NCS-TT106H-R HART DIN Rail Temperature Tansmitter

User Manual

MICROCYBER

Company Introduction

Microcyber Corporation，established as a high-tech enterprise by the Shenyang Institute of Automation Chinese Academy of Sciences, mainly engages in advanced industrial control systems, equipments, instruments and chips for industrial process automation control solutions in the research, development, production and application. Microcyber undertakes a number of national scientific and technical key task and “863” project, and has Liaoning

Province networked control systems engineering research center. The company successfully developed the FF H1 fieldbus protocol stack which is number one to be approved

internationally in China, and the Industrial Ethernet Protocol(HSE) which is number one to be approved in China, and the domestic first fieldbus instrument which has a function of national-level intrinsically safe explosion--proof and safety barrier. Also Microcyber participated in the drafting of the domestic first Ethernet-based industrial automation protocol standards (Ethernet for Plant Automation, EPA). As a result, serial products are composed of configuration, control software, embedded software, control system, instrument chip to the

OEM board, and make Microcyber be an industrial automation products provider in full range, and also further Microcyber‟s leading position in the field of fieldbus technology.

Microcyber is the FF member, the HART member and the Profibus National Organization (PNO) member.

Microcyber passes the Authentication of ISO 9001 Quality System, and has an outstanding innovative R&D team, plentiful practical experiences of design of the Automatic engineering, a leading product series, a huge market network, a strict quality management system and an excellent enterprise culture. All these further a solid foundation of entrepreneurship and sustainable development for Microcyber.

Carrying the ideals of employees, creating customer value and promoting enterprise development.

Microcyber is making progress with China.

Catalogue

1 Introduction

1.1 Security information

To ensure personal safety when performing operations, pay special attention to the instructions and procedures in this section.

Warning

- Ensure that the construction personnel who have obtained the relevant qualifications install
- Ensure that the working environment of the equipment is consistent with the corresponding hazard level certification
- Be extremely careful when in contact with wires and terminals

1.2 Overview

1.2.1 Manual

The purpose of this manual is to assist in the installation, operation, and maintenance of the NCS-TT106H-R Din Rail transmitter.

Section 2: Configuration

This section provides instructions for commissioning and operating the NCS-TT106H-R transmitter.

Section 3: Hardware Installation

This section contains the mechanical installation instructions for the transmitter.

Section 4: Electrical installation

This section contains electrical installation instructions for the transmitter.

Section 5: Operation and Maintenance

This section contains common operating and maintenance tips for your transmitter.

Section 6: Troubleshooting

This section describes troubleshooting tips for the most common transmitter operation problems.

Section 7: Technical Specifications

This section provides transmitter specifications and reference data.

Appendix A: Field Communicator Menu Tree

This section describes the Field Communicator menu tree.

Appendix B: HARTMPT Configuration Software Operator Interface

This section describes the HARTMPT configuration software operator interface.

1.2.2 Transmitter Overview

The Microcyber NCS-TT106H-R temperature transmitter provides a flexible and reliable temperature measurement solution. As a high precision transmitter, the NCS-TT106H-R is designed to meet your most demanding applications. HART communication converts different types of input signals into 4~20mA analog output signals.

The NCS-TT106H-R's superior performance is reflected in signal reliability, long-term

stability, high precision and advanced diagnostics (important in critical processes), minimizing the risk of use.

Its characteristics are as follows:

- Double channel input
- 4-20mA/HART protocol (version 7)
- General purpose input signal, RTD, thermocouple (TC), resistor, and voltage signal
- A variety of sensor wiring methods, parameter settings are simple and convenient
- High reliability, long-term stability, high measurement accuracy and advanced diagnostics

1.3 Precautions

1.3.1 General

Electrical temperature sensors, such as thermal resistors and thermocouples, generate low voltage signals that are proportional to the temperature they sense. The Microcyber NCS-TT106H-R converts the low voltage sensor signal to a standard 4-20 mA DC or digital HART signal that is insensitive to lead length and electrical noise. This signal is then transmitted to the control room via two lines.

1.3.2 Debugging

The transmitter can be commissioned before or after installation. It is useful to debug

on the workbench before installation to ensure that the device works correctly and is familiar with the function of the device.

1.3.3 Machinery

When choosing an installation location, consider the ease of operation of the device.

1.3.4 Electrical

In order to prevent errors caused by sensor lead resistance and electrical noise, proper electrical installation must be performed. For best results, shielded cables should be used in environments with severe electrical noise.

1.3.5 Installation Precautions

The measurement accuracy depends on whether the transmitter is properly installed. Install the transmitter close to the process line and use the smallest wire for best accuracy. Consideration should be given to ease of operation, personal safety, on-site calibration, and proper transmitter environmental requirements. The transmitter should be installed in such a way as to minimize vibration, shock and temperature fluctuations.

1.3.6 Environmental Considerations

The best practice is to install the transmitter in an environment where the ambient temperature changes very little. The transmitter electronics have an operating temperature limit of -40 to 85 °C. The transmitter should be installed in such a way

that it is protected from vibration and mechanical shock and is not in contact with corrosive substances.

2 Configuration

This section contains the commissioning work and tasks that should be performed on the workbench before installation, and provides a description of the field communicator and the HARTMPT configuration software for performing the configuration functions.

2.1 Configuration method

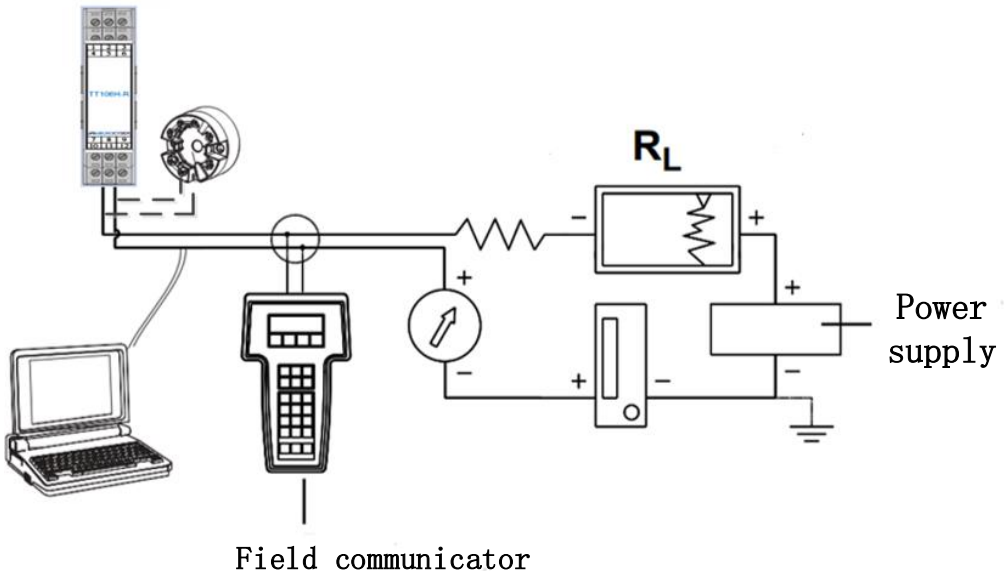
The Microcyber NCS-TT106H-R temperature transmitter can be configured before or after installation. Before the installation, using the field communicator , the HARTMPT configuration software to configure the transmitter on the workbench ensures that the transmitter is in good working condition.

2.1.1 Configuration on the workbench

The device required for configuration on the workbench includes the power supply, digital multimeter (DMM) and field communicator, HARTMPT configuration software.

Connect the device as shown in Figure 2-1. Connect the HART Communicator to any end node in the signal loop. In order to ensure successful HART communication, the resistance between the transmitter and the power supply must be at least 250Ω. Connect the field communicator leads to the power (+ and -) terminals on the top of the device.

Figure 2-1：Powering the transmitter for workbench configuration



Note：The signal loop can be grounded at any point or not grounded.。

The Field Communicator can be connected to any termination point in the signal loop. The signal load should between 250-500 ohms for normal communication.。

2.1.2 Selecting the configuration tool

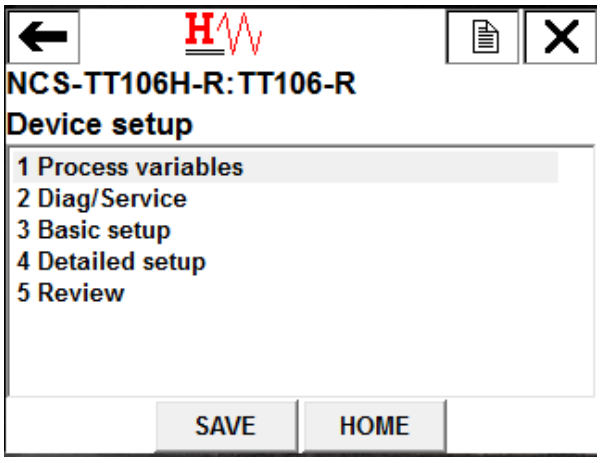
Configuration with the Field Communicator

A Field Communicator is a handheld device that exchanges information with a transmitter from any termination point in the controller, instrumentation site, or loop. To facilitate communication, the field communicator and transmitter should be connected in parallel as shown in this manual. The complete Field Communicator menu tree can be found in the Appendix A Field Communicator menu tree.

Figure 2-2 shows the interface of the field communicator device dashboard. The Field Communicator must be loaded with the latest DD to get the best transmitter performance. Please visit www.microcyber.com to download the latest DD library.。

Press and hold the power button to turn on the Field Communicator, and the Field Communicator will search for HART-compatible devices and prompt when to establish a connection. If the Field Communicator connection fails, means the device was not found. If this happens, please see Section 6: Troubleshooting.。

Figure 2-2：Field communicator device dashboard interface



Configuration with HARTMPT software

With the HARTMPT configuration software, you can debug and configure the instrument, monitor status and alarms, troubleshoot from the control room, perform advanced diagnostics, manage calibrations, and automatically log activity with the single application. The complete HARTMPT configuration software operator interface

can be found in the Appendix B HARTMPT Configuration Software operator interface.

The main functions of the HARTMPT configuration software are as follows:

- **Basic information**：including label, polling address, date, assembly number, etc.
- **Configuration information**：including information such as main variable range, damping, dynamic variable mapping and alarm current etc.
- **Sensor configuration**：Includes sensor type, connection and calibration etc.
- **Current calibration**：including output current calibration, fixed current output function
- **Variable monitoring**：Timed refresh of dynamic variables of selected devices

2.2 Transmitter basic configuration

The NCS-TT106H-R transmitter must be configured for specific basic variables before it can work. In most cases, all of these variables are pre-configured at the factory. If the transmitter is not configured, or if you need to modify the configuration variables, you need to configure.

2.2.1 Setting the PV (Host Variable) Unit

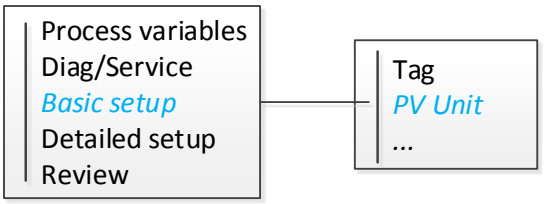
The engineering units supported by the transmitter are as follows: :

- Celsius
- Fahrenheit
- Rankine
- Kelvin

- Ohm
- mV

The choice of transmitter PV unit directly affects the selected sensor type. When the PV unit is temperature unit (Celsius, Fahrenheit, Rankine, and Kelvin), the two-channel accessible sensor types are RTD and thermocouple (TC); when the PV unit is ohm, the accessible sensor type is a resistance signal; when the PV unit is mV, the accessible sensor type is a voltage signal.

Configuring PV units with the Field Communicator



Configuring PV units with HARTMPT software

1. Select the "Configuration Information" tab.
2. Configure the unit variable in the ‘master variable setting’ area.

2.2.2 Configuring the sensor

The sensor includes the following information：

- Sensor type
- Connection
- Cold compensation
- Cold end preset

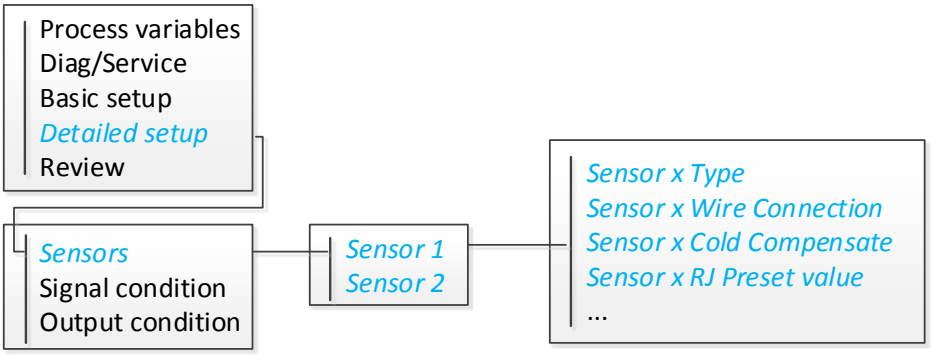
Sensor type includig resistance（0_500Ω、0_4000Ω）, thermal resistance（Cu50、Cu100、Pt100 和 Pt1000）, -100~+100mV , thermocouple（B、E、J、K、N、R、S and T）。

Connection can be set to 2-wire, 3-wire, or 4-wire (resistance, RTD signal), and the thermocouple is 2-wire. For sensor 2, it can only be set to 2-wire, 3-wire.

Cold compensation is only valid for thermocouples. Can be set to cold end disable, internal measurement, fixed value and sensor 2 measurement four ways. The cold end end disable, the transmitter will not compensate the cold end; the internal measurement, the cold compensation temperature is provided by the internal temperature measurement chip; the fixed value, the cold compensation temperature is the user-set cold junction preset value ; sensor 2 measurement, the temperature of the cold compensation is the measured value of sensor 2, at this time sensor 2 should be connected to Pt100.

The cold end preset value is the temperature set by the user externally, and the cold compensation mode is a fixed value.

Configuring Sensor with the Field Communicator



Configuring sensor with HARTMPT software

1. Select the “Sensor” Configuration tab。
2. . Configure the sensor in the “Sensor“ settings area。

2.2.3 Mapping HART variables

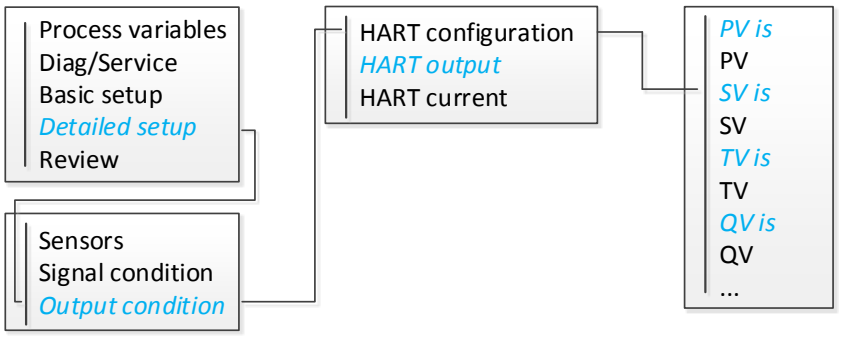
“Variable Mapping” displays a sequence of process variables. The NCS-TT106H-R dual sensor configuration allows the user to select primary variables (PV) and secondary variables (SV), tertiary variables (TV), and quadrant variables (QV). The variable options are ”Sensor 1”, ”Sensor 2”, ”Device Temperature”, ”Average”, and ”Difference”. 4-20mA analog signal represents the primary variable.

Average is the average of the sensor 1 and sensor 2 inputs.

Difference is the difference between the sensor 1 and sensor 2 inputs.

Note : If PV is configured for the average or difference measurement, the transmitter will give an alarm when sensor 1 and/or sensor 2 fails.

Mapping HART variables with field communication



Mapping HART variables with HARTMPT software

1. Select the "Config " tab.
2. Map HART variables in the ' Variable Mapping' area.

2.3 Configuring device output

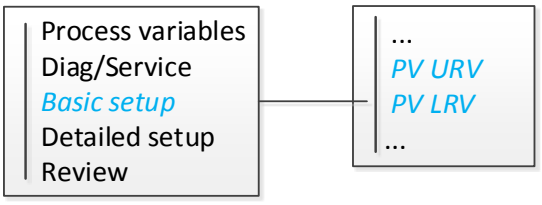
2.3.1 Reset the transmitter range

Reset the transmitter range to set the measurement range to the expected reading limit for a particular application. Setting the measurement range to the expected reading limit maximizes transmitter performance; the transmitter is most accurate when operating within the expected temperature range for a particular application.

The range of expected readings is determined by the lower range limit (LRV) and the upper range limit (URV). Reset the transmitter range values from time to time as needed to reflect changing process conditions.

Although the reset range function matches the sensor input to the 4-20 mA output as in conventional calibration, it does not affect the transmitter's input interpretation.

Reset the transmitter range with the Field Communicator



Reset the transmitter range with HARTMPTsoftware

1. Select“Config”lab。
2. In the ‘setting’ area, set the range upper limit and range lower limit parameters.

2.3.2 Damping

The damping function changes the response time of the transmitter to smooth out fluctuations in the output readings caused by rapid changes in the input. Determine the appropriate damping settings based on the required response time, signal stability, and other requirements for system loop dynamics. The default damping value is 0 seconds and can be set to any value between 0 and 32 seconds.。

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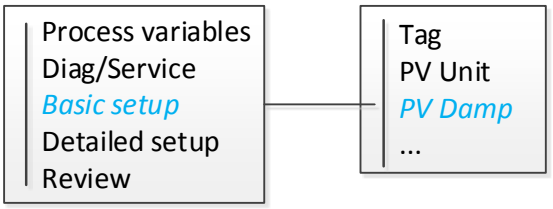
The selected damping value affects the response time of the transmitter. When set to 0 (disabled), the damping function is turned off and the transmitter output responds to

input changes as fast as the sensor algorithm allows. Increasing the damping value will increase the response time of the transmitter.

Set damping with the Field Communicator



Set damping with HARTMPT software

1. Select “Config” lab.
2. In ‘PV setting’ area，set damping parameters.

2.3.3 Configuring the alarm saturation level

During normal operation, the transmitter will drive the output based on measurements between the lower saturation point and the upper saturation point. If the sensor limit is exceeded, or the output exceeds the saturation point, the output is limited to the corresponding saturation point.

The NCS-TT106H-R transmitter automatically and continuously performs self-diagnosis. If the self-diagnosis detects a fault, the transmitter drives the output to the configured alarm value based on the type of alarm. Alarm information can be viewed and changed via alarm settings.

Alarm Setting can be configured using the Field Communicator and HARTMPT

software. The following restrictions apply to the level of customization: :

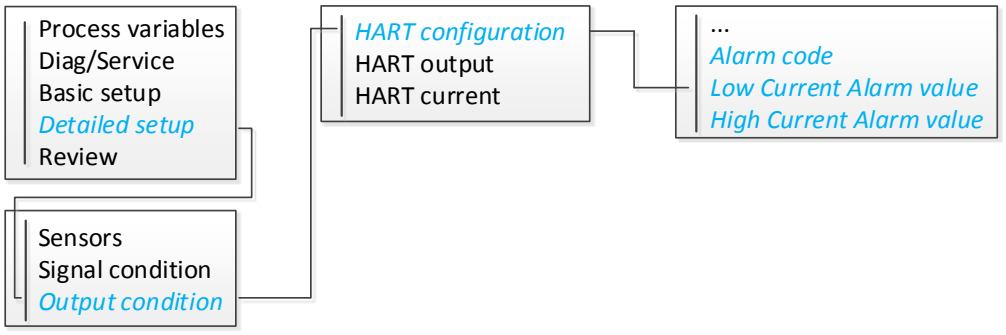
- Low alarm value must be lower than low saturation level
- High alarm value must be lower than high saturation level

Table 2-1: NCS-TT106H-R alarm and saturation values

Level	4-20mA saturation	4-20mA alarm
Low	3.8mA	3.5mA ~ 3.75mA
High	20.8mA	21.75mA ~ 23.0mA

Note : Transmitters set to HART multipoint mode digitally send all saturation and alarm messages, saturation and alarm conditions do not affect the analog output.

Configuring Alarm with the Field Communicator



Configuring Alarm with HARTMPT software

1. Select “Config” lab.
2. In ‘Alarm Setting’ area , Set alarm type and high and low alarm values.

2.4 Entering device information

Access the transmitter's information variables online using a field communicator or

other suitable communication device. The transmitter's information variables are listed below, including device identifiers, factory-set status variables, and other information.

Tag variable is the easiest way to identify and distinguish between different transmitters in a multi-transmitter environment. It is used to electronically mark the transmitter as required by the application. The defined tag is automatically displayed when the HART-based communicator establishes contact with the transmitter during power up. The tag can be up to 8 characters and the long tag can be expanded to 32 characters. None of these parameters affect the transmitter's primary variable readings, they are only used to provide information.

Date is a user-defined variable that provides the location to save the date of the latest version of the configuration information. It has no effect on the operation of the transmitter or HART-based communicator.

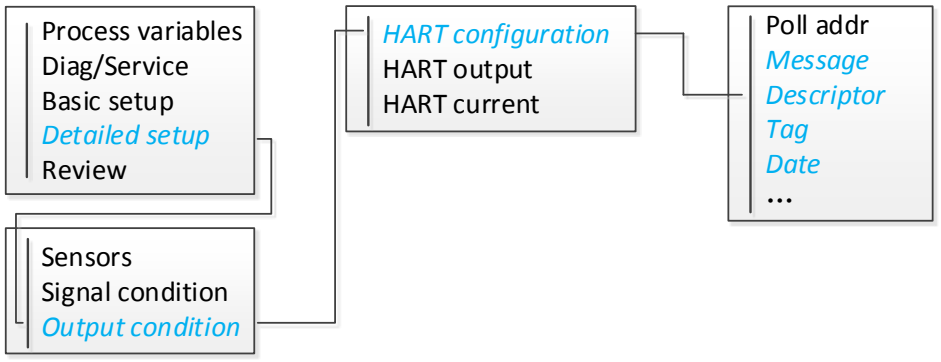
Description Variable provides a long, user-defined electronic tag that helps provide more specific transmitter identification information than the Tag Variable. The description can contain up to 16 characters and has no effect on the operation of the transmitter or HART-based communicator.。

Message variables provide the most specific user-defined way to identify individual

transmitters in a multi-transmitter environment. It supports up to 32 characters of information and is stored with other configuration data. Message variables have no effect on the operation of the transmitter or HART-based communicator.

Address variable activates multipoint communication. For HART 7, the transmitter's polling address must be specified as a number in the range 1-63. Each transmitter in a multipoint loop must have a unique polling address.

Configuring device information with the Field Communicator



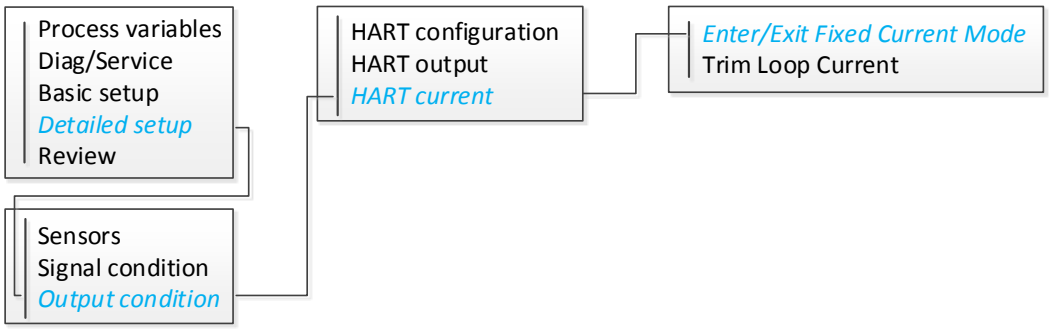
Configuring device information with HARTMPT software

1. Select “Info” lab。
2. In ‘Transmitter Information’area，Select parameters such as Message, Description, Tag, Date, etc.。

2.5 Perform loop test

Perform a loop test to verify transmitter output and loop integrity. To initiate a loop test, follow the steps below:

Perform a loop test with the Field Communicator



Perform a loop test with HARTMPT software

1. Select“Current Adj”lab。
2. In‘Fixed Output’area，select the current to test the output, or manually enter the current value.
3. Click the "Fixed Current Mode".

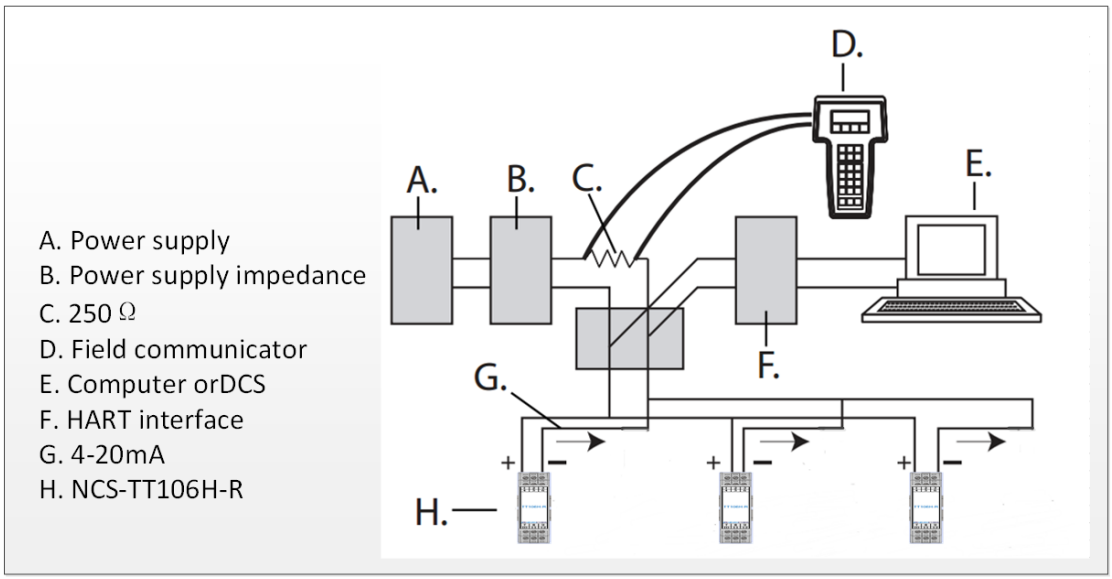
2.6 Establishing Multipoint Communication

Multiple points are the connection of multiple transmitters to a single communication line. Communication between the host and the transmitter takes place digitally. The NCS-TT106-R transmitter supports multi-point connections. Up to 63 transmitters can be connected to a single twisted pair with the HART protocol.。

The Field Communicator can test, configure, and format a multipoint connected NCS-TT106-R transmitter in the same manner as a standard point-to-point transmitter. Multi-point installation applications should consider the update rate of

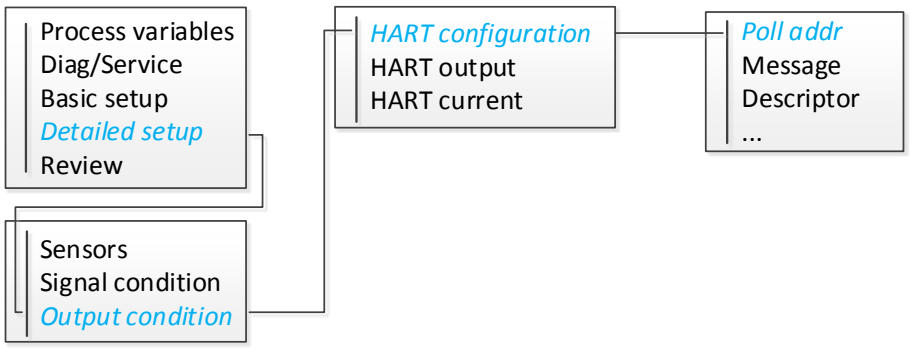
each transmitter, the combination of transmitter models, and the length of the transmission line. Each transmitter has a unique address (1-63) and corresponds to the commands defined in the HART protocol.

Figure 2-3: Typical Multipoint Connection Network



Note： The polling address of the NCS-TT106H-R transmitter is set to 0 at the factory, which allows operation with a 4-20 mA output signal in a standard point-to-point manner. If you wish to activate multipoint communication, the transmitter polling address must be changed to a number in the range 1-63. This change disables the 4-20mA analog output, making the output 4mA. The fault mode current is also disabled at this time.

Change the polling address with the Field Communicator



Change the polling address with HARTMPT software

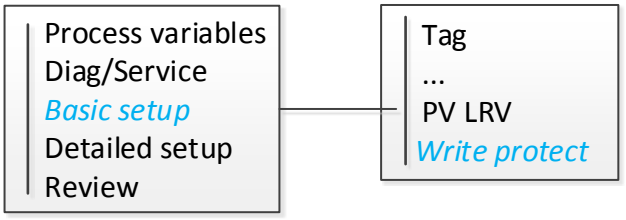
1. Select “Info”lab。
2. In the drop-down box for the 'Polling' tab, select the address you want to change.。

2.7 Transmitter Safety

The safe method available for the Microcyber NCS-TT106H-R transmitter is a software safety switch (write protection).

Write protection prevents accidental or unauthorized changes to transmitter configuration data. To enable write protection, please execute the following procedure.

Configuring write protection with the Field Communicator



Configuring write protection with HARTMPT software

1. Open the "View" menu and click the "Send Command" option .
2. In the pop-up dialog box, ‘command line’ fills in 187, and fills two hexadecimal data in ‘data to be sent’ (0001: open write protection 0000: turn off write

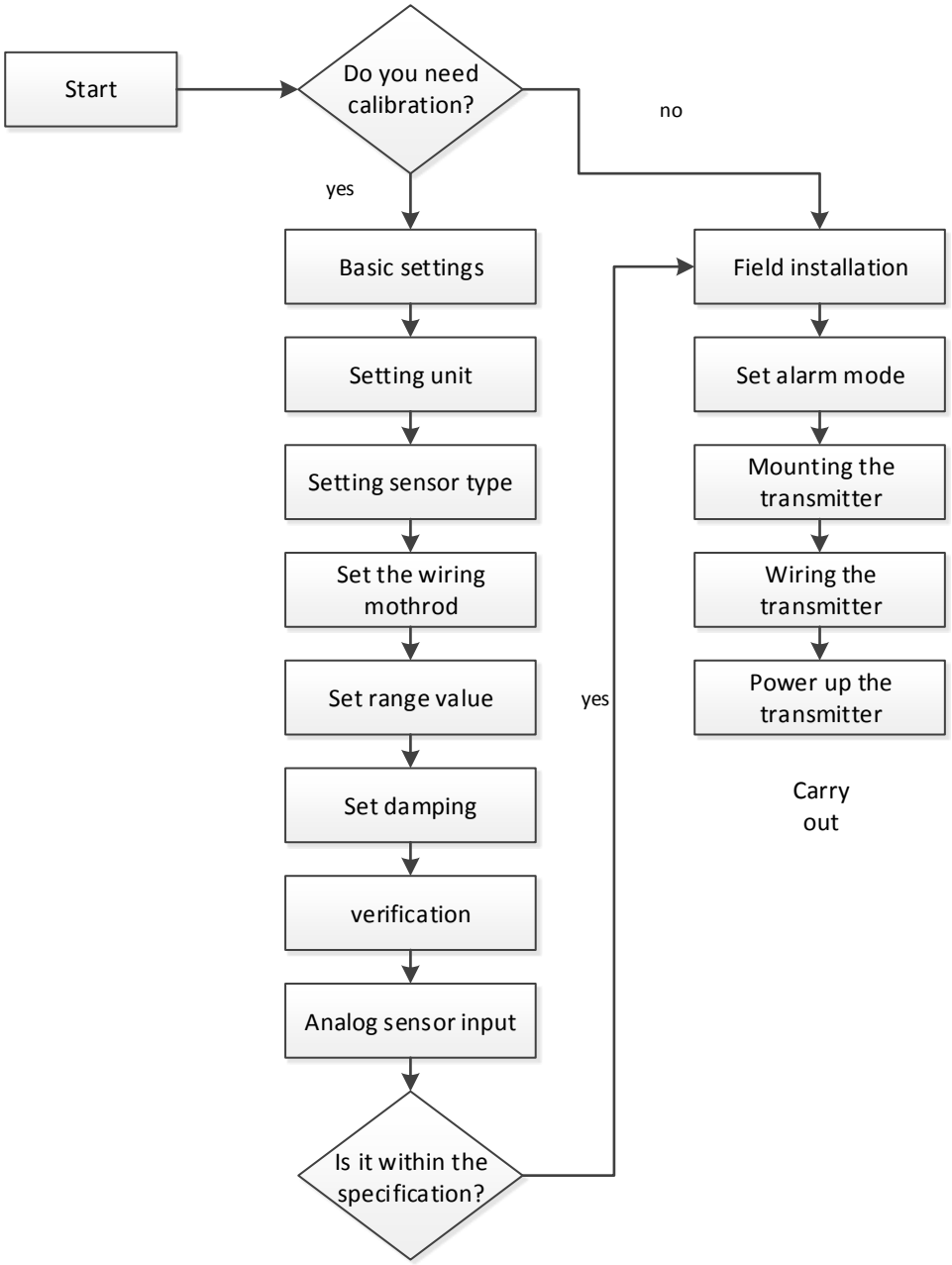
protection).

3. Click the 'Send' button.

3 Hardware Installation

3.1 Installation steps

Figure 3-1: Installation flowchart

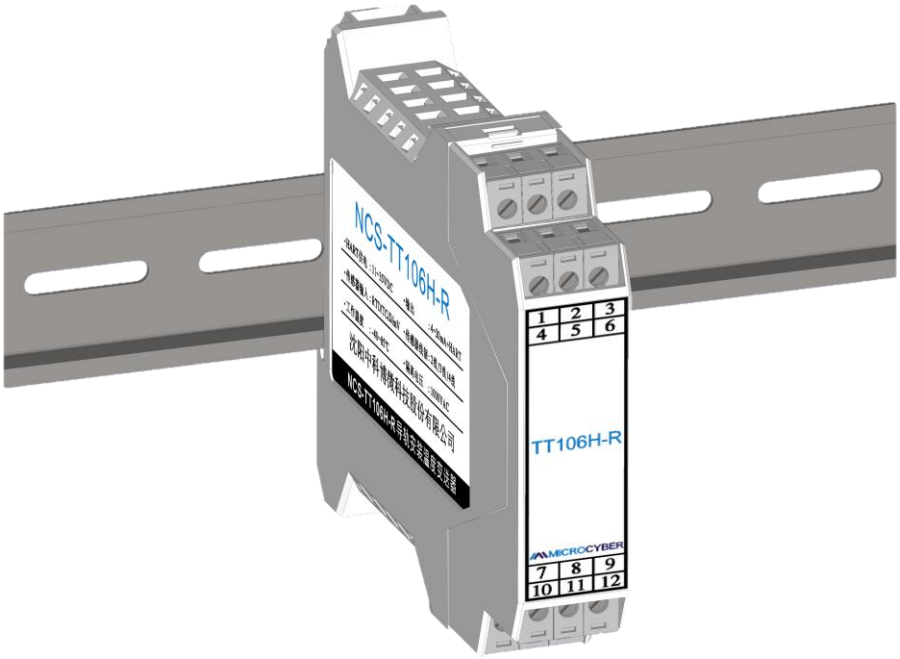


Set alarm status

Set the alarm status before putting the device into use to ensure that the correct function is performed in the event of a fault.

3.2 Installing the transmitter

Figure 3-2: Installation diagram



Mount directly to a wall or DIN rail.

4 Electrical Installation

4.1 Transmitter wiring and power supply

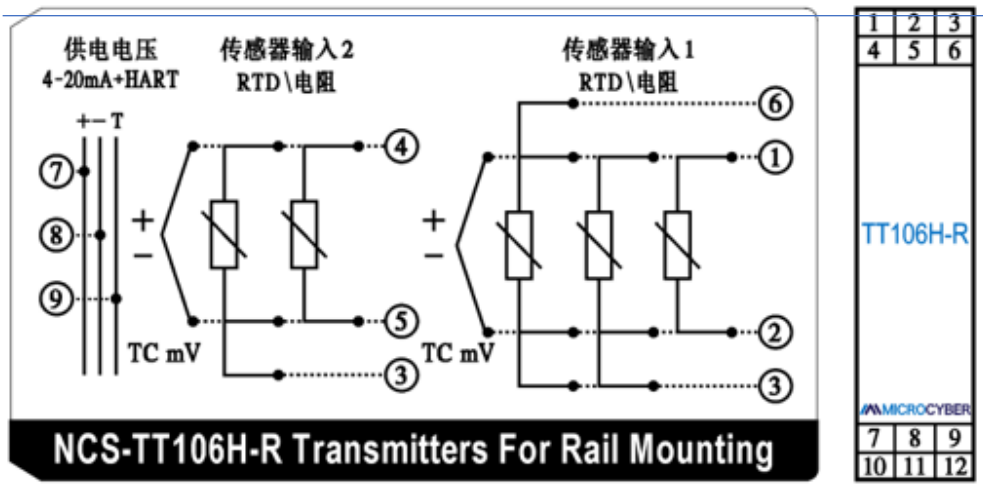
All power required by the transmitter is provided through the signal line. Use a normal copper wire of sufficient size to ensure that the voltage between the transmitter's power terminals is not less than 11 VDC.

If the sensor is installed in a high voltage environment and a fault condition or installation error occurs, there may be dangerous voltages on the sensor leads and transmitter terminals. Extreme care should be taken when contacting the wires and the ends.

Note : Do not apply high voltage (such as AC line voltage) to the transmitter terminals. Excessive voltage can damage the device.

4.2 Sensor connection

Figure 4-1: Sensor Wiring Diagram



Thermocouple or mV input

The thermocouple can be connected directly to the transmitter. If the transmitter is installed far from the sensor, use a suitable thermocouple extension cord. Use a copper wire to complete the mV input connection. For longer wiring, shielded wires should be used.

Thermal resistance or Ohm input

The transmitter accepts a variety of RTD configurations, including 2-wire, 3-wire or 4-wire configurations. If the wiring distance is long, the third or fourth lead should be connected.

Effect of sensor lead resistance - RTD input

When a 4-wire RTD is used, the influence of the lead resistance can be eliminated without affecting the accuracy. However, the 3-wire sensor cannot completely eliminate the lead resistance error because it is impossible to avoid the resistance imbalance between the leads. Using the same wire on all three leads makes the accuracy of the 3-wire RTD mounting method as accurate as possible. The 2-wire sensor produces the largest error because it directly increases the lead resistance to the sensor resistance. At this time, the “two-wire zero calibration” function is required to eliminate the error caused by the 2-wire thermal resistance installation.

4.3 Dual sensor input combination

Input Sensor 1									
Input Sensor 2		Thermal resistance 2-wire	Thermal resistance 3-wire	Thermal resistance 4-wire	Resistance 2-wire	Resistance 3-wire	Resistance 4-wire	Thermocouple	mV
	Thermal resistance 2-wire	☑	☑	☑	X	X	X	☑	X
	Thermal resistance 3-wire	☑	☑	☑	X	X	X	☑	X
	Resistance 2-wire	X	X	X	☑	☑	☑	X	X
	Resistance 3-wire	X	X	X	☑	☑	☑	X	X
	Thermocouple	☑	☑	☑	X	X	X	☑	X
	mV	X	X	X	X	X	X	X	☑

For two-channel measurements, the two channel measurement units must have the same settings (for example, both temperature units). It is not possible to measure the thermistor signal (Ohm) and the voltage signal (mV) separately through the two channels.

5 Operation and Maintenance

This section contains calibration information for the NCS-TT106H-R temperature transmitter.

5.1 Calibration

The calibration transmitter improves the measurement accuracy by digitally changing the transmitter's interpretation of the sensor input and correcting the factory-characterized characterization curve. During operation, the transmitter uses this information to generate process variable outputs in engineering units based on sensor inputs.

Calibration of the NCS-TT106H-R include the following steps：

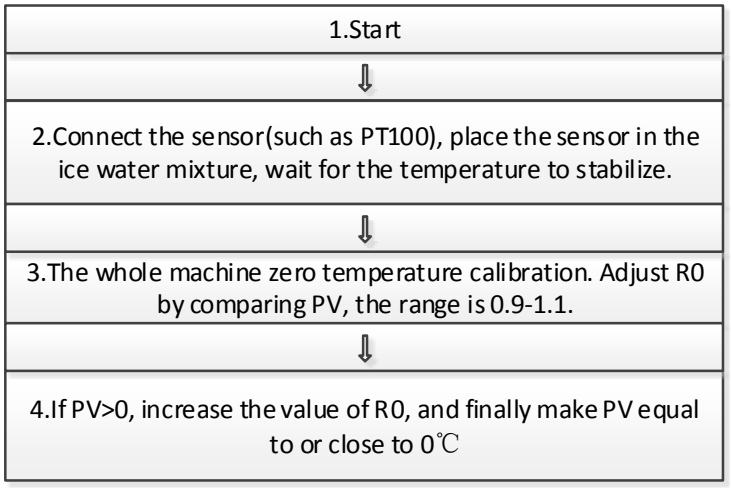
- **Sensor input adjustment**：digitally change the transmitter's interpretation of the input signal
- **Output adjustment**： Calibrate the transmitter to a 4-20mA reference scale
- **Transmitter accuracy calibration：**produces a characterization curve

5.1.1 Sensor Input Adjustment

Using the Field Communicator for Sensor Adjustment The Sensor Adjustment command allows you to change the transmitter's interpretation of the input signal. Sensor adjustments are used in verification procedures or applications that require

characterization of the sensor and transmitter together. The sensor adjustment function is for the calibrated transmitter and the adjustment is ranged (0.9 ≤ R0 adjustment factor ≤ 1.1).

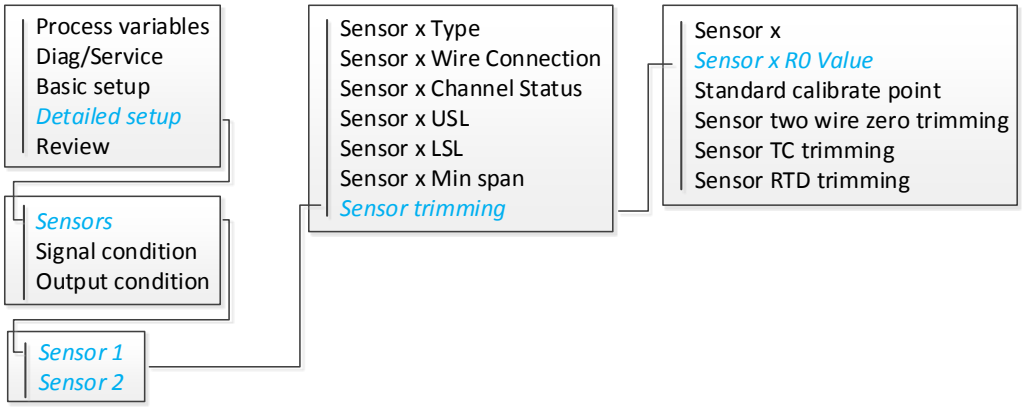
Figure 5-1: Sensor input adjustment flow chart



R0 adjustment factor is the zero temperature calibration of the whole machine (transmitter + sensor)

R0 adjustment factor, only the thermal resistance sensor is adjusted (RTD is suitable for low temperature measurement)

Sensor adjustment with the Field Communicator



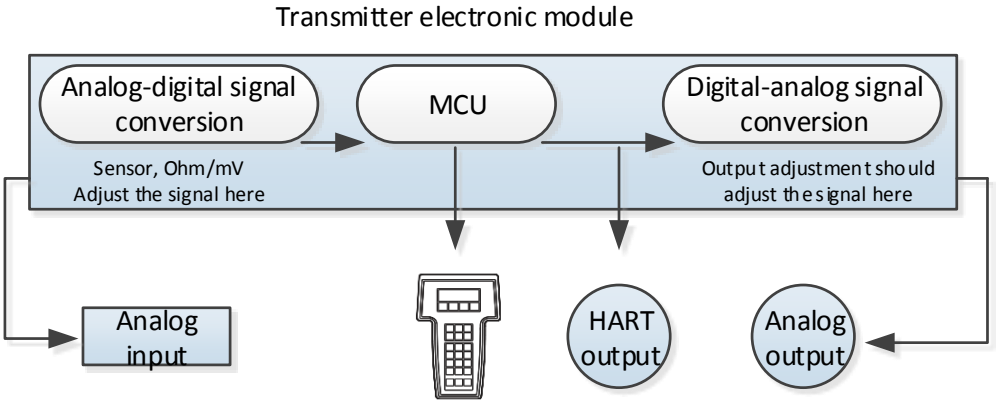
Sensor adjustment with HARTMPT software

1. Select “Sensor” lab。
2. In the sensor area, find the “R0 Adjust” and fill in the adjustment value.。
3. Finally click the ‘Correct’ button to complete the correction.

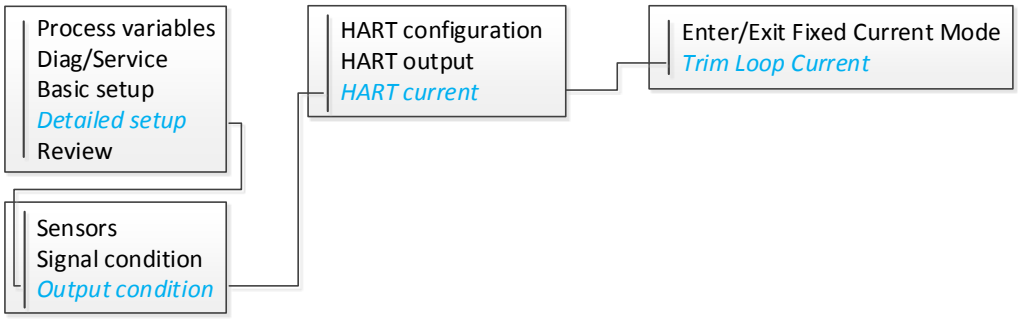
5.1.2 Adjusting the analog output

If the digital value of the primary variable matches the factory standard but the analog output of the transmitter does not match the reading on the output device, an output adjustment should be performed. The output adjustment function calibrates the transmitter to a 4-20 mA reference scale. The analog output signal should be adjusted periodically to maintain measurement accuracy.

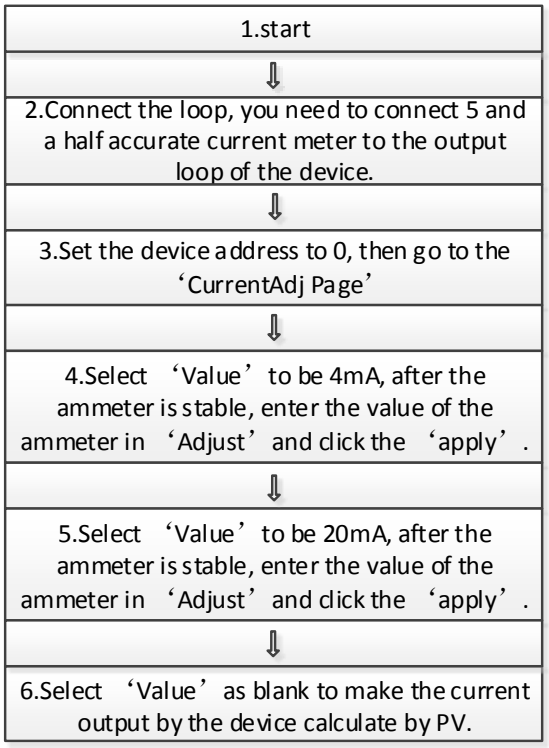
Figure 5-2: Measurement dynamics of the intelligent temperature transmitter



Adjust the analog output with the Field Communicator



Adjust the analog output with HARTMPT software

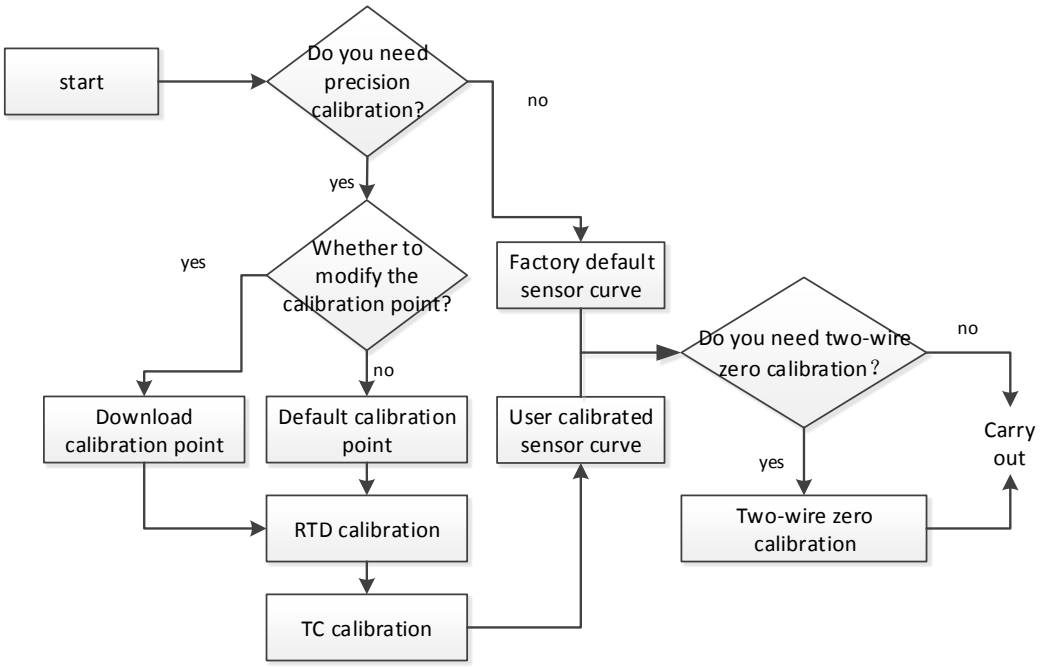


5.1.3 Transmitter Accuracy Calibration

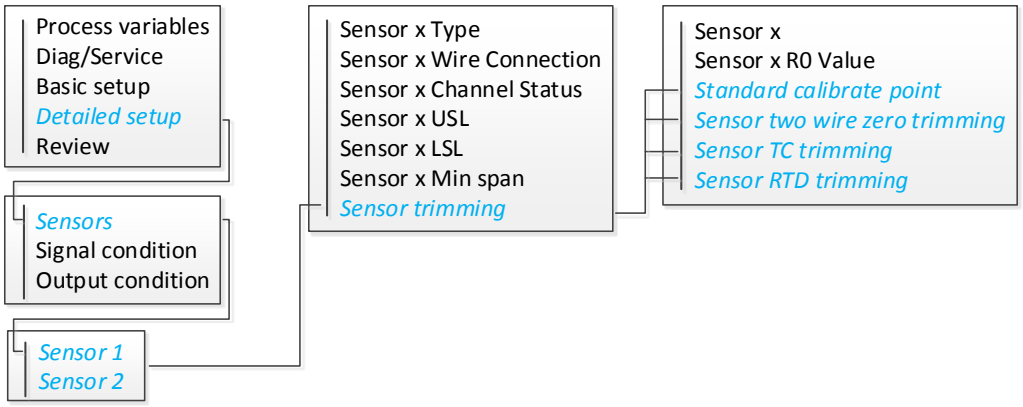
The transmitters are characterized at the factory, which means that they are factory-loaded with standard sensor curves stored in the transmitter firmware. Of course, the user can also perform user self-calibration on the transmitter (which will overwrite the factory default calibration data).

When the sensor type is thermal resistance or ohms and is installed in two-wire mode, you need to perform '2-wire Zero Calibrate'.

Figure 5-3: Transmitter Accuracy Calibration Flowchart



Perform transmitter accuracy calibration with the Field Communicator



Perform transmitter accuracy calibration with HARTMPT software

1. Select the “Sensor” tab and choose whether to modify the “Calibration Point” depending on the actual situation.

2. Click the ‘RTD Calibrate (Zero)’ button to perform an RTD calibration based on

the prompt.

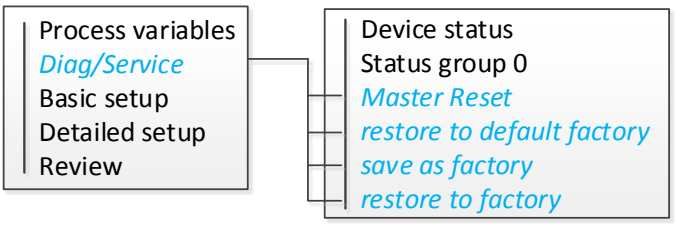
3. Click the ‘RTD Calibrate (0_500R)’ button to perform an RTD calibration based on the prompt.
4. Click the ‘RTD Calibrate (0_4000R)’ button to perform an RTD calibration based on the prompt.
5. Click the ‘TC Calibrate‘ button and follow the prompts to perform a TC calibration.
6. Click the ‘2-Wire Zero Calibrate’ button to perform a two-wire zero calibration as appropriate.

5.2 Service

The service functions supported by the transmitter are as follows:

- **Restore Setting** : software restart device
- **Restore to the default factory** : After execution, all configuration data is restored to the default factory state.
- **Save as factory** : After execution, save the current configuration as the factory value. When you perform "Restore to factory ", the configuration saved this time will be restored.
- **Restore to factory** : After execution, all configuration data is restored to the factory state. If the user saves the factory value, it will be restored to the user saved configuration, otherwise it will return to the default factory state.

Perform transmitter service with the Field Communicator



Perform transmitter service with HARTMPT software

1. Select the “Sensor” tab.
2. Click‘Restore to the default factory’, to perform a factory default restore.
3. Click ‘Restore to factory’, to perform the factory reset function.
4. Click ‘Save as factory’, to execute the function of saving to factory value.
5. Open the “View” menu, click the “Send Command” option, fill in the “Command Number -42” and perform the reset function.

5.3 HART Protocol

5.3.1 Device Version Information

Hardware version	1.0
Manufacturer ID	0x601E
Device type	0xE40B
HART protocol	7
Device version	1.0

5.3.2 Dynamic Variable and Measured Value

When leaving the factory, the following measured values are assigned to dynamic variables：

Dynamic variable	Measured value
Primary device variable (PV)	Sensor 1
Secondary device variable (SV)	Device temperature
Tertiary device variable (TV)	Sensor 1
Quaternary device variable (QV)	Sensor 1

5.3.3 Device variable and Measured Value

The following measurements are assigned to individual device variables：

Device variable code	Measured value
0	Sensor 1
1	Sensor 2
2	Device temperature
3	Average = (Sensor 1 + Sensor 2) * 0.5
4	Difference = Sensor 1 – Sensor 2

Note: Device variables can be obtained by HART command 9 or 33

5.3.4 HART Command

Command No.	Designation
Universal Command	
Cmd00	Read Unique Identifier
Cmd01	Read Primary Variable
Cmd02	Read Loop Current and Percent of Range
Cmd03	Read Dynamic Variable and Loop Current
Cmd06	Write Polling Address
Cmd07	Read Loop Configuration
Cmd08	Read Dynamic Variable Classifications
Cmd09	Read Device Variables with Status
Cmd11	Read Unique Identifier Associated with Tag
Cmd12	Read Message
Cmd13	Read Tag, Descriptor, Date
Cmd14	Read Primary Variable Transducer Information
Cmd15	Read Device Information
Cmd16	Read Final Assembly Number
Cmd17	Write Message
Cmd18	Write Tag, Descriptor, Date
Cmd19	Write Final Assembly Number
Cmd20	Read Long Tag

Cmd21	Read Unique Identifier Associated with Long Tag
Cmd22	Write Long Tag
Cmd38	Reset Configuration Changed Flag
Cmd48	Read Additional Device Status
Common Practice Command	
Cmd33	Read Transmitter Variables
Cmd34	Write Primary Variable Damping Value
Cmd35	Write Primary Variable Range Value
Cmd36	Set Primary Variable Upper Range Value
Cmd37	Set Primary Variable Lower Range Value
Cmd40	Enter/Exit Fixed primary Variable Current Mode
Cmd42	Perform Device Reset
Cmd44	Write Primary Variable Units
Cmd45	Trim Primary Variable Current DAC Zero
Cmd46	Trim Primary Variable Current DAC Gain
Cmd50	Read Dynamic Variable Assignments
Cmd51	Write Dynamic Variable Assignments

6 Troubleshooting

When there's any breakdown during startup or operation, please start troubleshooting in the checklist below. This will give you a direct understanding of the causes of the problem and the appropriate remedies.

6.1 Troubleshooting 4-20mA/HART Output

Table 6-1. Troubleshooting Checklist for 4-20mA Output

Symptoms or problems	Possible reasons	Corrective measures
No communication with field devices	Circuit wiring	■ Check whether the communicator imports the NCS-TT106 H-R transmitter DD file ■ Check if there is at least 250Ω resistance between the power supply and the communicator connection ■ Check if the supply voltage of the transmitter is adequate. If the field communicator is connected and the resistance in the circuit is 250Ω, the terminal voltage of the transmitter should be at least 11V to work. ■ Check if any intermittent short circuit or

		circuit break
Excessive output	Sensor input or connection failure	■ Check whether the sensor is open or short-circuited ■ Check if process variables are out of range
	Circuit wiring	■ Check for defects in terminals, interconnect pins or sockets
	Power supply	■ Check the output voltage of the power supply on the transmitter terminal. The value should be 11 to 35 VDC
Output instability	Circuit wiring	■ Check the output voltage of the power supply on the transmitter terminal. The value should be 11 to 35 VDC ■ Check if any intermittent short circuit or circuit break ■ Connect the field communicator and enter the loop test mode to generate 4mA, 20mA signals and user-selected values.
Low or no output	Sensor element	■ Check process variables to see if they are out of range
		■ Check the output voltage of the power supply on the transmitter terminal. The value should

	Circuit wiring	be 11 to 35 VDC ■ Check if any intermittent short circuit or circuit break ■ Check whether the polarity of the signal terminal is correct ■ Check circuit resistance ■ Connect field communicator and enter loop test mode

6.2 Diagnostic messages

Table 6-2. Status: Failure - immediate maintenance

Alarm name	Questions	Recommended measures
Electronic component failure	The transmission failure of key electronic components in the equipment. For example, AD chip failure. If there is a fault in the diagnosis of surface electronic components.	1. Restart transmitter 2. If this phenomenon persists, replace the transmitter.
	It indicates that the sensor circuit	1. Verify sensor wiring and

Sensor circuit break	break is detected. Sensors may be disconnected, inappropriately connected or malfunctioning.	circuit. Please refer to the wiring diagram on the sensor label to ensure correct wiring. 2. Verify the integrity of the sensor and the lead circuit of the sensor. If the sensor fails, repair or replace the sensor.
Sensor Short Circuit	Short circuit of sensor is detected. Sensors may be disconnected, inappropriately connected or malfunctioning.	1. Verify that the sensor connection is correct and connected to the terminal. 2. Verify the integrity of the sensor and the lead circuit of the sensor. If the sensor fails, repair or replace the sensor.

7 Technical specifications

7.1 Basic parameter

Table 7-1. Basic parameter

Specification	
Input	Pt100, Pt1000, Cu50, Cu100, 0~500Ω, 0~4000Ω B, E, J, N, K, R, S, T eight kinds of Thermocouple -100mV~+100mV voltage signal
Output	Single 2-wire equipment, 4-20mA/HART, linear with input
Power	11~35VDC
Channel	Two channels
RTD wiring method	2、3、4 wiring
Temperature limit	-40~85℃
Humidity limit	0-95% relative humidity
Start-up time	≤5s
Update time	0.8~1.3s, depending on sensor type and wiring mode
Housing protection level	IP20（terminal IP00）

Isolation	1000VAC
Power supply impact	±0.005%/V
Electromagnetic compatibility	Anti-interference requirements for industrial sites in GB/T 18268.1-2010 "Electromagnetic Compatibility Requirements for Electrical Equipment for Measurement, Control and Laboratory Part 1: General Requirements" The test method of power supply interface adopts GB/T 18268.23-2010 "Electromagnetic Compatibility Requirements for Electrical Equipment for Measurement, Control and Laboratory Part 23: Test Configuration, Working Conditions and Performance Criteria for Special Requirements with Integrated or Remote Signal Conditioning Transmitters"
Fault alarm	Linear output: 3.8 < I < 20.8 Upper limit fault: 21.75 < I < 23 Lower limit fault: 3.5 < I < 3.75

7.2 Technical specification of Thermal Resistance

RTD accuracy index

Signal type	Recommended scope (℃)	Accuracy (25℃)	Temperature drift (/℃)
Resistor	0 ~ 500Ω	±0.04Ω	±0.001Ω
	0 ~ 4000Ω	±0.35Ω	±0.015Ω
PT100	-200 ~ 850℃	±0.15℃	±0.003℃
PT1000	-200 ~ 850℃	±0.15℃	±0.005℃
Cu50	-50 ~ 150℃	±0.15℃	±0.005℃
Cu100	-50 ~ 150℃	±0.10℃	±0.003℃

Note: The test condition of RTD index is 4-wiring. 2 and 3 wiring meets the above-mentioned targets after eliminating line resistance errors.

RTD other technology index

Wiring	2、3、4
CMRR	≥70dB (50Hz and 60Hz)
Differential mode rejection ratio	≥70dB (50Hz and 60Hz)

7.3 Technical Index of Thermocouples

TC accuracy index

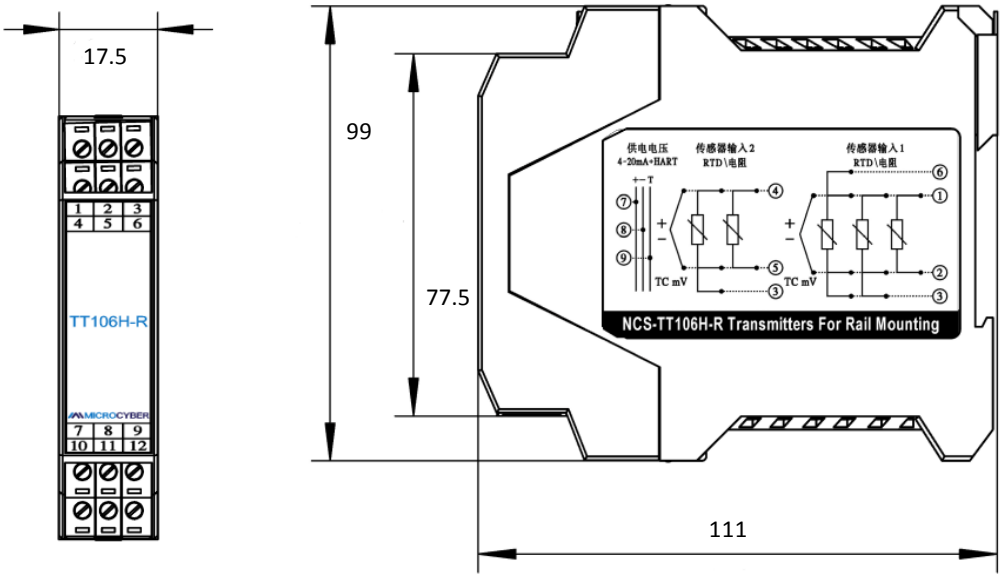
Signal type	Recommended scope (℃)	Accuracy (25℃)	Temperature drift (/℃)
mV	-100 ~ +100mV	±0.025mV	±0.001mV
B	500 ~ 1810℃	±0.77℃	±0.050℃
E	-200 ~ 1000℃	±0.20℃	±0.025℃
J	-190 ~ 1200℃	±0.35℃	±0.01℃
K	-200 ~ 1372℃	±0.40℃	±0.025℃
N	-190 ~ 1300℃	±0.50℃	±0.015℃
R	0 ~ 1768℃	±0.75℃	±0.023℃
S	0 ~ 1768℃	±0.70℃	±0.023℃
T	-200 ~ 400℃	±0.35℃	±0.015℃

TC other technology index

The accuracy of cold-end temperature compensation	±0.5℃ (Internal measurement) ±0.15℃ (Sensor 2 measurement , Pt100)
CMRR	≥70dB (50Hz and 60Hz)
DMRR	≥70dB (50Hz and 60Hz)

7.4 Housing dimension

Figure 7-1 Housing dimension (mm)



Appendix A Field Communicator Menu Tree

Figure A-1：NCS-TT106H-R Field Communicator Menu Tree-Process Variables

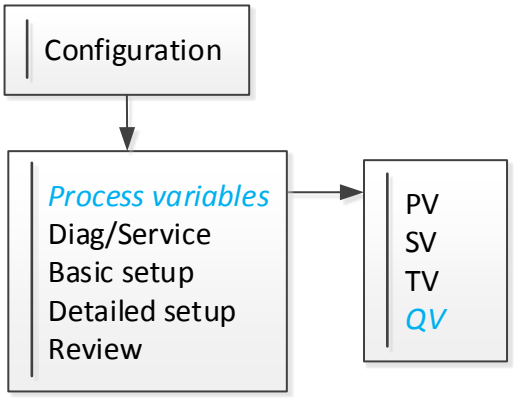


Figure A-2：NCS-TT106H-R Field Communicator Menu Tree - Diagnosis and Service

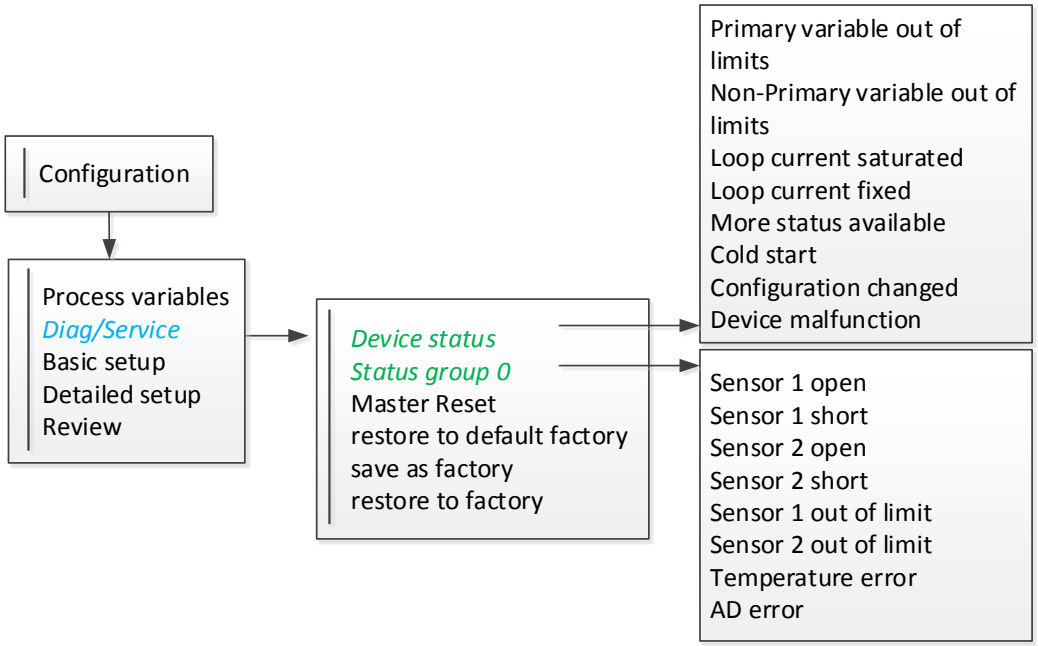


Figure A-3：NCS-TT106H-R Field Communicator Menu Tree - Basic Configuration

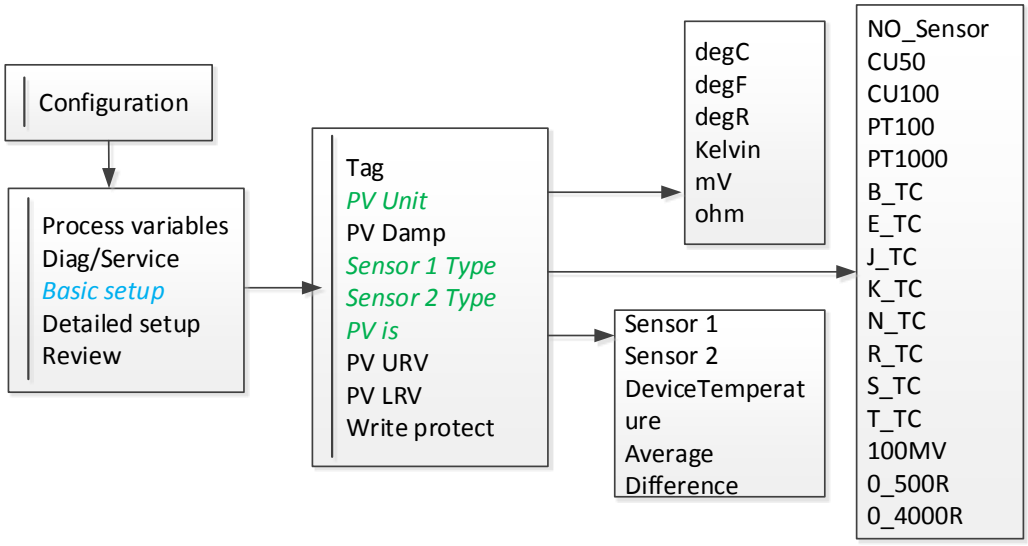


Figure A-4：NCS-TT106H-R Field Communicator Menu Tree - Review

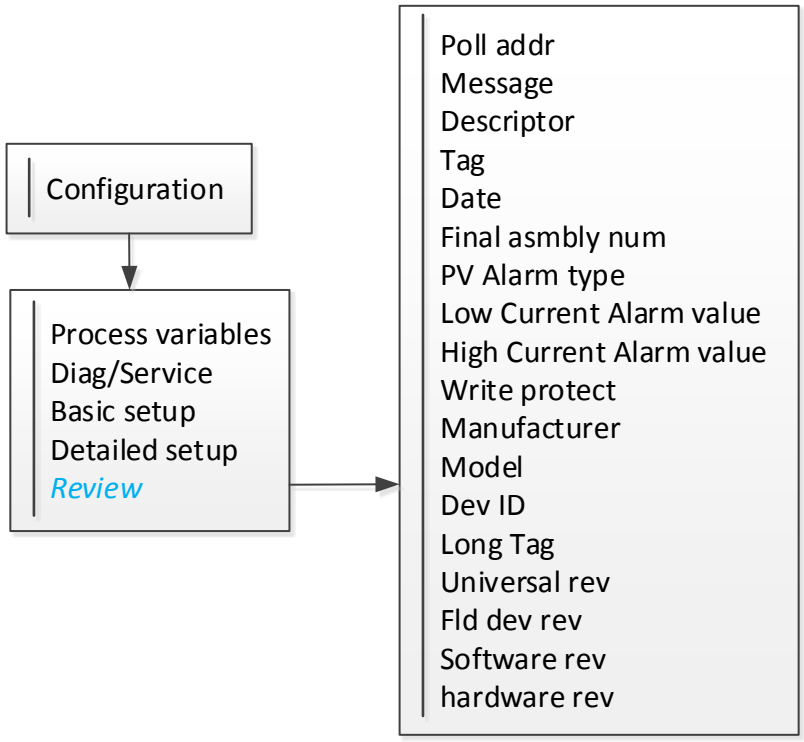
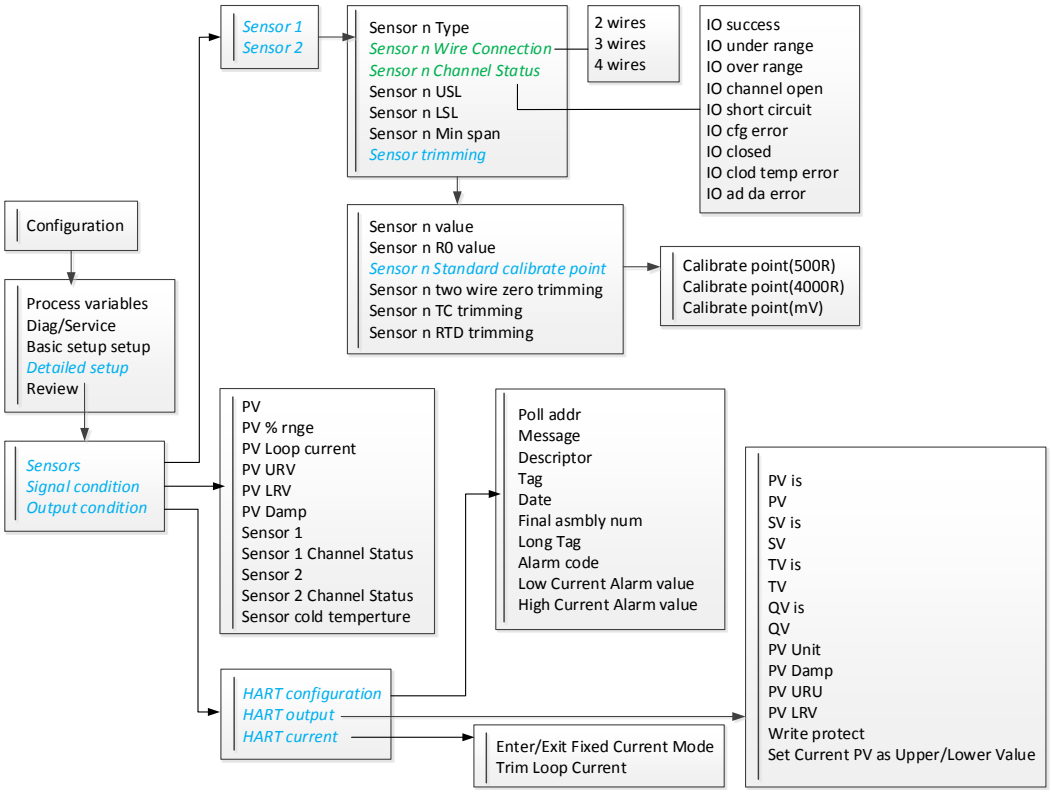
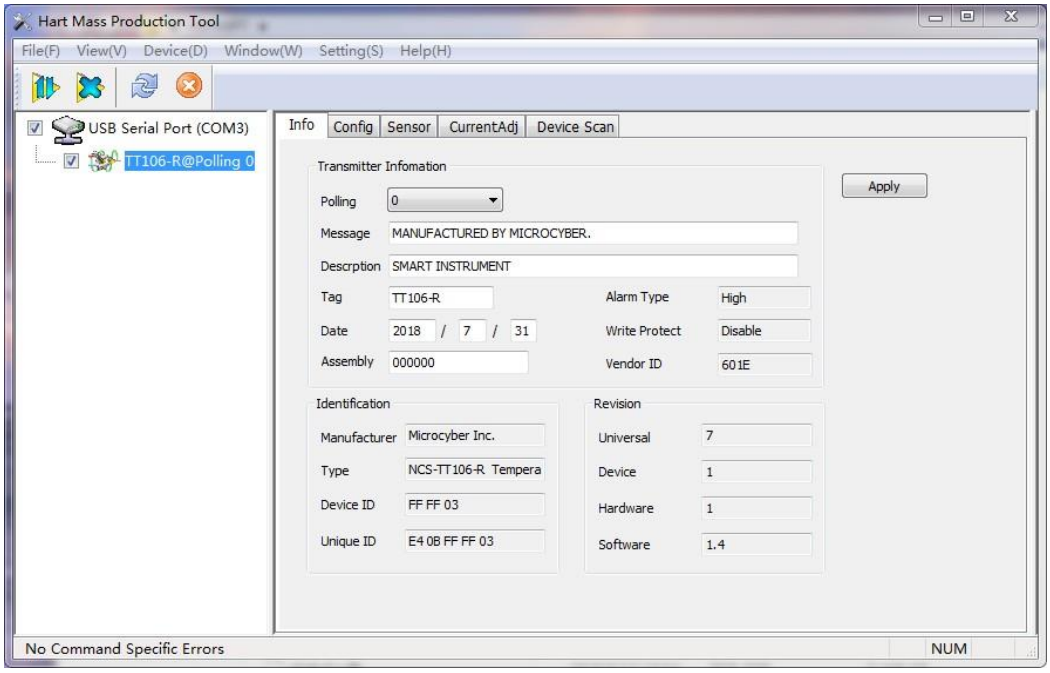


Figure A-5 : NCS-TT106H-R Field Communicator Menu Tree - Detailed Configuration



Appendix B HARTMPT Configuration Software Operating Interface

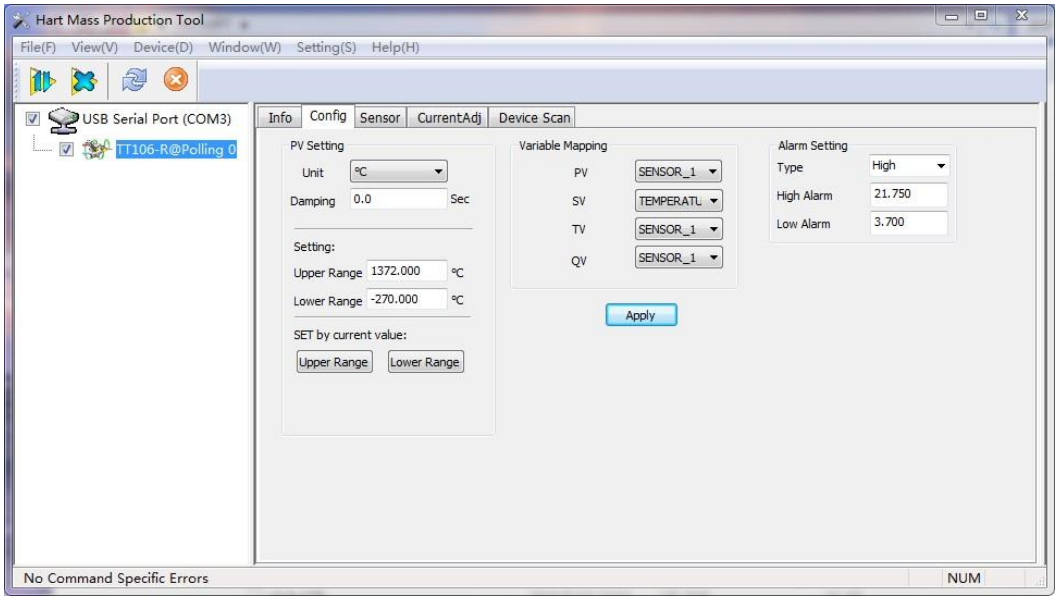
Figure B-1：HARTMPT Operating Interface - Basic Information



After the information is modified, it can be downloaded to the device by pressing the "Application" button.

- **Address** selection ranges from 0 to 63.
- **Message**s can be entered up to 32 characters.
- **Descriptions** can be entered up to 16 specified characters.
- **Tag** maximum length is 8 specified characters.
- **Dates** range from 1900 to 2155.
- **Assembly** maximum length is 6 specified characters.

Figure B-2：HARTMPT Operating Interface - Configuration Information



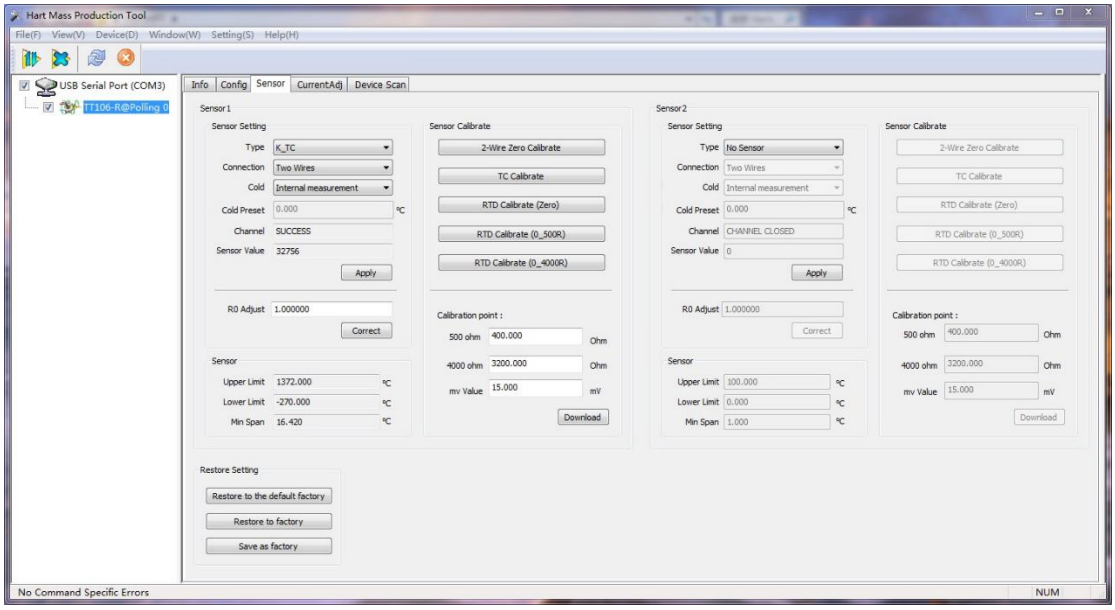
After modifying the information, click "Application" button to download it to the device.

- **Damping** ranges from 0 to 32 seconds.
- **Unit** can be set to C, F, R, K, mV, Ohm and PV units, which directly affect the selection of variables and sensor types associated with units. When modifying the unit, the upper and lower limits of the primary variable range cannot be changed at the same time. They should be modified separately.
- **Upper Range** corresponds to the PV value of 20 mA output current.
- **Lower Range** corresponds to the PV value of the output current of 4mA.
- **Set the " Upper Range " button with the current value.** The current PV value of the device is set to the upper limit of the range of the primary variable, and the lower limit of the range is unchanged.
- **Set the "Lower Range " button with the current value.** Set the current PV value of

the device to the lower limit of the range of the primary variable may change the upper limit at the same time.

- **Variable Mapping.** Configure the mapping relationship of dynamic variables.
- **Type** can set high alarm or low alarm.
- **High alarm** ranges from 21.75~23 mA.
- **Low alarm** ranges from 3.5 to 3.75 mA.

Figure B-3：HARTMPT Operating Interface-Sensor Configuration



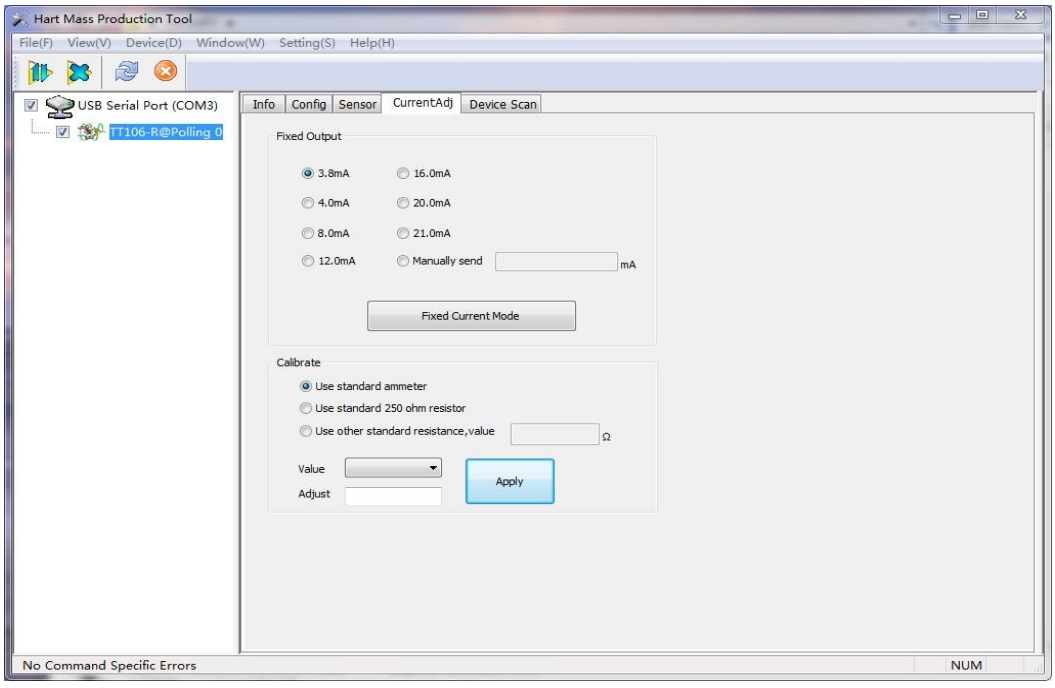
- **Type** includes resistance (0_500Ω、0_4000Ω), terminal resistance （Cu50、Cu100、Pt100 和 Pt1000), -100~+100mV , thermocouple (B、E、J、K、N、R、S 和 T)。
- **Connection** can be set to 2, 3, 4 wire system (resistance, thermal resistance

signal) and thermocouple to 2 wire system. Sensor 2 can only be set to 2 or 3 wires.

- **Cold** is only effective for thermocouples. It can be set in four ways: cold end prohibition, internal measurement, fixed value and sensor 2 measurement. If the cold end is forbidden, the transmitter will not compensate the cold end; if the temperature of the cold end is measured internally, the temperature of the cold end compensation is provided by the internal temperature measuring chip; if the temperature of the cold end compensation is fixed, the temperature of the cold end compensation is set externally; when the temperature of the sensor 2 is measured, the temperature of the cold end compensation is the value of the sensor 2, the sensor 2 should be connected externally with Pt100.
- **Channel :** Display sensor channel status (open circuit, short circuit & etc.).
- **Sensor value:** Display the original value of sensor channel.
- **R0 Adjust:** Correction of the error of the sensor itself (range 0.9-1.1).
- **2-wire Zero Calibrate:** When the temperature transmitter is connected to RTD in 2-wire mode, to avoid the error caused by the resistance on the cable, the sensor end can be short connected, and then the zero calibration button can be executed to eliminate the error caused by the resistance on the cable.
- **TC Calibrate** the thermocouple and millivolt signal are calibrated out of the factory.
- **RTD Calibrate** the thermal resistance and resistance signal are calibrated out of the factory.

- **Calibration point** standard values used for calibration of transmitters.
- **Restore to the default factory :** Click this button, all data will be restored to the default factory status
- **Save as factory:** Click this button to save the current configuration as factory value. When you click the “Restore factory settings” button again, the saved configuration will be restored.
- **Restore to factory :** Click this button to restore data to factory status. If the user has saved the factory value, the configuration saved by the user will be restored; otherwise, the default factory status will be restored.

Figure B-4：HARTMPT Operating Interface-Current Calibration



- **Current Calibration**

  - ✧ Connect the circuit, it is necessary to put more than five and a half bits ammeter in series in the output circuit of the equipment ;
  - ✧ Set the device's polling address as 0. Refer to basic information configuration. If the polling address is 0, you can skip this step ;
  - ✧ Enter current calibration tab ;
  - ✧ Select the current value of 4 mA. After the ammeter is stable, enter the ammeter reading in the "Adjustment Value" text box and click the "Application" button ;
  - ✧ Select the current value of 20 mA. After the ammeter is stable, enter the ammeter reading in the "Adjustment Value" text box and click the "Application" button ;
  - ✧ Select the "current value" as blank, so that the output current of the equipment is calculated according to the PV value.

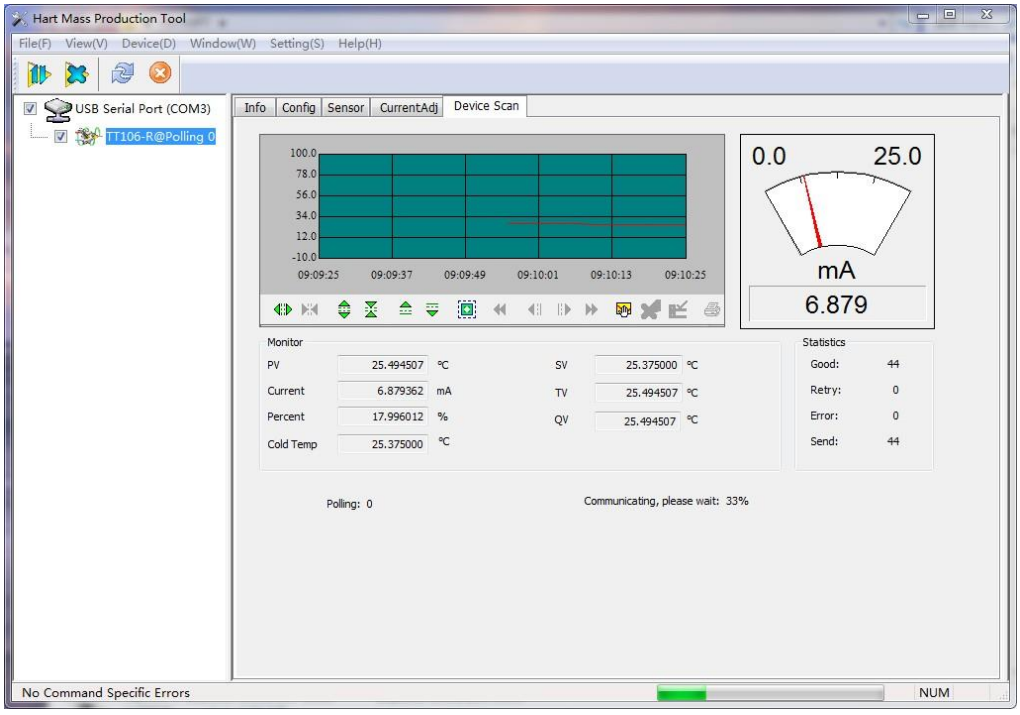
- **Fixed output**

  - ✧ Click the given fixed current value, or click on "Manual Send" and fill in the fixed current value to be output.
  - ✧ Click "Enter/Exit Fixed Current Mode" to enter or exit fixed current output mode.
  - ✧ The title of the button alternately displays "Enter Fixed Current Mode" and "Exit Fixed Current Mode" to prompt the user to operate.

Note: Calibration current and fixed current output function can only be performed when polling address of equipment is 0.

Other polling addresses are in full digital communication mode, which will prompt the error message “command execution failed”

Figure B-5：HARTMPT Operating Interface-Variable Monitoring



Periodically refresh the dynamic variables of the selected equipment and display the trend curve of the primary variable of the current equipment.

The refresh variables are:

- First variable, PV value, which is the primary variable.
- Secondary variable，SV value

- Tertiary variable，TV value
- Quaternary variable，QV value
- Current, the current value corresponding to primary variable
- Percent, percentage of primary variable
- Cold end temperature, equipment cold end temperature value

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