HART/ MODBUS Gateway
HTM-611

User Manual
REV 1.6

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Catalog

1 Product Overview

1.1 Product Function

HTM-611 is a gateway that achieving data communication between HART and MODBUS. HART side can be configured as a primary master or the secondary master. HTM-611 act as slave at the side of Modbus.

1.2 Product Features

- Application is simple: The user simply refer to the product manuals and application examples, configured according to the requirements then can achieve communication in a short period of time.
- Powerful: Support the interconnection between HART and MODBUS, transparent transmission between HART and serial.
- Rich debugging functions: Visual display of data exchange, HART slave command diagnosis and common debugging features are greatly convenient to the user's communication test.

1.3 Technical Specifications

[1] HART can be used as a primary master or the secondary master.

[2] Support one HART-channel, multi-point mode using gateway internal resistance support connecting 13 instruments, and using an external resistor (250Ω) support connecting 15 instruments

[3] Support single-point and multi-point mode at the side of HART

[4] Single-point mode, support data burst operation of slave device

[5] Support all commands of the HART protocol

[6] Each HART command can be configured for change-of-state output, polling output, initialization output or disable output

[7] HART per channel supports up to 128 user commands, HART output data buffer up to 1000 bytes, and the

input data buffer up to 1600 bytes.

[8] Can choose to use an internal or external sampling resistor

[9] Serial RS232, RS485, RS232 optional, baud rate: 300K, 600K, 1200K, 2400K, 9600K, 19.2 K, 38.4K, 57.6K, 115.2Kbps optional

[10] Serial side can be configured for MODBUS slave, support function code: 03H, 04H, 06H, 10H.

[11] MODBUS slave support RTU and ASCII communication.

[12] The serial port can be configured as universal mode, and achieve transparent data transmission with HART slave devices.

[13] Power: 24VDC (9V~30V), 80mA（24VDC）;

[14] Working circumstance temperature: -20~60℃, Humidity: 95%;

[15] External dimensions:（Width）40mm*（Height）125mm*（Depth)110mm;

[16] Installation: 35mm DIN RAIL;

[17] Protection Level: IP20;

1.4 Related Products

Other related products in SiboTech: HPM-610, PM-160 and so on.

If you want to get more information about these products, please visit SiboTech website: http://www.sibotech.net/en , or call the technical support hot line: +86-21-5102 8348.

2 Rapid Application Examples

The following “MODBUS master simulation software read the instantaneous value of the main variables (PV) of the device which short address is 0 through the HTM-611 ”example introduce the use of the Gateway HTM-611.

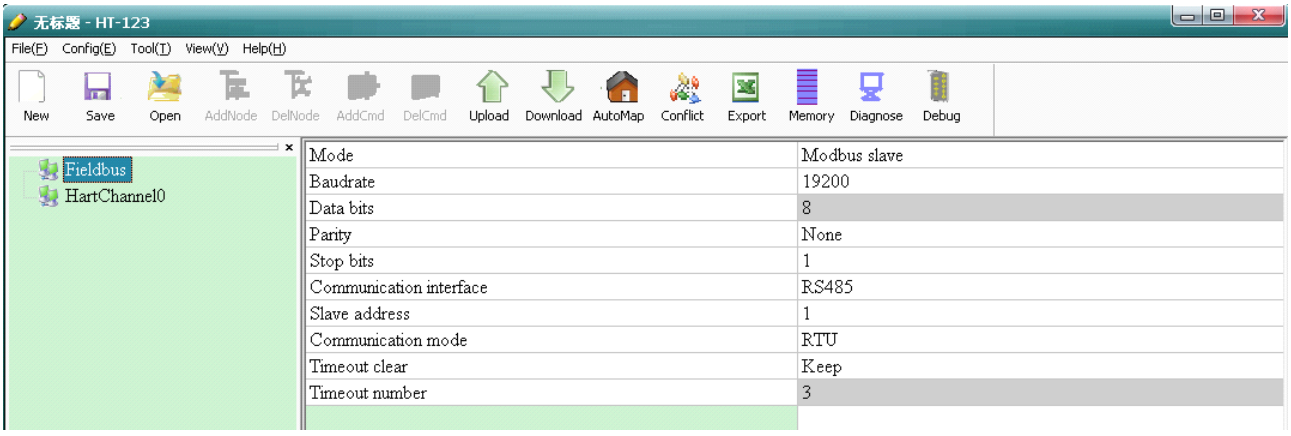
2.1 Gateway Configuration Parameters

2.1.1 Pre-configured connection settings

1. Turn gateway DIP switch to “ON”;
2. Connect the Gateway RS232 interface and the serial port of the computer with a serial cable, wiring methods see section 3.4.3 of this manual;
3. Power to the gateway, the digital tube display “CF” indicates that the gateway is in the configuration state. Double-click the installed software icon HT-123 to start the gateway configuration。

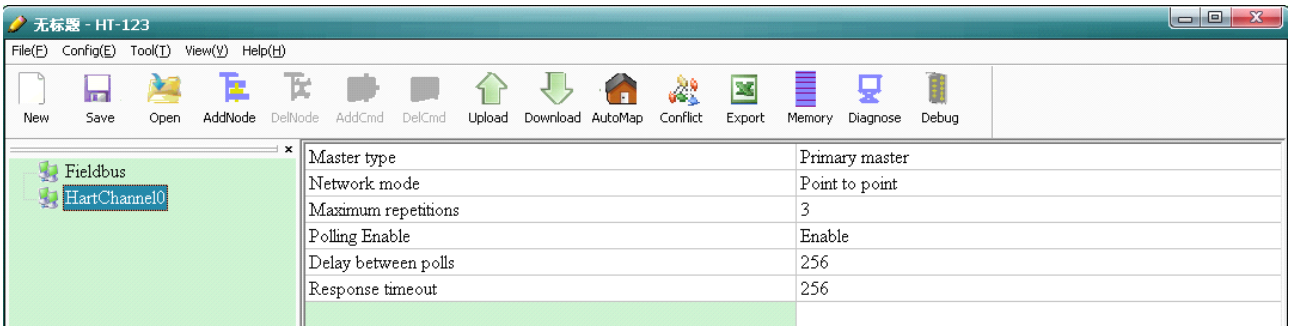
2.1.2 Software configuration

1. Open the HT-123 software installed on your computer.
2. Click “Fieldbus” in the tree view on the left, with the configuration table in the figure appears to the right:



Configuration is completed, press Enter to confirm.

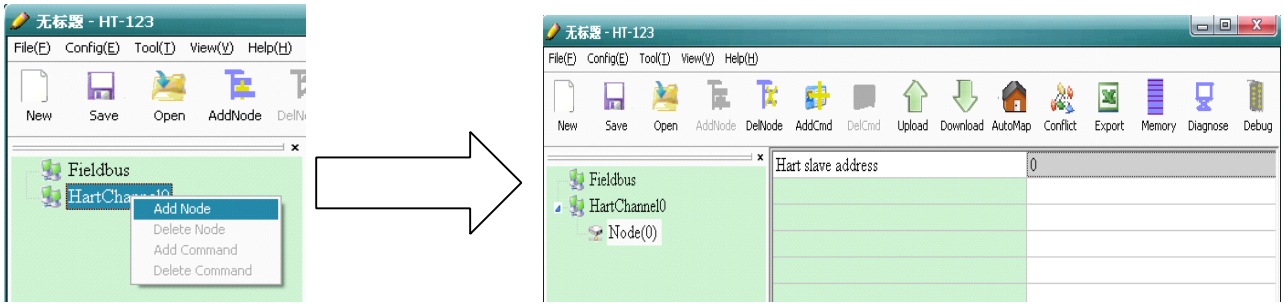
3. Click “HartChannel0” in the tree view on the left, with the configuration table in the figure appears to the right:



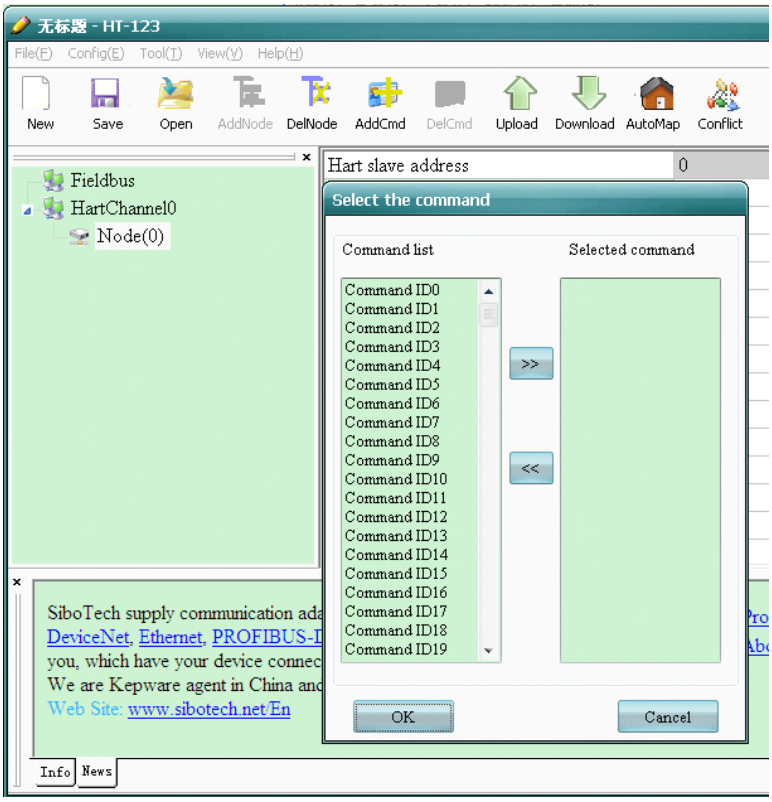
Configuration is completed, press Enter to confirm.

Note: HART protocol provide that the slave device which address is 0 work in a single-point mode, allows digital communication and analog communication exist at the same time. Slave address is 1 to 15 of the device work in multi-point mode, the analog output of the device is the minimum value (e.g. 4mA), only allow digital communication. The protocol also provides that the factory address of HART slave device is 0.

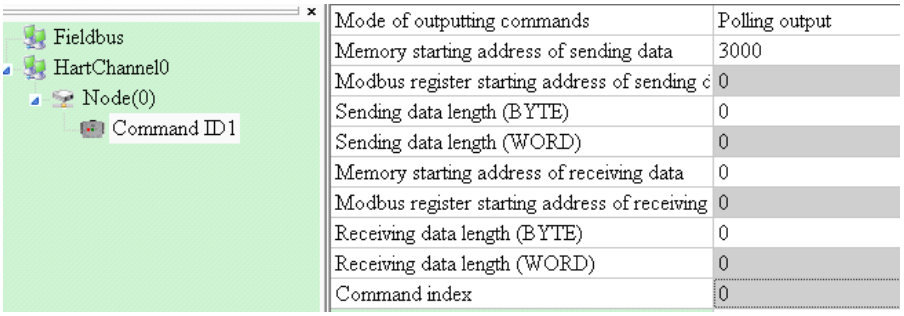
4. Right-click HartChannel0, in the pop-up menu, select “Add Node”, as shown below:



5. Right-click “Node (0)” in the pop-up menu, select Add command to add a command (command 1) in the dialog box, then OK to return.



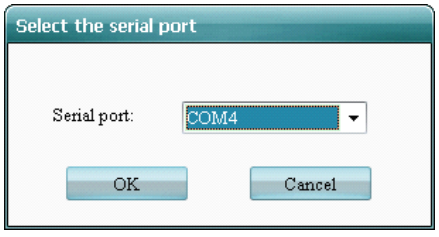
6. Click the "command ID1", with the configuration table in the figure appears to the right:



press Enter to confirm.

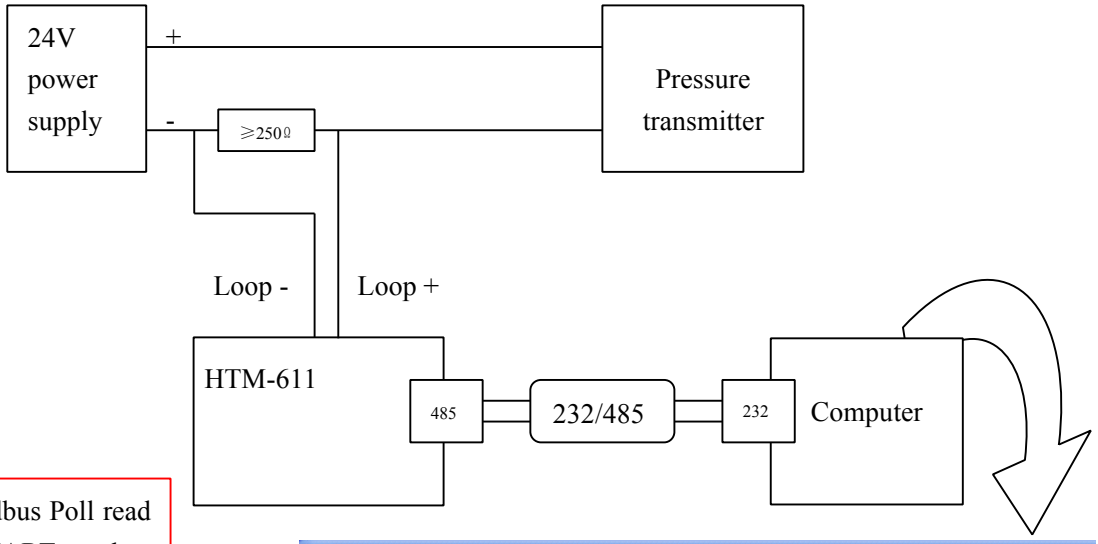
7. Click the icon 

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

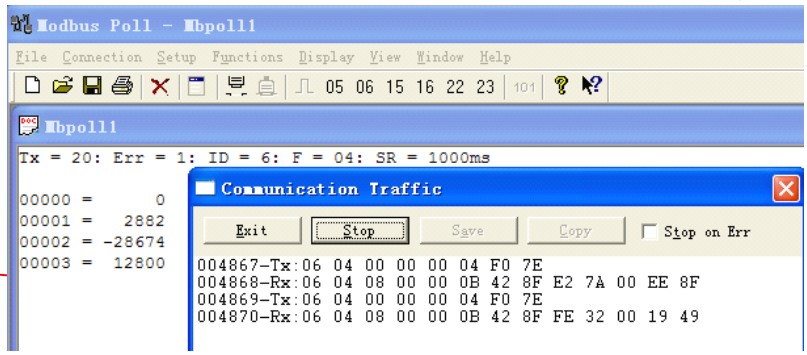


2.2 Function Demo

HART interface of the gateway HTM-611 connect a 2-wire pressure transmitter with slave address is 0, RS485 interface through RS485/RS232 converter connect to a computer, and computer with MODBUS POLL software to simulate a MODBUS master, then in data exchange window you can see the main variable value of the pressure transmitter:

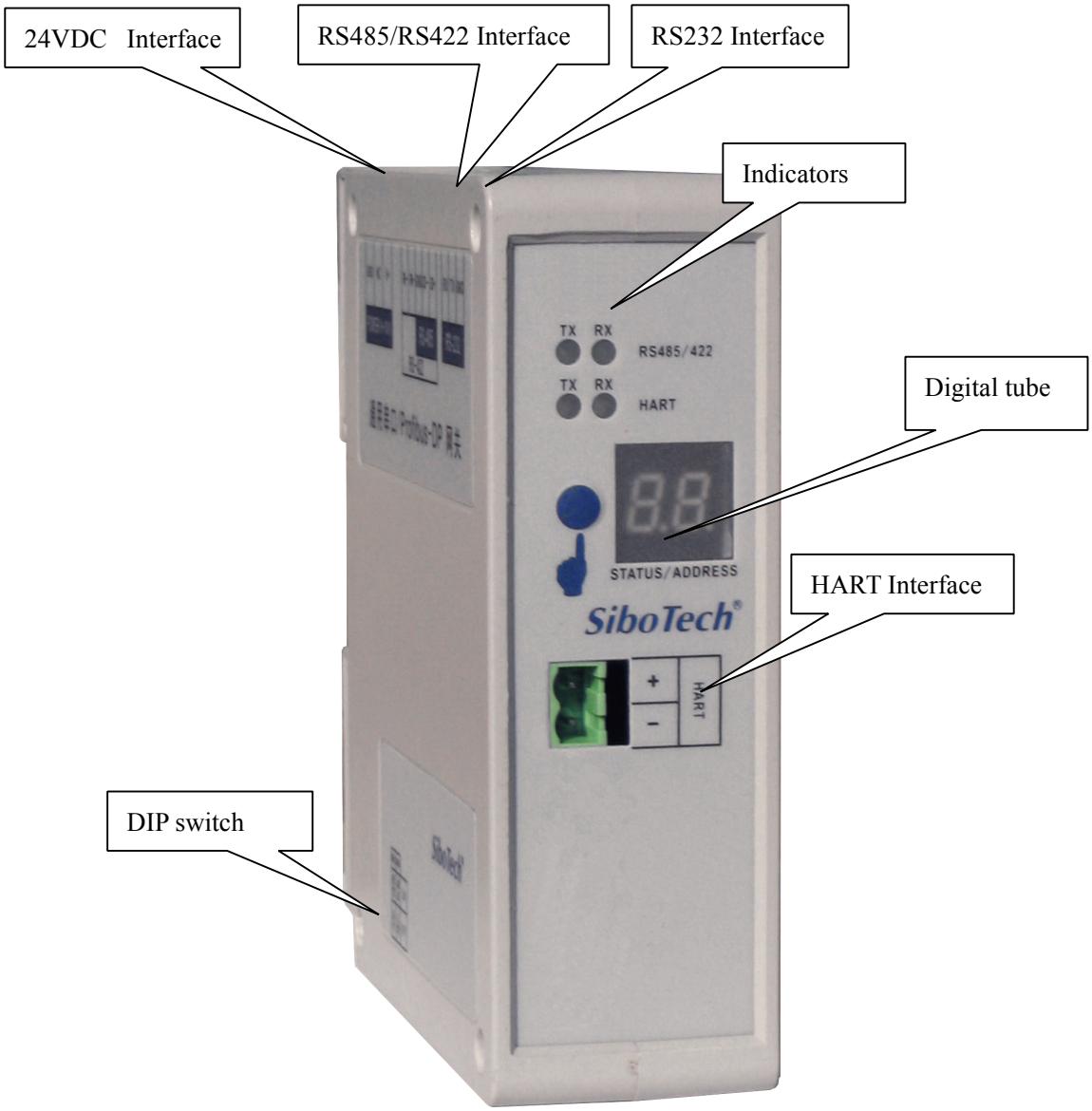


The Modbus Poll read the HART data "00,00,0B,42,8F,FE,32", where in the front two "00" which means that the device is in normal state, "0B" indicates that the pressure unit is PSI, "42, 8F, FE, 32" which means that the pressure value, the size is 71.9964752197266 (psi).



3 Hardware Descriptions

3.1 Product Appearance



Note: This picture is for reference only. Product appearance should accord to the real object.

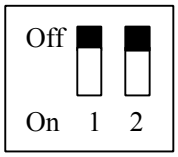
3.2 Indicators

Indicator	State	Status Description
PBF	Reserve	Reserve
	Reserve	Reserve
STA	Reserve	Reserve
	Reserve	Reserve
TX	Blinking	Bus data is sending
	Close	No data is sending
RX	Blinking	Bus data is receiving
	Close	No data is receiving

3.3 Configuration Switch

3.3.1 Status setting switch

Configuration switch located at the bottom of product, bit 1 is the debugging bit and bit 2 is the mode bit.



The debugging (bit 1)	Configuration (bit 2)	Description
Off	Off	Running mode
Off	On	Configuration Mode
On	Off	Debugging mode
On	On	Configuration Mode

Note: ①After re-configure the switch, you have to restart the HTM-611 to make the settings take effect!

②Set to debug mode, “MODBUS slave”or “common mode” will be compulsory for RS485 interface for communication port, RS232 interface for debugging interface.

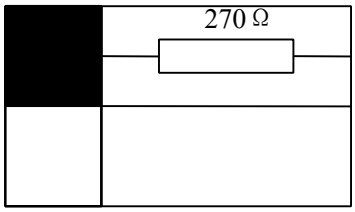
③Configuration interface using the RS232 interface.

3.3.2 The MODBUS address set button

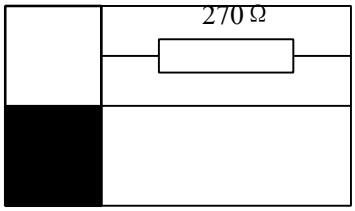
Under normal working condition of the HTM-611, digital tube always displays the address of the current Modbus address. Quickly press(double-click) the button twice in succession, the high bit starts flash, and the low bit always on, click the button to add 1 to start setting the Modbus address high bit. Long-press the button for 3 seconds, the high bit starts always on, and the low bit starts flash. Click the button to add 1to start setting the MODBUS address low bit. Then long-press the button for 3 seconds, the address flashing three times shows that the address set successfully. If no button action within ten seconds, HTM-611 exits the status of setting address and continue to display the original address. HTM-611 settable range of MODBUS address is 0 to 99 (decimal).

3.3.3 Internal / external sampling resistance switch

HTM-611 can choose using the internal sampling resistance or external sampling resistance for HART signal. The specifications of the internal resistance is 270Ω, 2W. When the power of the sampling resistance is more than 2W, you must use an external resistance.



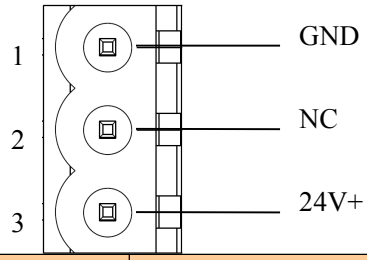
Switch to the top, using the internal sampling resistance



Switch to the bottom, using an external sampling resistance

3.4 Interface

3.4.1 Power Interface



Pin	Function
1	GND
2	NC(No Connect)
3	24V+，DC plus 24V

3.4.2 RS-485/RS-422 interface

The RS-485 interface of PM-160 is standard, and the RS-485 characteristics of the product are shown as follows:

1. The basic characteristics of RS-485 transmission technology

① Network topology: Linear bus, there are active bus termination resistors at both sides.

② Transfer rate: 300 bps~115.2Kbps.

③ Media: Shielded twisted-pair cable and also can cancel the shielding, depending on environmental conditions (EMC).

④Site number: 32 stations per subsection (without repeater), and can up to 127 stations (with RS485 repeater).

⑤Plug connection: 3-pin pluggable terminal.

2. The main points on RS-485 transmission equipments installation

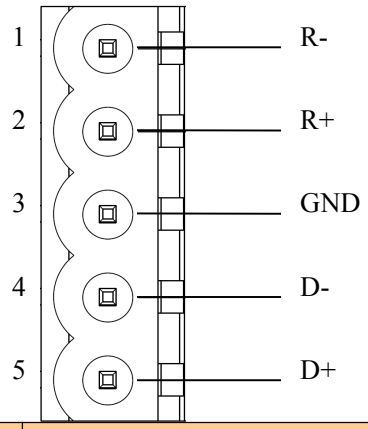
①All the equipments be connected with RS-485 bus;

②Subsection can be connected up to 32 sites;

③The farthest end of each bus has a termination resistor—120Ω 1/2W to ensure reliable operation of the

network.

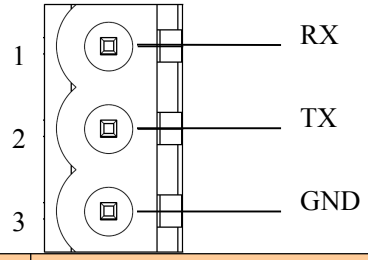
Serial interface uses 5-pin pluggable terminal and users can wire it according to the wiring instructions on the panel.



Pin	Function
1	R-, RS-422 Receive Negative
2	R+, RS-422 Receive Positive
3	GND
4	D-, RS-485/RS-422 Transmit Negative
5	D+, RS-485/RS-422Transmit Positive

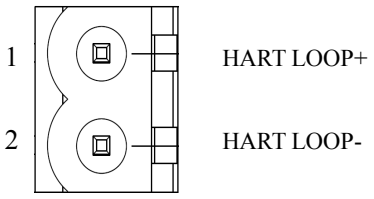
3.4.3 RS-232 interface

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



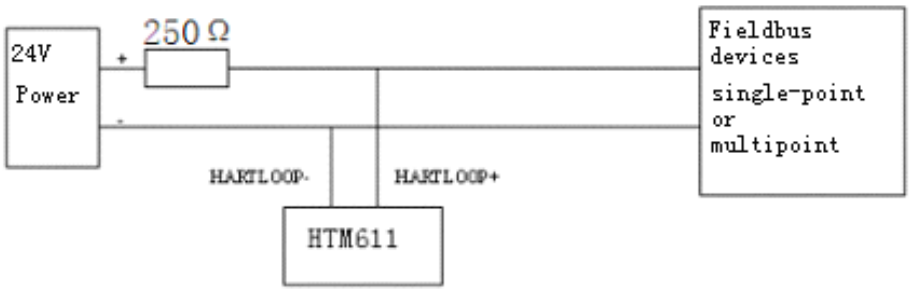
Pin	Function
1	RX，Connect user device RS232's RX
2	TX，Connect user device RS232's TX
3	GND，Connect user device RS232's GND

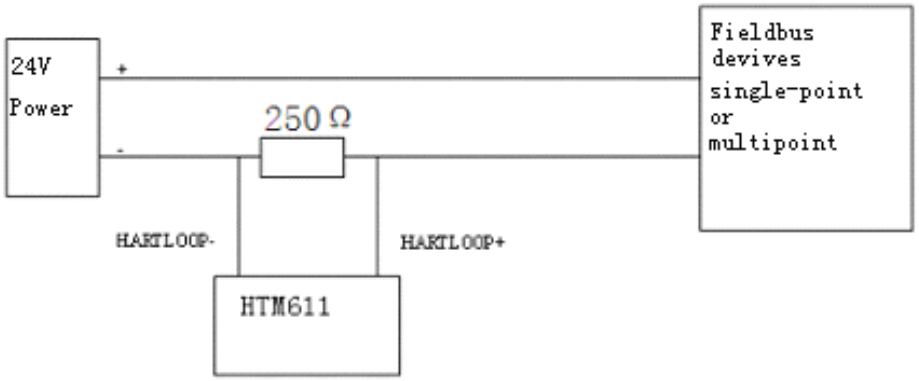
3.4.4 HART interface

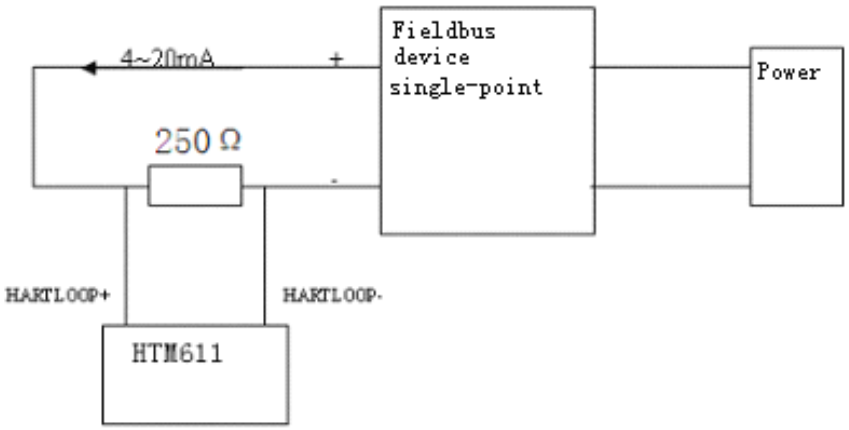


Pin	Function
1	Connect HART signal positive
2	Connect HART signal negative

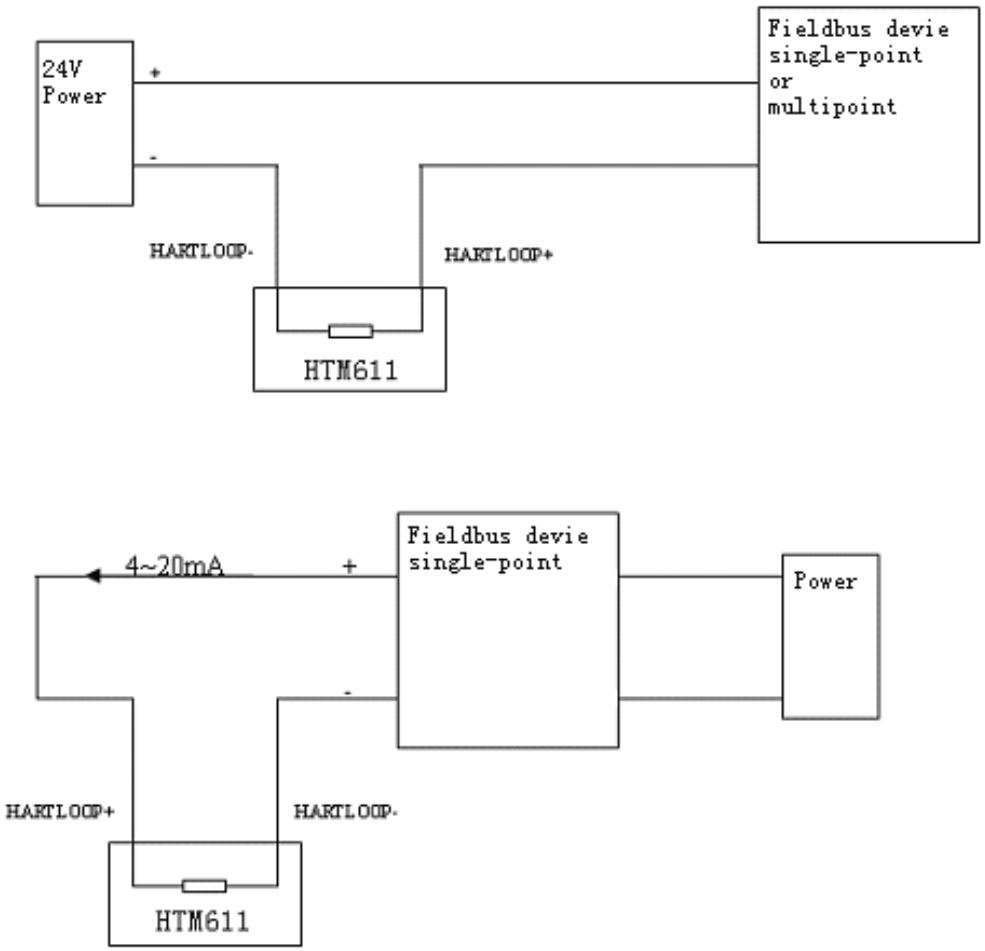
3.5 Topology of HTM-611







Do not use the internal resistance!



Using internal resistance!

Note: 1. Some HART slave instrument need to perform self-test and other internal work when power on, may not proceed HART communication then gateway can not receive the response of the instrument right now. Recommendations to the HART slave instrument and gateway separate power supply, so that the gateway can immediately establish communication with instrument.

2. When configuration HART commands in the software HT-123, the commands need to be configured according to the actual needs. To improve the speed of bus communication, it is recommended not to configure the empty node (in fact, not connected to the node) and empty commands(the actual unwanted commands).

4 Instructions Of Configuration Software

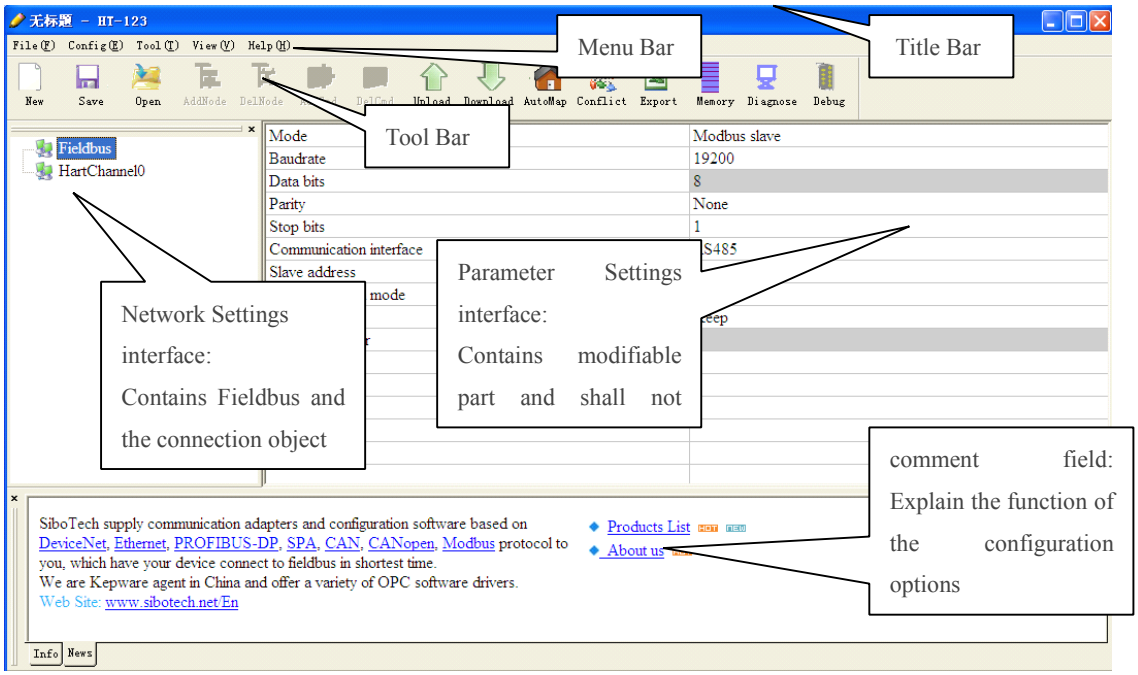
4.1 Software Interface Description

HT-123 is a software based on Windows platform, and used to configure HART series products

The following describes how to use the software HT-123 to configure the product HTM-611. you may also check the software user manual to get detailed usage.

Double-click on the icon 

to enter the main interface of software:

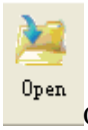


Tool Bar:

Toolbar interface as follow:

New: Create a new configuration file

Save**:** Save the configuration file



Open: Open the configuration file

AddNode: Add a HART slave node

DelNode: Delete a HART slave node

AddCmd: Add a HART command

DelCmd: Delete a HART command

Upload: Read the configuration file in the gateway

Download: Download the configuration file to the gateway

AutoMap: Used to automatically calculate the data store address by each command

Conflict: To check whether there are some conflicts about the data store address

Export: Output current configuration and saved as Excel spreadsheet form

Memory: Show the data exchange inside of the gateway

Diagnose: through this function could check instrument data

Debug: through this function could send any request message to Hart instruments and record the response information

4.2 Software Functional Specifications

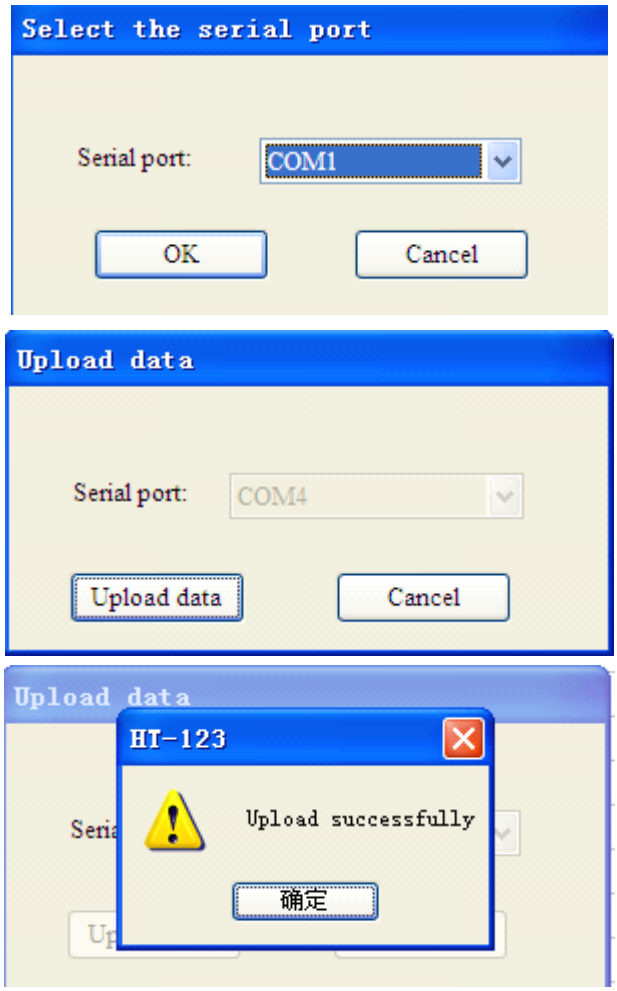
4.2.1 Connect to the hardware

To ensure that the gateway's configuration switch is in the ON state， Use a serial port line connected to the gateway's RS232 port and computer RS232 serial port. Electricity to the gateway ,and it's Digital tube display "CF".

4.2.2 Upload the configuration file in the gateway

Open the software "HT-123", Click on the icon 

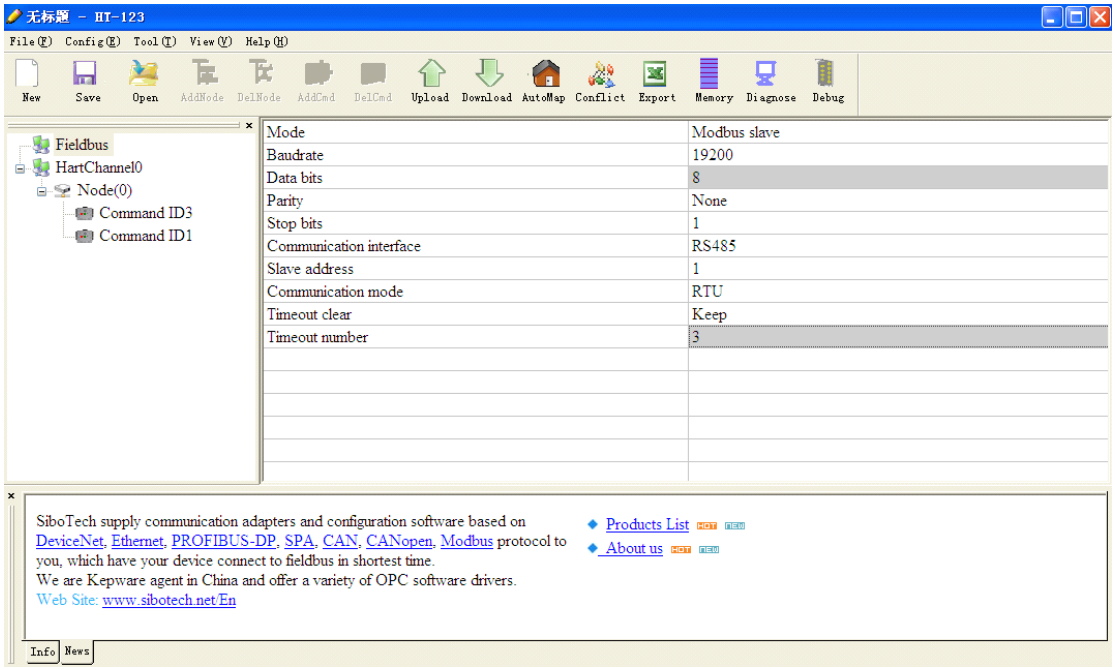
, Select the computer port connected to the gateway and then click "upload date", If it shows "upload successfully", it has been read the gateway's configuration file.



4.2.3 Configure the fieldbus

4.2.3.1 Configure the fieldbus as Modbus slave

Configuration interface is as below:



In this interface you can set the parameters as shown:

Mode: Be sure that ”Modbus Slave” is selected here

Baudrate: 300, 600, 1200, 2400, 9600, 19200, 38400, 57600, 115200bps

Data bits: 8

Parity: None、Odd, Even, Mark, Space

Stop bits: 1, 2

Communication interface: RS485, RS232

Slave address: 1~247

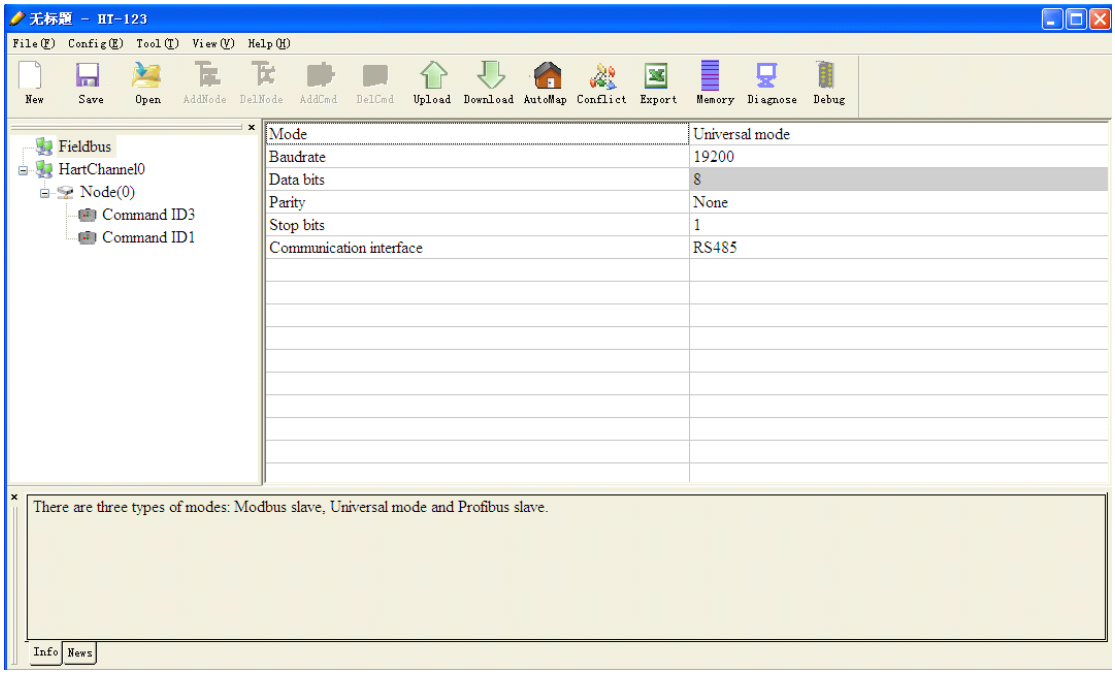
Communication mode: RTU, ACSII

Timeout clear: Keep, Clear

Timeout number: 1~14

4.2.3.2 Configure the fieldbus as Universal mode

Configuration interface is as below:



In this interface you can set the parameters as shown:

Baudrate: 300, 600, 1200, 2400, 9600, 19200, 38400, 57600, 115200bps

Data bits: 8

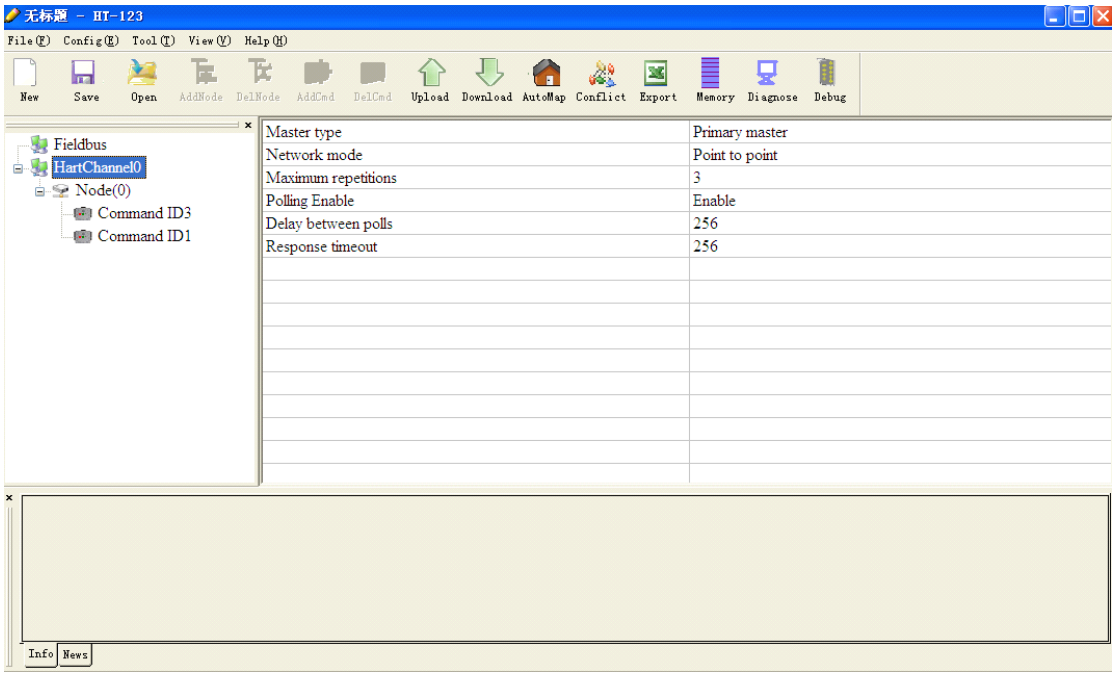
Parity: None, Odd, Even, Mark, Space

Stop bits: 1, 2

Communication interface: RS485, RS232

4.2.4 Configure the HARTChannel

4.2.4.1 Set the parameters of HARTChannel



Master type: Primary master, Secondary master

Network mode: Point to point, Multi-drop

Maximum repetitions: 0~5

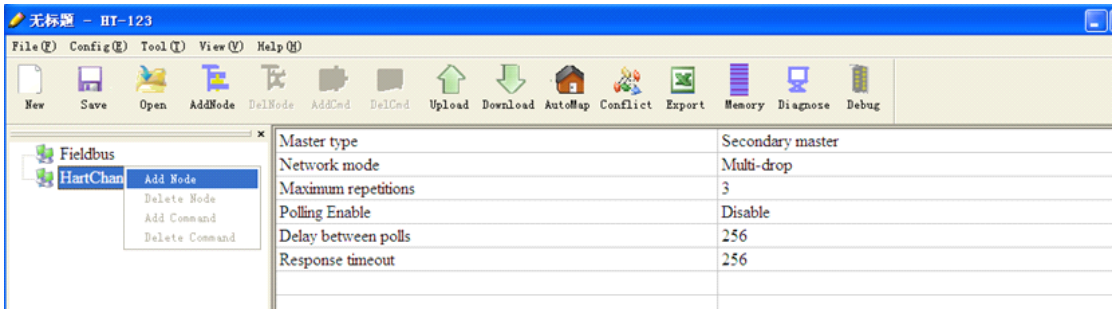
Polling Enable: Enable, Disable

Delay between polls: 256~65535ms

Response timeout: 256~65535ms

4.2.4.2 Add slave nodes

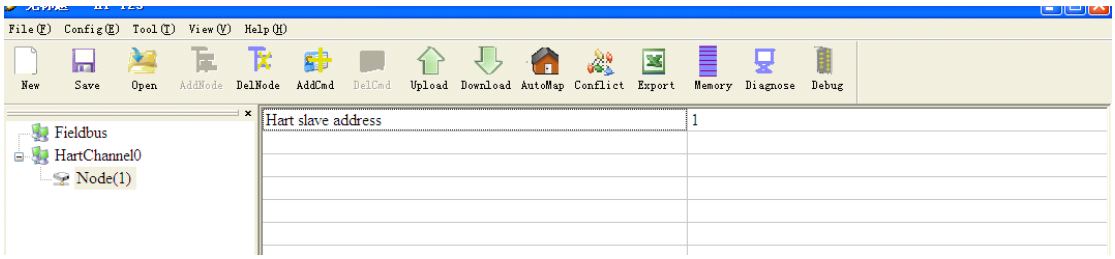
Select the ”HartChannel()” , Right click the mouse and click ”AddNode”



Select the ”Doe(1)” and set Hart slave address.

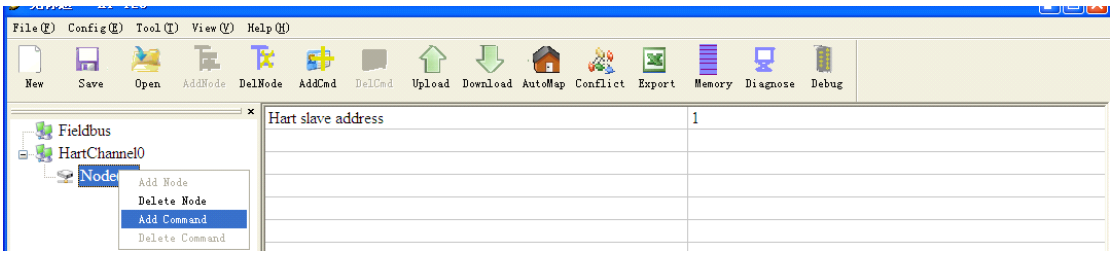
“Point to point” mode: The salve address can only be 0;

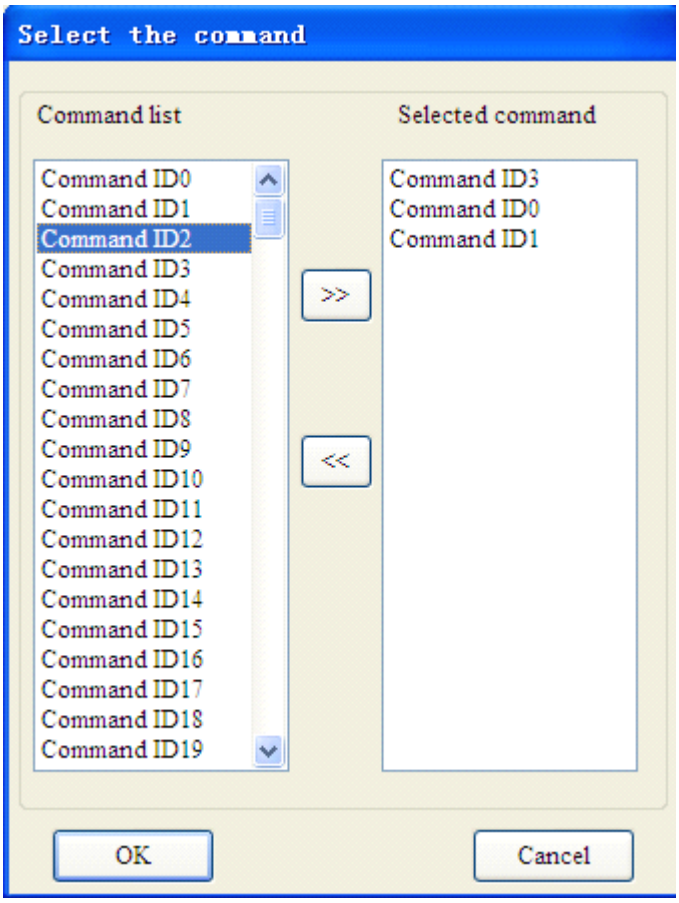
“Multi-drop” mode: The slave address can be 1to 15.



4.2.4.3 Add HART Commands

Select the “Node()” , Right click the mouse and click “AddCommand”

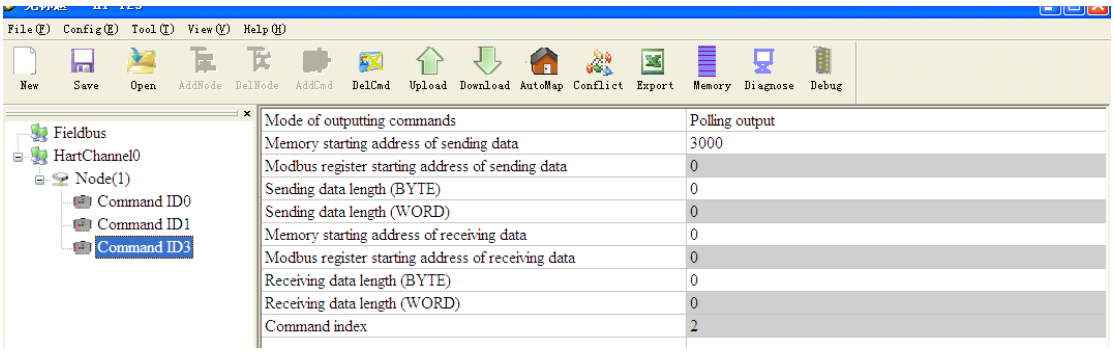




Note: the same command can only be configured once in a node.

4.2.4.4 Configure HART Commands

The Hart command configuration interface as shown below:



Mode of outputting command:

- ✓ Change-of-state output: end the command when the data changes in the sending data-buffer.
- ✓ Polling output: end the command periodically.

- ✓ Initialization output: end the command only when power on
- ✓ Disable output: he command will not be sent.

Set starting address of sending data: 000~3999

Modbus register starting address of sending data: 0~499

Sending data length(BYTE): 0~255

Sending data length(WORD): 0~127

Memory starting address of receiving data: 0~1599

Modbus register starting address of receiving data: 0~799

Receiving data length(BYTE): 0~255

Receiving data length(WORD): 0~127

Command index: The index of the command in the configured commands list

4.2.4.5 Delete a command

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

4.2.4.6 Delete a node

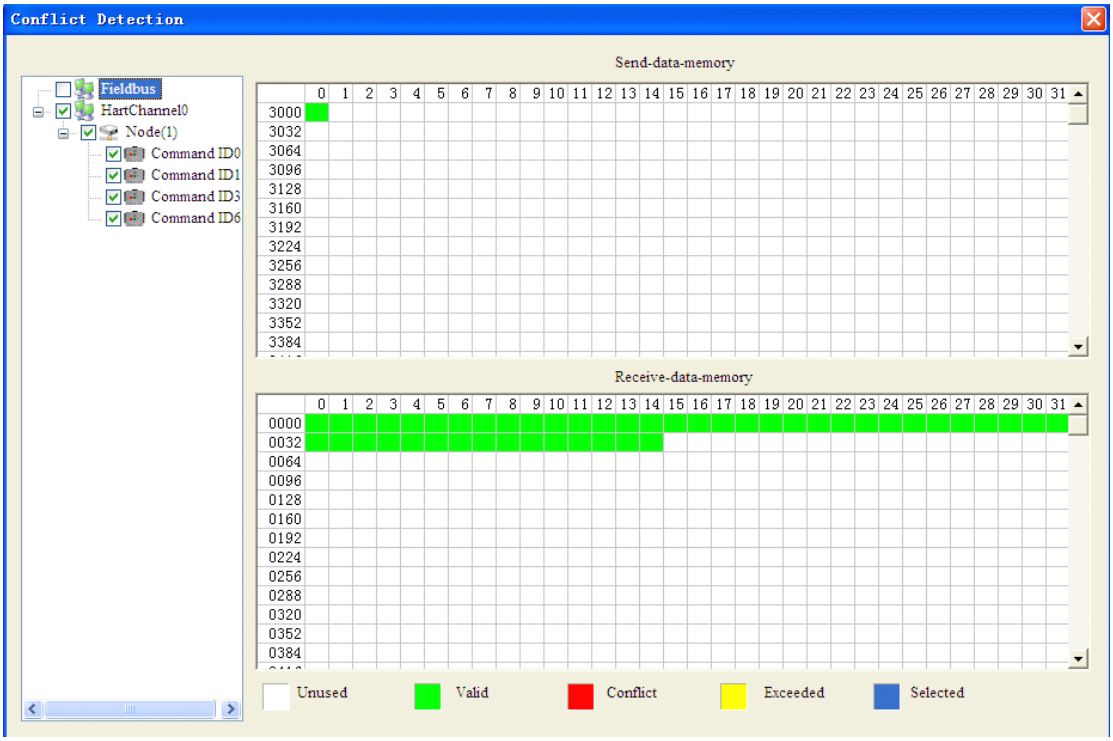
Select the node need to deleted, Right click the mouse and click “Delete Note”. Through the menu command can also be the same action.

4.2.5 Conflict detection

To check whether there are some conflicts about the data store address. The Conflict detection

Configuration interface as shown below:

The left side is configuration commands, the right side is data memory address including receive data storage address and send data storage



4.2.6 AutoMap

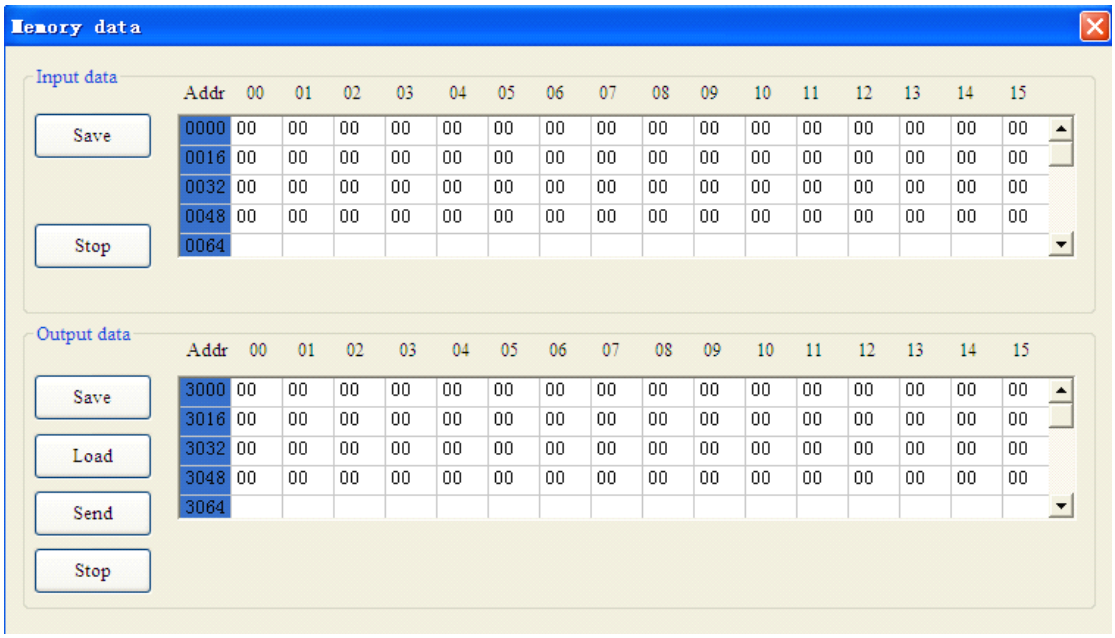
Used to automatically calculate the data store address by each command.

4.2.7 Memory

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

1. Ensure that the gateway's debug switch is in the ON state and the configuration switch is in the OFF state, Back online
2. Use a serial port line connected to the gateway's RS232 port and computer RS232 serial port, Open the software "HT-123", Click "Config—serial setting", Select the correct serial port
3. Click "Tool—Show Memory Data" or click on the icon 

, Interface is as follows：



It including input data and output data：

Input data: It shows the response message of each HART device

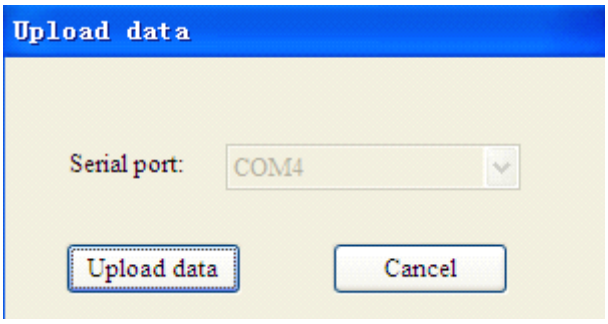
Output data: Users can modify and send message to each HART device in this place

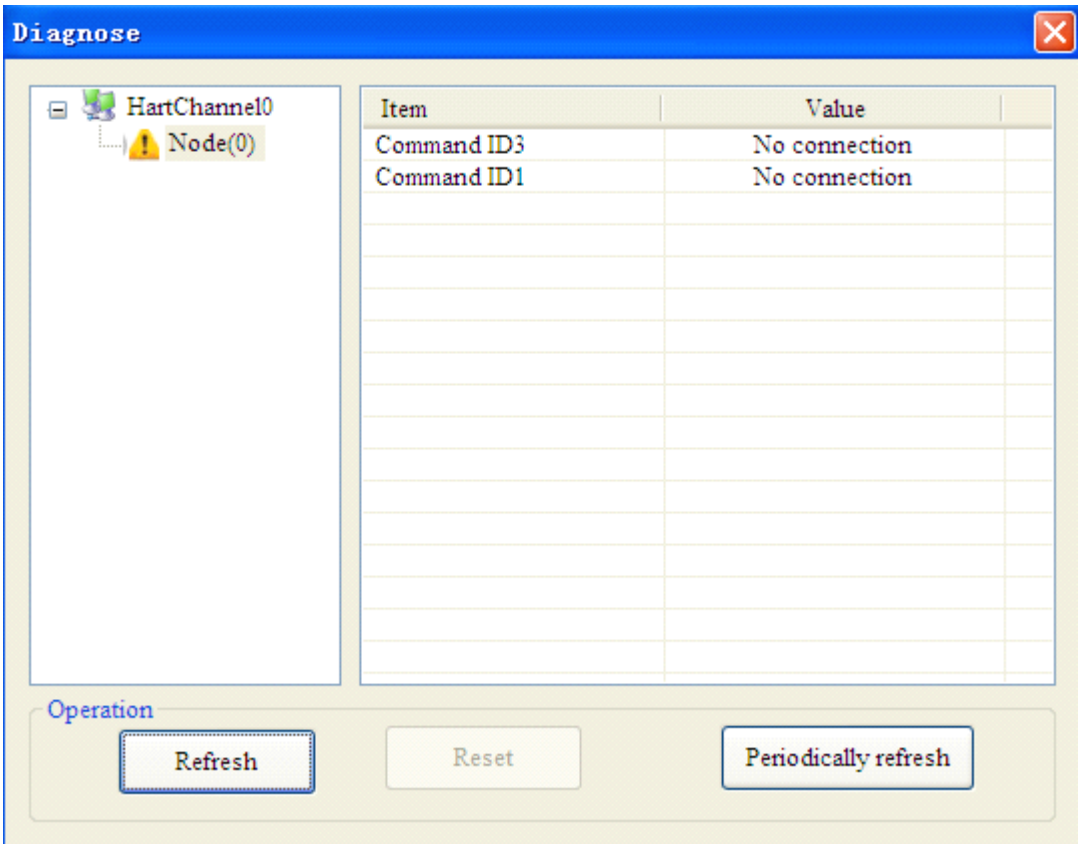
4.2.8 Diagnose

Through this function users could check each command execution，Steps are as follows:

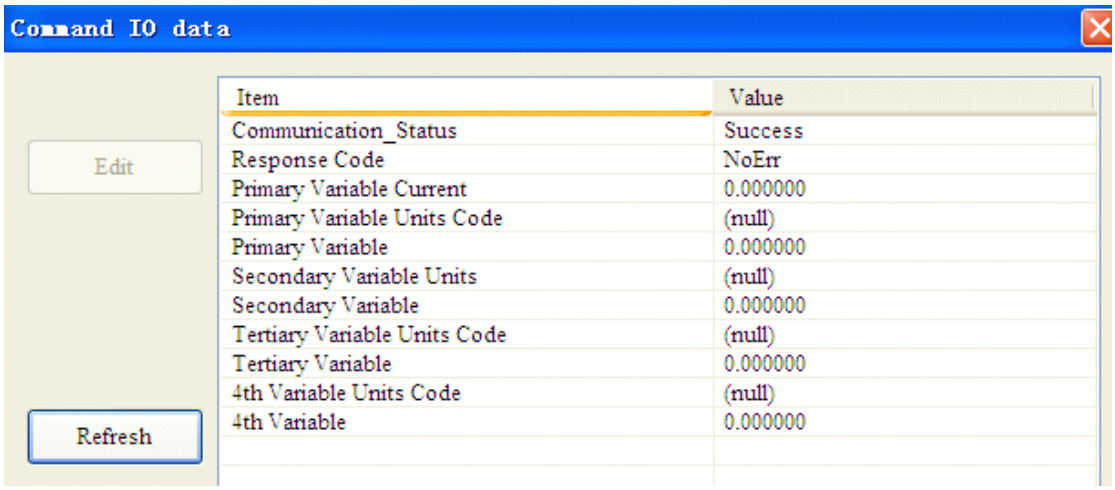
1. Ensure that the gateway's debug switch is in the ON state and the configuration switch is in the OFF state, Back online
2. Use a serial port line connected to the gateway's RS232 port and computer RS232 serial port, Open the software "HT-123", Click "Config—serial setting", Select the correct serial port
3. Click "Tool—Diagnose" or click on the icon 

，Interface is as follows:





Select the ”Node()”, it shows each command execution. Double click on the Command, There will be the following interface.

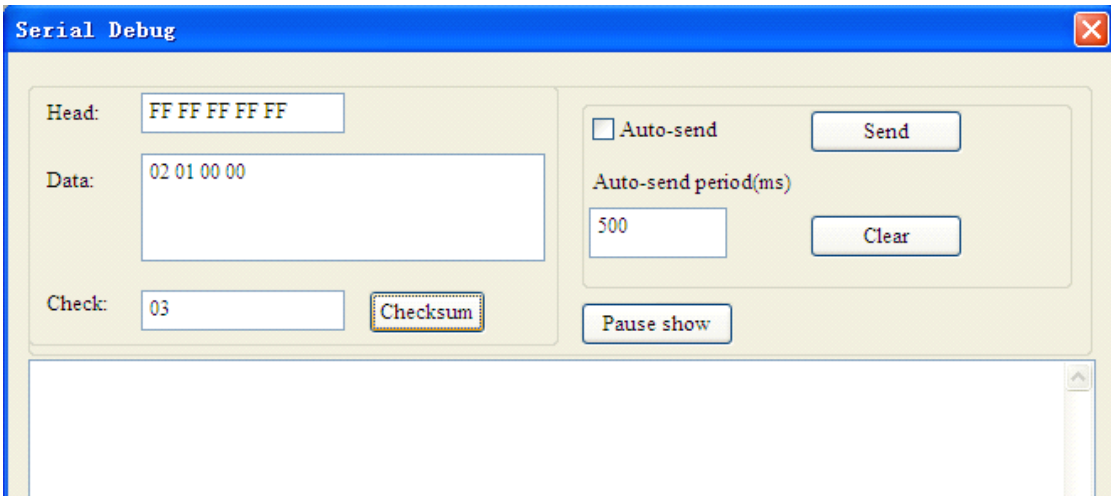


4.2.9 Debug

Through this function could send any request message to Hart instruments and record the response information. Steps are as follows:

1. Ensure that the gateway's debug switch is in the ON state and the configuration switch is in the OFF state, Back online
2. Use a serial port line connected to the gateway's RS232 port and computer RS232 serial port, Open the software "HT-123", Click "Config—serial setting", Select the correct serial port
3. Click "Tool—Serial debugging assistant" or click on the icon 

, Interface is as follows:



5 Working principle

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

	Gateway memory address	Corresponding Modbus register address	Description
Read-only part	0-1599	0-799	The HART data input area
	1600-1619	800-809	Device 0_cmd0 data
	1620-1639	810-819	Device 1_cmd0 data
	……	……	……Device 15_cmd0 data
	1920	960H	Gateway status
	1921	960L	Gateway HART port to send Views
	1922	961H	Gateway HART port to receive Views
	1923	961L	HART communication error number of times
	1924-1943	962-971	Reserve
	1944	972H	Device 0_cmd0's response status
	1945	972L	Device 1_cmd0's response status

	……	……	……Device15 _cmd0's response status
	1960-2119	980-1059	The response status of the user command
	2120-2391	1060-1195	Reserve
	2392	1196H	Universal Receiver label
	2393	1196L	Universal Receive Error Counter
	2394-2395	1197	The Generic Receive data length
	2396-2695	1198-1347	Universal receive data
	2696-2999		Reserve
Readable and writable part	3000-3999	0000-0499	The HART data output area
	4000	0500H	Reset send, receive, error counter
	4001	0500L	Polling is enabled
	4002	0501H	Trigger label
	4003	0501L	Trigger command number
	4004-4269	0502-0634	Reserve
	4270	0635H	Universal Send label
	4271	0635L	Universal mode enabled
	4272-4273	0636	The universal send data length
	4274-4573	0637-0786	Universal to send data

- The HART data input area: Stored HART slave device to the gateway data.
- The HART data output area: Stored the gateway to the HART slave device.
- Device 0_cmd0~ Device 15_cmd0: When the first execution of a station command, the gateway internal will automatically execute the 0 No. command to obtain the device information (to obtain the long address). The response data of these internal command is stored in this area.
- Gateway status: The gateway status indicates that the gateway state in which the HART network, Is defined as:

  0---- There are not HART communications.

  1----sending

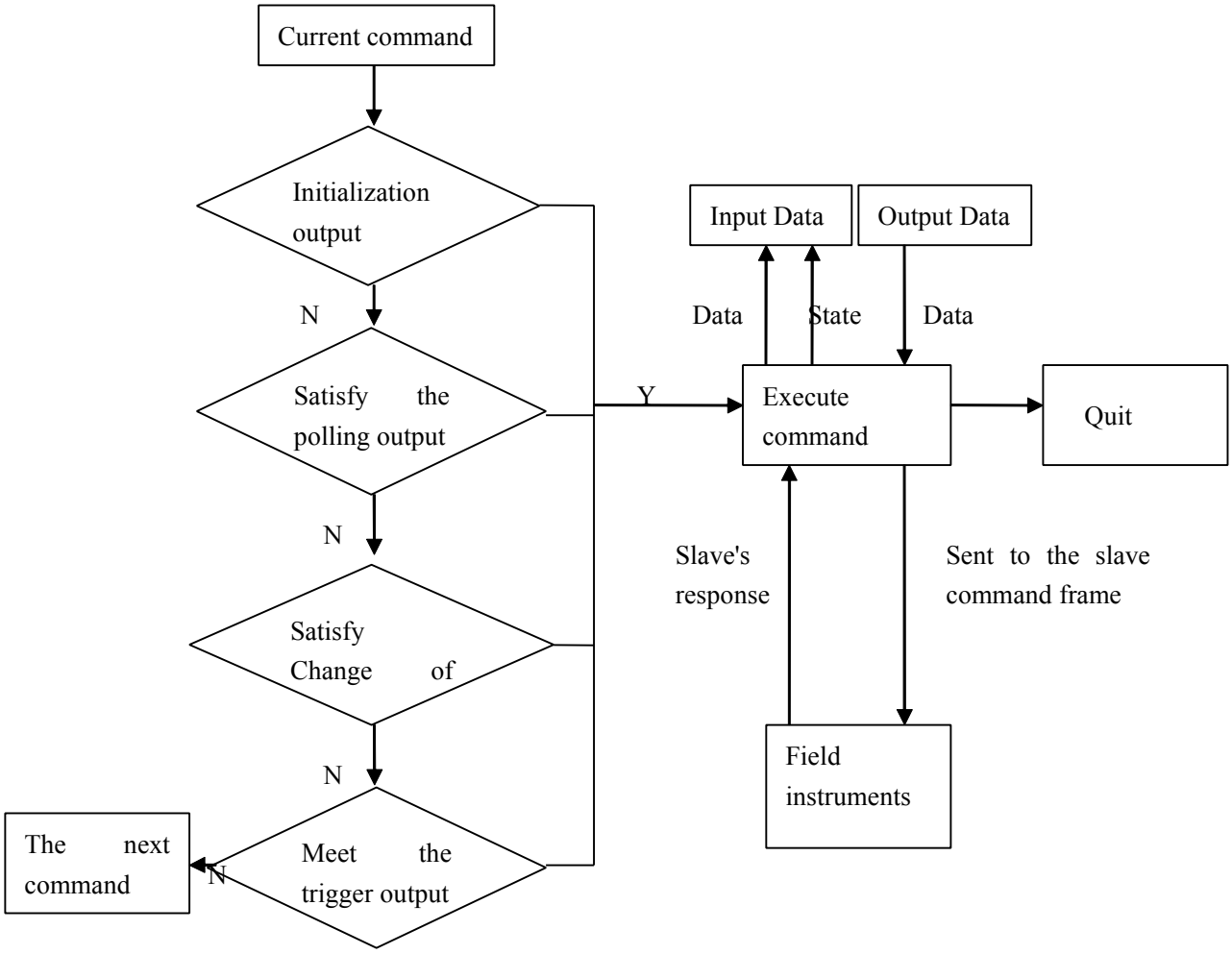
  2---- Waiting for a response

  3---- handing a response

- Gateway HART port to send Views: The HART Send counter
- Gateway HART port to receive Views: The HART Receive counter
- HART communication error number of times: The HART Receive Error counter
- Device 0_cmd0~ Device 15_cmd0's response status: Show that the response status of the internal command
- The response status of the user command: Show that the response status of the user commands

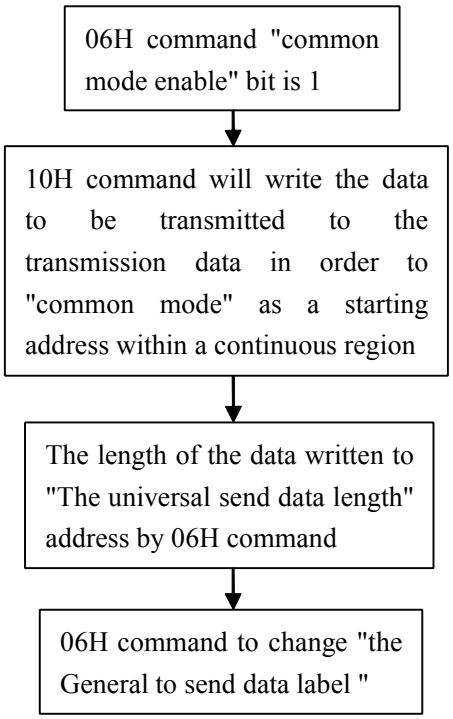
  Command state is defined:
  0---- Not performed
  1---- The correct response
  2---- Parity error
  3---- No Answer
  4---- Agreement defined error
  5----no connecting
- Universal Receiver label: The receive label under the generic model, this value changes in time that HART receives a HART frame
- The Generic Receive data length: Indicating the received data length in the common mode
- Universal Receive Error Counter: Show that the generic receive the number of errors
- Universal receive data: HART end of the received data stored in common mode
- Reset send, receive, error counter: For gateway control signal, change the value of the memory gateway causes the counter to 0
- Polling is enabled: This bit is readable and writable, write 1 enables the polling output When 0 is written to the output against polling; Reading 1 indicates that the polling state is enable, 0 indicates that the polling disabled state
- Trigger label: The user to change the value will result in a trigger operation
- Trigger command number: Trigger operation performed by the command number
- Universal mode enabled: The value of 1 indicates a general transfer function is enabled, otherwise prohibited Universal Transport
- Universal Send label: The send label under the generic model, this value changes in time will lead to to send a HART frame
- The universal send data length: The length of the transmission data of the generic model
- Universal to send data: the transmission data of the generic model

5.1 Perform a HART Command Flowchart



5.2 General to Send and Receive Data

There are two common ways for users to select: A fieldbus defined as common mode. The gateway will receive serial data to 3.5 character timeout frame, and unchanged by the HART interface to send out. Gateway sends data without modification by the serial that the data is HART interface received data. The character timeout time determined by baud rate , such as baud rate of 19200, Character time-out is considered to be (1/19200) * 10 * 3.5 ≈ 2ms. The other is through MODBUS command HART Universal frame transceiver indirect, Examples are as follows:



The gateway will receive the HART frame is stored in a continuous region within "the Universal receiving data" as a starting address. And length of the received data to fill in the "Universal received data length". Then change the value of the the Universal Receiver numeral ". If any data is not received within the response wait time ORDER "universal reception error counter" is incremented by 1. The user sending the the general frame before read the the Universal receiver label and the error counter, finished the general frame is a continuous need to read these two values, the changes so far until one occurs.

5.3 Trigger Command

Users can use MODBUS command HART commands to trigger any one of the gateway configuration. Specific approach to the user command with the MODBUS 6 Order To trigger number (with HT-123 configuration commands, the software will automatically calculate and display) written to the "trigger command number". Then rewrite "the trigger label" can be triggered by the gateway trigger operation once its value changes. The data portion will be stored in the device in response to "the reception data memory" specified by the command number .

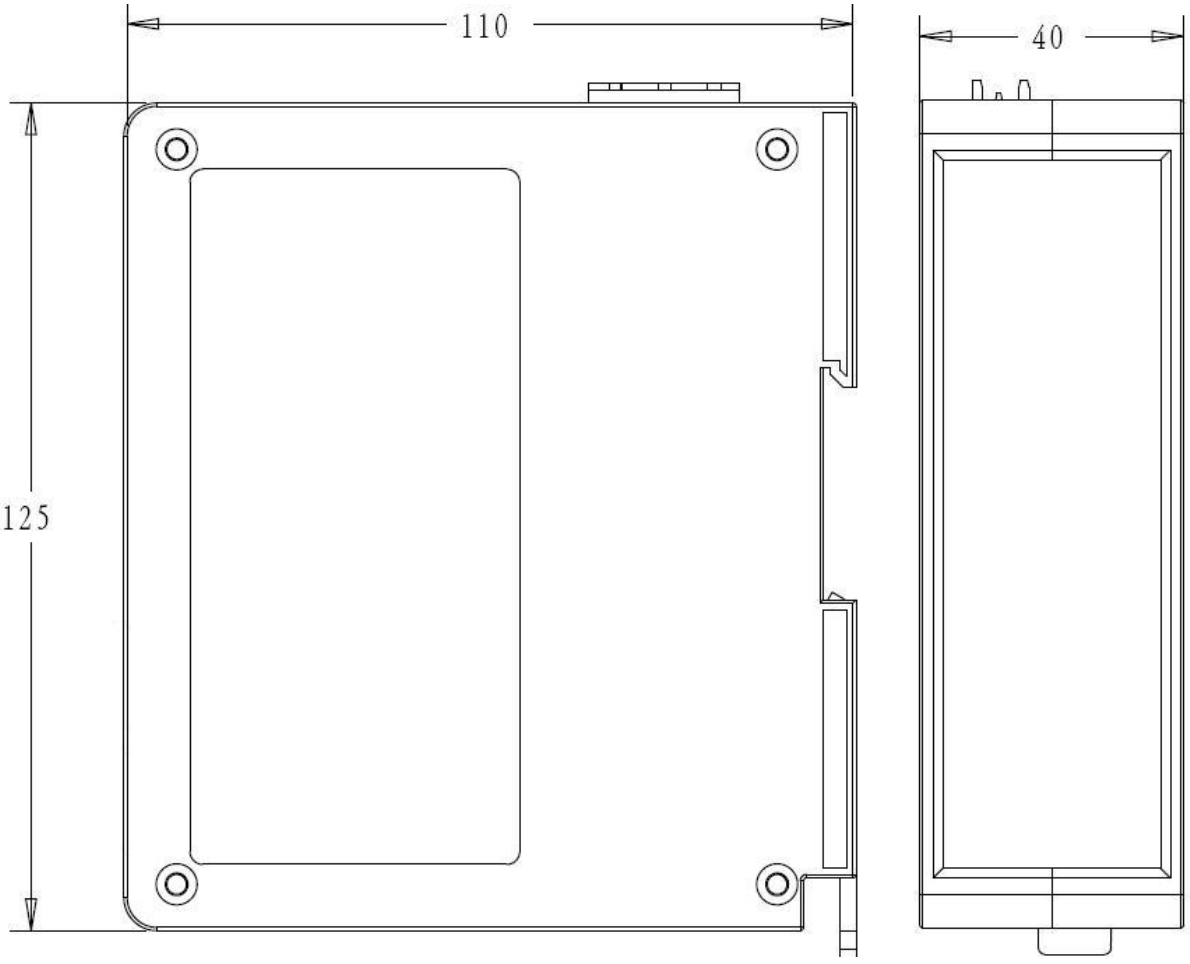
5.4 Data Exchange with MODBUS

Fieldbus configuration "Modbus slave", the user can address the gateway internal input and output buffer corresponding to data exchange, the status of the gateway and management, the transceiver can also be triggered operation and common frame.

6 Installation

6.1 Machine Dimension

Size: 40mm (weight)*125mm (height)*110mm (depth)



6.2 Installation Method

Using 35mm DIN RAIL