

HART/ Modbus Serial Gateway GT200-HT-RS

User Manual

V 3.2



SST Automation

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Important Information

Warning

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The product has many applications. The users must make sure that all operations and results are in accordance with the safety of relevant fields, and the safety includes laws, rules, codes and standards.

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1 Product Overview

1.1 Product Function

GT200-HT-RS is a gateway that can provide a seamless connection between HART and Modbus. At HART side it can be configured as a primary master or the secondary master, and acts as slave at the Modbus side.

1.2 Product Features

- Powerful Serial function: Support the interconnection between HART and Modbus , also support transparent transmission between HART and serial port.
- Multi debugging functions: It can display the exchanging data, and diagnosis the HART command.
- Easy configuration with free SST-HT-CFG software tool.

1.3 Technical Specifications

- [1] Used as a primary or a secondary HART master.
- [2] Supports one HART-channel, under multi-drop mode, support connecting at most 13 HART slaves with gateway internal resistor and support connecting 15 HART slaves with an external resistor (250Ω).
- [3] Supports point to point and multi-drop mode at the HART side.
- [4] Under point to point mode, support data burst operation.
- [5] Supports all commands of the HART protocol.
- [6] Each HART command can be configured for change-of-state output, polling output, initialization output or disable output.
- [7] Supports up to 128 HART commands, HART output data buffer is up to 1000 bytes, and the input data buffer is up to 1600 bytes.
- [8] Supports an internal or external HART sampling resistor.
- [9] Supports serial RS-232 and RS-485, baud rate supports:600, 1200, 2400, 4800, 9600, 19.2K, 38.4K, 57.6K, 115.2Kbps.

- [10] The serial port can be configured as Modbus slave, supports modbus function code: 03H, 04H, 06H, 10H.
- [11] Modbus slave supports RTU and ASCII communication.
- [12] The serial port can be configured as universal mode, and achieve transparent data transmission with HART slave devices.
- [13] Power: 24VDC (9V~30V), 80mA (24VDC).
- [14] Working circumstance temperature: -40°F~158°F(-40°C~70°C), Humidity: 5%~ 95% (non-condensing).
- [15] External dimensions (W*H*D): 1.0in*4.0 in *3.6in (25mm*100mm*90mm).
- [16] Installation: 1.4 in (35mm) DIN RAIL.
- [17] Protection Level: IP20.

1.4 Related Products

The related products include: GT200-HT-DP, GT200-DP-RS etc.

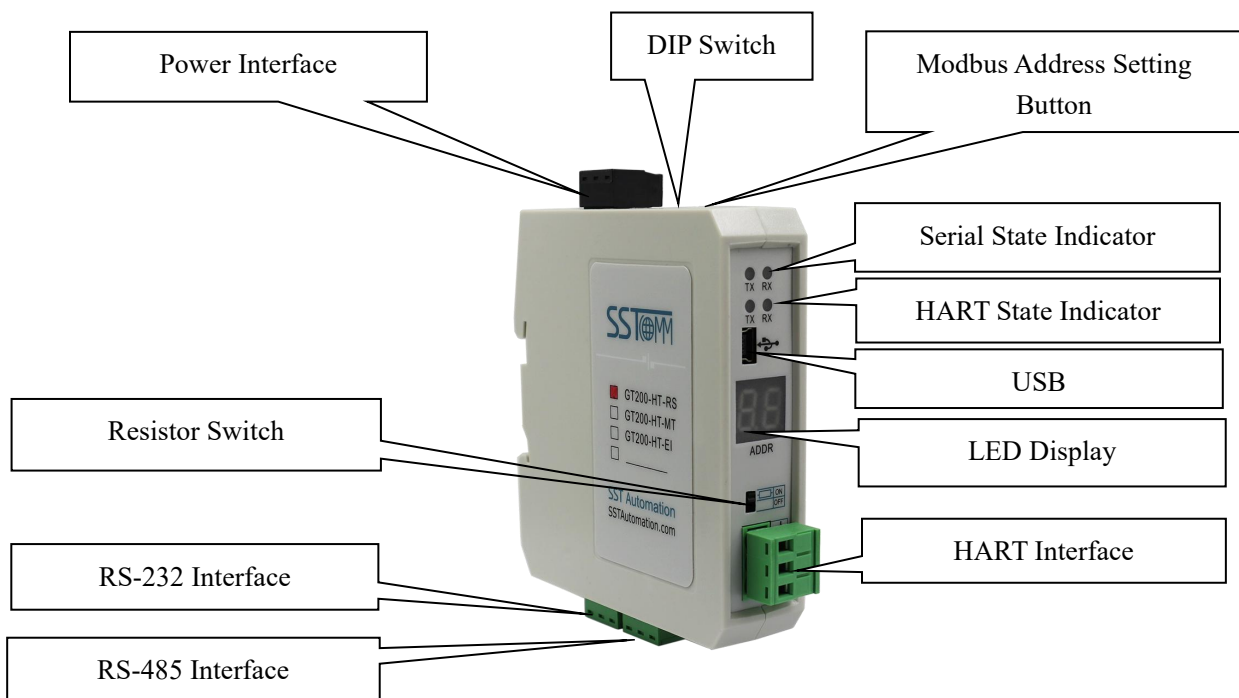
To get more information about related products, please visit SSTCOMM website: www.sstautomation.com.

1.5 Revision History

Revision	Date	Chapter	Description
V2.5	11/05/2021	All	Update the format
V3.2	11/29/2023	1,2 and 7	Delete RS-422 Interface and baud rate:300 Add chapter 7: Modbus Master Communication

2 Hardware Descriptions

2.1 Product Appearance



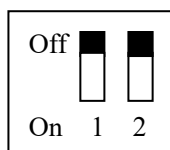
Note: This picture is for reference only. The product appearance is subject to the actual product.

2.2 LED Indicators

Indicator location	Indicator	State	State Description
Serial Indicator	TX	Blinking	Serial port data sending.
		OFF	No data is sending.
	RX	Blinking	Serial port data receiving.
		OFF	No data is receiving.
HART Indicator	TX	Blinking	HART Bus data sending.
		OFF	No data is sending.
	RX	Blinking	HART Bus data receiving.
		OFF	No data is receiving.

2.3 DIP Switch

The DIP switch is located at the bottom of product, bit 1 is the debug bit and bit 2 is the configuration bit.



Debugging (bit 1)	Configuration (bit 2)	Description
Off	Off	Run Mode
Off	On	Configuration Mode
On	Off	Debug Mode
On	On	Configuration Mode

Note:

- ① After re-configuring the switch, you have to restart the GT200-HT-RS to make the settings take effect! (Power off then Power On)
- ② Set to the debug mode, it will be compulsory to appoint RS-485 interface as communication interface, RS-232/USB interface as debugging interface.
- ③ Configuration interface uses the RS-232/USB interface.

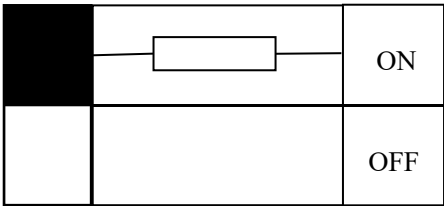
2.4 Modbus Address Setting Button

Under run mode of the GT200-HT-RS, LED display always displays the address of the current Modbus address.

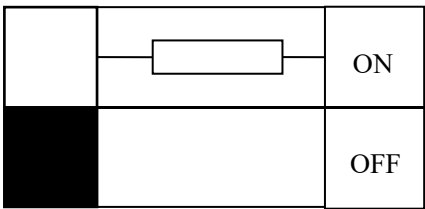
Quickly press (double-click) the button twice in succession, the high bit starts to flash, and the low bit is always on, click the button to add 1 to start setting the high bit of Modbus address. Long-press the button for 3 seconds, the high bit is always on, and the low bit starts to flash. Click the button to add 1 to start setting the low bit of Modbus address. At last, long-press the button again for 3 seconds, the address flashing three times shows that the address is set successfully. If no button action within ten seconds, GT200-HT-RS exits the status of setting address and continue to display the original address. The configurable range of Modbus address is 0 to 99 (Decimal).

2.5 Internal/External Sampling Resistor Switch

GT200-HT-RS can choose using the internal sampling resistor or external sampling resistor to get the HART signal. The specification of the internal resistor is 270Ω, 2W. When the power of the sampling resistor is more than 2W, you must use an external resistor.



Switch to ON, using the internal sampling resistor

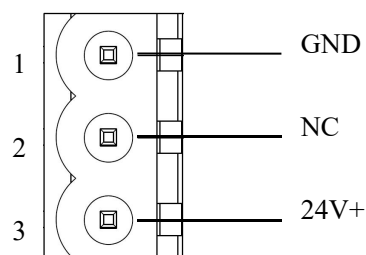


Switch to OFF, using the external sampling resistor

2.6 Interface

2.6.1 Power Interface

Pin	Function
1	Power GND
2	NC(Not Connected)
3	24V+, DC Positive 24V



2.6.2 RS-485 Interface

The RS-485 interface of GT200-HT-RS is a standard one, and the RS-485 characteristics of the product are shown as follows:

1. The basic characteristics of RS-485 transmission technology

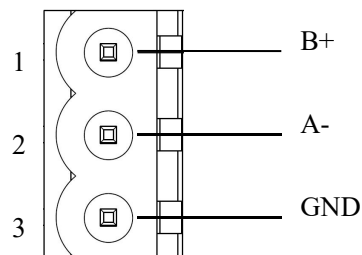
- ① Network topology: Linear bus, there are active bus terminal resistors at both sides.
- ② Transmission rate: 1200 bps~115.2Kbps.
- ③ Media: Shielded twisted-pair cable and also can cancel the shielding, depending on environmental conditions (EMC).
- ④ Site number: 32 stations per subsection (without repeater), and can increase up to 127 stations (with repeater).
- ⑤ Plug connection: 3-pin pluggable terminal.

2. The main points on the installation of RS-485 transmission equipment

- ① All the equipment are connected with RS-485 bus.
- ② Each subsection can be connected up to 32 sites.
- ③ The farthest two end of the bus has a terminal resistor—120Ω 1/2W to ensure reliable operation of the network.

Serial interface uses 3-pin pluggable terminal and users can wire it according to the wiring instructions on the panel.

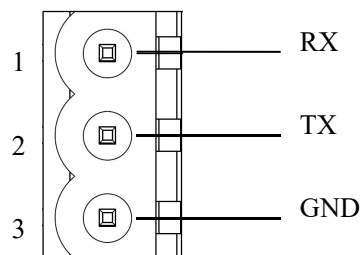
Pin	Function
1	B(+), RS-485
2	A(-), RS-485
3	GND



2.6.3 RS-232 Interface

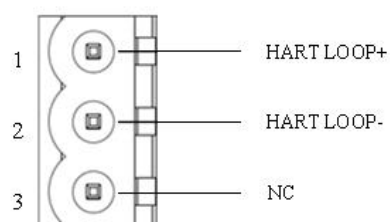
RS-232 interface uses one 3-pin pluggable open terminal, and its pin description is shown as follows:

Pin	Function
1	RX, Connect RS-232's RX of user device
2	TX, Connect RS-232's TX of user device
3	GND, Connect RS-232's GND of user device



2.6.4 HART Interface

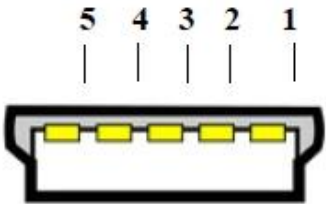
Pin	Function
1	Connect HART signal positive
2	Connect HART signal negative
3	NC



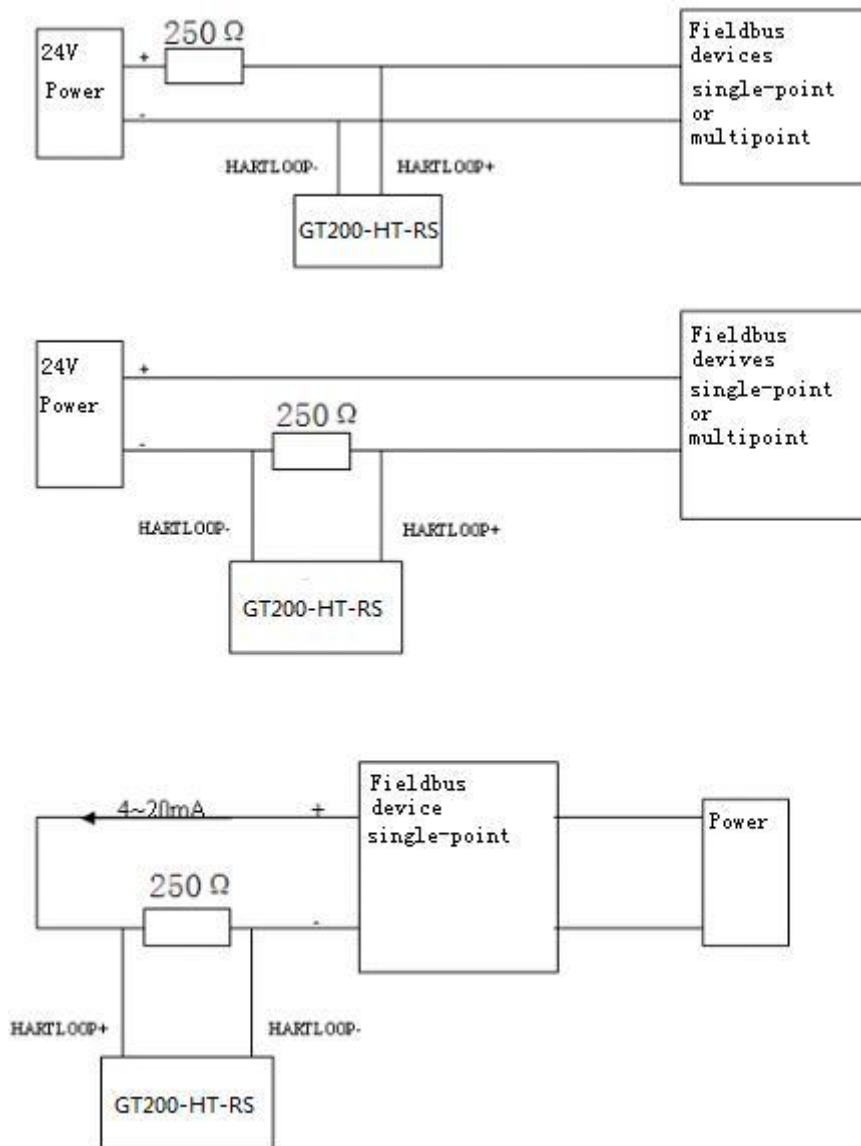
2.6.5 Mini B Type USB

Mini B type USB interface is defined as below:

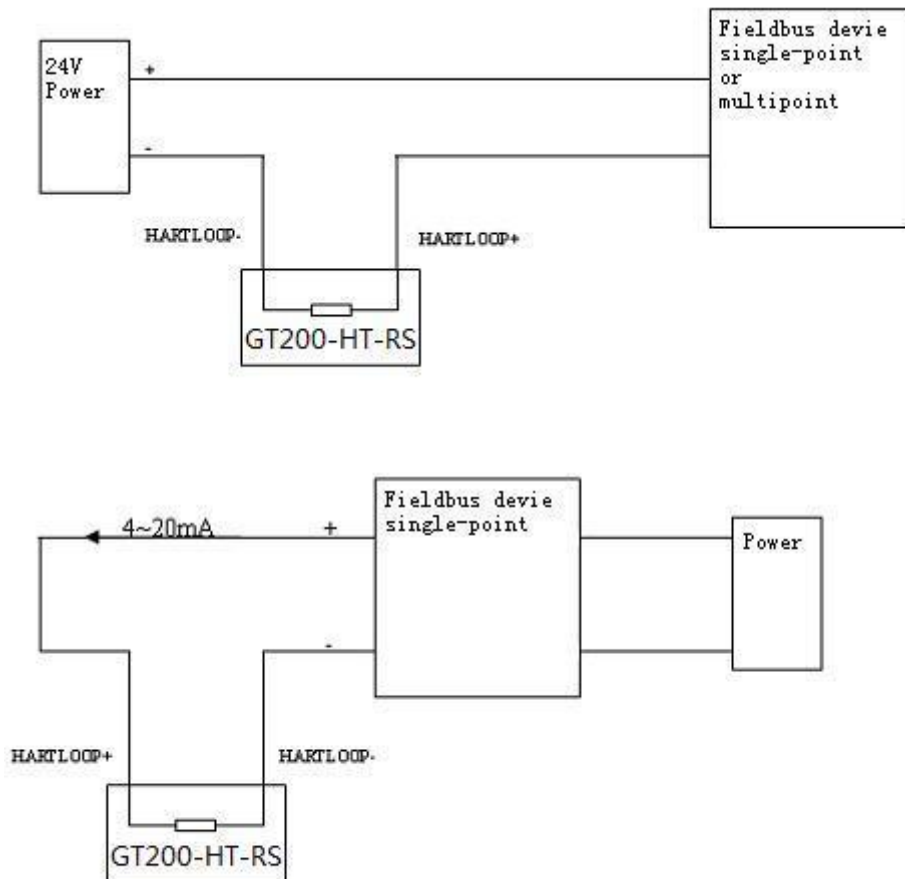
Pin	Name	Function
1	VBUS	+5V
2	D-	Data negative
3	D+	Data positive
4	IN	NC
5	GND	Signal Ground



2.6.6 Topology of GT200-HT-RS and Fieldbus Devices



Not using the internal resistor!



Using the internal resistor!

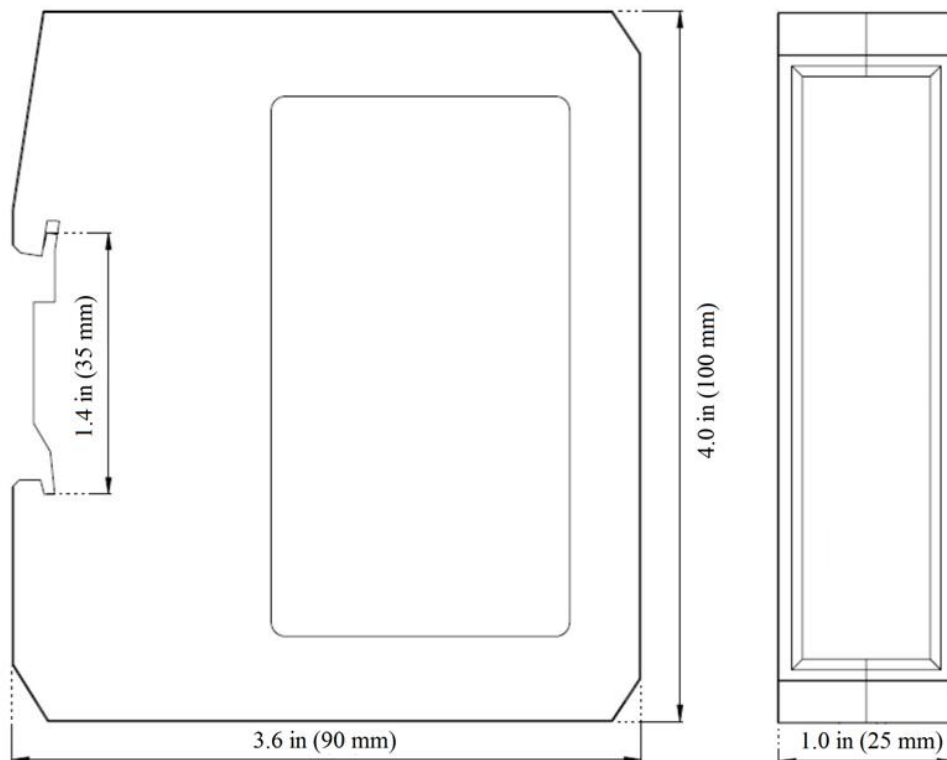
Note:

1. Some HART slave instrument need to perform self-test and other internal work when power is on, they may not start HART communication, then gateway cannot receive the response data of the instrument right now. It is recommended the HART slave instrument and gateway uses separate power supply so that the gateway can immediately establish communication with instrument.
2. When configuring HART commands in the software SST-HT-CFG, the commands need to be configured according to the actual demands. To improve the speed of bus communication, it is recommended not to configure the empty node (in fact, not connected to the node) and empty commands (the actual unnecessary commands).

3 Hardware Installation

3.1 Mechanical Dimensions

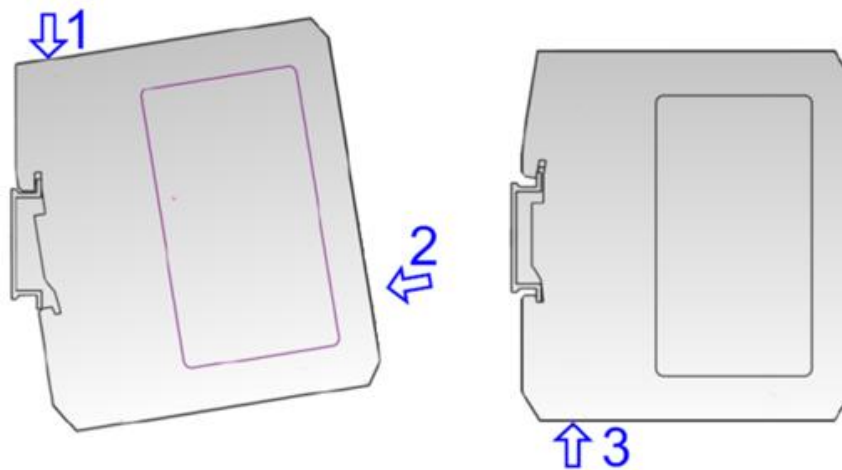
Size: 1.0 in (width)*4.0 in (height)*3.6 in (depth)



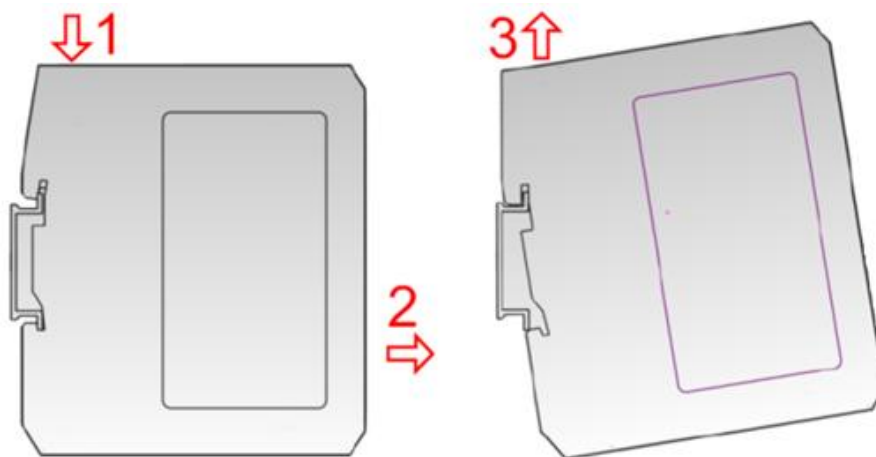
3.2 Installation Method

Using 1.4 in (35mm) DIN RAIL

Install the gateway



Uninstall the gateway



4 Quick Start Guide

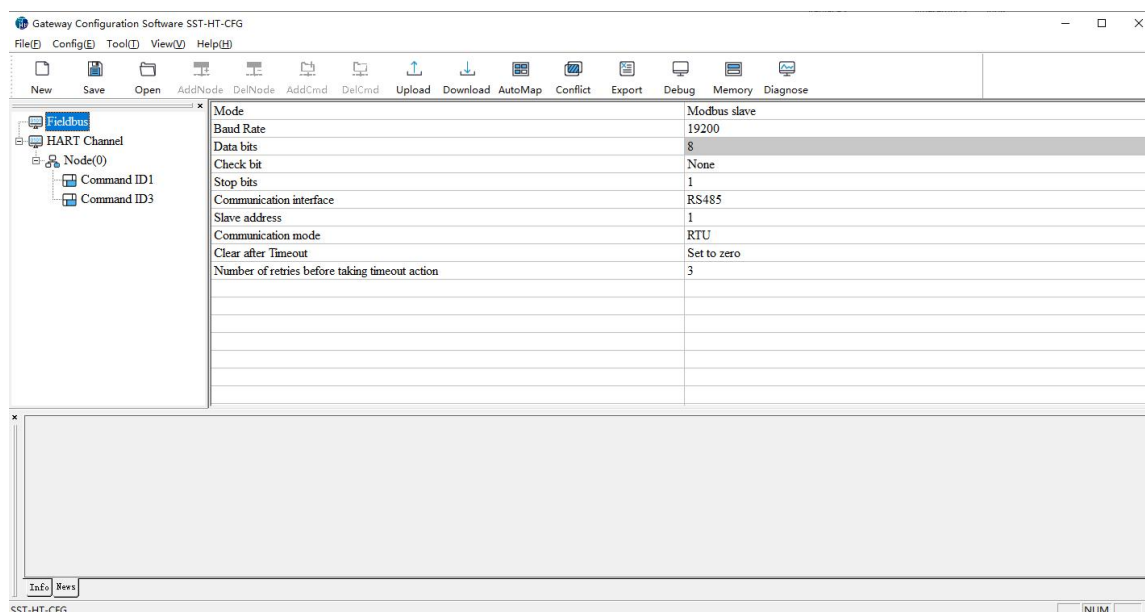
4.1 Gateway Configuration

4.1.1 Connection

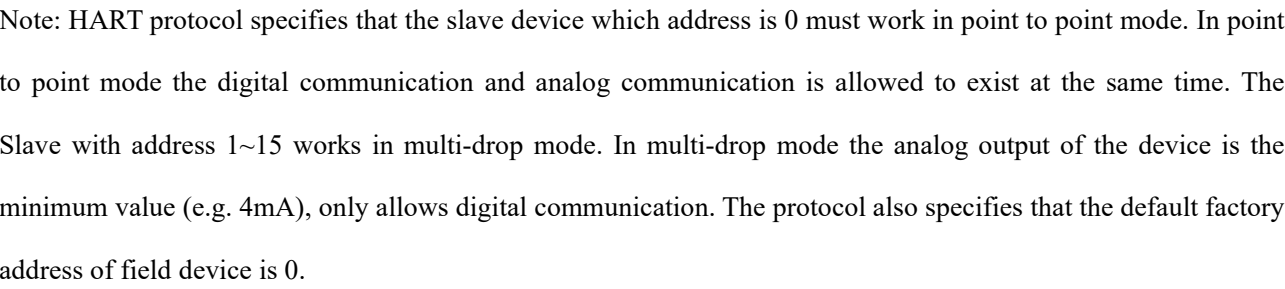
1. Turn gateway's configuration bit of DIP switch(refer to chapter 2.3) to "ON".
2. Connect the Gateway's RS-232/USB interface and the serial port of the computer with a serial cable, wiring methods see chapter 2.6.3 of this manual.
3. Power on the gateway, the LED display shows "CF", indicates that the gateway is in the configuration mode.
Run the SST-HT-CFG to start the gateway configuration.

4.1.2 Configuration

1. Run the SST-HT-CFG software installed on your computer.
2. Click "Fieldbus" in the tree view on the left, the configuration table is shown on the right as below:



3. Click "HART Channel" in the tree view on the left, the configuration table is shown on the right as below:



-
- The screenshot shows the 'Gateway Configuration Software SST-HT-CFG' interface. On the left, a context menu is open for the 'HART Channel' node, with 'Add Node' selected. A blue arrow points from this menu to the main configuration area. The main area shows a tree view with 'Fieldbus' and 'HART Channel' (containing 'Node(0)'). To the right, a table titled 'Hart slave address' is visible, with a single row containing the value '0'.

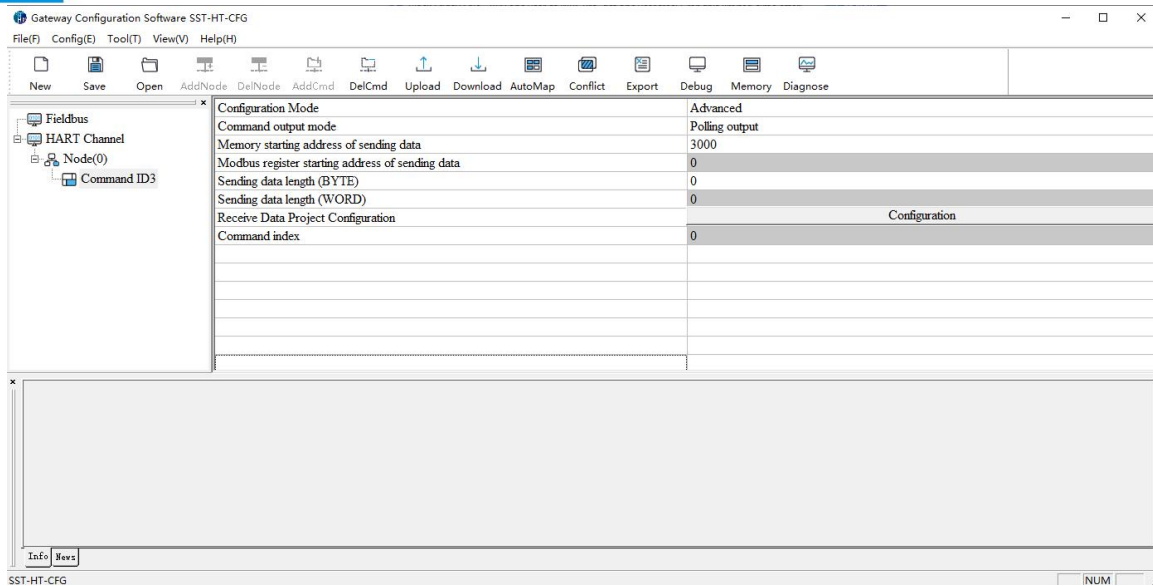
-
- The screenshot displays the 'Gateway Configuration Software SST-HT-CFG' interface. The top menu bar includes 'File(F)', 'Config(E)', 'Tool(T)', 'View(V)', and 'Help(H)'. Below the menu is a toolbar with icons for 'New', 'Save', 'Open', 'AddNode', 'DelNode', 'AddCmd', 'DelCmd', 'Upload', 'Download', 'AutoMap', 'Conflict', 'Export', 'Debug', 'Memory', and 'Diagnose'. On the left, a tree view shows the project structure: 'Fieldbus' (with a computer icon), 'HART Channel' (with a computer icon), and 'Node(0)' (with a node icon). The main workspace is titled 'Hart slave address' and contains a large, empty table with multiple columns. A 'Select the command' dialog box is open in the center. This dialog has two panes: 'Command list' on the left and 'Selected command' on the right. The 'Command list' pane contains a scrollable list of commands from 'Command ID0' to 'Command ID19'. Navigation arrows (up, down, left, right) are present between the panes. At the bottom of the dialog are 'OK' and 'Cancel' buttons. The bottom status bar of the main window shows 'Info' and 'News' tabs, and the text 'SST-HT-CFG' is visible in the bottom left corner.

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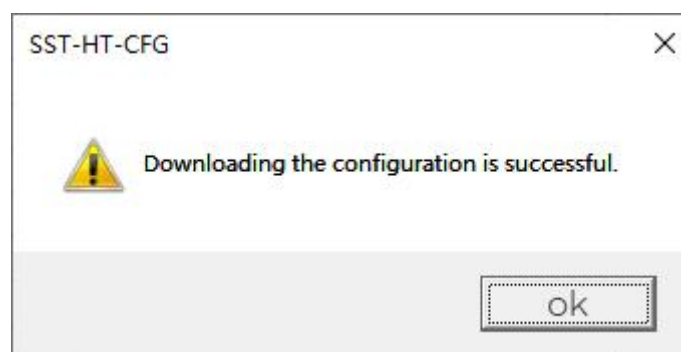
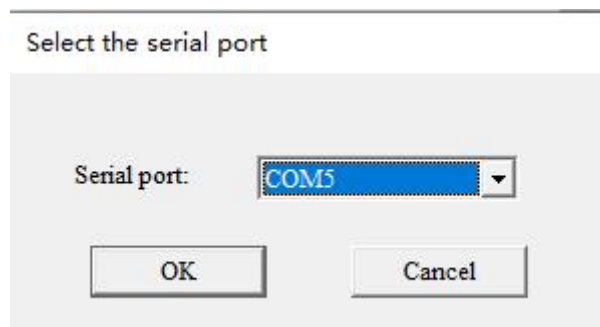
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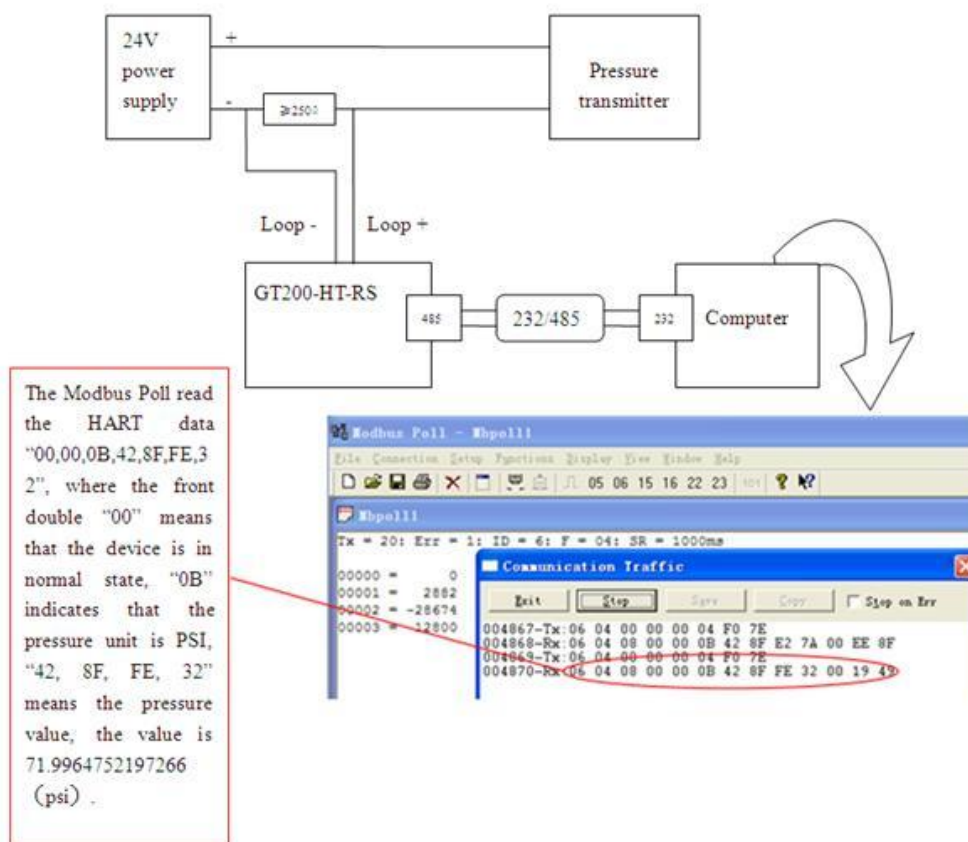


- Click the tool  **Download**, in the pop-up dialog box, select the serial port that gateway is connected to the computer, click OK and then click Download data:



4.1.3 Function Demo

HART interface of the gateway connects with a 2-wire pressure transmitter with slave address 0, RS-485 interface is connected to the computer through RS-485/RS-232 converter, and computer with configured Modbus POLL software can simulate to work as a Modbus master, then in data exchange window you can see the main variable value of the pressure transmitter:



5 Software Instructions

5.1 Software Interface Description

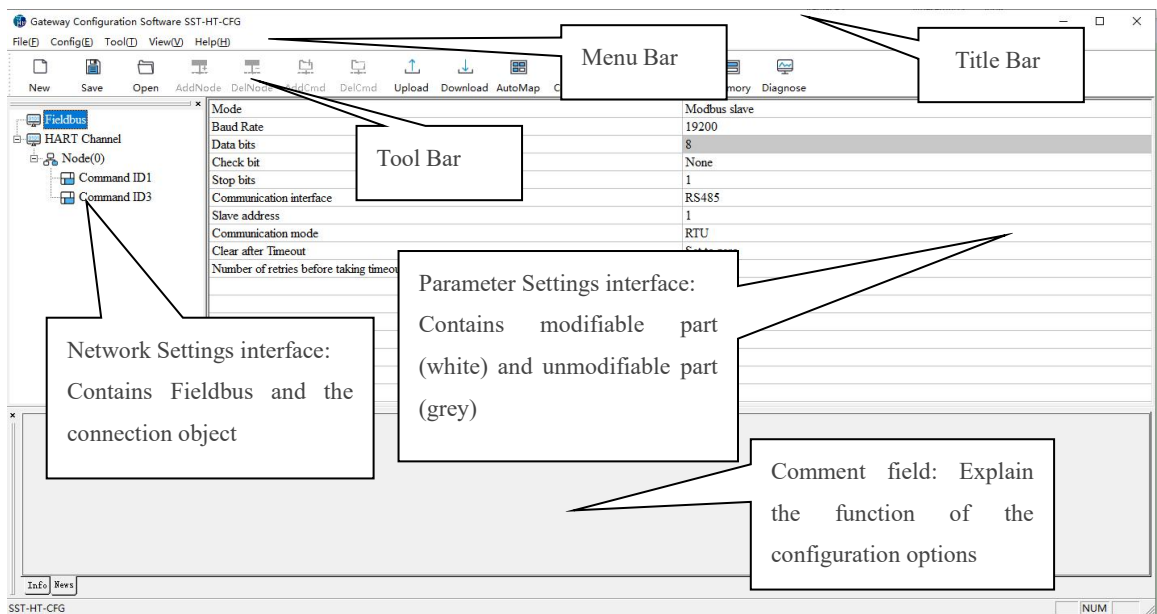
SST-HT-CFG is configuring software based on Windows platform, and used to configure HART series products.

The following describes how to use the software SST-HT-CFG to configure the product GT200-HT-RS. You may also check the software user manual to get detailed usage.



Double-click on the icon

to enter the main interface of software:



Tool Bar:

Toolbar interface shown as follow:



The function from left to right is: New, Save, Open, AddNode, DelNode, AddCmd, DelCmd, Upload, Download, AutoMap, Conflict, Export, Memory, Diagnose and Debug.



New: Create a new configuration project.

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 Save	Save: Save the current configuration.
 Open	Open: Open a configuration project.
 Add Node	Add Node: Add a HART node.
 Del Node	Delete Node: Delete a HART node.
 Add Cmd	Add Command: Add a HART command.
 Del Cmd	Delete Command: Delete a HART command.
 Upload	Upload: Upload the configuration from the gateway.
 Download	Download: Download the configuration to the gateway.
 AutoMap	Auto Map: Automatically calculate the mapped data address of each command.
 Conflict	Conflict: Check the mapping address in the Conflict Detection window.
 Export	Export Excel: Export current configuration as a table and save it as *.xls file.
 Debug	Debug: Through this function could send any request frame to HART fieldbus and show the response information received in HART, convenient to debug.
 Memory	Memory: Show the data exchange inside of the gateway.
 Diagnose	Diagnose: This function analyzes the operating condition of fieldbus devices.

5.2 Software Functional Description

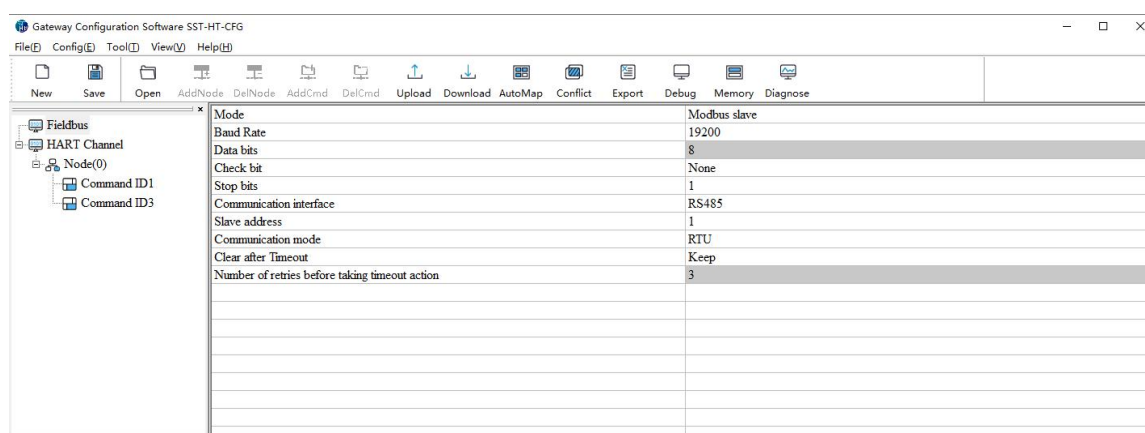
5.2.1 Connect with the Hardware

Put the gateway configuration switch to “ON”, use a serial port line to connect the gateway RS-232 port and that of computer or use USB cable line to connect gateway’s USB port and computer . Power on the gateway and its LED display displaying “CF” indicates it is in the configuration mode.

5.2.2 Configure the Fieldbus

5.2.2.1 Configure the fieldbus as Modbus slave

If you want to use the functionality of Modbus slave, click the “Fieldbus” in the tree view, select mode as “Modbus slave” in the right configuration plate, and then press ENTER to confirm, you will see the interface as below:



In this interface you can set the parameters as shown:

Baud rate: 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200bps.

Data bits: 8.

Check bits: None, Odd, Even, Mark, Space optional.

Stop bits: 1, 2.

Communication interface: RS-485, RS-232 optional.

Slave address: 0~247.

Communication mode: RTU, ASCII.

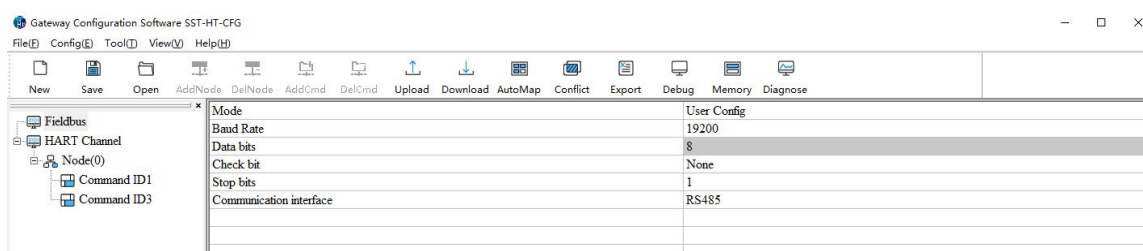
Clear after Timeout: When the HART commands exceed the no-reply times, whether or not to clear the HART input data buffer.

Number of retries before taking timeout actions: Set the timeout/clear times.

5.2.2.2 Configure the fieldbus as universal mode

The universal mode (transparent transmission mode) means that we can send HART frame directly through serial port (RS-232/RS-485), meantime gateway also will send out the data received from HART bus through serial port. In this process, the data don't change.

Click the "Fieldbus" in the tree view, select mode "User mode" in the right configuration plate, and then press ENTER to confirm, you will see the interface as below:

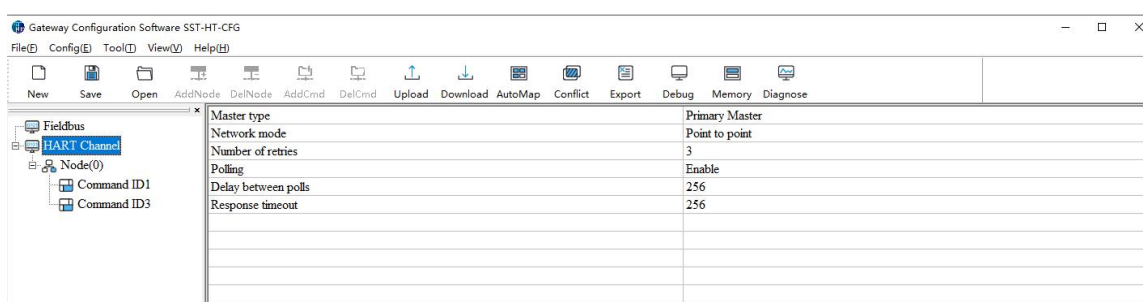


The range and meaning of general mode are the same as "Modbus Slave".

5.2.3 Configure the HART Fieldbus

5.2.3.1 Set the Parameters of HART Channel

Click the HART Channel in the tree view, in the right place will show the configuration plate:



Master type: Primary master, Secondary master.

Network mode: Select the networks link as point to point or multi-drop, in the point to point the gateway can only communicate with the slave device whose address is 0.

Number of retries: 0~5.

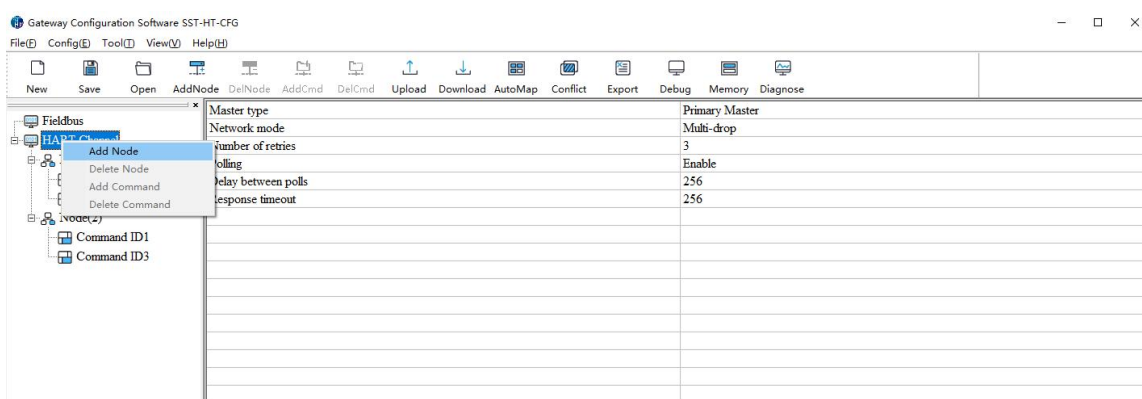
Polling : Enable, Disable.

Delay between polls: 256~65535ms.

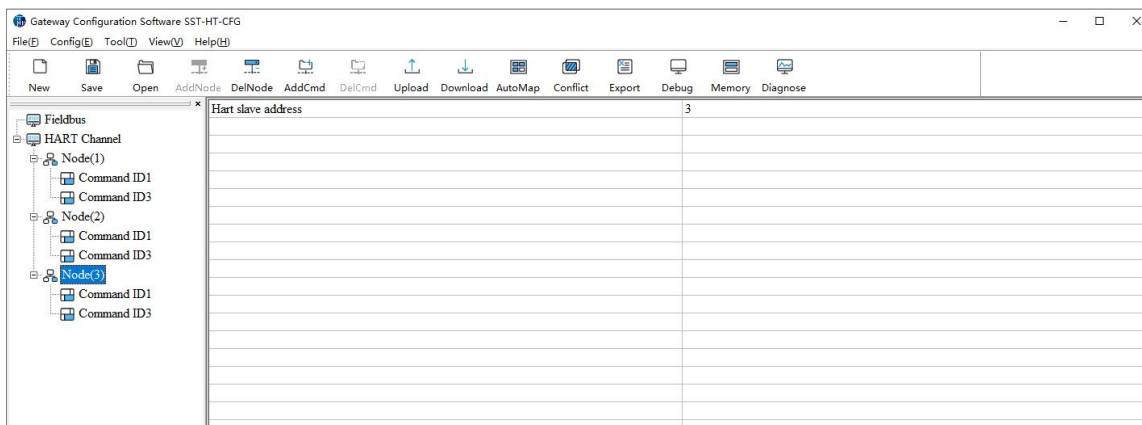
Response timeout: 256~65535ms.

5.2.3.2 Add Slave Nodes

Select the "HART Channel", Right click the mouse and click "Add Node".



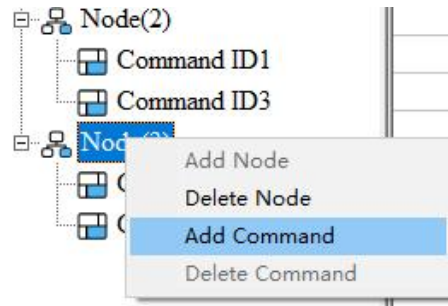
Click the added node, set slave address in the right configuration plate, and please notice that HART channel can only be equipped with one slave node when configured in the single point mode.



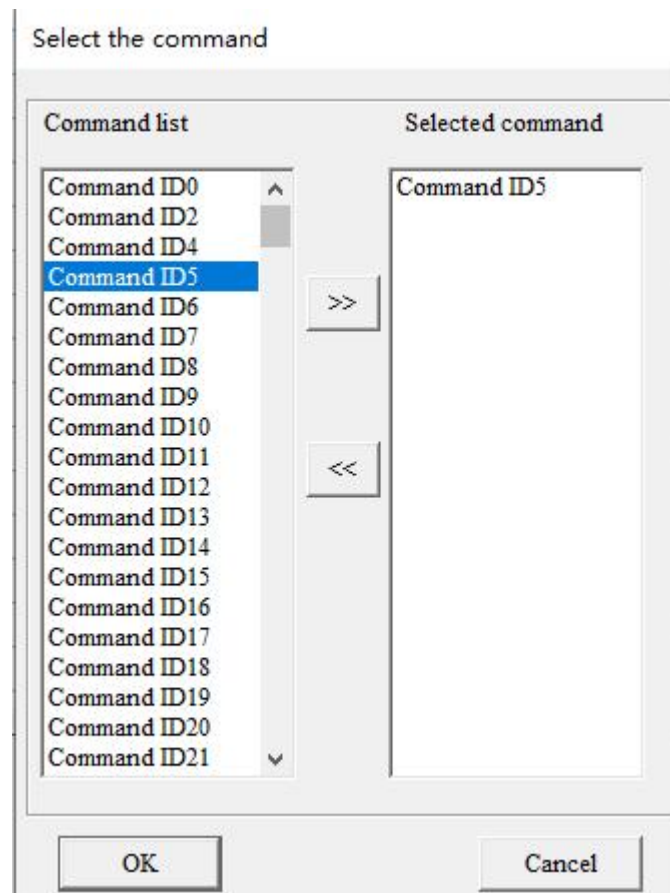
Note: When configured node numbers are more than the actual connected devices, the redundant node will lead to the longer time of polling circle. so, it is recommended that configured node numbers should be the same as actual devices.

5.2.3.3 Add HART Commands

Select the “Node (x)”, Right click the mouse and click “Add Command”.



Choose the command you want in the popup menu, and then click “OK” to exit:

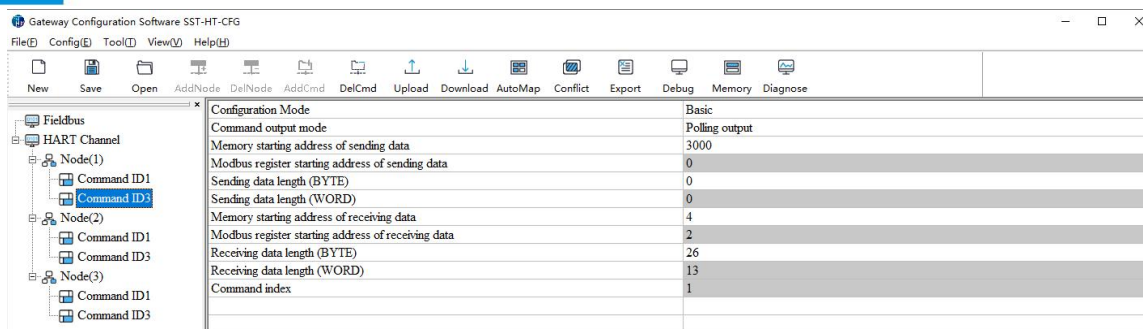


Note: the same command can only be configured once in one node.

5.2.3.4 Configure HART Commands

Click the command number in the tree view. you will see the configuration plate in the right place:

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Configuration Mode: Basic and advanced optional, “basic” is shown as above, “advanced” configuration can refer to chapter 5.2.3.7.

Command output mode: You can use the execution way of the command, change-of-state output, polling output, Initialization output and disable output optional:

Change-of-state output: Execute this command once s data buffer of HART changes.

Polling output: This order is put in the polling list, executed periodically.

Initialization output: Execute the command only once when power is on.

Disable output: The command will not be sent.

Memory starting address of sending data: Set the memory starting address of output data by this command, the range is 3000~3999.

Modbus register starting address of sending data: The property is automatically calculated by gateway, used for register addressing.

Sending data length (BYTE): Used to set the length of output data by this command.

Sending data length (WORD): The property is automatically calculated by gateway, used for user checking output data length, 1 word=2 byte.

Memory starting address of receiving data: Set the memory address of input data by this command. Response data only includes data area of HART frame.

Modbus register starting address of receiving data: The property is automatically calculated by gateway, used for register addressing.

Receiving data length (BYTE): Set the length of input data by this command.

Receiving data length (WORD): The property is automatically calculated by gateway, used for user checking output data length conveniently, 1 word=2 byte.

Command index: The property is automatically calculated by the configuration software, it indicates the index in

the configured command list this command belongs to.

5.2.3.5 Delete Commands

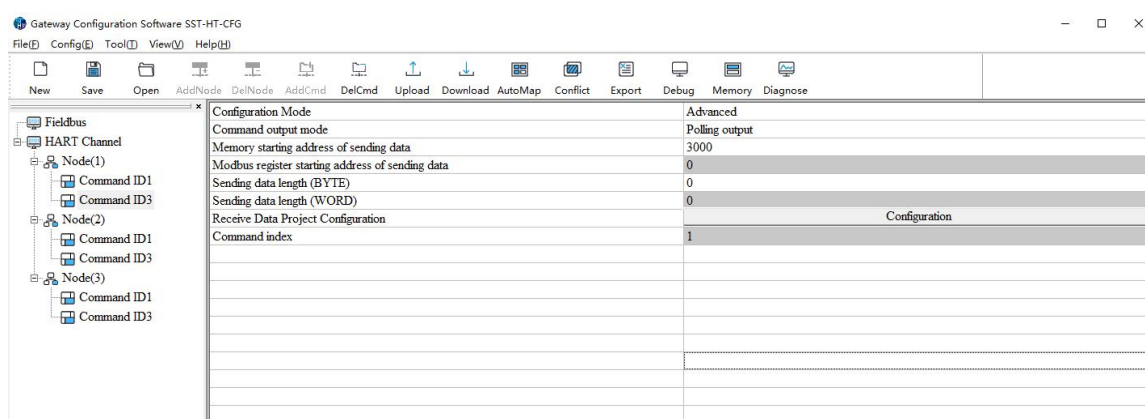
Select the command need to be deleted, Right click the mouse and click “Delete Command”. Through the menu command can also be the same action.

5.2.3.6 Delete Nodes

Select the node needed to be deleted, Right click the mouse and click “Delete Node”. Through the menu command can also be the same action.

5.2.3.7 Advanced Options to Configure Slave Commands

When using HART command configuration, sometimes users want to get one part data of one command. For example, No.1 HART command. The float value of main variable is only needed, no need to get unit of main variable, this is why advanced option exists. Advanced options is actually the execution of “segment mapping function”, it cut the response data of HART command and get the segment data. Users can get any part data they want. Below is the interface of Advanced Options:

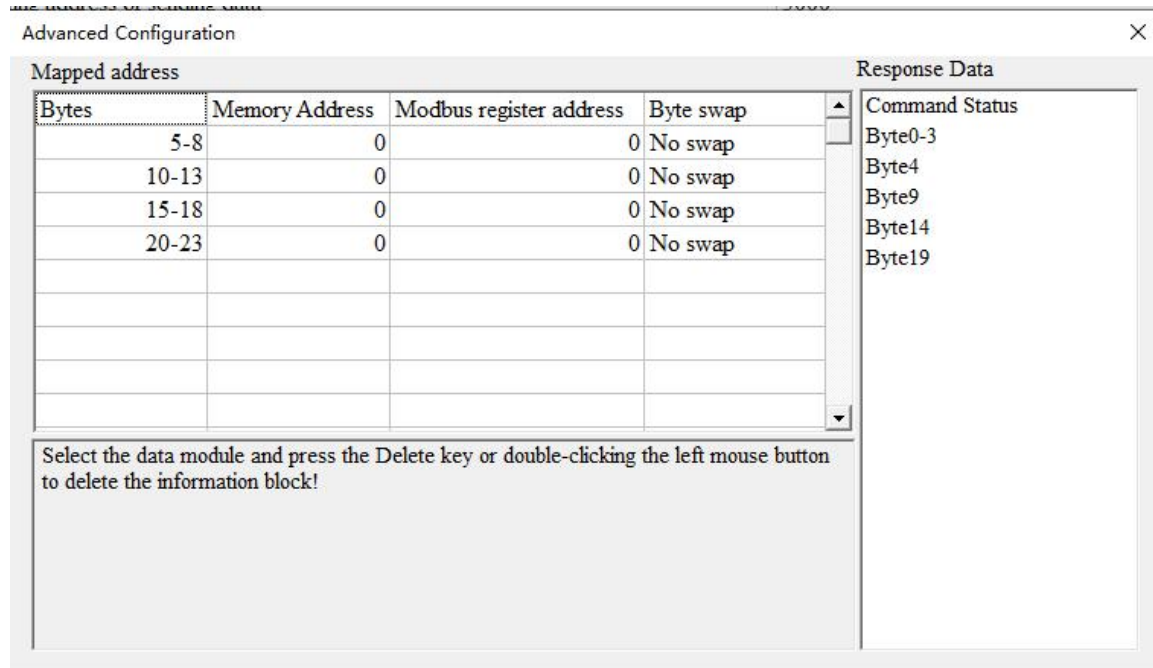


This interface details is described in chapter 5.2.3.4, so here we don't describe it. The below is the example of No.3 HART command, to show how to use “Segment Mapping” function, we can see one “configuration” button after the “receive data project configuration” option, click it:

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There are many parts in “Bytes”. For example, “Command Status” means the communication status and relevant code of HART response command, “Byte0-3” means byte 0 to 3 of data area of HART response command, and so on.

In the above example, click “Byte5-8” will show the Primary Variable in the left bottom area. Other column have the relevant explanation.

First to explain the “Mapped Address”:

Bytes: Response bytes of “Response Data”.

Memory Address: Assigned memory address which this byte is located in memory buffer area of GT200-HT-RS.

Modbus register address: The relevant Modbus register address of “Memory Address”. Note: this address is not a single address, that is the same memory area which it occupied.

Byte swap: There are two options, “no swap” and “register swap”, swap option is only valid to float type data. When using “no swap”, the byte order is byte1, byte2, byte3 and byte4. After using “register swap”, the byte order will be byte3, byte4, byte1 and byte2. For example, the original data is 0x12345678, it will be 0x56781234 after using “register swap”.

Close the dialog box, download the configuration into GT200-HT-RS.

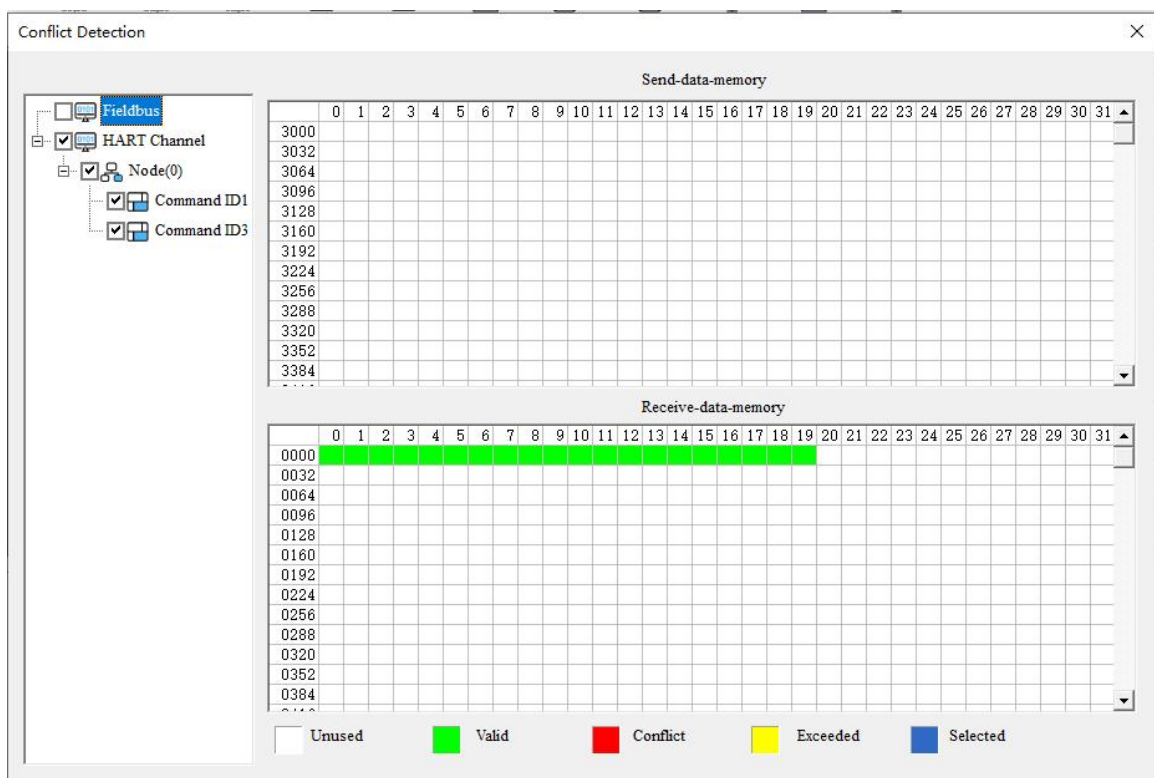
Others are the same with “Basic Mode”.

5.2.4 Conflict Detection

Conflict detection is used to check the distribution condition of the input and output data of all commands stored in the memory.



Click **Conflict** icon will show the conflict detection interface as follow:



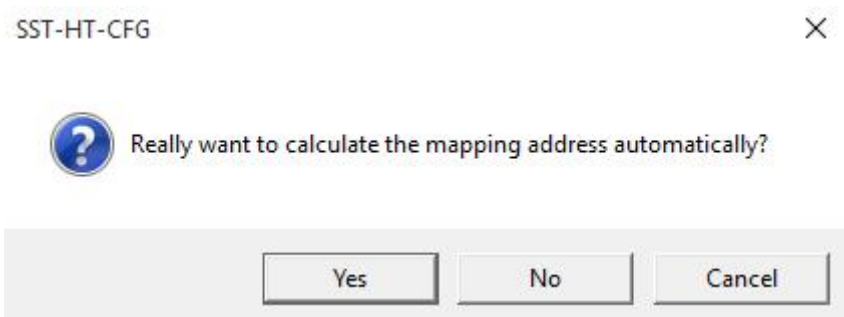
The left side is configuration commands, the right side is data memory address including receive data storage address and send data storage. Upper side is memory distribution of the HART’s sending data. lower side is memory distribution of the HART’s receiving data. When one memory unit is configured with two commands or more, the memory unit will display red color. When the distributed memory exceeds the defined scale of gateway, the exceeding part will display yellow color. White color area shows the usable memory. Green color area indicates occupied memory. Clicking one command, the distribution shown in blue will show the storage location of input/output data.

5.2.5 Auto Mapping

Automap will automatically distribute the memory with no conflict according to the input/output bytes number by users’ commands.



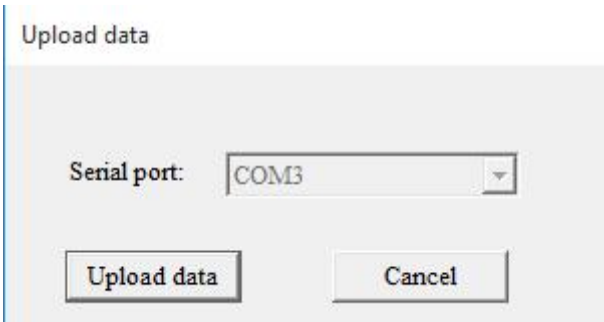
You should set the correct input/output bytes for each commands, then click **AutoMap** label, select “yes” in the popup menu.

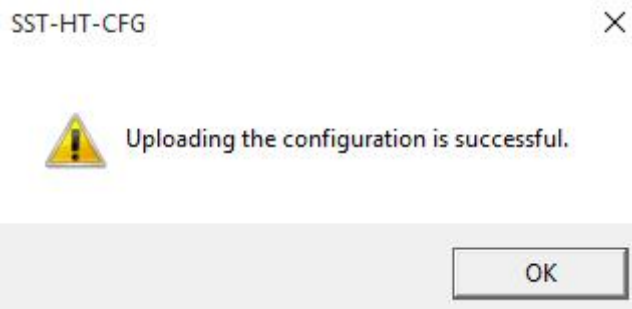


5.2.6 Upload configuration



Open the software “SST-HT-CFG”, Click on the icon **Upload** , Select the computer port connected to the gateway and then click “upload data”, If it shows “upload successfully”, which indicates that configuration file had been uploaded to the SST-HT-CFG.





5.2.7 Download Configuration



Click the icon **Download** . it will download the configuration into the gateway.

5.2.8 Memory Data Display

Show the data exchange inside of the gateway, users can use this function to debug the HART fieldbus in the absence of the Modbus master station. Steps are as follows:

1. Set the DIP switch's debug bit to ON state and the configuration bit to OFF state, restart the gateway.
GT200-HT-RS is in the debug mode.
2. Use a serial port line to connect the GT200-HT-RS's RS-232 port and computer RS-232 serial port or use USB way to connect it, open the software "SST-HT-CFG", Click "Config—Serial Connection", Select the correct serial port



3. Click "Tool—Show Memory Data" or click on the icon **Memory** , Interface is as follows:

The screenshot shows a software window titled "Memory data" with a close button (X) in the top right corner. It contains two main sections: "Input data" and "Output data".

Input data section:

- Buttons: "Save" and "Stop".
- Table with columns: Addr, 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 10, 11, 12, 13, 14, 15.
- Row 0000: C0, 40, 44, 69, BF, FF, 44, 69, 00, 00, 41, B8, 00, 00, 42, C8.
- Row 0016: 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00.
- Row 0032: 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00.
- Row 0048: 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00.
- Row 0064: (empty).

Output data section:

- Buttons: "Save", "Load", "Send", and "Stop".
- Table with columns: Addr, 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 10, 11, 12, 13, 14, 15.
- Row 3000: 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00.
- Row 3016: 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00.
- Row 3032: 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00.
- Row 3048: 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00.
- Row 3064: (empty).

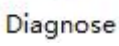
As is shown in the table, upper table shows the memory distribution of HART input data, lower table shows the output data. When you need to change the output data, click the “stop” button firstly, then change the related data or load the already saved data table, at last, click the “sending data”.

5.2.9 Diagnose

Through this function users will know which device is not communicating, execution condition of configured commands, data transmit of gateway and displays of certain command, operating steps are as follows:

1. Set the DIP switch’s debug bit to ON state and the configuration bit to OFF state, back online.
GT200-HT-RS is in the debug mode.
2. Use a serial port line to connect the GT200-HT-RS’s RS-232 port and computer RS-232 serial port or use USB way to connect it, open the software “SST-HT-CFG”, Click “Config—Serial Connection”, Select the correct serial port

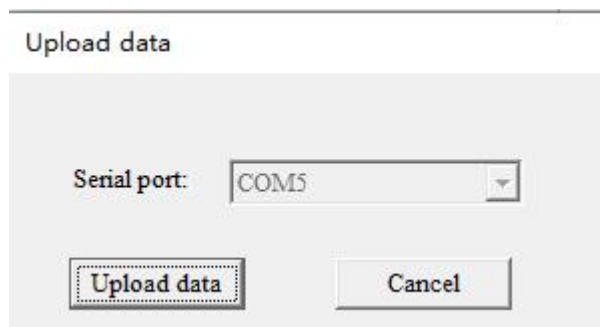


3. Click “Tool—Diagnose” or click on the icon  , Interface is as follows:

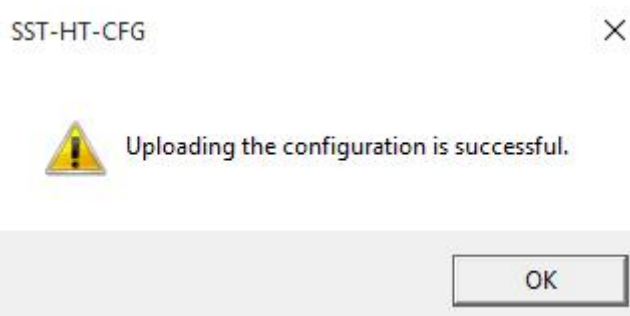
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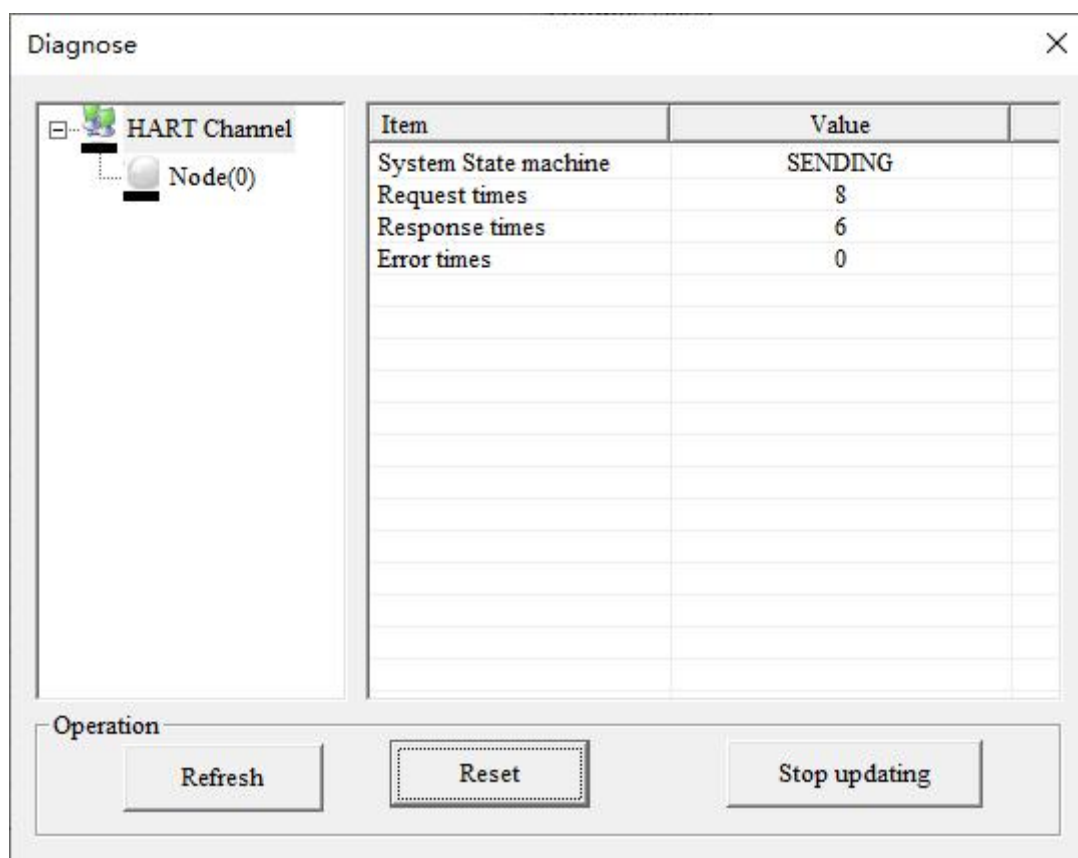
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4. Click “Upload data” will see a picture as below:



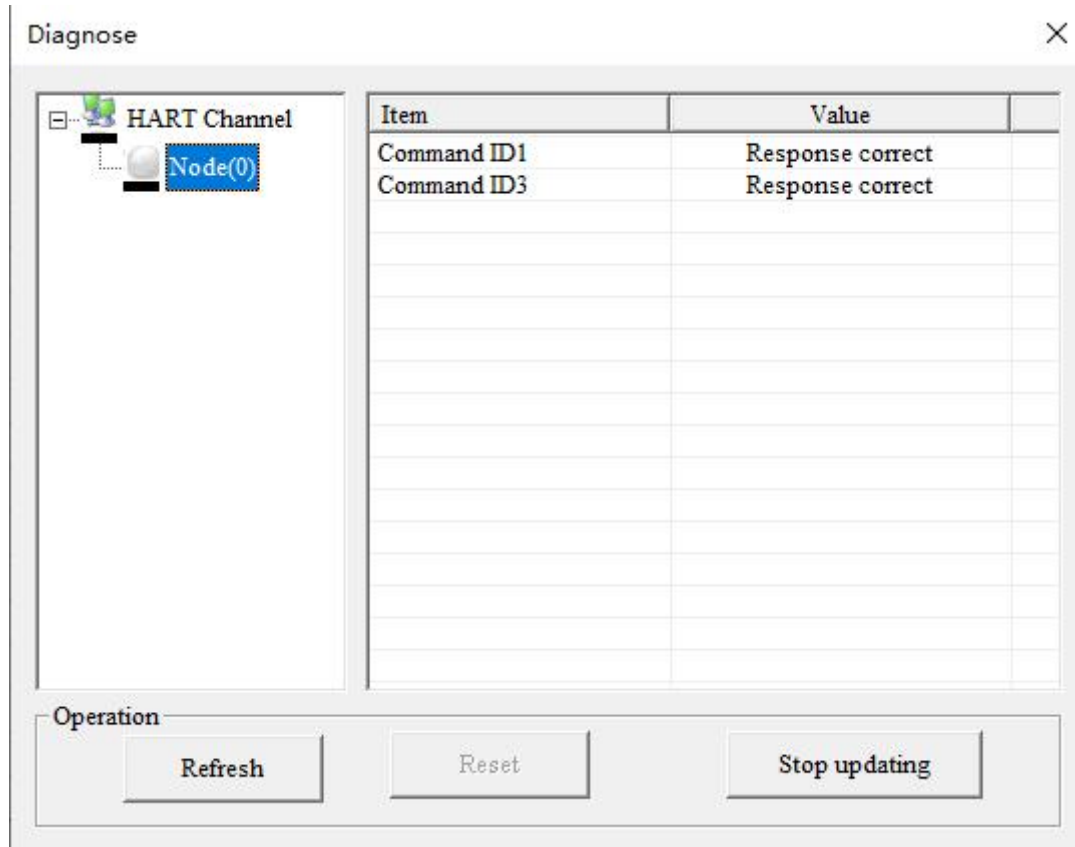
5. Click “OK” button to get in the interface of diagnose:



Click on “HART Channel” in this interface, it will show the status of HART fieldbus part in the right place, press

“Refresh” button will update the data once, click on “Periodically refresh”, the software will update the data every 500ms.

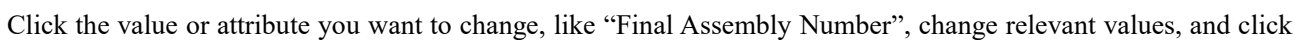
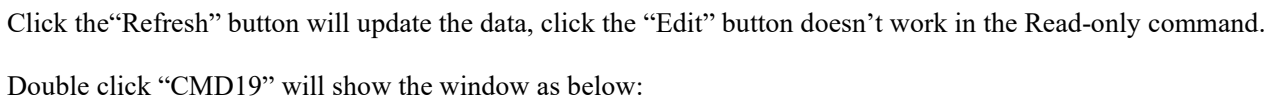
6. Click Node(x), it is shown as below:



It shows the response status of configured commands.

Click “Refresh” will fresh these command status, “Periodically refresh” will fresh command status once.

- Double click command 0, 1, 2, 3, 6, 11, 12, 13, 14, 15, 16, 17, 18, 19 will show their command information, command 6, 17, 18 and 19 can start data input.



“Modify” can execute this operation of write command.

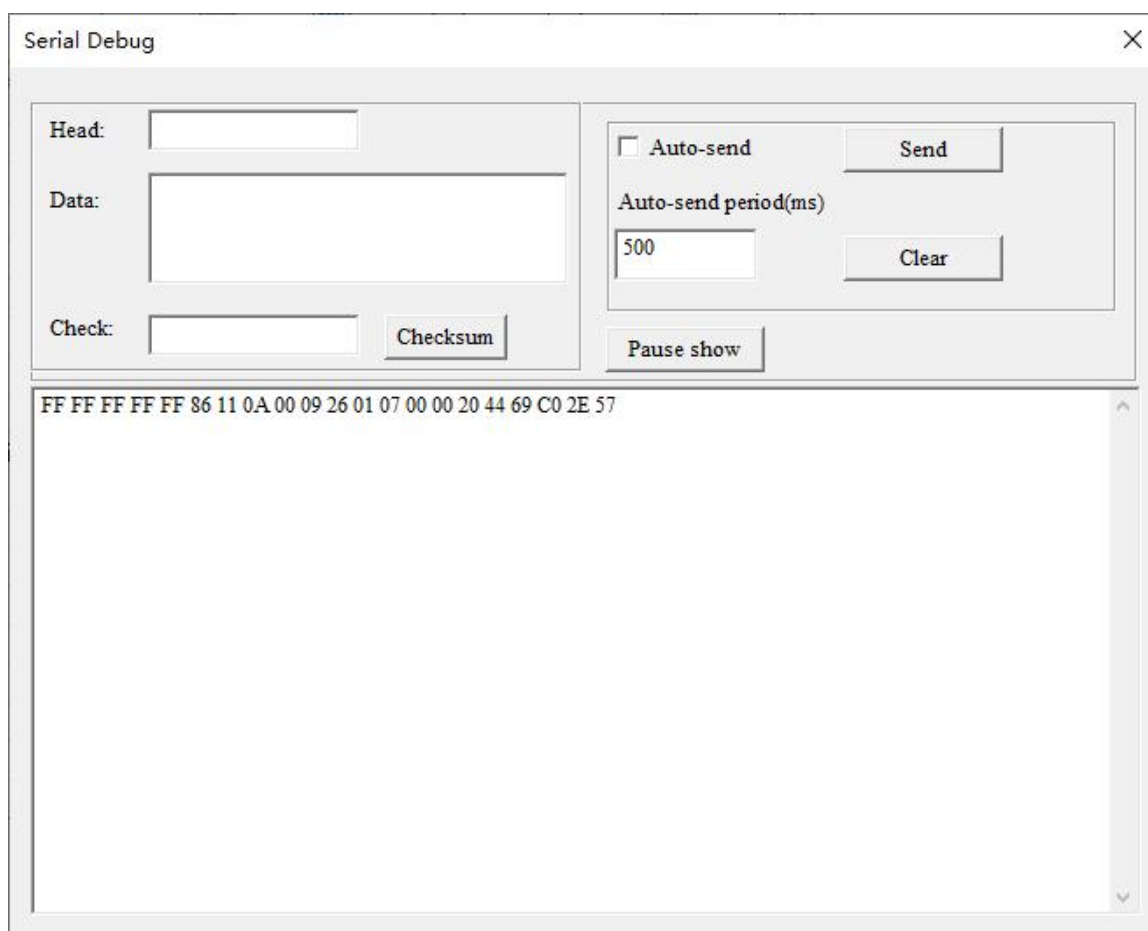
5.2.10 Serial Debug

Through this function could send any request message to HART instruments and record the response information.

Steps are as follows:

1. Set the DIP switch’s debug bit to ON state and the configuration bit to OFF state, restart the gateway. Now GT200-HT-RS is in the debug mode.
2. Use a serial port line to connect the GT200-HT-RS’s RS-232 port and computer RS-232 serial port or use USB way to connect it, open the software “SST-HT-CFG”, Click “Config—Serial Connection”, Select the correct serial port.

3. Click “Tool—Serial Debugging Assistant” or click on the icon  , Interface is as follows:



In this interface, click “Auto-send” or “Send” will combine data head, data, and check code into one frame and send out it. The data that the gateway received from HART fieldbus will be shown in the blank place below. The “Checksum” button only checks part of the data. Here is an example.

The screenshot shows a window titled "Serial Debug" with a close button (X) in the top right corner. The window is divided into several sections:

- Head:** A text box containing "FF FF FF FF FF".
- Data:** A text box containing "02 01 00 00".
- Check:** A text box containing "03".
- Checksum:** A button located below the Check text box.
- Auto-send:** A checkbox that is currently unchecked.
- Send:** A button located to the right of the Auto-send checkbox.
- Auto-send period(ms):** A text box containing "500".
- Clear:** A button located below the Auto-send period text box.
- Pause show:** A button located below the Auto-send period text box.

Below these configuration fields is a large, empty rectangular area with a vertical scrollbar on the right side, intended for displaying received data.

In this example, command ID0 is composed of data head, data and check code. It uses short address. when you click “Send”, you will get the response data.

Note: Under this function, gateway will stop to execute the configured command. Turn off this function, gateway will return to execute the configured command.

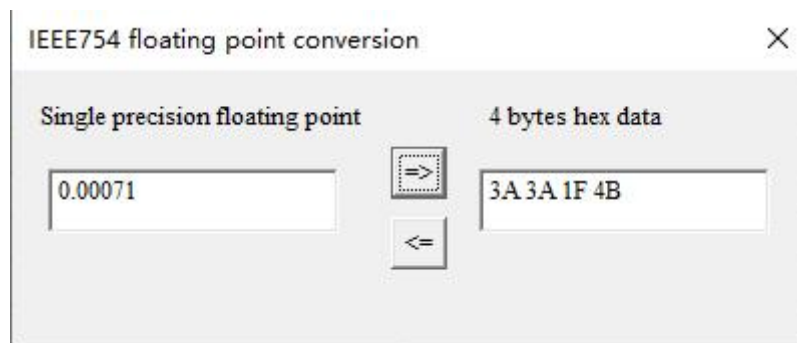
5.2.11 Useful Tools

In the “Tools” menu, there are two useful tools: They are used to finish data conversion.

PACKED ASCII conversion:



IEEE 754 conversion:



5.2.12 Use USB Port

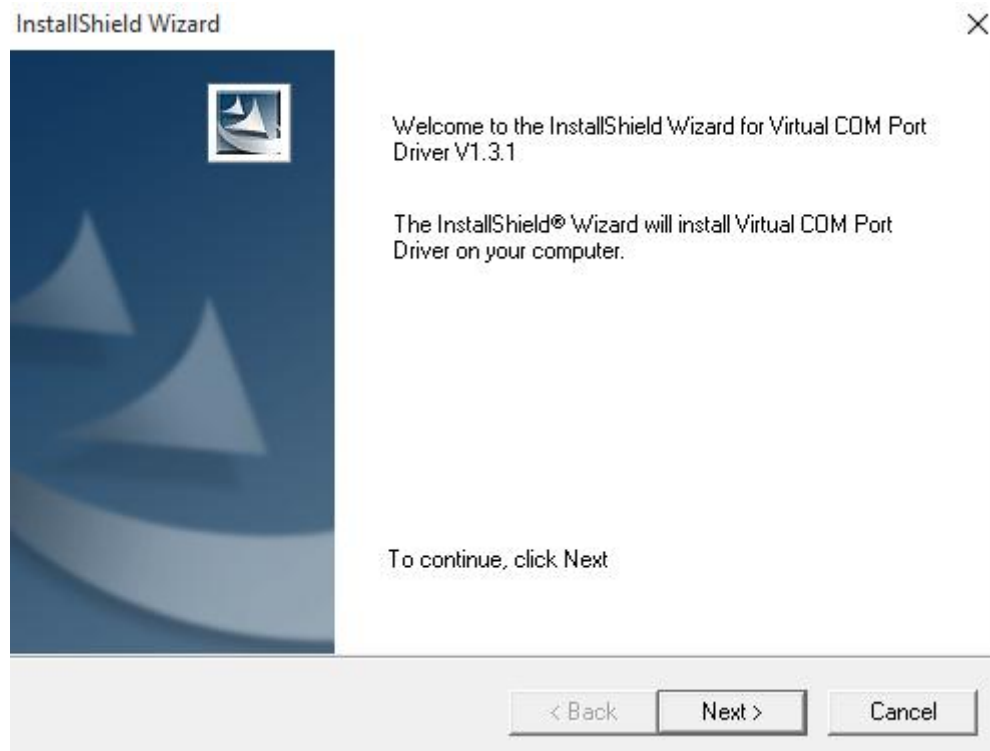
For now, USB port is only used for debugging and configuration. Its function is the same as RS-232 under configuration and debug. After installing USB driver, this USB driver will generate a virtual COM port on PC, GT200-HT-RS can communicate with PC through this virtual COM port. Please ensure that this USB driver is installed before using this function.

Installing driver, as show below:

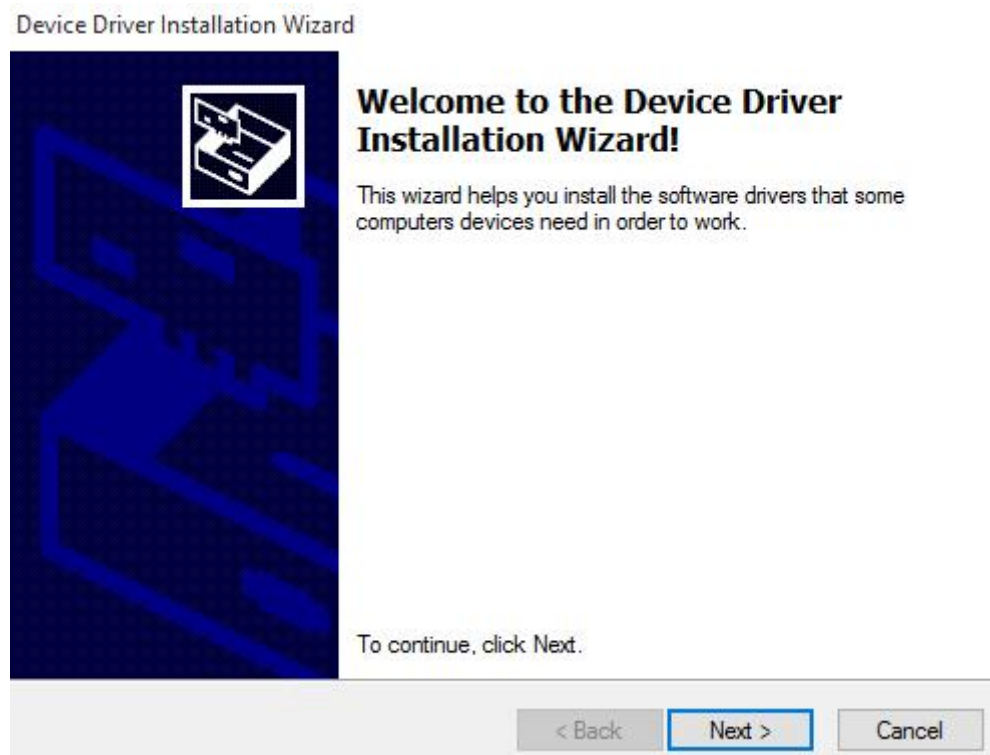
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Click "Next",

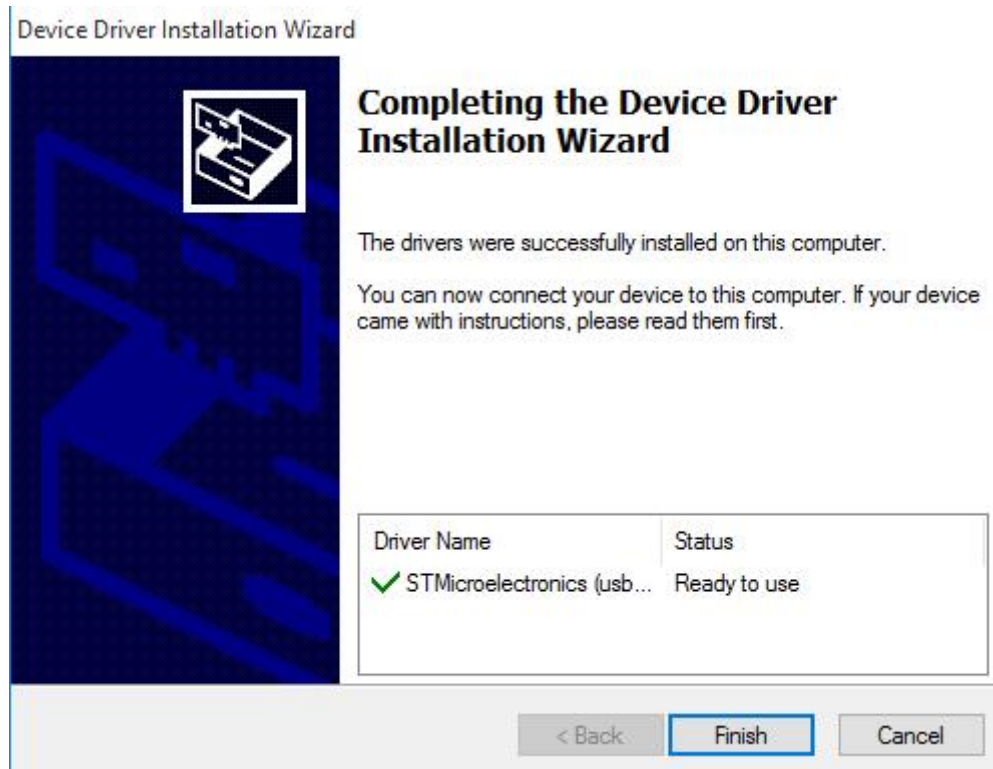


Click "Next",

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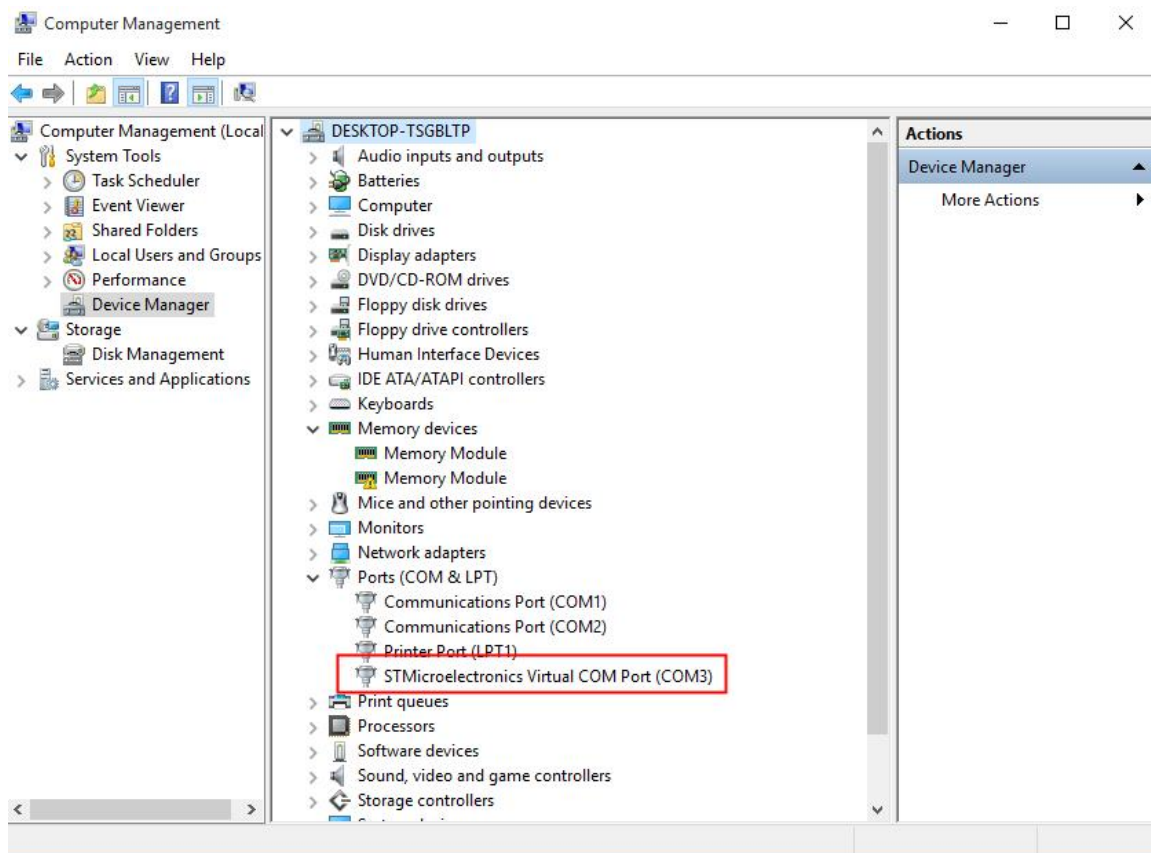
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Click "Finish", to finish the installation of USB driver.

How to find this virtual COM port? Use USB cable line to connect GT200-HT-RS and PC, set bit 2 of DIP switch to ON, and power on the product. Open the "Computer Management" of PC, you will find there is one new COM port under "Port (COM&LPT)", as shown "STMicroelectronics Virtual COM Port (COM3), that is the virtual COM Port:

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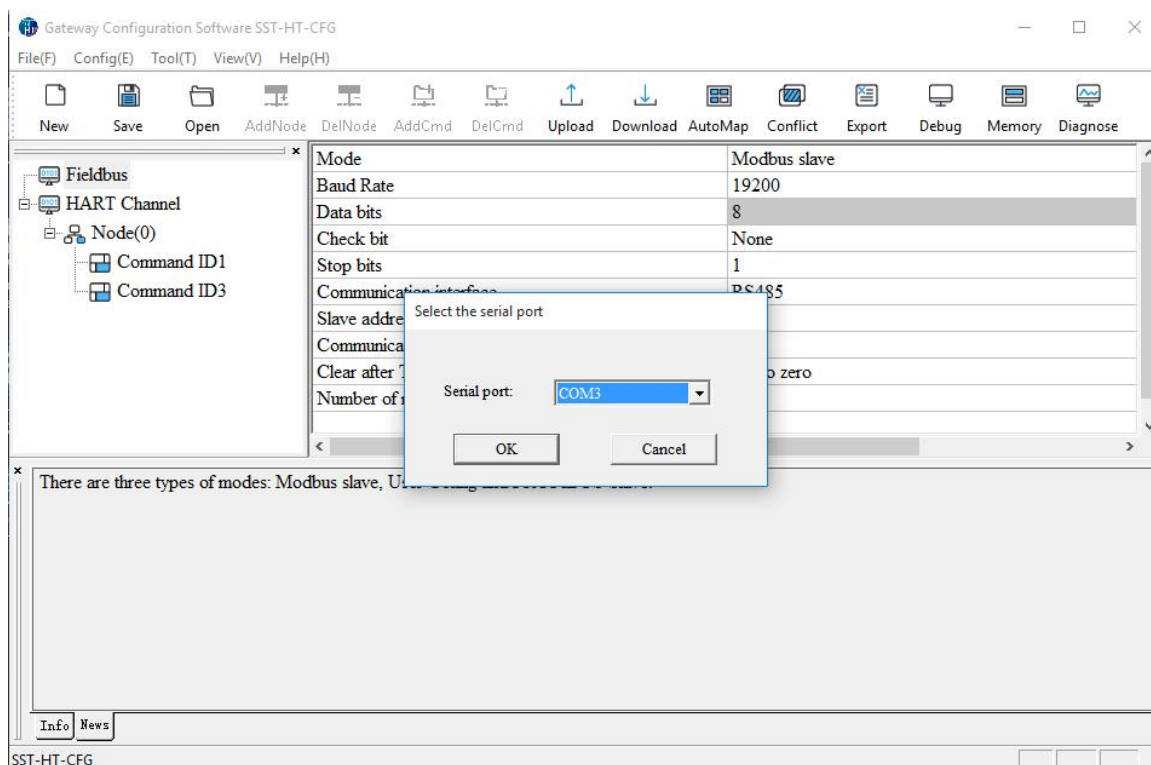
Noted: Different computer, the serial number will be different.

Open SST-HT-CFG software, click “Config” and choose Serial port, here choose COM3, as shown below:

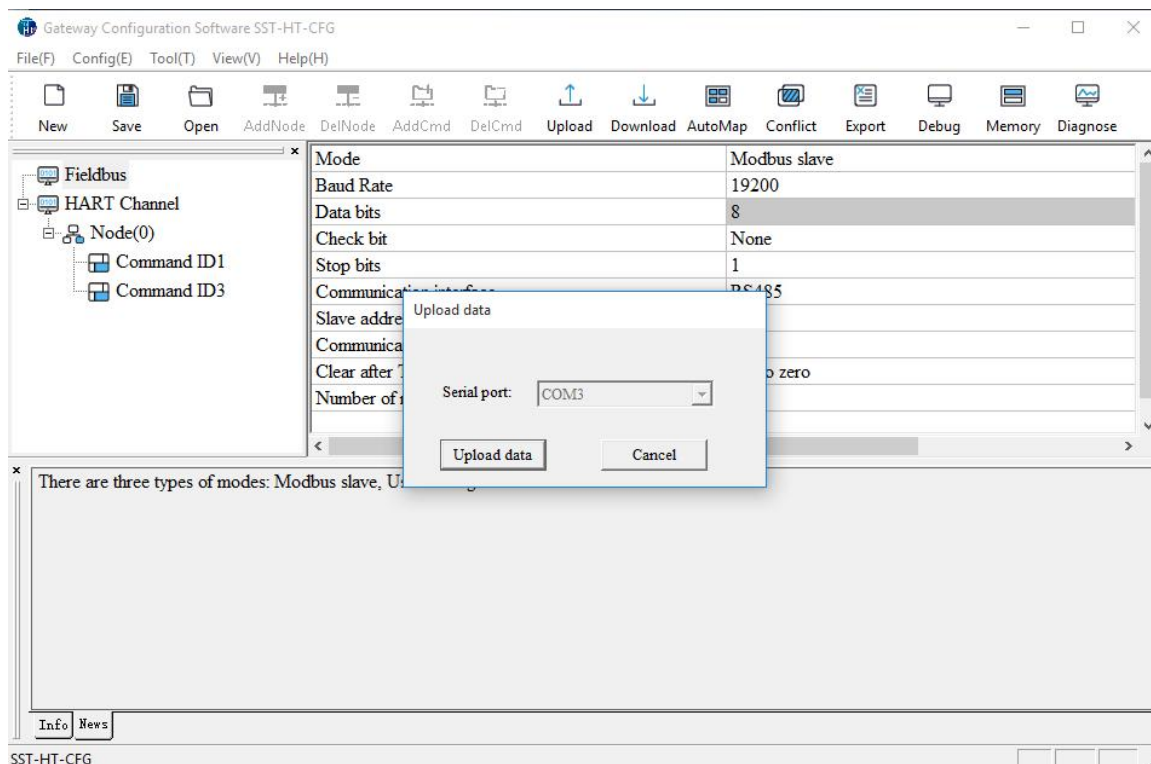
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After choosing serial port, click “Upload” on the toolbar:

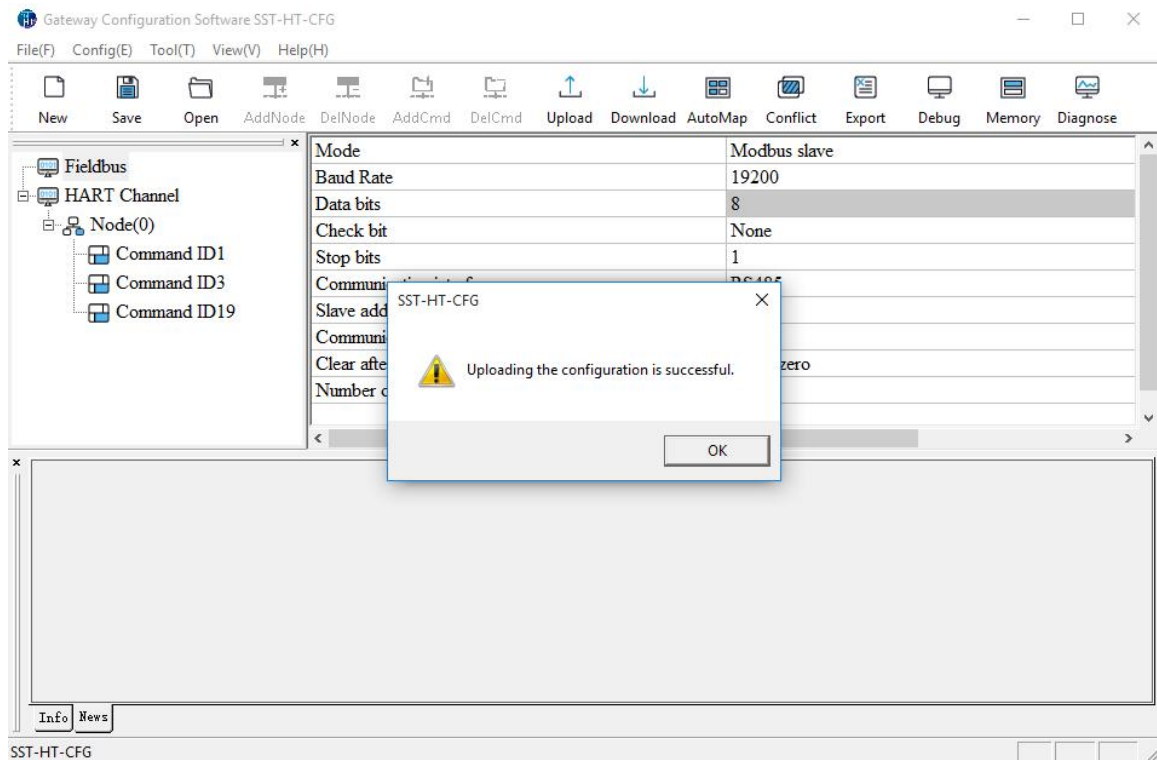


After clicking Upload data, it will show uploading succeeded:

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6 Working Principle

Inside the gateway it opens up a length of 5000 bytes of memory as the data exchange of input and output buffers. Memory of 0 to 2999 acts as the storage area of the HART HART input data and device status. Memory of 3000 to 4999 acts as storage area of the HART HART output data and control variables. The specific assignment shown in the table below:

	Gateway memory address	Corresponding Modbus register address	Description
Read-only part	0-1599	0-799	The HART data input area
	1600-1619	800-809	Device 0_cmd0 data
	1620-1639	810-819	Device 1_cmd0 data
			Device 15_cmd0 data
	1920	960H	Gateway status
	1921	960L	Send times of Gateway's HART port
	1922	961H	Receive times of Gateway's HART port
	1923	961L	HART communication error times
	1924-1943	962-971	Reserved
	1944	972H	Device 0_cmd0's response status
	1945	972L	Device 1_cmd0's response status
			Device15 _cmd0's response status
	1960-2119	980-1059	The response status of the user command
	2120-2391	1060-1195	Reserved
	2392	1196H	Universal receive label
	2393	1196L	Universal receive Error Counter
	2394-2395	1197	Universal receive data length
	2396-2695	1198-1347	Universal receive data
	2696-2999		Reserved
Readable and writable part	3000-3999	0000-0499	The HART data output area
	4000	0500H	Reset to send, receive, error counter
	4001	0500L	Polling enabled

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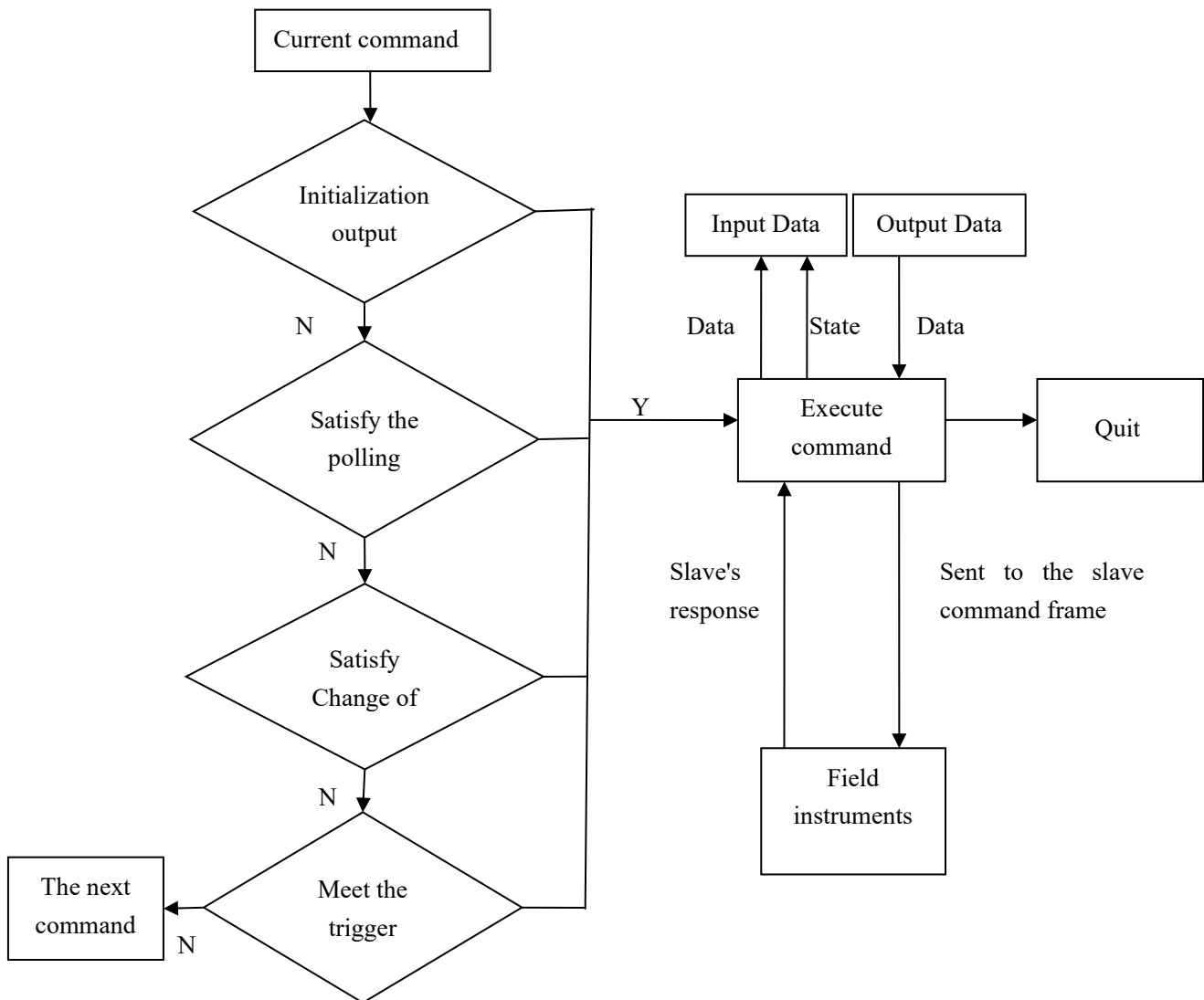
	4002	0501H	Trigger label
	4003	0501L	Trigger command number
	4004-4269	0502-0634	Reserved
	4270	0635H	Universal send label
	4271	0635L	Universal mode enabled
	4272-4273	0636	Universal send data length
	4274-4573	0637-0786	Universal to send data

- The HART data input area: Store the data that HART slave device sends to gateway.
- The HART data output area: Store the data that the gateway sends to the HART slave device.
- Device 0_cmd0~ Device 15_cmd0: When operating a slave command for the first time, the gateway internal will automatically execute the No. 0 command to obtain the device information (to obtain the long address). The response data of this internal command is stored in this area.
- Gateway status: The gateway status indicates what the gateway state is in the HART network, defined as:
 - 0---- No HART communication
 - 1----sending
 - 2---- Waiting for a response
 - 3---- Handling a response
- Send times of HART port on gateway: The HART send counter.
- Receive times of HART port on gateway: The HART receive counter.
- HART communication error times: The HART Receive error counter.
- The response status of Device 0_cmd0~ Device 15_cmd0: Show that the response status of the internal command.
- The response status of user command: Show that the response status of the user command.
 - Command state is defined:
 - 0---- Not executed
 - 1---- Correct response
 - 2---- Parity error
 - 3---- No answer
 - 4---- Error defined in agreement
 - 5---- Not connected
- Universal Receive label: The receive label under the universal mode, this value which changes one time

indicates that HART end receives a HART frame.

- Universal receive data length: Indicating the received data length under the universal mode.
- Universal Receive Error Counter: Indicate the universal receive error number.
- Universal receive data: Store the received data at HART side under the universal mode.
- Reset send, receive, error counter: The gateway's control signal, when the value of memory changes, gateway causes all the counter to 0.
- Polling is enabled: This bit is readable and writable, writing 1 enables the polling output, writing 0 disables polling output. Reading 1 indicates that the polling state is enabled, 0 indicates that the polling is in the disabled state.
- Trigger label: Change the value will result in a trigger operation.
- Trigger command number: Command number executed by trigger operation.
- Universal mode enabled: The value of 1 indicates a universal transfer function is enabled, otherwise disables universal transport function.
- Universal send label: The send label under the universal mode, this value changes in time will lead to send a HART frame.
- The universal send data length: The length of send data under the universal mode.
- Universal to send data: Data needs to send under the universal mode.

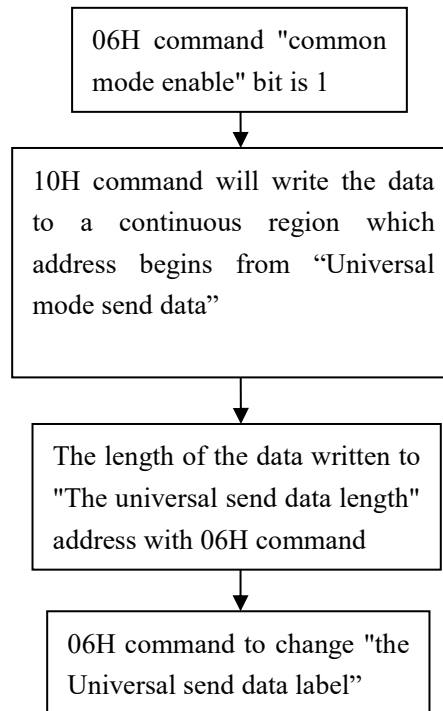
6.1 Flow chart of Executing One HART Command



6.2 Universal Send and Receive Data

There are two universal ways for user to select: One is that fieldbus is defined as universal mode. The gateway will receive the serial data in the way of 3.5 character timeout broken frame and send out the data unmodified from the HART interface. Gateway sends data out from serial which is received from HART interface without modification. The character timeout is determined by baud rate, such as 19200, Character timeout is considered to be $(1/19200) * 10 * 3.5 \approx 2\text{ms}$. The other is to start transmit-receive of HART common frame of HART indirectly

through Modbus command, here is an example:



The gateway will store the received HART frame in a continuous region within "the Universal receive data" as a starting address and write the length of the received data in the "Universal received data length". Then change the value of the Universal receive label". If no data is received within the response waiting time, the gateway will order "universal receive error counter" to plus 1. Before sending the general frame, user should read the universal receive label and the error counter. After transmitting the general frame, it needs to read these two values continuously until one of them changes.

6.3 Trigger Command

Users can use Modbus command to trigger any HART command which is configured by gateway. The specific approach is: using command ID6 of Modbus to write the user command number which needs to be triggered (when SST-HT-CFG configures commands, the software will automatically calculate and display) to the "trigger command number". Then rewriting "the trigger label" can trigger the value to change and trigger the gateway to finish a trigger operation. Parts of response data in the device will be stored to "the receive data memory" which specified by this command number.



6.4 Data Exchange with Modbus

When fieldbus is configured as "Modbus slave", user can exchange data, inquire about the status of gateway and manage according to the corresponding address of gateway in the internal input and output buffer. Also you can do some trigger operation and transmission of common frame.

7 Modbus Master Communication

GT200-HT-RS Gateway provides a solution for HART instruments to communicate with Modbus master through RS-485 or RS-232 interface, the gateway acts as slave, the following example illustrates how the gateway communicates with Modbus Poll (Modbus RTU/ASCII master emulation software).

1. Configure point-to-point mode (HART address is 0) with HART Commands ID1, ID3 and ID6. The common HART command format can be found in Appendix B, and the configuration is as follows:

- (1) When configuring HART Command ID1, the response is 2 bytes more than the actual one (command state) because HART Command ID1 is without request. In the command state, byte 0 (primary variable unit) and the primary variable are 7 bytes in total, and after mapping to 4 Modbus register addresses, there will be 1 byte extra, resulting in the last 3 bytes of the primary variable being placed in the last 2 Modbus registers, and the actual primary variable value cannot be read. So it should be configured to advanced mode to extract the primary variable for direct acquisition.

Command ID1: Read primary variable (PV)

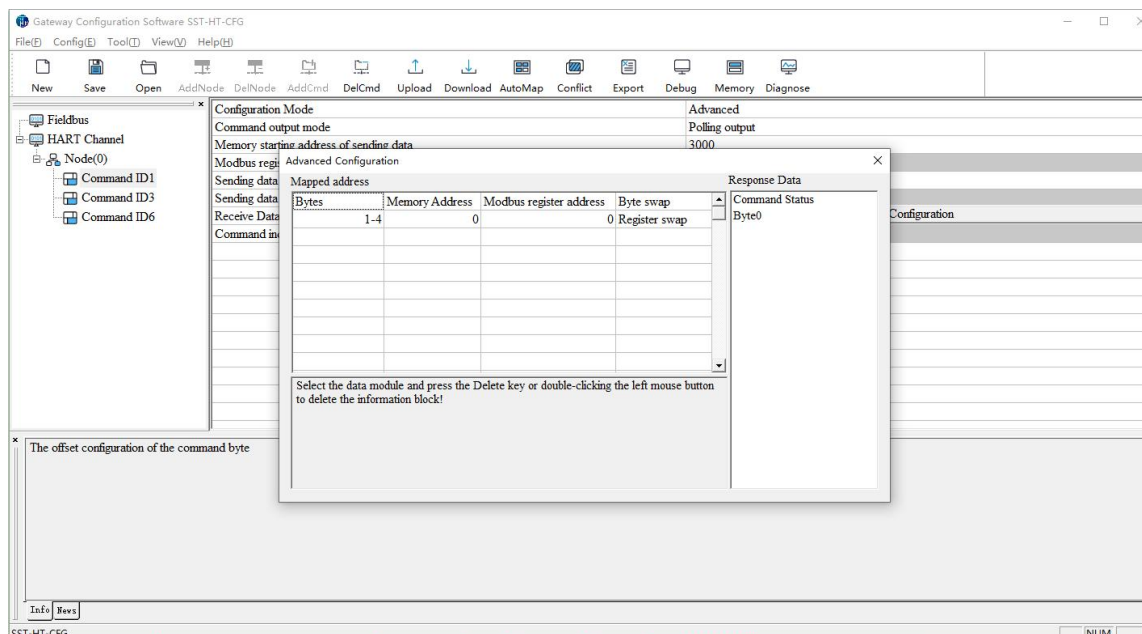
Returns the value of the primary variable as a floating-point type

Request: None

Response:

Byte	Description
Byte 0	Primary Variable Units
Byte 1-4	Primary Variable

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(2) When configuring HART command ID3, use the advanced function to configure the primary variable (PV), the secondary variable (SV), and the tertiary variable (TV).

Command ID3: Reads four (predefined) dynamic variables and the primary variable current

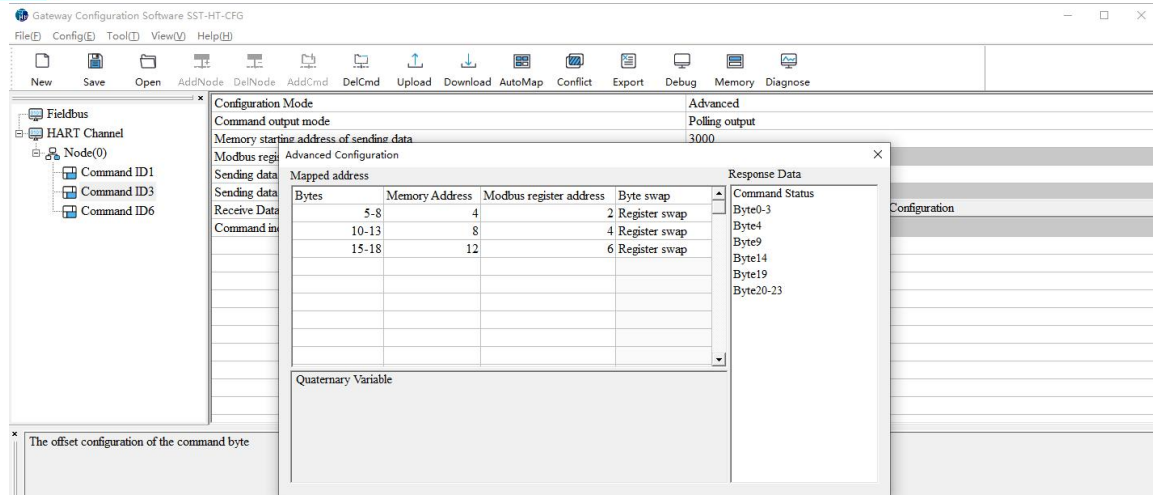
Reads the primary variable current and 4 (at most) pre-defined dynamic variables, the primary variable current always matches the device's AO output current. primary, secondary, tertiary and quaternary variables defined for each device type.

Request: None

Response:

Byte	Description
Byte 0-3	Primary Variable Loop Current (units of milli-amperes)
Byte 4	Primary Variable Units Code
Byte 5-8	Primary Variable
Byte 9	Secondary Variable Units Code
Byte 10-13	Secondary Variable
Byte 14	Tertiary Variable Units Code
Byte 15-18	Tertiary Variable
Byte 19	Quaternary Variable Units Code
Byte 20-23	Quaternary Variable

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(3) The configuration of HART Command ID6 is used to modify the address of the HART device.

Command ID6: Write POLLING address

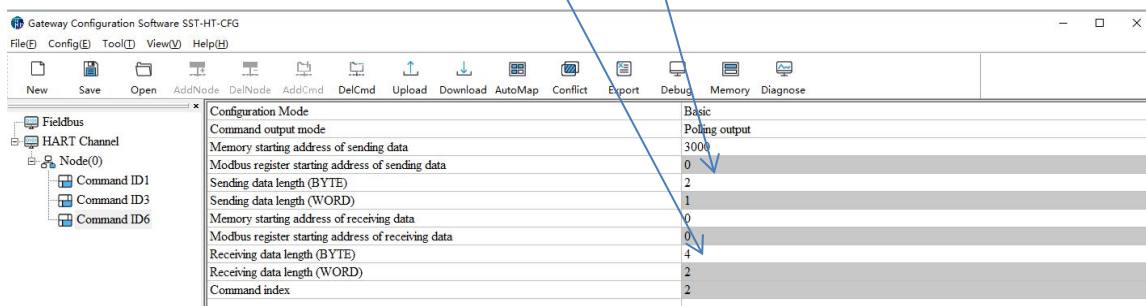
This is the data link layer management command. This command writes the Polling address and loop current mode to the field device.

Request:

Bytes	Description
Byte 0	Polling Address (Between 0-15)
Byte 1 (Only on supported HART devices)	Loop Current Mode (0=Disabled, 1=Enabled)

Response:

Bytes	Description
Byte 0	Polling Address (Between 0-15)
Byte 1 (Only on supported HART devices)	Loop Current Mode (0=Disabled, 1=Enabled)



2. Click **Conflict**, through **AutoMap**, to view the mapping address of the command in the gateway buffer. The

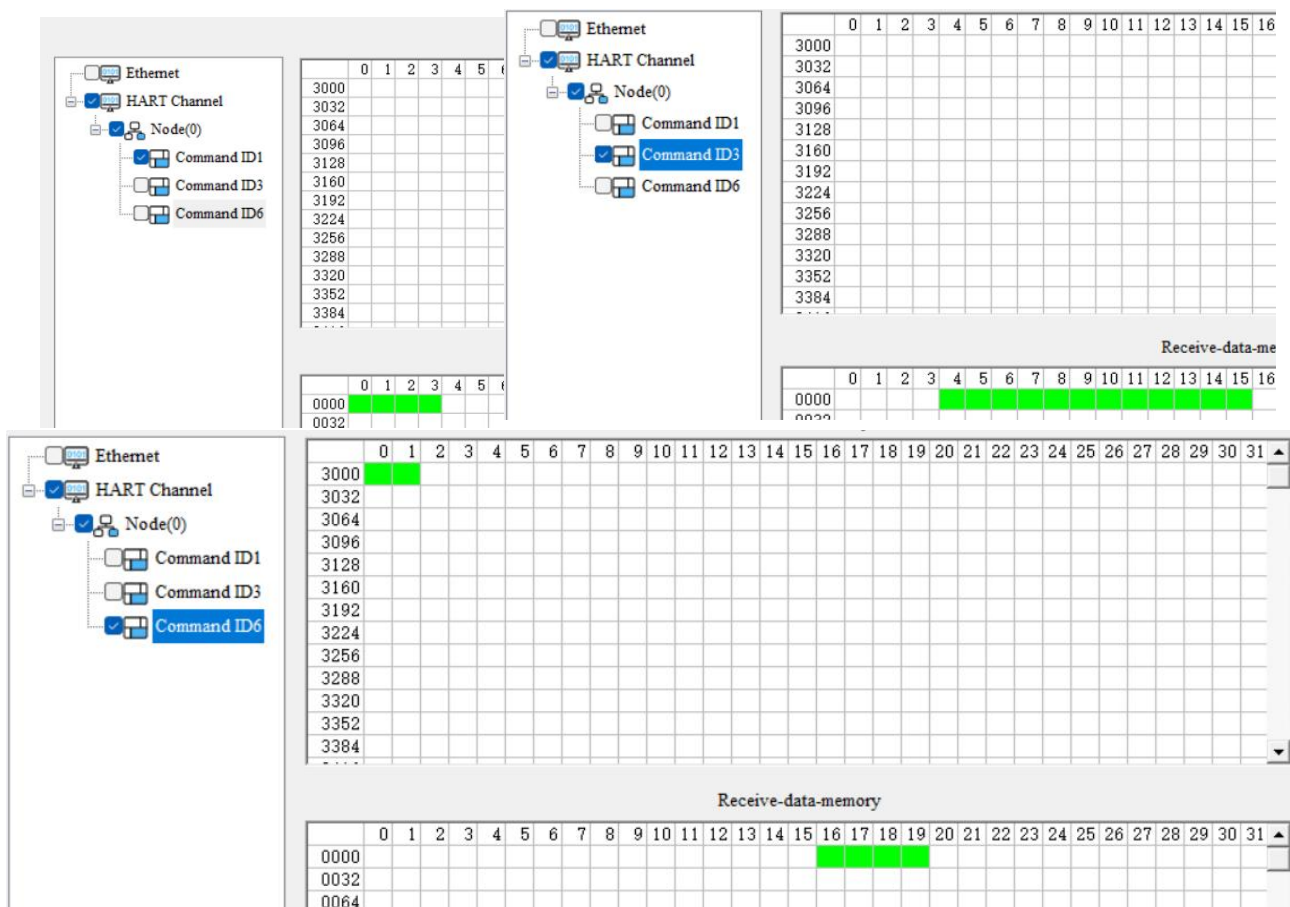
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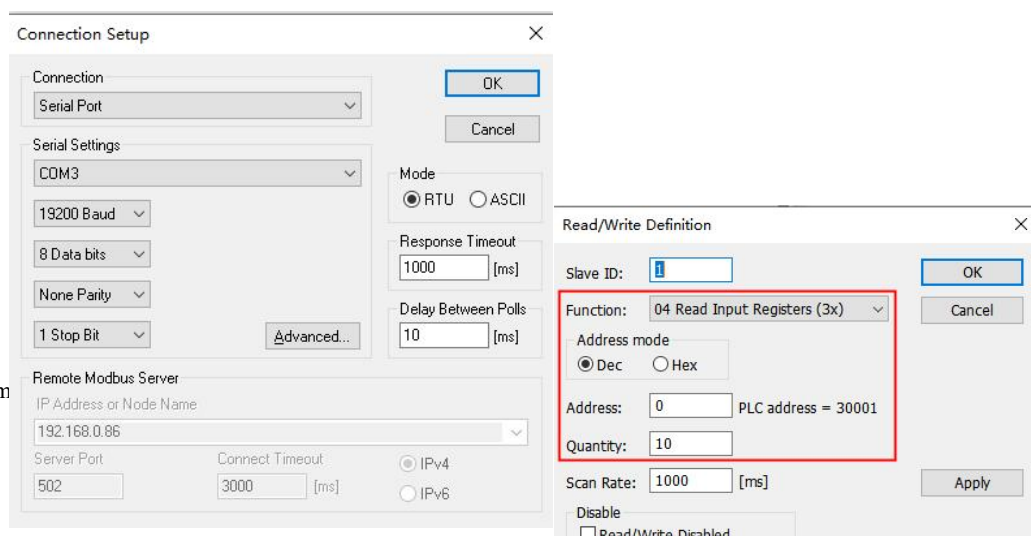
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primary variable of HART Command ID1 corresponds to gateway input buffer 0-3, Command ID3 corresponds to 4-15, Command ID6 request corresponds to output buffer 3000-3001, and response corresponds to 16-19. as follows:

Modbus RTU/ASCII Master uses 04 function code, using 3x0001-3x0002 corresponding to the primary variable of HART Command ID1, 3x0003-3x0008 corresponding to the primary variable of HART Command ID3, the secondary and tertiary variables. 3x0009-3x0010 corresponds to the command status of HART Command ID6, the Polling address and loop current mode of the device with the 06/16 function code. The use of 4x0001 should correspond to the Polling address and loop current mode of the requested device of HART Command ID6.



3. Use Modbus Poll and the gateway to connect and read/write data with the following configuration:



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4. Use Modbus POLL to read data (3x0001-3x0010) and write data via 4x0001. The data in the gateway buffer



can be viewed in **Memory**) and the actual floating-point data of the HART device can be viewed via



Gateway Configuration Software SST-HT-CFG

File(E) Config(E) Tool(T) View(V) Help(H)

New Save Open AddNode DelNode AddCmd DelCmd Upload Download AutoMap Conflict Export Debug Memory Diagnose

Fieldbus

- HART Channel
 - Node(0)
 - Command ID1
 - Command ID3
 - Command ID6

Mode

Modbus slave

Baud Rate 19200

Data bits 8

Check bit None

Stop bits 1

Communication interface RS485

Slave address 1

Communication mode RTU

Clear after Timeout Keep

Number of retries before taking timeout action 3

Memory data

Input data

Addr	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
0000	BF	D8	44	69	33	33	40	73	20	BF	D8	44	69	20	00	00
0010	41	C0	00	00	00	00	00	00	00	00	00	00	00	00	00	00
0032	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
0040	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
0064	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00

Output data

Addr	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
3000	01	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
3010	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
3032	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
3040	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
3064	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00

Modbus Poll - Mbpoll2

File Edit Connection Setup Functions Display View Window Help

Mbpoll1

Tx = 44: Err = 0: ID = 1: F = 04: SR =

Alias	Value
0	0x0000
1	0xBFD8
2	0x4469
3	0x3333
4	0x4073
5	0x20BF
6	0xD844
7	0x6920
8	0x0000
9	0x41C0
10	0x0000

Mbpoll2

Tx = 30: Err = 0: ID = 1: F = 03: SR =

Alias	Value
0	0x0000
1	0x0100
2	0x0000
3	0x0000
4	0x0000
5	0x0000
6	0x0000
7	0x0000
8	0x0000
9	0x0000
10	0x0000

Mbpoll1

Tx = 76: Err = 0: ID = 1: F = 04: SR =

Alias	Value
0	0x0000
1	934.998

Item

Primary Variable

Value

935.002869

GT200-HT-RS

HART / Modbus Serial Gateway

User Manual

Command IO data

Item	Value
Primary Variable Current	3.800000
Primary Variable Units Code	(null)
Primary Variable	934.997009
Secondary Variable Units	(null)
Secondary Variable	24.000000
Tertiary Variable Units Code	(null)
Tertiary Variable	0.000000
4th Variable Units Code	(null)
4th Variable	0.000000

2	3.8
3	--
4	934.996
5	--
6	24
7	--
8	0
9	--