MS0210/MS0213/MS0207

Temperature Electronic Boards

User Manual

MICROCYBER

Warning

1. It is forbidden for users to disassemble and install the temperature electronic boards by themselves.
2. Please check whether the power supply voltage of the temperature electronic boards meets the power supply voltage requirement in the manual.

Version: V1.3

Disclaimer

The contents of this manual have been checked to confirm the consistency of the hardware and software described. Since errors cannot be completely excluded, absolute consistency cannot be guaranteed. However, we will periodically check the data in this manual and make the necessary corrections in subsequent versions. Any suggestions for improvements are welcome.

Company Profile

Microcyber Corporation is a high-tech enterprise initiated and founded by Shenyang Institute of Automation, Chinese Academy of Sciences, mainly engaged in networked control system, industrial communication and instrumentation, development, production and application. Microcyber Corporation has undertaken a number of national science and technology projects such as the National Science and Technology Major Project, National High Technology Research and Development Program (863 Program), Smart Manufacturing Equipment Development Project, etc. It is the unit for the construction of National Engineering Research Center for Networked Control System.

Microcyber Corporation successfully developed the first internationally certified fieldbus protocol master stack, the first nationally certified fieldbus instrument, the first domestic safety instrument certified by TÜV Germany, and co-hosted with other units the formulation of the first domestic industrial Ethernet protocol standard EPA and the first industrial wireless communication protocol standard WIA-PA, which became an IEC international standard.

Our products and technologies have won two National Science and Technology Progress Awards, one National Science and Technology Invention Award, one First Prize of Science and Technology Progress of Chinese Academy of Sciences, one First Prize of Science and Technology Progress of Liaoning Province, and our products have been exported worldwide. We have successfully completed more than 200 large-scale automation projects.

Microcyber Corporation is a member of FCG organization; a member of PNO.

Microcyber Corporation has successfully passed ISO9001:2008 quality management system certification and ISO/TS16949 quality system certification for the automotive industry. Excellent R&D team, rich experience in automation engineering design and implementation, industry-leading products, large market network and excellent corporate culture have laid a solid foundation for the company's start-up and sustainable development.

Carrying employees' ideals, creating customer value and promoting corporate development.

CONTENT

1 OVERVIEW 1

2 INTRODUCTION OF TEMPERATURE ELECTRONIC BOARDS 2

2.1 DIMENSION 2

2.2 HARDWARE INTERFACE 2

2.3 BUS POWER INTERFACE 3

3 FF INTELLIGENT TEMPERATURE TRANSMITTER CONFIGURATION 4

3.1 TOPOLOGY CONNECTION 4

3.2 FUNCTION BLOCK 5

3.3 FUNCTION CONFIGURATION 5

3.3.1 Configuration environment 6

3.3.2 Sensor type configuration 6

3.3.3 Two-wire zero calibration configuration 6

3.3.4 Enabling cold-end temperature compensation 6

3.3.5 Two-point linearized calibration 7

3.3.6 Multi-point linearization calibration 7

3.3.7 User default configuration 9

3.3.8 LCD display configuration 9

4 PA SMART TEMPERATURE TRANSMITTER CONFIGURATION 11

4.1 TOPOLOGICAL CONNECTION 11

4.2 FUNCTIONAL BLOCK 11

4.3 FUNCTIONAL CONFIGURATION 12

4.3.1 Configuration Environment 12

4.3.2 Temperature Conversion Block Parameter Configuration 13

4.3.3 PROFIBUS Cyclic Data Communication Configuration 19

4.3.4 PROFIBUS Non-cyclic Data Communication Configuration 21

4.3.5 Online Configuration Function 23

4.3.6 Sensor Type Configuration 24

4.3.7 Two-line System Zero-point Calibration Configuration 24
4.3.8 Enable the Cold-end Temperature Compensation 24
4.3.9 Custom TC Sensor Type 24
4.3.10 Custom-defined RTD Sensor Type 25
4.3.11 Multipoint-linearized Calibration 25
4.3.12 Two-point Linearized Calibration 26
5 HART TEMPERATURE MODULE CONFIGURATION 28
5.1 TOPOLOGICAL CONNECTIONS 28
5.1.1 4~20mA Compatibility mode 28
5.1.2 Networking Mode 28
5.2 FUNCTION CONFIGURATION 29
5.2.1 Configuration Tool 29
5.2.2 Basic Information Configuration 29
5.2.3 Configuration Information Configuration 30
5.2.4 Sensor Configuration 31
5.2.5 Current Calibration 34
5.2.6 Variable Monitoring 35
5.2.7 linear correction 36
6 SITE ADJUSTMENT 37
6.1 LCD AND KEY DESCRIPTION 37
7 MAINTENANCE 39
8 TECHNICAL SPECIFICATIONS 40
8.1 BASIC PARAMETER 40
8.2 TECHNICAL INDICATORS OF THERMAL POWER RESISTANCE 41
8.3 THERMO COUPLE TECHNICAL INDICATORS 41

1 Overview

Temperature electronic boards adopts fieldbus technology, is a new generation of intelligent temperature module, it can match a variety of RTD (RTD), thermocouple (TC), resistance (Ω) and voltage (mV) signal sensors, with high precision, wide range characteristics, conducive to the launch of high-precision HART, FF, PA temperature transmitter products in the short term.

Electronic boards are factory calibrated for the supported sensor types, and after the user connects the sensors to the temperature electronic boards properly, they are ready to work with a simple configuration.

Figure 1.1 Temperature electronic boards

Users can configure and configure the temperature suite card through the HART configuration software provided by Microcyber, which also provides a DD file supporting the 475 hand controller format for easy configuration and configuration through the 475 hand controller. In the case of local operation, a rich set of adjustment functions can also be performed through the three buttons equipped on the temperature set card, such as configuration and configuration of sensor type, wiring method, upper and lower ranges and units.

The LCD meter head adopts a white backlit dot matrix LCD screen, which can intuitively display the current temperature value and the percentage of the range, and can be rotated within 90°/180°/360°, providing convenience for users to observe from any angle.

See the rest of this manual for additional details on electronic board for temperature transmitter.

2 Introduction of Temperature electronic boards

2.1 Dimension

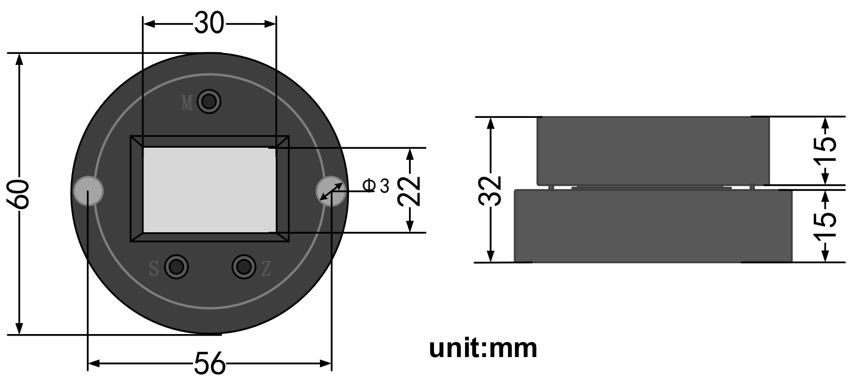


Figure 2.1 Dimension

2.2 Hardware interface

The overall hardware interface diagram of the Electronic board for temperature transmitter is shown in Figure 2.2:

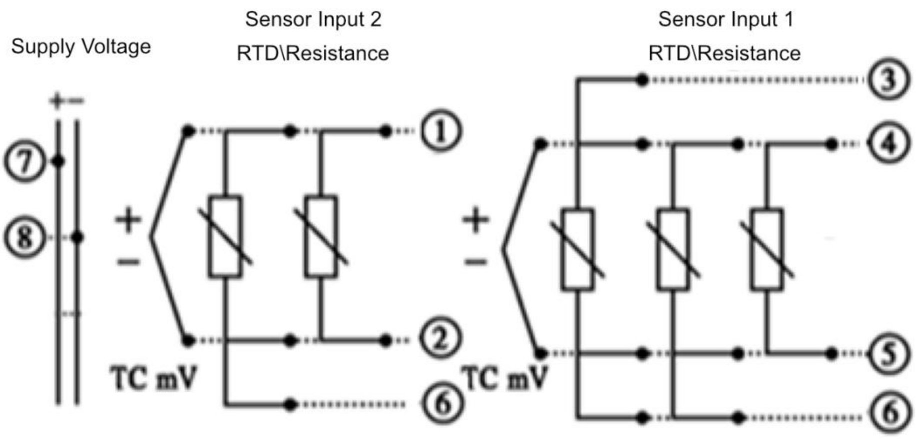


Figure 2.2 Hardware interface description

Sensor input 1									
Sensor input 2		Thermal resistance 2-wire	Thermal resistance 3-wire	Thermal resistance 4-wire	Resistance 2-wire	Resistance 3-wire	Resistance 4-wire	TC	mV
	Thermal resistance 2-wire	☑	☑	☑	X	X	X	☑	X
	Thermal	☑	☑	☑	X	X	X	☑	X

	resistance 3-wire								
	Resistance 2-wire	X	X	X	☑	☑	☑	X	X
	Resistance 3-wire	X	X	X	☑	☑	☑	X	X
	TC	☑	☑	☑	X	X	X	☑	X
	mV	X	X	X	X	X	X	X	☑

Figure 2.3 Sensor wiring description

When performing dual-channel measurements, both channels must have the same setting for the unit of measurement (e.g., both in temperature units).

MS0210 Fault Alarm and Configuration Protection Dipswitch

The dip switch marked with "AL" is the fault alarm current selection switch; the dip switch marked with "WP" is the configuration protection or not selection switch.

- Fault alarm setting

The HART electronic board for temperature transmitter has a self-diagnostic function. When a fault is detected, such as sensor open circuit, sensor short circuit or AD error, the electronic board will automatically output alarm current. The alarm current mode depends on the setting of the fault alarm current dip switch on the communication card, when the "AL" dip switch is set to OFF side is high alarm, the alarm current ≥ 21.75mA; when the "AL" dip switch is set to ON side is low alarm, the alarm current ≤ 3.7mA. Alarm current ≤ 3.7mA.

- Configuration protection settings

The HART electronic board for temperature transmitter provides a dipswitch setting for device configuration protection or not. When the dipswitch is set to the ON side, the card does not allow any changes to the configuration of the device when the configuration is protected. Conversely, a dipswitch on the OFF side allows changes to the device configuration to be performed.

2.3 Bus power interface

The power supply of the fieldbus electronic board for temperature transmitter shares a pair of cables with the bus signals, called bus cables.

The bus cable should not be shared with the power lines of high-powered equipment or open wire slots, and should be kept away from high-powered equipment. The shield wire at both ends of the bus should be grounded.

3 FF Intelligent temperature transmitter configuration

3.1 Topology connection

The FF transmitter supports a variety of network topology wiring methods, as shown in Figure 3.1. Figure 3.2 gives the bus connection of the FF transmitter. Terminal matching resistors need to be connected at both ends of the bus to ensure the signal quality. The maximum length of the bus is 1900 meters, which can be extended up to 10 km by using repeaters.

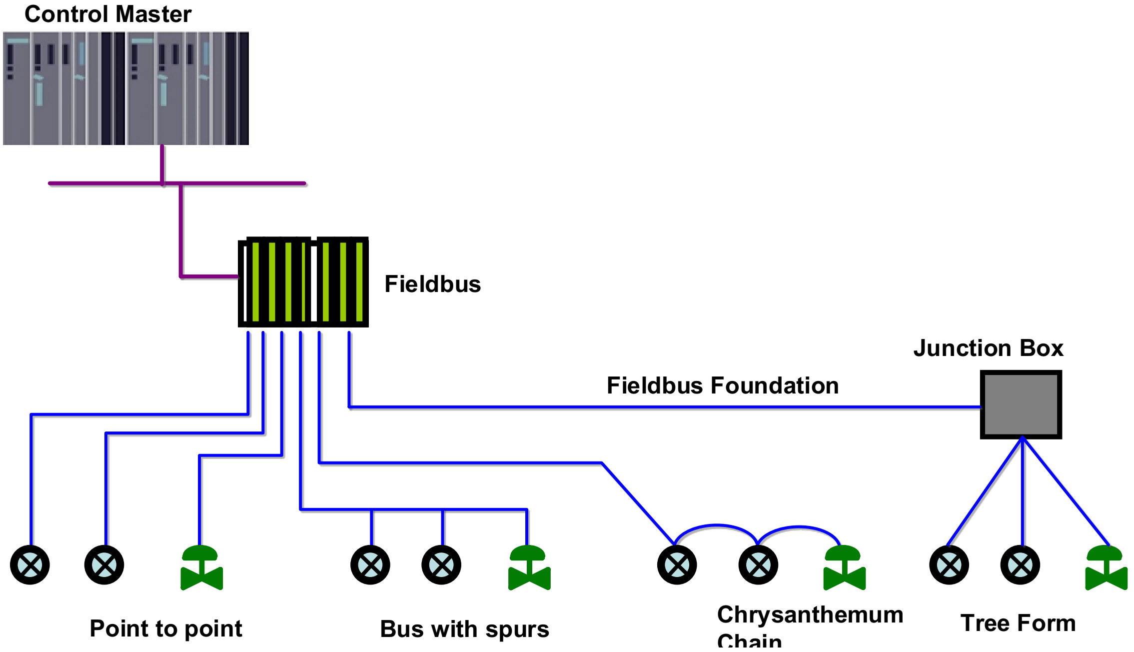


Figure 3.1 FF Network Topology

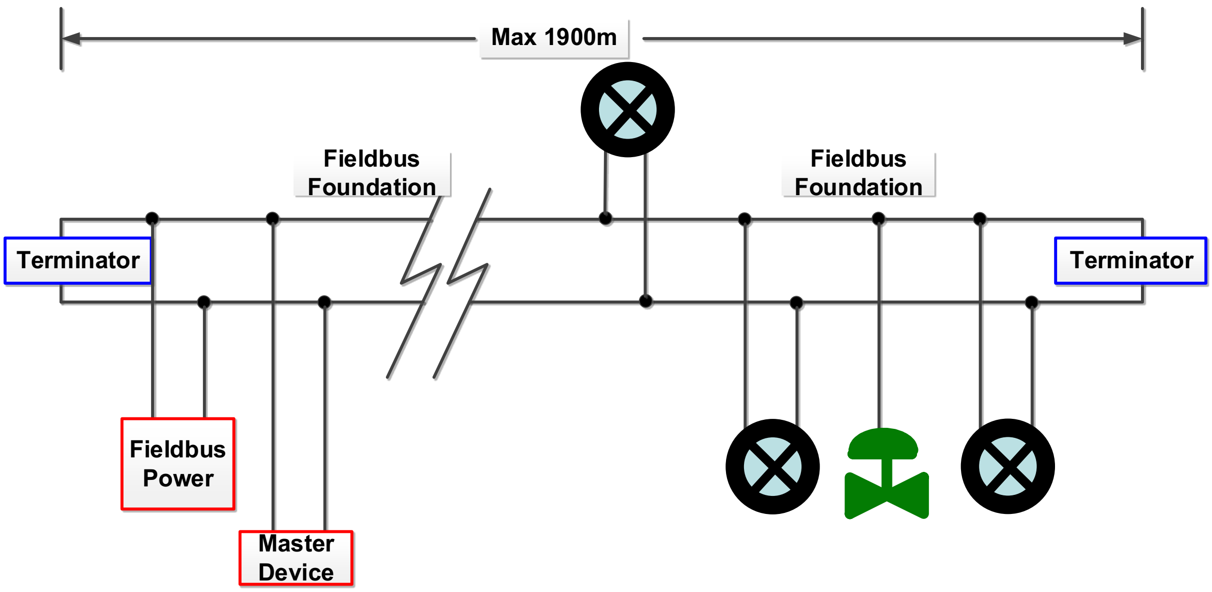


Figure 3.2 FF bus connection

3.2 Function block

The FF Smart Temperature Transmitter implements the function blocks of the FF standard, as shown in the table below. Please consult the relevant FF protocol documentation for the configuration of the function blocks.

Function block name	Description
RES	Resource block to describe the characteristics of the field device, such as device name, manufacturer, and serial number. Resource blocks have no input or output parameters. A device usually has only one resource block
TEMP_SENSORX	Transformation blocks that read sensor hardware data or write field data to the corresponding hardware. Transformation blocks contain information such as range, sensor type, linearization, I/O data, etc.
DSP	Display block for configuring the display information on the LCD
PID	PID function block to perform PID control functions, as well as setpoint adjustment, process parameter (PV) filtering and alarm, output tracking, etc.
AI	Analog input function block, used to obtain the input data of the conversion block, and can be transferred to other function blocks, with functions such as range conversion, square root, and elimination of trailing numbers
IS	Input selection, the function block has four analog inputs for input parameter selection or can be selected by reference to certain criteria such as best, maximum, minimum, medium or average
SC	Signal characterization, the same curve can describe two signal characteristics. The second input can be selected from x to y. The inverse function can be used to read back the variable characterization.
AR	The module is designed to allow simple use of popular measurement mathematical functions.
OS	The Output Distributor block provides the ability to drive two control outputs from a single input. Each output is a linear function of some part of the input.

3.3 Function configuration

The smart temperature transmitter supports the configuration and debugging of common FF configuration software, such as Microcyber FF configuration software, NCS4000 configuration software, NI-FBUS Configurator from NI, and DeltaV from Rosemont. The following is an introduction to the configuration method of intelligent temperature transmitter, mainly taking Microcyber FF configuration software as an example.

3.3.1 Configuration environment

1. PC with Windows XP, Windows 7 or Windows 10 operating system

2. NI USB-8486, H1 bus power supply, H1 terminal matcher

3. NI-FBUS Configurator

3.3.2 Sensor type configuration

The type of sensor, such as PT100, CU50, etc., can be set by modifying the SENSOR_TYPE parameter of the converter block.

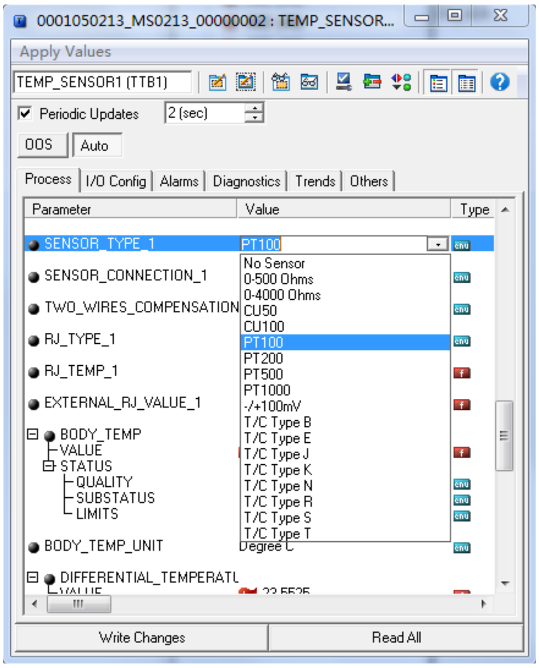


Figure 3.3 Configuration of sensor types

3.3.3 Two-wire zero calibration configuration

In two-wire measurements, the TWO_WIRES_COMPENSATION parameter of the converter block can be used for two-wire zero calibration. First the channel zero value is given, i.e. the channel is shorted. Then the parameter TWO_WIRES_COMPENSATION is set to Start and after successful writing, the parameter is read until the value of the parameter is Finished and the two-wire zero calibration is successful.

3.3.4 Enabling cold-end temperature compensation

In the use of thermocouples as sensors, the transformation block parameter SENCONDARY_VALUE indicates the cold end temperature value, the sensor in the default case first enable the cold end compensation function, the user can also set the cold end compensation through the parameter RJ_TYPE, set to Internal to enable the cold end compensation, then the value of PRIMARY_VALUE is the temperature value after the cold end compensation, set to no reference to disable the cold end compensation, then the value of PRIMARY_VALUE is the temperature value without the cold end compensation.

3.3.5 Two-point linearized calibration

The temperature transmitter has been rigorously calibrated before leaving the factory and normally does not require further calibration by the user. However, if the user needs to perform a two-point calibration, he can use the parameters CAL_POINT_HI, CAL_POINT_LO and CAL_UNIT to perform a two-point linearization calibration. The operation steps are as follows:

1. Determine the sensor type and set the SENSOR_TYPE parameter. Set the calibration unit parameter CAL_UNIT according to the sensor type, currently only three units are supported: Celsius, Ohm and Millivolt.

2. Set the Transformer MODE parameter to OOS and the SENSOR_CAL_METHOD parameter to "User Trim Standard Calibration".

3. After the input is stabilized, the calibration data is written to CAL_POINT_LO or CAL_POINT_HI according to whether the operation is upper or lower limit calibration, and no writing error is indicated to indicate successful calibration. **Note that the written calibration data and the actual input channel data must not deviate greatly, otherwise the calibration will fail.**

3.3.6 Multi-point linearization calibration

With the calibration parameters CAL_POINT_X and CAL_POINT_Y of the transformation block, users can complete the multi-point linearization calibration of the instrument by themselves. The calibration steps are as follows:

1. The intelligent temperature transmitter provides 16 calibration point inputs, i.e., the CAL_POINT_Y array of parameters of the transformation block, and the user can write the output values to be calibrated in turn and select the units. For example, when performing a three-point interpolation calibration, the user can select 10, 20 and 30 as calibration points and write these three values in the CAL_POINT_Y array in turn, as shown in Figure 3.4.

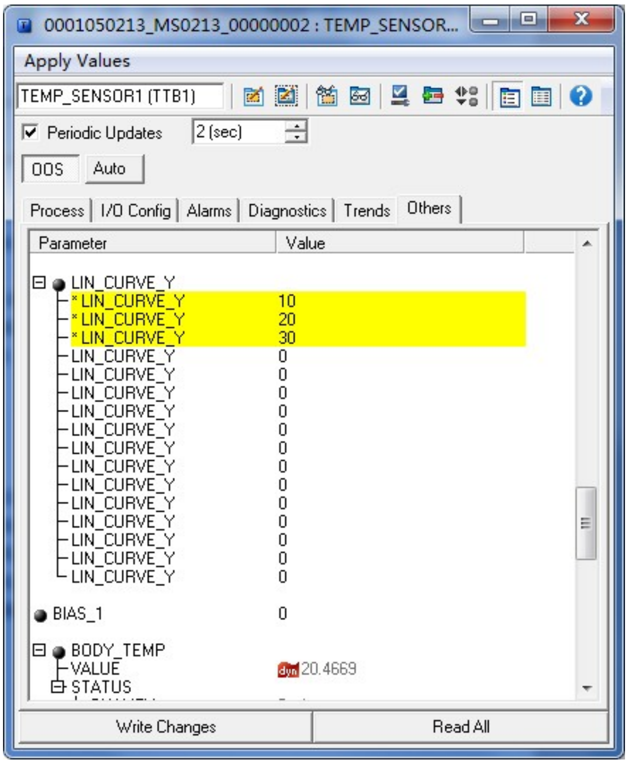


Figure 3.2 CAL_POINT_Y configuration

2. Input the standard signal through the standard source and open the corresponding transformation block on the configuration software, read the value of parameter PRIMARY_VALUE respectively, and write the value to CAL_POINT_X array. For example, write the read values 10.2, 20.5 and 30.4 in the CAL_POINT_X array, as shown in Figure 3.5. This is the end of the calibration work.

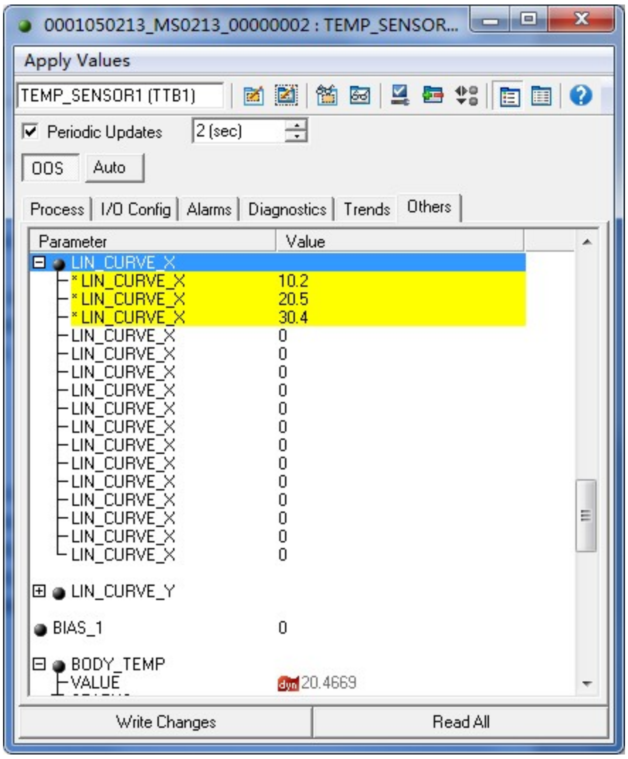


Figure 3.3 CAL_POINT_X configuration

3. Set the parameter SENSOR_CAL_METHOD to "User Trim special Calibration" and the parameter ENABLE_LIN_CURVE to "Enable Curve" to make the intelligent temperature transmitter work according to the calibrated characteristic curve.

3.3.7 User default configuration

With the user default configuration USERPARM_SAVE_RST of the transformation block, the user can save and restore the custom default configuration parameters. Specific parameters are configured under:

1) Save as user default：Set the current configuration parameters as user default configuration parameters.

2) Reset user default：Restore the configuration parameters as user-defined configuration parameters.

3.3.8 LCD display configuration

By default, the intelligent temperature transmitter display shows four groups of display information, as shown in Figure 3.6. If the user needs to display other function block parameter information, can be configured as follows (X represents 1, 2, 3, 4, a total of four groups of parameters, each group can be configured differently. (Intelligent temperature transmitter can cycle through four groups of different parameter information). If the parameters are configured incorrectly, the smart temperature transmitter display will only show CONFIG_ERR.

1) DISP_VALUE_X：This parameter is a display parameter. When the data source is selected, the data and status are loaded automatically.

2) DISP_VALUE_UNIT_X：This parameter is the display parameter data unit. The data units are loaded automatically when the data source is selected.

3) DISP_SOURCE__X：This parameter is the data source for the display parameters. It can be selected by the user. For example, if you need to display PV2, select Primary Value 2.

4) DISP_VALUE_FORMAT_：This parameter is a display parameter format, which can be selected by the user.

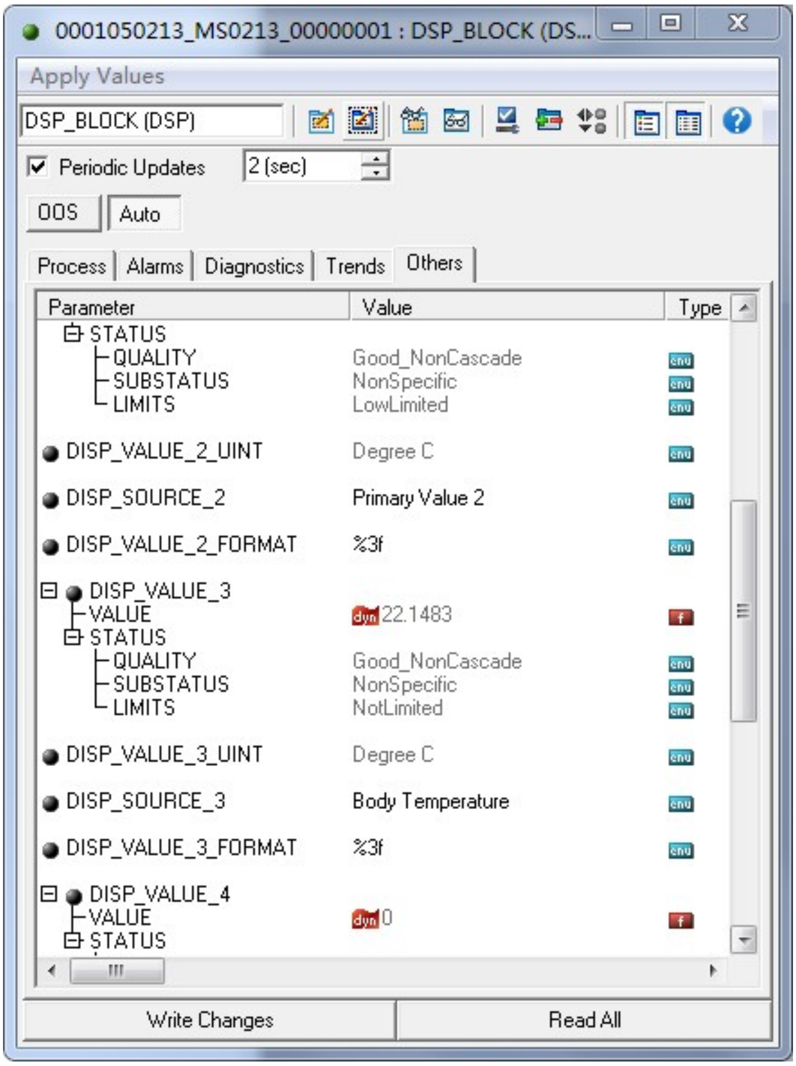


Figure 3.4 Parameter configuration of the display block

4 PA Smart Temperature Transmitter Configuration

4.1 Topological Connection

A PROFIBUS PA network topology can have a variety of different structures, as shown in Figure 4.1Figure 4.2 shows the bus connection of the PA instrument. Both ends of the bus need to be connected to terminating resistors to ensure the quality of the bus signal. The bus has a maximum length of 1,900 m and can be extended to 10 km using a repeater.

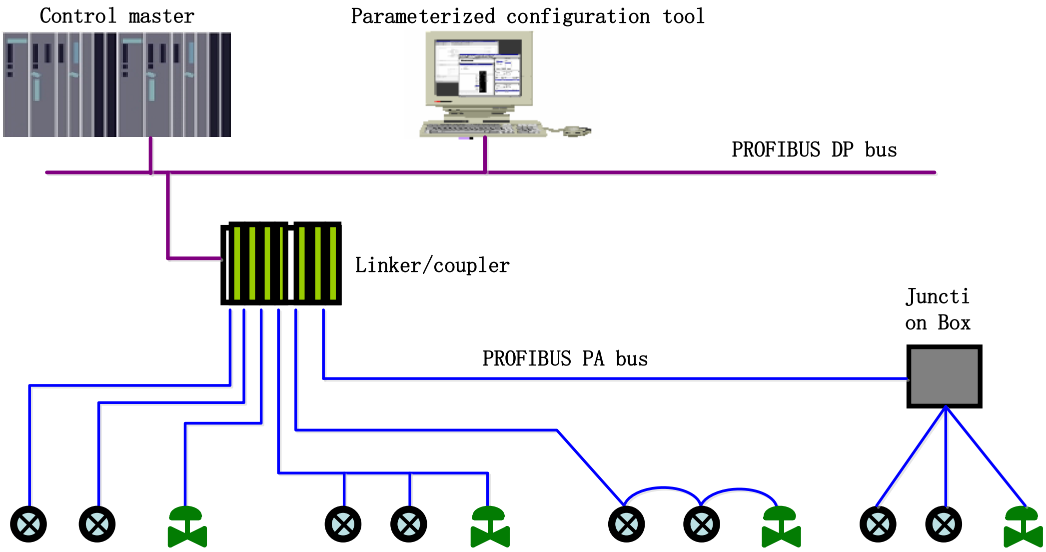


Figure 4.1 PROFIBUS PA network topology

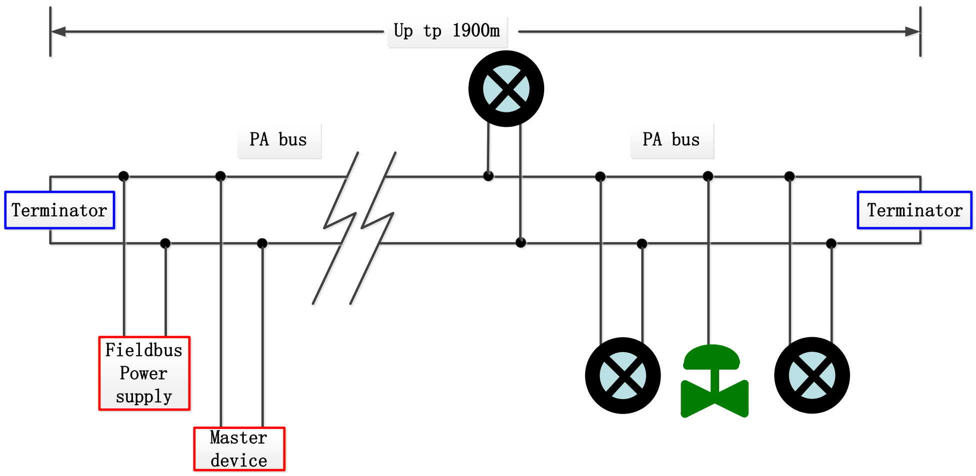


Figure 4.2 PROFIBUS PA bus connection

4.2 Functional Block

The PA-type smart transmitter implements the PA standard function block, as shown in the table below. For the function block configuration method, please refer to the PROFIBUS PA regulation.

Function block name	Functional block description

Physical Block	The Physical Function Block (PB). Specific hardware information and identification and diagnosis information are described, including the device bit number, software version, hardware version, installation date, etc
Transducer Block1	Convert Block (TB). Separating the functional block from the input and output characteristics of the instrument, it mainly completes the calibration and linearization of the input and output data, and provides the processed data to the AI functional block through the internal channel
Transducer Block2	Transducer Block (TB). Separating the functional block from the input and output characteristics of the instrument, it mainly completes the calibration and linearization of the input and output data, and provides the processed data to the AI functional block through the internal channel
Analog Input Block1	Analog Quantity Input function block (AI). The simulated process values are obtained from the conversion block through the internal channels, which are processed, and the appropriate measurements are provided to the main station equipment through the bus communication
Analog Input Block2	Analog Quantity Input function block (AI). The simulated process values are obtained from the conversion block through the internal channels, which are processed, and the appropriate measurements are provided to the main station equipment through the bus communication
Analog Input Block3	Analog Quantity Input function block (AI). The simulated process values are obtained from the conversion block through the internal channels, which are processed, and the appropriate measurements are provided to the main station equipment through the bus communication
Analog Input Block4	Analog Quantity Input function block (AI). The simulated process values are obtained from the conversion block through the internal channels, which are processed, and the appropriate measurements are provided to the main station equipment through the bus communication

4.3 Functional Configuration

The parameter configuration of PA intelligent transmitter follows PROFIUBS PA line gauge version 3.02. You can read and write the functional block parameters of the transmitter using the Siemens equipment management software Simatic PDM, or use the Siemens Step7 configuration software.

4.3.1 Configuration Environment

1) For the PC, the operating system is Windows 2000 or Windows XP;

2) Siemens Step7 configuration software, Siemens PDM equipment management software;

3) A DP / PA coupler or a linker;

4) Class 1 main station such as PLC, class 2 main station such as CP5611 card;

5) PA terminal Matcher;

6) Standard temperature source.

4.3.2 Temperature Conversion Block Parameter Configuration

The conversion block separates functional blocks from physically proprietary I / O devices such as sensors and actuators, and relies on the implementation of the device manufacturer to access or control I / O devices. With access to the I / O device, the conversion block can acquire input data or set output data. Generally, conversion blocks are linearized, characteristic, temperature compensation, control, and exchange data. The structure of the conversion block is shown in Figure Figure 4.3.

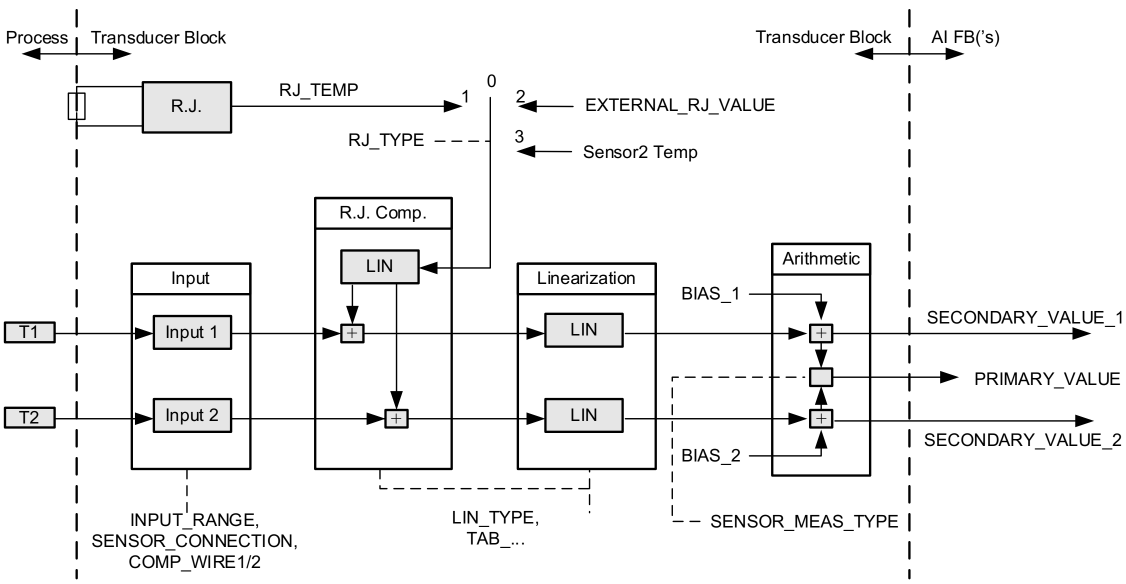


Figure 4.1 Conversion block structure

The parameters of the conversion blocks are shown in the table below

Parameter	Functional description
INPUT_FAULT_GEN	Enter a fault: an error diagnostic object with all values. 0: The equipment is normal Bit 0: Rj Error Bit 1: Hardware error Bit 2 - 4: Reserved Bit 5: Manufacturer designated

Parameter	Functional description
	Bit 6: Communication error Bit 7: Manufacturer designated
INPUT_FAULT_1	Enter a fault: an error diagnostic object related to SV _ 1. 0: Enter normal Bit 0: Reserved Bit 1: Above the upper limit Bit 2: Broken circuit Bit 3 - 5: Reserved Bit 6: Communication error
INPUT_FAULT_2	Enter a fault: an error diagnostic object related to SV _ 2. See the bit definition： INPUT_FAULT_1.
BIAS_1	Channel 1 process variable deviation values. The units are specified by the PRIMARY _ VALUE _ UNIT.
BIAS_2	Channel 2 process variable deviation values. The units are specified by the PRIMARY _ VALUE _ UNIT.
INPUT_RANGE	0: mV range 1 => mV 100 128: Ω range 1 => Ohm 500 129: Ω range 2 => Ohm 4000
LIN_TYPE	Linear type.
SENSOR_MEAS_TYPE	Sensor mathematical function type. The encoding is as follows: 0: PV = SV_1 1: PV = SV_2 128: PV = SV_1 - SV_2 D-value 129: PV = SV_2 - SV_1 D-value 192: PV = ½ * (SV_1 + SV_2) Average value 193: PV = ½ * (SV_1 + SV_2) Redundant value

Parameter	Functional description
	220： PV= SV_1 Hot reserve value
SENSOR_WIRE_CHECK_1	Enables open circuit detection or short circuit detection. The encoding is as follows: 0: open circuit detection, short circuit detection are enabled; 1: open circuit detection enabling, short circuit detection is prohibited; 2: Open circuit detection prohibition, short circuit detection enabling 3: Open circuit detection and short circuit detection are prohibited.
SENSOR_WIRE_CHECK_2	Enables open circuit detection or short circuit detection. The encoding is as follows: 0: open circuit detection, short circuit detection are enabled; 1: open circuit detection enabling, short circuit detection is prohibited; 2: Open circuit detection prohibition, short circuit detection enabling 3: Open circuit detection and short circuit detection are prohibited.
PRIMARY_VALUE	Transmitter measurements and status. The units are specified by the PRIMARY _ VALUE _ UNIT.
PRIMARY_VALUE_UNIT	Transmitter measuring value engineering unit code.
UPPER_SENSOR_LIMIT	Sensor physical upper limit value.
LOWER_SENSOR_LIMIT	Sensor physical lower limits.
SECONDARY_VALUE_1 (SV_1)	Process values and states derived from channel 1 and corrected by BIAS _ 1. The units are specified by the PRIMARY _ VALUE _ UNIT.
SECONDARY_VALUE_2 (SV_2)	Process values and states derived from channel 2 and corrected by BIAS _ 2. The units are specified by the PRIMARY _ VALUE _ UNIT.

The thermocouple additional parameters are shown in the following table:

Parameter	Functional description
EXTERNAL_RJ_VALUE	Fixed values from an external reference point. The units are specified by the PRIMARY _ VALUE _ UNIT. If the unit of PRIMARY _ VALUE _ UNIT is not a temperature unit (for example, mV), the unit is set to °C.
RJ_TEMP	Reference point temperature. The units are specified by the PRIMARY _ VALUE _ UNIT. If the unit of PRIMARY _ VALUE _ UNIT is not a temperature unit (for example, mV), the unit is set to °C.
RJ_TYPE	Set the reference point type. The encoding is as follows: 0: no reference, no use of compensation; 1: Internal, the reference point temperature self-measured by the equipment; 2: External, the reference point temperature from the outside; 3: Sensor2 channel 2 (only Sensor1 only); Default choice 1.

Additional thermal resistance parameters are shown in the table below:

Parameter	Functional description
COMP_WIRE1	Linear compensation for selecting 2 or 3 lines. Units were fixed to the Ω.
COMP_WIRE2	Linear compensation for selecting 2 or 3 lines. Units were fixed to the Ω.
SENSOR_CONNECTION	Sensor1, Sensor2 can choose 2,3,4 (only Sensor1 support) wire system to connect with the sensor. 0: second line system; 1: third line system; 2: four line system.

The manufacturer custom parameters are shown in the following table:

Parameter	Functional description
SENSOR_VALUE_1	Sensor 1 raw data values.
SENSOR_VALUE_2	Sensor 2 raw data values.
CAL_POINT_HI	The highest-point calibration value. Units are specified by CAL _ UNIT.

CAL_POINT_LO	The lowest-point calibration value. Units are specified by CAL _ UNIT.
CAL_MIN_SPAN	Minimum step size allowed during the calibration. This minimum step size ensures that the calibration process proceeds smoothly, so that the highest calibration lowest point is not too close, and the unit is specified by CAL _ UNIT.
CAL_UNIT	Calibration unit. It currently only supports three units: Celsius, ohm and millivolt.
TWO_WIRES_COMPENSATION	Two-line zero-point compensation.
CUSTOM_TC_NAME	The name used to store the user-defined TC type.
CUSTOM_TC_POLY_COUNT	User-defined number of TC type polynomials: 1~5.
CUSTOM_TC_MIN_IN	User-defined TC type minimum input value (x).
CUSTOM_TC_MIN_OUT	User-defined TC type minimum output value (y).
CUSTOM_TC_MAX_OUT	User custom TC type maximum output value (y).
CUSTOM_TC_POLY1	The first set of user-defined TC type polynomial coefficient consists of 6 data: Upper limit of the first paragraph, x^0 coefficient a, x^1 coefficient b, x^2 coefficient c, x^3 coefficient d, x^4 coefficient e.
CUSTOM_TC_POLY2	The second set of user-defined TC type polynomial coefficients consists of 6 data: Upper limit of the second segment, x^0 coefficient a, x^1 coefficient b, x^2 coefficient c, x^3 coefficient d, x^4 coefficient e.
CUSTOM_TC_POLY3	The third set of user-defined TC type polynomial coefficient consists of 6 data: Upper limit of the third paragraph, x^0 coefficient a, x^1 coefficient b, x^2 coefficient c, x^3 coefficient d, x^4 coefficient e.
CUSTOM_TC_POLY4	The fourth set of user-defined TC type polynomial coefficient consists of 6 data: Upper limit of the third paragraph, x^0 coefficient a, x^1 coefficient b, x^2 coefficient c, x^3 coefficient d, x^4 coefficient e.

CUSTOM_TC_POLY5	The fifth set of user-defined TC type polynomial coefficients consists of 6 data sets: Upper limit of the fifth paragraph, x^0 coefficient a, x^1 coefficient b, x^2 coefficient c, x^3 coefficient d, x^4 coefficient e.
CUSTOM_TC_RJ_POLY	User custom temperature polynomial coefficient of TC type, composed of 4 data: The x^0 coefficient a, x^1 coefficient b, x^2 coefficient c, x^3 coefficient d.

CUSTOM_RTD_NAME	The name used to store the user-defined RTD type.
CUSTUM_RTD_POLY_COUNT	User-defined number of RTD type polynomials: 1~5.
CUSTOM_RTD_MIN_IN	User-defined RTD type minimum input value (x).
CUSTOM_RTD_MIN_OUT	User-defined RTD type minimum output value (y).
CUSTOM_RTD_MAX_OUT	User custom RTD type maximum output value (y).
CUSTOM_RTD_POLY1	The first set of user-defined TC type polynomial coefficient consists of 6 data: Upper limit of the first paragraph, x^0 coefficient a, x^1 coefficient b, x^2 coefficient c, x^3 coefficient d, x^4 coefficient e.
CUSTOM_RTD_POLY2	The second set of user-defined TC type polynomial coefficient consists of 6 data: Upper limit of the first paragraph, x^0 coefficient a, x^1 coefficient b, x^2 coefficient c, x^3 coefficient d, x^4 coefficient e.
CUSTOM_RTD_POLY3	The third set of user-defined TC type polynomial coefficient consists of 6 data: Upper limit of the first paragraph, x^0 coefficient a, x^1 coefficient b, x^2 coefficient c, x^3 coefficient d, x^4 coefficient e.
CUSTOM_RTD_POLY4	The fourth set of user-defined TC type polynomial coefficient consists of 6 data: Upper limit of the first paragraph, x^0 coefficient a, x^1 coefficient b,

	x^2 coefficient c, x^3 coefficient d, x^4 coefficient e.
CUSTOM_RTD_POLY5	The fifth set of user-defined TC type polynomial coefficient consists of 6 data: Upper limit of the first paragraph, x^0 coefficient a, x^1 coefficient b, x^2 coefficient c, x^3 coefficient d, x^4 coefficient e.
TAB_ENTRY	The calibration table is currently selected for index.
TAB_X_Y_VALUE	Value of the current selection item of the calibration table (x, y)
TAB_MIN_NUMBER	Minimum number of points in the calibration table.
TAB_MAX_NUMBER	Maximum points of the calibration table.
TAB_OP_CODE	Calibrate the table operation method.
TAB_STATUS	Calibrate the table operation status.
TAB_ACTUAL_NUMBER	Actual number of points of the calibration table.

4.3.3 PROFIBUS Cyclic Data Communication Configuration

PROFIBUS DP Cyclic data communication refers to the exchange of input and output data in the form of master and slave polling, and the communication mode is unconnected. In each cycle cycle, the class 1 master station actively sends the data exchange request, while the slave station passively responds to the master station request. Cyclic data communication is mainly used in the configuration of the slave station and the PLC master station equipment. Through cyclic data communication, the master station PLC obtains the input data of the slave station or exports the output data to the slave station.

The circular data communication configuration of PA intelligent transmitter is basically the same as the PROFIBUS DP slave station, but the coupler or linker should be used between PA bus and DP bus.

The PA intelligent transmitter cycle data comes from the output parameters of 4 AI function blocks in the device, and each AI transmits 5 bytes, including 4 bytes of floating-point data and 1 byte of status data. For recurrent communication, the transmitter supports two identifiers, the short identifier 0x94 and the long identifier 0x42,0x84,0x08,0x05. Cycle data communication configuration for PROFIBUS PA using Siemens Step7.

Examples of the configuration of the PA transmitters using the Siemens Step7 are described below.

Open SIMATIC Manager, select the PLC master station and create a new project, see Figure 4.4.

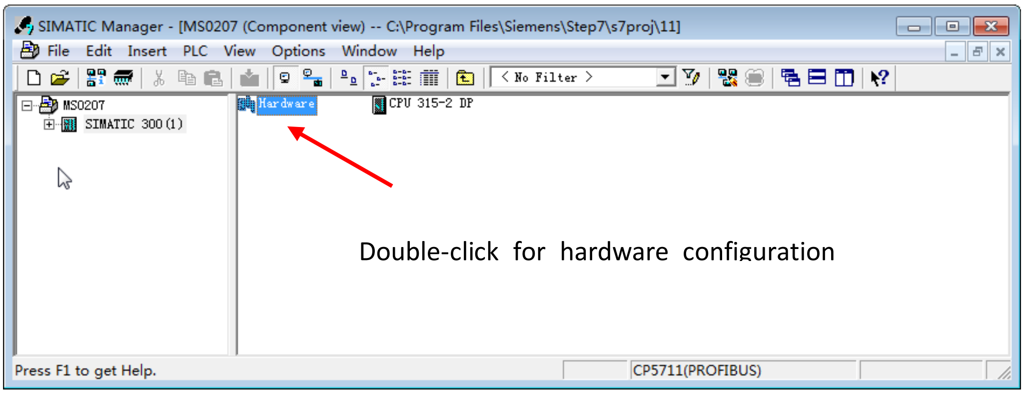


Figure 4.4 Select the PLC main station and build a new project

Double-click Hardware punch HW Config software hardware configuration. Select the GSD file for the Install GSD installation PA transmitter in the Option menu, see Figure 4.5.

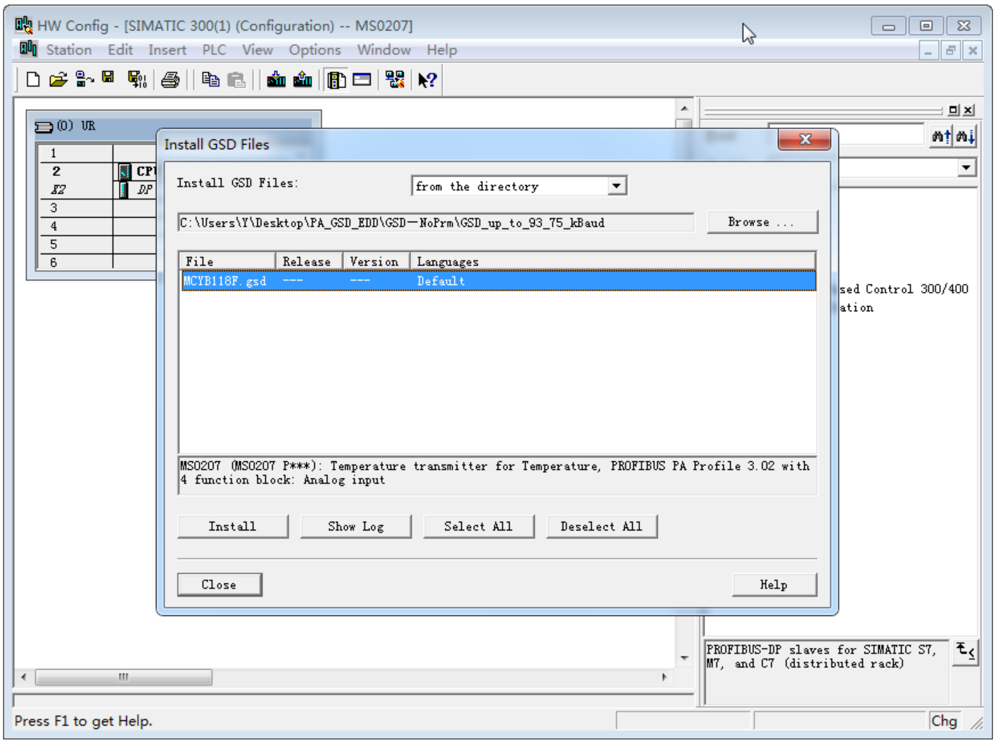


Figure 4.5 Install the GSD file

After the GSD file is successfully installed, the just installed PA device is listed in the PROFIBUS-PA category in the device list on the right side of the HW Config software. Select it with the mouse and drag and drop it on the PROFIBS DP bus, see Figure 4.6.

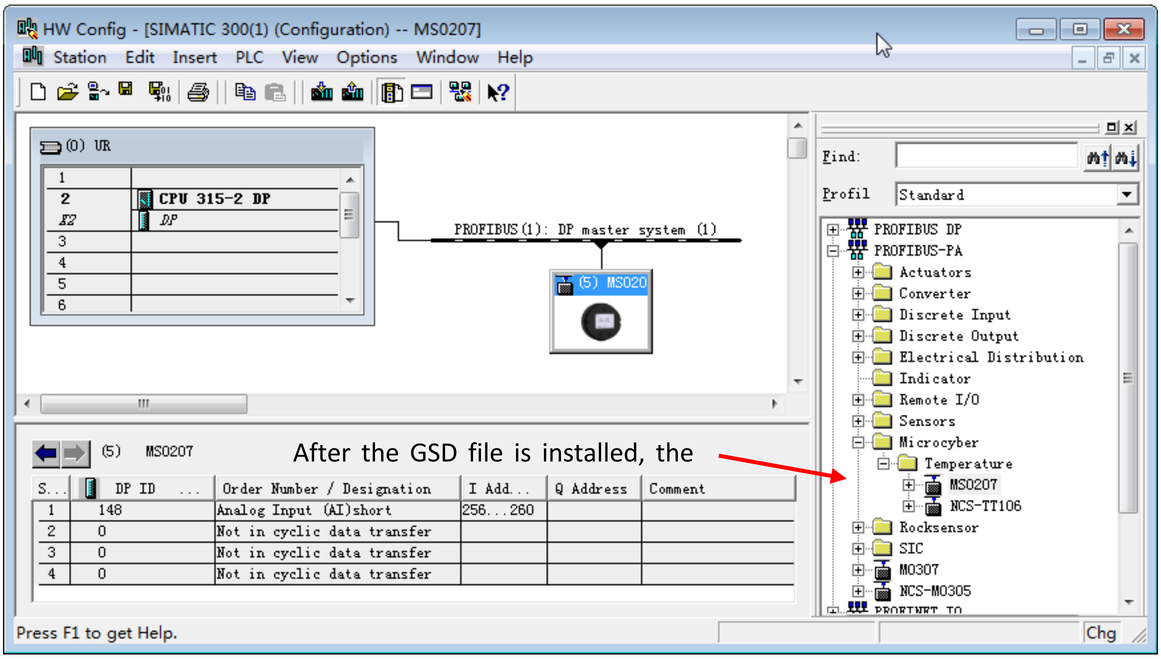


Figure 4.2 Drag the PA device to the PROFIBUS DP bus

In the PLC menu, select Download to download the configuration information to the PLC master station. This completes the cyclic data communication configuration of PA instrument and main station, as shown in Figure 4.7.

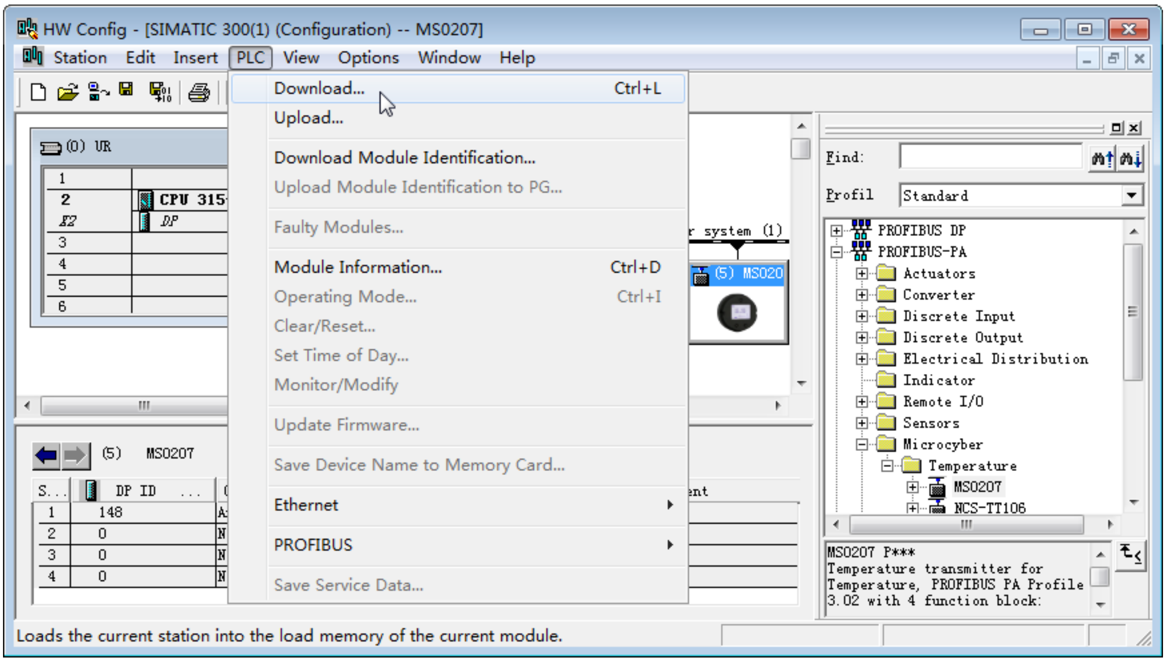


Figure 4.7 Download the configuration information to the PLC

4.3.4 PROFIBUS Non-cyclic Data Communication Configuration

PROFIBUS DP Non-circular data communication refers to the connection-oriented data communication between class 2 master stations and slave stations. This data communication is performed in non-cyclic cycles of the bus without affecting the cyclic data communication. The non-circular data is mainly the parameters of PA functional blocks and the identification and diagnosis information of the equipment. Non-circular data communication is mainly used in the management, diagnosis, identification, adjustment and maintenance of PA equipment.

Non-cyclic data communication configuration of PA instrument can be performed through Siemens equipment management software SIMATIC PDM.

The following are examples of using SIMATIC PDM for non-cyclic communication configuration of PA intelligent transmitter.

Open the Device catalog... software and import the GSD file. For the MS0207 to select the imported Microcyber \ MS020 Figure 4.8.

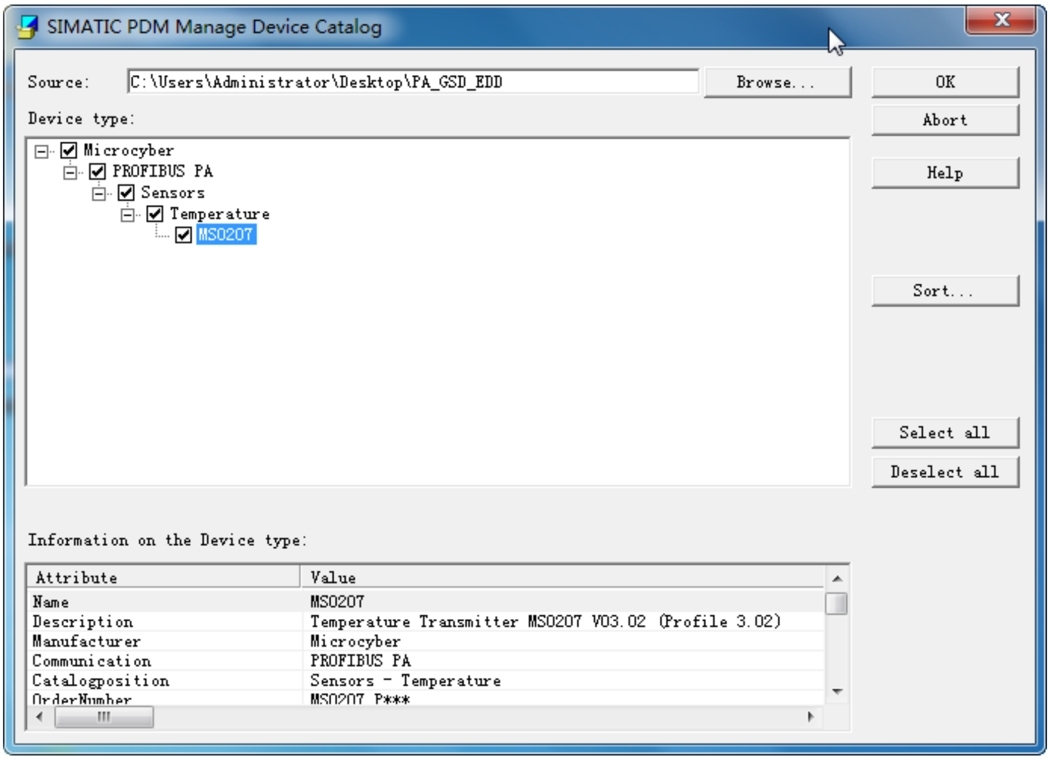


Figure 4.8 Select the device type

Open the LifeList software included with SIMATIC PDM and select the Start Scan DP bus under the Scan menu, see Figure 4.9.

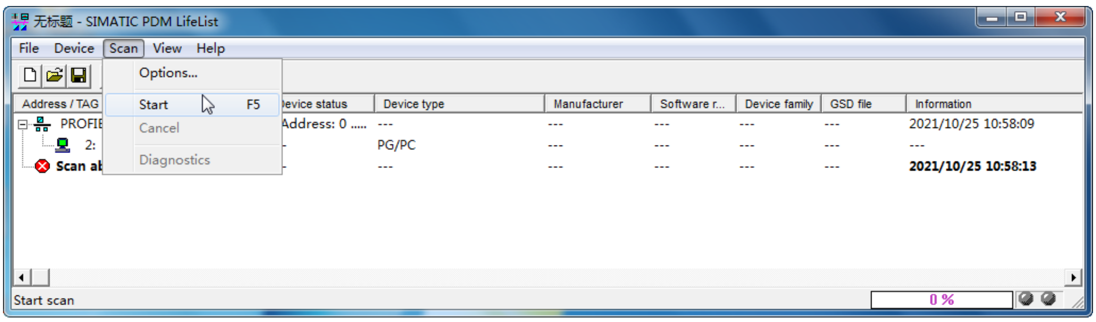


Figure 4.9 Start the LifeList

After scanning the bus, the slave station equipment on the DP bus will be listed, while displaying the equipment manufacturer ID number and some diagnostic information,

See Figure Figure 4.10.

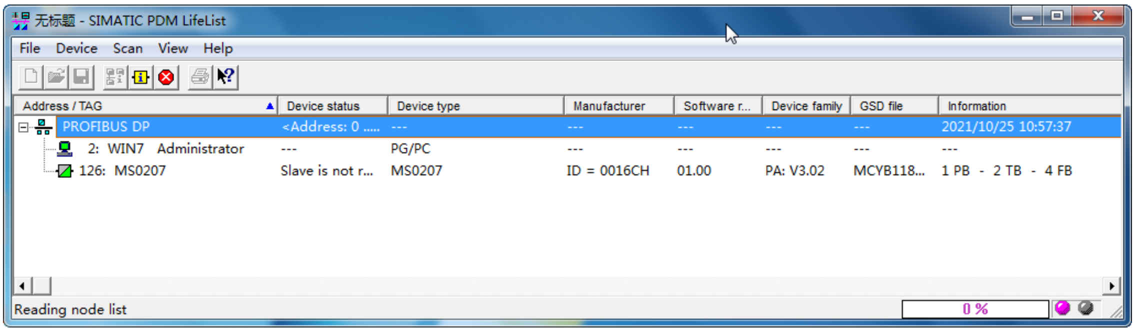


Figure 4.10 Scan DP Bus lists the PA devices

Double-clicking on the PA device will start the SIMATIC PDM software. This software enables parameter read to write and diagnosis of the PA device. The parameter reading and writing of the PA instrument can be completed through the upload and download function of the PDM software, see Figure 4.11.

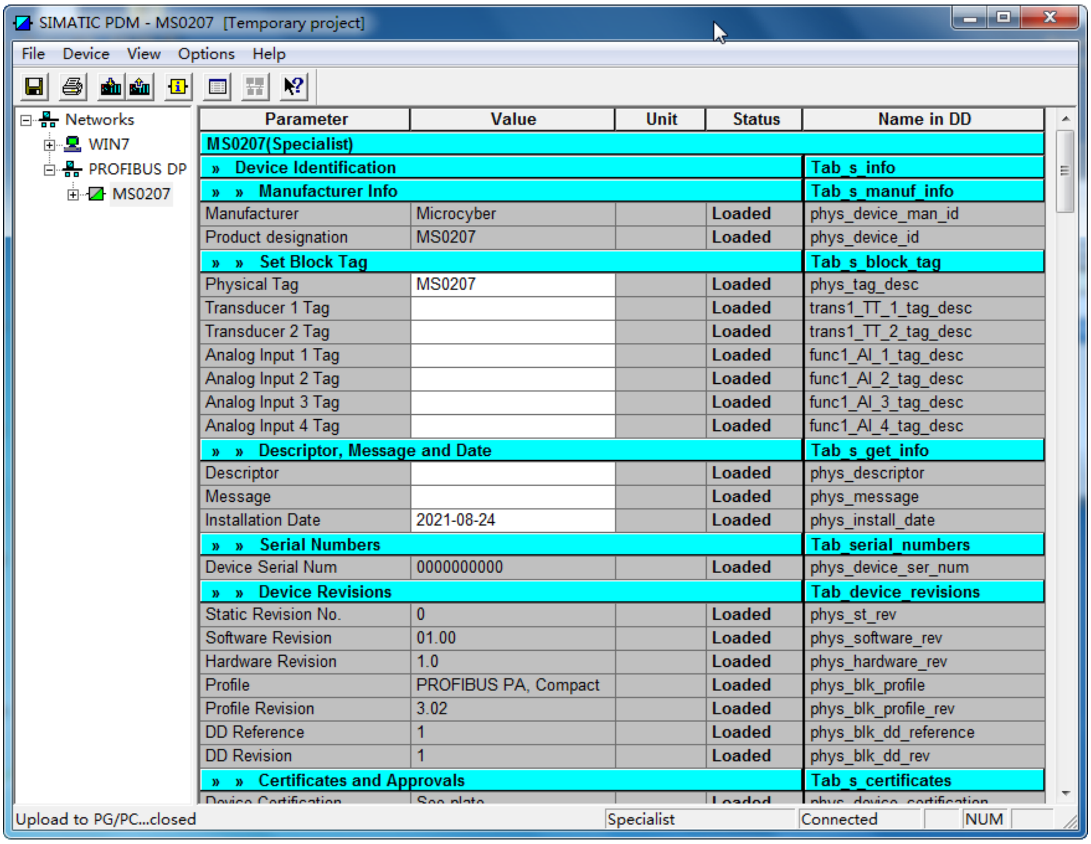


Figure 4.11 Equipment management using PDM software

4.3.5 Online Configuration Function

The PA-type intelligent transmitter realizes the functional block of the PA standard, and the online state function realizes the function of separate configuration of the functional block parameters. With PDM software, select Device-> Configuration items to write the function block parameters.

4.3.6 Sensor Type Configuration

By modifying the Characterization Type and Input Range and Mode parameters of the conversion block, such as PT 100, CU 50, etc. When the Characterization Type parameter is Linear, the Input Range and Mode parameter is valid.

4.3.7 Two-line System Zero-point Calibration Configuration

In the two-line measurement, the two-line zero-point calibration can be carried out. First give the channel zero value, which is connecting the sensor to the cable end short. Then open the PDM software, configure, select Device-> Configuration-> Transducer Block 1 items, and set the two-line calibration function in the Set 2-Wire Compensation box in the Advanced Settings.

Press the Write button, when the Finished dialog box appears, it indicates that the two-line zero point calibration is successful;

Press the Reset button, when the Finished dialog box appears, the two-line zero calibration zero is successful.

4.3.8 Enable the Cold-end Temperature Compensation

When using the thermocouple as the sensor, the conversion block Reference Junction Temperature parameter represents the cold end temperature value, and the Primary Value represents the temperature value of the measured end phase for the cold end. If the Primary Value output measurement is required to 0 degrees (i. e. the cold end temperature is 0 degrees), it can be achieved by setting the Reference Junction parameter.

When the Reference Junction parameter is set to Internal measured reference junction, the cold end temperature is the internal collected value of the temperature transmitter;

When the Reference Junction parameter is set to External Fixed Value, the cold end temperature is the Ext Reference Junction Temperature value;

When the Reference Junction parameter is set to Sensor2, the cold-end temperature is measured at Sensor2. Note: When selecting this option, channel 2 shall be configured as a thermoresistance or thermocouple.

By default, the cold-end temperature compensation Reference Junction parameter is set to Internal measured reference junction.

4.3.9 Custom TC Sensor Type

When Characterization Type selects Custom defined TC, multiple groups of custom linear polynomials appear. Fill in the appropriate polynomial coefficient and range to complete a custom TC type.for instance:

CUSTOM_TC_NAME	Custom TC Example
CUSTOM_TC_POLY_COUNT	5
CUSTOM_TC_MIN_IN	-6500.0

CUSTOM_TC_MIN_OUT	-100.0
CUSTOM_TC_MAX_OUT	1200.0

Example of the polynomial coefficient of a custom TC sensor

CUSTOM_TC_POLY_X	max.input limit in µV for POLY_X	4th degree coefficient for POLY_X	3th degree coefficient for POLY_X	2nd degree coefficient for POLY_X	1st degree coefficient for POLY_X	0degree coefficient for POLY_X
CUSTOM_TC_POLY_1	-3200.0	-3.84E-13	-5.65E-9	-3.36E-5	-6.10E-2	-8.44E1
CUSTOM_TC_POLY_2	3500.0	-8.13E-15	7.29E-11	-4.18E-7	2.53E-2	-1.08E-2
CUSTOM_TC_POLY_3	10000.0	-1.35E-15	1.50E-11	1.41E-7	2.26E-2	4.18
CUSTOM_TC_POLY_4	30000.0	3.49E-18	2.19E-12	-1.53E-7	2.68E-2	-9.26
CUSTOM_TC_POLY_5	70000.0	6.27E-17	-8.76E-12	5.34E-7	8.69E-3	1.65E2

	3th degree coefficient	2nd degree coefficient	1st degree coefficient	0 degree coefficient
CUSTOM_TC_RJ_POLY	-1.11E-4	2.65E-2	3.94E1	3.94E-1

For example, if the input voltage at the TC end of the temperature transmitter is 5000 µ V and the temperature of the cold end is 25°C, the voltage value corresponding to the cold end temperature can be calculated according to the formula:

$U_{RJ} = 3.94 * 10^{-1} + 3.94 * 10^{1} * 25 + 2.65 * 10^{-2} * 25^{2} - 1.11 * 10^{-4} * 25^{3} = 1000\ \mu V$

Add this voltage to the input end of TC (5000 + 1000) and then the corresponding temperature value is calculated according to the calculation formula:

4.18 + 2.26 * 10-2 * 6000 + 1.41 * 10-7 * 60002 + 1.50 * 10-11 * 60003 - 1.35 * 10-15 * 60004 = 146.3 °C

4.3.10 Custom-defined RTD Sensor Type

When Characterization Type selects Custom defined RTD, multiple groups of custom linear polynomials appear. Fill in the appropriate polynomial coefficient and range to complete a custom TC type. You can refer to the custom TC method for setting.

4.3.11 Multipoint-linearized Calibration

Considering the sensor accuracy and error problems, our temperature transmitter also provides a multi-point linearized calibration function. Provide 2-16 calibration points and can be selected according to the requirements.

When Calibration-> User Calibration Table is selected, a dialog box pup and the user can add data for multiple calibration points according to the requirements. The dialog box provides three functions: reading, writing and reset tables. When writing a table, the first need to enter several calibration points need to be written, through this way to choose the number of calibration points.

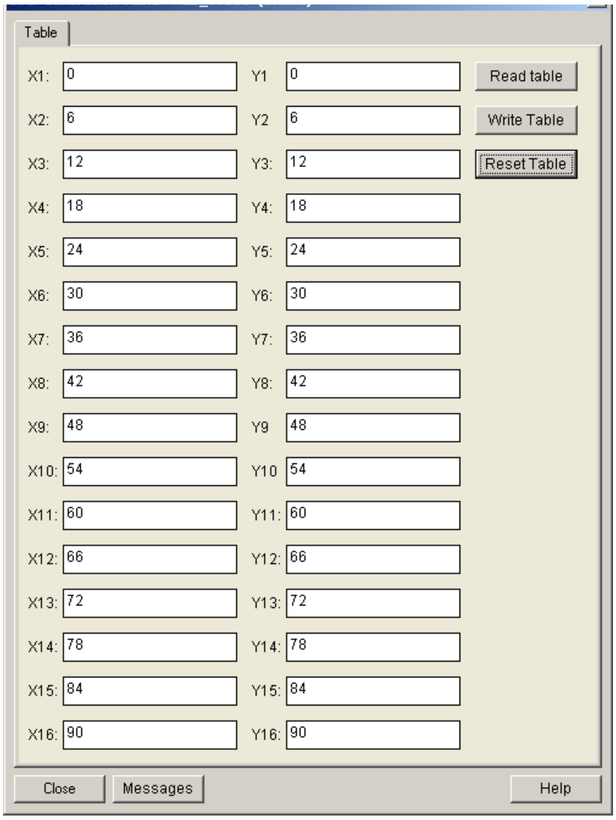


Figure 4.12 Multi-point calibration of users

4.3.12 Two-point Linearized Calibration

The temperature transmitter has been strictly corrected before leaving the factory, and generally does not require the user to correct again. The user uses the parameters such as Lower Calibration Point, Upper Calibration Point, and Calibration Unit to achieve the two-point linearized calibration.

The operation steps are performed as follows:

1） Open the PDM software, after the configuration, select Device-> Calibration-> Lower / Upper item, and call out the temperature calibration page.

2） Determine the sensor type and set the Characterization Type and Input Range and Mode parameters. The calibration unit Calibration Unit parameter is set according to the sensor type, and currently only three units of degrees Celsius, ohm and millivolt are supported. After setting up, write the parameters.

3） The standard data of the channel needs to be calibrated through the standard source. After the input is stable, the calibration data is written to the Upper Calibration Point or Lower Calibration Point parameter according to the upper limit or lower limit calibration. Without prompt write error, the calibration is successful.

Note that the written calibration data and the actual input channel data cannot be greatly biased, otherwise the calibration will fail.

Note: When Device-> Master Reset is used, the instrument CPU will be reset, resulting in a temporary interruption of communication. This is a normal phenomenon and can be reconnected.

5 HART temperature module Configuration

5.1 Topological Connections

Temperature module can be divided into 4-20 mA compatible mode and networking mode.

5.1.1 4~20mA Compatibility mode

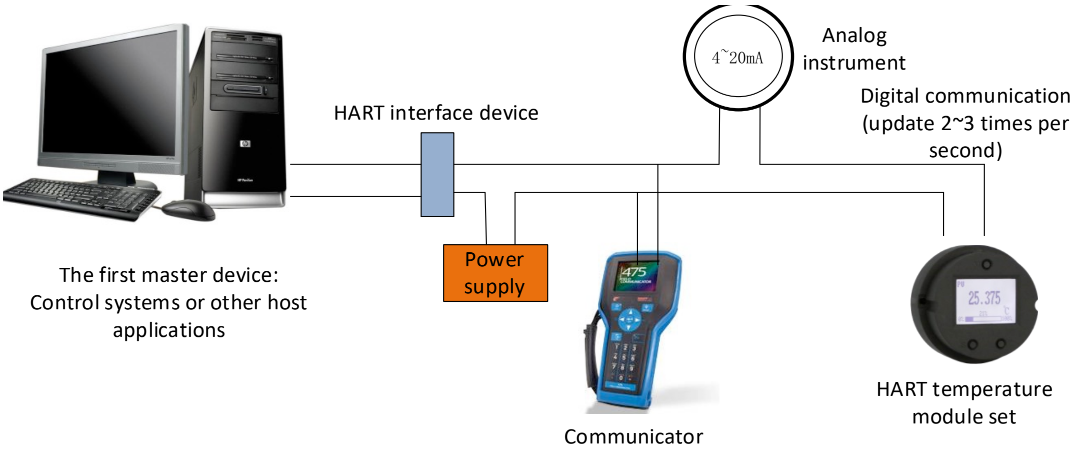


Figure 5.1 4-20 mA Compatibility mode

Characteristic:

Access to the upper control system through HART interface equipment

Analog and digital communication methods are shared.

HART slave station device short address is 0.

5.1.2 Networking Mode

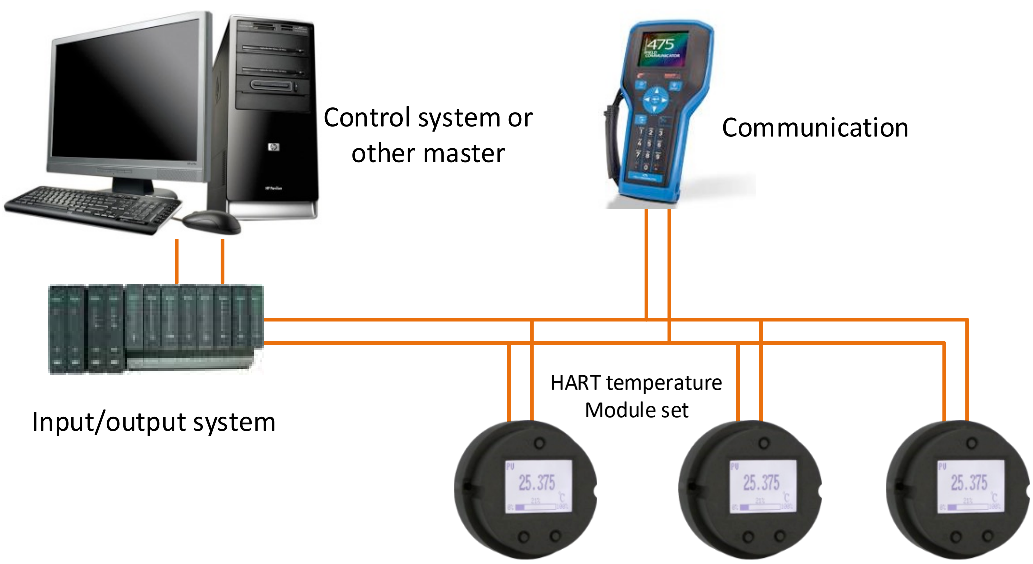


Figure5.2 HART Networking Mode

Characteristic:

Access to the upper control system through AI module;

Using only the digital function of the HART system, the current on the line is fixed at 4 mA;

HART7. 0 supports up to 64 device networking (polling addresses 0-63).

5.2 Function Configuration

Temperature module supports configuration debugging of HARTMPT configuration software of Microcyber Control and general HART configuration software such as SDC625 of HART Foundation. The following is mainly about the configuration method of temperature module, taking Microcyber's HARTMPT configuration software as an example. Mainly includes the following functions:

Configuration of basic information: Configure basic information of online device, including label, address, date, assembly number, etc.

Configuration information configuration: configure configuration information of online device, including main variable range, damping and other information;

Sensor information configuration: configure sensor information of online device, including type, wire system, etc.

Current calibration: it can calibrate (4-20) mA current of on-line device or set fixed current output;

Variable monitoring: can refresh all dynamic variables of the selected online device regularly and display the trend curve of the current device main variable;

5.2.1 Configuration Tool

PC with serial port, operating system is Windows 2000 \ Windows XP \ Windows 7;

Hart modem and serial port line;

Matching resistance (230～550) Ω；

5.2.2 Basic Information Configuration

The basic information of the HART temperature module can be read or modified through the Basic Information tab. Modifiable information includes device short address, message, description, station number, date, assembly number; Non-modifiable information includes alarm selection, write protection, manufacturer ID, manufacturer, device type, device ID, long address, and version information as shown in Figure 5.3.

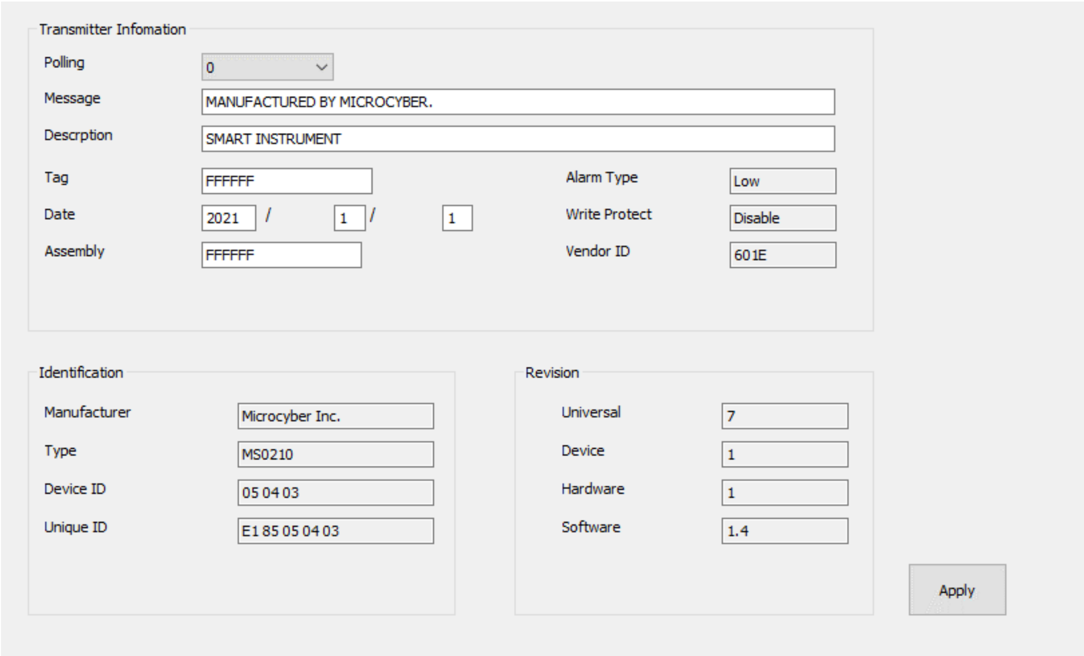


Figure5.3 Basic Information

When the information is modified, you can download it to device by pressing the Apply button.

Address selection ranges from 0 to 15;

Messages can be entered up to 32 characters;

Descriptions can be entered with up to 16 specified characters;

The maximum length of tag is 8 specified characters.

Dates range from 1900 to 2155;

The maximum length of the assembly number is 6 specified characters.

5.2.3 Configuration Information Configuration

The configuration information of the sleeve can be read or modified by the configuration information tab, including the output variables (main variable, cold end temperature value, current value, percentage) of the device, the setting of the main variable information (damping value, unit, upper range limit, lower range limit), etc., as shown in Figure 5.4.

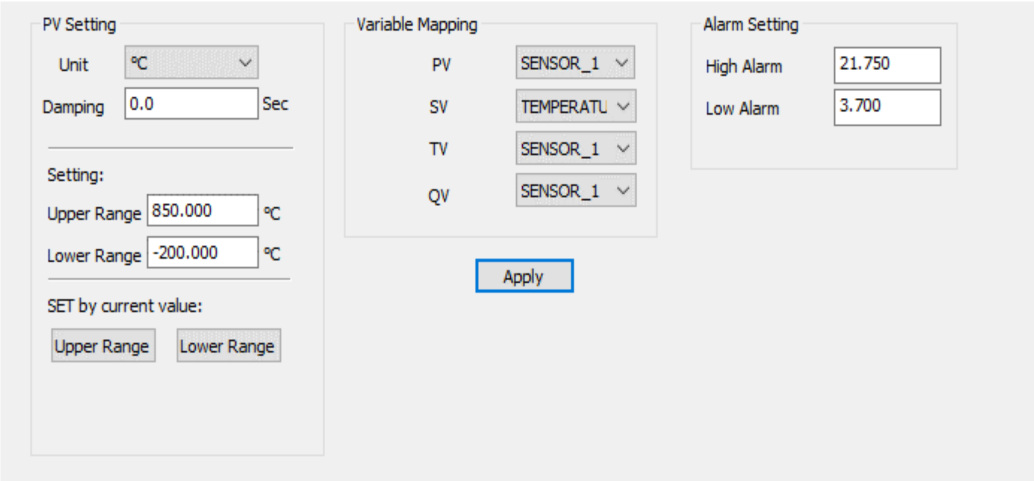


Figure5.4 Configuration Information

- _ Damping: Range 0-32 seconds.
- _ Unit: Changes in PV units directly affect the variables associated with the unit, such as upper and lower limits of range, upper and lower limits of sensor, etc. When modifying units, the upper and lower limits of the range of main variables can not be changed at the same time, but should be modified separately.
- _ Units can be set to: C, F, R, K, mV, Ohm.
- _ Upper Range Limit: PV value corresponding to 20 mA output current.
- _ Lower Range Limit: PV value corresponding to 4 mA output current.
- When the information is modified, you can download it to device by pressing the Apply button.
- _ Set the "Upper Range Limit" button with the current value: Set the current PV value of device to the upper range of the main variable without changing the lower range limit.
- _ Set the Lower Range Limit button with the current value: Set the current PV value of device to the lower limit of the range of the main variable, which may change at the same time.
- _ Set the "main variable zero" button with the current value: at zero temperature, take the current PV value of device as the main variable zero.

5.2.4 Sensor Configuration

The Sensor Information tab allows you to view the currently configured sensor information (upper limit, lower limit, minimum span) as well as the type, wire configuration, etc. of each sensor individually. As shown in Fig. 5.5.

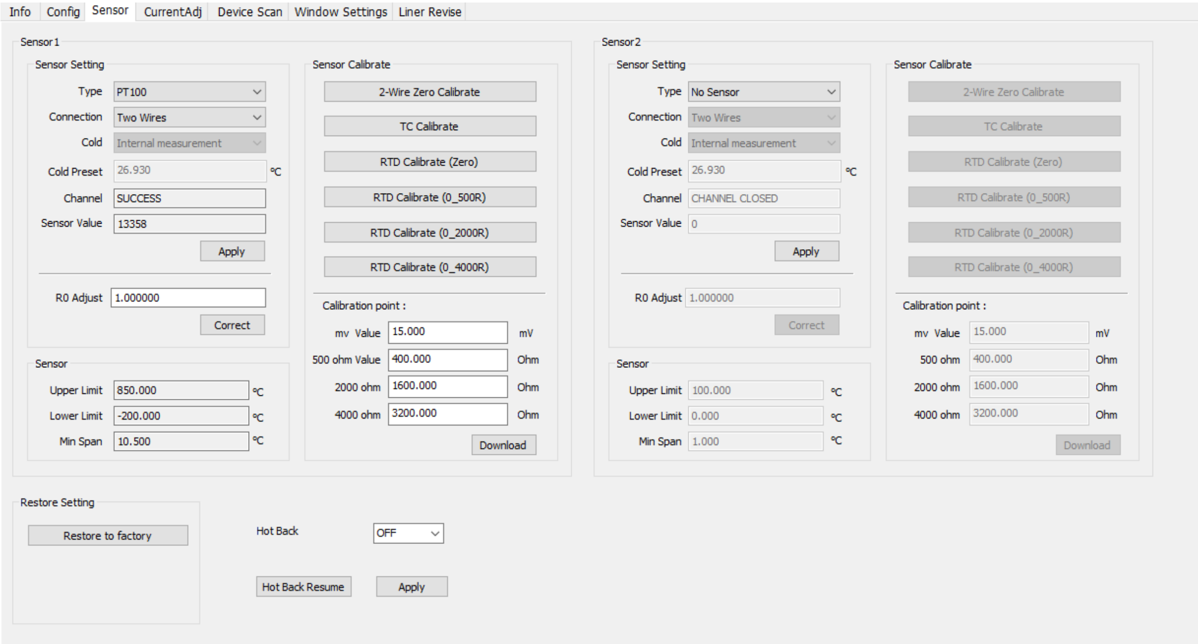


Figure 5.5 Sensor Configuration

Sensor Type: Set the supported sensor type as shown in the table below:

Sensor type	Description
0_500R	Resistance，(0 ~ 500) Ω
0_4000R	Resistance，(0 ~ 4000) Ω
CU50	Cu50
CU100	Cu100
PT100	PT100
PT200	PT200
PT500	PT500
PT1000	PT1000
100mV	Millivolt voltage signal, range: (- 100 ~ 100) mV
B_TC	B_TC
E_TC	E_TC
J_TC	J_TC
K_TC	K_TC

N_TC	N_TC
R_TC	R_TC
S_TC	S_TC
T_TC	T_TC

- Sensor types include resistance (0_500 Ω, 0_4000 Ω), thermal resistance (cu50, cu100, PT100 and PT1000), - 100 ~ + 100mV, thermocouple (B, e, J, K, N, R, s and T).
- The wire system can be set to 2, 3 and 4 wire system (resistance and thermal resistance signal), and the thermocouple is 2-wire system. For sensor 2, it can only be set to 2 or 3-wire system.
- Cold junction compensation is only valid for thermocouples. It can be set to four modes: cold end prohibition, internal measurement, fixed value and sensor 2 measurement. If the cold end is prohibited, the transmitter will not compensate the cold end; Internal measurement, the temperature of cold end compensation is provided by the internal temperature measurement chip; Fixed value, the temperature of cold end compensation is the temperature set externally; Sensor 2 measures, and the temperature of cold end compensation is the measured value of sensor 2. At this time, sensor 2 should be externally connected with PT100.
- The channel status displays the sensor channel status (open circuit, short circuit, etc.).
- The sensor channel value displays the original value of the sensor channel.
- R0 correction coefficient corrects the error of the sensor itself (range 0.9 ~ 1.1).
- Two wire zero calibration when the temperature transmitter is connected to RTD in a two-wire system, in order to avoid the error caused by the resistance on the cable, short circuit the sensor end, and then click the "two-wire zero calibration" button to eliminate the error caused by the resistance on the cable.
- TC calibration factory calibrates thermocouples and millivolt signals.
- RTD calibration carries out factory calibration for thermal resistance and resistance signal.
- Calibration point is the standard value used when calibrating the transmitter.
- Restore the factory default value. Click this button to restore all data to the default factory state.
- Save as factory value click this button to save the current configuration as factory value. Click the "restore factory settings" button again to restore the configuration saved this time.
- Restore factory settings click this button to restore the data to factory status. If the user has saved the factory value, the configuration saved by the user will be restored; Otherwise, restore to the default factory state.

5.2.5 Current Calibration

The current calibration steps are as follows:

The current calibration steps are as follows:

1) To connect the circuit, a five and a half bit accuracy ammeter shall be connected in series on the device output circuit;

2) Set the polling address of the device to 0. See the basic information configuration. If the polling address is already 0, you can skip this step;

3) Enter the current calibration tab;

4) Select "current value" as 4 mA. After the ammeter is stable, enter the reading of the ammeter in the "adjustment value" text box and click the "apply" button;

5) Select "current value" as 20 mA. After the ammeter is stable, enter the reading of the ammeter in the "adjustment value" text box and click the "apply" button;

6) Select "current value" as blank, so that the current output by the device is calculated according to the PV value.

Note: when the current value currently output by the device is high alarm current, 4 Ma cannot be calibrated; When the current value currently output by the device is low alarm current, 20 mA cannot be calibrated;

Configure current fixed output:

The user can configure the fixed current output in the current calibration tab. After clicking "send manually", enter the current value of the device to be fixed output in the next text box, and click "enter / exit the fixed current mode" to enter or exit the fixed current output mode. The title of the button displays "enter fixed current mode" and "exit fixed current mode" in turn to prompt the user for operation.

During continuous operation, the temperature module continuously compares the value of the main variable with the upper and lower limits of the range. When the value of the main variable exceeds the upper and lower limits of the range, the temperature module outputs a fixed current to indicate that the main variable exceeds the range. When the main variable is high and the upper limit value, the output of temperature module is fixed at 20.8 mA; When it is lower than the lower limit, the output of temperature module is fixed at 3.8 mA.

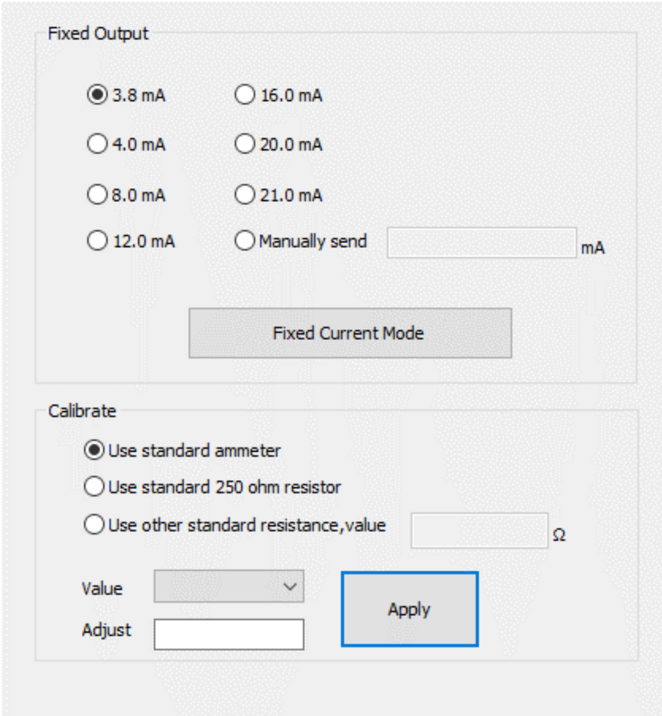


Figure5.6 Current calibration

Note: the calibration current and fixed current output functions can only be performed when the polling address of device is 0. Other polling addresses are in full digital communication mode, and the error message "command execution failed" will be prompted.

5.2.6 Variable Monitoring

Through the variable monitoring tab, you can regularly refresh all dynamic variables of the selected device and display the trend curve of the main variable of the current device. The currently refreshed variables are PV value, current value, percentage and cold end temperature.

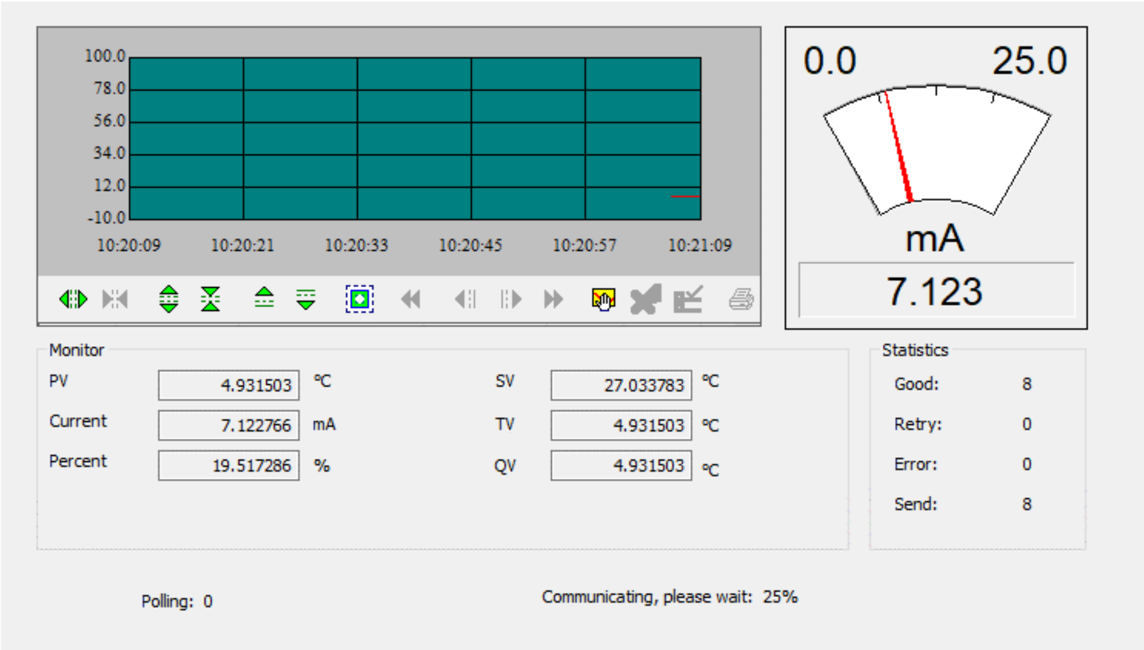


Figure5.7 Variable Monitoring

5.2.7 linear correction

Through the linear correction function, the sensor can be calibrated at multiple points. The correction mode can be "analog quantity" and "digital quantity". The correction points can be freely selected between 2 and 16 points. When the second multi-point calibration is required, click the "restore default" button before the next calibration.

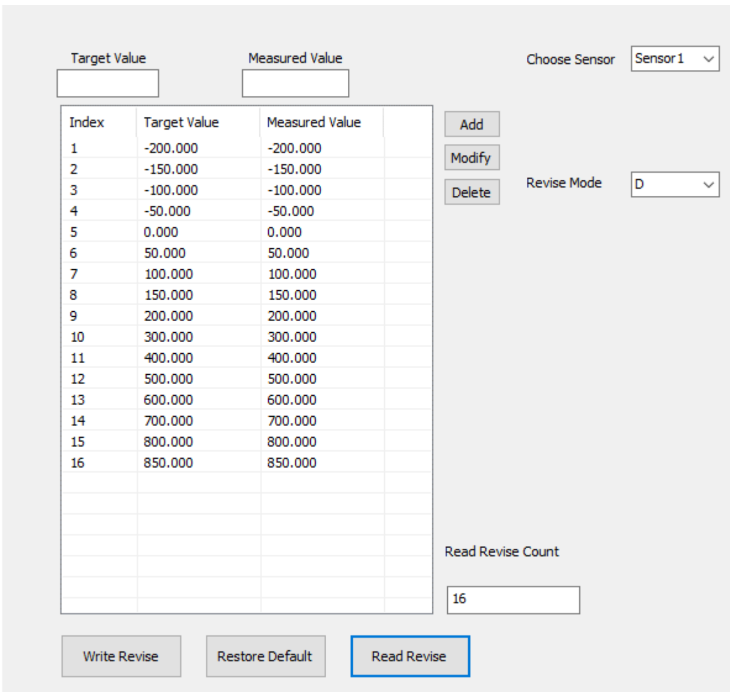


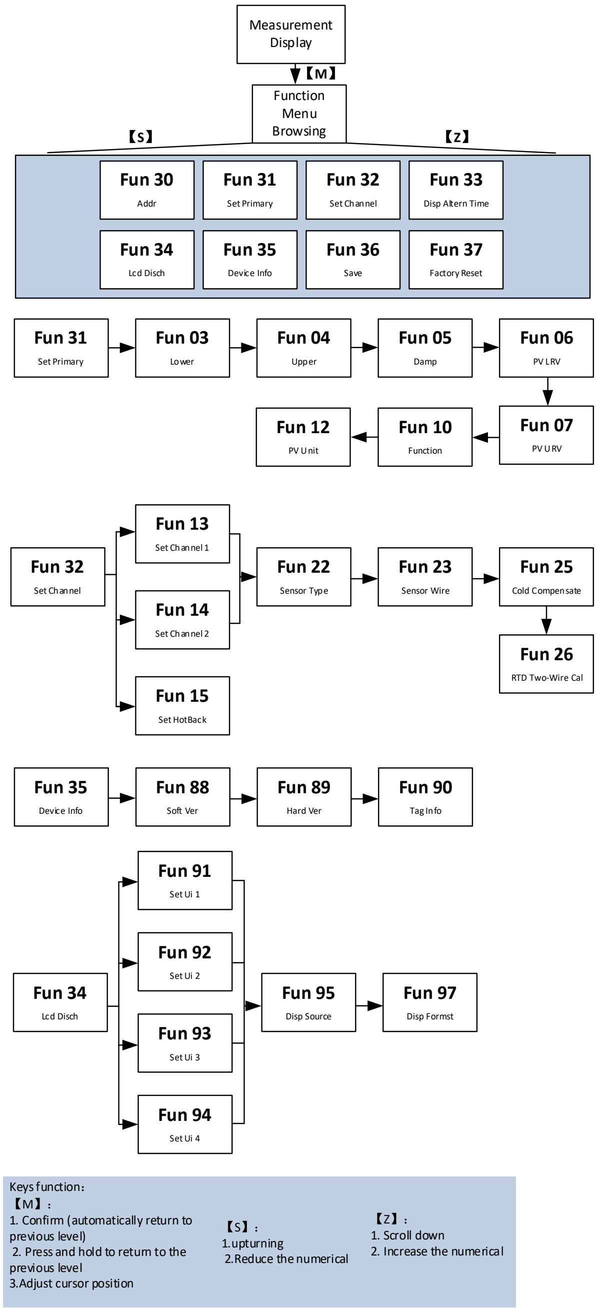
Figure5.8 linear correction

6 Site Adjustment

6.1 LCD and key description

The temperature transmitter is equipped with dot matrix LCD and local button adjustment function, so that users can fully adjust the temperature transmitter (temperature transmitter + sensor + housing) locally.

There are 3 keys, [M], [S], [Z] keys, and [M] keys are the mode keys, mainly responsible for "Function selection", "Cursor Move", and "OK".The [S] and [Z] keys are the input adjustment keys, mainly responsible for the "front and back menu turn" and the "value of the addition and subtraction".



Note: ① F F / PA protocol does not have the Fun 31 and Fun 15 menus.

② PA protocol adds the Fun 12 menu after the Fun 26.

③ FF protocol adds the Fun 6, Fun 7, and Fun 12 menu after Fun 26, and the Fun 6, Fun 7 and Fun 12, and Fun 22 cannot be changed at the same time.

7 Maintenance

Phenomenon	Solution
No Communication	Temperature module connection Check the bus cable connection Check power polarity Check the bus cable shield for single point grounding
	network connections Check the network topology correctness
	Address conflict The default short address is set by the temperature module to 0. But address conflicts are still possible on one network. When a conflict occurs, please reset the address of the device. Sometimes it will be completely offline, you can cut off the conflict device first, and then power on one by one, and modify the address of the new power device to the non-conflict address. Power up in order, change the address, until all online.
	Temperature module fault Replace it and test by other temperature modules
Read error or Output alarm current	Temperature module connection problem Check the sensor for short circuit, open circuit, ground, etc Check the sensor for fault
	Noise Distrub Regulate damping Check the terminals for moisture Check whether the cable laying is far away from the strong interference sources
	Software Settings Check that the sensor type is configured correctly

8 Technical Specifications

8.1 Basic Parameter

Input Signal	Pt100、Pt1000、PT 200、PT500、CU50、CU100、0～500Ω、 0~4000 Ω; B E J K N R S T thermocouple, -100mV~100mV	
RTD mode of connection	2,3,4 wires connection	
Power	FF/PA	(9～32)VDC
	HART	(11.5～45)VDC
Bus protocol	(4～20)mA+HART, FF, PA	
Channels	2 channels	
Insulation	1000VAC	
Display	LCD LCD display or no display (optional)	
Temperature Range	Operating temperature of the transmitter body: (-40~85) ℃ (no display) (-20~70) ℃ (with display)	
Humidity Range	(5～95)%RH	
Storage Temperature	-40 ～ 85℃	
Start Time	5-Second Time (HART) 8-Second (FF, PA)	
Refresh Time	The 0.8 ~ 1.3s depends on the type and wiring mode of the sensor	
Damping Adjustment	Time constant of 0 to 32 seconds	
Cold-end Temperature	±0.5℃	
Alerting signal (only HART)	The alarm output can be set at 3.5 … 23 mA Upper / lower limit current 20.8mA / 3.7mA	
Current accuracy	0.03%	

(only HART)	
Voltage Influence	±0.005%/V
Ex Level	Ex ia IIC T4 Ga (developed according to this standard, not certified)

8.2 Technical indicators of thermal power resistance

- RTD Accuracy (25°C)

Sensor type	Working range (°C)	Accuracy (25°C)	Heating drift (per ° C)
Resistance	0~500Ω	±0.04Ω	±0.001Ω
	0~4000Ω	±0.35Ω	±0.015Ω
PT100	-200 ~ 850°C	±0.15°C	±0.003°C
PT 200	-200 ~ 850°C	±0.15°C	±0.005°C
PT 500	-200 ~ 850°C	±0.15°C	±0.005°C
PT1000	-200 ~ 850°C	±0.15°C	±0.005°C
CU50	-50 ~ 150°C	±0.15°C	±0.005°C
CU100	-50~ 150°C	±0.10°C	±0.003°C

- Other technical indicators of RTD

Wiring	2,3,4 wire
Common mode rejection	70 dB (50 Hz and 60 Hz)
Differential mode inhibition ratio	70 dB (50 Hz and 60 Hz)

8.3 Thermo Couple technical indicators

- Thermal couple accuracy (25°C)

Signal type	Sensor range range (°C)	accuracy (25°C)	Heating drift (per ° C)
mV	-100mV ~ +100mV	±0.025mV	±0.001 mV
B	500 °C~ 1810°C	±0.77°C	±0.050°C
E	-200 °C~ 1000°C	±0.20°C	±0.025°C
J	-190 °C~ 1200°C	±0.35°C	±0.01°C

K	-200℃ ~ 1372℃	±0.40℃	±0.025℃
N	-190℃ ~ 1300℃	±0.50℃	±0.015℃
R	0℃ ~ 1768℃	±0.75℃	±0.023℃
S	0 ℃~ 1768℃	±0.70℃	±0.023℃
T	-200℃ ~ 400℃	±0.35℃	±0.015℃

- Other technical indicators of the thermocouple

Sensor type	B, E, J, N, K, R, S, T; (-100~100) mV voltage
Common mode rejection	70 dB (50 Hz and 60 Hz)
Differential mode inhibition ratio	70 dB (50 Hz and 60 Hz)

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