

HART / Modbus TCP Gateway

GT200-HT-MT

User Manual

V 4.0

Rev B



SST Automation

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Important Information

Warning

The data and examples in this manual cannot be copied without authorization. SST Automation reserves the right to upgrade the product without notifying users.

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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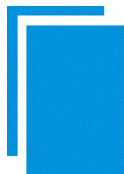


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1 Product Overview

1.1 Product Function

The GT200-HT-MT gateway can provide a seamless connection between HART instruments and Modbus TCP Clients. It can connect up to 15 HART slave devices to up to 4 Modbus TCP Clients to easily read and write data between HART and Modbus TCP. On the HART side, the GT200-HT-MT can be configured as a primary or secondary master, and on the Ethernet side it functions as a Modbus TCP Server.

1.2 Product Features

- Easy to use: The product manual includes application examples to quickly configure the gateway to read and write data to HART instruments .
- Powerful functionality: Supports quick scanning and modification of the HART slave address, point-to-point mode which allows the coexistence of an analog 4-20mA signal alongside a digital HART signal, and primary master and secondary master functionality on the HART side.
- Convenient debugging features: The configuration software SST-HI-CFG offers a real-time visual display of data traffic as well as HART command diagnostics and communication debugging functions that greatly facilitate user communication tests.

1.3 Technical Specifications

- [1] IP address conflict detection.
- [2] Can be configured as either a primary or secondary HART master.
- [3] Supports single-point and multi-point mode at the HART side.
- [4] Support for online scanning of HART devices and modification of address functions.
- [5] Under point-to-point mode, supports data burst operation from slave.
- [6] Supports one HART-channel with optional internal or external terminal resistors, under multi-point mode, supports connecting at most 13 HART slaves with gateway internal resistor and supports connecting 15 HART slaves with an external resistor (250 Ohm).
- [7] Supports all commands of the HART 6 protocol.



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- [8] Each HART command can be configured for change-of-state output, polling output, initialization output or disable output.
- [9] HART channels support up to 127 user commands, a mix of basic and advanced modes, with a maximum of 30 commands in advanced mode, HART output data buffers up to 1000 bytes and input data buffers up to 1600 bytes.
- [10] The Ethernet side supports setting static IP or DHCP. the IP will be fixed to 192.168.0.11 after 30s of unsuccessful DHCP assignment.
- [11] The Modbus TCP side supports function codes: 03, 04, 06, 16.
- [12] The Modbus TCP side supports 03, 04 function codes for data reading.
- [13] The Modbus TCP side supports a maximum input byte count of 1600 bytes and a maximum output byte count of 1000 bytes.
- [14] Up to 4 TCP connections can be established simultaneously on the Modbus TCP side.
- [15] Power: 24VDC (11V-30V), 70mA (24VDC).
- [16] Operating temperature: -40 °F-140 °F (-40 °C-60 °C). Humidity: 5%- 95% (without condensation).
- [17] Dimensions (W*H*D): 1.0 in * 4.0 in * 3.6 in (25 mm * 100 mm * 90 mm).
- [18] Installation: 35mm DIN RAIL.
- [19] Protection Level: IP20.

1.4 Related Products

Related products include:

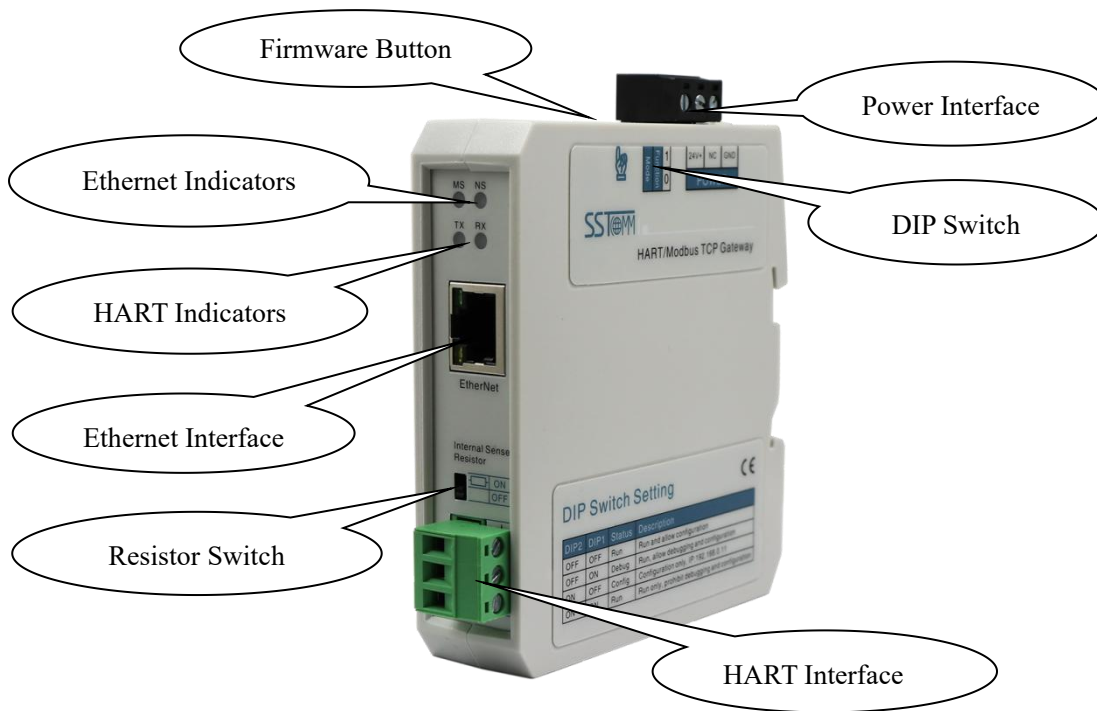
- GT200-HT-RS
- GT200-3HT-MT
- GT200-3HT-RS
- GT100-HT-EI

To get more information about related products, please visit SST Automation's website: www.sstautomation.com.

1.5 Revision History

Revision	Date	Chapter	Description
V4.0, Rev B	10/09/2025	ALL	Fixed minor issues and improved text clarity
V4.0, Rev A	12/22/2023	Chapters 2.7.1, 2.7.2, 6.11	Fixed the node points for the Point-to-Point wiring diagrams in Chapter 2.7.1 Added external HART resistor examples for the Multi-Drop wiring diagrams in Chapter 2.7.2 Added instructions on how to configure the Modbus TCP register addresses in Chapter 6.1.1
V4.0	10/30/2023	ALL	V4.0 new release, Added Modbus TCP function code selected, Slave scan...

2 Hardware Description



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

2.2 LED Indicators

Indicator	State		Description
TX	Green blinking		HART data transmitting
	Green off		No data transmitting
RX	Green blinking		HART data receiving
	Green off		No data receiving
NS	Green on		Modbus TCP connection is established. Communication is normal.
	Green blinking		Modbus TCP connection is not established.
MS	Static IP	Red off	Module status: IP address starts normally
		Red blinks 3 times	Module status: Static IP initializing
	DHCP	Red blinks 5 times and then turns off	Module status: DHCP allocate address successfully
		Red light blinks for 30s and then turns off	Module status: DHCP allocation failed, IP address fixed at 192.168.0.11

2.3 Firmware Button

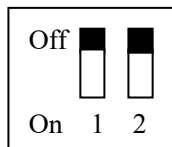
The firmware button is located at the top of the product and used to enter the bootload state to download the firmware.

Action	Description
Hold then power on	Bootload state to update firmware.

Note: Under normal circumstances, please do not press the button!

2.4 Configuration DIP Switch

The configuration DIP switches are located at the top of the product. Turn Function (Bit 1) to Off and Mode (Bit 2) to Off and power on (or reboot) to put the device work into Run Mode.

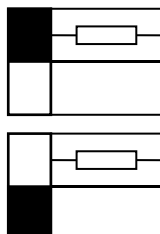


Function (Bit 1)	Mode (Bit 2)	Mode	Description
Off	Off	Run Mode	Allows configuration and communication.
On	Off	Debug Mode	Allows configuration, communication and debugging.
Off	On	Configuration Mode	IP address is fixed at 192.168.0.11. Allows configuration. Prohibits Ethernet and HART communication.
On	On	Run Mode	Allows communication. Prohibits configuration and debugging.

Note: To apply mode switching, please restart the gateway.

2.5 Internal Series Resistor Switch

The GT200-HT-MT has an internal series resistor (270 Ohm /2 W) required for the HART channel. When the internal resistor is enabled, up to 13 HART instruments can be connected. When the power going through the series resistor is more than 2W, you must use an external series resistor (250 Ohm /3 W) which allows the gateway to be connected to up to 15 HART instruments.



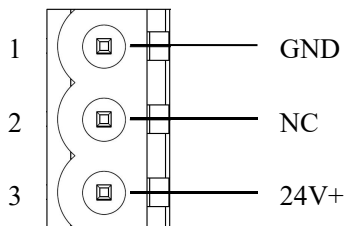
Switch to ON: Using the internal series resistor

Switch to OFF: Using the external series resistor

2.6 Interfaces

2.6.1 Power Interface

The GT200-HT-MT includes one power interface. A 24V DC power supply is recommended.



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

2.6.2 Ethernet Interface

The Ethernet interface uses RJ45 interface, follows the IEEE802.3u 100BASE-T standard.

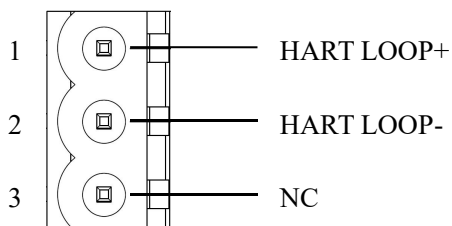
Its pin (standard Ethernet signal) is defined as below:



Pin	Description
S1	TXD+, Transmit Data+, Output
S2	TXD-, Transmit Data-, Output
S3	RXD+, Receive Data+, Input
S6	RXD-, Receive Data-, Input
S4,5,7,8	Reserved

Note: The Ethernet interface is not compatible with crossover cables. It is recommended to use a standard CAT5 or CAT5E Ethernet patch cable.

2.6.3 HART Interface



Pin	Description
1	Connected to HART signal +
2	Connected to HART signal -
3	NC (Not connected)



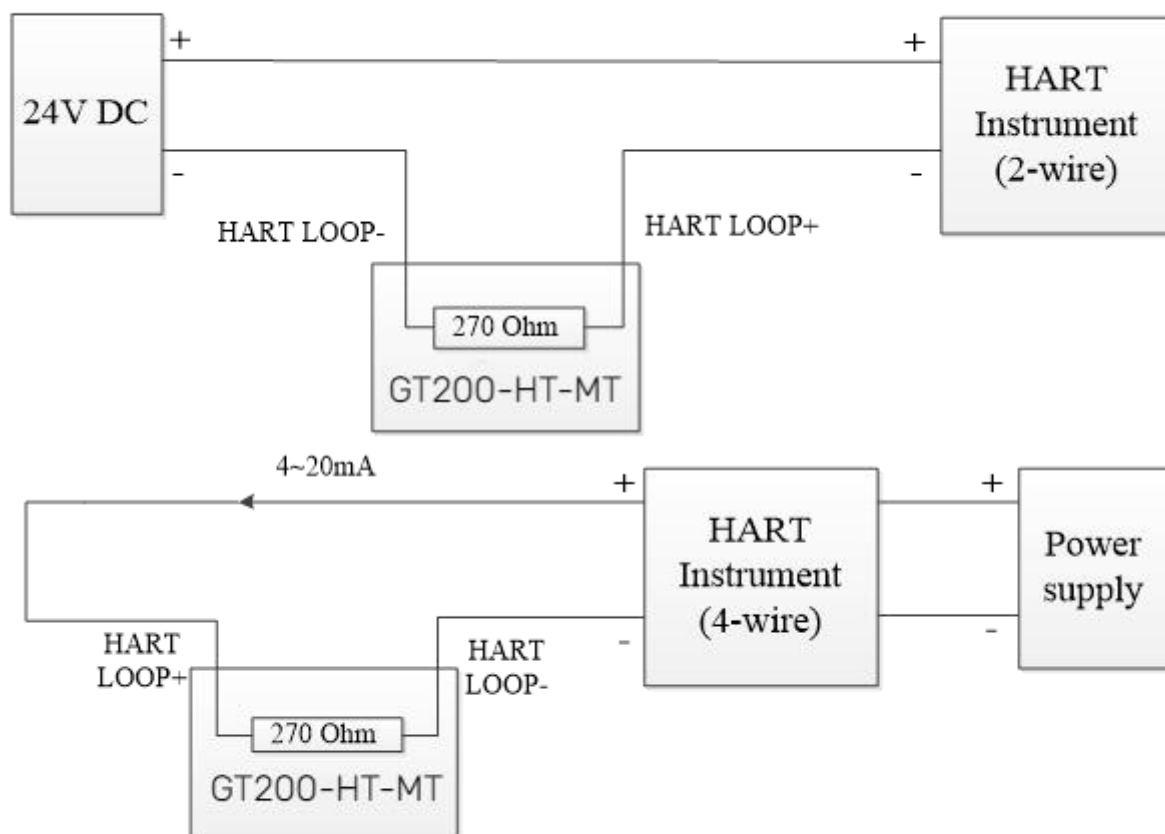
2.7 Topology of GT200-HT-MT and HART Instruments

Notes:

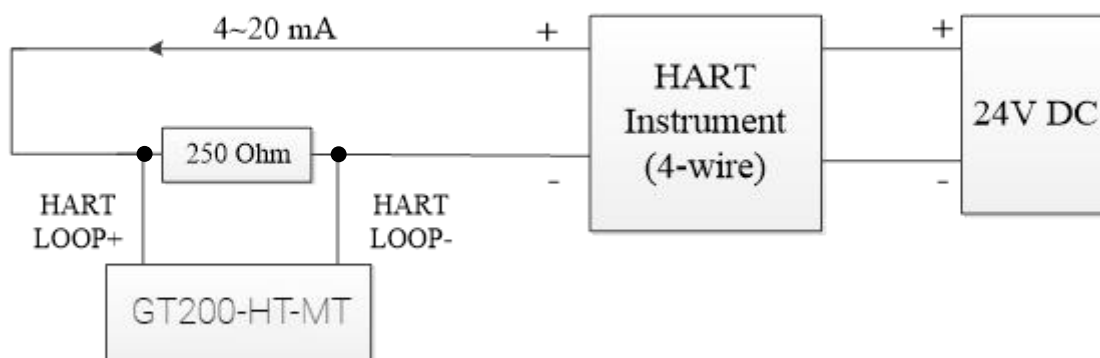
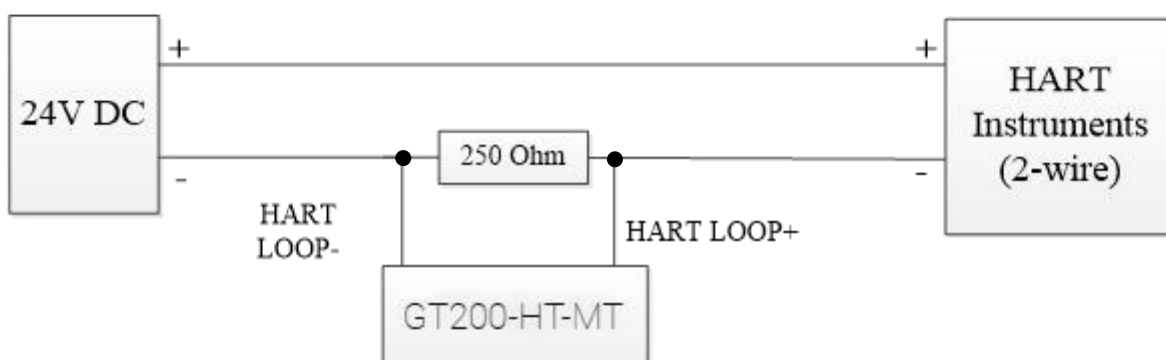
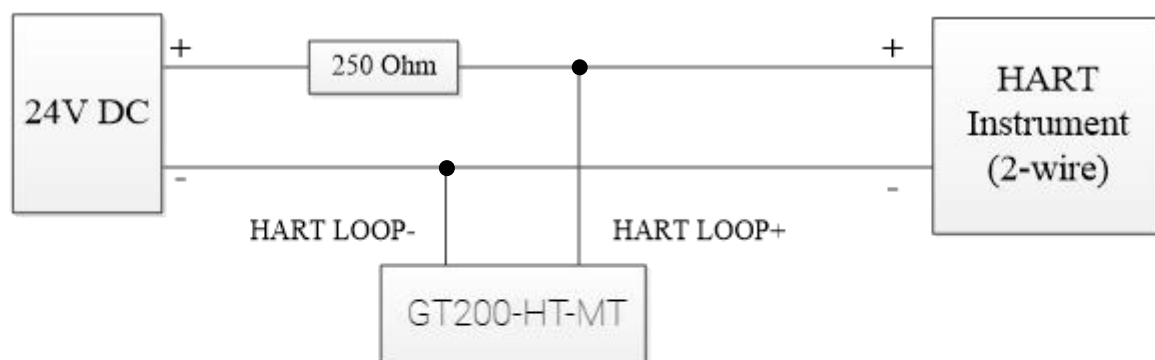
1. Some HART instruments need to perform internal work such as self-test when they are first powered on, and may not communicate with HART at this time. It is recommended to use the separate power supply for the HART instruments and the GT200-HT-MT, to ensure stable communication.
2. To improve the communication efficiency of the field bus, it is recommended not to configure empty nodes or unused commands in the SST-HI-CFG configuration software.
3. HART devices can be categorized as either two-wire systems or four-wire systems. A two-wire system means that HART devices have only two wires for both communication and power supply, while a four-wire system means that the power supply and communication lines of HART devices are separated.
4. 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.
5. When using Multi-Drop mode, the HART instruments should be configured to Fixed Current mode at 4mA.
6. When connecting more than 13 HART instruments, disable the internal resistor and use an external resistor (250 Ohm /3 W). See [Chapter 2.5](#).

2.7.1 Point-to-Point Wiring

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



When using the internal resistor

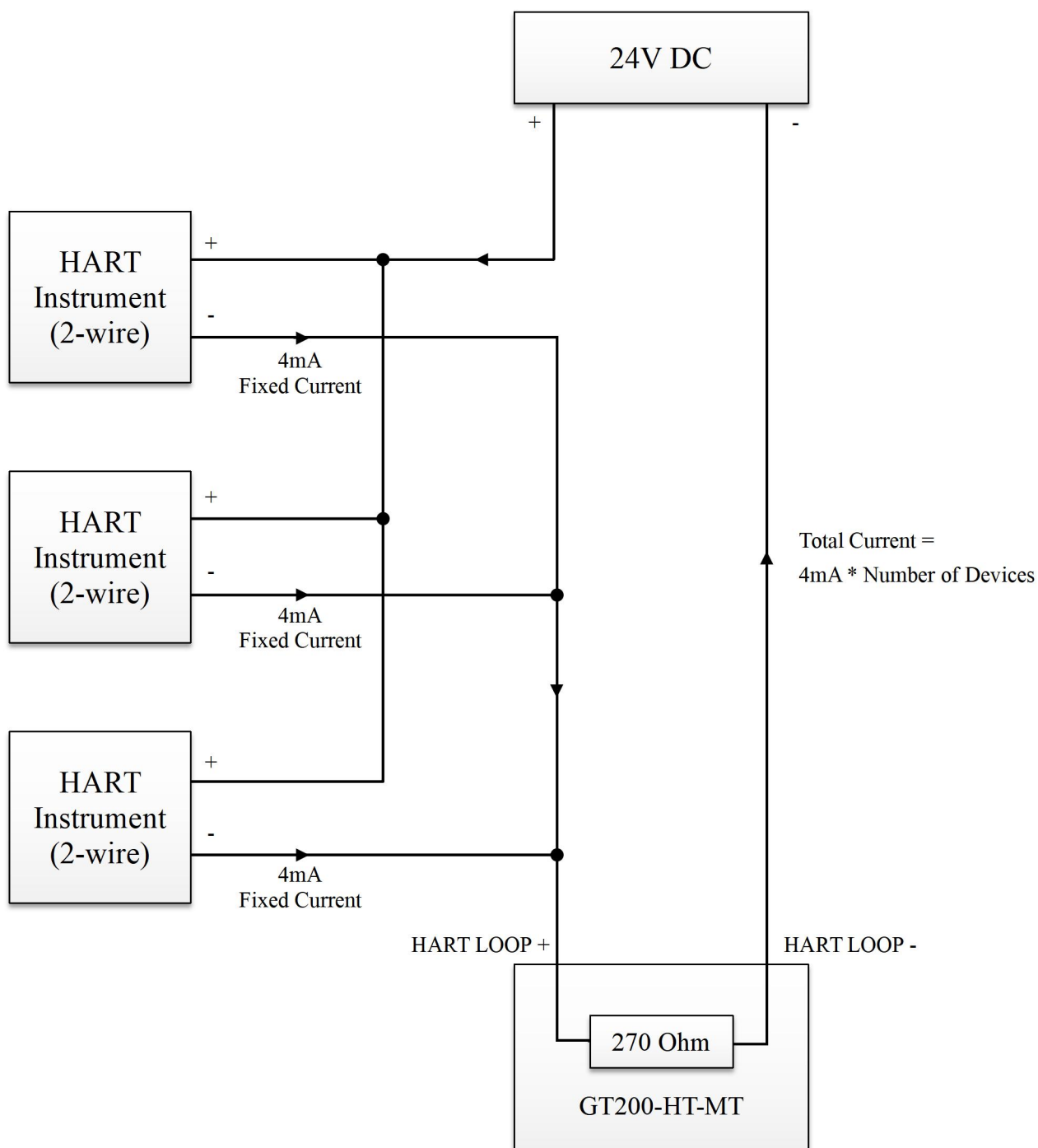


Options when using an external resistor

2.7.2 Multi-Drop Wiring

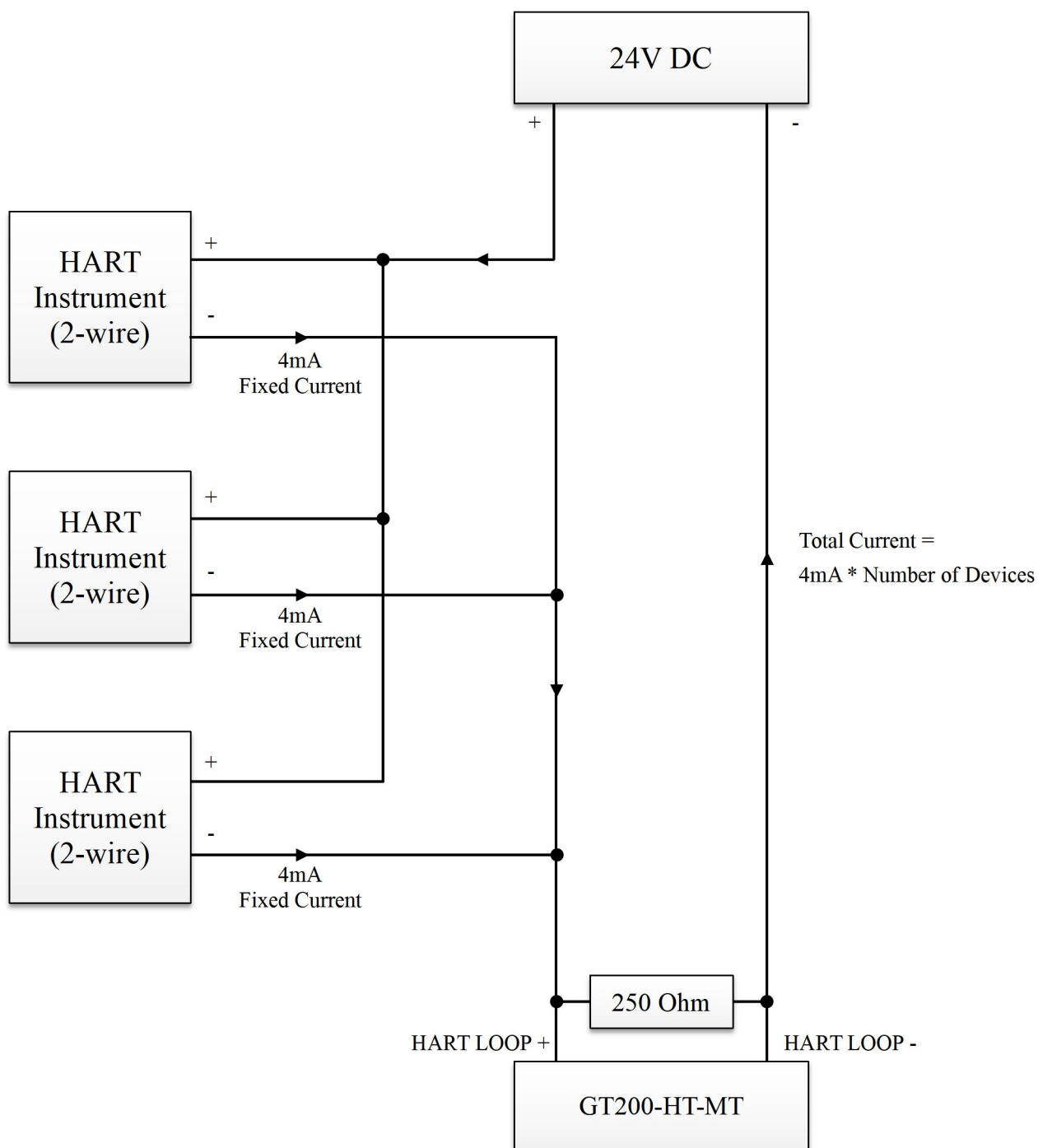
The following are the topologies for two wire and four wire multi-drop wiring.

Two wire – When using the internal resistor:



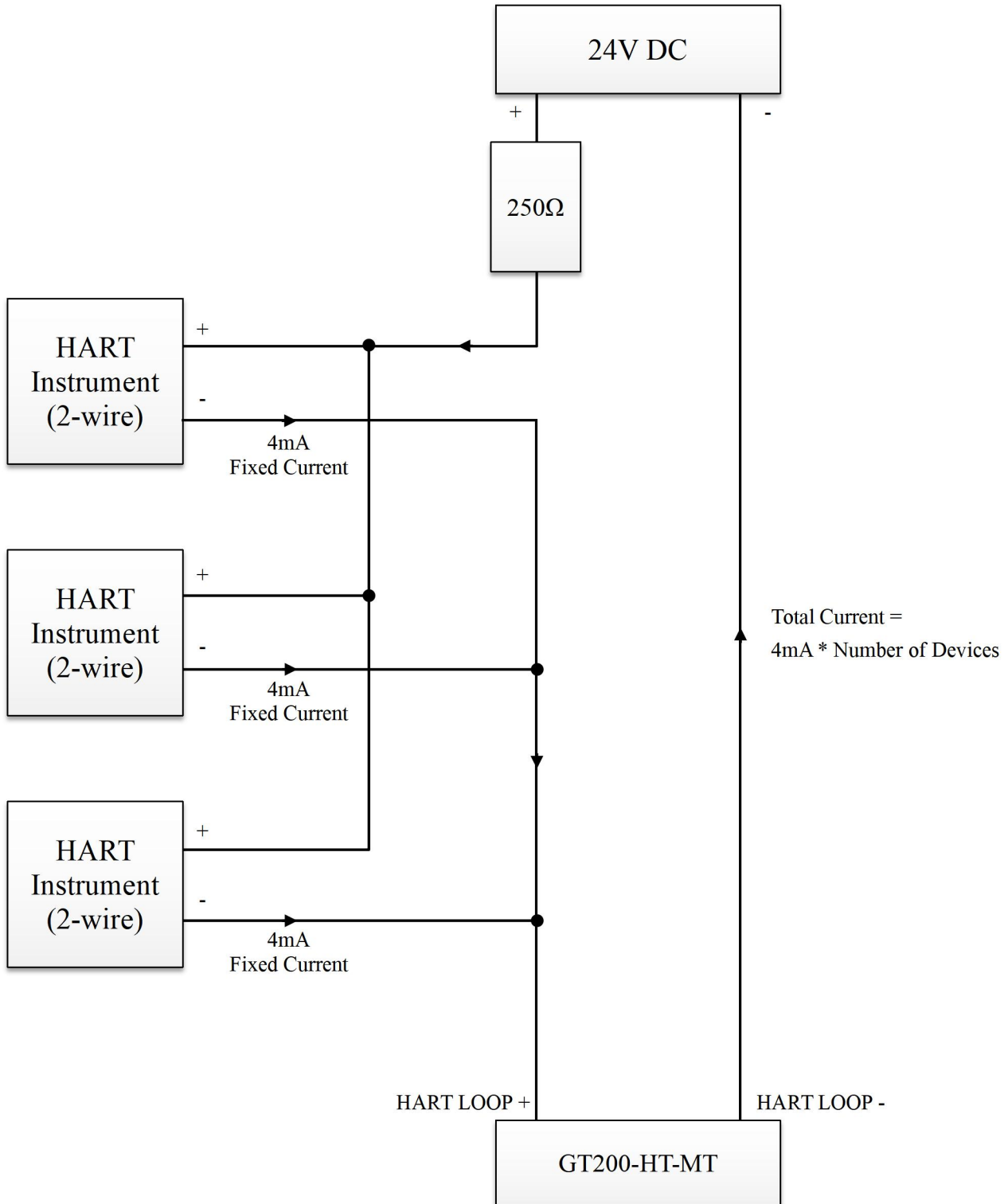
Maximum Cable Length: 450m for 15 Devices

Two wire – When using an external resistor:



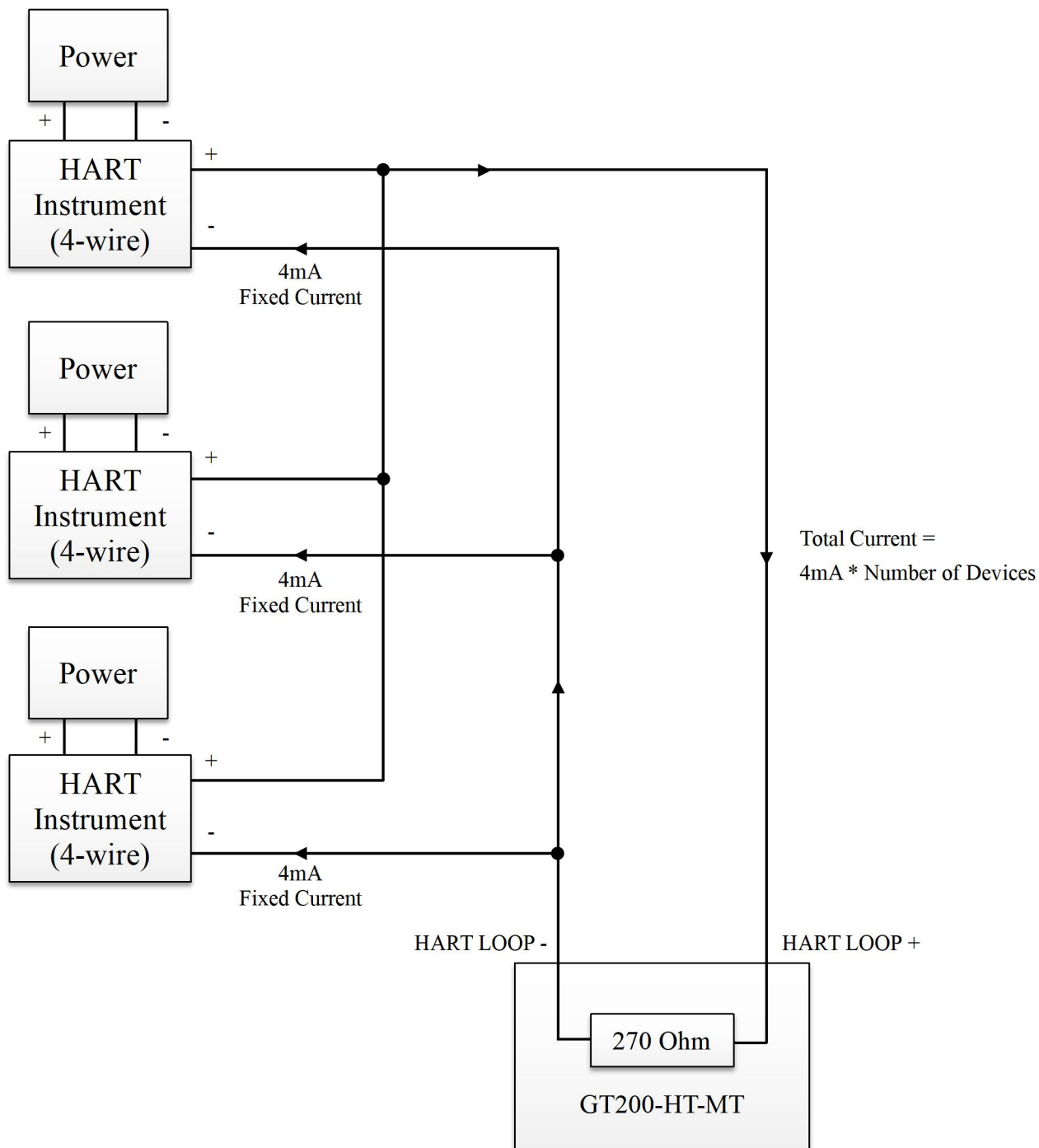
Maximum Cable Length: 450m for 15 Devices

Two wire – When using an external resistor:



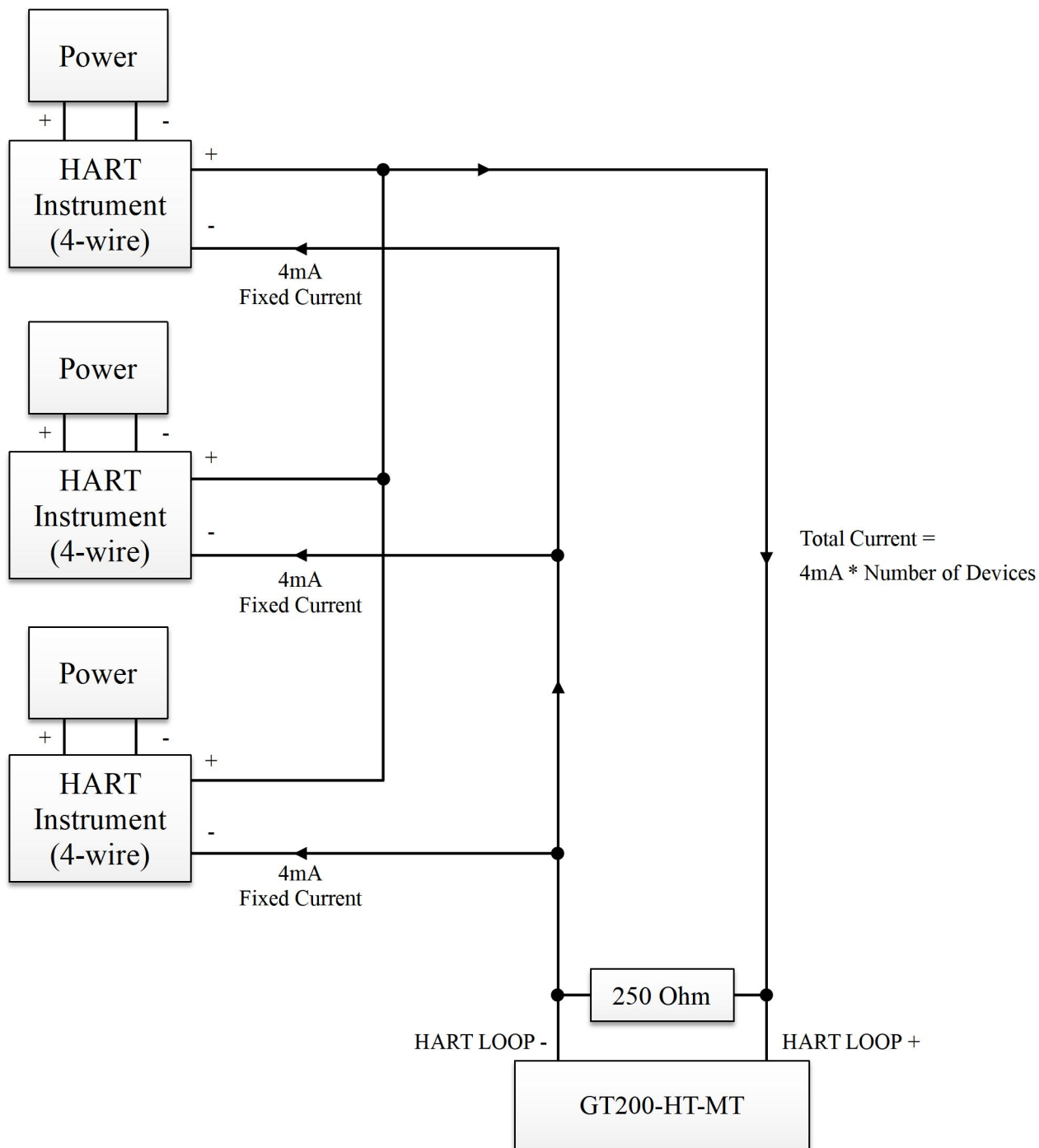
Maximum Cable Length: 450m for 15 Devices

Four wire – When using the internal resistor:



Maximum Cable Length: 450m for 15 Devices

Four wire – When using an external resistor:



Maximum Cable Length: 450m for 15 Devices

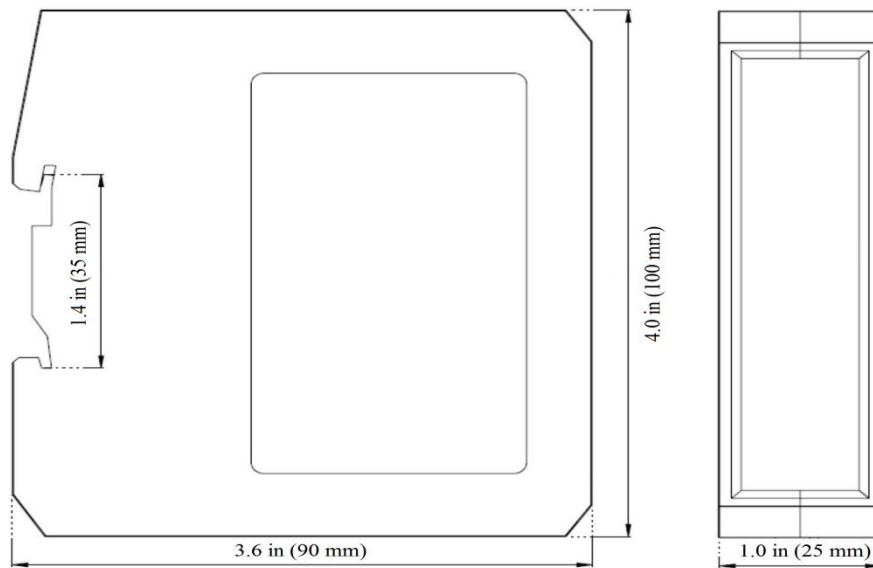


3 Hardware Installation

3.1 Mechanical Dimensions

Size (width * height * depth):

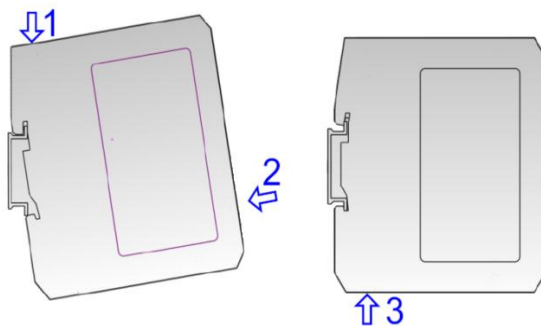
1.0 in * 4.0 in * 3.6 in (25 mm * 100 mm * 90 mm)



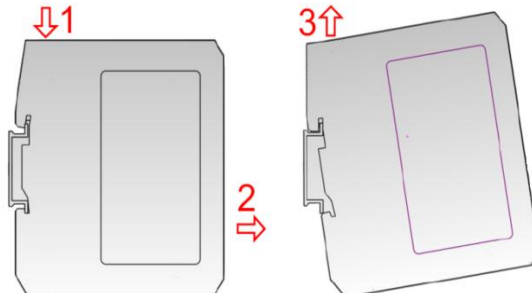
3.2 Installation Method

Using 1.4 in (35mm) DIN RAIL.

Install



Uninstall

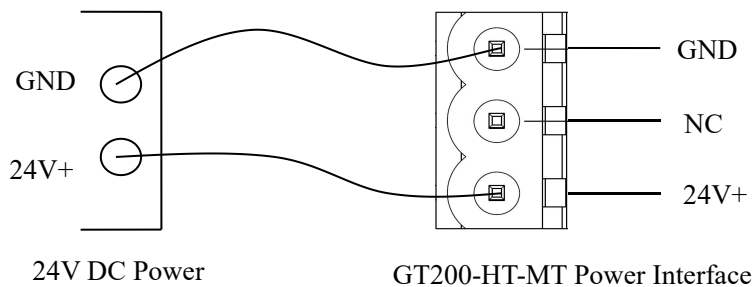




4 Quick Start Guide

4.1 Hardware Connection

1. Make sure the GT200-HT-MT is in the appropriate operating mode that allows for configuration. Set the gateway to Configuration Mode by setting the DIP switches to 1-OFF, 2-ON while the gateway is powered off.
2. Connect the Ethernet port of the gateway to the network port of the computer with a network cable. For details about the Ethernet interface, refer to [Chapter 2.6.2](#).
3. Connect the HART instruments to the GT200-HT-MT. Refer to the wiring diagrams shown in [Chapter 2.7](#).
4. Connect the power supply to the gateway as shown in the figure below.



5. Power on the gateway, the gateway will be in Configuration Mode at this time. The IP of the gateway will be fixed to 192.168.0.11, and the IP of the connected computer should be set to a static IP within the 192.168.0.X subnet. Double-click the installed software icon SST-HI-CFG to start the configuration of the gateway.
6. After the gateway has been configured, power off the gateway and set the gateway to Run Mode by setting the DIP switches to 1-OFF, 2-OFF, then power on the gateway.

- 

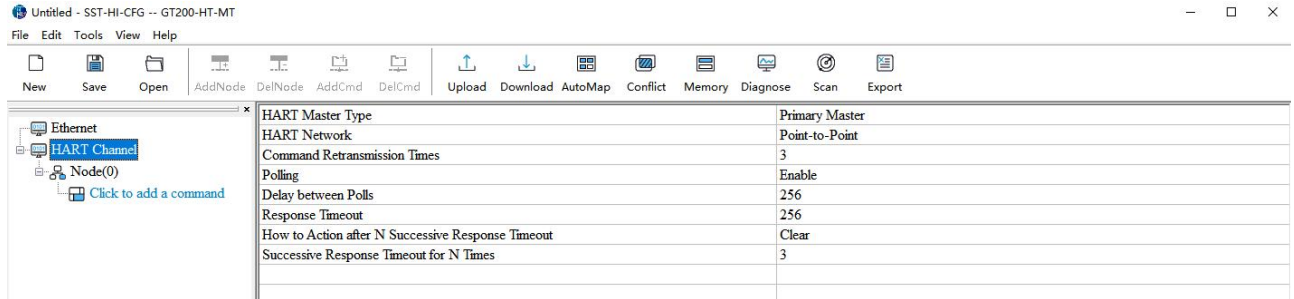
-
- The screenshot displays the 'Gateway Configuration Software SST-HI-CFG -- GT200-HT-MT' application window. The menu bar includes File, Edit, Tools, View, and Help. The toolbar contains icons for New, Save, Open, AddNode, DelNode, AddCmd, DelCmd, Upload, Download, AutoMap, Conflict, Memory, Diagnose, Scan, and Export.
- On the left, a tree view shows the configuration hierarchy: Ethernet > HART Channel > Node(0) > Command ID1 and Command ID3. The main area is divided into two panes:
- Left Pane (Properties):** Lists various configuration options such as Type of Protocol, Assign IP Mode, IP Address, Subnet Mask, Default Gateway, DNS1, DNS2, Enable Unit ID, Unit ID(1~247), Function Code of Modbus TCP Client Reading Data, Starting Address of Read-Only Register (Input Data), and Starting Address of Read/Write Register (Output Data).
 - Right Pane (Values):** Displays the current values for each option, including 'Modbus TCP Server', 'Manually Assign', '192.168.0.11', '255.255.255.0', '192.168.0.1', 'Disable', and '04 Read Input Data, 03 Read Back Output Data'.
- At the bottom left, there are tabs for 'Info' and 'News'.

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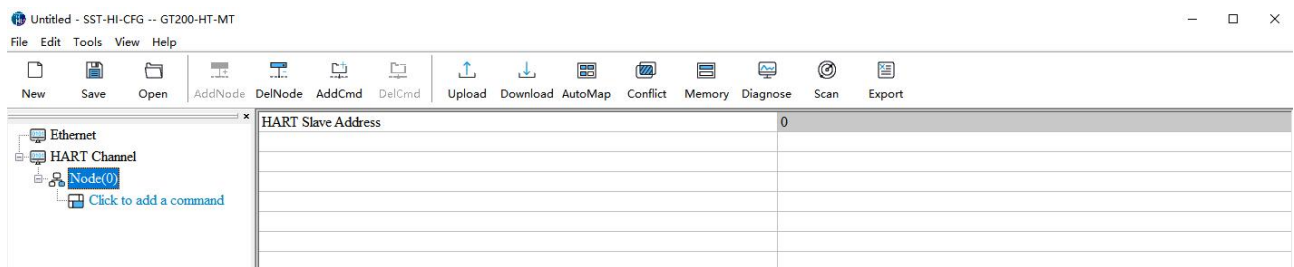
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3. Select "HART Channel" on the left and set the HART channel parameters. As shown below, the GT200-HT-MT is configured as the primary master and using the point-to-point mode.



Note: The HART protocol specifies that devices with slave address 0 work in point-to-point mode, and this allows HART signals and an analog 4-20mA signal to exist at the same time. Devices with slave addresses from 1 to 15 work in multi-drop mode, and this forces the analog output of the HART devices to their minimum value (such as 4mA), which means that only HART signal communication is allowed. The protocol also specifies that the factory address of the field device is configured to 0 by default.

4. You can either click "Click to add a node", select "HART Channel" and click "Add Node" on the toolbar, or right-click "HART Channel" and click "Add Node" to add a node to the HART channel.

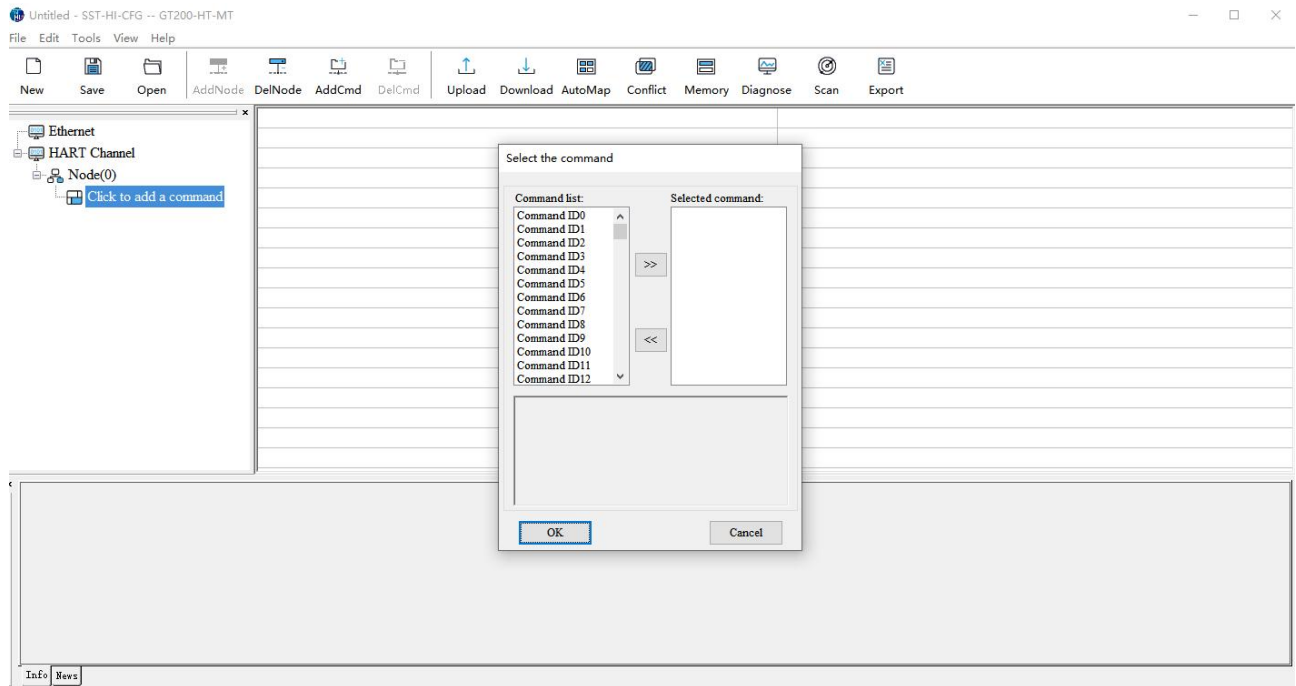


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5. You can either click "Click to add a command", select "Node (0)" and click "Add Cmd" in the toolbar, or right-click "Node (0)" and click "Add command" to add a command in the corresponding node. In the pop-up dialog box, add command ID1 by double-clicking or selecting and clicking ">>", and click OK".



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6. Click “Command ID1”. The configuration of the HART commands (Basic and Advanced) are shown below:

The first screenshot shows the 'Basic' configuration mode for 'Command ID1'. The configuration table is as follows:

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

The second screenshot shows the 'Advanced' configuration mode for 'Command ID1'. The configuration table is as follows:

Configuration Mode	Advanced
Mode of Outputting Commands	Polling
Memory Starting Address of Sending Data	3000
Modbus TCP Starting Address of Sending Data	0
Length of Sending Data (BYTE)	0
Length of Sending Data (WORD)	0
Configuration of Receiving Data	Configuration
Command Index	0

To read the Primary Variable, move Bytes 1-4 (primary variable) to the mapping address section of the window. This allows the data to be received and read at the specified Modbus register address.

The 'Advanced Configuration' window displays the 'Mapping address' table and the 'Response data' section. The 'Mapping address' table is as follows:

Bytes	Memory Address	Modbus Register Address	Byte Swap
1-4	0	0	Register Swap

The 'Response data' section shows:

Command Status
Byte0

At the bottom, instructions are provided: "Add: Double-click the data block on the right" and "Delete: Select the data block on the left and press the Delete key or double-click the data block on the left to delete".

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- Click the icon , select the gateway in the pop-up dialog box and click "Download", then click "Download Configuration".

Search Device ×

No.	Model	IP Address	MAC Address	Firmware version	Type of Protocol	Status
1	GT200-HT-MT	192.168.0.11	64-EA-C5-1E-00-00	4.0	Modbus TCP Server	Run enable remote configuration

Searched

Download

Click "Download" to download the configuration.

SST-HI-CFG ×

 Download is successful, whether to perform remote reset?

4.3 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 Request		Data in Response			
#	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

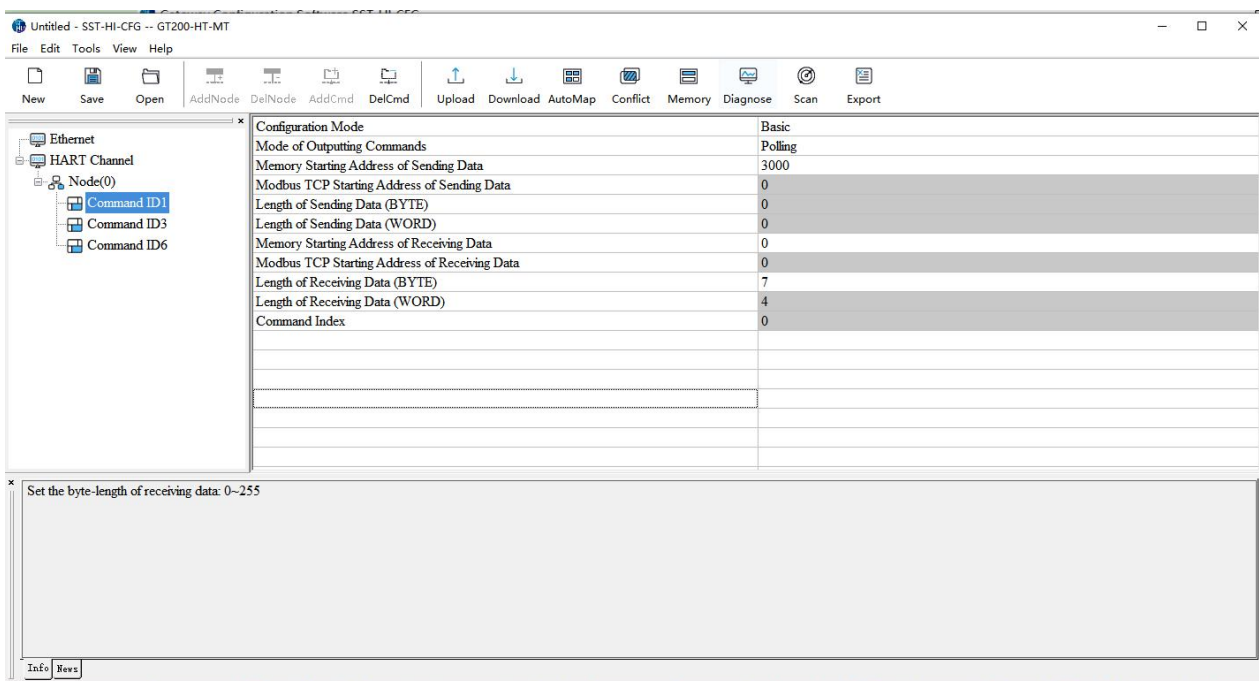
Returns the primary variable value in float data type.

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.

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

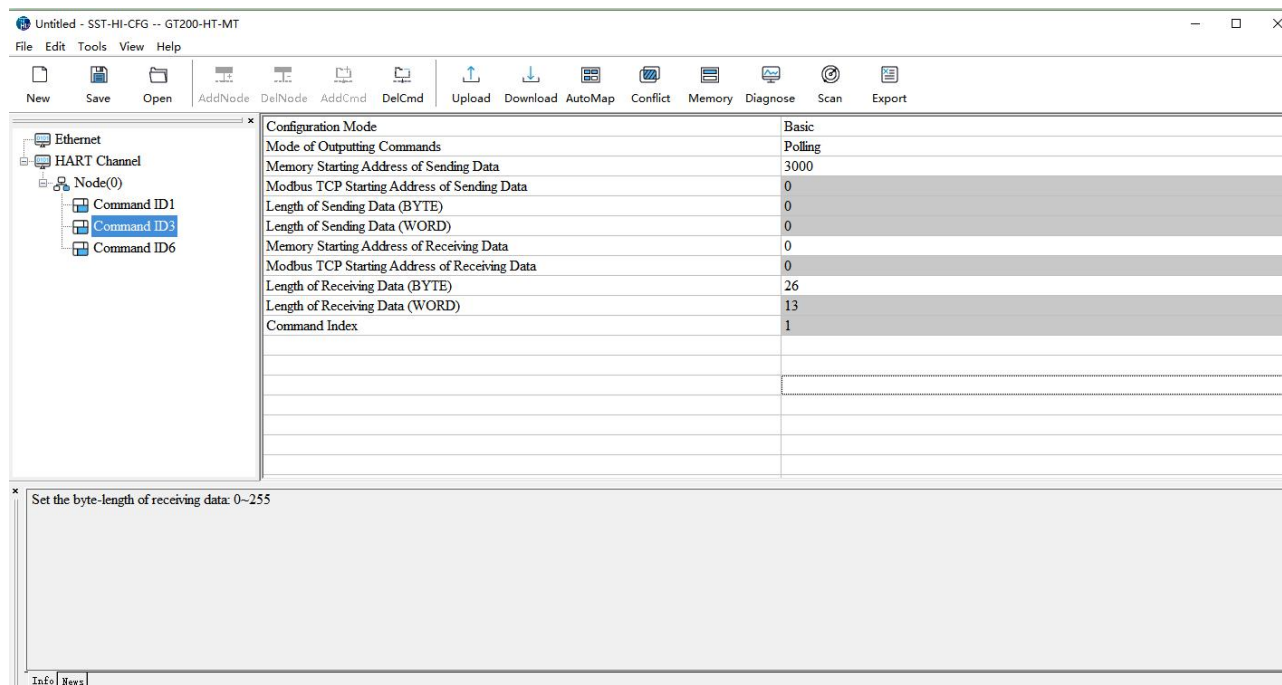
Reads the primary variable current and four (at most) pre-defined dynamic variables. The primary variable current always matches the AO output current of the device. A second, third and fourth variable is defined for each device type, E.g. The second variable can be the sensor temperature, etc.

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)”.

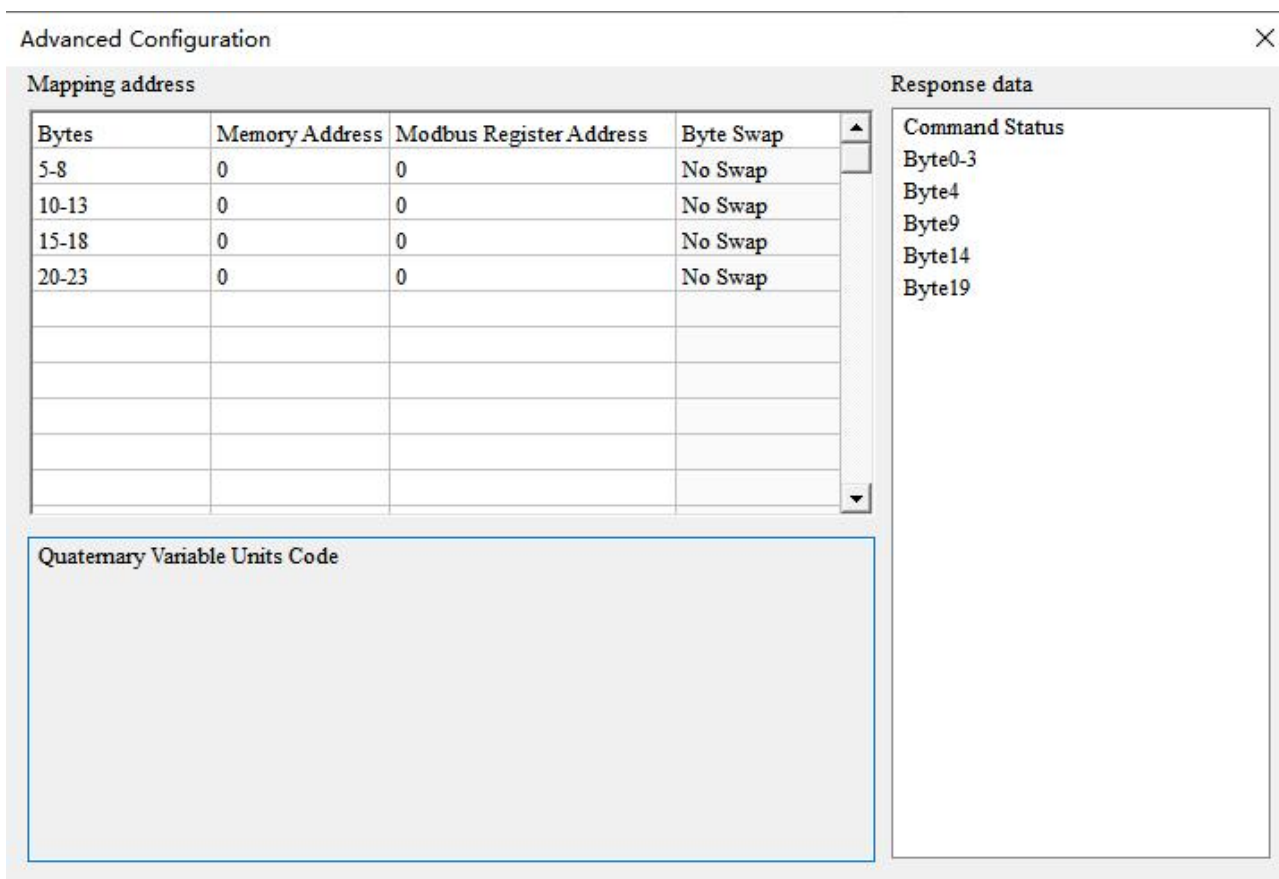
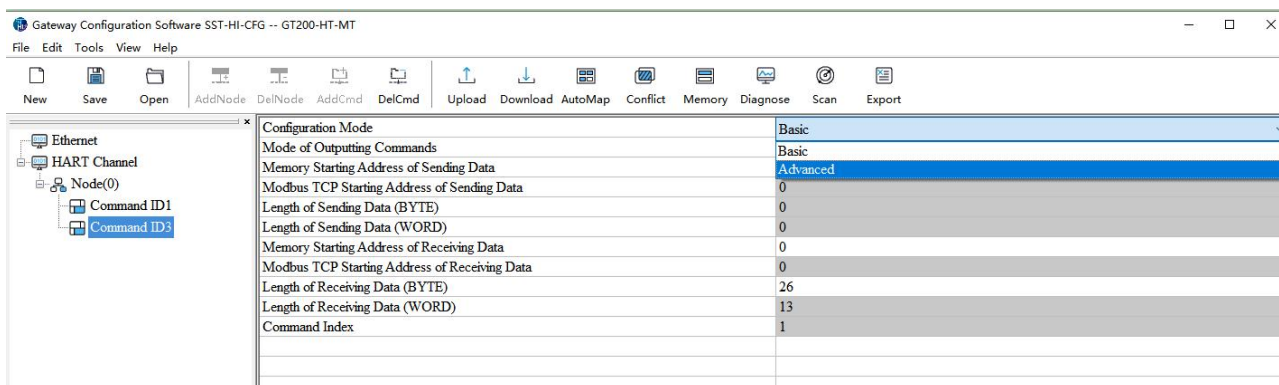
The “Length of Receiving Data (BYTE)” will be 26, which is the sum of 2 status bytes and 24 device response bytes.

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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.



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:

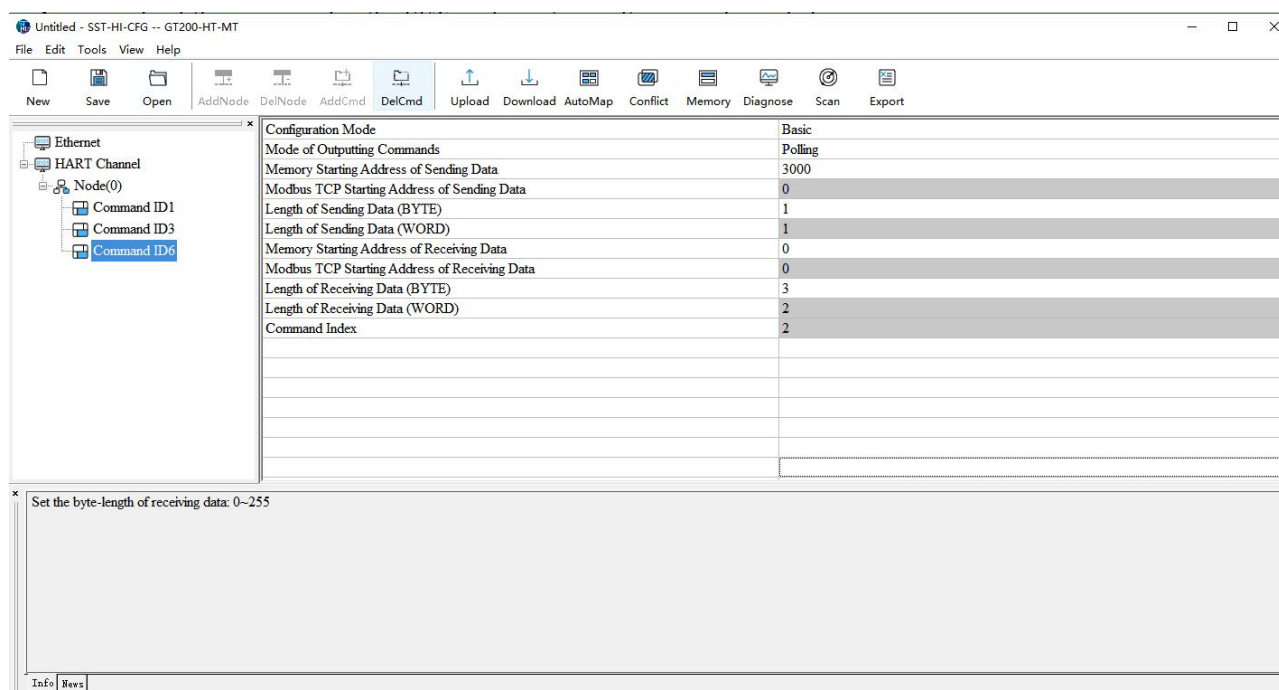
Byte	Description
Byte 0	Polling Address (Between 0-15)
Byte 1 (Only on supported HART devices)	Loop Current Mode (0=Disabled, 1=Enabled)

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)”.

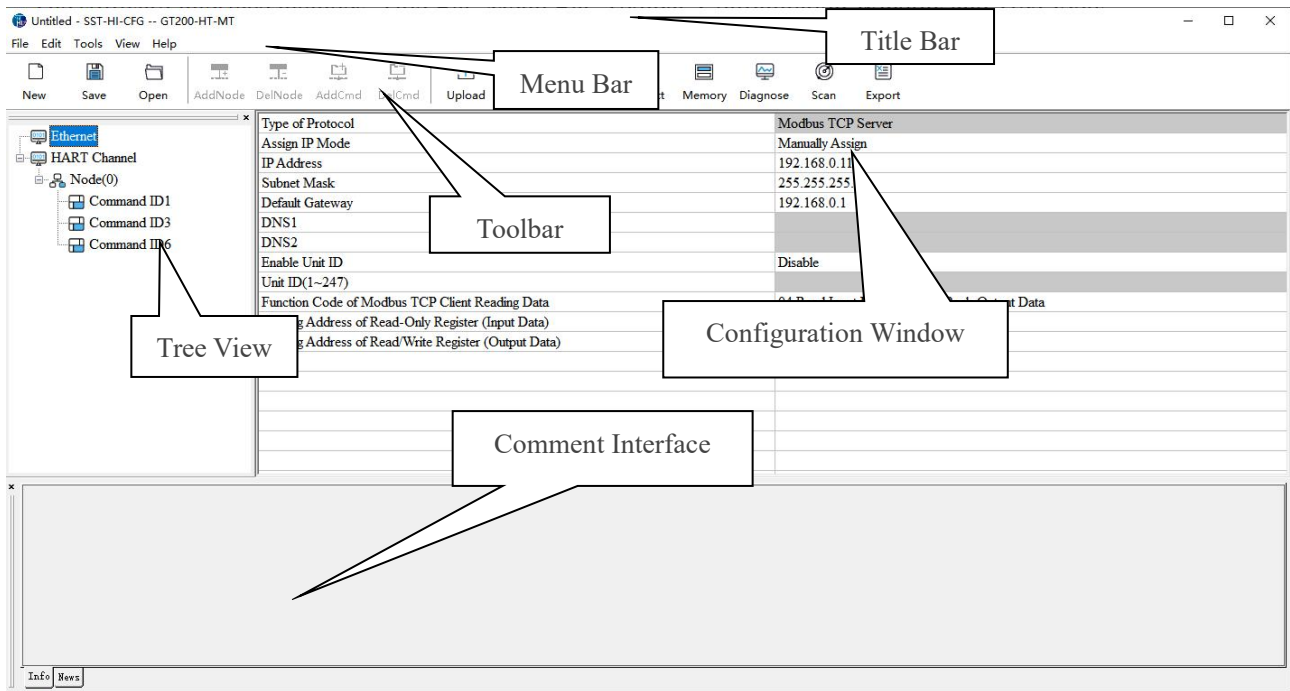
The “Length of Receiving Data (BYTE)” will be 4, which is the sum of 2 status bytes and 2 device response bytes.

5 Software Instructions

5.1 Main Interface

The software interface includes: Title Bar, Menu Bar, Toolbar, Configuration Window and Tree View.

Note: The gray parameters cannot be changed.



5.2 Toolbar

The toolbar is shown as below:

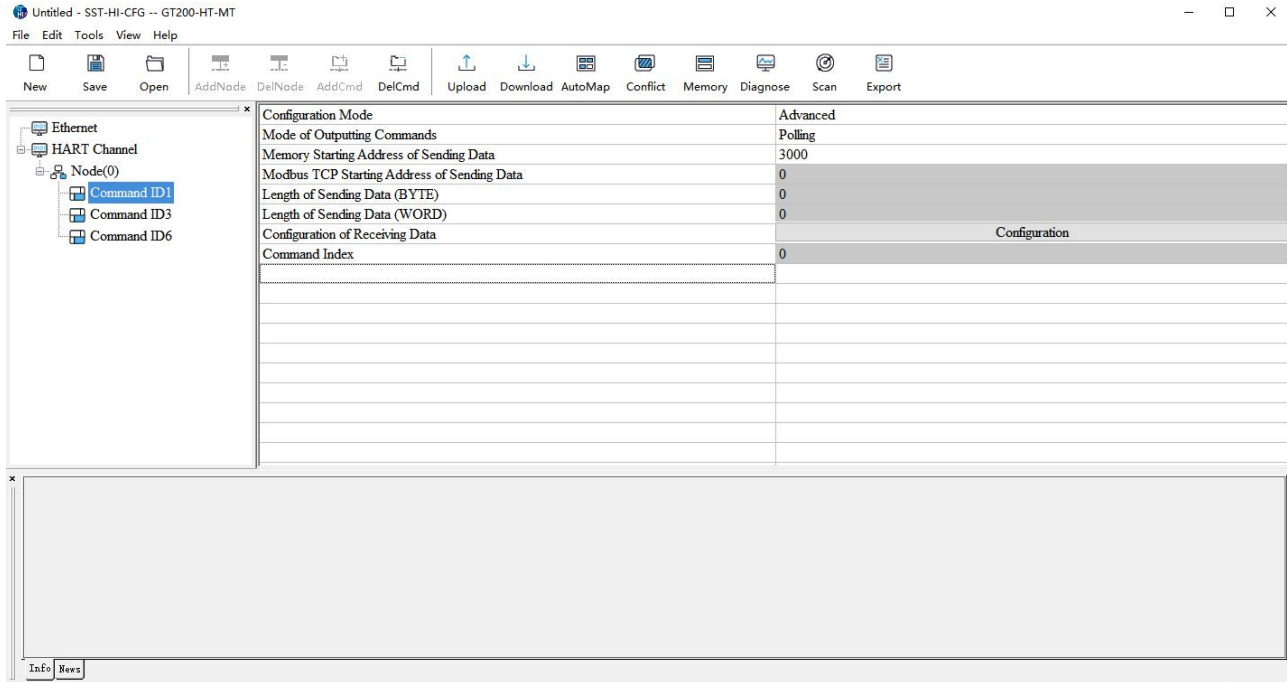


The toolbar provides icon shortcuts to major functions.

	New: Create a new configuration project.
	Save: Save the current configuration.
	Open: Open a configuration project.
	Add Node: Add a HART node.
	Delete Node: Delete a HART node.
	Add Command: Add a HART command.
	Delete Command: Delete a HART command.
	Upload: Upload the configuration from the gateway.
	Download: Download the configuration to the gateway.
	Auto Map: Automatically calculate the mapped data address of each command.
	Conflict: Check the mapping address in the Conflict Detection window.
	Memory: Show the data exchange inside of the gateway.
	Diagnose: This function analyzes the operating condition of fieldbus devices.
	Slave Scan: This function can scan and calculate how many slave devices and relevant slave addresses the HART master is connecting with. This also supports also supports modifying slave addresses.
	Export Excel: Export current configuration as a table and save it as *.xls file.

5.3 Comments Interface

The comments interface displays the explanation of the corresponding configuration item. For example, when selecting "Mode of Outputting Commands", the comments interface is as below:

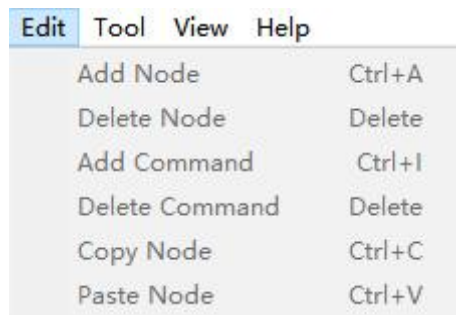


5.4 Tree View Operations

5.4.1 Edit the Items in the Left Tree View

Users can edit the items in the left tree view three different ways:

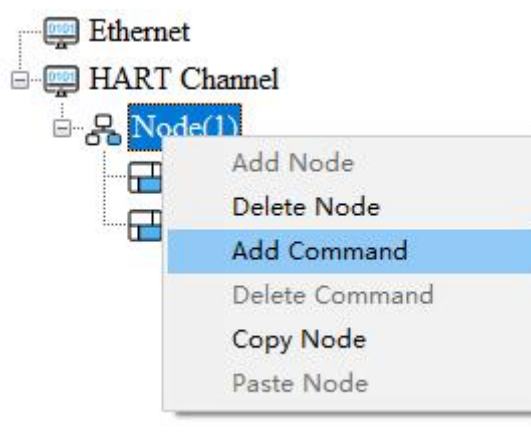
1. Edit with the commands in the menu.



2. Edit with the icon in the toolbar. Please see "[Toolbar](#)" chapter for details.



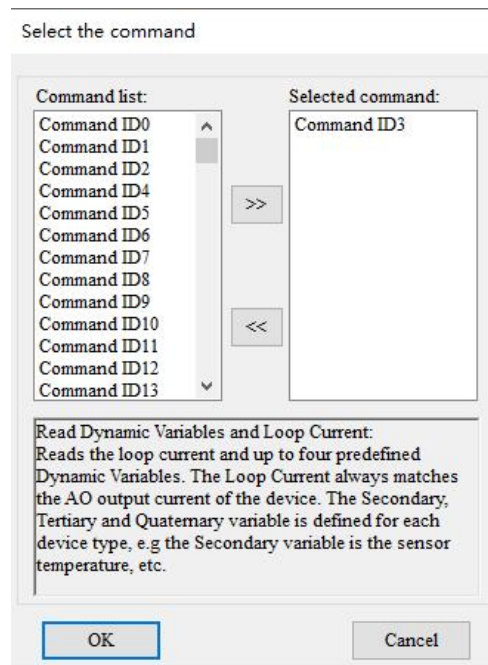
3. Right click the item.



5.4.2 HART Node and Command Operations

Users can edit HART nodes and commands by three operation ways in the "[Tree View Operations](#)" chapter.

1. Add node: Select the "HART Channel" and add a new node. A new node named "Node-X" will be added under the HART Channel. The maximum number of nodes is 15 (Multi-drop).
2. Delete node: When deleting a node, all commands under the node will be deleted.
3. Add command: Select a node and add a command. The pop-up window shows the HART command list. Double click the command and Selected command, click OK the new command will be added under the node.



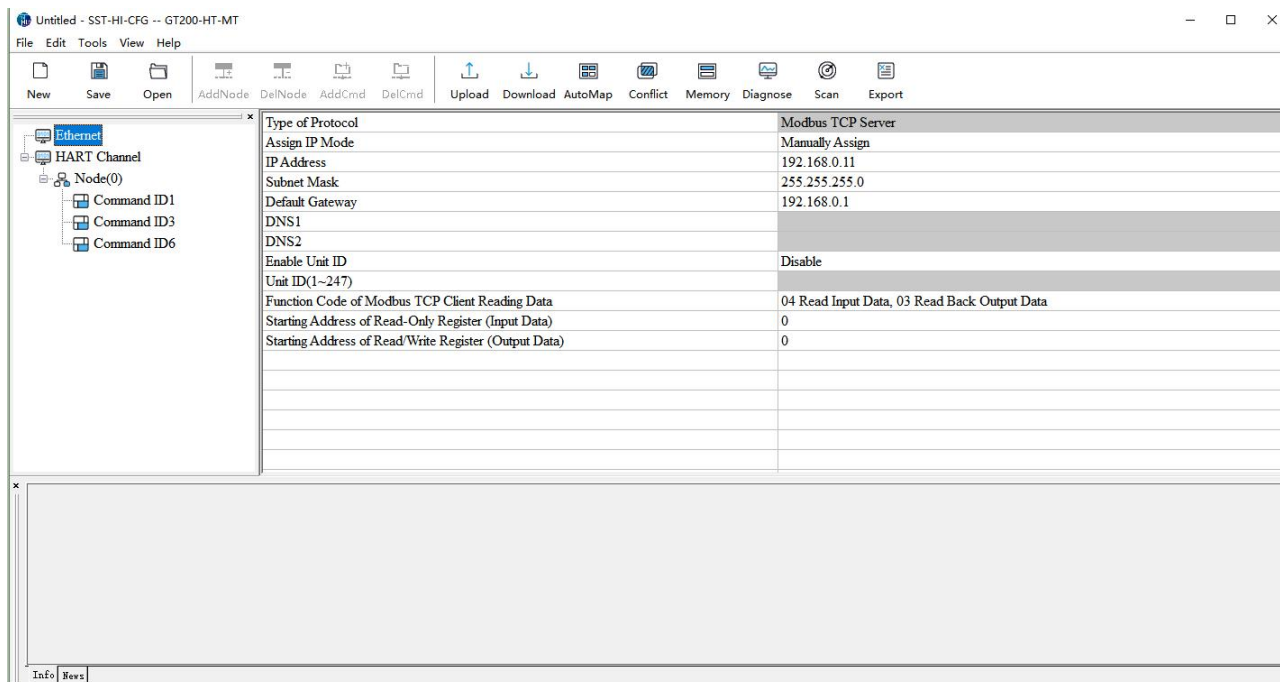
Note: The same command can only be configured once in one node.

4. Delete command: Select a command and then delete it.
5. Copy node: Select an existing node and copy the node. The commands under the node will be copied at the same time.
6. Paste node: Select the HART Channel or an existing node and paste the node. The pasted node has the same parameters with the copied node.

5.5 The Operation of Configuration Interface

5.5.1 Modbus TCP Server

Click the Ethernet in the equipment view interface, this will display the configuration view interface as follows:



Assign IP Mode: Manually Assign, DHCP

IP Address: Set the IP address of the device.

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

Default Gateway: Set the network gateway address of the device.

DNS1/ DNS2: Reserved.

Enable Unit ID: Enable Or Disable are the 2 available options.

Enable: As a Modbus TCP server device, the gateway can manually set the value of its server ID address.

Disable: The server ID address value of the gateway as a Modbus TCP server device is arbitrary and can be adaptive to the Modbus TCP Client.

Function Code of Modbus TCP Client Reading Data:

Set whether to use function code 04 or 03 on the Modbus TCP Client to read the HART device data (input data) collected through the gateway. This option also sets which function code is used to read back the data written to HART devices (output data).



Starting Address of Read-Only Register (Input Data):

The gateway is used as Modbus TCP server to support the client to read the starting address of the input data using the 04/03 function code.

It is necessary to fill in the protocol address (base 0) format here, and displayed in decimal. Range 0-64736.

For example:

04 function code: The PLC address format is 30001, then you need to fill in it as the protocol address format 0.

03 function code: The PLC address format is 40001, then you need to fill in it as the protocol address format 0.

Starting Address of Read/Write Register (Output Data):

The gateway is used as Modbus TCP server to support the client to write the starting address of the input data using the 06/16 function code. Using the 03/04 function code to read the starting address of the output data.

It is necessary to fill in the protocol address (base 0) format here, and the decimal number is displayed. Range : 0-65036.

For example:

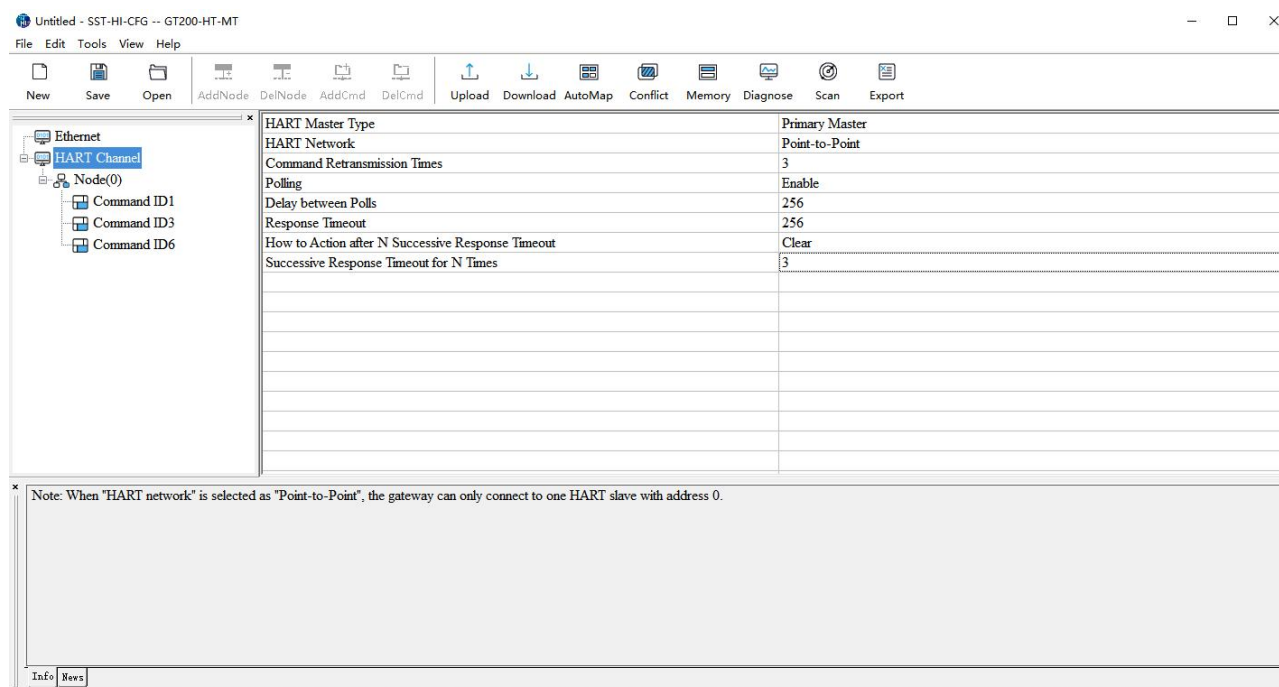
04 function code: The PLC address format is 30001, then you need to fill in it as the protocol address format 0.

03 function code: The PLC address format is 40001, then you need to fill in it as the protocol address format 0.

5.5.2 HART Configuration

5.5.2.1 HART Channel Configuration View

Click the HART Channel in the equipment view interface, this will display the configuration view interface as follows:



HART Master Type: Primary master, Secondary master

HART Networks: Supports two HART Network: Point-to-Point and Multi-drop. The gateway can communicate with the HART slave device with 0 as its address in Point-to-Point mode.

Command Retransmission Times: Select the number of retransmitting a HART command: 0-5.

Polling: Determines if the polling function will be used, "Enable" means that the polling function will be enabled.

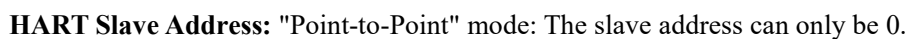
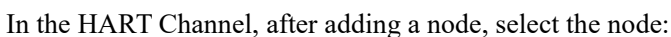
Delay between Polls: Set the time of the polling command (The time interval from a command to send to start the next command) with the range of 256 - 65535ms.

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

How to Action after N successive Response Timeout: Clear HART input data or not when number of timeout is more than value of parameter "Successive Response Timeout for N times".

Successive Response Timeout for N times: When the value of parameter "How to Action after N successive Response Timeout" is "Clear", the parameter is effective: 1-14.

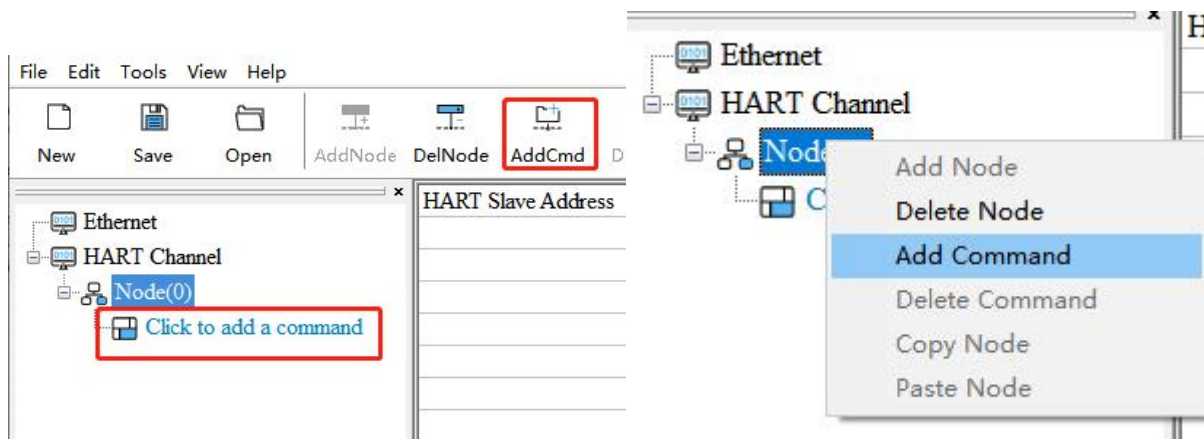
Choose to click "Click to add a node" or select "HART Channel" and click "Add Node" in the toolbar, or right-click "HART Channel" and click "Add Node" to add nodes in the HART channel.



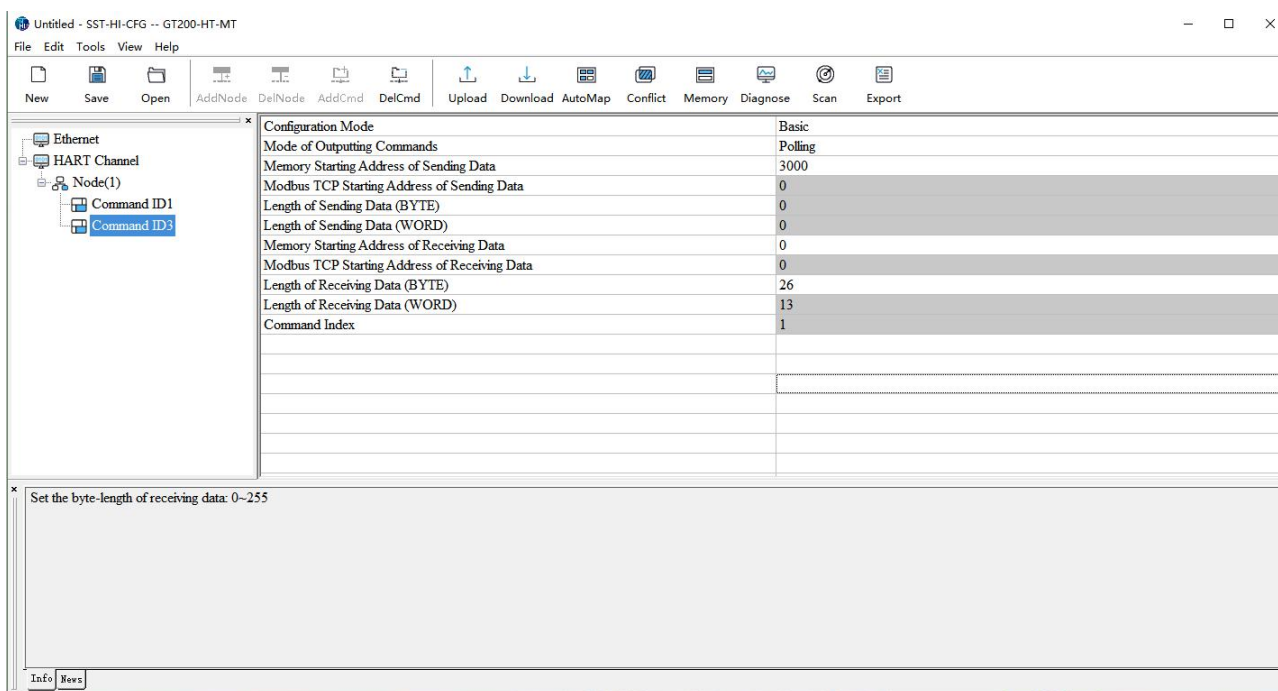
"Multi-drop" mode: The slave address can be 1 to 15.

5.5.2.3 Command Configuration

Choose to click "Click to add a node" or select "HART Channel" and click "Add Node" in the toolbar, or right-click "HART Channel" and click "Add Node" to add nodes in the HART channel.



After adding commands under a node, select the command:



Configuration Mode: Basic and Advanced (2 available options).

Mode of Outputting Commands: Mode of Outputting Command:

Polling: Send the command periodically.

Change of State: Send the command when the data in the output data buffer changes.

Initialization: Send the command only when power on.

Disable: The command will not be sent.



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Memory Starting Address of Sending Data: Set the memory starting address of output data by this command, the range is 3000-3255.

Modbus TCP Starting Address of Sending Data: The starting address of the Modbus TCP master station to send data: 3000-3255.

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

Length of Sending Data (WORD): The property is automatically calculated by the 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. The response data only includes data area of the HART frame.

Modbus TCP Starting Address of Receiving Data: The property is automatically calculated by the gateway, used for register addressing.

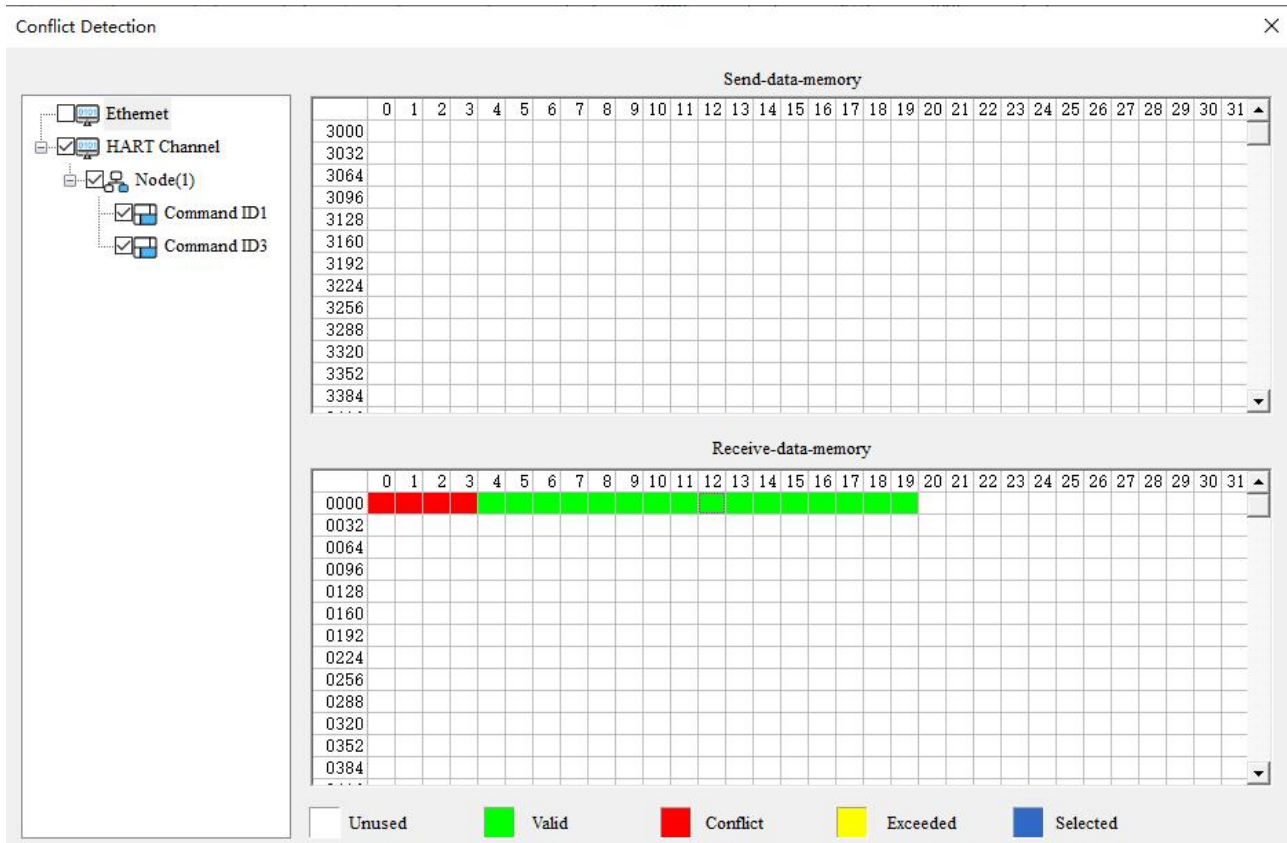
Length of Receiving Data (BYTE): Set the length of input data by this command.

Length of Receiving Data (WORD): The property is automatically calculated by the 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.

5.5.3 Conflict Detection

The data is stored in the gateway's buffer. To check if there are conflicts in the data mapping address, open the conflict detection window by clicking the "Conflict" icon.



Each grid represents one byte address.

Green: Read command is shown in input mapping area, it will be in green without conflict.

Yellow: Write command: When the address mapping area is located in the input area, it will be in yellow without conflict.

Blue: When the address mapping area is located in the output area, it will be in blue without conflict.

Red: In the input area or output area, when different commands occupy the same byte, this byte area will be in red.

5.5.4 Show Memory Data

The Memory function in SST-HI-CFG can show the data exchange inside of the gateway. Users can use this function to debug the HART fieldbus. The operating steps are as follows:

- 1) Ensure that the function bit on the configuration DIP switch is set to ON state and the mode bit of configuration switch is in the OFF state, restart the gateway. Then the GT200-HT-MT is in the debug mode.
- 2) Use a network line to connect the GT200-HT-MT's RJ-45 port and a computer.
- 3) Open the show memory data window by clicking the "Memory" icon.

Memory data
×

Save

Stop

Addr	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
0000	BF	F5	44	69	BF	F5	44	69	FF	FF	41	A7	00	1C	42	C8
0016	00	00	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
0048	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
0064																

Save

Load

Send

Stop

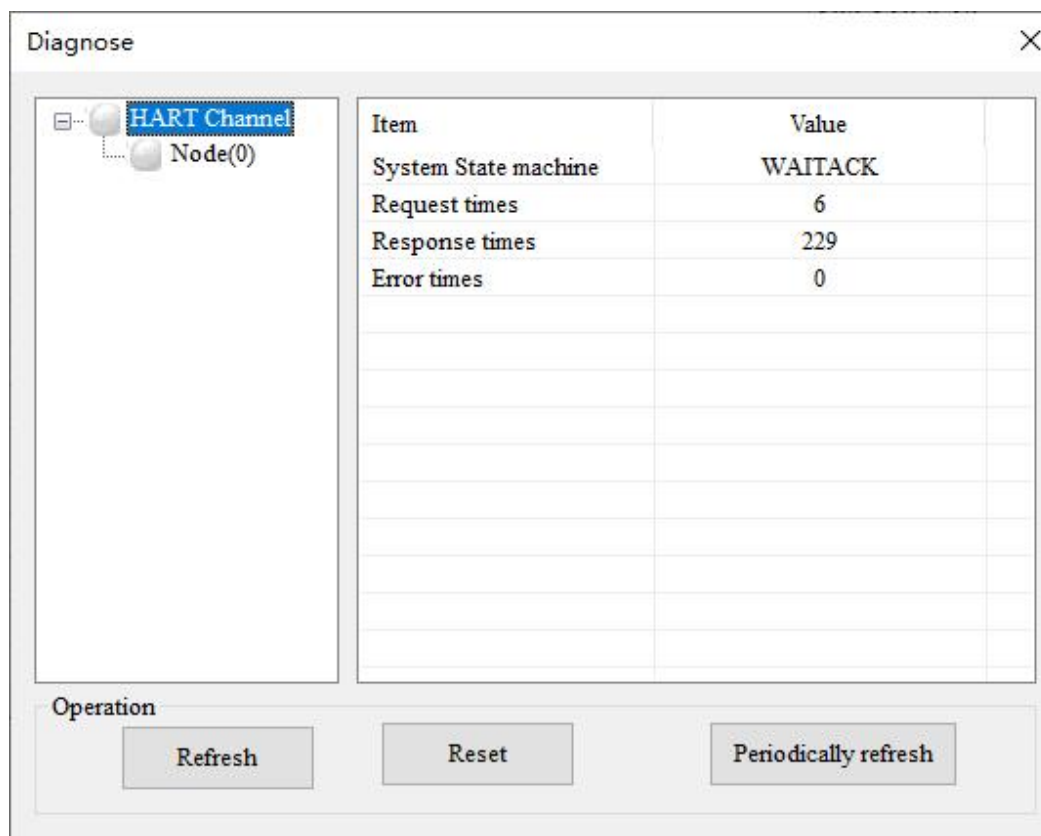
Addr	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
3000	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
3016	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
3032	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
3048	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
3064																

5.5.5 Diagnose

Through this function, users will know which device is not communicating. The execution condition of configured commands, data transmission of the gateway and the displays of certain command's operating. Steps are as follows:

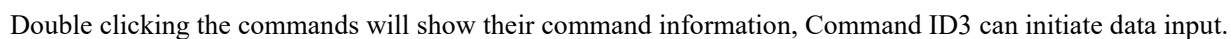
- 1) Ensure that the GT200-HT-MT's function bit of configuration switch is in the ON state and the mode bit of configuration switch is in the OFF state, restart the gateway. GT200-HT-MT is in the debug mode.
- 2) Use a network line to connect the GT200-HT-MT's RJ-45 port and a computer.
- 3) Open the Diagnose window by clicking the "Diagnose" icon.

Click the "HART Channel" in this interface, it will show the status of the HART fieldbus part on the right. Press the "Refresh" button, this will update the data once. Click "Periodically refresh", to have the software update the data every 500ms.



It shows the response status of the configured commands.

Click "Refresh" this will refresh these command status, "Periodically refresh" will refresh the command status once.



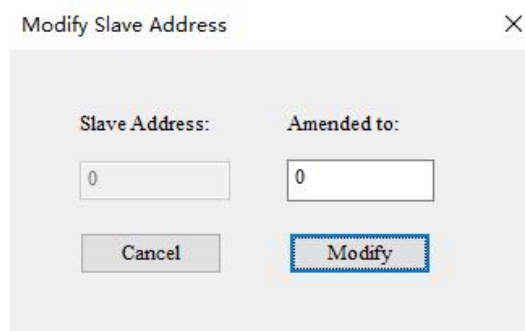
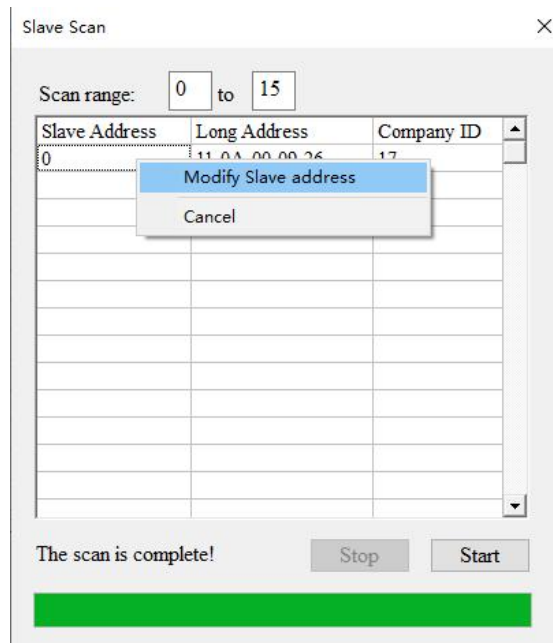
The slave scan function can help users to check the HART slave address and modify the slave address. Steps are as follows:

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Click "Start" in "Slave Scan" interface, it will show the short address, long address and ID of HART slave devices which are connected to the gateway.

Move to the relevant device and right click it, and click "Modify Slave Address" will show the "Modify slave address" interface, input the address you want to change in the "Amended to" text.



After modification, the HART slave address has been modified, the gateway must be restarted.



5.5.7 Modify Device ID

The modify device ID function can help users to check the Device ID, let the user know the currently selected GT200-HT-MT device ID value, and can modify the value. Steps are as follows:

- 1) Turn the GT200-HT-MT configuration (operation) DIP switch to "ON", and then power on again. At this point the GT200-HT-MT is running in configuration (run) mode.
- 2) Connect the network card interface of GT200-HT-MT to the computer.
- 3) Click "Tools -> Modify Device ID", and the device search interface will pop up.

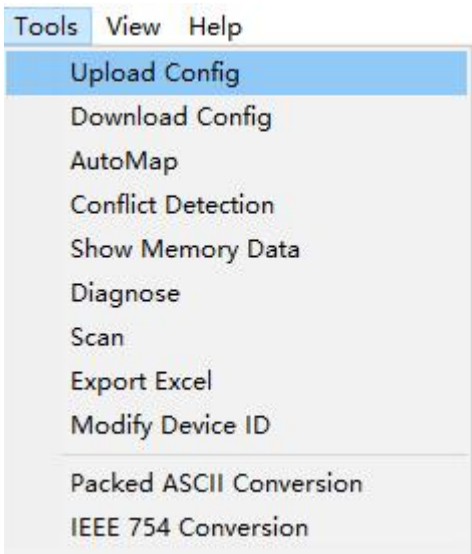
5.5.8 Conversion Tools

In the "Tools" menu, there are two practical tools: They are used to switch between IEEE754 and PACKED ASCII conveniently.

5.5.9 Hardware Communication

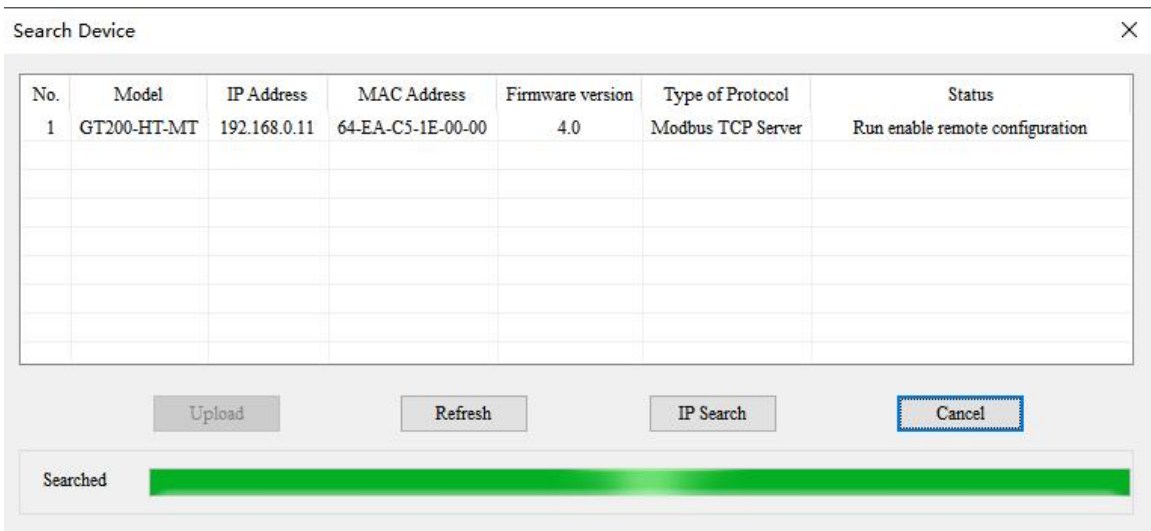
5.5.9.1 Ethernet Configuration

The hardware communication menu items are as follows:



5.5.9.2 Upload Configuration

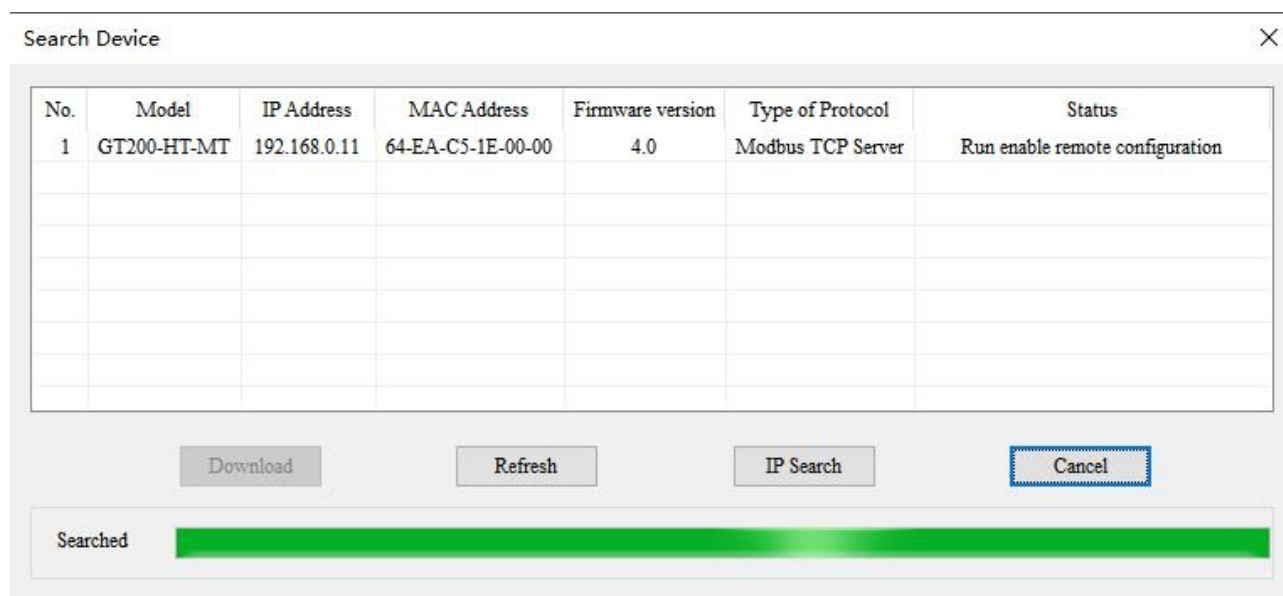
Choose upload configuration, it will pop up the dialog box of searching equipment:



Select the equipment you want to configure and click "Upload" to enter into the upload dialog box.

5.5.9.3 Download Configuration

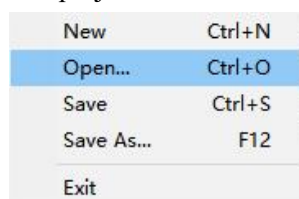
The operation of download configuration is the same as upload configuration:



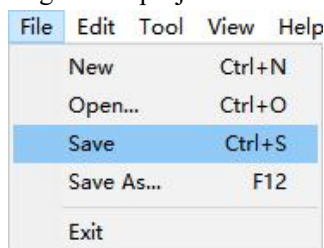
Note: Before downloading, please confirm all configurations have been completed and right.

5.5.10 Open/Save Project

Select "Open" to open an existing configuration project:



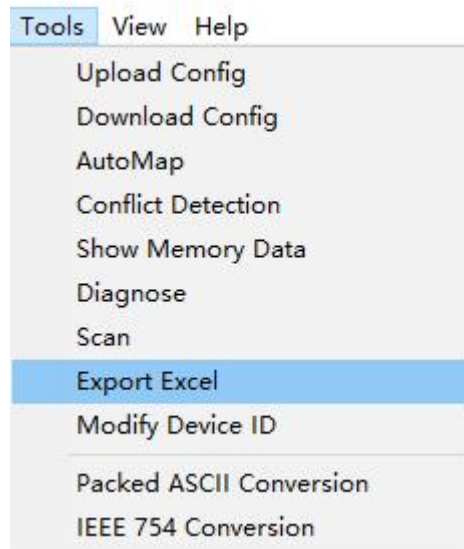
Select "Save" or "Save As..." to save the configuration project as a *.xml file.



5.5.11 Export Excel

The configuration can be exported as a table.

Please confirm that Microsoft Excel is installed on your computer before using this function.

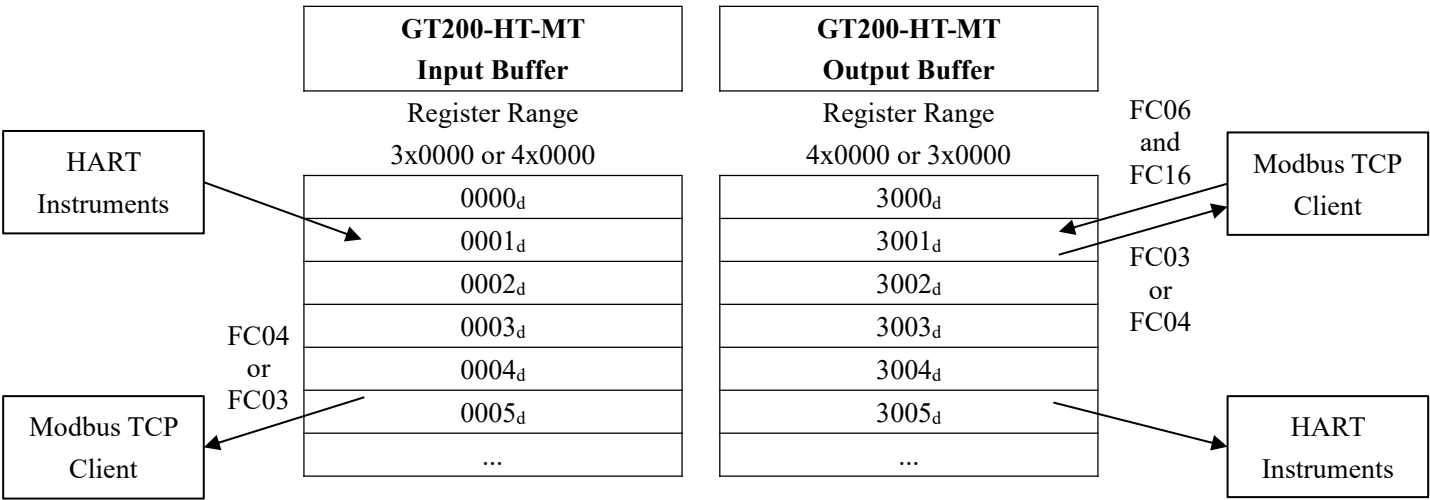


6 Interface Design Description

6.1 Data Exchange

Data exchange between HART and Modbus TCP via the GT200-HT-MT is defined through “data mapping”. When data is read or written, it is initially stored in the internal memory buffer of the GT200-HT-MT before being transmitted between HART and Modbus TCP. There are two internal data buffer areas in the GT200-HT-MT: One is the Modbus TCP network input buffer and the other is the Modbus TCP network output buffer. Incoming data from the HART instruments will be mapped to the input buffer so that it can be read by the Modbus TCP client.. Similarly, output data from the Modbus TCP client will be mapped to the output buffer so that the GT200-HT-MT can write the output data to the HART instruments.

For more details and examples, please refer to Chapters [5.5.3](#), [6.1.1](#), and [7](#).



6.1.1 Modbus TCP Register Address Mapping

The Modbus TCP register addresses that are used to read and write data to HART devices are determined by the location of the GT200-HT-MT internal memory buffer addresses. Each internal memory buffer address holds 8 bytes of data, and each Modbus register holds 16 bytes of data. This means that every two internal buffer addresses correspond to a single Modbus register address. The GT200-HT-MT internal memory mapping addresses can be manually configured in the SST-HI-CFG configuration software. The function codes that are used to read data from the internal memory buffer addresses can be configured by setting the function code mode in the SST-HI-CFG configuration software. The Modbus TCP register starting address offset can also be configured in the software. For more details on setting the function code mode and starting addresses, see Chapter 5.5.1.

When the function code mode of the GT200-HT-MT is configured to "04 Read Input Data, 03 Read Back Output Data" and the starting addresses are set to "0", function code 04 is used on the Modbus TCP Client to read the HART response data from the gateway. This means that the data read in the 3x0000 Modbus TCP register range will correspond to the HART response data. Function Codes 06 and 16 are used to write request data to the HART devices. Function code 03 is used to read back the HART request data that has been written to the HART devices, which means that this data will be read in the 4x0000 Modbus TCP register range. The data mapping relationship between the GT200-HT-MT internal memory buffer and Modbus TCP is shown below.

Function Code of Modbus TCP Client Reading Data		04 Read Input Data, 03 Read Back Output Data	
Starting Address of Read-Only Register (Input Data)		0	
Starting Address of Read/Write Register (Output Data)		0	

Modbus TCP Register Address	GT200-HT-MT Input Buffer	Modbus TCP Register Address	GT200-DP-MT Output Buffer
Function Code 04		Read: Function Code 03	
		Write: FC06/FC16	
3x0000	0000 _d	4x0000	3000 _d
	0001 _d		3001 _d
3x0001	0002 _d	4x0001	3002 _d
	0003 _d		3003 _d
3x0002	0004 _d	4x0002	3004 _d
	0005 _d		3005 _d
X	2*X	Y	2*Y
	(2*X)+1		(2*Y)+1
...	...	...	...

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Note: Modbus TCP addresses in SST-HI-CFG are expressed in base-0 notation. If the Modbus TCP Client uses base-1 notation, the addresses will be offset by one.

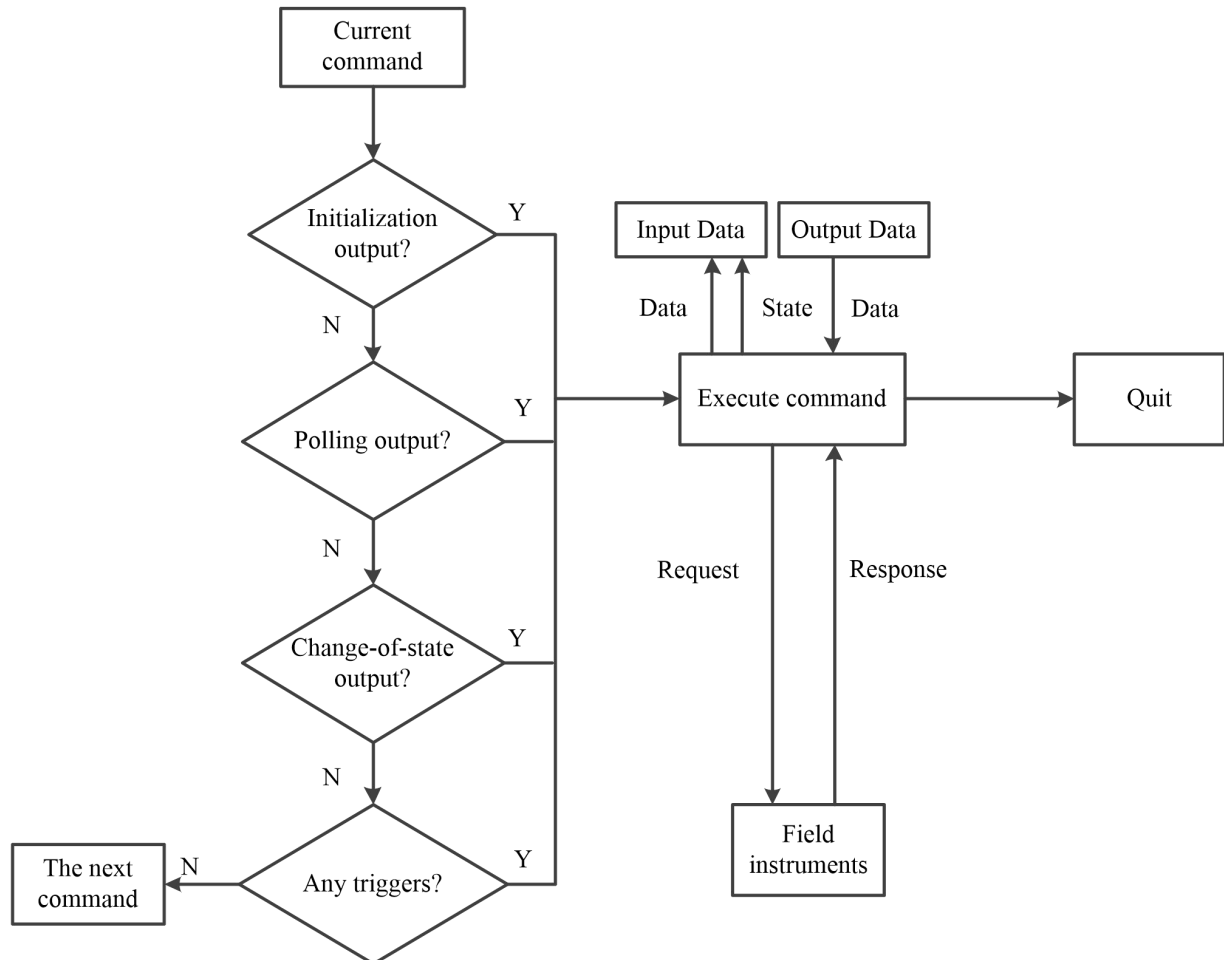
When the function code mode of the GT200-HT-MT is configured to "03 Read Input Data, 04 Read Back Output Data" and the starting addresses are set to "0", function code 03 is used on the Modbus TCP Client to read the HART response data from the gateway. This means that the data read in the 4x0000 Modbus TCP register range will correspond to the HART response data. Function Codes 06 and 16 are used to write request data to the HART devices. Function code 04 is used to read back the HART request data that has been written to the HART devices, which means that this data will be read in the 3x0000 Modbus TCP register range. The data mapping relationship between the GT200-HT-MT internal memory buffer and Modbus TCP is shown below.

Function Code of Modbus TCP Client Reading Data	03 Read Input Data, 04 Read Back Output Data
Starting Address of Read-Only Register (Input Data)	0
Starting Address of Read/Write Register (Output Data)	0

Modbus TCP Register Address	GT200-HT-MT Input Buffer	Modbus TCP Register Address	GT200-DP-MT Output Buffer
Function Code 03		Read: Function Code 04 Write: FC06/FC16	
4x0000	0000 _d	3x0000	3000 _d
	0001 _d		3001 _d
4x0001	0002 _d	3x0001	3002 _d
	0003 _d		3003 _d
4x0002	0004 _d	3x0002	3004 _d
	0005 _d		3005 _d
X	2*X	Y	2*Y
	(2*X)+1		(2*Y)+1
...	...	...	...

Note: Modbus TCP addresses in SST-HI-CFG are expressed in base-0 notation. If the Modbus TCP Client uses base-1 notation, the addresses will be offset by one.

6.2 Flowchart for Executing a HART Command



7 How to Connect to a Modbus TCP Client

The GT200-HT-MT gateway allows HART instruments to communicate with Modbus TCP Clients in a Modbus TCP network by having the gateway function as a Modbus TCP Server. The following example illustrates how the gateway communicates with a Modbus TCP Client by using Modbus Poll (Modbus TCP Client emulation software).

1. Configure SST-HI-CFG in point-to-point mode (HART address of 0) with HART Commands ID1, ID3 and ID6. The common HART command format can be found in [Chapter 4.3](#), and the configuration is as follows:
 - (1) When configuring HART Command ID1 in basic mode, the size of the data received from the command is 2 bytes greater than the actual response (command response). This is because the received data includes 2 bytes for a Command Status for command-specific diagnostic codes.. In the command response, the primary variable unit (byte 0) and the primary variable (bytes 1-4) along with the Command Status are 7 bytes in total. When mapping these 7 bytes to 4 Modbus register addresses, there will be a 1 byte offset resulting in the last 3 bytes of the primary variable being placed in the last 2 Modbus registers. This will cause the actual primary variable value to not be able to be read.

HART Response	Modbus TCP Register Address	GT200-HT-MT Input Buffer Address
Function Code 04		
Command Status	3x0000	0000 _d
		0001 _d
Byte 0	3x0001	0002 _d
Bytes 1-4		0003 _d
	3x0002	0004 _d
		0005 _d
	3x0003	0006 _d
0007 _d		

It is recommended to configure HART Command ID1 in advanced mode to align the primary variable with the Modbus TCP register address for direct acquisition.

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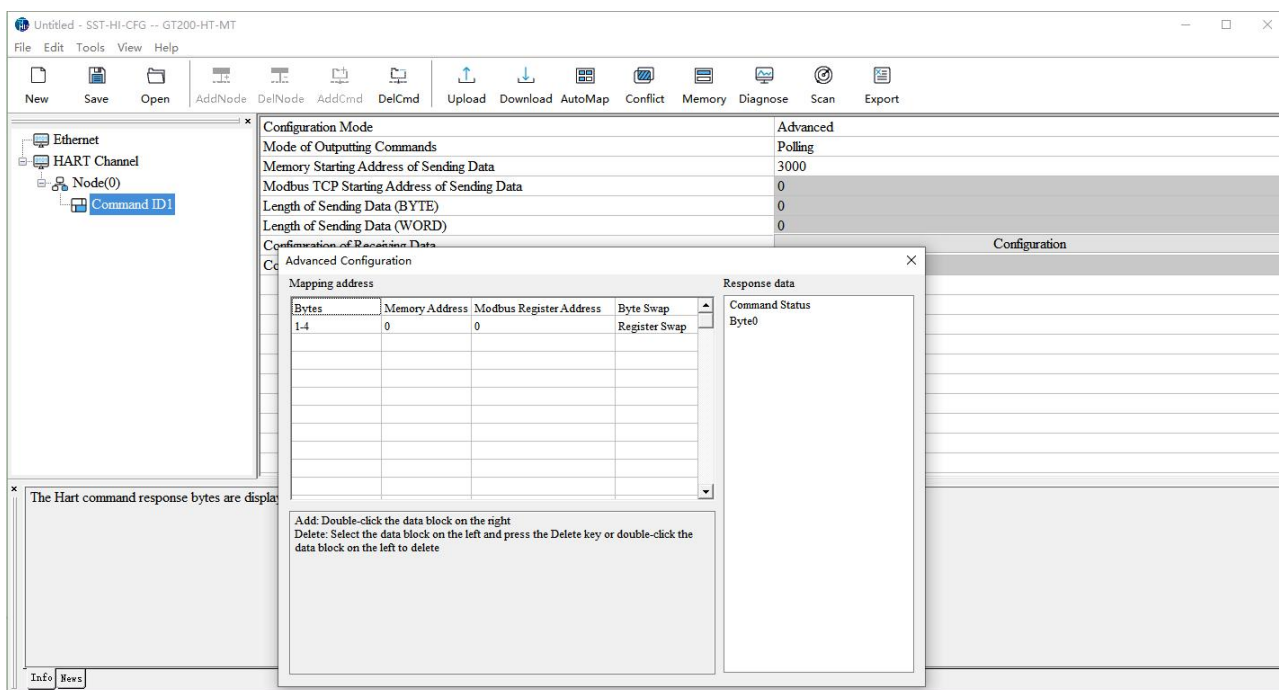
Command ID1: Read primary variable (PV)

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).

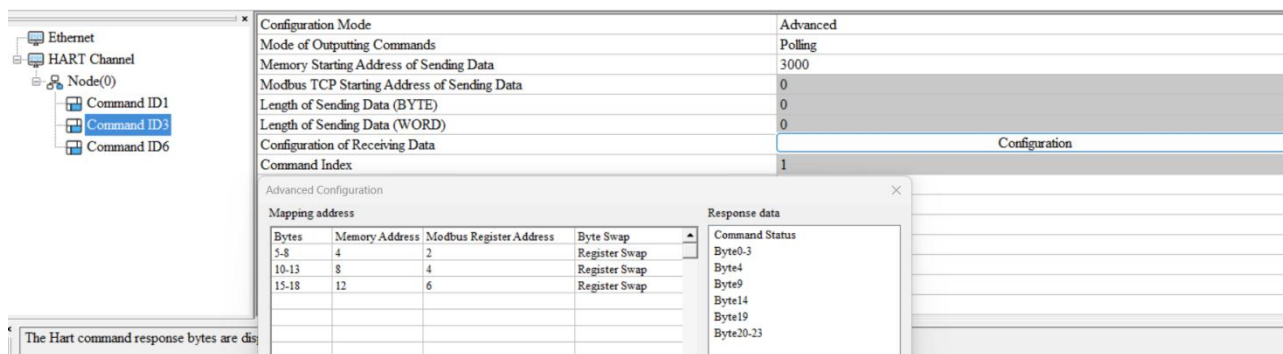
Command ID3: Reads four (predefined) dynamic variables and the primary variable current

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 (mA)
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:

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

Length of Sending Data (BYTE)

2

Response:

Bytes	Description
Command Status (2 Bytes)	0=Success 2=Invalid Poll Address Selection 5=Too Few Data Bytes Received 7=In Write Protect Mode 12=Invalid Mode Selection 32=Busy
Byte 0	Polling Address (Between 0-15)
Byte 1 (Only on supported HART devices)	Loop Current Mode (0=Disabled, 1=Enabled)

Length of Receiving Data (BYTE)

4

New	Save	Open	AddNode	DelNode	AddCmd	DelCmd	Upload	Download	AutoMap	Conflict	Memory	Diagnose	Scan	Export
Ethernet HART Channel Node(0) Command ID1 Command ID3 Command ID6 Configuration Mode Mode of Outputting Commands Memory Starting Address of Sending Data EtherNet/IP Starting Address of Sending Data Length of Sending Data (BYTE) Length of Sending Data (WORD) Memory Starting Address of Receiving Data EtherNet/IP Starting Address of Receiving Data Length of Receiving Data (BYTE) Length of Receiving Data (WORD) Command Index Basic Polling 3000 3000 2 1 0 0 4 2 2														

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2. Click  , through  , to view the mapping address of the command in the gateway buffer. The primary variable of HART Command ID1 corresponds to gateway input buffer 0000-0003, Command ID3 corresponds to 0004-0015, Command ID6 request corresponds to output buffer 3000-3001, and response corresponds to 0016-0019. as follows:

The Modbus TCP Client uses function code 04 to read the HART response data from the gateway. Modbus registers 3x0000-3x0001 correspond to the primary variable of HART Command ID1, 3x0002-3x0007 correspond to the primary, secondary, and tertiary variables of HART Command ID3, 3x0008-3x0009 correspond to the command status, polling address, and loop current mode of HART Command ID6. Function Codes 06/16 are used to write the HART request data to the gateway. Modbus register 4x0000 corresponds to the Polling address and loop current mode of the requested device of HART Command ID6.

HART Response	Modbus TCP Register Address	GT200-HT-MT Input Buffer Address
Function Code 04		
Command ID1 Primary Variable (Bytes 1-4)	3x0000	0000 _d
		0001 _d
	3x0001	0002 _d
		0003 _d
Command ID3 Primary Variable (Bytes 5-8)	3x0002	0004 _d
		0005 _d
	3x0003	0006 _d
		0007 _d
Command ID3 Secondary Variable (Bytes 10-13)	3x0004	0008 _d
		0009 _d
	3x0005	0010 _d
		0011 _d
Command ID3 Tertiary Variable (Bytes 15-18)	3x0006	0012 _d
		0013 _d
	3x0007	0014 _d
		0015 _d
Command ID6 Command Status	3x0008	0016 _d
		0017 _d
Command ID6 Polling Address (Byte 0)	3x0009	0018 _d
Command ID6 Loop Current Mode (Byte 1)		0019 _d

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HART Request	Modbus TCP Register Address	GT200-HT-MT Output Buffer Address
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Read: Function Code 03

Write: FC06/FC16

Command ID6 Polling Address (Byte 0)	4x0000	3000 _d
Command ID6 Loop Current Mode (Byte 1)		3001 _d

The screenshot displays the configuration interface for the HART Channel. On the left, a tree view shows 'Ethernet' connected to 'HART Channel', which is further connected to 'Node(0)'. Under 'Node(0)', 'Command ID1', 'Command ID3', and 'Command ID6' are listed. The 'Command ID6' is selected. In the center, a table shows the HART Channel data buffer addresses (3000 to 3384) and their corresponding Modbus TCP register addresses (0 to 6). The 'Receive-data-memory' section at the bottom shows a table of addresses (0 to 31) with the value 0000 at address 0 and 0032 at address 1.

This screenshot shows the same configuration interface as the previous one, but with the 'Receive-data-memory' section expanded. The table shows addresses 0 to 31, with the value 0000 at address 0, 0032 at address 1, and 0064 at address 2. The 'Command ID6' is still selected in the tree view.

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

Note: The gateway acts as Modbus TCP Server. Use the Modbus Poll software as a Modbus Client to connect to the gateway. The gateway supports using either function codes 03 or 04 (configured in SST-HI-CFG) to read data from HART devices. The gateway supports using either function codes 06 or 16 (preset single/multiple registers) to write data to HART devices. Function Codes 03 or 04 (configured in SST-HI-CFG) can read back the data written to HART devices.

Function Code of Modbus TCP Client Reading Data	04 Read Input Data, 03 Read Back Output Data
Starting Address of Read-Only Register (Input Data)	04 Read Input Data, 03 Read Back Output Data
Starting Address of Read/Write Register (Output Data)	03 Read Input Data, 04 Read Back Output Data

The Connection Setup dialog box is configured for a Modbus TCP/IP connection. The Connection type is set to 'Modbus TCP/IP'. Under Serial Settings, COM32 is selected, with 115200 Baud, 8 Data bits, None Parity, and 1 Stop Bit. The Mode is set to RTU. The Response Timeout is 300 ms and the Delay Between Polls is 50 ms. The Remote Modbus Server section shows the IP Address or Node Name as 192.168.0.11, Server Port as 502, and Connect Timeout as 100 ms. IPv4 is selected for the connection type.

The Read/Write Definition dialog box for Slave ID 1 is configured for a read operation. The Function is set to '04 Read Input Registers (3x)'. The Address mode is set to Dec. The Address is 0, with a note that the PLC address is 30001. The Quantity is 10. The Scan Rate is 1000 ms. The 'Read/Write Once' button is highlighted. The View section shows Rows set to 10, with 'Hide Name Columns' and 'PLC Addresses (Base 1)' checked.

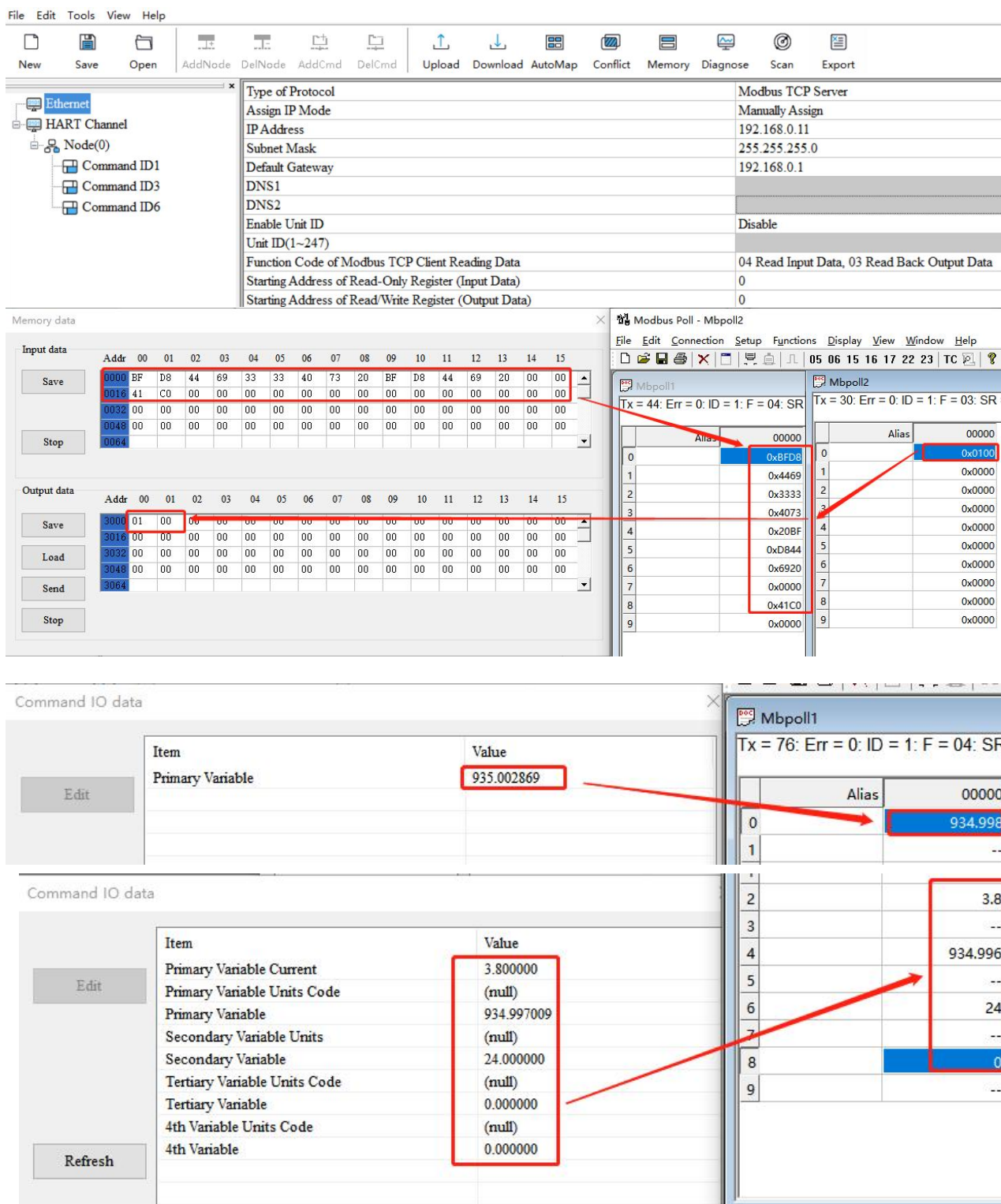
The Read/Write Definition dialog box for Slave ID 1 is configured for a read operation. The Function is set to '03 Read Holding Registers (4x)'. The Address is 0, with a note that the Protocol address is E.g. 40011 -> 10. The Quantity is 1. The Scan Rate is 1000 ms. The 'Read/Write Once' button is highlighted. The View section shows Rows set to 10, with 'Hide Alias Columns' and 'PLC Addresses (Base 1)' checked.

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4. Use Modbus POLL to read data (3x0000-3x0009) and write data via 4x0000. The data in the gateway buffer can be viewed in  Memory (refer to [Chapter 5.5.4](#)) and the actual floating-point data of the HART device can be viewed via  Diagnose (refer to [Chapter 5.5.5](#)).



The screenshot displays the GT200-HT-MT software interface, showing the configuration and data for a Modbus TCP Gateway.

Modbus Configuration:

Item	Value
Type of Protocol	Modbus TCP Server
Assign IP Mode	Manually Assign
IP Address	192.168.0.11
Subnet Mask	255.255.255.0
Default Gateway	192.168.0.1
DNS1	
DNS2	
Enable Unit ID	Disable
Unit ID(1~247)	
Function Code of Modbus TCP Client Reading Data	04 Read Input Data, 03 Read Back Output Data
Starting Address of Read-Only Register (Input Data)	0
Starting Address of Read/Write Register (Output Data)	0

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
0016	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
0048	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
3016	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
3048	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:

Alias	Value
00000	0x0000
0x469	0x469
0x3333	0x3333
0x4073	0x4073
0x20BF	0x20BF
0xD844	0xD844
0x6920	0x6920
0x0000	0x0000
0x41C0	0x41C0
0x0000	0x0000

Modbus Poll - Mbpoll1:

Alias	Value
00000	0x0000
0x0100	0x0100
0x0000	0x0000
0x0000	0x0000
0x0000	0x0000
0x0000	0x0000
0x0000	0x0000
0x0000	0x0000
0x0000	0x0000
0x0000	0x0000

Command IO data:

Item	Value
Primary Variable	935.002869

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