measurement.	Block the heat source using a board, etc.
The measured value is not stable.	This product is being affected by vibrations.	Prevent the vibrations.
	This product is being subjected to rapid temperature changes.	Wait a moment until the internal temperature of this product stabilizes.

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