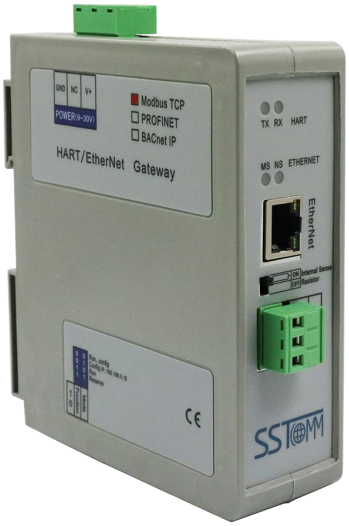
HART / Modbus TCP Gateway
GT200-HT-MT

User Manual

V 1.2

Rev G



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-MT is a gateway that can provide a seamless connection between HART instruments and a Modbus TCP network. It can connect HART slave devices to a Modbus TCP network and realize bi-directional data exchange easily. The HART interface can be configured as a primary master or a secondary master. It acts as a server at the Modbus TCP side.

1.2 Product Features

- Easy to use: The GT200-HT-MT can achieve seamless data communication following simple steps. Users only need to refer to the product manual and application instances and can realize data communication of a gateway in a short time according to the requirements of the configuration.
- Powerful functionality: Support fast acquisition of the HART slave address and modification, single-point mode of coexistence of HART communication and 4~20mA data acquisition, HART side supports the primary master and the secondary master.
- Easy-to-use configuration software: The GT200-HT-MT can be configured by SST-HE-CFG software easily.
- Multi debugging functions: The configuration software SST-HE-CFG can provide a visual display of data exchange as well as HART command diagnostics and communication debugging functions that greatly facilitate user communication tests.

1.3 Technical Specifications

[1] The HART interface can be configured as a primary master or the secondary master.

[2] The HART interface supports point-to-point mode and multi-drop mode.

[3] Supports one HART channel.

- In point-to-point mode, the GT200-HT-MT supports burst communication.

- In multi-drop mode, up to 13 HART instruments can be connected with an internal series resistor (270Ohm/2W), and up to 15 HART instruments with an external series resistor (250Ohm/3W).

[4] Supports all commands of the HART 6 protocol.

[5] Each HART command can be configured to different outputting mode: change-of-state output, polling output, initialization output or disable output.

[6] Supports up to 100 HART commands. Max output data: 2000 bytes, max input data: 3000 bytes.

[7] Ethernet 10/100M adaptive routing. Supports IP address conflict detection and automatic routing functions.

[8] Supports connection with up to 36 Modbus TCP clients and 512 requests simultaneously.

[9] The Ethernet interface can be configured as a Modbus TCP server, supporting function codes:03H, 04H, 06H, 10H.

[10] Power supply: 24VDC (11V~30V), <100mA (24VDC).

[11] Working temperature: -4°F~140°F(-20°C~60°C). Rel Humidity: 5%~ 95% (non-condensing).

[12] Dimensions(W*H*D): 1.6 in*5.0 in*4.4 in (40mm*125mm*110mm).

[13] Installation: 1.38 in (35mm) DIN RAIL.

[14] Protection Level: IP20.

1.4 Related Products

Related products include:

- GT200-HT-RS
- GT200-3HT-RS
- GT200-3HT-MT
- GT200-HT-EI
- GT200-HT-DP
- GT200-MT-2RS
- GT200-MT-2RS485

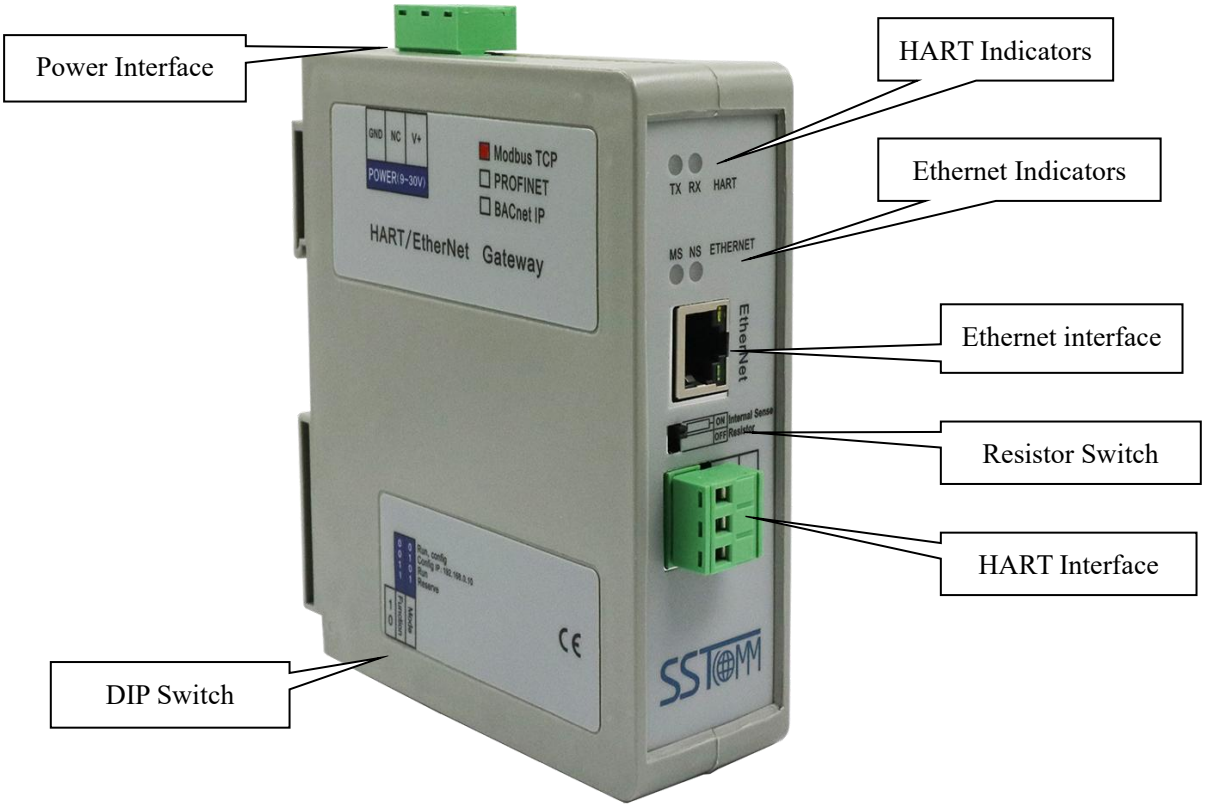
If you want to get more information about related products, please visit SSTCOMM website: www.sstautomation.com.

1.5 Revision History

Revision	Date	Chapter	Description
V1.2, Rev A	02/11/2017	ALL	Add description for chapter 4.2.7, 4.2.8.
V1.2, Rev B	11/16/2020	ALL	
V1.2, Rev C	12/25/2020	Chapter 5	
V1.2, Rev D	7/23/2021	Chapter 4, 6	New chapter 4.2. Address table revised.
V1.2, Rev E	07/01/2022	Chapter 5.2.2.3	Add HART Common Commands (ID 1 and ID 3) to this section
V1.2, Rev F	08/12/2022	Chapter 1.1, 1.2, 1.3, 1.4, 2.3.1, 2.3.2, 2.5, 2.5.1, 4.1.1, 4.1.2, 4.2, 5.1, 5.2.1, 5.2.2.1, 5.2.2.2, 5.2.2.3, 5.2.2.4, 5.2.2.5, 5.2.2.6, 5.2.2.7, 5.2.3, 5.2.4, 5.2.5, 5.2.7, 5.2.8, 5.2.9, 6.1	Revised some mistakes. Corrected figure in chapter 2.3.2. Added two wire and four wire multi-drop wiring in chapter 2.5.1. Updated software configuration screenshot.
V1.2, Rev G	09/16/2022	Chapter 2.5.1, 2.5.2, 4.3, 4.4, 5.2.2.3	Added troubleshooting steps for multiple HART devices in chapter 4.3. Added list of HART commands in chapter 4.4 and moved content from chapter 5.2.2.3. Moved Multi-Drop Wiring to chapter 2.5.2 and added Point-to-Point Wiring in chapter 2.5.1.

2 Hardware Descriptions

2.1 Product Appearance



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

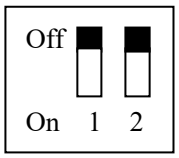
2.2 LED Indicators

LED	State	Description
TX	Flashing	HART channel is sending data
	OFF	No data sending
RX	Flashing	HART channel is receiving data
	OFF	No data is received
NS	OFF	Communication error in Modbus TCP network
	Flashing	Communication running
MS	Red	IP address conflicts
	Red, flashing	Connection is OFF / Configuration Mode / DHCP, BOOTP, IP address conflict detection
	Red, flashing (For 3 seconds)	Connection is OFF

2.3 Configuration Switch/Button

2.3.1 Configuration Switch

The configuration DIP switches are located at the bottom of the GT200-HT-MT and are used to set the operating mode of the device.



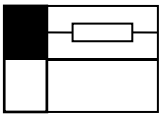
Mode (Bit 1)	Function (Bit 2)	Description
Off	Off	Running mode, configuration enable
Off	On	Running mode, configuration disable
On	Off	Configuration mode, IP is fixed at 192.168.0.10
On	On	Reserved

Note: To apply mode switching, restart the gateway.

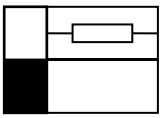
2.3.2 Resistor Switch

The GT200-HT-MT has an internal series (270Ohm/2W) resistor required for the HART channel. This supports up to 13 HART instruments to be connected.

When the power of the series resistor is more than 2W, you must use an external series resistor (250Ohm/3W), which allows the gateway to support up to 15 HART instruments to be connected.



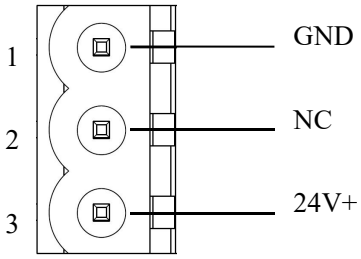
Switch to ON, using the internal series resistor



Switch to OFF, using the external series resistor

2.4 Interface

2.4.1 Power Interface



Pin	Description
1	Power ground
2	Not connected
3	+24V DC

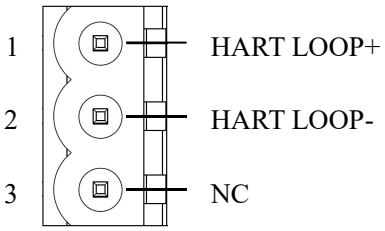
2.4.2 Ethernet Interface

The Ethernet interface uses RJ45 interface, follows the IEEE802.3u 100BASE-T standard, 10/100M adaptive routing. its pin (standard Ethernet signal) is defined as below:

RJ-45 port

Pin	Description
S1	TXD+, Transmit Data+, Output
S2	TXD-, Transmit Data-, Output
S3	RXD+, Receive Data+, Input
S4	Bi-directional Data+
S5	Bi-directional Data-
S6	RXD-, Receive Data-, Input
S7	Bi-directional Data+
S8	Bi-directional Data-

2.4.3 HART Interface



Signal	Description
HART LOOP+	Connected to HART signal+
HART LOOP-	Connected to HART signal-
NC	Not connected

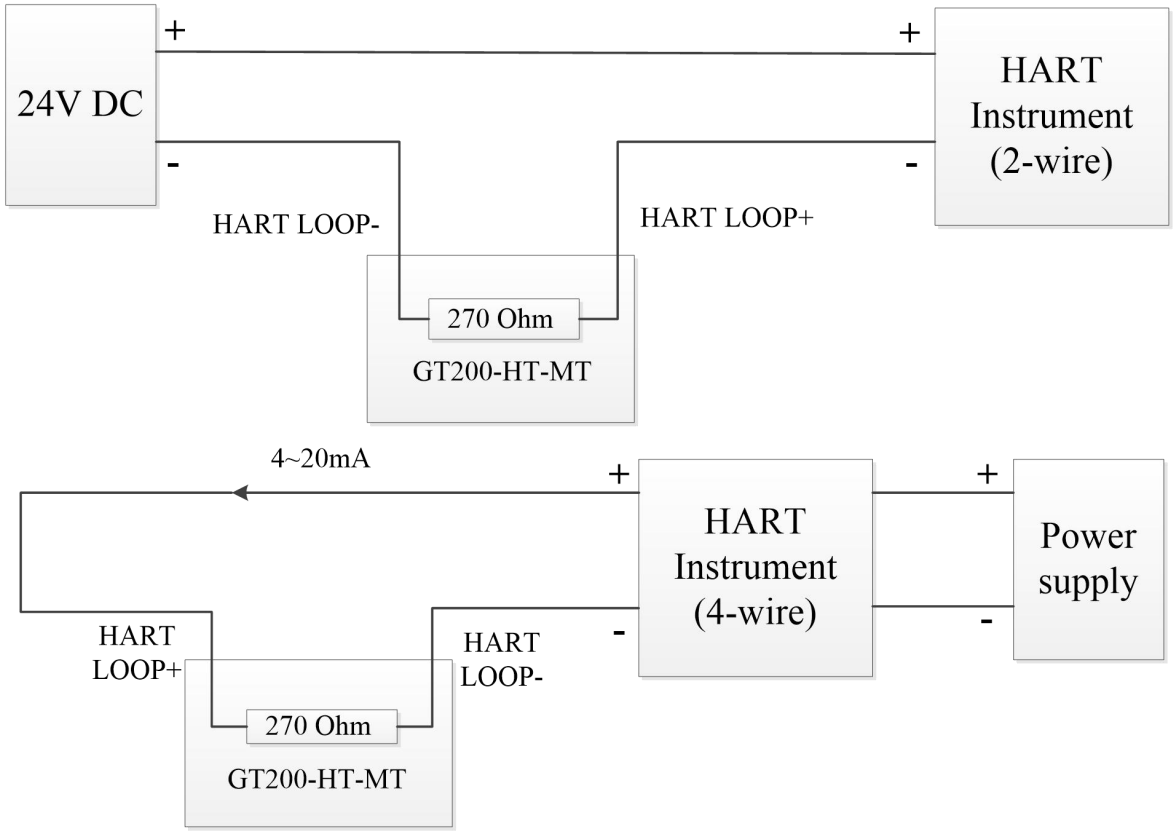
2.5 Topology of GT200-HT-MT and HART Instruments

Notes:

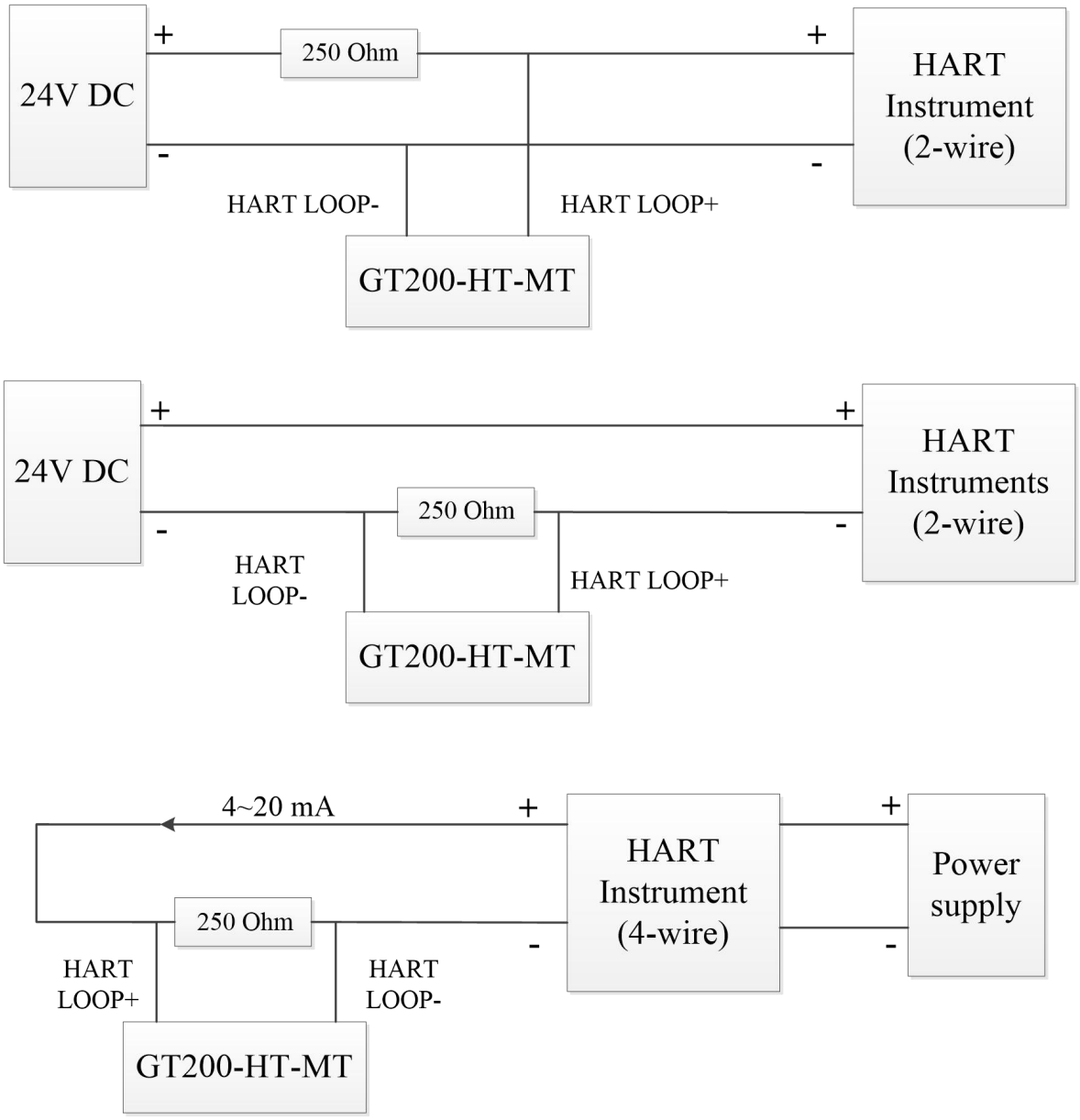
1. It is recommended to use a separate power supply for the HART instruments and the GT200-HT-MT to ensure stable communication.
2. To improve the communication efficiency of the field bus, it is recommended not to configure empty nodes or unnecessary commands in the SST-HE-CFG software.
3. If there are two or more HART instruments connected in the same network, their HART LOOP wires should be connected in parallel with each other.

2.5.1 Point-to-Point Wiring

The following are the topologies for two wire and four wire point-to-point wiring.



When using the internal resistor

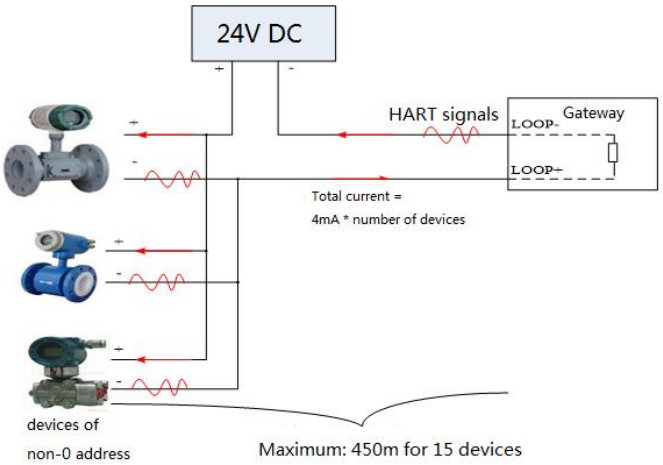


Options when using an external resistor

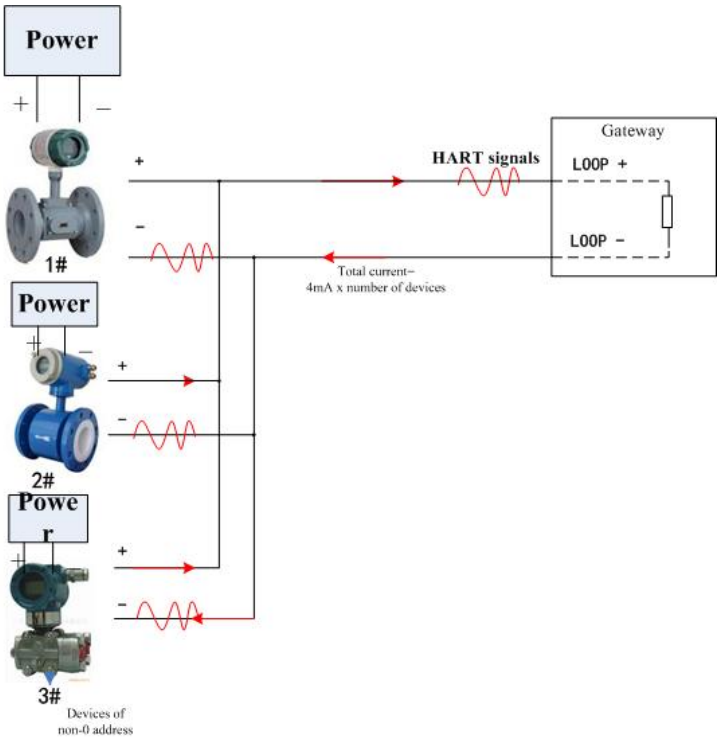
2.5.2 Multi-Drop Wiring

The following are the topologies for two wire and four wire multi-drop wiring.

Two wire:



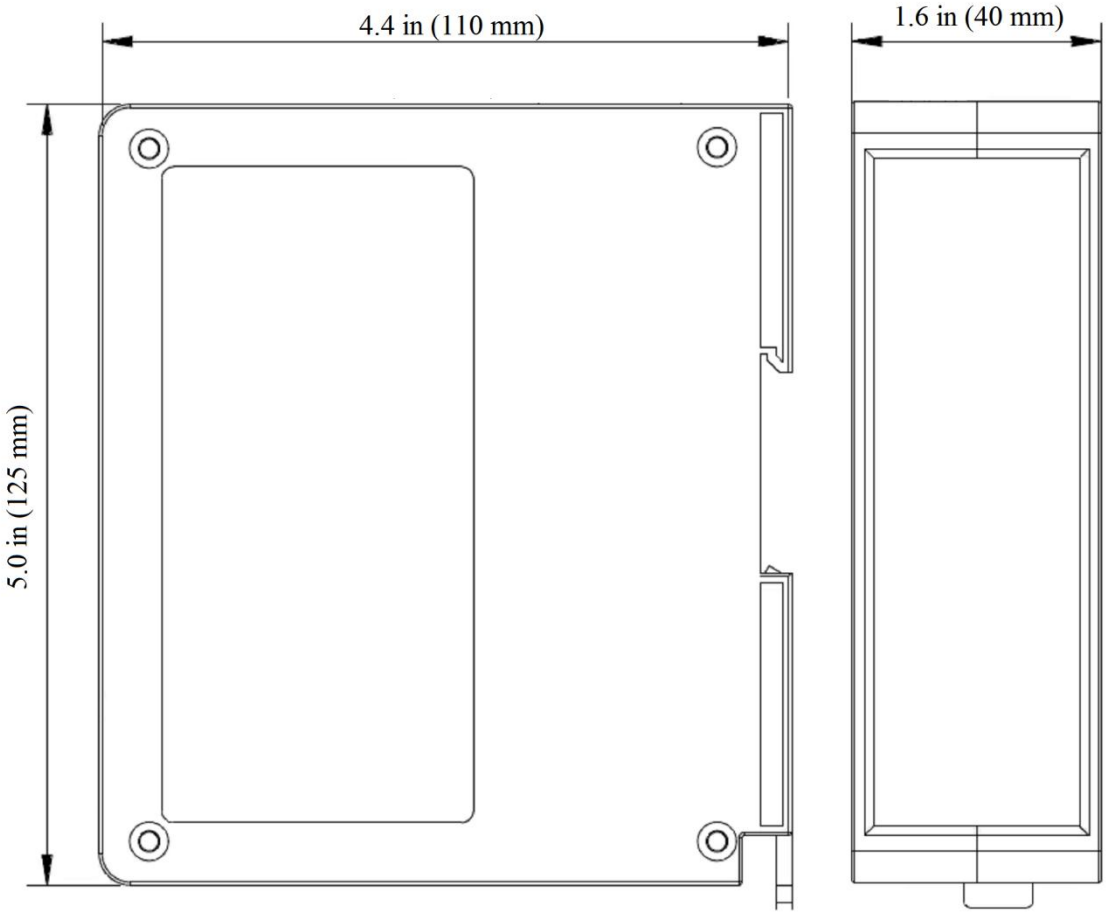
Four wire:



3 Hardware Installation

3.1 Mechanical Dimensions

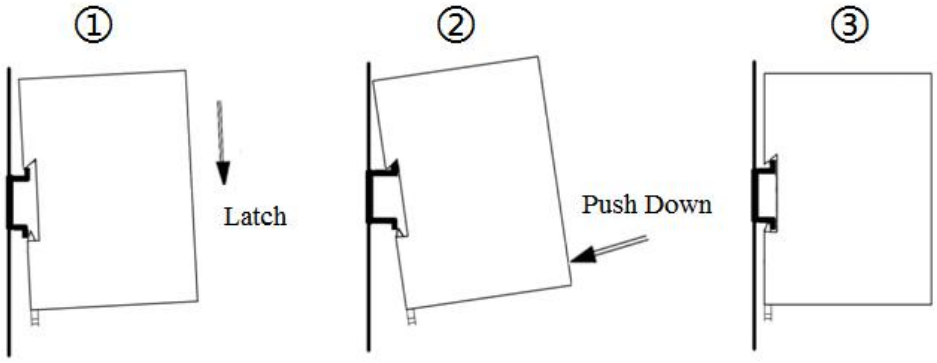
Size: 1.6 in (width) *5.0 in (height) *4.4 in (depth)



3.2 Mounting Method

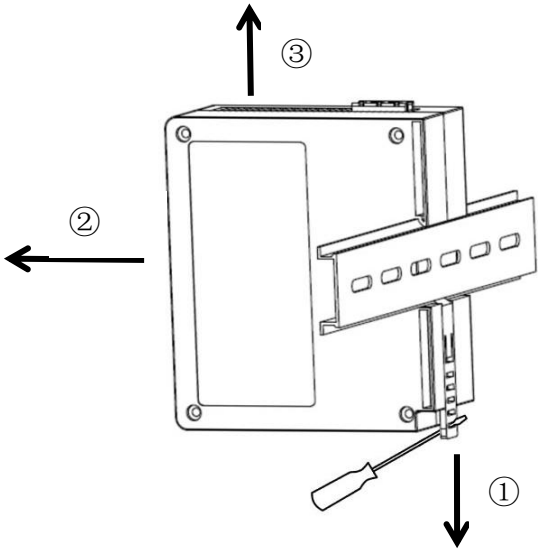
Using 1.38 in (35mm) DIN RAIL.

Install the gateway



Uninstall the gateway

1. Use a screwdriver to pass through the DIN RAIL bar, pull down and hold.
2. Pull out the gateway.
3. Lift up the gateway.



4 Quick Start Guide

4.1 Start

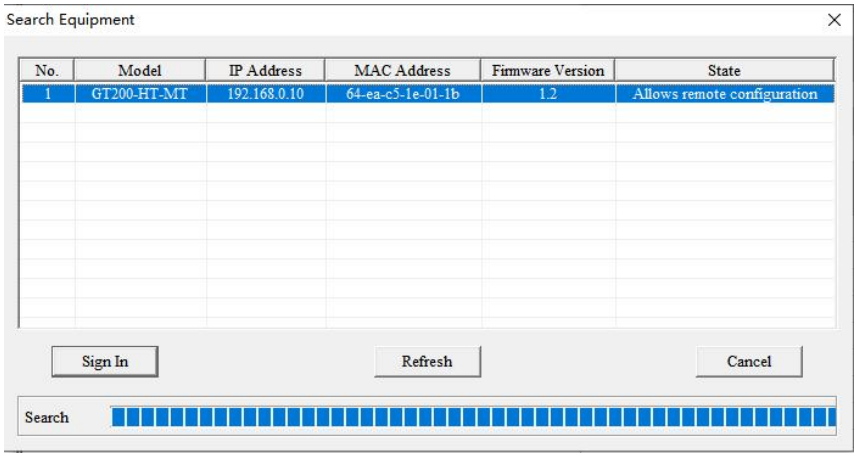
4.1.1 Connection

1. Make sure the GT200-HT-MT is in the appropriate operating mode that allows for configuration. It is recommended to set the gateway to configuration mode (configuration switches Bit 1 ON and Bit 2 OFF) then the IP of the gateway will be fixed at 192.168.0.10.
2. Connect the GT200-HT-MT to the computer by Ethernet cable.
3. Connect the HART instruments and the power supply. Refer to the topology displayed in chapter 2.5.
4. Power on the gateway and run the SST-HE-CFG software to start the configuration process.

4.1.2 Default Configuration

1. Open the SST-HE-CFG software installed on your computer.

2. Click “Upload” and “Sign In” to the gateway.



3. You will see the factory default configuration settings are shown below:

Mode	Modbus TCP
Assign IP Mode	Manually Assign
IP Address	192.168.0.10
Subnet Mask	255.255.255.0
Default Gateway	192.168.0.1
DNS1	0.0.0.0
DNS2	0.0.0.0

Note: There are already two commands and an IP Address preset into the device. You can edit these parameters for your needs.

Command ID1 is pre-configured to read the PV. (For your reference, the default configuration for this command is shown below.)

Configuration Mode	Basic
Mode of Outputting Commands	Polling
Memory Starting Address of Sending Data	3000
Modbus Register Starting Address of Sending Data	1500
Length of Sending Data (BYTE)	0
Length of Sending Data (WORD)	0
Memory Starting Address of Receiving Data	0
Modbus Register Starting Address of Receiving Data	0
Length of Receiving Data (BYTE)	7
Length of Receiving Data (WORD)	4
Command Index	0

Command ID3 is pre-configured to read the PV, SV, TV, and QV. (For your reference, the default configuration for this command is shown below.)

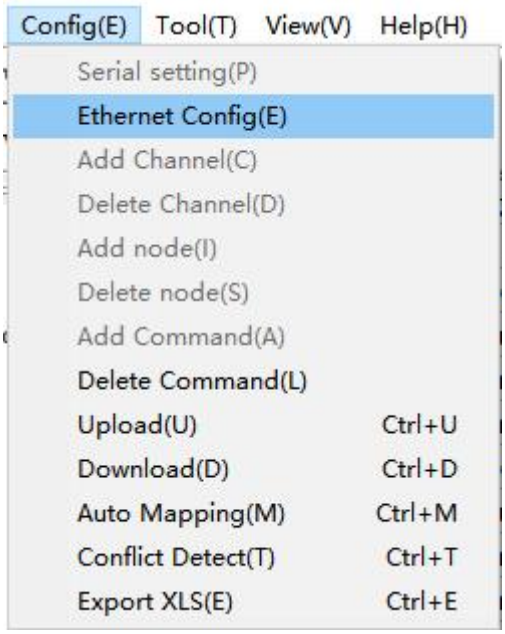
Configuration Mode	Basic
Mode of Outputting Commands	Polling
Memory Starting Address of Sending Data	3000
Modbus Register Starting Address of Sending Data	1500
Length of Sending Data (BYTE)	0
Length of Sending Data (WORD)	0
Memory Starting Address of Receiving Data	7
Modbus Register Starting Address of Receiving Data	3
Length of Receiving Data (BYTE)	26
Length of Receiving Data (WORD)	13
Command Index	1

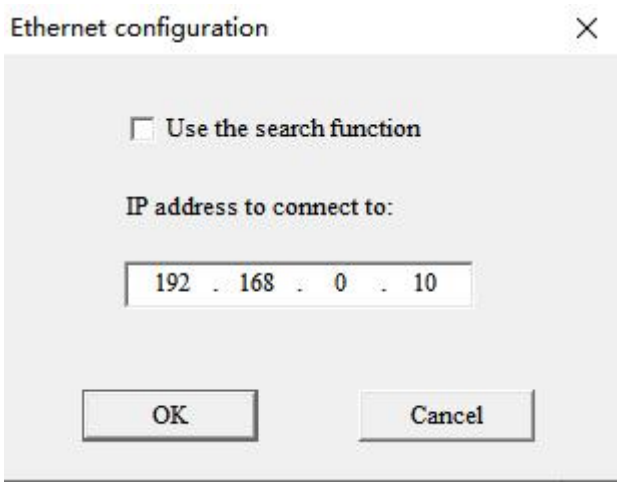
4.1.3 Configuration

1. Open the SST-HE-CFG software installed on your computer.

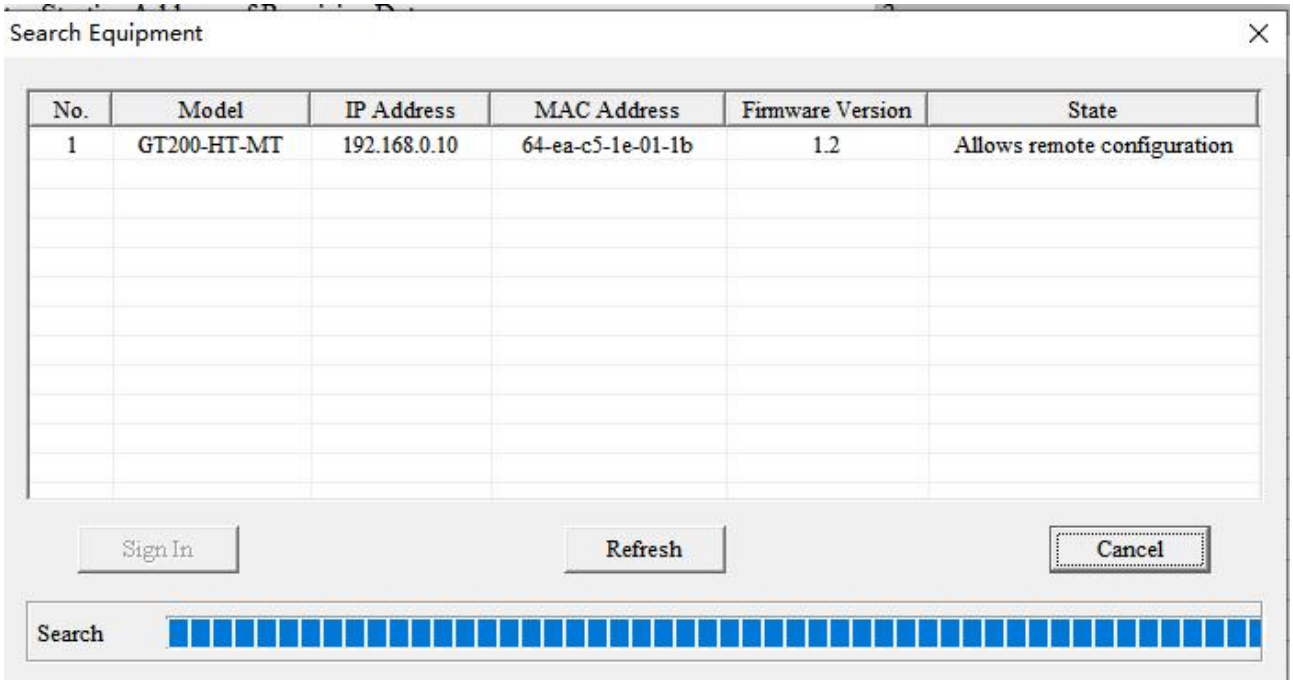
2. Click “Fieldbus” in the “Mode” item on the right and choose “Modbus TCP”.

3. Select “Ethernet Config” in “Config” menu.





4. Click “OK”. Select the gateway and sign in.



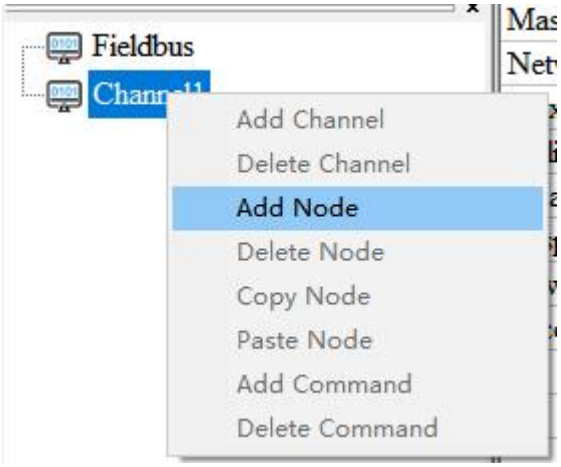
5. Select the “Fieldbus” on the left and configure the parameters as below:

Mode	Modbus TCP
Assign IP Mode	Manually Assign
IP Address	192.168.0.10
Subnet Mask	255.255.255.0
Default Gateway	192.168.0.1
DNS1	0.0.0.0
DNS2	0.0.0.0

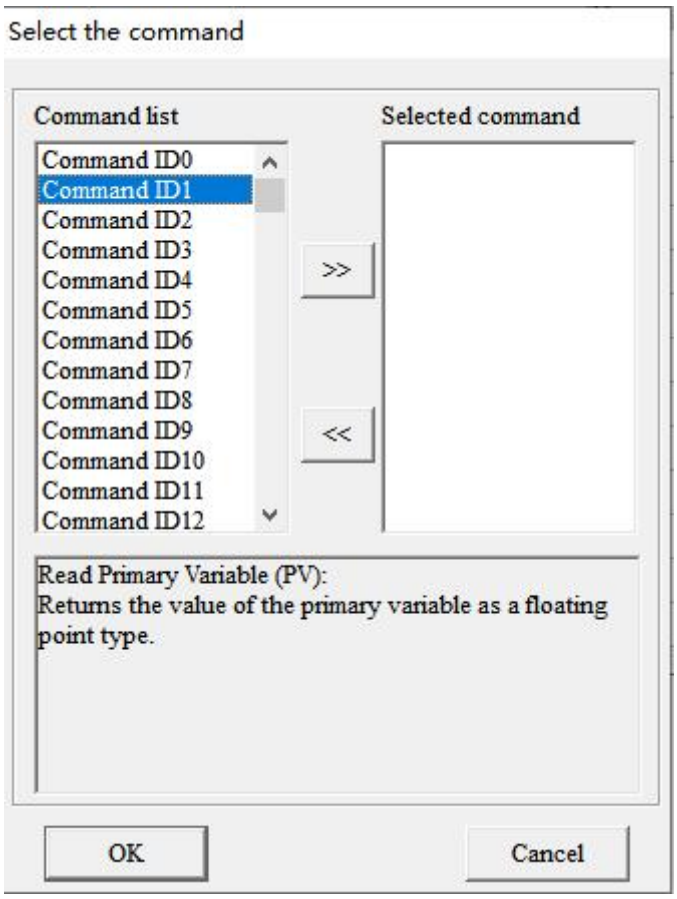
6. Click the HART channel on the left and configure the parameters as below:

Master Type	Primary Master
Network Mode	Point-to-Point
Maximum Repetitions	3
Polling	Enable
Delay Between Polls	256
Response Timeout	256
How to Action after N Successive Response Timeout	Hold
Successive Response Timeout for N Times	3

7. Right click the channel, select “Add Node”.



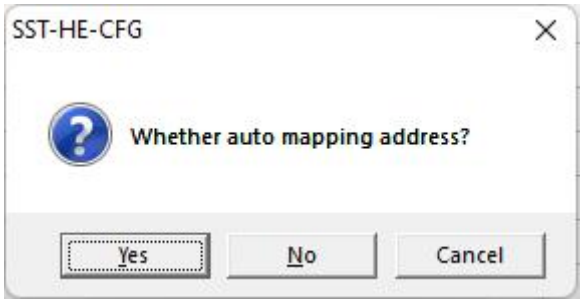
8. Right click on “Node(0)” and select “Add Command” and add Command ID1 box (double click on “Command ID1” or select “Command ID1” and click “»”). Click OK.



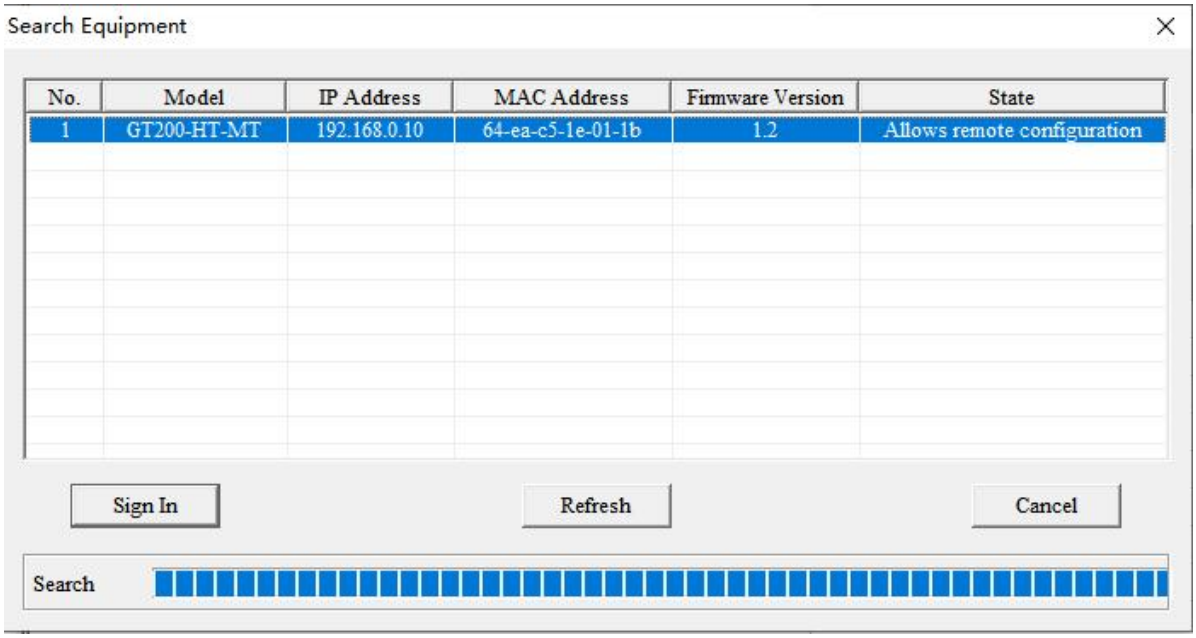
9. Click “Command ID1” and configure the parameters as below:

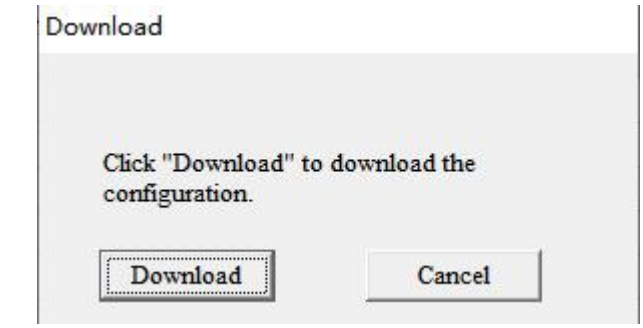
Configuration Mode	Basic
Mode of Outputting Commands	Polling
Memory Starting Address of Sending Data	3000
Modbus Register Starting Address of Sending Data	1500
Length of Sending Data (BYTE)	0
Length of Sending Data (WORD)	0
Memory Starting Address of Receiving Data	0
Modbus Register Starting Address of Receiving Data	0
Length of Receiving Data (BYTE)	7
Length of Receiving Data (WORD)	4
Command Index	0

10. Click the AutoMap icon



11. Click the Download icon



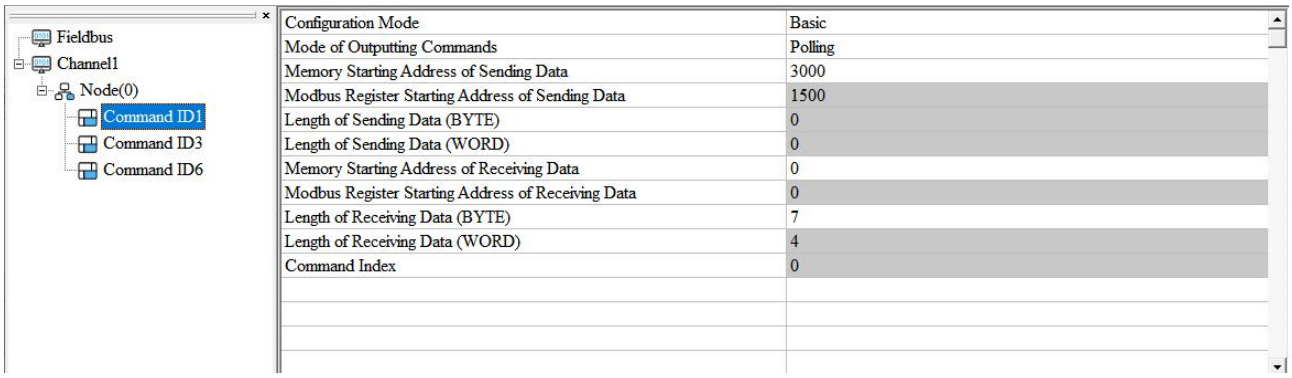


4.2 Communication with Modbus TCP Client

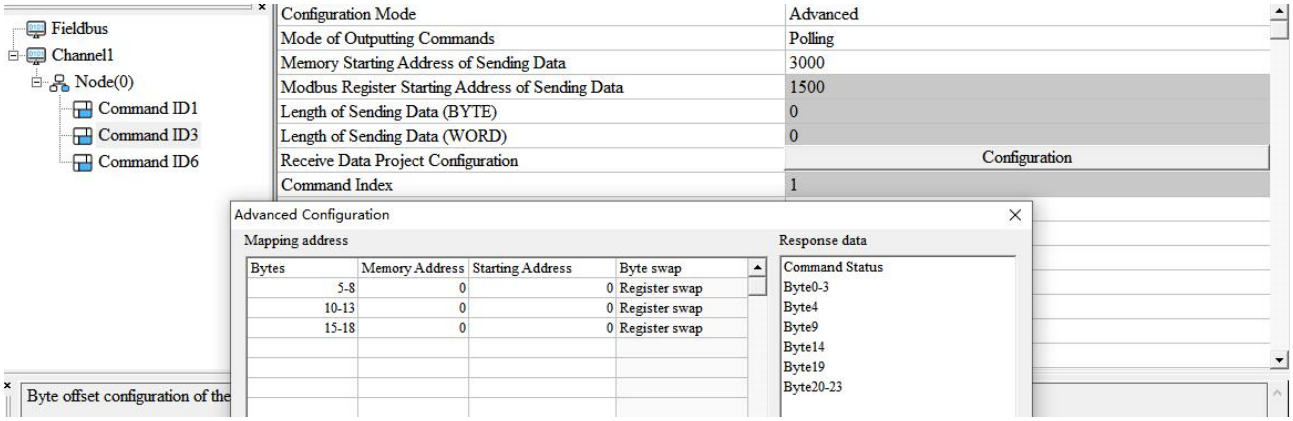
The GT200-HT-MT is able to connect HART instruments to Modbus TCP network as a Modbus TCP server. The following example shows how the GT200-HT-MT communicates with Modbus Poll (a Modbus simulator software).

1. Configure the GT200-HT-MT with some HART nodes and commands. In this example, the GT200-HT-MT is configured with HART commands 1, 3 and 6 for one node.

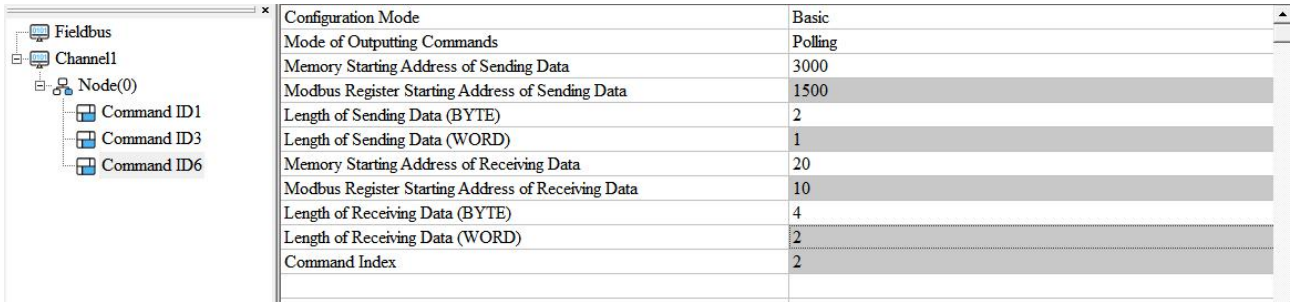
   (1) Command 1: All the response data bytes can be read by the Modbus TCP client.



(2) Command 3: Advanced configuration mode. Double click any values to filter them out. Update the configuration to read only bytes No.5-8, 10-13 and 15-18. The others can be filtered out. The remaining bytes are the secondary, tertiary and quaternary variables.

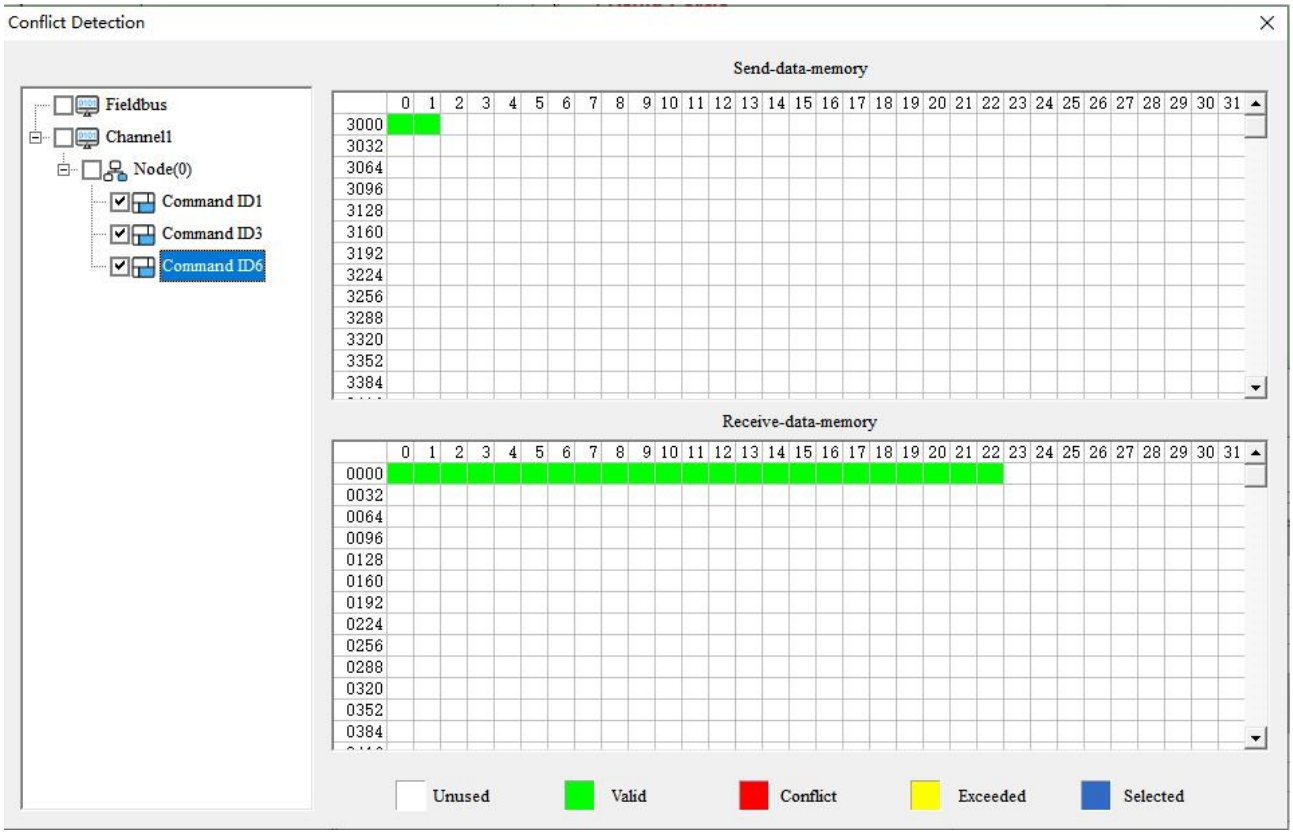


(3) Command 6: 2-byte request and 2-byte response. The response data length includes the command status bytes.

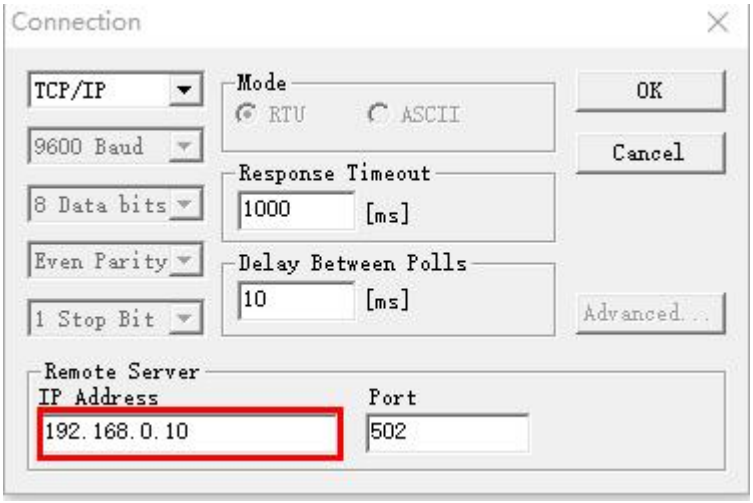


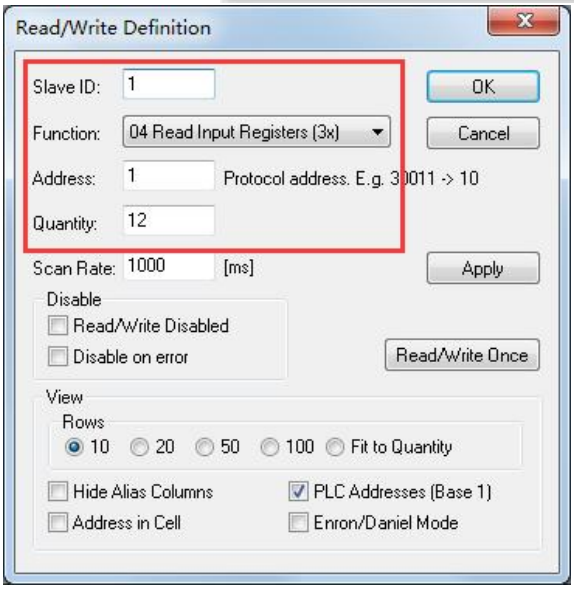
2. After mapping the data, check the buffer address in Conflict Detection window. The request data bytes of command 6 are stored in 3000~3001 bytes. The response data bytes of command 1 are stored in 0~6 bytes, command 3 in 7~18bytes and command 6 in 19~22 bytes.

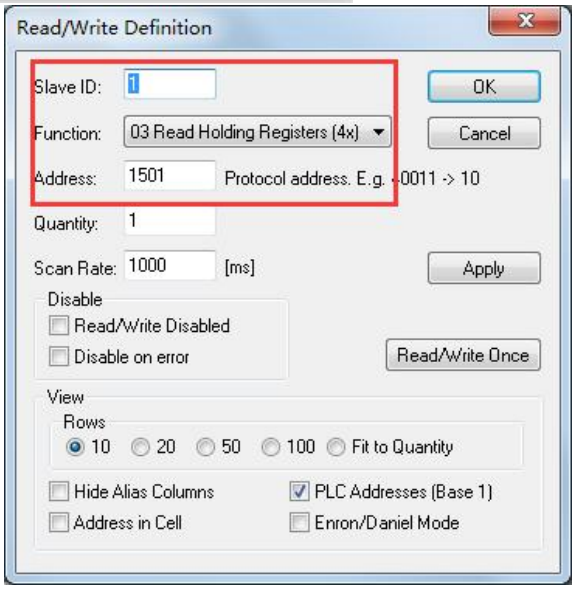
   According to the address table in chapter 6.1, Modbus TCP client should read/write the 4x1501 holding register by function code 03 / 06 or 16, and read the 3x0001 to 3x0004 input registers by function code 04. For Command 3 and 6, it's 3x0005 to 3x0010 and 3x0011 to 3x0012.



This example uses Modbus Poll on the computer to simulate the Modbus TCP client. Set the correct server IP and read/write parameters.

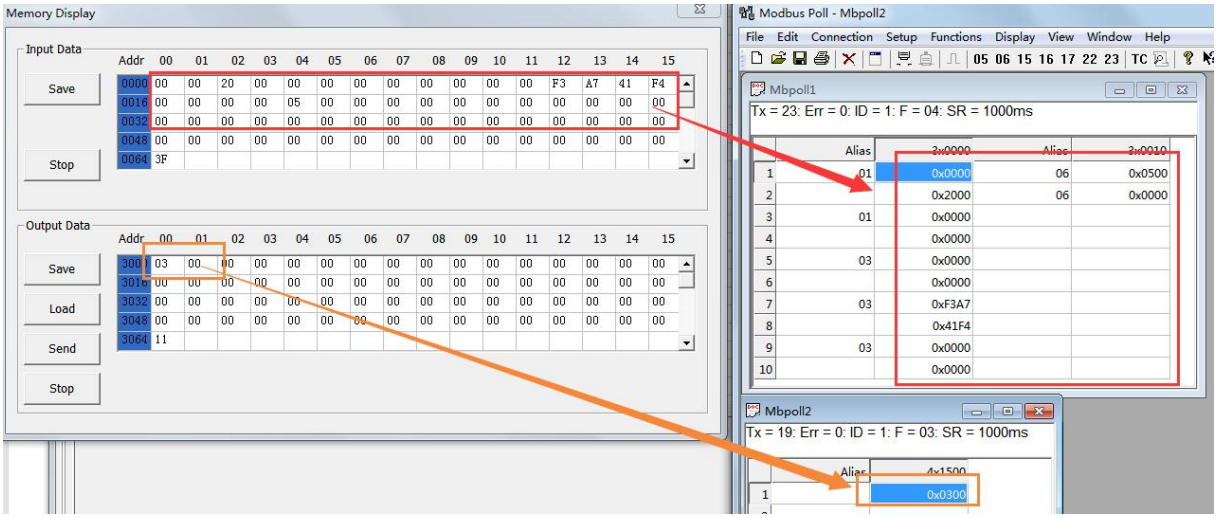




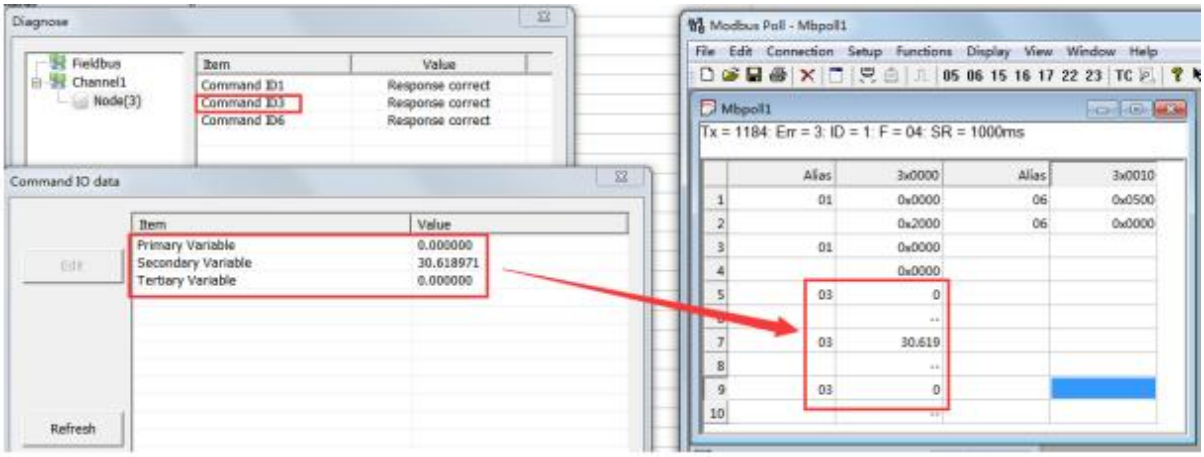


3. You can use the advanced function Memory Data Display (see chapter 5.2.7) or Diagnose (see chapter 5.2.8) to monitor the HART communication.

(1) Memory Data Display



(2) Diagnose: According to the specifications of HART command, you can convert the hexadecimal data to float number.



4.3 Troubleshooting Multiple HART Devices

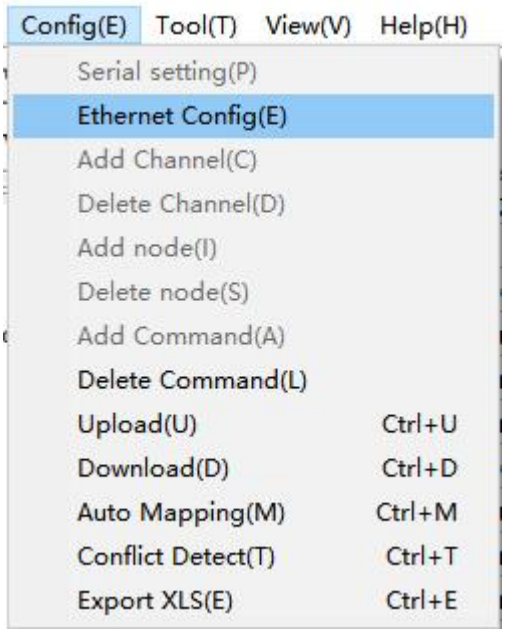
The GT200-HT-MT can receive data from up to 15 HART devices connected on the same bus. The following example shows how to configure the GT200-HT-MT in multi-drop mode to receive data from multiple HART nodes.

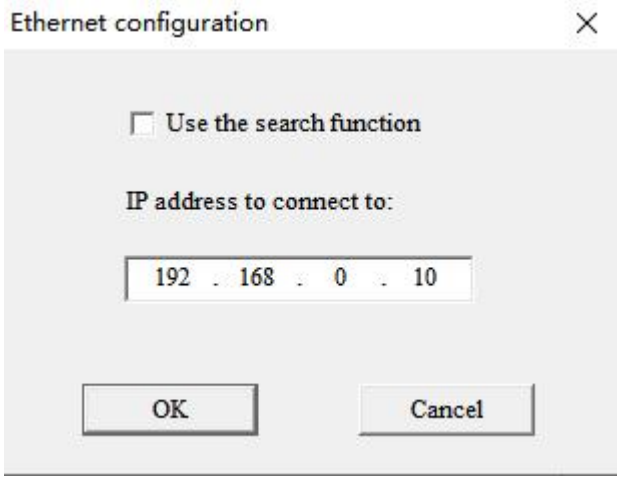
4.3.1 Identifying HART Slave Addresses

Each HART device can have an assigned slave address between 0-15. If the address of a HART device is unknown, the SST-HE-CFG software can be used to identify the address with the following steps:

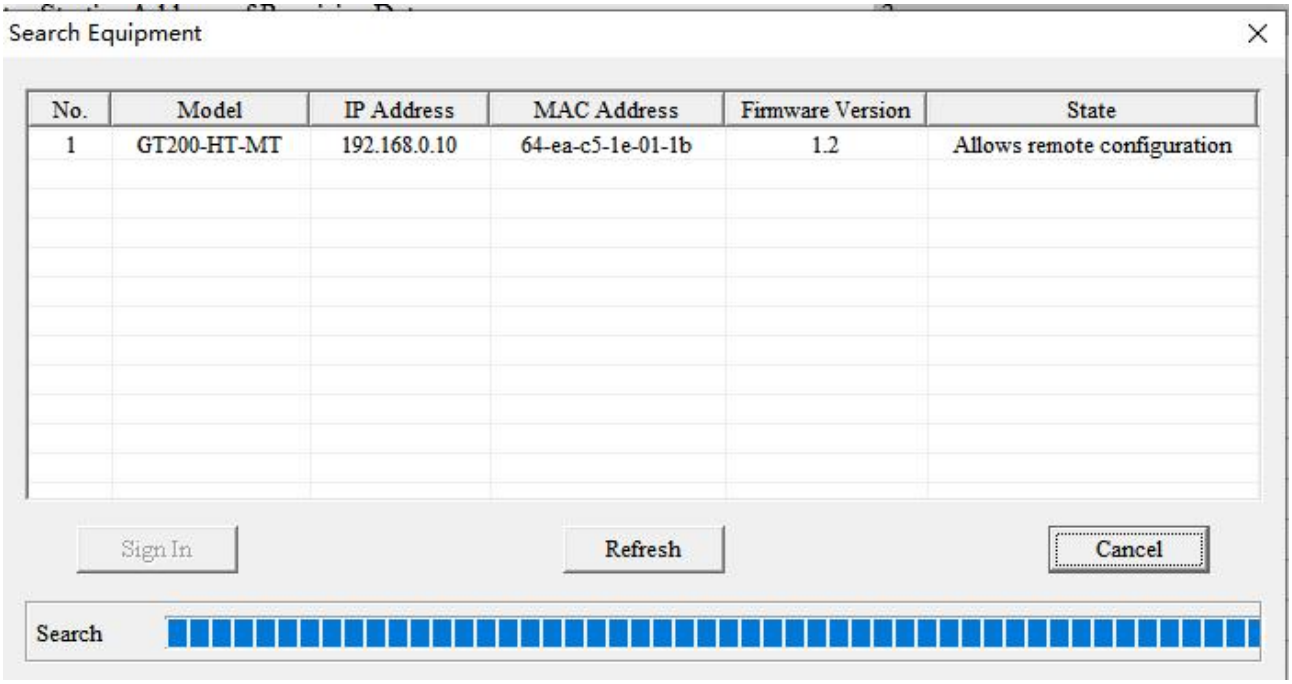
1. Select a single HART device to find the address for. Addresses will need to be found one at a time. Connect the HART device to the GT200-HT-MT using the wiring diagrams from Chapter 2.5.1.
2. Open the SST-HE-CFG software installed on your computer.

3. Click "Fieldbus" in the "Mode" item on the right and choose “Modbus TCP”.
4. Select "Ethernet Config" in "Config" menu.





5. Click "OK". Select the gateway and sign in.



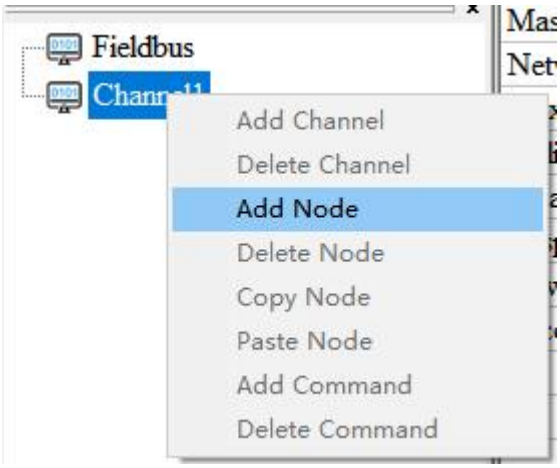
6. Select the "Fieldbus" on the left and configure the parameters as below:

Mode	Modbus TCP
Assign IP Mode	Manually Assign
IP Address	192.168.0.10
Subnet Mask	255.255.255.0
Default Gateway	192.168.0.1
DNS1	0.0.0.0
DNS2	0.0.0.0

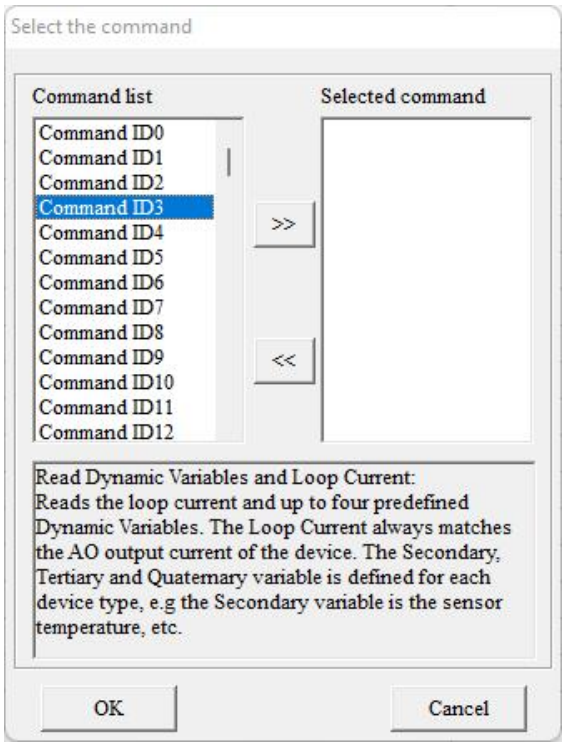
7. Click the HART channel on the left, configure the parameters as below:

Master Type	Primary Master
Network Mode	Point-to-Point
Maximum Repetitions	3
Polling	Enable
Delay Between Polls	256
Response Timeout	256
How to Action after N Successive Response Timeout	Hold
Successive Response Timeout for N Times	3

8. Right click the channel, select “Add Node”.



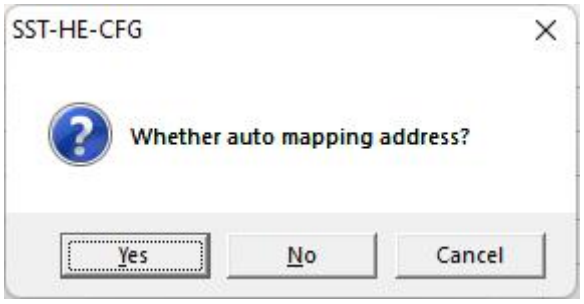
9. Right click on “Node(0)” and select “Add Command” and add Command ID3 box (double click on “Command ID3” or select “Command ID3” and click “»”). Click OK.



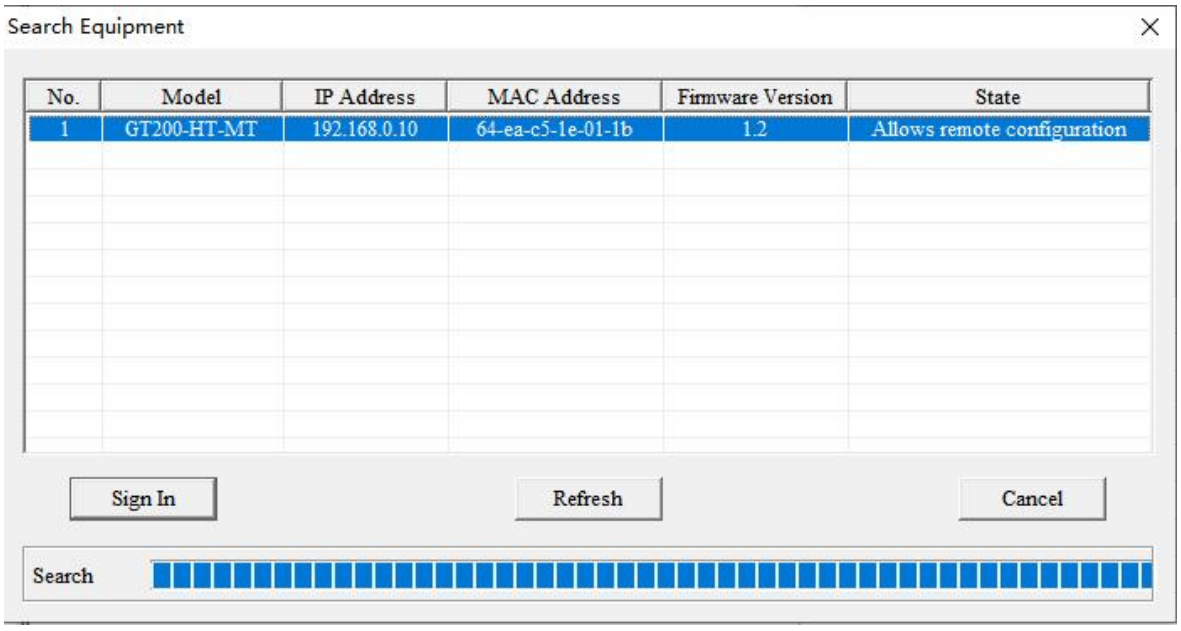
10. Click “Command ID3” and configure the parameters as below:

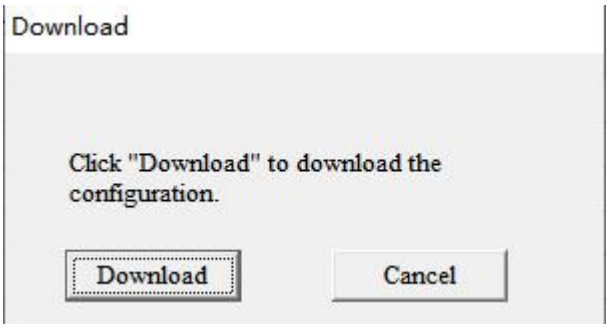
Configuration Mode	Basic
Mode of Outputting Commands	Polling
Memory Starting Address of Sending Data	3000
Modbus Register Starting Address of Sending Data	1500
Length of Sending Data (BYTE)	0
Length of Sending Data (WORD)	0
Memory Starting Address of Receiving Data	0
Modbus Register Starting Address of Receiving Data	0
Length of Receiving Data (BYTE)	26
Length of Receiving Data (WORD)	13
Command Index	0

11. Click the AutoMap icon



12. Click the Download icon



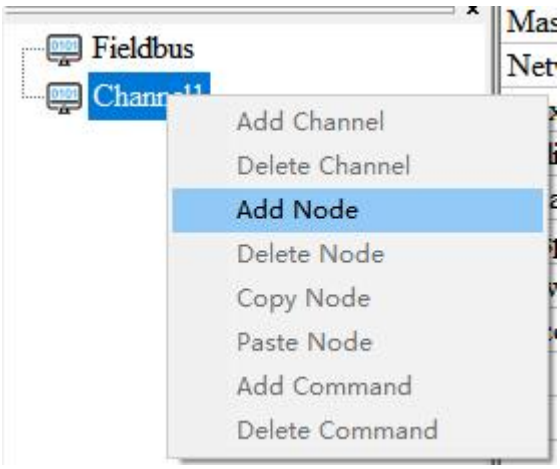


13. Check the LED indicators to verify the device status. If both TX and RX lights are flashing, then the device is configured to slave address 0. If the RX light is not flashing, then change Network Mode to Multi-drop and proceed to step 14.

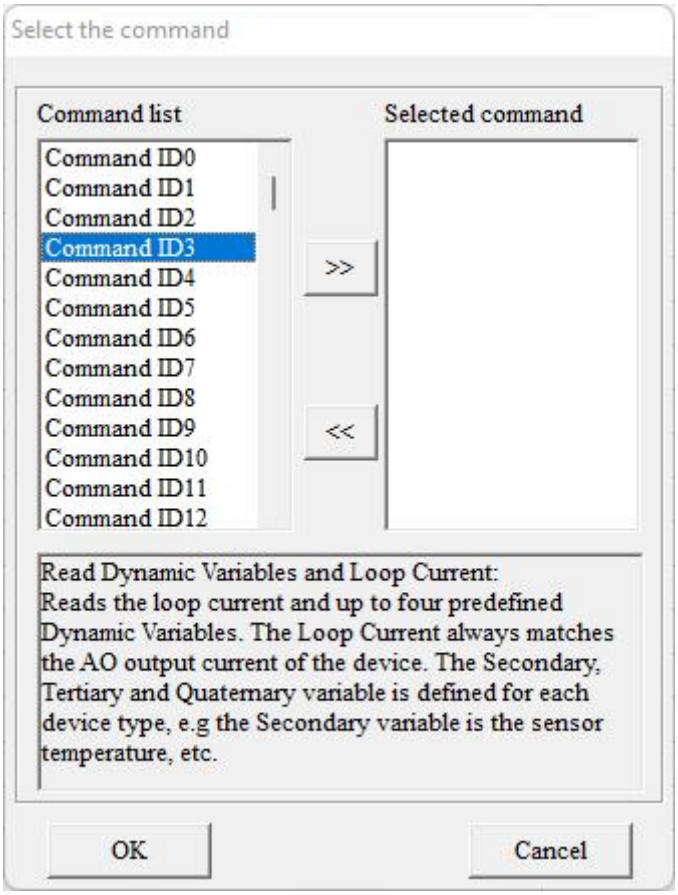
14. Click the HART channel on the left and configure the parameters as below:

Master Type	Primary Master
Network Mode	Multi-drop
Maximum Repetitions	3
Polling	Enable
Delay Between Polls	256
Response Timeout	256
How to Action after N Successive Response Timeout	Hold
Successive Response Timeout for N Times	3

15. Right click the channel, select “Add Node”.



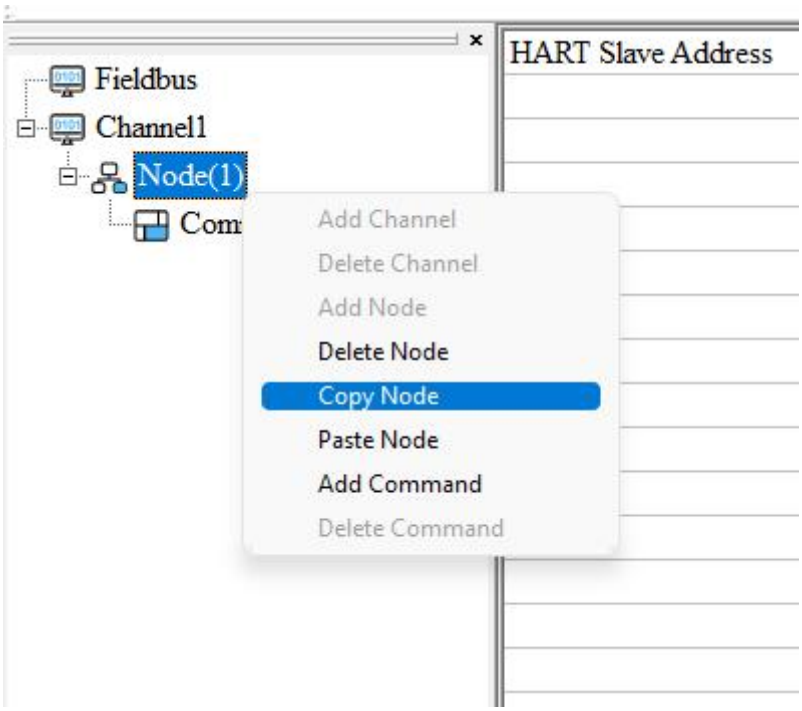
16. Right click on “Node(1)” and select “Add Command” and add Command ID3 box (double click on “Command ID3” or select “Command ID3” and click “»”). Click OK.



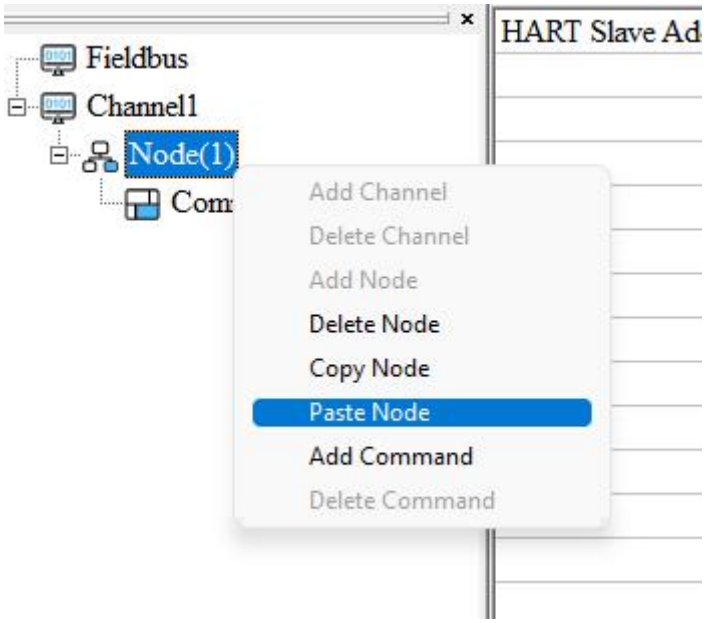
17. Click “Command ID3” and configure the parameters as below:

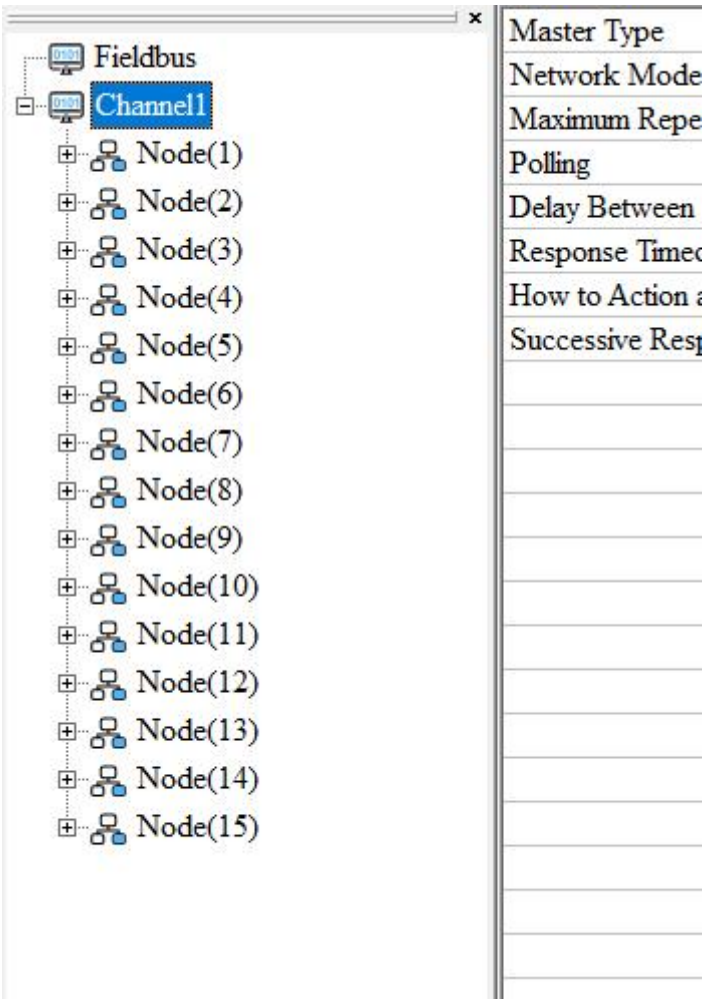
Configuration Mode	Basic
Mode of Outputting Commands	Polling
Memory Starting Address of Sending Data	3000
Modbus Register Starting Address of Sending Data	1500
Length of Sending Data (BYTE)	0
Length of Sending Data (WORD)	0
Memory Starting Address of Receiving Data	0
Modbus Register Starting Address of Receiving Data	0
Length of Receiving Data (BYTE)	26
Length of Receiving Data (WORD)	13
Command Index	0

18. Right click on “Node(1)” and select “Copy Node”.

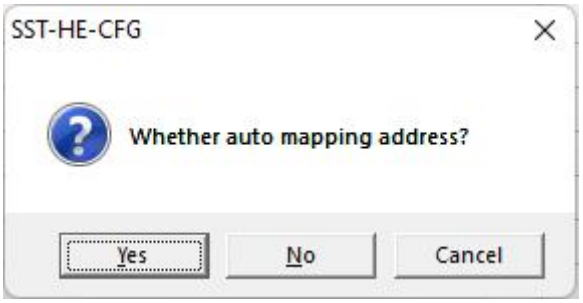


19. Right click on “Node (1)” and select “Paste Node”. Repeat this step until there are 15 nodes.

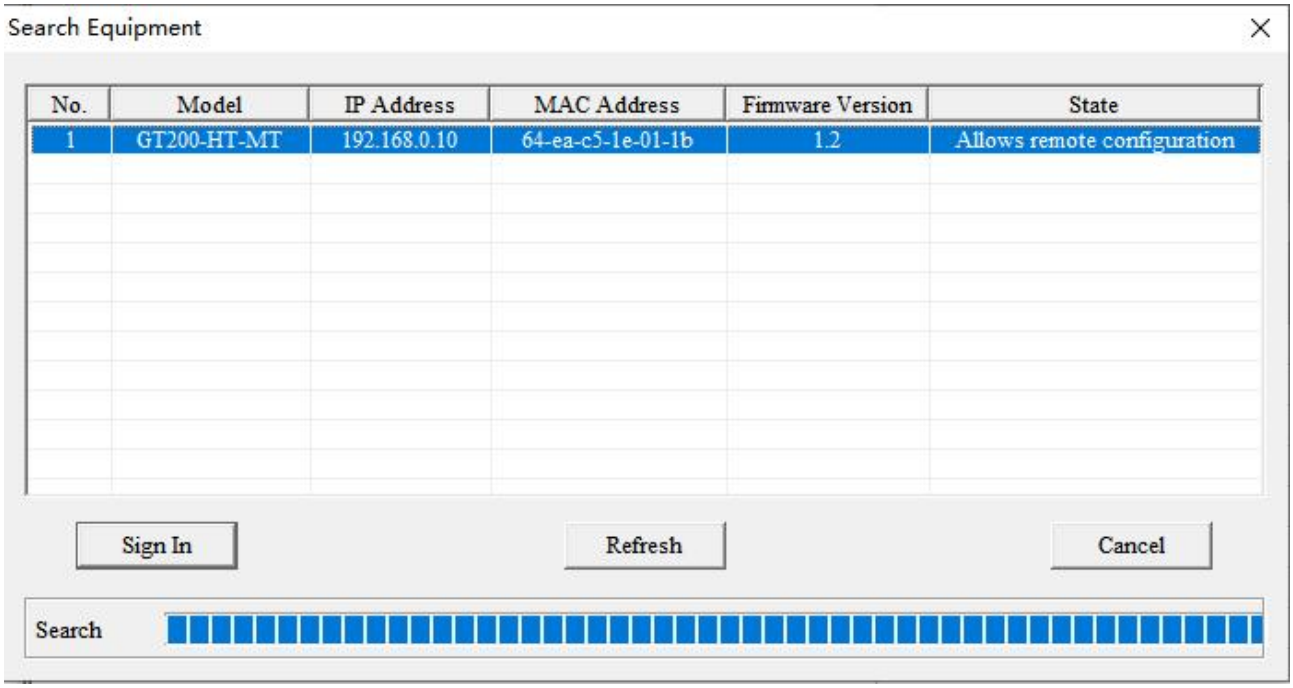


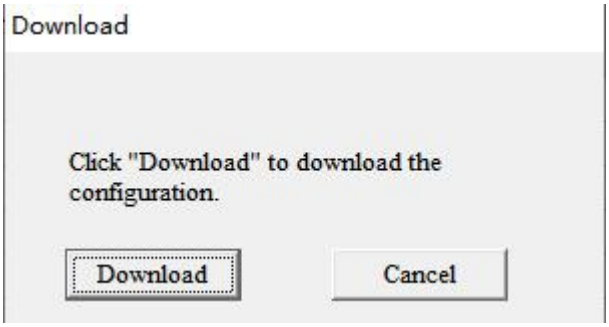


20. Click the AutoMap icon



21. Click the Download icon



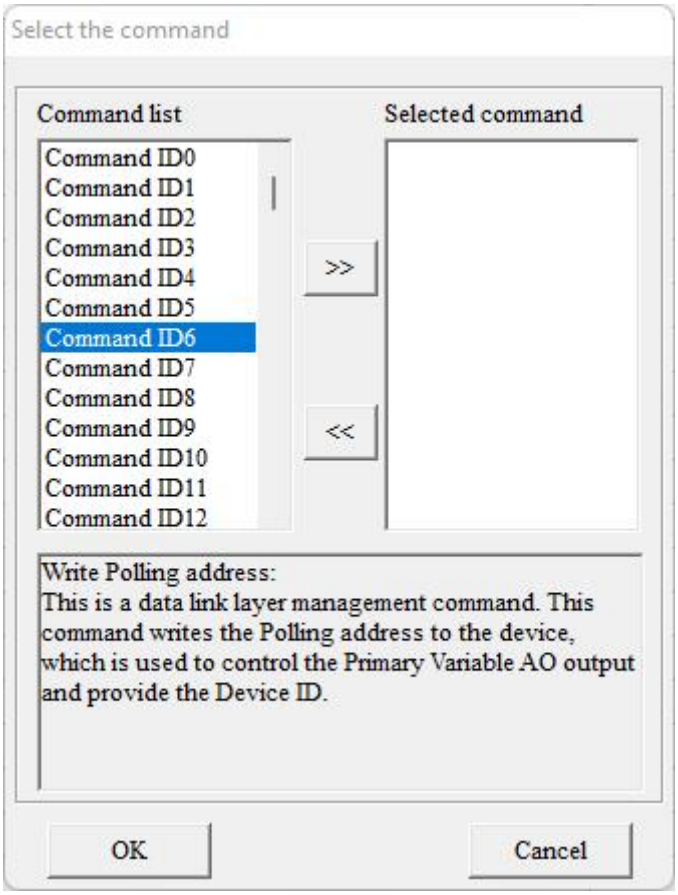


22. Check the LED indicators to verify the device status. If both TX and RX lights are flashing, then the device is configured in multi-mode and has a slave address anywhere between 1-15. To find the exact slave address, remove nodes and repeat steps 20-22. If the RX light is not flashing, then change the Master Type to "Secondary Master", remove all nodes, and repeat steps 7-22.

4.3.2 Changing HART Slave Addresses

The SST-HE-CFG software has a built-in Debug mode with a Memory Display function that can be used to read and write data to HART devices. This functionality can be used to change the HART slave address of the device with the following steps:

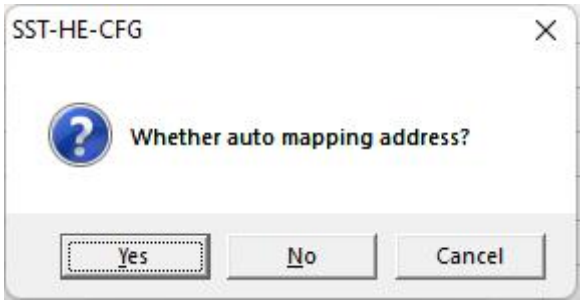
1. Right click on “Node” and select "Add Command" and add Command ID6 box (double click on “Command ID6” or select "Command ID6" and click "»"). Click OK.



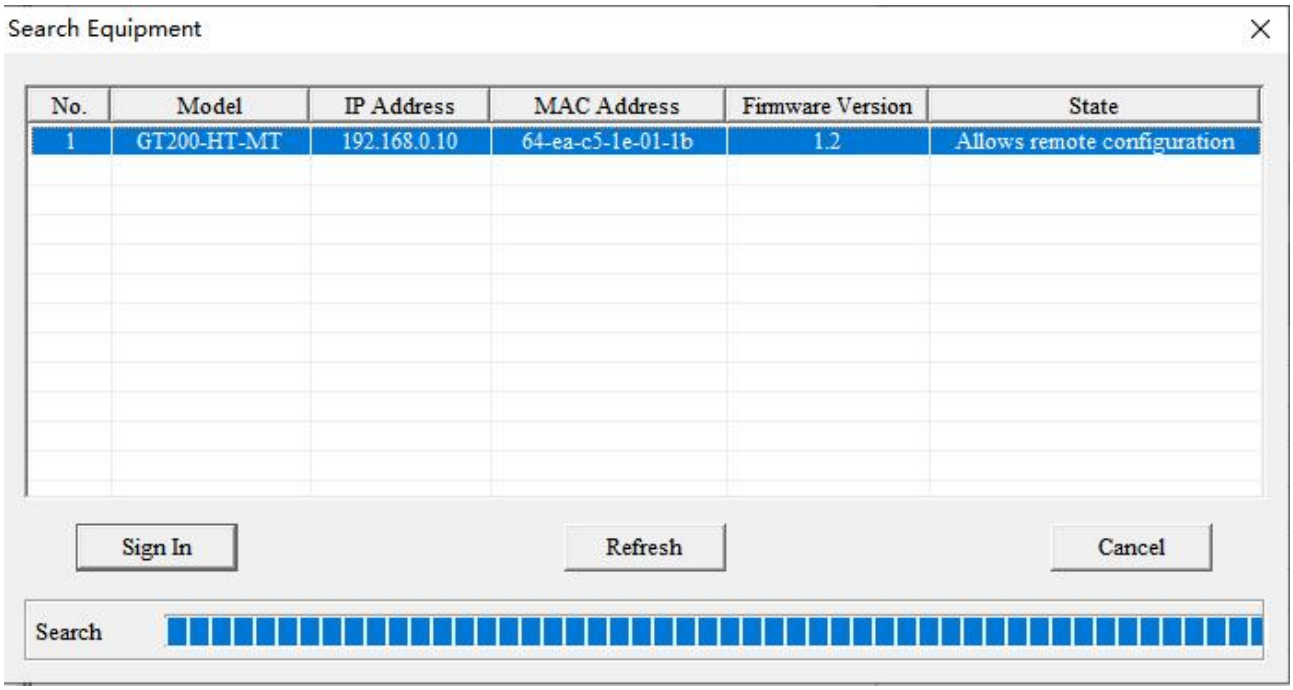
2. Click “Command ID6” and configure the parameters as below:

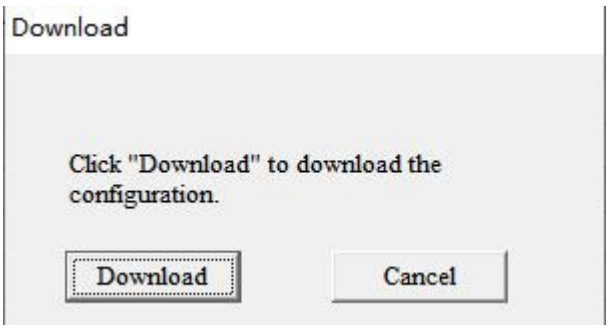
Configuration Mode	Basic
Mode of Outputting Commands	Polling
Memory Starting Address of Sending Data	3000
Modbus Register Starting Address of Sending Data	1500
Length of Sending Data (BYTE)	1
Length of Sending Data (WORD)	1
Memory Starting Address of Receiving Data	0
Modbus Register Starting Address of Receiving Data	0
Length of Receiving Data (BYTE)	4
Length of Receiving Data (WORD)	2
Command Index	0

3. Click the AutoMap icon



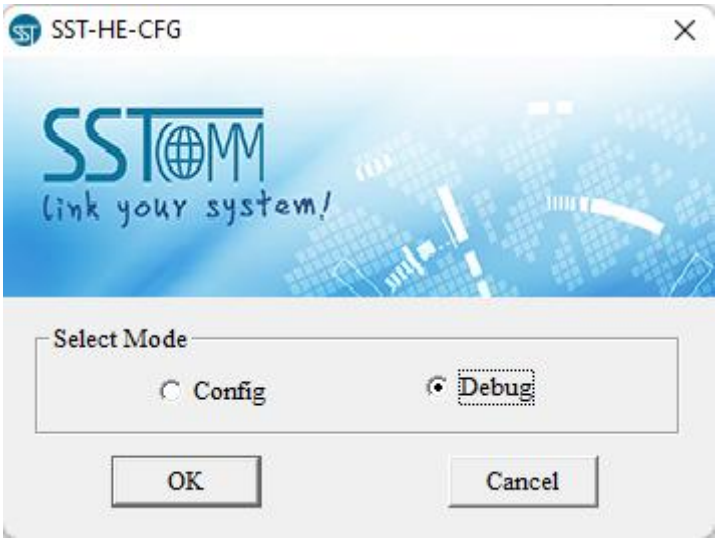
4. Click the download icon





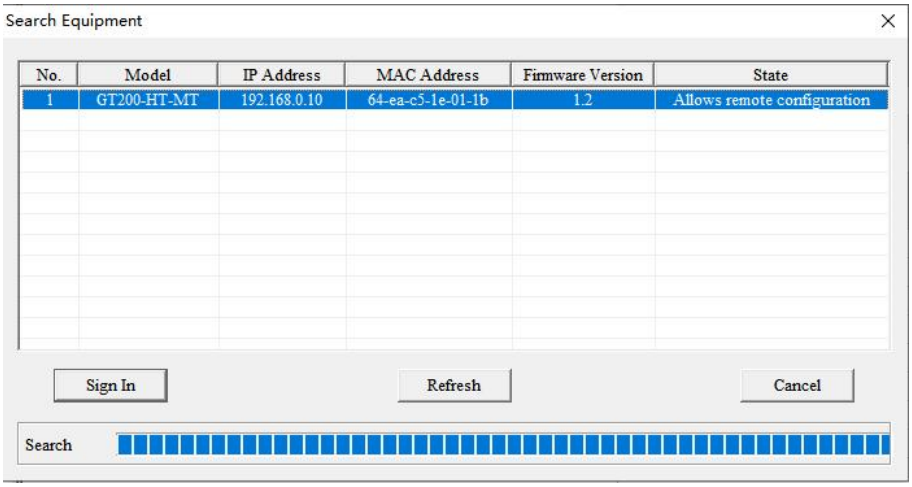
Mode Switch

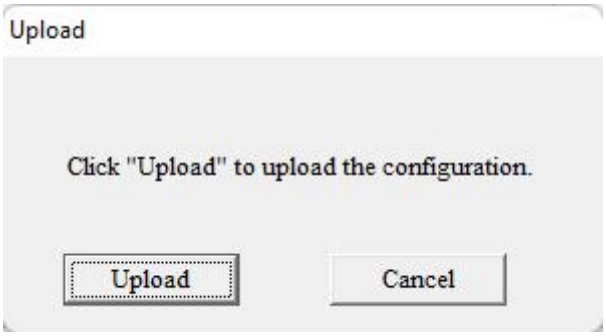
5. Click the Mode Switch icon to switch into Debug mode



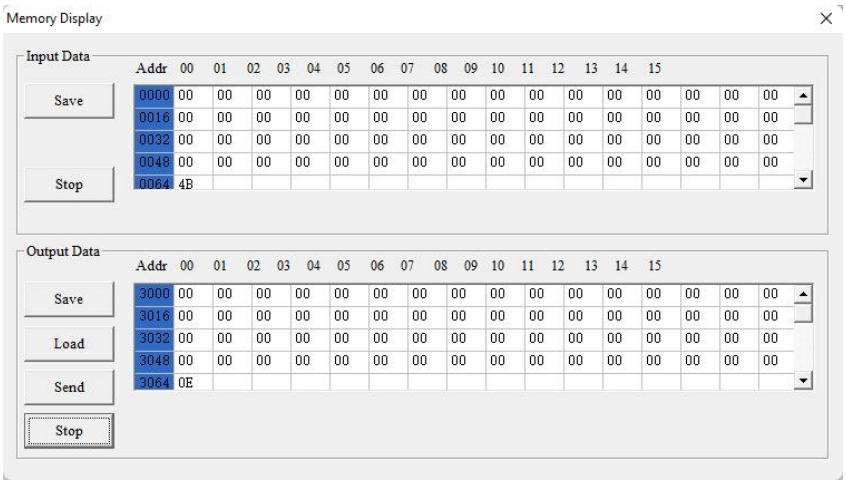
Diagnose

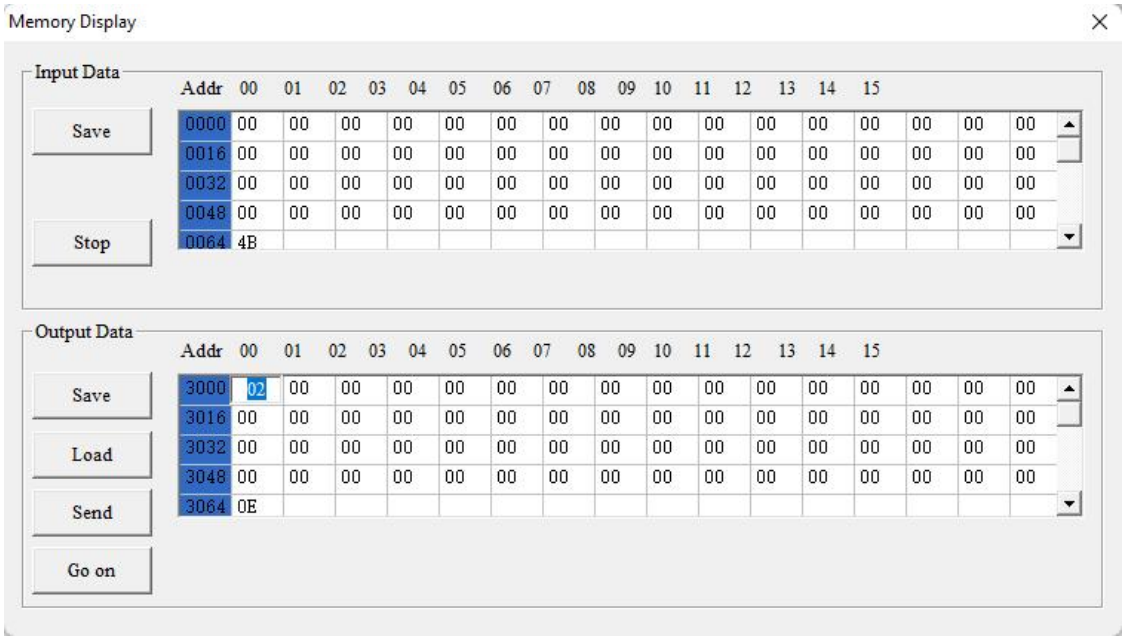
6. Click the Diagnose icon

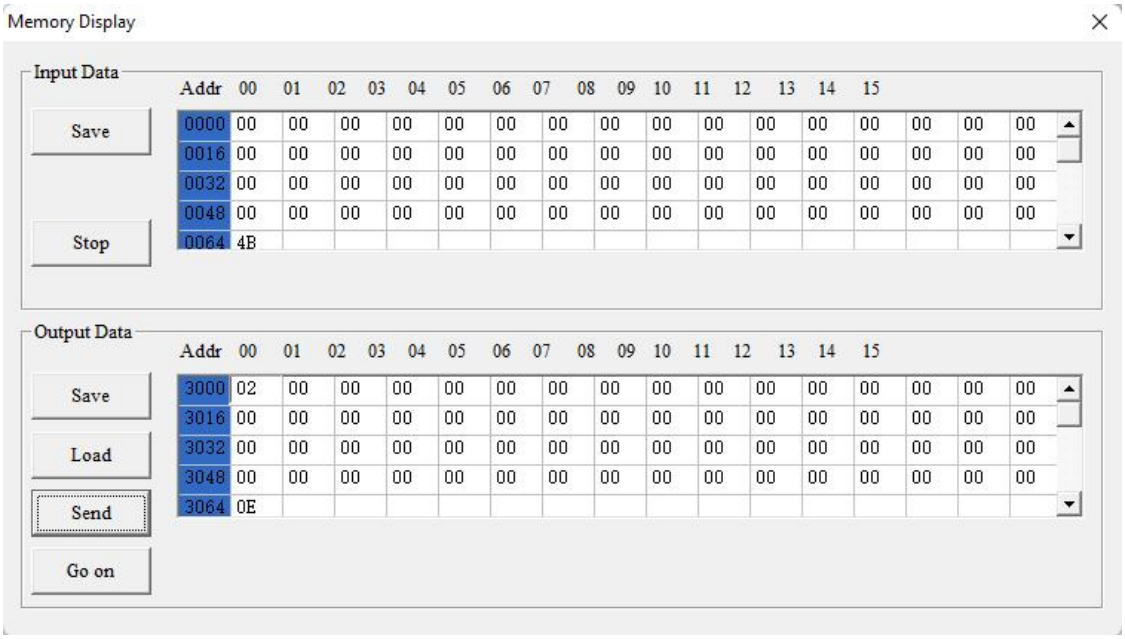


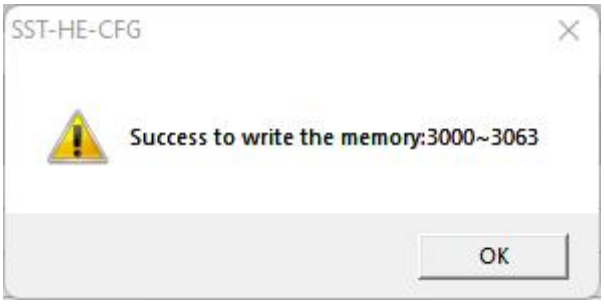


7. Click “Stop” in the Output Data box, update memory address 3000 with the desired HART slave address, and click the “Send” button. The following example shows how to change from slave address 0 to address 2.

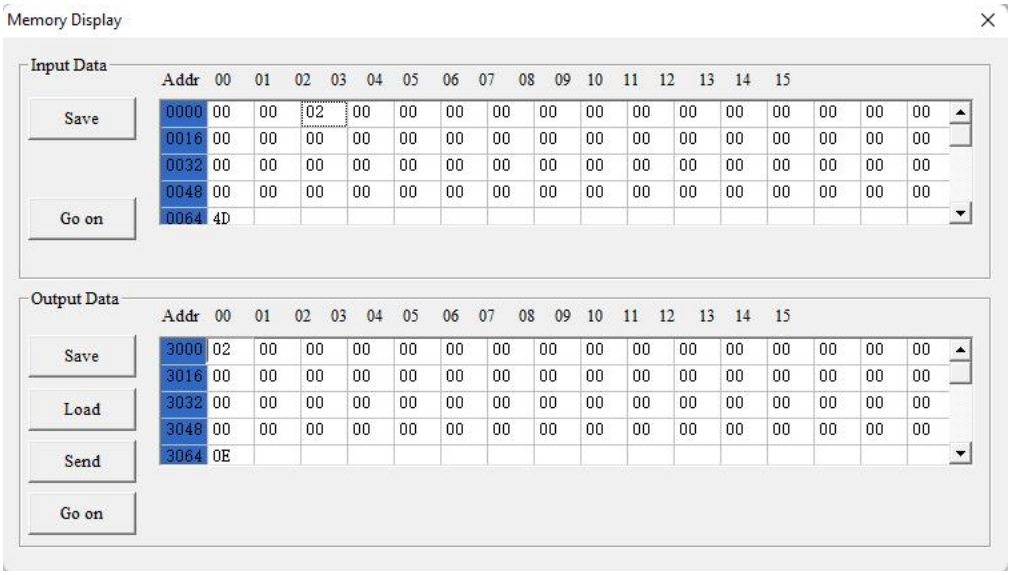








8. In the Input Data box, memory address 0002 will update to show the HART device's new slave address. Power cycle the HART device for apply the changes.



4.4 Common HART Commands

The following is a short list of useful HART commands that can be used for common applications of most HART devices. More information about supported commands is available from FieldComm Group at the following link: https://library.fieldcommgroup.org/20127/TS20127/7.2/

Note: The front two bytes of the actual response data is the status info of the device. The data after that two bytes is the device response data.

Command		Data in Command			Data in Reply		
#	Function	Byte	Data	Type	Byte	Data	Type
1	Read primary variable		None		0	PV units code	Enum-8
					1-4	Primary variable	Float
3	Read current and four (predefined) dynamic variables		None		0-3	Current (mA)	Float
					4	PV units code	Enum-8
					5-8	Primary variable	Float
					9	SV units code	Enum-8
					10-13	Secondary variable	Float
					14	TV units code	Enum-8
					15-18	Tertiary variable	Float
					19	QV units code	Enum-8
					20-23	Quaternary variable	Float
6	Write polling address	0	Polling address	Unsigned-8	0	Polling address	Unsigned-8
		1	Loop current mode	Enum-8	1	Loop current mode	Enum-8

Command 1 (Command ID1): Read Primary Variable

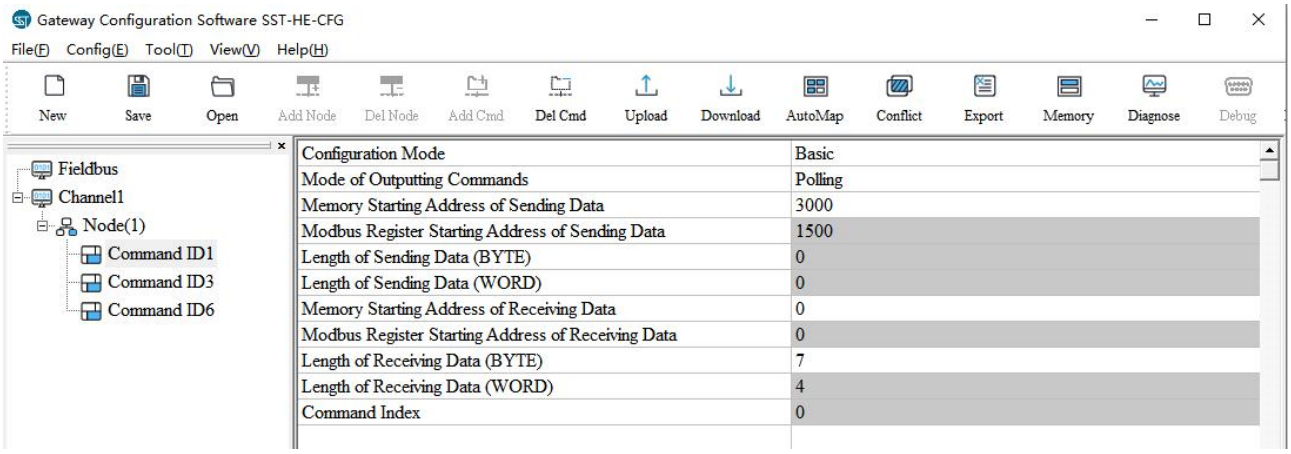
Returns the primary variable value in float data type.

Request: None

Response:

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

An example of this command in the SST configuration software is shown below:



As the request is “None”, the user should fill “0” for the section “Length of Sending Data (BYTE)”.

The “Length of Receiving Data (BYTE)” will be 7, which is the sum of 2 status bytes and 5 device response bytes.

Command 3 (Command ID 3): Read Dynamic Variable and Primary Variable Current

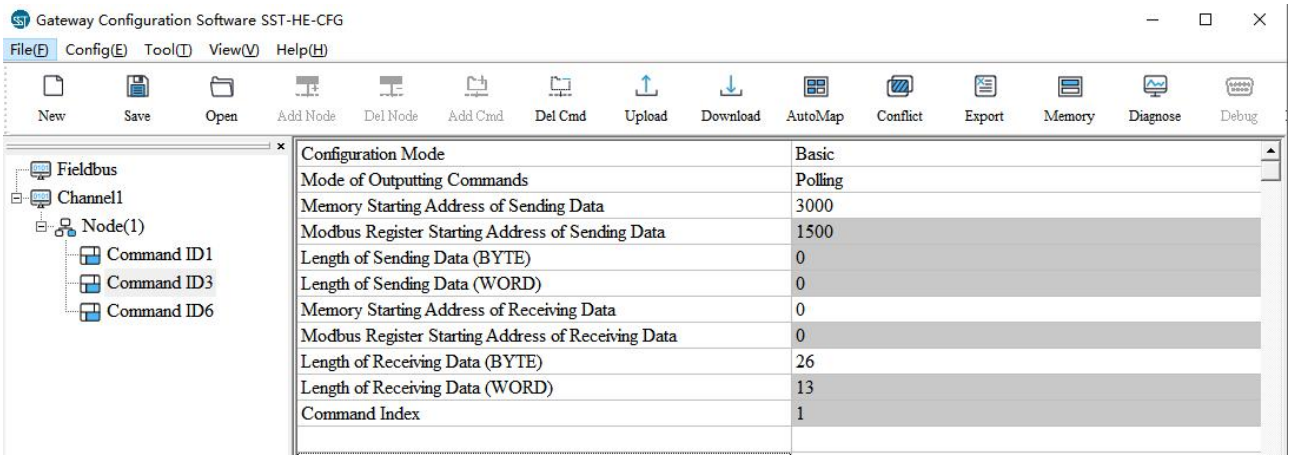
Reads the primary variable current and four (at most) pre-defined dynamic variables. The primary variable current always matches the AO output current of the device. A second, third and fourth variable is defined for each device type, E.g. The second variable can be the sensor temperature, etc.

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

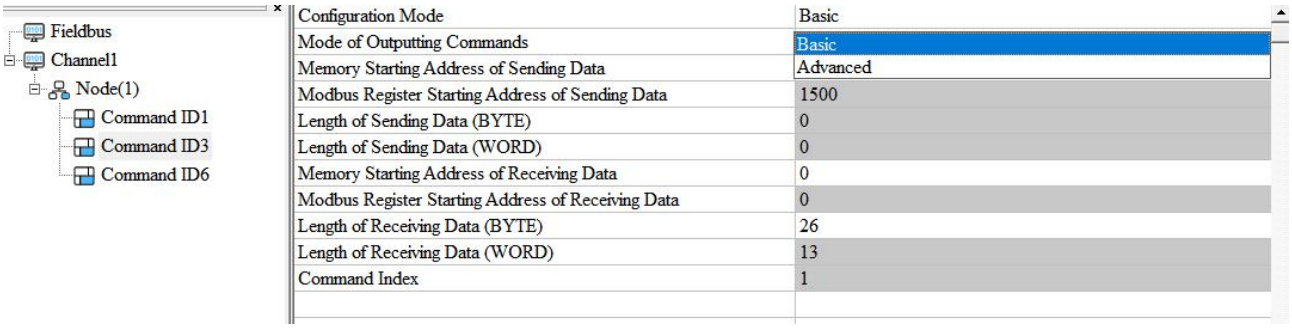
An example of this command in the SST configuration software is shown below:

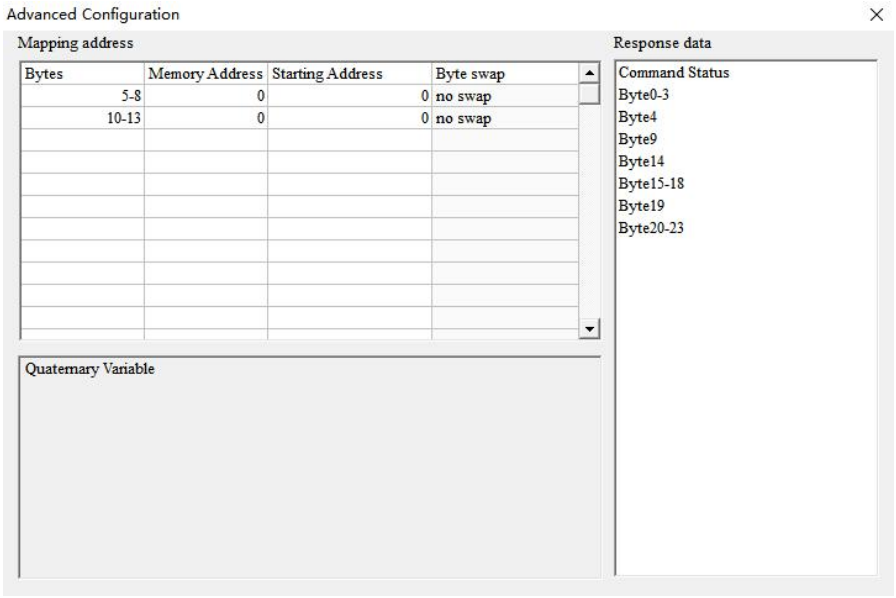


As the request is “None”, the user should fill “0” for the section “Length of Sending Data (BYTE)”.

The “Length of Receiving Data (BYTE)” will be 26, which is the sum of 2 status bytes and 24 device response bytes.

If the user does not need to map all the variables to the Modbus TCP registers, please follow the guide below. Switch to the “Advanced Configuration Mode”, click the “Configuration” button, and only select the variable(s) needed. In this example, only the “Primary Variable” and the “Secondary Variable” are selected. For more details on Advanced Configuration Mode, please refer to chapter 5.2.2.7.





Note: Selected variables are listed in the left table. Variables corresponding to the bytes are listed in the beginning of this chapter.

Command 6 (Command ID6): Write Polling Address

Writes the polling address (HART slave address) to the field device.

Request:

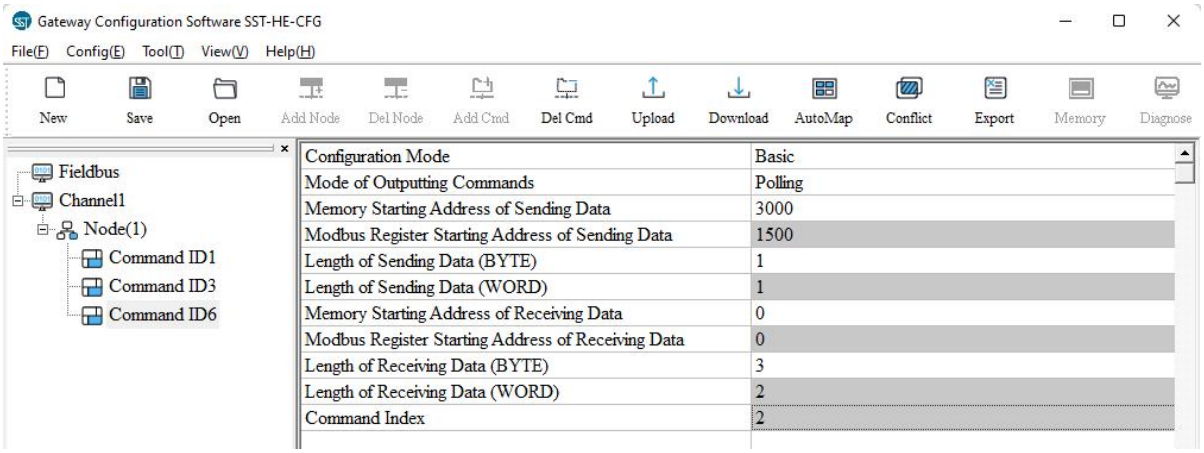
Byte	**Description**
Byte 0	Polling Address (Between 0-15)
Byte 1 (Only on supported HART devices)	Loop Current Mode (0=Disabled, 1=Enabled)

Response:

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

Note: Some HART devices do not support configuring the Loop Current Mode. These devices will only expect to receive Byte 0 of the request.

An example of this command in the SST configuration software is shown below:



If the HART device does not support configuring the Loop Current Mode, the user should fill “1” for the section “Length of Sending Data (BYTE)”.

The “Length of Receiving Data (BYTE)” will be 3, which is the sum of 2 status bytes and 1 device response bytes.

If the HART device does support configuring the Loop Current Mode, the user should fill “2” for the section “Length of Sending Data (BYTE)”.

The “Length of Receiving Data (BYTE)” will be 4, which is the sum of 2 status bytes and 2 device response bytes.

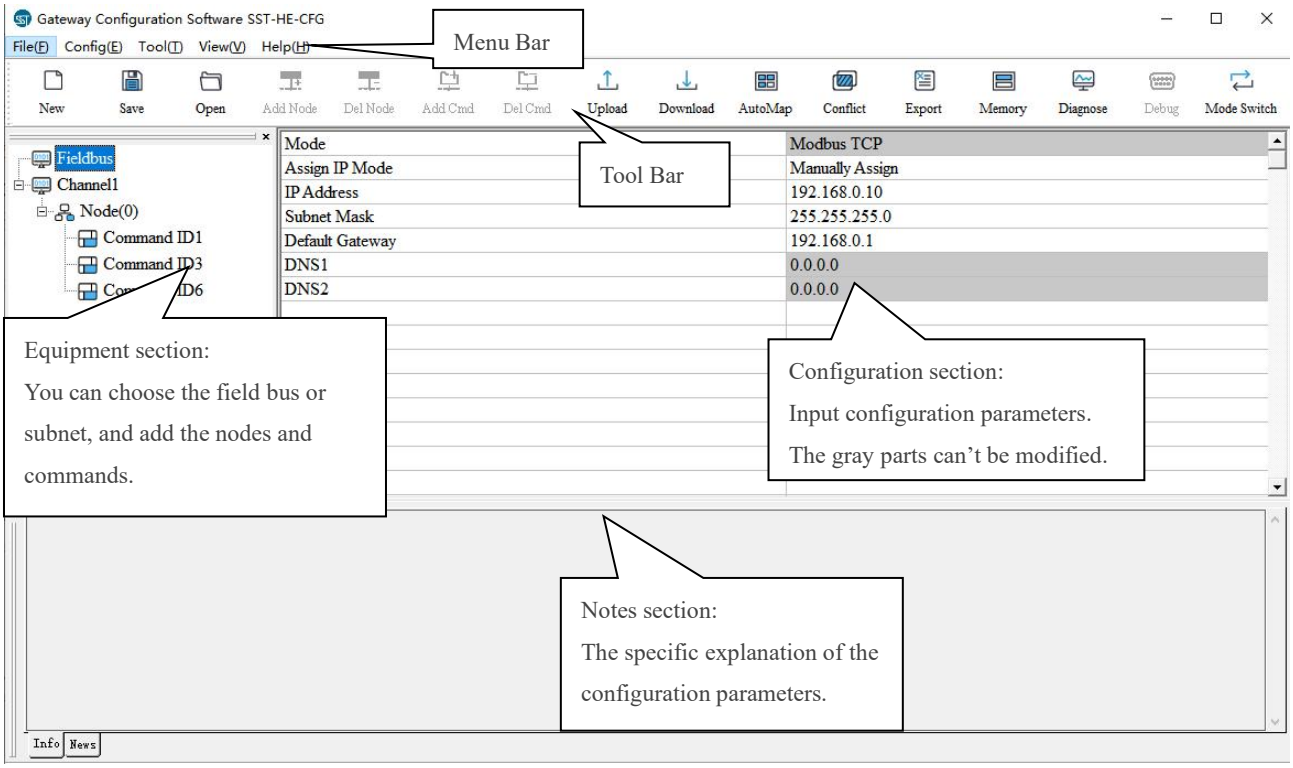
5 Software Instructions

5.1 Software Interface Description

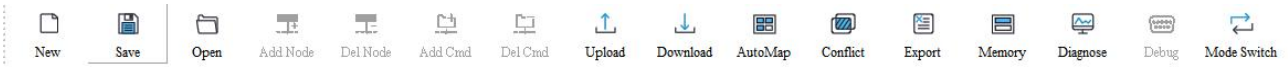
SST-HE-CFG is a configuration software based on Windows platform, and is used to configure HART series products.

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

Open the SST-HE-CFG and enter the main interface of the software:



Tool Bar:



New: Create a new configuration file

Save: Save the configuration file

Open: Open the configuration file

AddNode: Add a HART node (device)

DelNode: Delete a HART node (device)

AddCmd: Add a HART command

DelCmd: Delete a HART command

Upload: Upload the configuration from the GT200-HT-MT and open it in the software

Download: Download the configuration to the GT200-HT-MT

AutoMap: Automatically calculate the mapping address

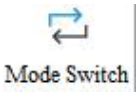
Conflict: To check whether there are some conflicts in the data buffer

Export: Output the configuration and save it as an Excel form

Memory: Show the data in the buffer of the GT200-HT-MT.

Diagnose: Analyze operation of fieldbus devices.

Debug: Send any request to Hart devices and show the response information received. (Only for GT200-3HT-RS model)

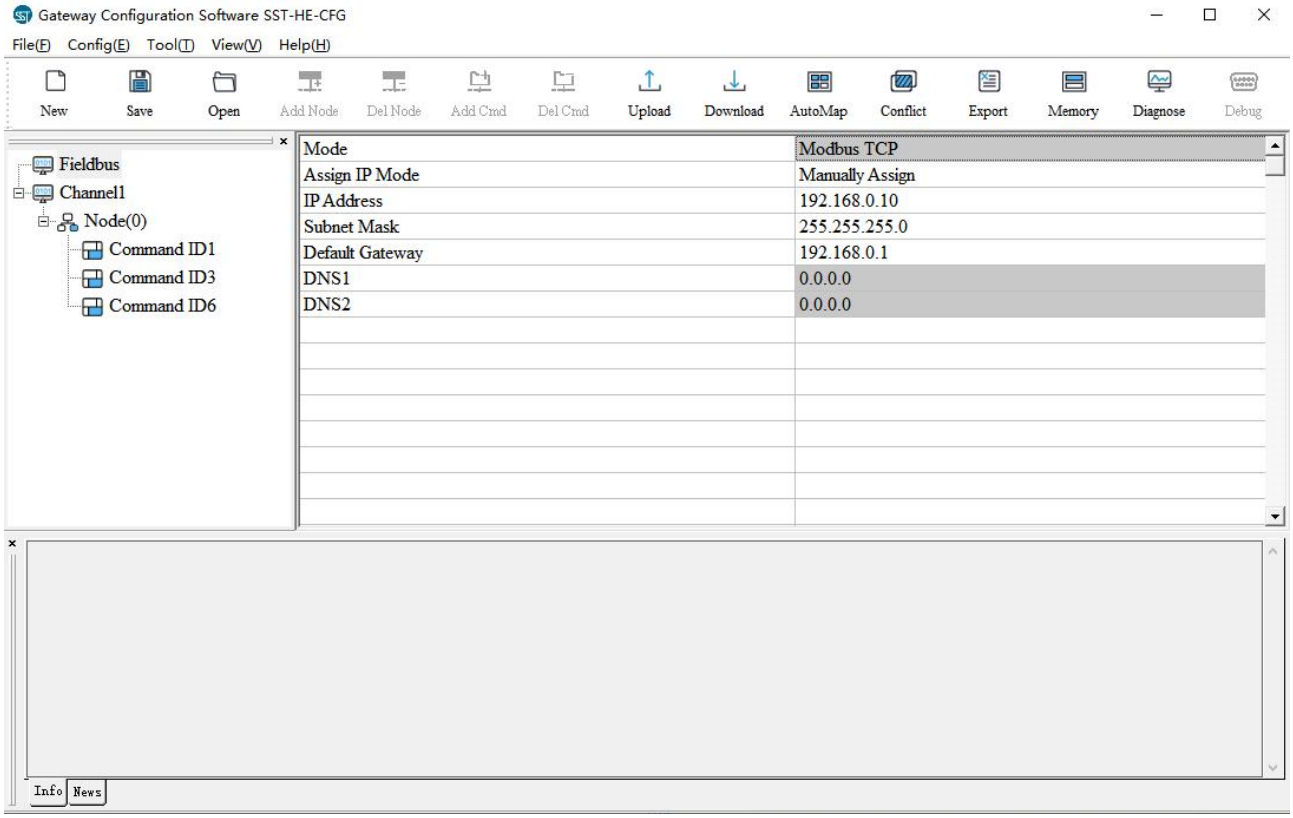


Mode Switch: Switch the mode to debugging or configuring.

5.2 Software Functional Specifications

5.2.1 Configure the Modbus TCP Fieldbus

Click the "Fieldbus" on the left and select "Modbus TCP" in the "Mode" in the configuring plate on the right, as shown below:



Assign IP Mode: Manual Assign, BOOTP, DHCP optional.

IP Address: Set the IP address of the GT200-HT-MT.

Subnet Mask: Set the subnet mask of the GT200-HT-MT.

Default Gateway: Set the gateway address of the GT200-HT-MT.

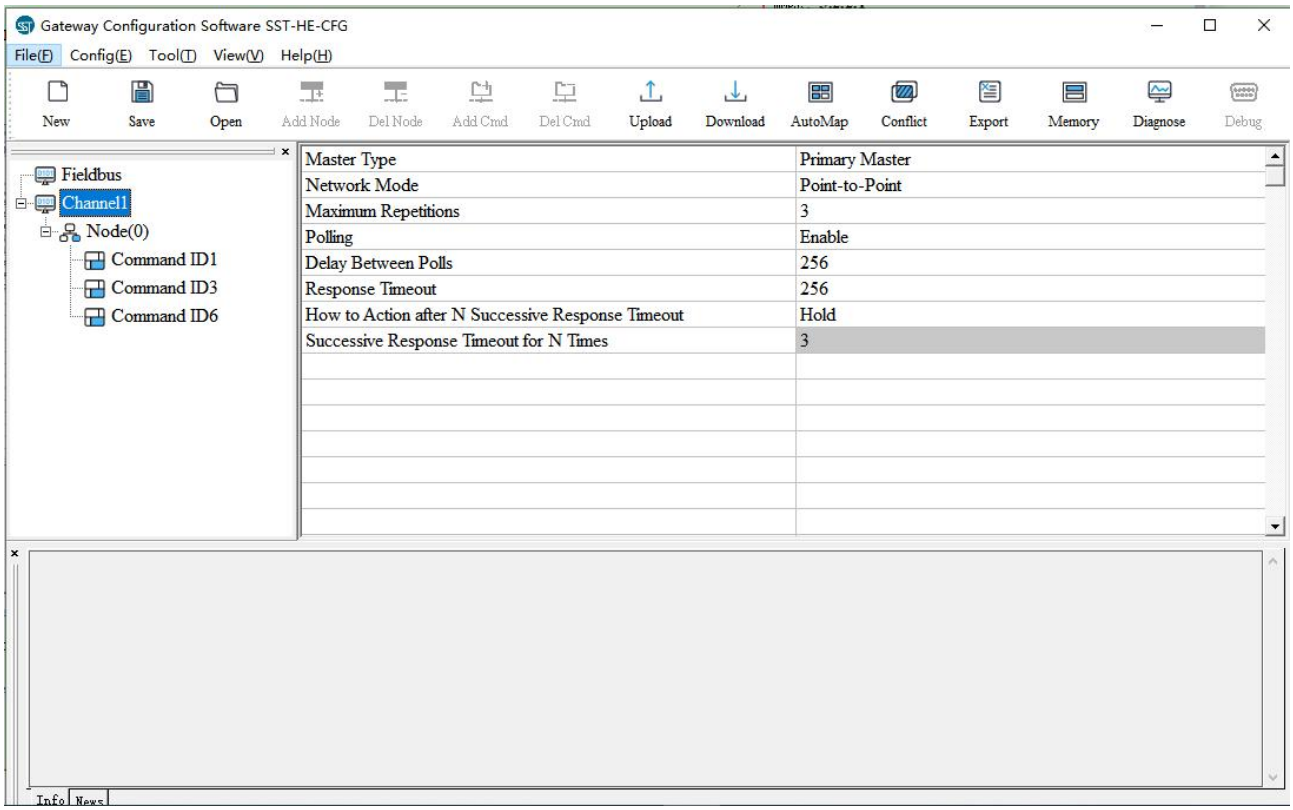
DNS1: Default 0.0.0.0.

DNS2: Default 0.0.0.0.

5.2.2 Configure the HART Fieldbus

5.2.2.1 Set the Parameters of HART Channel

Click the "HartChannel0" on the left, then the configuration plate will be shown as below:



Master type: Primary master, Secondary master optional.

Network mode: Select the network mode of HART. In “point-to-point” mode, only one HART instruments of address 0 can be connected.

Maximum repetitions: Select the number of the HART command retries, ranging from 0 to 5.

Polling Enable: Select whether to use polling feature.

Delay between Polls: Set delay time between two commands with the range from 256~65535ms.

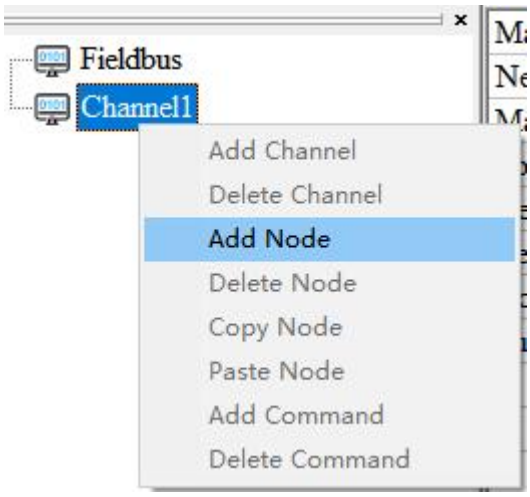
Response Timeout: Set the maximum wait time that the gateway waits for the HART slave device to respond, ranging from 256 to 65535 ms.

How to Action after N successive Response Timeout: Select whether to clear input data when the number of response timeouts is more than the set number, or keep the data.

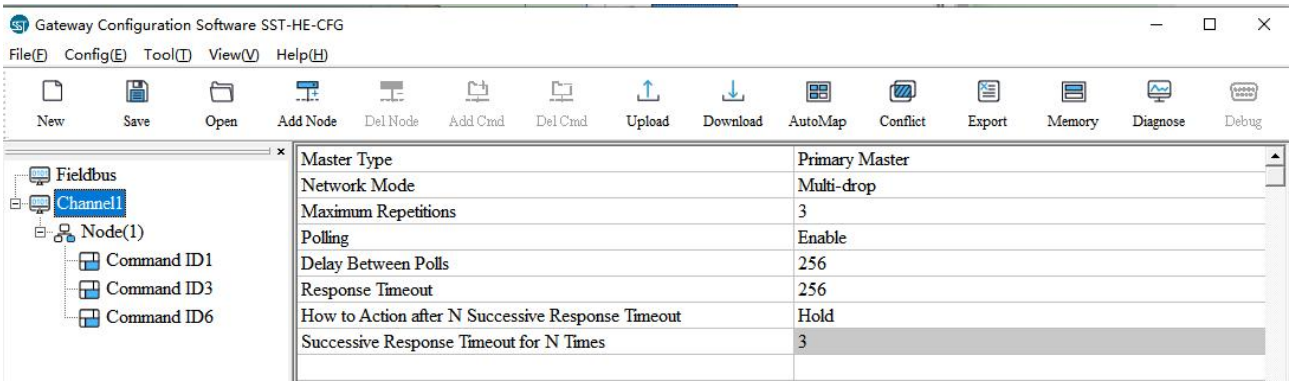
Successive Response Timeout for N times: The max number of timeouts before the data is cleared, ranging from 1 to 14.

5.2.2.2 Add Slave Nodes

Click the selected HART channel, right click on it and select "Add Node" in the pop-up menu.



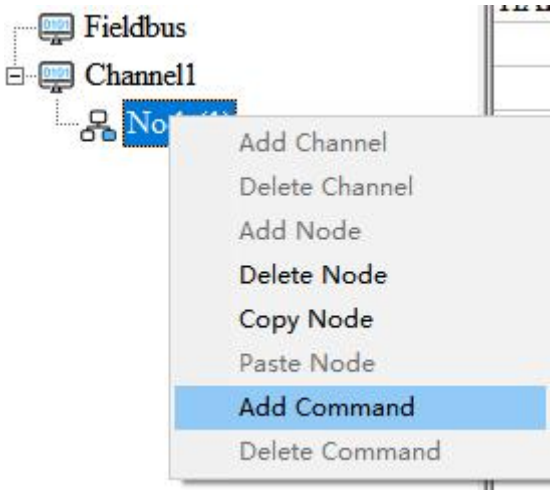
Click the added node, set device address in the right configuration plate.



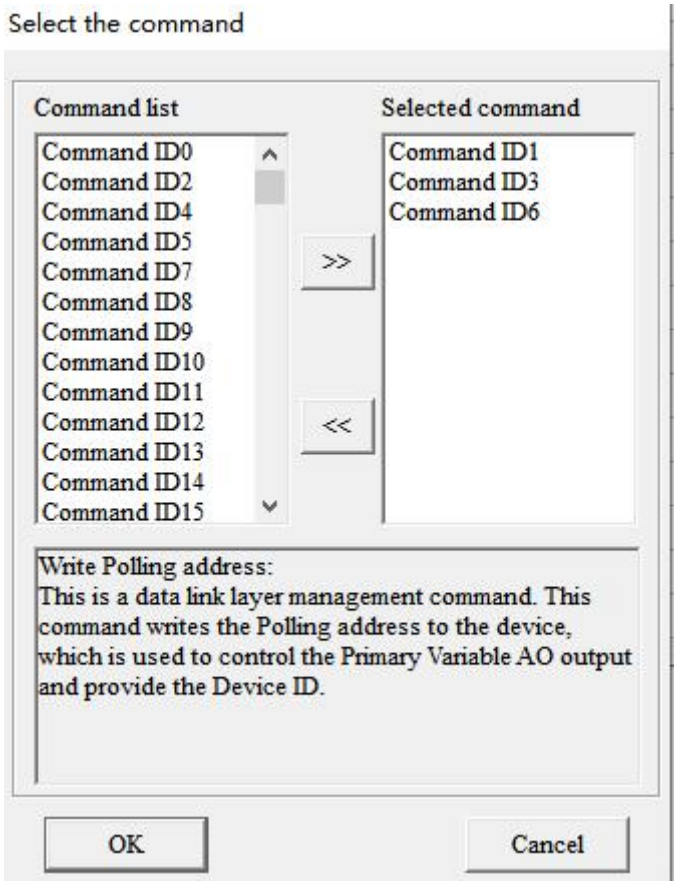
Note: When the number of configured nodes numbers is more than the actual connected devices, the redundant nodes will lead to a longer polling time. It is recommended that the number of configured nodes correspond with the number of actual devices.

5.2.2.3 Add HART Commands

Right click on a Node and select "Add Command" in the pop-up menu



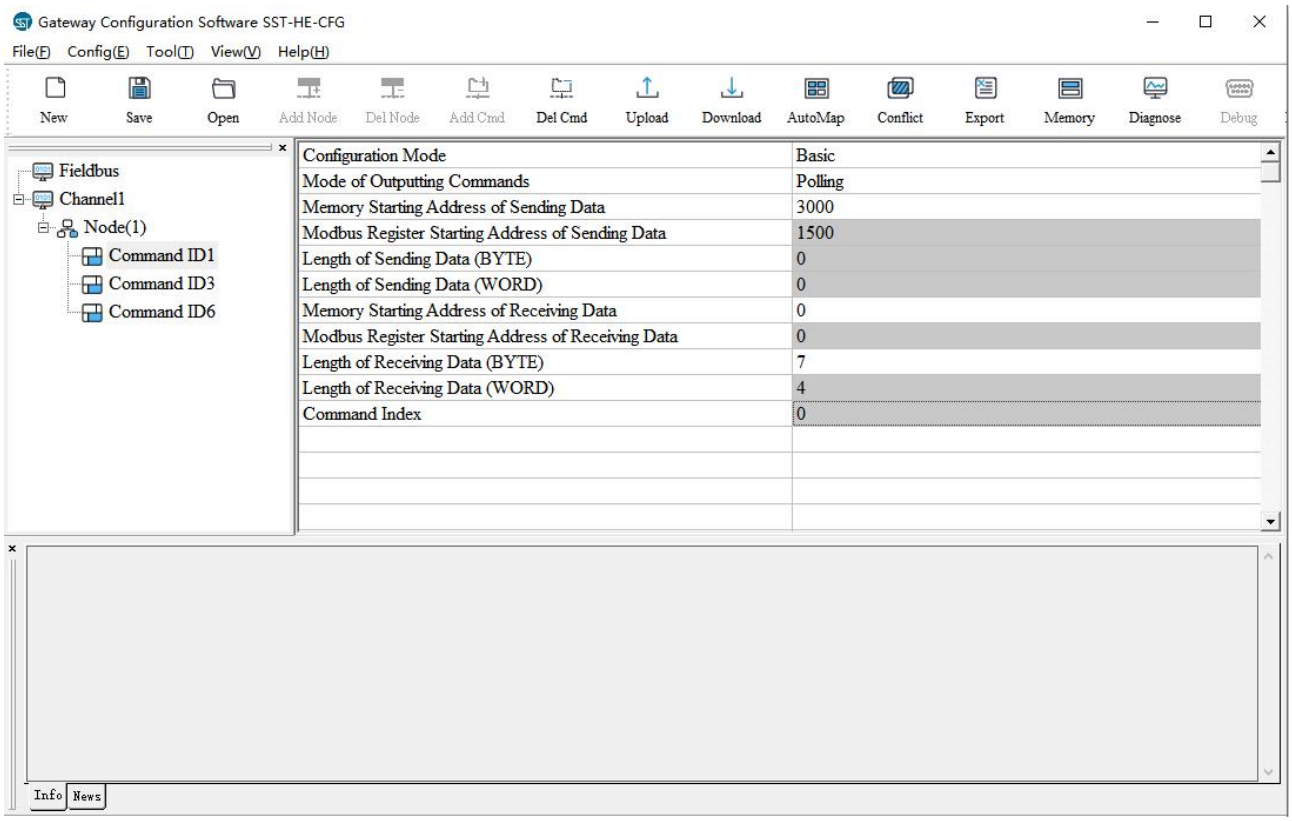
Choose the command you want to add in the pop-up dialog box, and then click "OK" to exit:



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

5.2.2.4 Configure HART Commands

Click the command ID on the left, you will see the configuration plate of the command on the right:



Mode of outputting commands: Change-of-state, polling output, Initialization output and disable output optional.

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

Polling output: The command is put in the polling list and executed periodically.

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

Disable output: The command will not be sent.

Memory starting address of sending data: Set the start address in data buffer of output data of this command. The range is 3000~4999.

Modbus register starting address of sending data: This parameter is automatically calculated and used for register addressing.

Sending data length (BYTE): Set the length of output data of this command.

Sending data length (WORD): This parameter is automatically calculated. 1 word=2 bytes.

Memory starting address of receiving data: Set the start address in data buffer of input data of this command. The

range is 0~2999.

Modbus register starting address of receiving data: This parameter is automatically calculated and used for register addressing.

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

Receiving data length (WORD): This parameter is automatically calculated. 1 word=2 bytes.

Command index: This parameter is automatically calculated and it indicates the index of this command in the configured command list.

5.2.2.5 Delete Commands

Select the command you want to delete and, right click on it and select "Delete Command". This can also be done through the menu bar or tool bar.

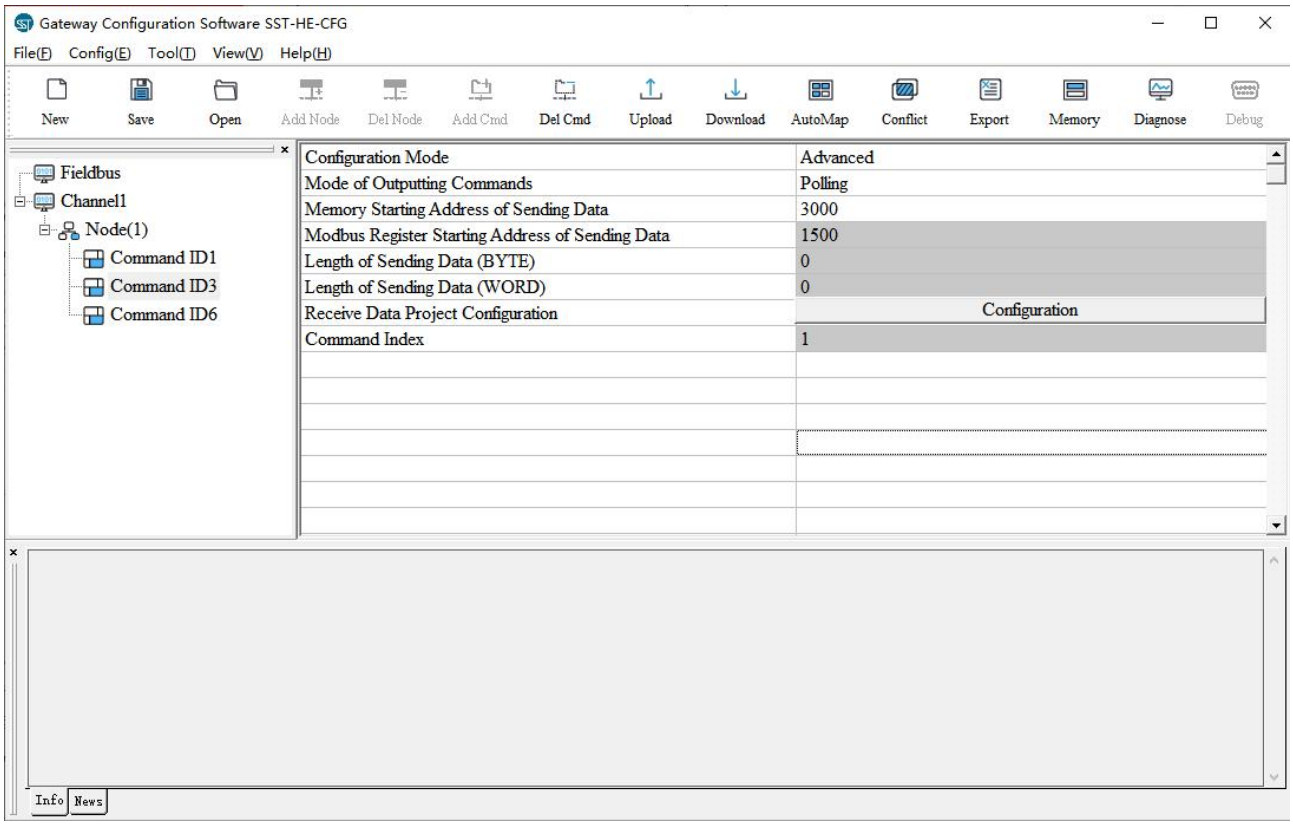
5.2.2.6 Delete Nodes

Select the node you want to delete, right click on it and select "Delete Node". This can also be done through the menu bar or tool bar. When a node is deleted, all commands under this node will also be deleted.

5.2.2.7 Advanced Options to Configure HART Commands

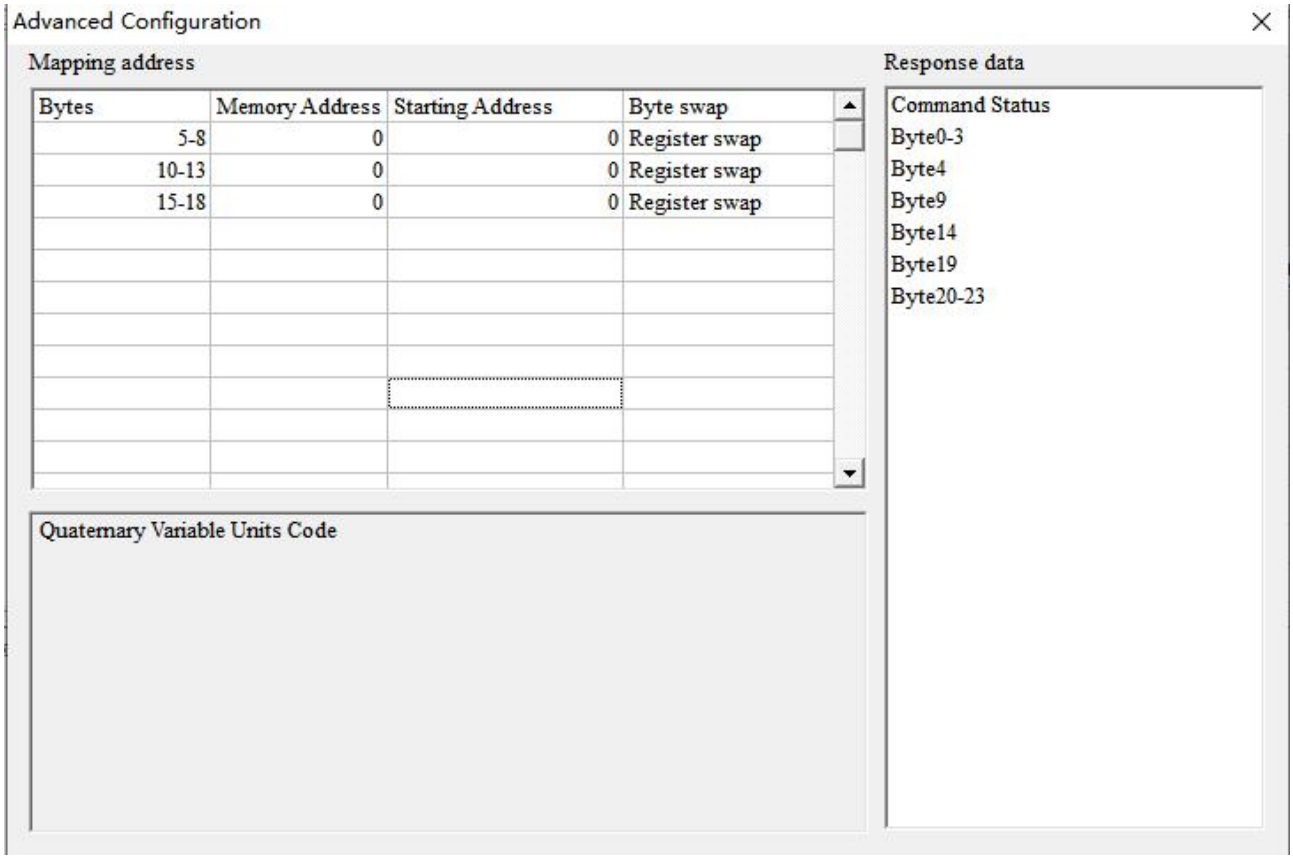
The GT200-HT-MT can filter the input data in advanced configuration mode which can be useful when users only need one part of the data from one command. For example, if a user only needs the main variable of No.1 HART command, the advanced options can be used to filter out the unneeded units of the main variable. The advanced options is the execution of the “segment mapping function”. The input data of the HART command is divided into segments that can be extracted independently. Users can get any part of the data they want.

Below is the Advanced Options interface:



Below is an example of the “Segment Mapping” function using the No. 3 HART command. Click the "configuration" button in the "Receive Data Project Configuration" option once the configuration mode is set to “Advanced”.

Double-click on a variable to add or delete it.



Bytes: Input bytes of "Response Data". In the above example, clicking on "Byte5-8" will show the information “Primary Variable” in the left bottom area.

Memory Address: Set the start address of these bytes in data buffer.

Starting address: This parameter is automatically calculated and is the relevant Modbus register address of "Memory Address".

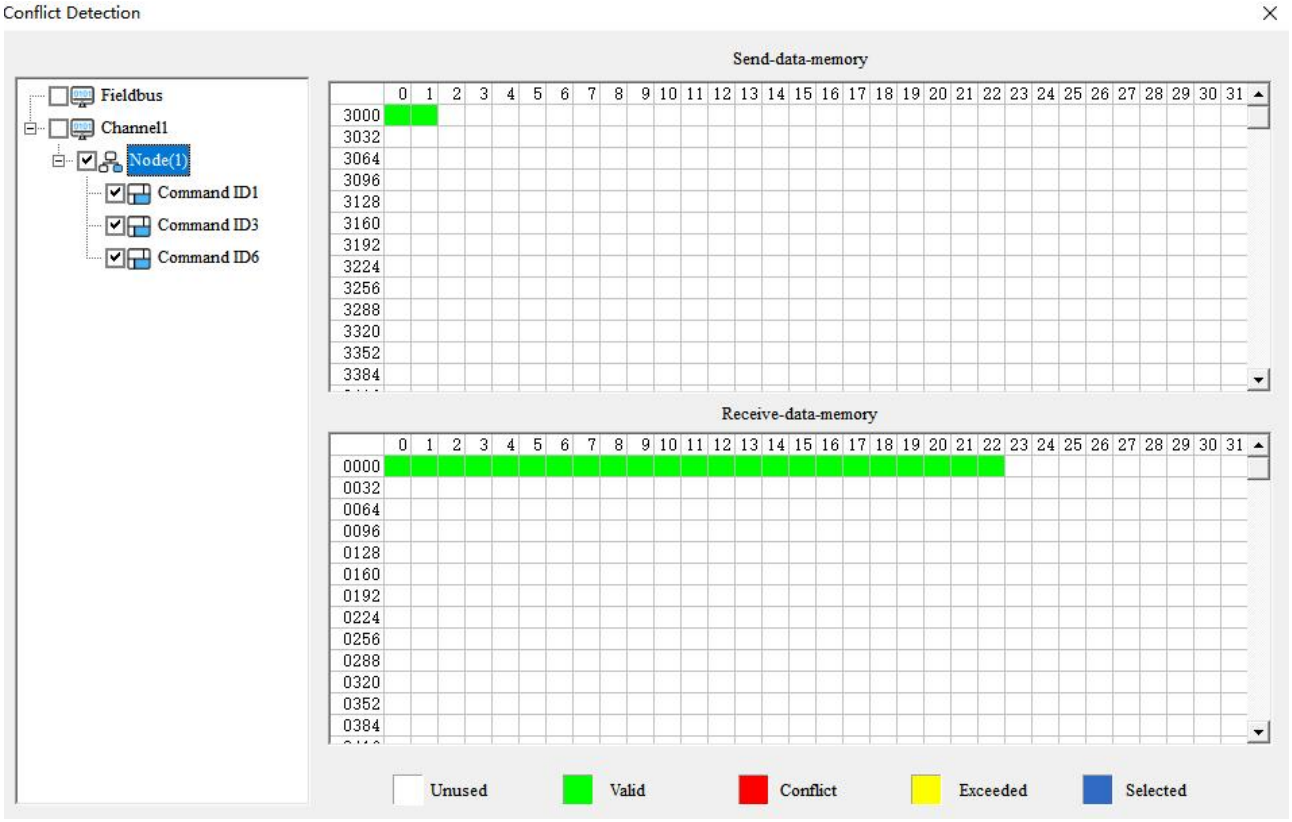
Byte swap: Select between "No swap" and "Register swap". This function is optional and is only valid to float type data. For example, if the original data is 0x12345678, it will be 0x56781234 when using "register swap".

5.2.3 Conflict Detection

"Conflict Detection" is used to check the distribution of the input and output data of all commands stored in the data buffer.

Click

icon to open the conflict detection box:



The left side of the tree view shows the configuration commands. The right side of the tree view shows the data memory address which includes the receive data storage address and the send data storage. The top side shows the memory distribution of the HART channel sending data. The bottom side shows the memory distribution of the HART channel receiving data.

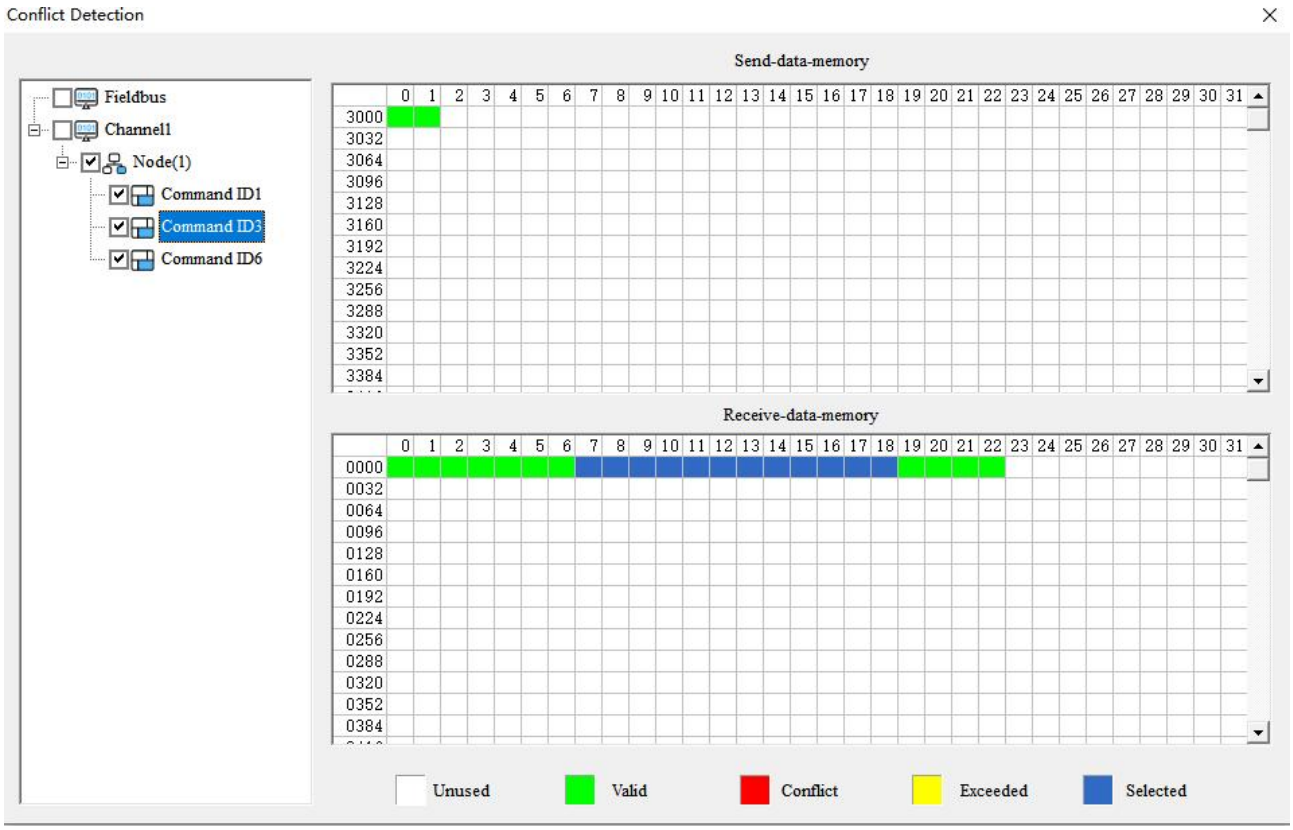
White colored areas are usable addresses.

Green colored areas are occupied addresses.

Red colored areas are memory addresses that are configured with two or more commands.

Yellow colored areas are mapped addresses that exceed the defined range of the GT200-HT-MT.

Clicking on a command will show the corresponding memory addresses in blue.

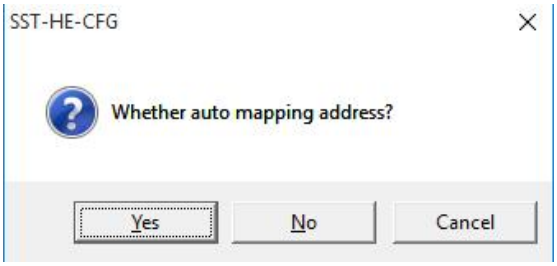


5.2.4 Auto Mapping

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

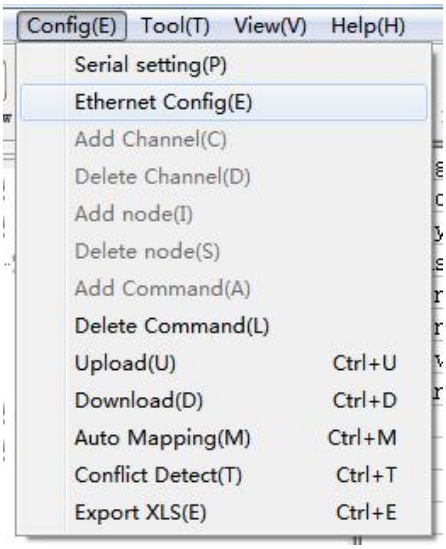
Set the correct input/output bytes for each command, then click

icon and select "yes" in the pop-up menu.

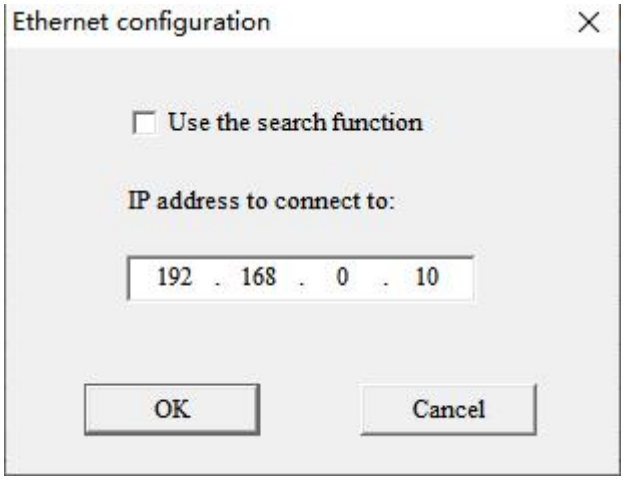


5.2.5 Upload Configuration

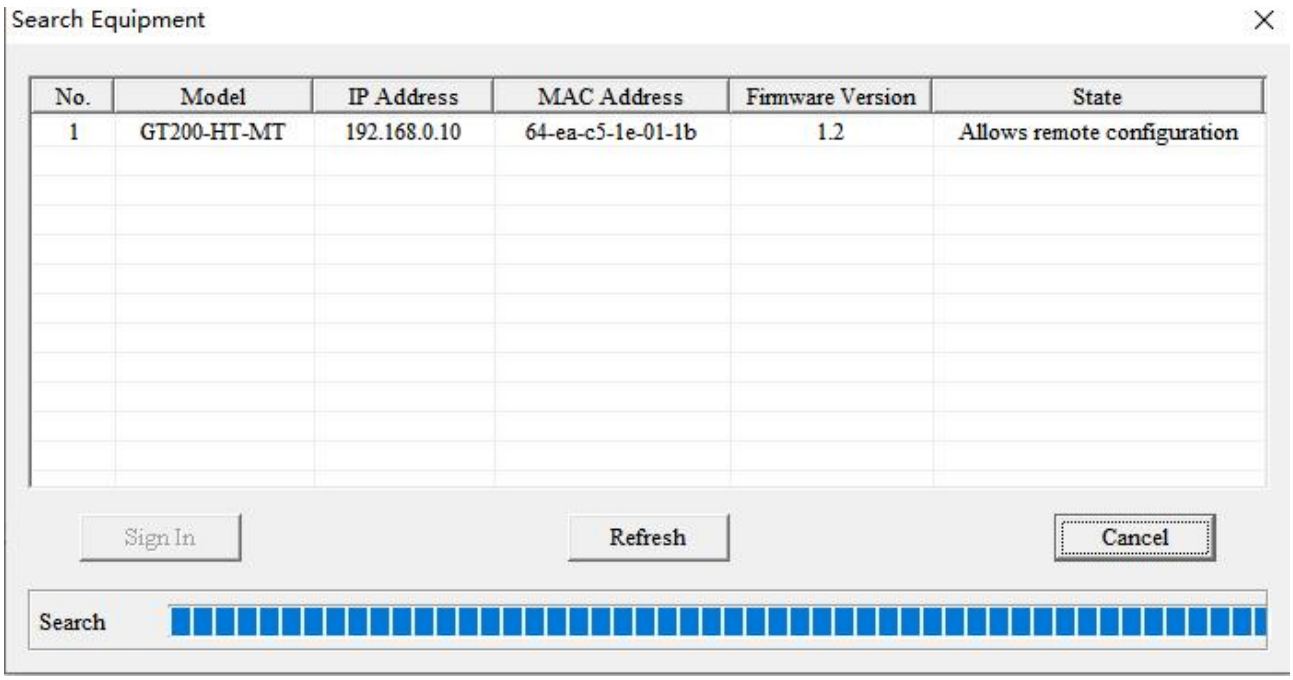
Select “Config” >> “ Ethernet Config” in the menu bar:



The "Ethernet Configuration" box is shown as below:



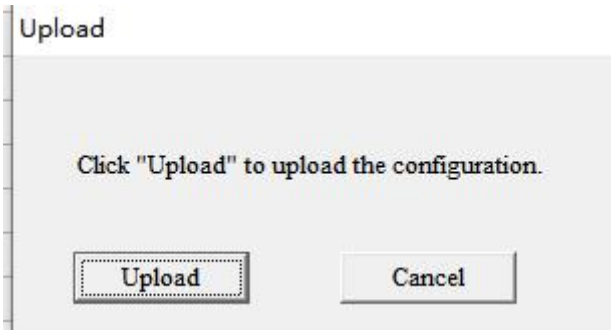
When ticking "Use the search function", it will search all identifiable hardware and show them in the device list:



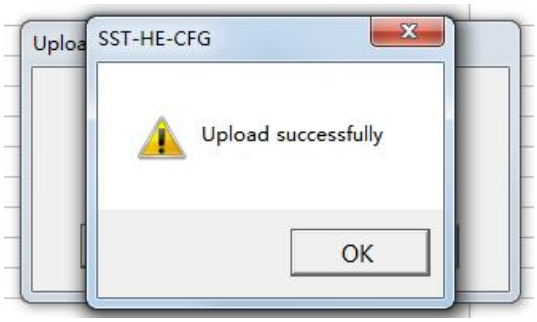
Select a device and click "Sign in" to connect the device.

When not ticking "Use the search function", it will only search the appointed hardware and only show this hardware in the device list.

Click the upload icon again, the pop-up box is shown as below:



Click "Upload" button.



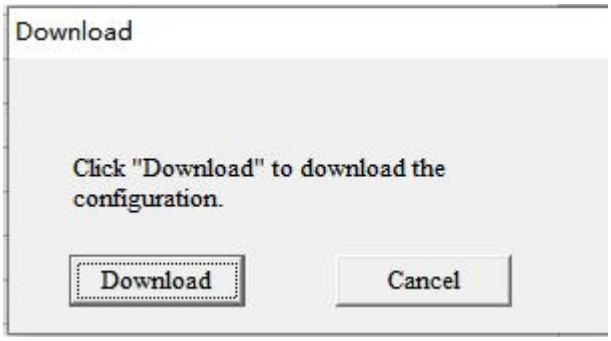
Now, users can upload the configuration of the GT200-HT-MT into the software and open it there.

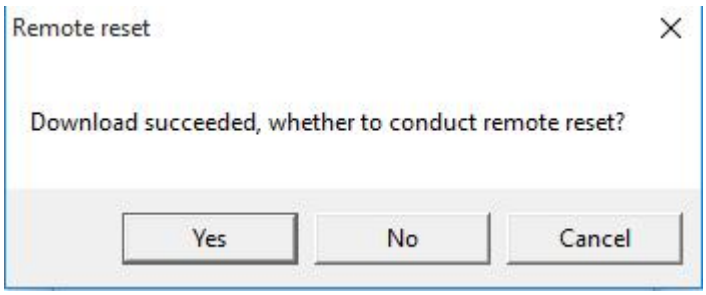
5.2.6 Download Configuration

After configuring the command, click

button, the pop-up box is as shown below.

Click "Download data".





Notes: Before downloading, please confirm all configuration is correct.

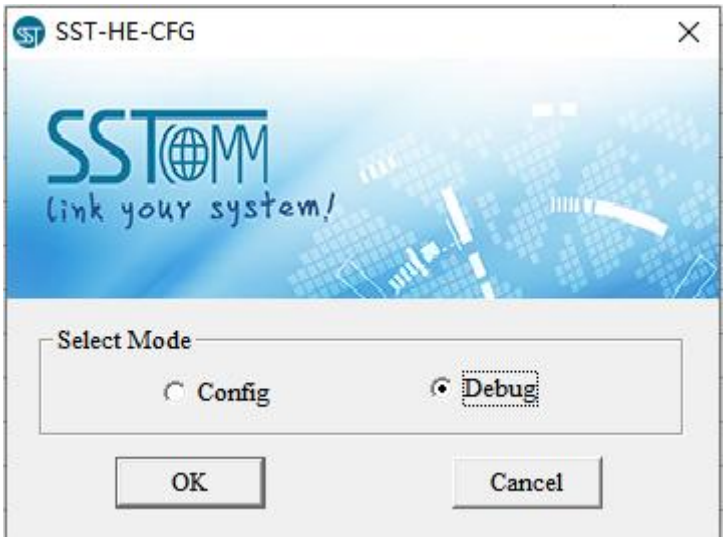
5.2.7 Memory Data Display

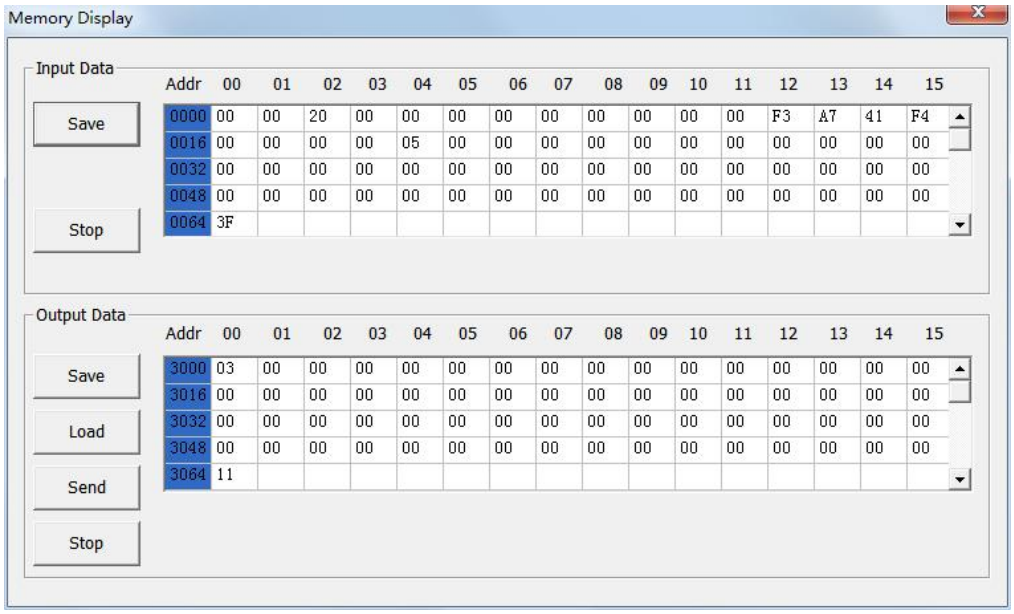
This function shows the data exchange inside of the gateway and is useful in debugging the HART fieldbus in the absence of an EtherNet/IP connection. Users can check the data in buffer of the GT200-HT-MT following these steps:

1. Ensure that the GT200-HT-MT is set to running mode. Set the configuration DIP switch Bit 1 OFF and Bit 2 OFF, then restart the gateway. The GT200-HT-MT now is in running mode.
2. Connect the GT200-HT-MT to the computer using the Ethernet interface. Open the software "SST-HE-CFG",

click "Tool" >> "Select Mode" and select debug mode. You can also click Mode Switch to change mode.

3. Click on the icon Memory. Choose the required gateway in the device scanning window, as shown below:





4. The upper table shows the memory distribution of HART input data, and the lower table shows the output data. When you need to modify the output data, first click the "Stop" button. Then modify the required data or load the already saved data table. Finally, click "Send".

5.2.8 Diagnose

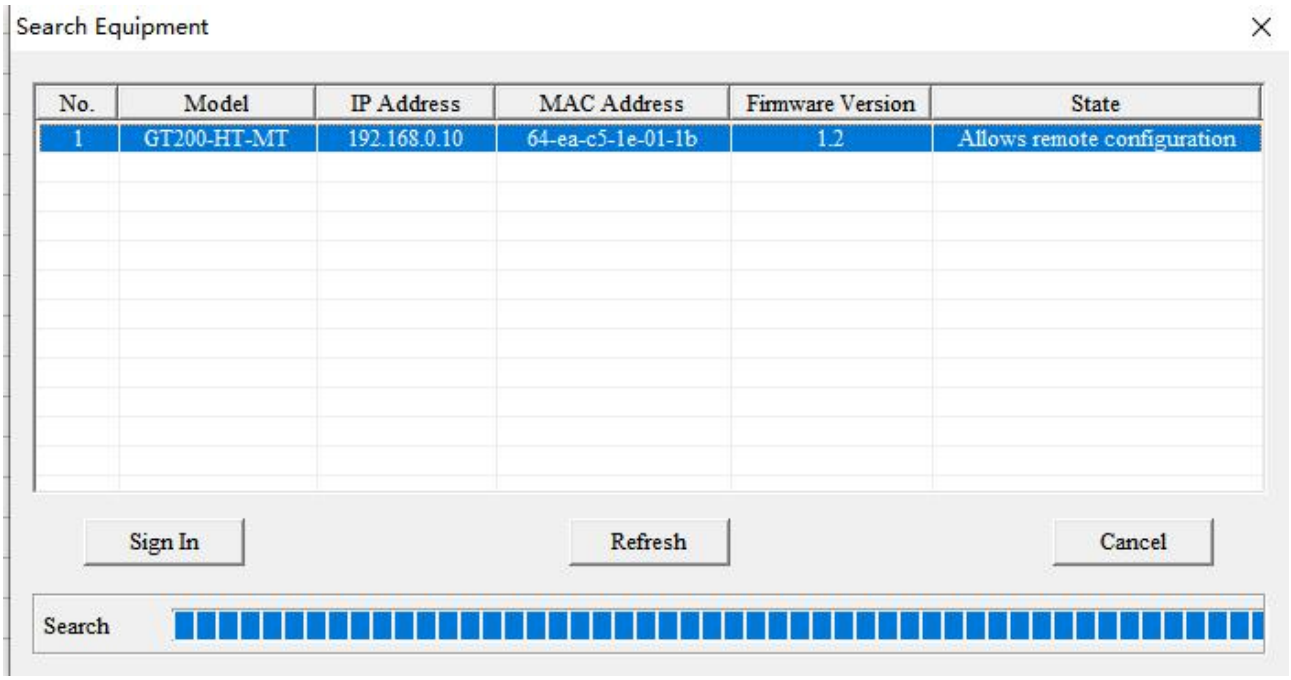
This function helps users to check the communication status of HART instruments, the execution of HART commands, the status of data transmission and reception. It also displays the specific commands and real-time data. The steps are as follows:

1. Ensure that the GT200-HT-MT is set to running mode. Set the configuration DIP switch Bit 1 OFF and Bit 2 OFF, then restart the gateway. The GT200-HT-MT now is in running mode.
2. Connect the GT200-HT-MT to the computer using the Ethernet interface. Open the software "SST-HE-CFG", click "Tool" >> "Select Mode" and select debug mode. You can also click

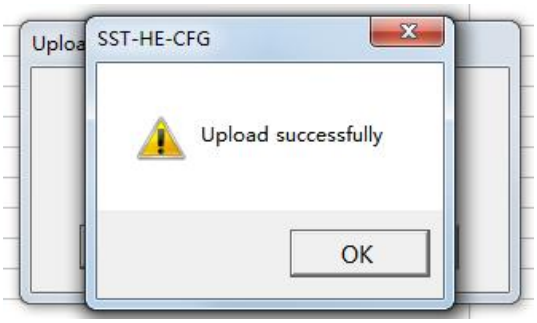
to change mode.

3. Click

and upload the configuration of the required gateway, as shown below:

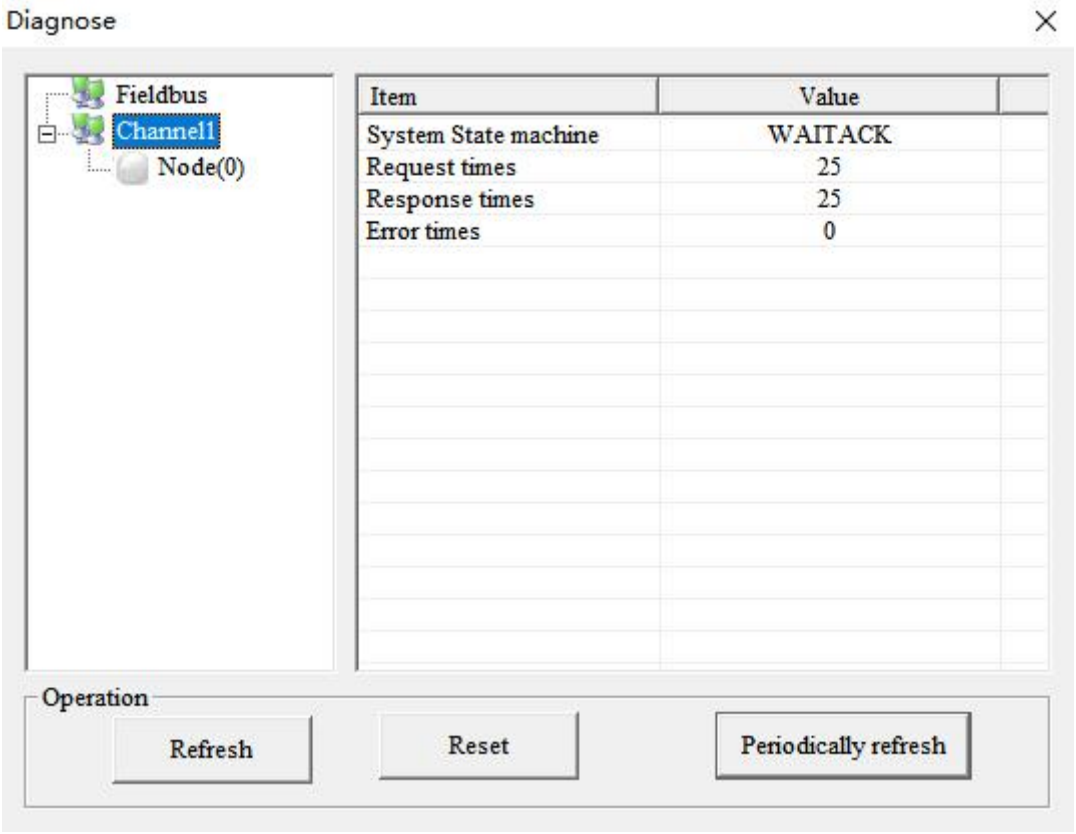


4. Click "Upload data":

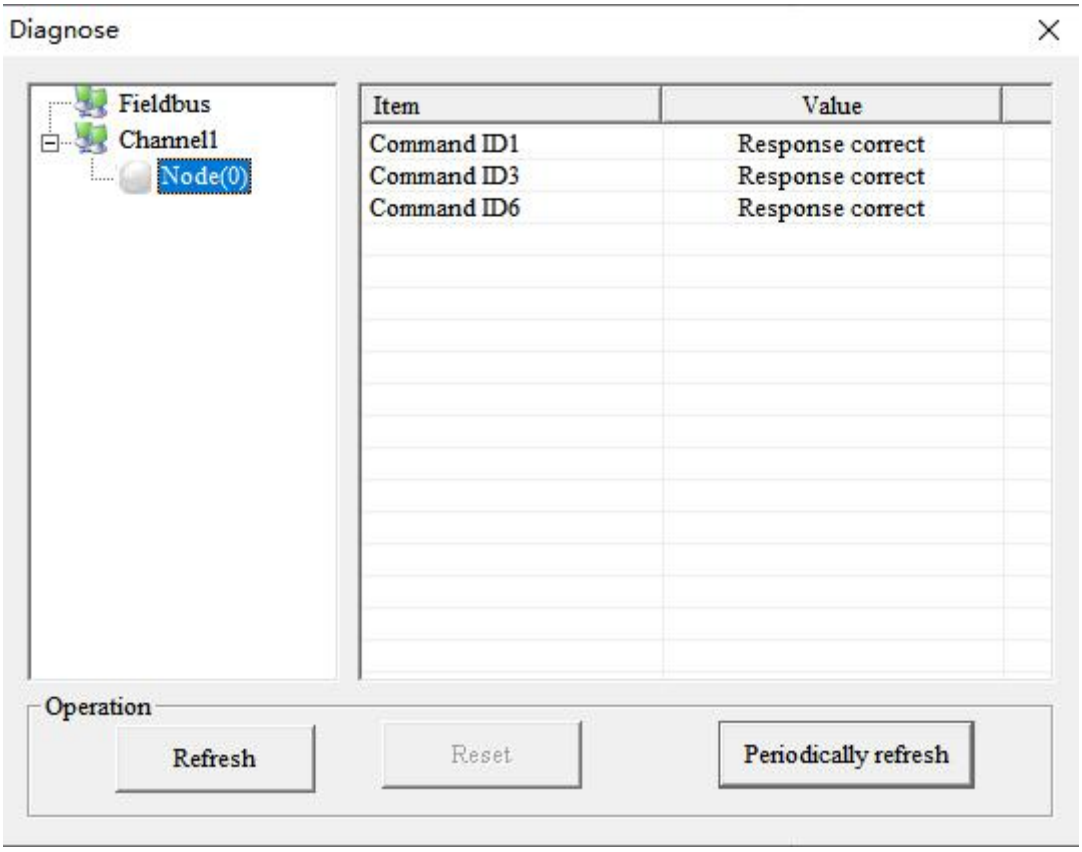


5. Click "OK" to open the diagnostic box. Click "Channel 1" and the right side will display the status of the HART fieldbus.

   Click "Refresh" to refresh the data once. Click "Reset" to clear the system status Click " Periodically refresh" to update the data in periodically.

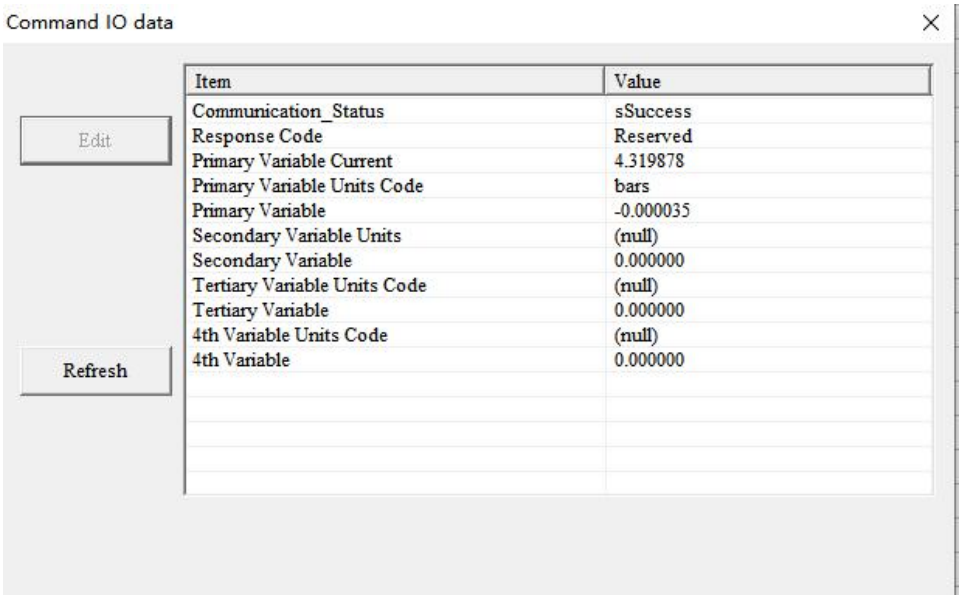


6. Click Node (x) and the response status of the configured commands will be shown on the right.



7. Double click on a command and the detailed information will be show in the pop-up box.

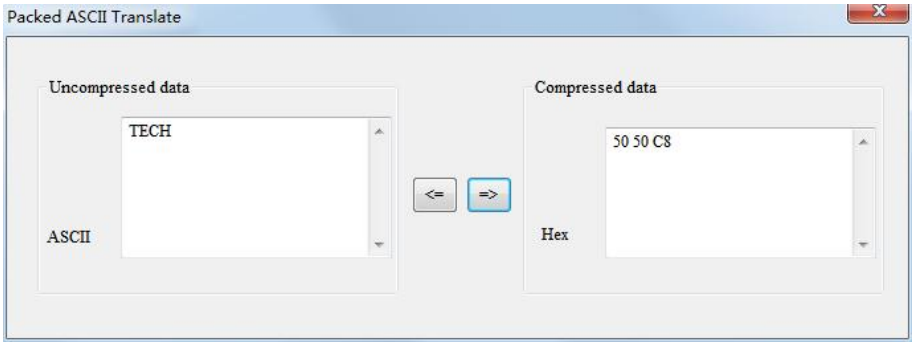
   For example, double click on "Command ID3":

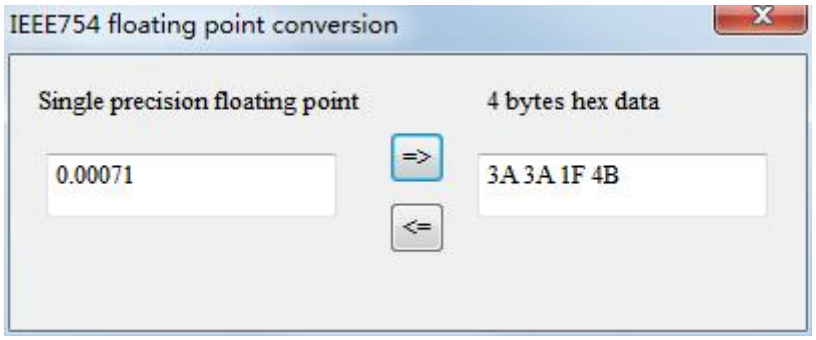


   Click "Refresh" to update the data. "Edit" in the read-only command does not work.

5.2.9 Conversion Tools

There are two practical tools in the "Tools" menu to convert hexadecimal data to 1EEE754 floats or PACKED ASCII codes.





6 Working Principle

6.1 Address Table

The GT200-HT-MT has a memory buffer of 8156 bytes. 0 to 4999 of the buffer is used for the HART input data and output data. 5000~8155 of the buffer is used for the status of the HART channel and control bytes.

HART Channel	Buffer Address	Modbus Address[1]		Read/Write[2]	Description
		Function Code	Address		
Input/Output Data	0-2999	04	0-1499 (3x0001-3x1500)	Read	HART input data (response data)[3]
	3000-4999	03, 06, 16	1500-2499 (4x1501-4x2500)	Read/Write	HART output data (request data)[4]
State and Control Bytes	5000-5019	04	2500-2509	Read	Device 0_cmd0 response data[5]
	5020-5039		2510-2519		Device 1_cmd0 response data
	……		……		……
	5300-5319		2650-2659		Device 15_cmd0 response data
	5320		2660 H		HART channel status[6]
	5321		2660 L		HART channel request counter
	5322		2661 H		HART channel response counter
	5323		2661 L		HART channel error counter
	5324		2662 H		Device 0_cmd0 status[7]
	5325		2662 L		Device 1_cmd0 status
	……		……		……
	5339		2669 L		Device15 _cmd0 status
	5340-5439		2670-2719		Configured HART command status[8]
	5744	03, 06, 16	2872 H	Read/Write	Counters reset trigger[9]
	5745		2872 L		Polling output control byte[10]
	5746		2873 H		Command request trigger[11]
	5747		2873 L		Triggered command index[12]
Others	Reserved				

Notes:

1. Modbus Address

The Modbus TCP client should use the corresponding function code(s) to read or write the data from/to the GT200-HT-MT, with the specified address. The Modbus address in the above table is based 0 and decimal.

For example, the Modbus address 0-1499 for the HART input data, is also the 3x0001-3x1500 as PLC address (based 1). For more example, please see chapter 4.2 Communication with Modbus TCP Client.

2. **Read/Write**

   (1) **Read:** The Modbus TCP client can only use function code 04 to read these data from the GT200-HT-MT.

   (2) **Write:** The Modbus TCP client can use function code 03 to read these data from the GT200-HT-MT, and use function code 06 or 16 to write data to the GT200-HT-MT.

3. **HART input data (response data):** The response data bytes from HART instruments.

4. **HART output data (request data):** The request data bytes sent by the Modbus TCP client through GT200-HT-MT.

   * For more details about the relationship between buffer address and Modbus address, please refer to chapter 4.2.

5. **Device N_cmd0 response data:** The GT200-HT-MT will always send a request of HART command 0 to get instrument information. The response data bytes will be stored in these addresses. The "N" is the HART instrument address.

6. **HART channel status:** The present status of the HART channel.

Table 6.1 - HART Channel Status

Value	Description
00	No data communication
01	Sending request
02	Waiting for response
03	Processing response

7. **Device N_cmd0 statues:** The status of the HART command 0 which is automatically sent. See Note 5 above.

Table 6.2 - Command Status

Value	Description
00	No request
01	Correct response
02	CRC error
03	No response
04	Errors defined by HART protocol
05	Disconnection with HART instrument(s)

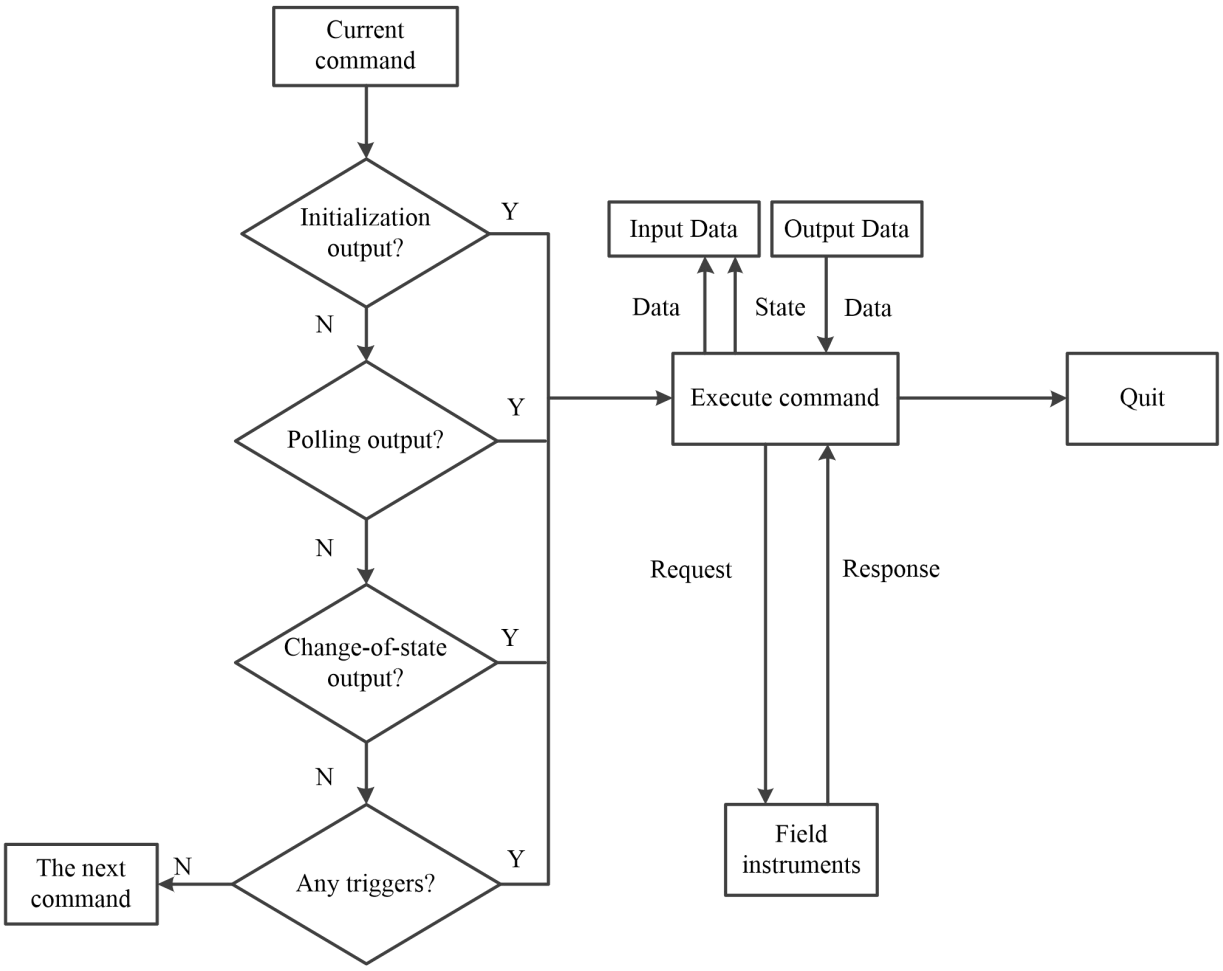
8. **Configured HART command status:** The status of configured HART command(s). These commands are configured in SST-HE-CFG software and will generate a unique "Command index". The status will be arranged in index order. For example, the high byte of 2670 input register (3x2671) is the status of the command of index 00, and the low byte of 3x2671 register is the status of the command of index 01. The status details refer to the *Table 6.2 - Command Status.*
9. **Counters reset trigger:** When this trigger changes the value, all the counters of HART channel (request, response and error) will reset to 0.
10. **Polling output control byte:** This control byte is defined as below.

Table 6.3 - Polling Output Control Byte

Value	Description
01	Enable polling output. The HART commands will be sent periodically.
00	Disable polling output. The HART commands will be sent with the trigger signal, see Note 11 and 12 for details.

11. **Command request trigger:** When this trigger changes the value, a request of the HART command will be sent. The triggered HART command is specified by the "Command index", see Note 12.
12. **Triggered command index:** The command index of the triggered HART command. The command is configured in SST-HE-CFG software and will generate a unique "Command index".

6.2 Flowchart of Executing One HART Command



6.3 Trigger Command

Users can trigger any HART command by sending a trigger byte and command index, following the steps below:

(The address table refers to chapter 6.1)

1. Disable the polling output. You can disable it in SST-HE-CFG software or by changing the “Polling output control byte” by Modbus TCP client.
2. Write the index of the command that you want to trigger, to the “Triggered command index” address. The command index is generated when you configure the HART command in SST-HE-CFG software.
3. Change the “Command request trigger” value.

4. Now the command of the index in “Triggered command index” address is triggered. The response data bytes will be stored in the corresponding buffer address.