SenseFuture

Device Communication Parameters & Command Format Specification

Striving for the Bright Future of Precision Optoelectronic Measurement.

SenseFuture Technologies Co., Ltd.

Contents

SenseFuture

1. Factory Default Communication Parameters

Parameters	value
Baud rate (default)	38400(TTL Interface) / 9600(RS485 Interface)
Data Bits	8
Stop bit	1
Parity bits	no
Address (default)	1

2. Communication Frame Format

Notice：Communication must be carried out in strict accordance with the instruction format, otherwise the device cannot respond.

2.1 ASCII Format

2.1.1 Temperature Controller General Parameter Command

Read：	Send：AAA=?@
	Reply：OKAAA=xxx@\r\n
Write：	Send：AAA=xxx@
	Reply：OKAAA=xxx@\r\n

●**AAA** is the ASCII Code Command,**xxx** is the Parameter value.

Example：Query/Set the PWM Output Frequency

Read：	Send：FPWM=?@
	Reply：OKFPWM=2@\r\n
Write：	Send：FPWM=2@
	Reply：OKFPWM=2@\r\n

2.1.2 Temperature Controller Channel Control Command

Read：	Send：TCn:AAA=?@
	Reply：OKAAA=xxx@\r\n
Write：	Send：TCn:AAA=xxx@
	Reply：OKAAA=xxx@\r\n

●**n** is the number of channels in **TCn**.For example ： TC1 is channel1 , TC2 is channel2;

●**AAA** is the ASCII Code Command,**xxx** is the Parameter value.

Example：ASCII Code Communication (channel1).(Channel2 can change TC1 to TC2)

Read：	Send：TC1:TG=?@
	Reply：OKTC1:TG=2500000@\r\n
Write：	Send：TC1:TG=2500000@
	Reply：OKTC1:TG=2500000@\r\n

2.2 Modbus-RTU Format

1. This product supports 03H,10H function code format.

2. Channel Control Command：This protocol takes channel1 as an example, its address range is 0x1000H~0x1999H, channel2 on the basis of channel1 address offset 0x1000H, and so on.

Function Code (HEX)	Instructions
0x03H	Read single or multiple registers
0x10H	Write single or multiple registers

●Read：

Host Command Format **(HEX)**：

Station Number	Function Code	Register Address		Number of Registers		CRC	
		High Bytes	Low Bytes	High Bytes	Low Bytes	High Bytes	Low Bytes
01	03	10	00	00	02	C0	CB

Device Acknowledgment **(HEX)**：

Station Number	Function Code	Byte Count	Register Data				CRC	
			Data 1	Data 2	Data 3	Data 4	High Bytes	Low Bytes
01	03	04	00	26	25	A0	01	10

●Write：

Host Command Format **(HEX)**：

Station Number	Function Code	Register Address		Number of Registers		Byte Count	Register Data				CRC	
		High Bytes	Low Bytes	High Bytes	Low Bytes		Data 1	Data 2	Data 3	Data 4	High Bytes	Low Bytes
01	10	10	00	00	02	04	00	26	25	A0	C5	4C

Device Acknowledgment **(HEX)**：

Station Number	Function Code	Register Address		Number of Registers		CRC	
		High Bytes	Low Bytes	High Bytes	Low Bytes	High Bytes	Low Bytes
01	10	10	00	00	02	45	08

3. Communication Command

3.1 Target Temperature Configuration

3.1.1 Query/Set Target Temperature Command

Command Type	ASCII Command	Register Address	Data Type	Number of Registers	Accessibility	Data Range
Channel Control Command	TG	0x1000H	int 32	2	Read / Write	-40000000~100000000
Description: 2500000 means 25.00000℃						

3.2 Temperature Controller Parameter Configuration

Temperature Calculation Model and Polynomial Correction.For details,see Appendix 1.

3.2.1 Query/Set Actual Temperature Command

Command Type	ASCII Command	Register Address	Data Type	Number of Registers	Accessibility	Data Range
Channel Control Command	TCADJTEMP	0x1002H	int 32	2	Read / Write	-40000000~100000000
Description: 2500000 means 25.00000℃						

3.2.2 Read the Resistance of the Sensor

Command Type	ASCII Command	Register Address	Data Type	Number of Registers	Accessibility	Data Range
Channel Control Command	RESISTOR	0x1004H	uint 64	4	Read Only	1~500000000000
Description: 10000000000 indicates that the resistance value of the current channel sensor is 10.000000kΩ						

3.2.3 Query/Set the Calculation Model

Command Type	ASCII Command	Register Address	Data Type	Number of Registers	Accessibility	Data Range
Channel Control Command	POLYOMIAL	0x1300H	uint 16	1	Read / Write	0~2

Description:

0：**B-value** Model (Parameters：NTC R_0 and B-value, polynomial temperature correction function enabled)

1：**PT** Model (Parameter：PT R_0, A, B and C values, polynomial temperature correction function enabled)

2：Steinhart-Hart(**S-H**) Model (Parameters：A_0, A_1, A_2, A_3 and A_4 values, polynomial temperature correction function disabled)

PS：Polynomial temperature correction function：A_0~A_7, $T_c = T_m + A_0 + A_1*T_m + A_2*T_m\text{^}2 + A_3*T_m\text{^}3 + A_4*T_m\text{^}4 + A_5*T_m\text{^}5 + A_6*T_m\text{^}6 + A_7*T_m\text{^}7$. (c= corrected; m = measurement)

3.2.4 Query/Set the NTC B

Command Type	ASCII Command	Register Address	Data Type	Number of Registers	Accessibility	Data Range
Channel Control Command	BX	0x1301H	uint 32	2	Read / Write	100000~5000000
Description: 395000 means the B value is 3950.00						

3.2.5 Query/Set the NTC R_0(Ω)

Command Type	ASCII Command	Register Address	Data Type	Number of Registers	Accessibility	Data Range
Channel Control Command	RP	0x1303H	uint 32	2	Read / Write	1~9000000
Description: 10000 means that the standard value of the NTC resistance is 10.000kΩ						

3.2.6 Query/Set the NTC Internal Resistor(Ω)

Command Type	ASCII Command	Register Address	Data Type	Number of Registers	Accessibility	Data Range
Channel Control Command	NTCRP	0x1305H	uint 64	4	Read / Write	1~11000000000
Description: 10000000000 means that the internal reference resistance of the NTC resistor is 10.000000000kΩ						

3.2.7 Query/Set the PT(Platinum) R_0(Ω)

Command Type	ASCII Command	Register Address	Data Type	Number of Registers	Accessibility	Data Range
Channel Control Command	PT1000RP	0x1309H	uint 32	2	Read / Write	0~10000000
Description: 1000000 means that the standard value of the PT1000 resistance is 1.000kΩ						

3.2.8 Query/Set the Callendar-van-Dusen Coefficient A of PT1000 Resistance (PT A)

Command Type	ASCII Command	Register Address	Data Type	Number of Registers	Accessibility	Data Range
Channel Control Command	PTA	0x130BH	int 32	2	Read / Write	-9000000~9000000
Description: 3908300 means that the A value in the PT model is 3.9083E-3						

3.2.9 Query/Set the PT B

Command Type	ASCII Command	Register Address	Data Type	Number of Registers	Accessibility	Data Range
Channel Control Command	PTB	0x130DH	int 32	2	Read / Write	-9000000~9000000
Description: -577500 means that the B value in the PT model is -5.775E-7						

3.2.10 Query/Set the PT C

Command Type	ASCII Command	Register Address	Data Type	Number of Registers	Accessibility	Data Range
Channel Control Command	PTC	0x130FH	int 32	2	Read / Write	-90000~90000
Description: -41830 means that the C value in the PT model is -4.183E-12						

3.2.11 Query/Set the PT Internal Resistor(Ω)

Command Type	ASCII Command	Register Address	Data Type	Number of Registers	Accessibility	Data Range
Channel Control Command	PTRP	0x1311H	uint 64	4	Read / Write	1~2100000000

Description: 2000000000 means that the internal reference resistance of the PT1000 resistor is 2.000000kΩ

3.2.12 Query/Set the A_0~A_7 Base

Command Type	ASCII Command	Register Address	Data Type	Number of Registers	Accessibility	Data Range
Channel Control Command	POLA0	0x1315H	int 64	4	Read / Write	-99999999999999~ 99999999999999
Description: The floating point part of the A_0 coefficient scientific notation: 99999999999999 stands for 9.99999999999. (The same after A_1~A_7); ASCII Command of A_n: **POLAn** (n is 0~7) Modbus A_0~A_7 Address: 0x1315H, 0x131AH, 0x131FH, 0x1324H, 0x1329H, 0x132EH, 0x1333H, 0x1338H						

3.2.13 Query/Set the A_0~A_7 Exponent

Command Type	ASCII Command	Register Address	Data Type	Number of Registers	Accessibility	Data Range
Channel Control Command	POLEA0	0x1319H	int 16	1	Read / Write	-100~100
Description: A_0 coefficient the index part of scientific notation : 100 . At this point, A_0=9.9999999999999E+100. (The same after A_1~A_7) ASCII Command of A_n: **POLEAn** (n is 0~7) Modbus A_0~A_7 Address : 0x1319H, 0x131EH, 0x1323H, 0x1328H, 0x132DH, 0x1332H, 0x1337H, 0x133CH						

3.2.14 Query/Set the Max Temperature Thresholds(℃)

Command Type	ASCII Command	Register Address	Data Type	Number of Registers	Accessibility	Data Range
Channel Control Command	OVERTEMPUP	0x133DH	int 32	2	Read / Write	-300000000~500000000
Description : When the measuring temperature is greater than the maximum control temperature, the temperature controller indicator blinks rapidly. 500000000 represents 5000°C						

3.2.15 Query/Set the Min Temperature Thresholds(℃)

Command Type	ASCII Command	Register Address	Data Type	Number of Registers	Accessibility	Data Range
Channel Control Command	OVERTEMPLOWER	0x133FH	int 32	2	Read / Write	-300000000~500000000
Description: When the measuring temperature is less than the minimum control temperature, the temperature controller indicator blinks rapidly. 300000000 represents 3000°C						

3.2.16 Query/Set Open/Short Circuit Output Protection Function

Command Type	ASCII Command	Register Address	Data Type	Number of Registers	Accessibility	Data Range
Channel Control Command	ONSENSOR	0x110CH	int 16	1	Read / Write	0~1
Description: 0: No operation. (Temperature can be given by external communication instruction **TC1:TCADJTEMP**). 1: When the sensor is not connected or the sensor is short-circuited, the temperature controller does not output voltage.						

3.3 Temperature Controller Output Configuration

3.3.1 Query/set the Max Output(%)

Command Type	ASCII Command	Register Address	Data Type	Number of Registers	Accessibility	Data Range
Channel Control Command	LIMITED	0x110EH	int 16	1	Read / Write	0~90
Description: 50 means that the maximum output of the current channel is 50% of the input voltage.						

3.3.2 Query/Set the Output Enable

Command Type	ASCII Command	Register Address	Data Type	Number of Registers	Accessibility	Data Range
Channel Control Command	ENABLE	0x1100H	uint 16	1	Read / Write	0~1
Description: 0：Output voltage is disabled; 1：Output voltage is enabled.						

3.3.3 Query/Set the Power-On Delay Output

Command Type	ASCII Command	Register Address	Data Type	Number of Registers	Accessibility	Data Range
Channel Control Command	STARTUPDELAY	0x110FH	uint 16	1	Read / Write	10~180
Description: x：Start after x seconds of startup delay (Only when it is output state before power off, the next startup will take effect delayed startup).						

3.3.4 Query/Set the Output Mode

Command Type	ASCII Command	Register Address	Data Type	Number of Registers	Accessibility	Data Range
Channel Control Command	MODE	0x1101H	uint 16	1	Read / Write	0~3
Description: 0：Cool&Heat; 1：Cool Only; 2：Heat Only; 3：Output percentage setting via communication.						

3.3.5 Query/Set the Output Polarity

Command Type	ASCII Command	Register Address	Data Type	Number of Registers	Accessibility	Data Range
Channel Control Command	PIDPOL	0x1102H	uint 16	1	Read / Write	0~1
Description: 0：Positive polarity output; 1：Negative polarity output.						

3.3.6 Query/Set the Output Voltage Percentage

Command Type	ASCII Command	Register Address	Data Type	Number of Registers	Accessibility	Data Range
Channel Control Command	PWMDUTY	0x1103H	int 64	4	Read / Write	-2000000~2000000
Description: 200000 means that the current output voltage percentage is 10%						

3.3.7 Query/Set the Temperature Ramp Rate

Command Type	ASCII Command	Register Address	Data Type	Number of Registers	Accessibility	Data Range

Channel Control Command	SPEED	0x1108H	uint 16	1	Read / Write	0~255 (V4.2.2 and below) 0~10000 (V4.2.3 and later)
Description: v4.2.2 and below versions : Temperature ramp rate, unit °C/s. 0 means no temperature change slope, 100 means 1°C/s. v4.2.3 and later versions : Temperature ramp rate, unit °C/s. 0 means no temperature change slope, 1000 means 1°C/s.						

3.3.8 Query/Set the Cooling/Heating Ratio

Command Type	ASCII Command	Register Address	Data Type	Number of Registers	Accessibility	Data Range
Channel Control Command	CHRATIO	0x1109H	uint 16	1	Read / Write	10~250
Description: Cooling/Heating Coefficient, 100 represents 1.00.						

3.3.9 Query/Set the Forward Starting Voltage

Command Type	ASCII Command	Register Address	Data Type	Number of Registers	Accessibility	Data Range
Channel Control Command	FDEADV	0x110AH	uint 16	1	Read / Write	0~400
Description: 200 represents 1% of the forward output initial voltage percentage.						

3.3.10 Query/Set the Reverse Starting Voltage

Command Type	ASCII Command	Register Address	Data Type	Number of Registers	Accessibility	Data Range
Channel Control Command	BDEADV	0x110BH	uint 16	1	Read / Write	0~400
Description: 200 represents -1% of the reverse output initial voltage percentage.						

3.3.11 Query/Set the PWM Output Frequency

Command Type	ASCII Command	Register Address	Data Type	Number of Registers	Accessibility	Data Range
General Parameter Command	FPWM	0x000DH	uint 16	1	Read / Write	0~3
Description: 0：PWM output frequency is 0.5HZ;　1：PWM output frequency is 1HZ; 2：PWM output frequency is 10HZ;　3：PWM output frequency is 100HZ.						

3.3.12 Query/Set the Over_Temp Action

Command Type	ASCII Command	Register Address	Data Type	Number of Registers	Accessibility	Data Range
General Parameter Command	OVERTTEMP	0x000BH	uint 16	1	Read / Write	0~1
Description: 0：When the sensor temperature is higher than the high threshold or lower than the low threshold, continue output. 1：When the sensor temperature is higher than the high threshold or lower than the low threshold, stop output.						

3.3.13 Query/Set Temperature Controller Mode Selection

Command Type	ASCII Command	Register Address	Data Type	Number of Registers	Accessibility	Data Range

General Parameter Command	CONTMODE	0x0004H	int 16	1	Read / Write	0~3

Description:

0：Independent control for each channel (default).

1：channel1($_{\text{Actual target T}}$)= channel2($_{\text{measured T}}$)+ channel1($_{\text{set target T}}$).

2：The Voltage /PWM output of channel2 follows the Voltage /PWM output of channel1.

3：channel1($_{\text{Actual target T}}$) = channel2 ($_{\text{measured T}}$)+ channel1($_{\text{set target T)}}$, Voltage /PWM output of channel2 follows Voltage /PWM output of channel1.

3.4 PID Configuration

3.4.1 Query/Set the P in PID

Command Type	ASCII Command	Register Address	Data Type	Number of Registers	Accessibility	Data Range
Channel control Command	KP	0x1200H	uint 32	2	Read / Write	0~9000000

Description: The coefficient of P in the PID formula.

3.4.2 Query/Set the I in PID

Command Type	ASCII Command	Register Address	Data Type	Number of Registers	Accessibility	Data Range
Channel control Command	KI	0x1202H	uint 32	2	Read / Write	0~9000000

Description: The coefficient of I in the PID formula.

3.4.3 Query/Set the D in PID

Command Type	ASCII Command	Register Address	Data Type	Number of Registers	Accessibility	Data Range
Channel control Command	KD	0x1204H	uint 32	2	Read / Write	0~9000000

Description: The coefficient of D in the PID formula.

3.4.4 Query/Set PID Self-tuning

Command Type	ASCII Command	Register Address	Data Type	Number of Registers	Accessibility	Data Range
Channel control Command	AUTOPID	0x1107H	uint 16	1	Read / Write	0~2

Description:

0：non-PID self-tuning and non-PID real-time automatic optimization;

1：PID self-tuning;

2：PID real-time automatic optimization.

3.5 Temperature Controller Basic Configuration

3.5.1 Query the Current Temperature Controller Model TEC

Command Type	ASCII Command	Register Address	Data Type	Number of Registers	Accessibility	Data Range
General parameter Command	TEC	0x0001H	uint 16	1	Read Only	0~255

Description:

1：TEC103； 2：TEC207L； 3：TEC207； 4：TEC215L； 5：TEC215； 6：TEC215Pro； 7：TEC107L； 8：TEC107；

9：TEC115L； 10：TEC115L； 11：TEC115Pro； 12：TEC100L； 13：TEC100； 14：TEC100Pro； 15：TEC403L； 16：TEC403； 17：TEC403Pro； 18：TEC415L； 19：TEC415； 20：TEC603L； 21：TEC603； 22：TEC615L； 23：TEC615； 24：TEC615Pro； 25：TEC803L； 26：TEC803； 27：TEC815L； 28：TEC815； 29：TEC815Pro； 30：TEC203L； 31：TEC203.

3.5.2 Query the Version Number

Command Type	ASCII Command	Register Address	Data Type	Number of Registers	Accessibility	Data Range
General parameter Command	FPV	0x000CH	uint 16	1	Read Only	100~999
Description： 100 represents the version number 1.0.0						

3.5.3 Query/Set the Temperature Controller Address

Command Type	ASCII Command	Register Address	Data Type	Number of Registers	Accessibility	Data Range
General parameter Command	ADDRESS	0x0002H	uint 16	1	Read / Write	0~255
Description： Temperature controller device address.						

3.5.4 Query/Set the UART TTL Volatility

Command Type	ASCII Command	Register Address	Data Type	Number of Registers	Accessibility	Data Range
General parameter Command	BOUNDTABLEONE	0x0008H	uint 16	1	Read / Write	0~7
Description： 0：4800； 1：9600； 2：19200； 3：38400； 4：57600； 5：115200； 6：23400； 7：460800.						

3.5.5 Query/Set the RS485 Volatility

Command Type	ASCII Command	Register Address	Data Type	Number of Registers	Accessibility	Data Range
General parameter Command	BOUNDTABLETWO	0x0009H	uint 16	1	Read / Write	0~7
Description： 0：4800； 1：9600； 2：19200； 3：38400； 4：57600； 5：115200； 6：23400； 7：460800.						

3.5.6 Query the Temperature Controller's Internal Temperature

Command Type	ASCII Command	Register Address	Data Type	Number of Registers	Accessibility	Data Range
General parameter Command	SINTERIORTEMP	0x0003H	int 16	1	Read Only	-20~120
Description： 20 indicates that the temperature of the temperature controller itself is 20°C.						

3.5.7 Query/Set the Temperature Controller Over-temperature Threshold

Command Type	ASCII Command	Register Address	Data Type	Number of Registers	Accessibility	Data Range
General parameter Command	OVERTVPT	0x000AH	uint 16	1	Read / Write	40~120
Description： 100 indicates that the temperature controller begins to gradually reduce the output power after its own temperature reaches 100.						

3.5.8 Query the Error Code

Command Type	ASCII Command	Register Address	Data Type	Number of Registers	Accessibility	Data Range
General parameter Command	ERRORCODE	0x0007H	uint 16	1	Read Only	0~3

Description:
0: There are no errors.
1: The temperature of the temperature controller itself is greater than the overtemperature threshold.
2: The temperature of the sensor in channel1 is greater than the high threshold or lower than the low threshold.
3: The temperature of the sensor in channel2 is greater than the high threshold or lower than the low threshold.

3.5.9 Restore Factory Setting

Command Type	ASCII Command	Register Address	Data Type	Number of Registers	Accessibility	Data Range
General parameter Command	RESET	0x0000H	uint 16	1	Write Only	1

Description: Restore factory Settings.

3.6 Other Data Query

3.6.1 Query: Comprehensive Data Retrieval

Command Type	ASCII Command	Register Address	Data Type	Number of Registers	Accessibility	Data Range
General parameter Command	INQUIRE	/	/	/	/	1

Description: Represents the current control temperature of channel1 is 25°C, the control temperature of channel2 is 25°C, the maximum output of channel1 is 30%, the maximum output of channel2 is 30%, the output mode of channel1 is two-way mode, the output mode of channel2 is two-way mode, the output of channel1 can be opened, the output of channel2 can be opened, The P of channel1 PID is 3000, the P of channel2 PID is 3000, the I of channel1 PID is 150, the I of channel2 PID is 150, the D of channel1 PID is 0, the D of channel2 PID is 0, the standard resistance of channel1 NTC resistance 10KΩ, the standard resistance of channel2 NTC resistance 10KΩ, The B value of channel1 NTC resistance is 3950, the B value of channel2 NTC resistance is 3950, the current version number of the temperature controller is 207L, the standard resistance of channel1 PT1000 is 1kΩ, the standard resistance of channel2 PT1000 is 1kΩ, and the cooling/heating coefficient of channel1 is 1.00, channel2 coefficient/heating coefficient is 1.00,channel1 of temperature change slope change is not limited, channel2 of temperature change slope change is not limited, channel1 control temperature to ±0.01 degrees is the STATE pin output high level, channel2 control temperature to ±0.01 degrees is the STATE pin output high level, When the temperature of channel1 is greater than 5000°C, the controller will turn off the output; when the temperature of channel2 is greater than 5000°C, the controller will turn off the output; when the temperature of channel1 is less than -3000°C, the controller will turn off the output; when the temperature of channel1 is less than -3000°C, the controller will turn off the output; the forward dead zone voltage of channel1 is 0. channel2 positive dead zone voltage is 0, channel1 negative dead zone voltage is 0,channel2 negative dead zone voltage is 0, the internal reference resistance of channel1 NTC resistor is 10KΩ, the internal reference resistance of channel2 NTC resistor is 10kΩ, the internal reference resistance of channel1 PT1000 resistor is 2KΩ, The internal reference resistance of the channel2 PT1000 resistance is 2KΩ. The PT A of the channel1 is divided by 10E9, and the PT A of the channel2 is divided by 10E9.The PT B of the channel1 divided by 10E12,the PT B of the channel2 divided by 10E12. PT C of the channel1 divided by 10E16, and the PT C of the channel2 is divided by 10E16. The polarity output in the channel1 is positive, and the polarity output in the channel2 is positive.
PS: If it is a two-channel temperature controller, the data of TC2 will be sent directly after sending the data of TC1.

3.6.2 Query: Key Data Retrieval

Command Type	ASCII Command	Register Address	Data Type	Number of Registers	Accessibility	Data Range
General parameter Command	DATADEMAND	/	/	/	/	1~2

Description:

Represents the current temperature of channel1 is 24.8150℃, the resistance of channel1 is 0, and the actual output percentage of channel1 is 0. The temperature of the channel2 is 84.9520℃, the resistance of the channel2 is 0, and the actual output percentage of the channel2 is 0.

Send：DATADEMAND=2@

Return：

TC1:TCADJTEMP=2518788@TC1:RESISTOR=9916909257@TC1:OUTV=1000000000@TC2:TCADJTEMP=999999999@TC2:RESISTOR=0@TC2:OUTV=0@SINT ERIORTEMP=34@

Indicates that the current temperature of channel1 is 25.18788℃, the resistance of channel1 is 9916.909257Ω, and the actual output voltage of channel1 is 10V. The unconnected temperature sensor of the channel2 shows 999999999, the resistance of the channel2 is 0, and the actual output percentage of the channel2 is 0.

PS：If it is a two-channel Temperature Controller, the data of TC2 will be sent directly after sending the data of TC1.

4. Command Preview Table

Function	Register Name	Communication Protocol	Register Address（0x）	Accessibility	Data Type	Data Range
Target Temperature Configuration	Query/Set Target Temperature Command	TC1:TG	1000(TC1) 2000(TC1)	Read / Write	int32	-40000000~100000000
Temperature Controller Parameter Configuration	Query/Set Actual Temperature Command	TC1:TCADJTEMP	1002(TC1) 2002(TC2)	Read / Write	int32	-40000000~100000000
	Read the Resistance of the Sensor	TC1:RESISTOR	1004(TC1) 2004(TC2)	Read Only	uint64	1~500000000000
	Query/Set the Calculation Model	TC1:POLYOMIAL	1300(TC1) 2300(TC2)	Read / Write	uint16	0~2
	Query/Set the NTC B	TC1:BX	1301(TC1) 2301(TC2)	Read / Write	uint32	100000~5000000
	Query/Set the NTC R0(Ω)	TC1:RP	1303(TC1) 2303(TC2)	Read / Write	uint32	1~9000000
	Query/Set the NTC Internal Resistor(Ω)	TC1:NTCRP	1305(TC1) 2305(TC2)	Read / Write	uint64	1~11000000000
	Query/Set the PT(Platinum) R0(Ω)	TC1:PT1000RP	1309(TC1) 2309(TC2)	Read / Write	uint32	0~10000000
	Query/Set the Callendar-van-Dusen Coefficient A of PT1000 Resistance (PT A)	TC1:PTA	130B(TC1) 230B(TC2)	Read / Write	int32	-9000000~9000000
	Query/Set the PT B	TC1:PTB	130D(TC1) 230D(TC2)	Read / Write	int32	-9000000~9000000
	Query/Set the PT C	TC1:PTC	130F(TC1) 230F(TC2)	Read / Write	int32	-90000~90000
	Query/Set the PT Internal Resistor(Ω)	TC1:PTRP	1311(TC1) 2311(TC2)	Read / Write	uint64	1~2100000000
	Query/Set the A0 Base	TC1:POLA0	1315(TC1) 2315(TC2)	Read / Write	int64	-99999999999999~99999999999
	Query/Set the A0 Exponent	TC1:POLEA0	1319(TC1) 2319(TC2)	Read / Write	int16	-100~100
	Query/Set the A1 Base	TC1:POLA1	131A(TC1) 231A(TC2)	Read / Write	int64	-99999999999999~99999999999
	Query/Set the A1 Exponent	TC1:POLEA1	131E(TC1) 131E(TC2)	Read / Write	int16	-100~100

	Query/Set the A2 Base	TC1:POLA2	131F(TC1) 231F(TC2)	Read / Write	int64	-99999999999999~99999999999
	Query/Set the A2 Exponent	TC1:POLEA2	1323(TC1) 2323(TC2)	Read / Write	int16	-100~100
	Query/Set the A3 Base	TC1:POLA3	1324(TC1) 2324(TC2)	Read / Write	int64	-99999999999999~99999999999
	Query/Set the A3 Exponent	TC1:POLEA3	1328(TC1) 2328(TC2)	Read / Write	int16	-100~100
	Query/Set the A4 Base	TC1:POLA4	1329(TC1) 2329(TC2)	Read / Write	int64	-99999999999999~99999999999
	Query/Set the A4 Exponent	TC1:POLEA4	132D(TC1) 232D(TC2)	Read / Write	int16	-100~100
	Query/Set the A5 Base	TC1:POLA5	132E(TC1) 232E(TC2)	Read / Write	int64	-99999999999999~99999999999
	Query/Set the A5 Exponent	TC1:POLEA5	1332(TC1) 2332(TC2)	Read / Write	int16	-100~100
	Query/Set the A6 Base	TC1:POLA6	1333(TC1) 2333(TC2)	Read / Write	int64	-99999999999999~99999999999
	Query/Set the A6 Exponent	TC1:POLEA6	1337(TC1) 2337(TC2)	Read / Write	int16	-100~100
	Query/Set the A7 Base	TC1:POLA7	1338(TC1) 2338(TC2)	Read / Write	int64	-99999999999999~99999999999
	Query/Set the A7 Exponent	TC1:POLEA7	133C(TC1) 233C(TC2)	Read / Write	int16	-100~100
	Query/Set the Max Temperature Thresholds(℃)	TC1:OVERTEMPUP	133D(TC1) 233D(TC2)	Read / Write	int32	-3000000000~500000000
	Query/Set the Min Temperature Thresholds(℃)	TC1:OVERTEMPLOWER	133F(TC1) 233F(TC2)	Read / Write	int32	-3000000000~500000000
	Query/Set Open/Short Circuit Output Protection Function	TC1:ONSENSOR	110C(TC1) 210C(TC2)	Read / Write	int16	0~1
Temperature Controller Output Configuration	Query/set the Max Output(%)	TC1:LIMITED	110E(TC1) 210E(TC2)	Read / Write	int16	0~90
	Query/Set the Output Enable	TC1:ENABLE	1100(TC1) 2100(TC2)	Read / Write	int64	0~1
	Query/Set the Power-On Delay Output	TC1:STARTUPDELAY	110F(TC1) 210F(TC2)	Read / Write	int16	10~180
	Query/Set the Output Mode	TC1:MODE	1101(TC1) 2101(TC2)	Read / Write	int64	0~3
	Query/Set the Output Polarity	TC1:PIDPOL	1102(TC1) 2102(TC2)	Read / Write	int16	0~1
	Query/Set the Output Voltage Percentage	TC1:PWMDUTY	1103(TC1) 2103(TC2)	Read / Write	int32	-2000000~2000000
	Query/Set the Temperature Ramp Rate	TC1:SPEED	1108(TC1) 2108(TC2)	Read / Write	int32	0~255 (V4.2.2 and below) 0~10000 (V4.2.3 and later)
	Query/Set the Cooling/Heating Ratio	TC1:CHRATIO	1109(TC1) 2109(TC2)	Read / Write	int16	10~250

	Query/Set the Forward Starting Voltage	TC1:FDEADV	110A(TC1) 210A(TC2)	Read / Write	int16	0~400
	Query/Set the Reverse Starting Voltage	TC1:BDEADV	110B(TC1) 210B(TC2)	Read / Write	uint16	0~400
	Query/Set the PWM Output Frequency	FPWM	000D	Read / Write	uint16	0~3
	Query/Set the Over_Temp Action	OVERTTEMP	000B	Read / Write	uint16	0~1
	Query/Set Temperature Controller Mode Selection	CONTMODE	0004	Read / Write	uint16	0~3
PID Configuration	Query/Set the P in PID	TC1:KP	1200(TC1) 2200(TC2)	Read / Write	int64	0~9000000
	Query/Set the I in PID	TC1:KI	1202(TC1) 2202(TC2)	Read / Write	uint16	0~9000000
	Query/Set the D in PID	TC1:KD	1204(TC1) 2204(TC2)	Read / Write	uint16	0~9000000
	Query/Set PID Self-tuning	TC1:AUTOPID	1107(TC1) 2107(TC2)	Read / Write	uint16	0~2
Temperature Controller Basic Configuration	Query the Current Temperature Controller Model TEC	TEC	0001	Read / Write	uint16	0~255
	Query the Version Number	FPV	000C	Read / Write	uint16	100~999
	Query/Set the Temperature Controller Address	ADDRESS	0002	Read / Write	uint16	0~255
	Query/Set the UART TTL Volatility	BOUNDTABLEONE	0008	Read / Write	int16	0~7
	Query/Set the RS485 Volatility	BOUNDTABLETWO	0009	Read / Write	uint32	0~7
	Query the Temperature Controller's Internal Temperature	SINTERIORTEMP	0003	Read / Write	uint32	-20~120
	Query/Set the Temperature Controller Over-temperature Threshold	OVERTVPT	000A	Read / Write	uint32	40~120
	Query the Error Code	ERRORCODE	0007	Read / Write	uint16	0~3
	Restore Factory Setting	RESET	0000	Read Only	uint16	1
Other Data Query	Query: Comprehensive Data Retrieval	INQUIRE	/	Read Only	uint16	1
	Query: Key Data Retrieval	DATADEMAND	/	Read / Write	uint16	1~2

Notice：Due to product updates, previous version maybe not support the latest communication protocol, please understand!

Appendix 1： Temperature Calculation Model and Polynomial Correction

01 NTC temperature sensor

Basic equation calculation method (B-Value Model)	
$R= R_0 \times \exp[B \times (1/(T+273.15)-1/298.15)]$	
T	Temperature, in degrees Celsius (°C)
R	The actual resistance value of the sensor, in ohms (Ω)
R_0	Resistance of NTC at 25°C R(25°C), in ohms (Ω)
B	Sensor β value parameters
C language temperature calculation formula： $T= 1/(1/(298.15)+1/B*\ln(R/R_0))-273.15$	

Steinhart-Hart equation calculation method (S-H Model)	
$1/(T+273.15)= A_0+ A_1 \times \ln(R) + A_2 \times [\ln(R)]^2+A_3 \times [\ln(R)]^3+A_4 \times [\ln(R)]^4$	
T	Temperature, in degrees Celsius (°C)
R	The actual resistance value of the sensor, in ohms (Ω)
$A_0,...,A_4$	Sensor coefficient (shared with polynomial temperature correction)

02 PT (platinum) resistance temperature sensor

-200~0°C temperature range (PT Model)	
$R= R_0 \times [1+A \times T+B \times T^2+C \times (T-100)T^3]$	
T	Temperature, in degrees Celsius (°C)
R	The actual resistance value of the sensor, in ohms (Ω)
R_0	Resistance value of PT at 0°C, in ohms (Ω)
A, B, C	Sensor coefficient

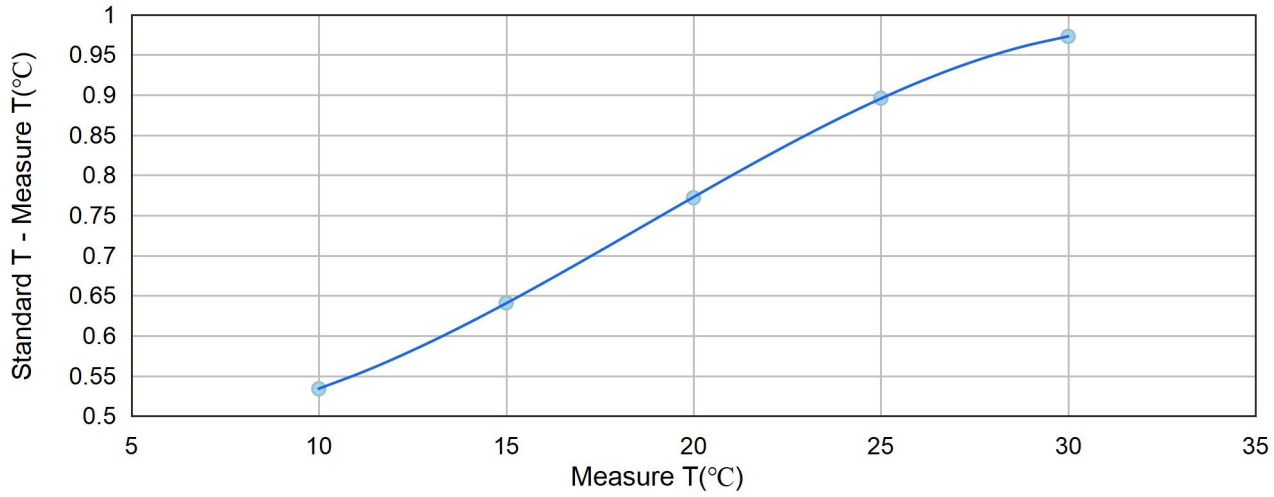
0~800°C temperature range (PT Model)	
$R= R_0 \times [1+A \times T+B \times T^2]$	
T	Temperature, in degrees Celsius (°C)
R	The actual resistance value of the sensor, in ohms (Ω)
R_0	Resistance value of PT at 0°C, in ohms (Ω)
A, B	Sensor coefficient

03 Polynomial temperature correction

$T_C=T_B+A_0+A_1\times T_B+A_2\times T_B^2+A_3\times T_B^3+A_4\times T_B^4+A_5\times T_B^5+A_6\times T_B^6+A_7\times T_B^7$	
T_C	Polynomial temperature corrected temperature in degrees Celsius (°C)
T_B	Polynomial temperature the temperature before correction, in degrees Celsius (°C), which can be the temperature calculated by the B-Value or PT model, but not by the S-H model. That is to say, when the B-Value and PT models are selected, the polynomial temperature correction function is always on. But when the S-H model is selected, the polynomial temperature correction function is disabled. (Please note that this function is only available in hardware versions v4.2.2 and above.)
$A_0,...,A_7$	Temperature correction factor

Case description: NTC temperature sensor with temperature controller polynomial temperature correction

An instrument uses an NTC temperature sensor for temperature measurement, setting R0 and B values of 10,000Ω and 3950, respectively. The polynomial correction coefficient A0~A7 is set to 0, and the whole system is calibrated with the standard temperature sensor. Then measure the temperature and standard temperature gauge as shown in the table below：



Measure T(°C) T_B	Standard T(C) T_S	Standard T - measured T(°C) ΔT
10.000	10.534	0.534
15.000	15.641	0.641
20.000	20.772	0.772
25.000	25.896	0.896
30.000	30.973	0.973

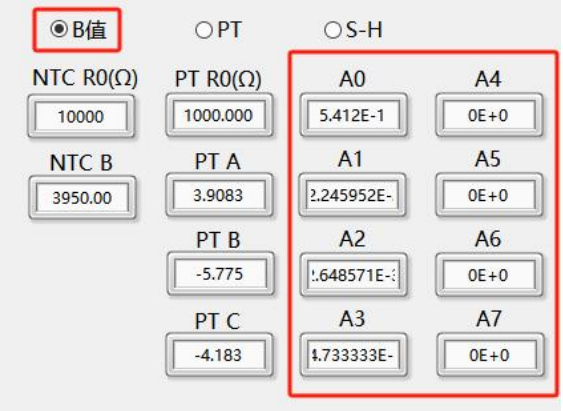
Using the polynomial of Excel to fit the temperature difference (standard T - measured T) vs measured temperature in 3rd degree polynomial (select several polynomials according to the situation), the polynomial

correction formula is as follows：

$$TC=TB+(5.412000e-1)+(-2.245952e-2)\times TB+(2.648571e-3)\times TB2+(-4.733333e-5)\times TB3$$

To wit：

Temperature correction factor	value
A_0	5.412000e-1
A_1	-2.245952e-2
A_2	2.648571e-3
A_3	-4.733333e-5
A_4... A_7	0



Write the value of A_0-A_7 through the computer software, as shown in the figure above, that is, the polynomial temperature correction is complete.

Notice: The temperature sensor of our company is not calibrated by default. If you need calibration, you can contact our official customer service.
(Email：sales@sensefuture.com)

Version Change Log

Version No.	Modification Details	Change Date	Reviewer
1.0	Latest Initial Version	2025/4/10	WST、WYR
1.1	New additions: 4. Command preview table New thermostat models	2025/4/21	WST、WYR

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SenseFuture

Original Aspiration Determines the Future,
Innovation Creates Value,
Sharing Unites Hearts.

Anticipating a win-win collaboration!