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IO-Link

Electronic Temperature Sensor and Temperature Probe

SENTINEL INDUSTRIAL AUTOMATION

Operating Instructions

CE

TIANJIN SENTINEL ELECTRONICS CO .,LTD.
www.sentinel-china.com

Thank you for choosing the Sentinel TBH Series Programmable Display Integrated Temperature Sensor. This manual mainly describes the specifications, features, usage, and accessories of the temperature sensor. Please read this manual carefully before using the product. Our company reserves the right to continuously improve the product. For the latest version of the documentation, please refer to the Sentinel company website (www.sentinel-china.com), as updates will not be separately notified.

1 Safety Instructions

■ Please read and follow these safety precautions before installing, operating, and maintaining the product.

■ To ensure personal and equipment safety, please follow the operating instructions or technical documentation to ensure that the product is suitable for your application range and is not subject to any limitations.

■ This product should be used in an environment that meets the design specifications. Failure to do so may result in malfunctions, and any issues arising from non-compliance are not covered by the warranty.

■ We are not liable for any personal injury or property damage caused by improper operation. Warranty claims will be void if the equipment is improperly installed or used.
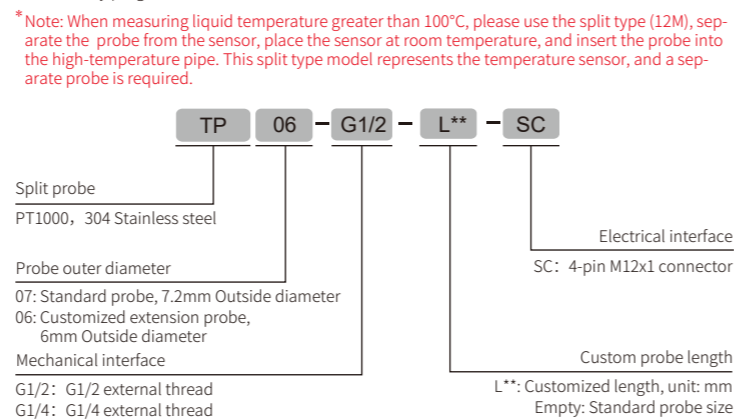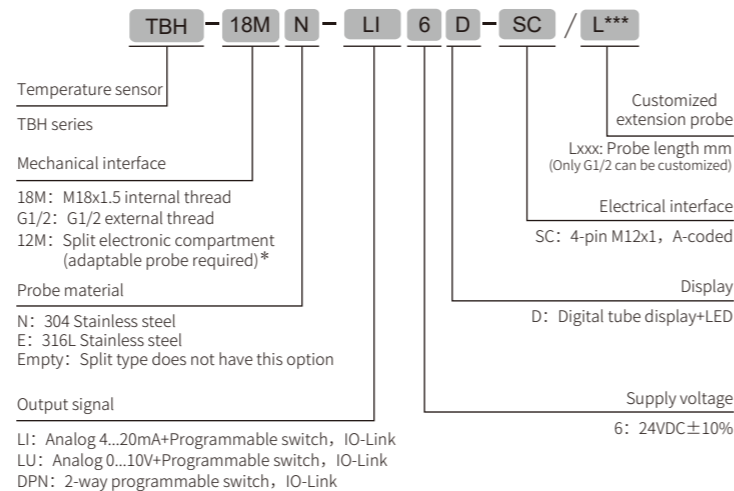
2 Product Overview

The temperature sensor monitors system temperatures in machines and equipment. Sentinel's temperature sensors feature a compact design, stainless steel construction, and built-in IO-Link communication. The integrated and separate series cater to different temperature ranges, environmental conditions, and installation depths.

3 Features and Functions

■ IO-Link function

■ 4-digit large digital tube display，Mirroring, semi-transparent design

■ Upper part of the housing can be rotated 300° (G1/2 only)

■ NO/NC, PNP/NPN/push-pull, hysteresis/window configurable

■ Switching signal/analog signal configurable, Switching signal/IO-Link configurable

■ Sensor parameters can be set via buttons and IO-Link

■ The start and end point of the analog signal can be set

■ Standard 4-pin A-code M12 interface

■ Simple key operation, with key lock function

■ The display panel adopts an integrated molded housing
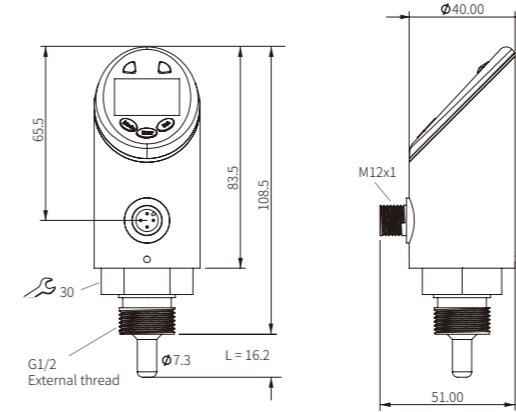
■ The housing body is made of stainless steel
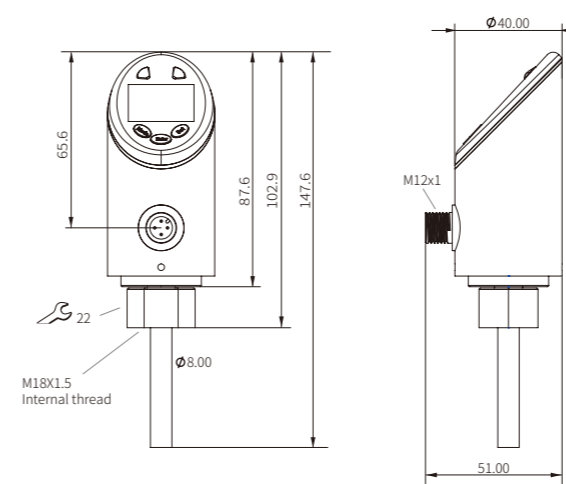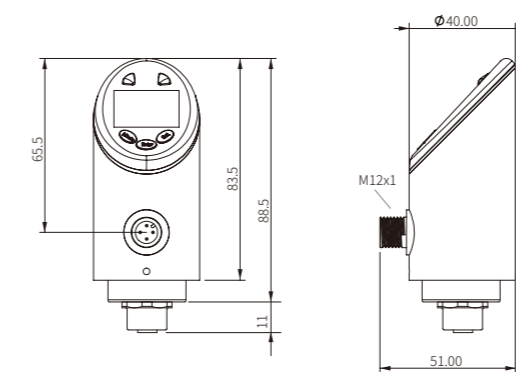
4 Selection Guide

TBH – 18M – N – LI – 6 – D – SC / L***

Temperature sensor
TBH series

Mechanical interface
18M：M18x1.5 internal thread
G1/2：G1/2 external thread
12M：Split electronic compartment (adaptable probe required)*

Probe material
N：304 Stainless steel
E：316L Stainless steel
Empty：Split type does not have this option

Output signal
LI：Analog 4...20mA+Programmable switch，IO-Link
LU：Analog 0...10V+Programmable switch，IO-Link
DPN：2-way programmable switch，IO-Link

*Note: When measuring liquid temperature greater than 100℃, please use the split type (12M), separate the probe from the sensor, place the sensor at room temperature, and insert the probe into the high-temperature pipe. This split type model represents the temperature sensor, and a separate probe is required.

Customized extension probe
Lxxx: Probe length mm (Only G1/2 can be customized)

Electrical interface
SC：4-pin M12x1，A-coded

Display
D：Digital tube display+LED

Supply voltage
6：24VDC±10%

TP – 06 – G1/2 – L** – SC

Split probe
PT1000，304 Stainless steel

Probe outer diameter
07: Standard probe, 7.2mm Outside diameter
06: Customized extension probe, 6mm Outside diameter

Mechanical interface
G1/2：G1/2 external thread
G1/4：G1/4 external thread

Electrical interface
SC：4-pin M12x1 connector

Custom probe length
L**: Customized length, unit: mm
Empty: Standard probe size
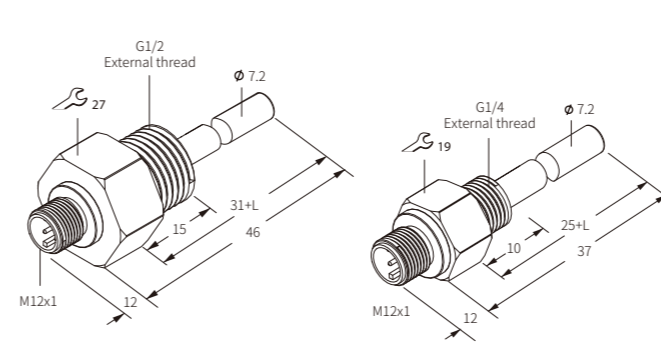
5 Dimensions

Unit : mm

5.1 G1/2 External thread

Ø40.00
65.5
83.5
108.5
M12x1
30
G1/2 External thread
Ø7.3
L = 16.2
51.00

5.2 M18 Internal thread

Ø40.00
65.6
87.6
102.9
147.6
M12x1
22
M18X1.5 Internal thread
Ø8.00
51.00

5.3 Split electronic compartment

Ø40.00
65.5
83.5
88.5
M12x1
11
51.00

5.4 Probe

G1/2 External thread
Ø 7.2
27
15
31+L
46
M12x1
12

G1/4 External thread
Ø 7.2
19
10
25+L
37
M12x1
12
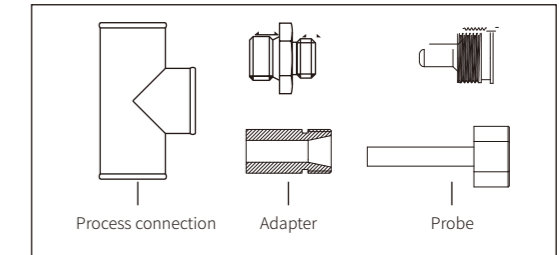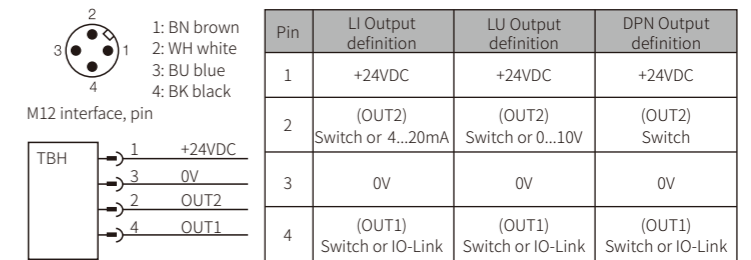
Note: L in this drawing size is the default length

6 Installation Instructions

Before installing or dismantling the equipment, ensure that there is no leakage at the process connection.

Use an appropriate adapter to screw into the process connection. The adapter must be ordered separately as an accessory.

Place the sensor onto the adapter and tighten the nut with a maximum torque of 50 Nm. Ensure that the probe is inserted into the pipeline to a depth of at least 12 mm.
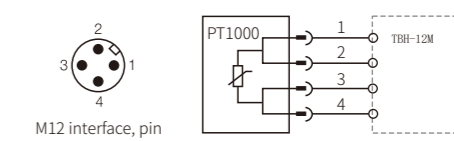

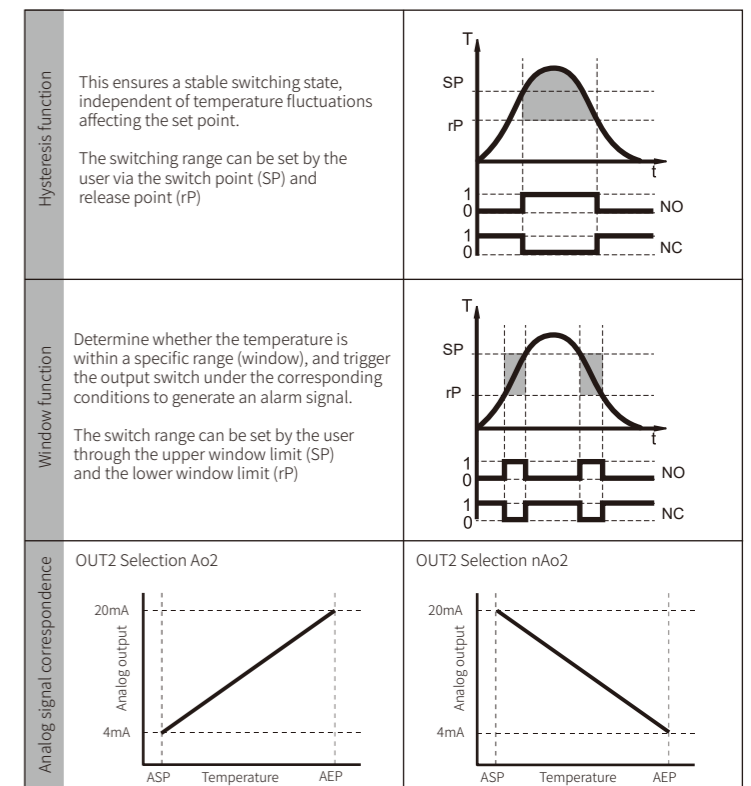Process connection   Adapter   Probe

7 Wiring Diagram

7.1 Sensor wiring instructions

M12 interface, pin

1: BN brown
2: WH white
3: BU blue
4: BK black

TBH
1 +24VDC
3 0V
2 OUT2
4 OUT1

Pin	LI Output definition	LU Output definition	DPN Output definition
1	+24VDC	+24VDC	+24VDC
2	(OUT2) Switch or 4...20mA	(OUT2) Switch or 0...10V	(OUT2) Switch
3	0V	0V	0V
4	(OUT1) Switch or IO-Link	(OUT1) Switch or IO-Link	(OUT1) Switch or IO-Link

7.2 Probe wiring instructions

M12 interface, pin

PT1000
1 TBH-12M
2
3
4

8 Description of Switching Signal Data and Analog Signal Data Output

Hysteresis function

This ensures a stable switching state, independent of temperature fluctuations affecting the set point.

The switching range can be set by the user via the switch point (SP) and release point (rP)

T, SP, rP, t, 1/0 NO, 1/0 NC

Window function

Determine whether the temperature is within a specific range (window), and trigger the output switch under the corresponding conditions to generate an alarm signal.

The switch range can be set by the user through the upper window limit (SP) and the lower window limit (rP)

T, SP, rP, t, 1/0 NO, 1/0 NC

Analog signal correspondence

OUT2 Selection Ao2

20mA / 4mA — Analog output
ASP Temperature AEP

OUT2 Selection nAo2

20mA / 4mA — Analog output
ASP Temperature AEP

When selecting analog output, users can determine the corresponding relationship by setting the analog starting point (ASP) and analog end point (AEP). The minimum distance between ASP and AEP is 10℃; AEP should be larger than ASP;

Note: 1. When setting SP, it must be greater than rP. You can set the SP value first and then rP. If the set SP is less than rP, rP will drop to the maximum value allowed.
2. When setting AEP, it must be greater than ASP. You can set AEP first and then ASP. If the set AEP is less than ASP, ASP will drop to the maximum value allowed.

9 Display and Operation Panel

Enlarged view of unit display area

PWR | bar | MPa | m³/h | m/s | % | °C | °F
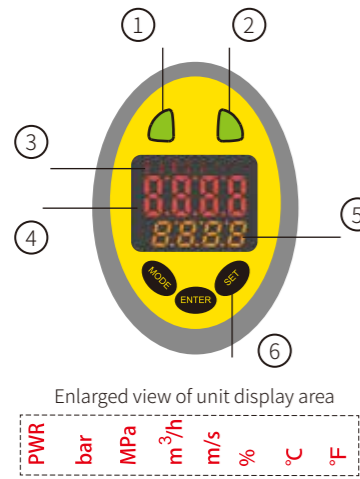
	Definition	Status Indication	
1	Output Status Indicator Light OUT1	Green	On: The corresponding switch pin is turned on for output Off: The corresponding switch pin turns off the output Note: This LED indicates the output status and is not an alarm light.
2	Output Status Indicator Light OUT2		
3	Unit display area PWR	Red	Steady on: Power supply is normal Off: Power supply is abnormal Flashing: IO-Link communication is normal
	Unit display area °C °F	Red	On: represents the unit of the current digital tube display data Off: Not the current unit
4	Data display area (large digital tube)	Red	Display sensor measurement data Display "-----" means the data is invalid
5	Status display area (small digital tube)	Orange	Error code is displayed, indicating sensor abnormality or data abnormality The error code Err is displayed, indicating sensor abnormality or data abnormality The display Loc means the key lock is on
6	Setting button		

Note: The display area adopts a semi-transparent design. It can be seen when the LED is on, but not when it is off; other unused units are not visible on the sensor.

10 IO-Link Process Data Mapping

BYTE	BYTE0							
BIT	15	14	13	12	11	10	9	8
DATA	Tbit13	Tbit12	Tbit11	Tbit10	Tbit9	Tbit8	Tbit7	Tbit6

BYTE	BYTE1							
BIT	7	6	5	4	3	2	1	0
DATA	Tbit5	Tbit4	Tbit3	Tbit2	Tbit1	Tbit0	OUT2	OUT1

Note 1:
Tbit represents 14-bit temperature data. The temperature data is a signed number in °C. The integrated sensor range is -500 to 1500 (the split sensor range is -500 to 5000), which means the actual temperature is magnified 10 times. OUT1 and OUT2 represent the output status; Use the right shift instruction to remove OUT1 and OUT2 to obtain 14-bit temperature data.
Note 2:
When the temperature data is invalid, the data is -4096.

11 FAC Default Parameter

Parameter List	SP1	rP1	SP2	rP2	AEP2	ASP2	Un It	toC1	toC2
FAC Default Value	60℃	50℃	60℃	50℃	100℃	0℃	℃	no1	no2
Parameter List	oUt1	oUt2	d IS1	d IS2	FoU1	FoU2	d iro	Loc	
FAC Default Value	PnP1	PnP2	hyS1	hyS2	oFF1	oFF2 *	UP	0:unlock	

* When [oUt2] selects analog signal output, In case of an internal fault, The output signal will run according to the parameter settings in [FoU2].

	FoU2=ON	FoU2=OFF
[oUt2]=Ao2	20mA	4mA
[oUt2]=nAo2	4mA	20mA

12 Key Operation

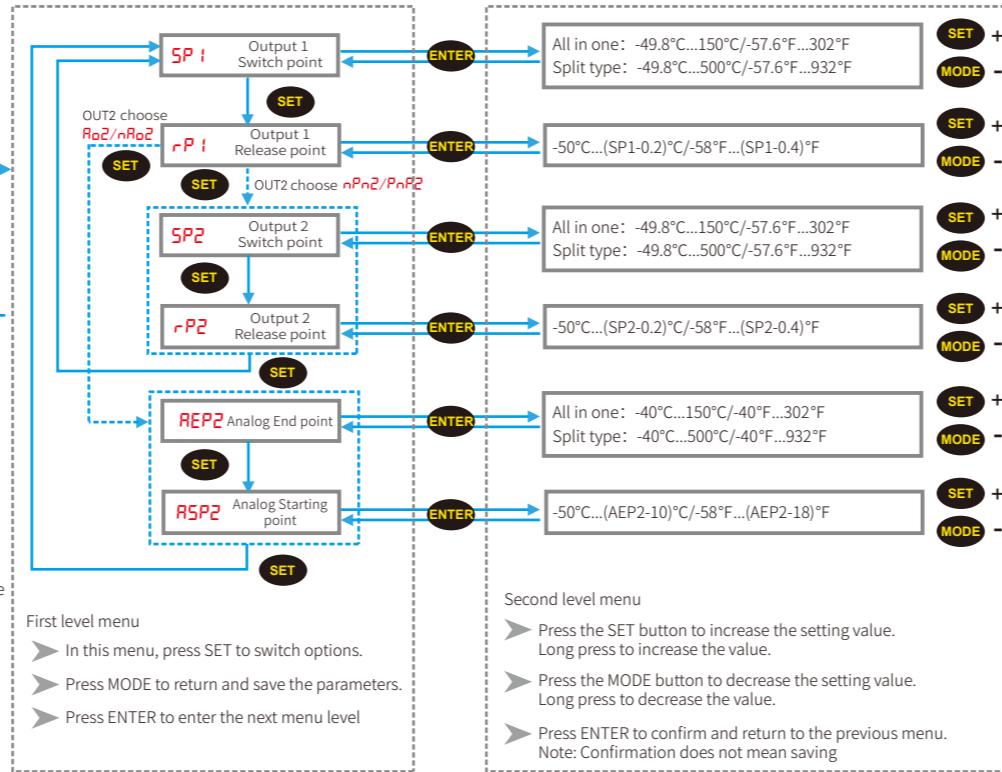### 12.1 Simple menu operation

Normal display mode

In this mode, press the MODE button for more than 2 seconds to enter the first level menu

In this mode, press the ENTER key + SET key simultaneously for more than 6 seconds to turn the key lock on or off
When turned on, the small digital tube display area will display Loc

First level menu
- In this menu, press SET to switch options.
- Press MODE to return and save the parameters.
- Press ENTER to enter the next menu level

Menu	Description	Second level range
SP1	Output 1 Switch point	All in one: -49.8°C...150°C/-57.6°F...302°F Split type: -49.8°C...500°C/-57.6°F...932°F
rP1	Output 1 Release point	-50°C...(SP1-0.2)°C/-58°F...(SP1-0.4)°F
SP2	Output 2 Switch point	All in one: -49.8°C...150°C/-57.6°F...302°F Split type: -49.8°C...500°C/-57.6°F...932°F
rP2	Output 2 Release point	-50°C...(SP2-0.2)°C/-58°F...(SP2-0.4)°F
AEP2	Analog End point	All in one: -40°C...150°C/-40°F...302°F Split type: -40°C...500°C/-40°F...932°F
ASP2	Analog Starting point	-50°C...(AEP2-10)°C/-58°F...(AEP2-18)°F

OUT2 choose Ao2/nAo2
OUT2 choose nPn2/PnP2

Second level menu
- Press the SET button to increase the setting value. Long press to increase the value.
- Press the MODE button to decrease the setting value. Long press to decrease the value.
- Press ENTER to confirm and return to the previous menu. Note: Confirmation does not mean saving
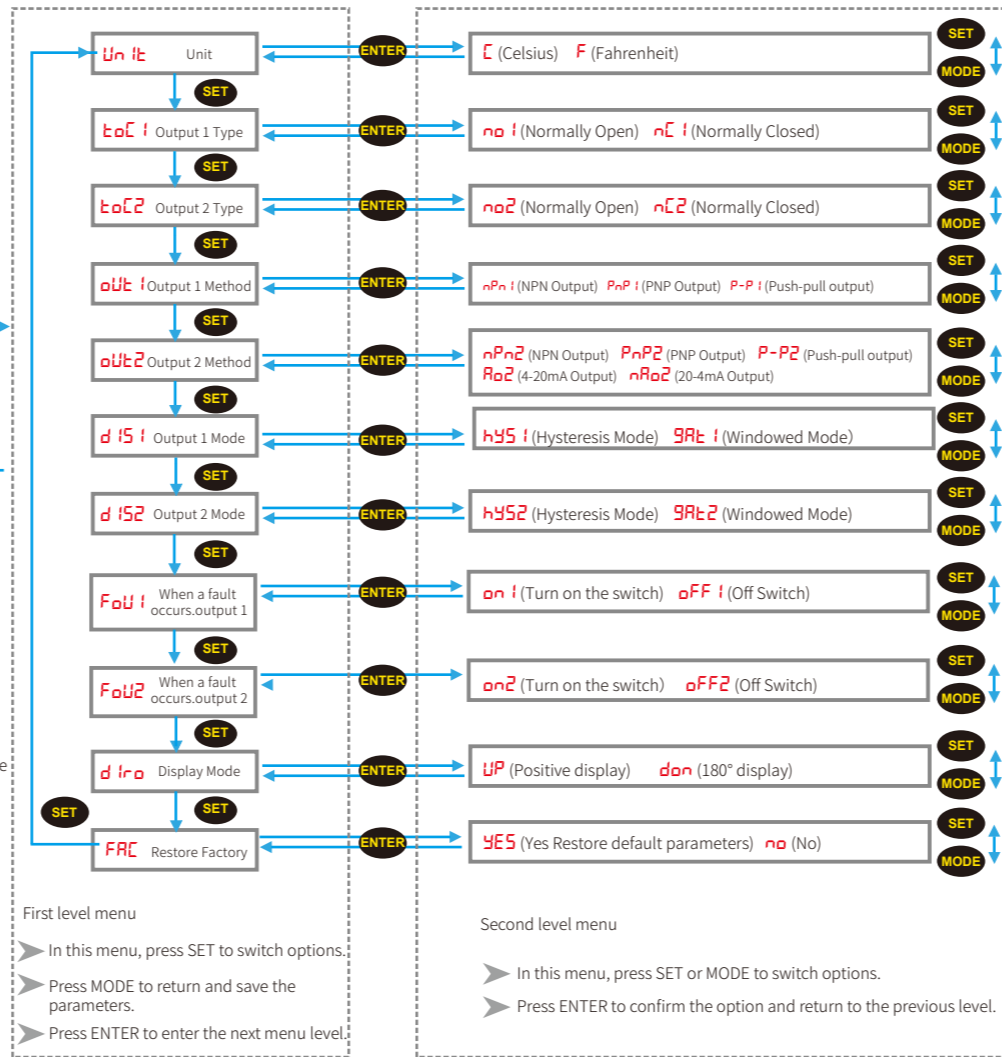
12.2 Programming menu operation

Normal display mode

In this mode, press the MODE and SET keys simultaneously for more than 2 seconds to enter the first level programming menu

In this mode, press the ENTER key + SET key simultaneously for more than 6 seconds to turn the key lock on or off.

When turned on, the small digital tube display area will display Loc

Menu	Description	Second level options
Un It	Unit	C (Celsius) F (Fahrenheit)
toC1	Output 1 Type	no1 (Normally Open) nC1 (Normally Closed)
toC2	Output 2 Type	no2 (Normally Open) nC2 (Normally Closed)
oUt1	Output 1 Method	nPn1 (NPN Output) PnP1 (PNP Output) P-P1 (Push-pull output)
oUt2	Output 2 Method	nPn2 (NPN Output) PnP2 (PNP Output) P-P2 (Push-pull output) Ao2 (4-20mA Output) nAo2 (20-4mA Output)
d IS1	Output 1 Mode	hyS1 (Hysteresis Mode) gAt1 (Windowed Mode)
d IS2	Output 2 Mode	hyS2 (Hysteresis Mode) gAt2 (Windowed Mode)
FoU1	When a fault occurs.output 1	on1 (Turn on the switch) oFF1 (Off Switch)
FoU2	When a fault occurs.output 2	on2 (Turn on the switch) oFF2 (Off Switch)
d iro	Display Mode	UP (Positive display) don (180° display)
FAC	Restore Factory	YES (Yes Restore default parameters) no (No)

First level menu
- In this menu, press SET to switch options.
- Press MODE to return and save the parameters.
- Press ENTER to enter the next menu level.

Second level menu
- In this menu, press SET or MODE to switch options.
- Press ENTER to confirm the option and return to the previous level.

Note: After entering the simple or programming menu, if there is no key operation within 3.5 minutes, it will automatically return to the normal display mode without changing the setting parameters;
For the switch output mode, NPN controls the 0V switch, providing a low level without a high level; PNP controls the 24V switch, providing a high level without a low level;
P-P push-pull is a combination of NPN and PNP;

13 IO-Link Parameter

13.1 Parameter data / Request data /Indexing Service(ISDU indexed service data unit)

Index	Subindex	Parameter name	length	Permissions	Describe
0x02 2	0	System Commands	1Byte	Write	0x80 128 Reset device 0x82 130 Restore factory settings
0x10 16	0	Manufacturer's name	8Byte	Read	Sentinel
0x11 17	0	Manufacturer Description	41Byte	Read	Sentinel Industrial Ethernet manufacturer
0x12 18	0	Product name	14Byte	Read	TBH-xxx-xxx-SC
0x13 19	0	Product ID	8Byte	Read	19841701
0x14 20	0	Product Description	26Byte	Read	Temperature sensor io-link
0x15 21	0	Serial-Number	10Byte	Read	1984170101
0x16 22	0	Hardware version	8Byte	Read	HW-V0.01
0x17 23	0	Software version	8Byte	Read	FW-V0.01
0x18 24	0	Apply Tags	maximum 32Byte	Read Write	ApplicationSpecificTag is used to mark the device in the application This item is defined in the IODD file. Included in the DataStorage (DS)
0x19 25	0	Function Label	maximum 32Byte	Read Write	FunctionTag is a special tag for device functions, including This item is not defined in the IODD file, It can be set directly through Index.
0x1A 26	0	Local Tags	maximum 32Byte	Read Write	LocationTag is a special tag used for local devices, including DS This item is defined in the IODD file, It can be set directly through Index.
0x24 36	0	Device status	1Byte	Read	0: The equipment is operating normally; 1: Need to maintain; 2: Running incorrect environment or parameters; 3: Device abeyance; 4: Device failed to run;

Index	Subindex	Parameter name	Length	Permissions	Ranges	
0x1F4 500	0	Unit	1Byte	Read Write	0: °C Celsius	1: °F Fahrenheit
0x1F5 501	0	toC1 Output 1 Type	1Byte	Read Write	0: NO Normally open	1: NC Normally Closed
0x1F6 502	0	toC2 Output 2 Type	1Byte	Read Write	0: NO Normally open	1: NC Normally Closed
0x1F7 503	0	oUt1 Output 1 method	1Byte	Read Write	0: NPN output 1: PNP output 2: P-P push-pull output	
0x1F8 504	0	oUt2 Output 2 method	1Byte	Read Write	0: NPN output 1:PNP output 2:P-P push-pull output 3:Ao(4-20mA) 4:nAo(20-4mA)	
0x1F9 505	0	diS1 Output 1 Mode	1Byte	Read Write	0: hyS hysteresis mode	1: gAt window mode
0x1FA 506	0	diS2 Output 2 Mode	1Byte	Read Write	0: hyS hysteresis mode	1: gAt window mode
0x1FB 507	0	diro Display Mode	1Byte	Read Write	0: UP positive display	1: don 180°display
0x1FC 508	0	Lock Key lock	1Byte	Read Write	0: Unlocked	1: Key locked
0x1FD 509	0	When FoU1 fails, output mode 1	1Byte	Read Write	0: oFF1(Off switch)	1: on1(Turn on the switch)
0x1FE 510	0	When FoU2 fails, output mode 2	1Byte	Read Write	0: oFF2(Off switch)	1: on2(Turn on the switch)
0x258 600	0	SP1 Output 1 Switch point	2Byte	Read Write	All in one: -498 to 1500 Note: Unit °C SP1 should be greater than rP1 otherwise it will be rejected Split type: -498 to 5000 Note: Unit °C SP1 should be greater than rP1 otherwise it will be rejected	
0x259 601	0	rP1 Output 1Release point	2Byte	Read Write	All in one: -500 to 1498 Note: Unit °C rP1 should be less than SP1 otherwise it will be rejected Split type: -500 to 4998 Note: Unit °C rP1 should be less than SP1 otherwise it will be rejected	
0x25A 602	0	SP2 Output 2 Switch point	2Byte	Read Write	All in one: -498 to 1500 Note: Unit °C SP2 should be greater than rP2 otherwise it will be rejected Split type: -498 to 5000 Note: Unit °C SP2 should be greater than rP2 otherwise it will be rejected	
0x25B 603	0	rP2 Output 2 Release point	2Byte	Read Write	All in one: -500 to 1498 Note: Unit °C rP2 should be less than SP2 otherwise it will be rejected Split type: -500 to 4998 Note: Unit °C rP2 should be less than SP2 otherwise it will be rejected	
0x25C 604	0	ASP2 Analog Starting point	2Byte	Read Write	All in one: -500 to 1400 Note: Unit °C ASP2 should be smaller than AEP2 otherwise it will be rejected Split type: -500 to 4900 Note: Unit °C ASP2 should be smaller than AEP2 otherwise it will be rejected	
0x25D 605	0	AEP2 Analog End point	2Byte	Read Write	All in one: -400 to 1500 Note: Unit °C AEP2 should be greater than ASP2 otherwise it will be rejected Split type: -400 to 5000 Note: Unit °C AEP2 should be greater than ASP2 otherwise it will be rejected	

13.2 Error code

32785 / 0x8011： Invalid index 32819 / 0x8033： The length of the written parameter exceeds the defined length
32786 / 0x8012： Invalid subindex 32820 / 0x8034： The length of the written parameter is less than the defined length
32816 / 0x8030： The written parameter exceeds the settable range

13.3 General information

The sensor has an IO-Link communication interface and requires a module with IO-Link function (IO-Link master) to operate. For more detailed information about IO-Link, please visit the company website.