HDS

HART Device Simulator

User's Manual
(v1.10)

Warranty

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1. Introduction

HART Device Simulator (called HDS) is the HART device simulation software developed by ICP DAS. It can be used to simulate multi HART slave devices simultaneously to exchange data with HART master device by using ICP DAS HART converter (like**:** I-7567 / I-7570 / I-7547) connected to any COM port (USB / 232 / 485 / Ethernet). By this way, users can develop or verify the HART master program without any HART slave device. The below figure is the application of HDS.

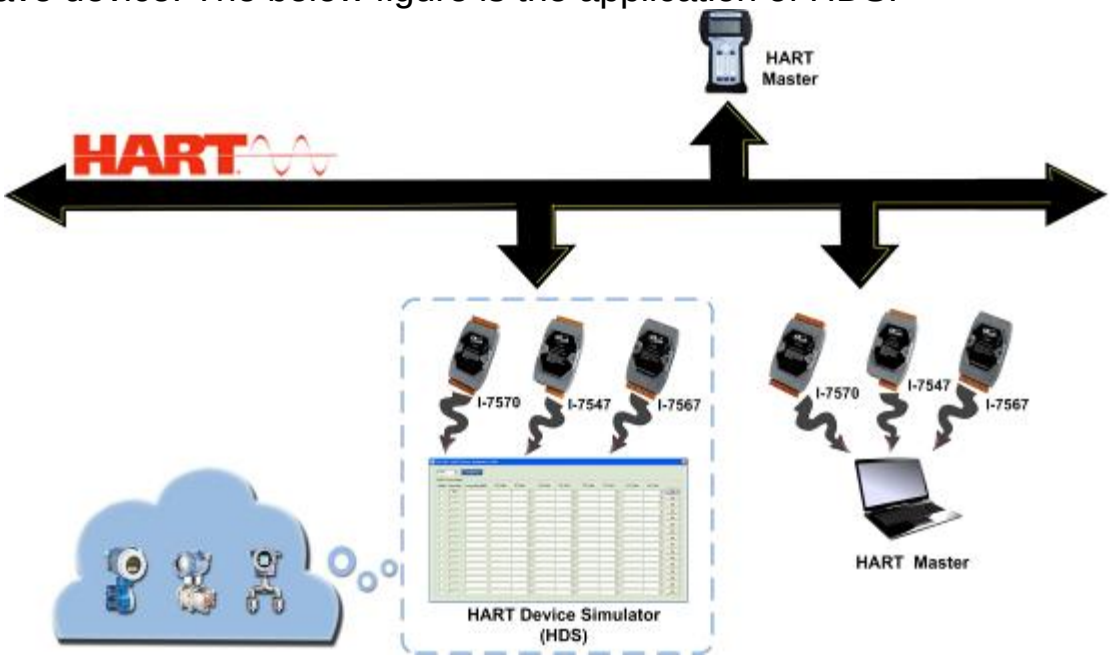


Figure 1-1 **:** HDS Application

1.1 HDS Features

- **Free** HART slave device simulation software

  (**Must work with one of ICP DAS HART converter**: I-7567/ I-7570/ I-7547)

- Support a lot of HART commands (like**:** CMD0 / 1 / 2 / 3 …)
- Provide the setting for the long frame address of HART device.
- Provide the setting for the value and unit of HART command 3.
- Support 16 HART devices simulation simultaneously (address 0 ~ 15).
- Exchange data with HART master device by using ICP DAS HART converter (like**:** I-7567 / I-7570 / I-7547)
- Support HART communication data log.
- Provide the “adjustable” HART device status bit

1.2 HDS Information

- Compatible with command revision 5, 6, 7 of HART protocol.
- When the COM port is open, the HDS will listen for the incoming requests and response data.
- Only the HART simulation device with the “Enabled” option checked will response data.
- The field of the “Short Frame Address” is fixed.
- The field of the “Long Frame Address” with 5 bytes can be set to simulate the different HART manufacturer’s slave device.
- All the HART communication data can be logged to file.
- The four main values and units of PV / SV / TV /QV of HART command 3 can be set for every HART simulation device.

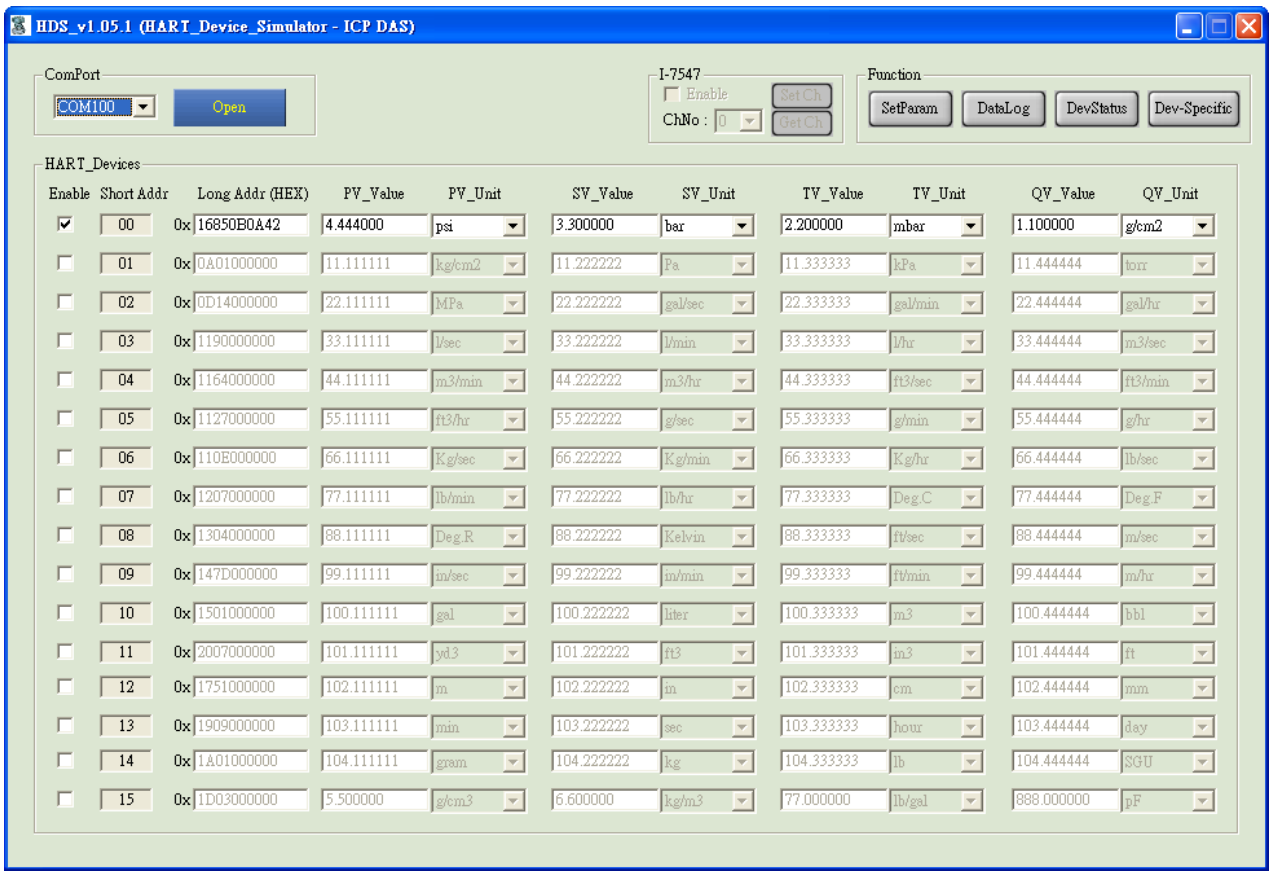


Figure 1-2 **:** HDS Tool

2. HDS Tool

The HDS software includes the below files.

(1) **HDS.exe** => The main program.

(2) **HDS.ini** => The record file for parameters.

=> Users can execute the “HDS.exe” to run HDS program.

=> HDS software can be downloaded from **:**

http://ftp.icpdas.com/pub/cd/fieldbus_cd/hart/converter/hds/software/. ◦

2.1 HDS Operation

Execute the **HDS** tool.

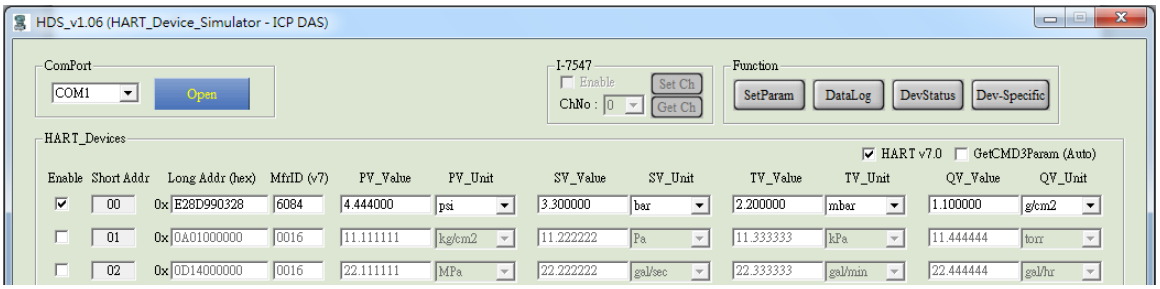


Figure 2-1**:** HDS Main Screen

2.1.1 **ComPort**

Choose the “ComPort” number and click the “Open” button.

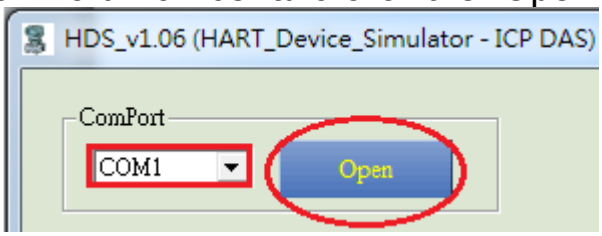
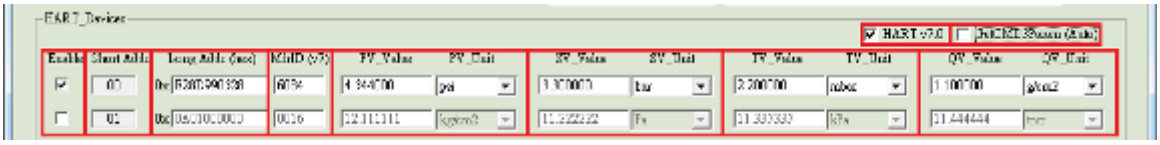


Figure 2-2**:** Open the “ComPort”

2.1.2 **Parameter of HART Simulation Device**



(1) “**HART v7.0**” option **:** (Available after version v1.06)
=> If checked, “MfrID” field will be enabled

(2) “**GetCMD3Param**” option **:** (Available after version v1.06)
=> If checked, HDS will load CMD3 parameters settings from INI file

(3) “**Enable**” option **:**

=> If checked, the corresponding HART simulation device will be enabled.

(4) “**Short Addr**” field **:** (fixed, decimal)
=> The Short Frame Address of HART simulation device.

(5) “**Long Addr (HEX)**” field **:** (can be set, hex)
=> The Long Frame Address of HART simulation device.

(6) “**MfrID**” field **:** (can be set, hex)
=> Enabled if “HART v7.0” checked, the manufacturer ID for HART v7.0

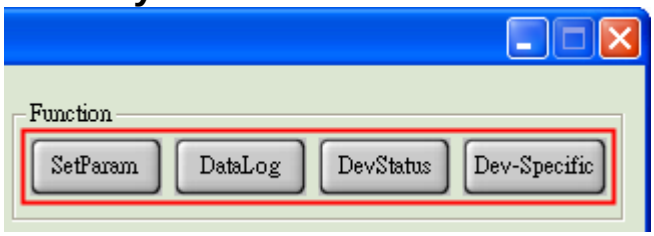
(7) “**PV_Value** / **PV_Unit**” field **:** (can be set)
=> The PV value and unit of HART simulation device.

(8) “**SV_Value** / **SV_Unit**” field **:** (can be set)
=> The SV value and unit of HART simulation device.

(9) “**TV_Value** / **TV_Unit**” field **:** (can be set)
=> The TV value and unit of HART simulation device.

(10) “**QV_Value** / **QV_Unit**” field **:** (can be set)
=> The QV value and unit of HART simulation device.

2.1.3 System Function



(1) "SetParam" button :

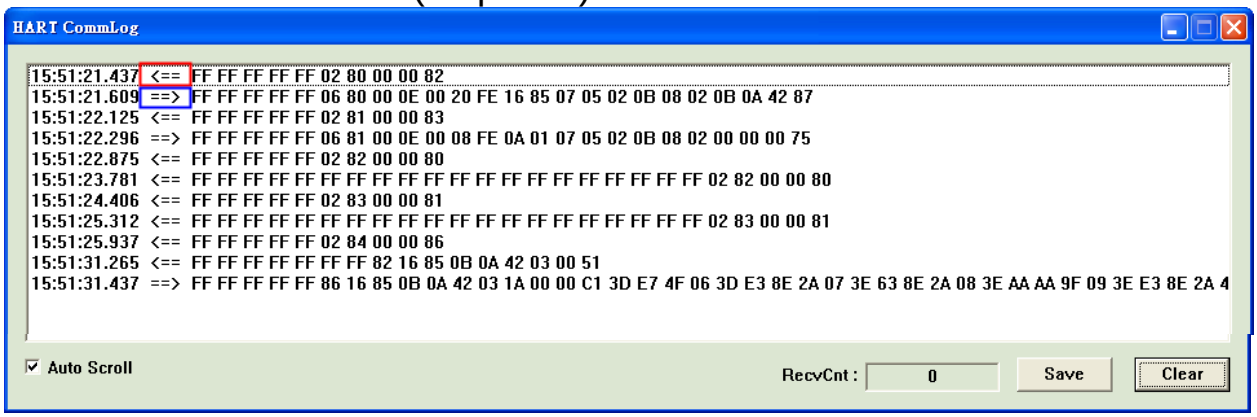
=> Set the current parameters of HART simulation device and save to the HDS.ini file. When executing the HDS tool next time, it will load the new settings.

(2) "DataLog" button :

=> It will open the HART communication screen.

<1> **<== :** HDS receive HART command.

<2> **==> :** HDS send(response) HART command.



[1] "**Auto Scroll**" option **:**

=> If checked, it will show the latest HART communication data.

[2] "**RecvCnt**" field **:**

=> Show the total number of received HART command of HDS not including the response command.

[3] "**Save**" button **:**

=> Save all the HART communication data to file.

[4] "**Clear**" button **:**

=> Clear all the HART communication data.

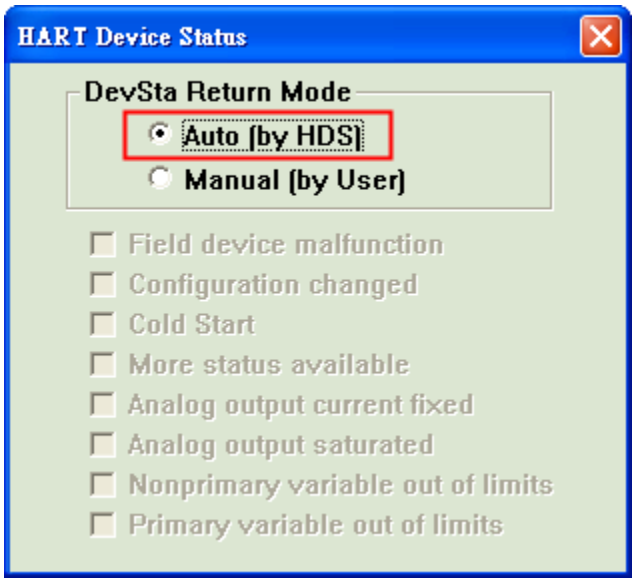
(3) "DevStatus" button : (Supported in v1.02)

The "DevSta Return Mode" option :

=> It is used to set the return mode of HART device status. (All the simulated HART devices use the same settings)

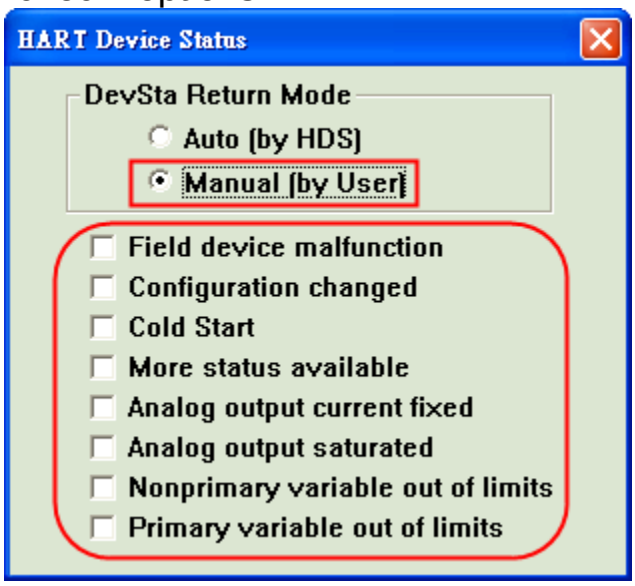
[1] Auto Mode :

The HART device status is decided by HDS software according to the current HART comm. status.



[2] Manual Mode :

The HART device status is decided by users according to the below “check” options.

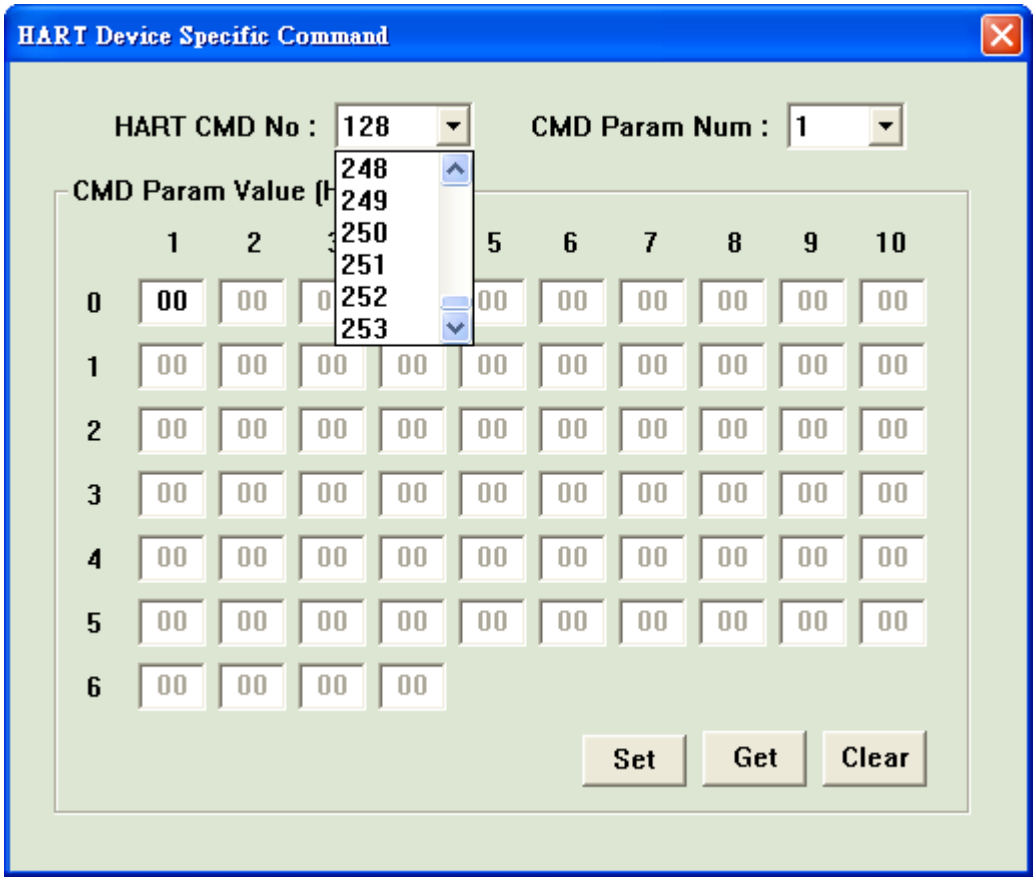


(4) “Dev-Specific” button : (Supported in v1.05.1)

[1] It is used to set the parameters of the device-specific command. (All the simulated HART devices use the same settings)

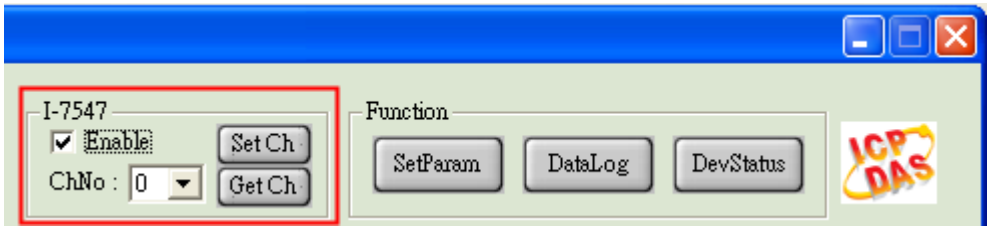
[2] It supports 64 parameters for every device-specific command.

[3] It supports device-specific command from 128 ~ 253.



[1] "**HART CMD No**" option **:**
=> Choose HART device-specific command no.
[2] "**CMD Param Num**" field **:**
=> Choose the amount of parameters for the chosen HART device-specific command no.
[3] "**CMD Param Value (Hex)**" field **:**
=> Set the parameter value with Hexadecimal format.
[4] "**Set**" button **:**
=> Save the settings of the screen to the HDS.ini file.
[5] "**Get**" button **:**
=> Get the settings from the HDS.ini file and show them to the screen.
[6] "**Clear**" button **:**
=> Set all the parameter value to be zero.

2.1.4 **I-7547 Function**



(1) "Enable" checkbox :

=> When checked, the HART channel setting of I-7547 will be enabled.

(2) "ChNo" combox :

=> It is used to choose the HART channel no. of I-7547.

(3) "SetCh" button :

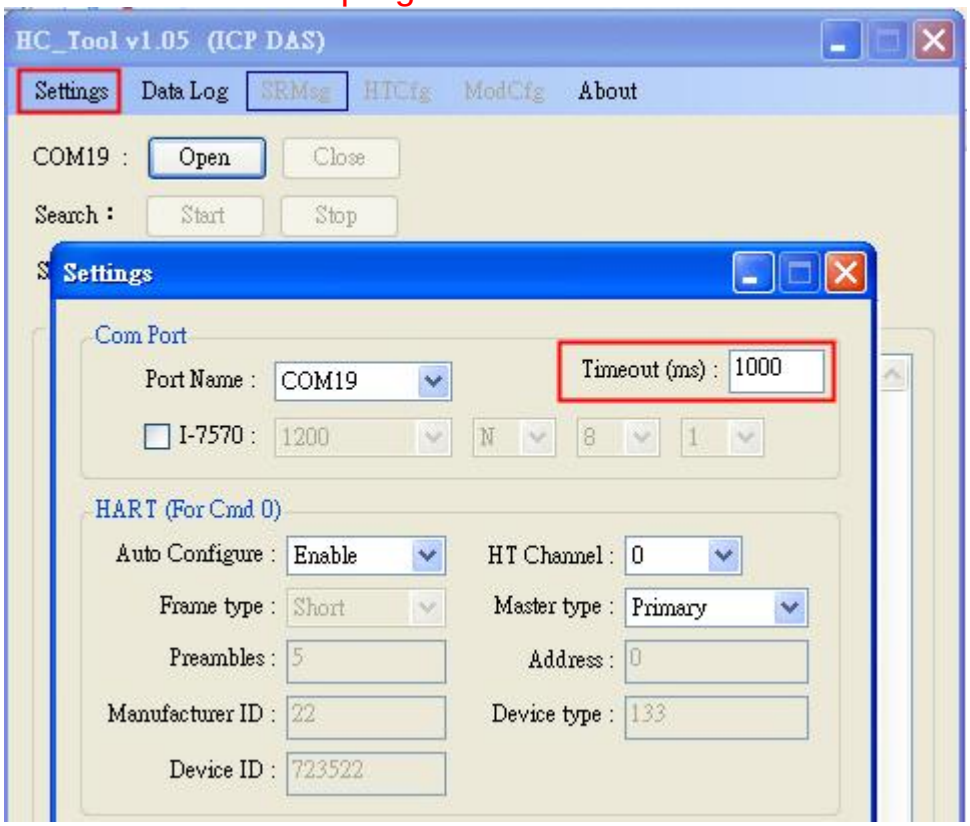
=> It is used to set the HART communication channel of I-7547.

(4) "GetCh" button :

=> It is used to get the current HART communication channel of I-7547.

[Note]

1. When using I-7547, the timeout value should be more than 1000ms in the HART master program for stable HART communication.



2.2 HDS Other Function

2.2.1 **HART Supported Command**

HDS supports a lot of HART commands as below**:**

1. Universal command :

00, 01, 02, 03, 07, **08**, **09**, **11**, 12, 13, 14, 15, 16, 17, 18, 19, **20**, **21**, **22**

2. Common-Practice command :

[1] 33 ~ 38
[2] 40 ~ 44
[3] 47 ~ 51
[4] 59, 71, 76, 89, 90, 95, 108, 109

3. Device-Specific command :

128 ~ 253

3. FAQ

Q01. Run the HDS tool step by step?

A01 : (2015/12/17)

Example

(1) Hardware required:

[1] I-7567 or I-7570 or I-7547 * 1 (as Slave)

[2] I-7567 or I-7570 or I-7547 * 1 (as Master)

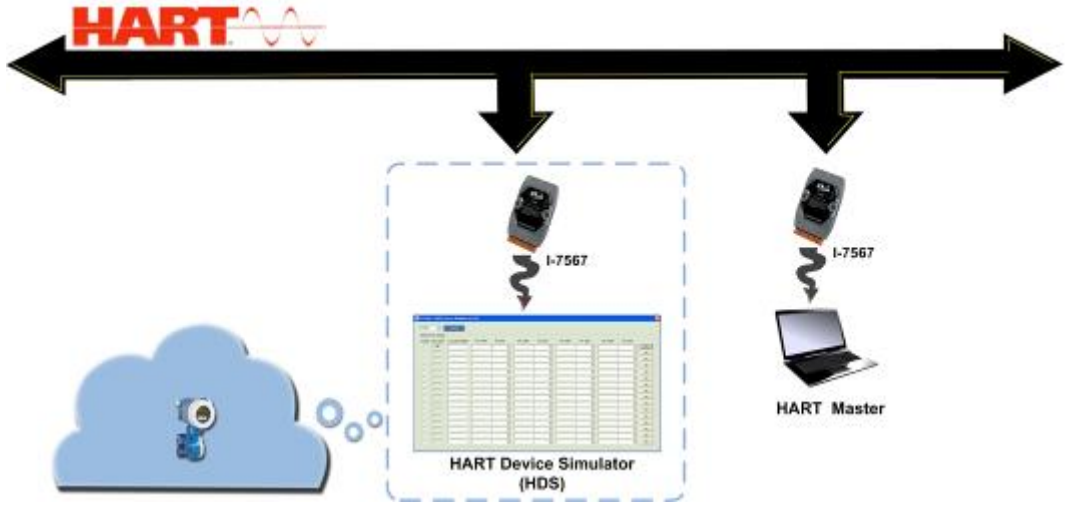
[3] PC

(2) Software required:

[1] HDS (for Slave)

[2] HC_Tool (for Master)

(3) Application structure:



(4) Procedure:

[1] Simulate HART Slave Device

<1> Connect 1 ICP DAS HART converter to PC

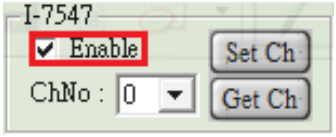
<2> Run HDS tool

<3> Choose the ComPort number and click the “Open” button

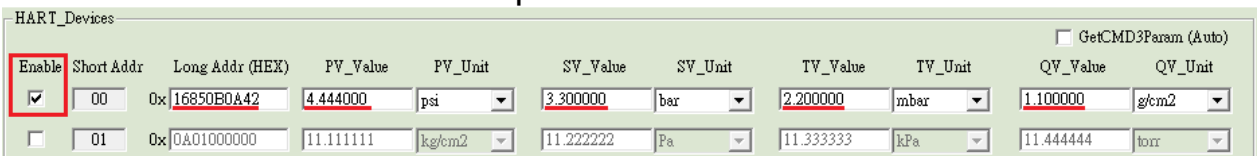
<4> If using I-7547, please do the following 2 steps

i. Use VxComm Utility to create virtual ComPort for I-7547, detailed instruction refer to Chapter 4.1 of I-7547 manual ftp://ftp.icpdas.com.tw/pub/cd/fieldbus_cd/hart/converter/i-7547/manual/

ii. After Opened the virtual ComPort, tick Enable box as below and choose channel number and “Set Ch”



<5> Check the “Enable” option for device to simulate



<6> Set the value of the “Long Addr” and “PV/SV/TV/QV” fields

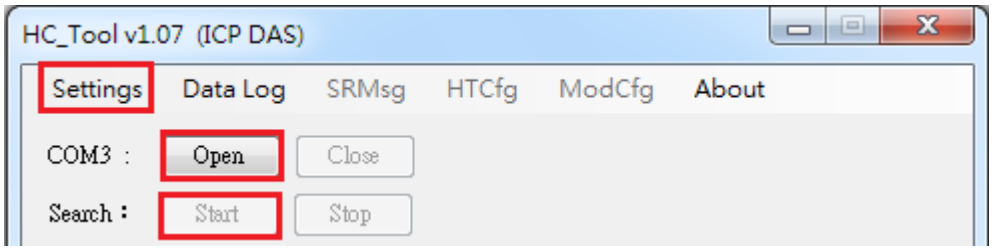
<7> Click the “SetParam” button to save the settings

[2] Test with HART Master Program

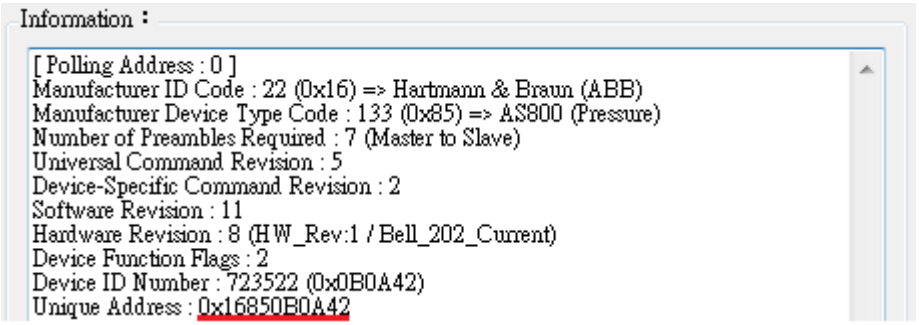
<1> Connect another ICP DAS HART converter to PC

<2> Run HC_Tool

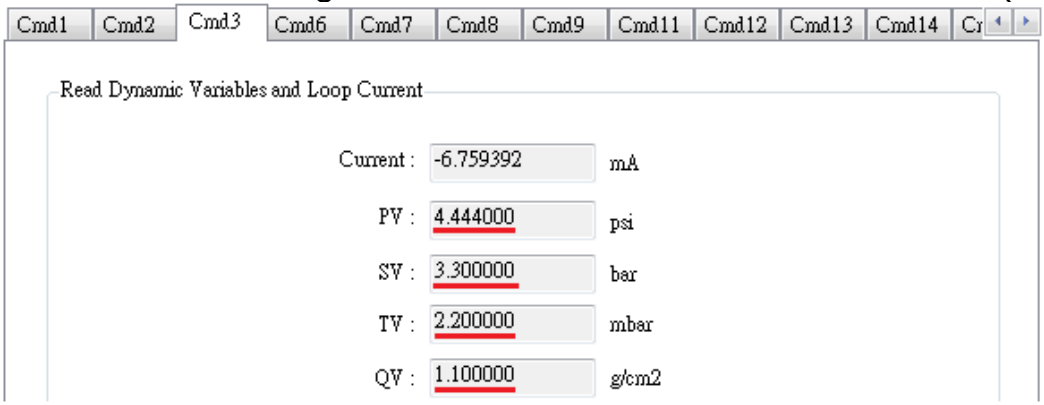
<3> Choose the ComPort number in “Setting” and click the “Open” and “Start” button



Search result as below



<4> Choose “HTCfg” to send and receive HART commands (CMD3)

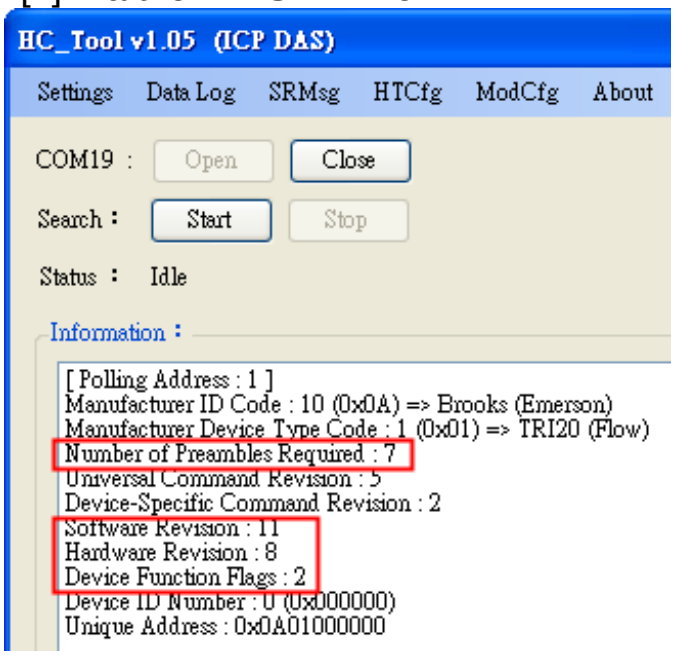


Q02. How to modify the parameters for HART simulated device?

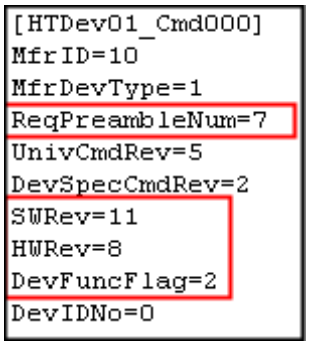
A02 : (2016/10/03)

(1) Modify the hardware parameters.

[1] Via the "**HDS.ini**" file.



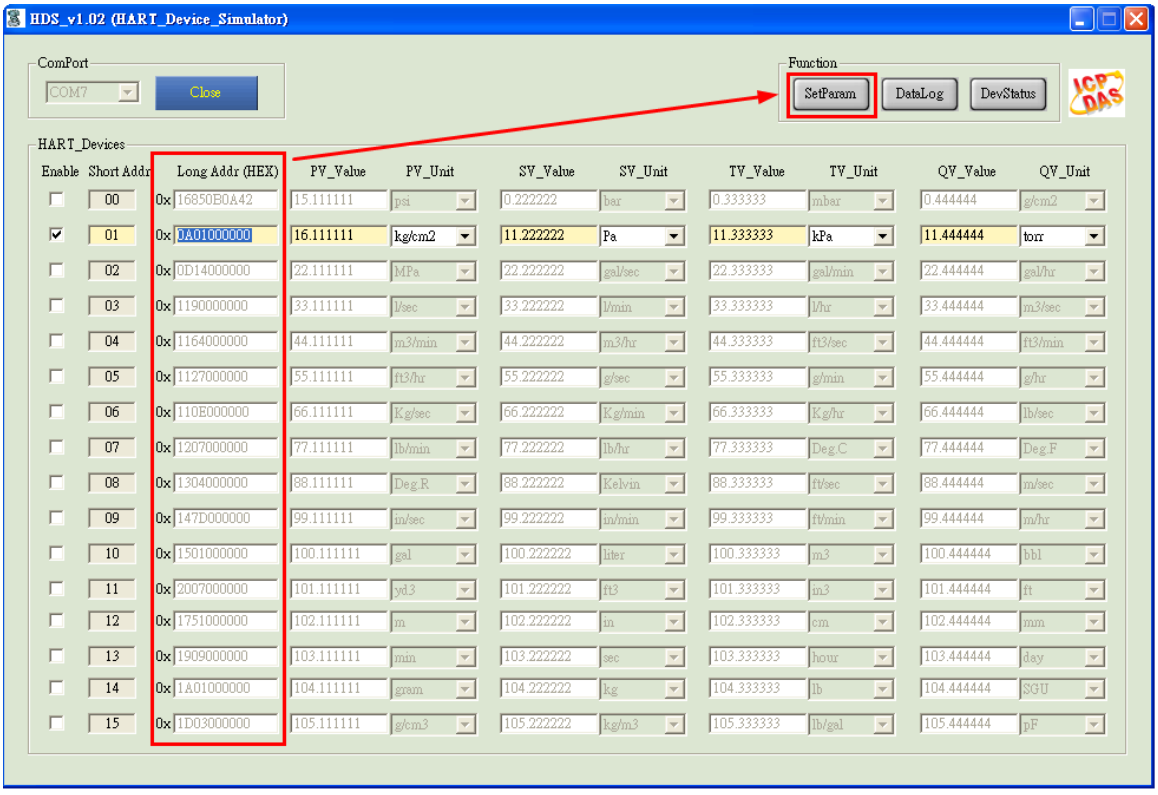
(HC_Tool)



(HDS.ini)

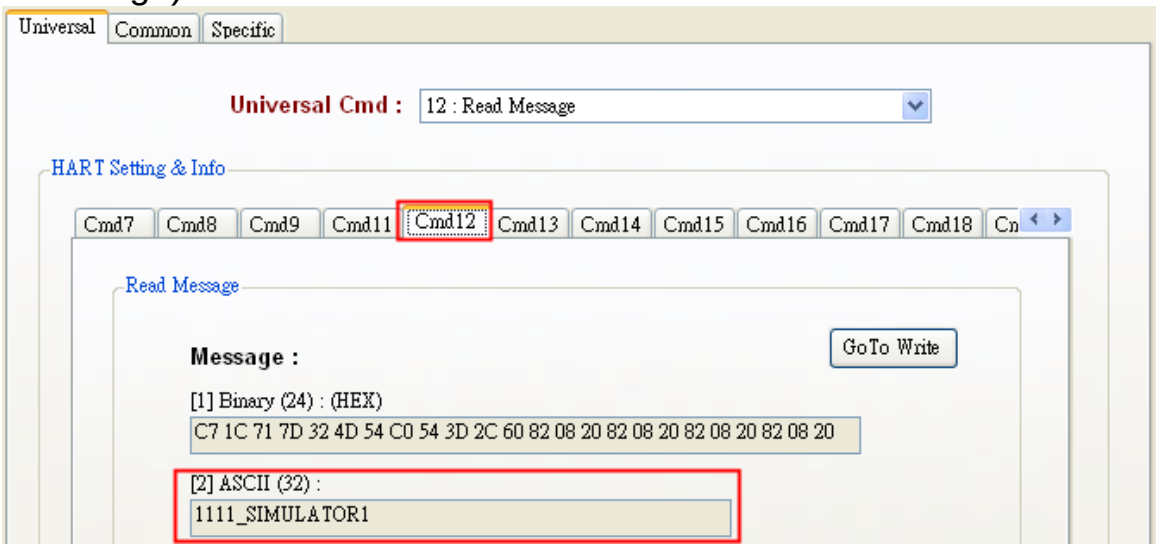
(2) Modify the "Long Frame Address".

[1] Modify the value in the "**Long Addr (HEX)**" field of the HDS software and then click the "SetParam" button.

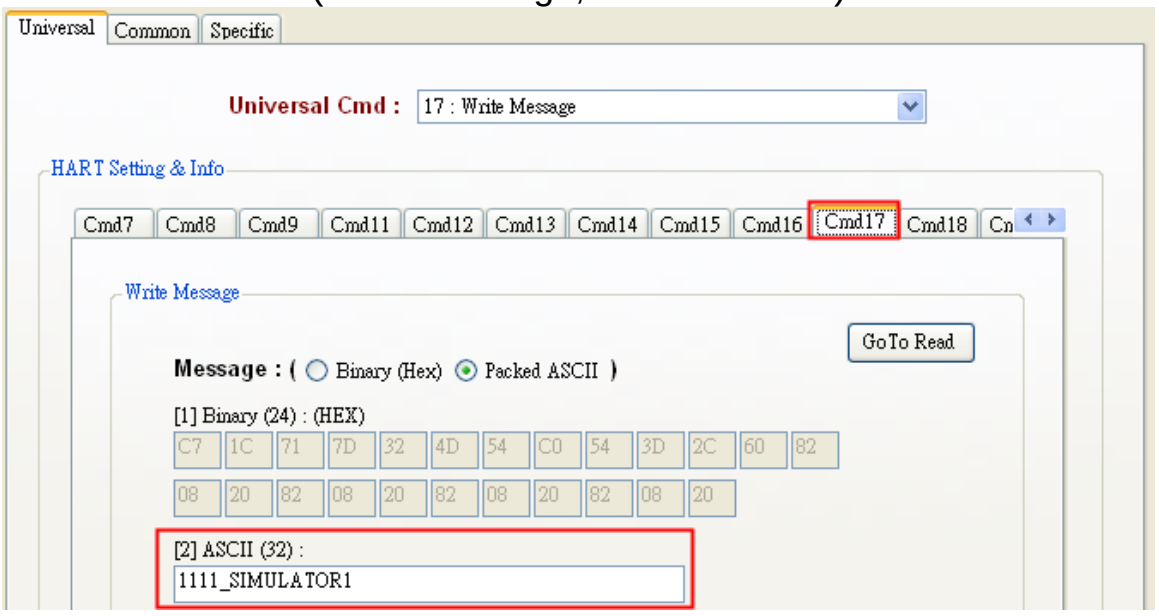


(3) Modify the value of “HART CMD12” (Read Message) ?

[1] In HC_Tool (HART Master), send the “HART CMD17” (Write Message).



(Read Message, HART CMD12)



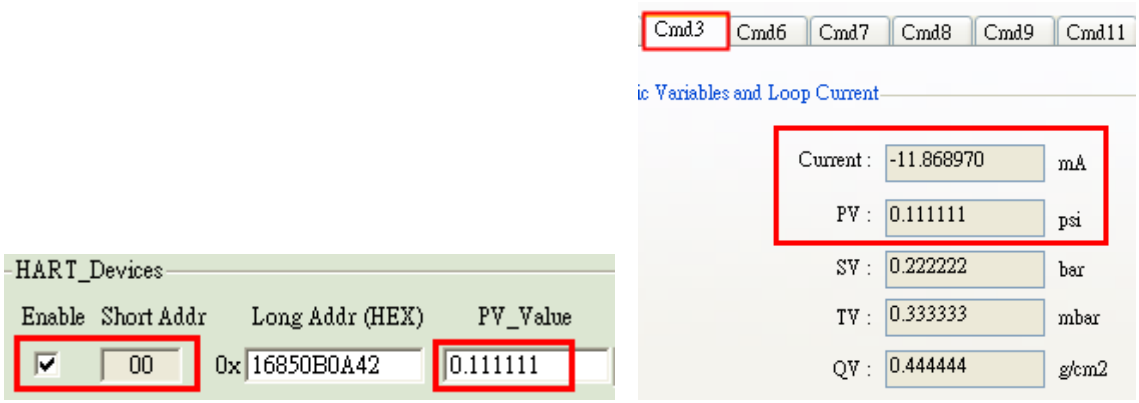
(Write Message, HART CMD17)

(4) Modify the current value ?

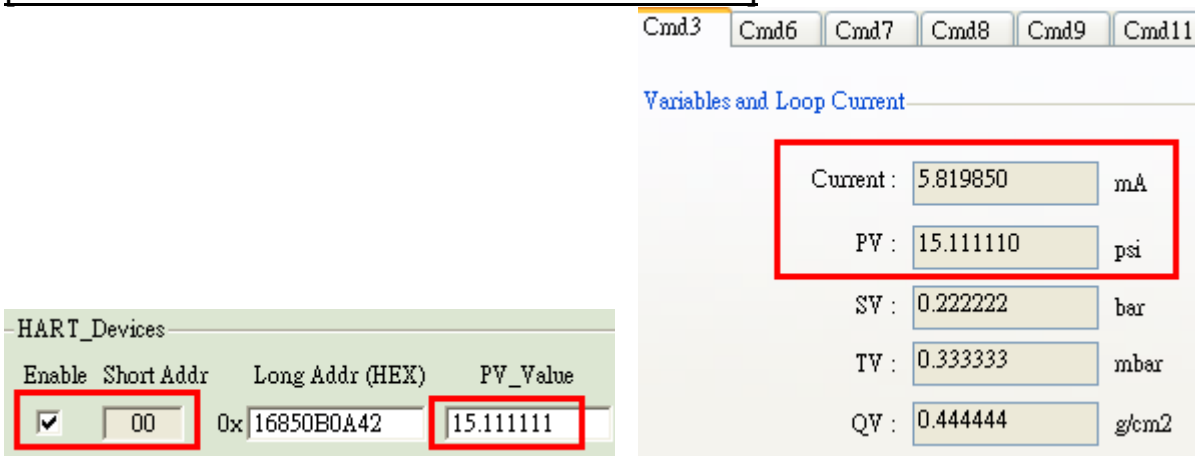
[1] “Point to Point”模式:

HART device address must be 0. The current will vary depending on the PV value.

[Ex1 : PV=0.11111 => Current=-11.868970]



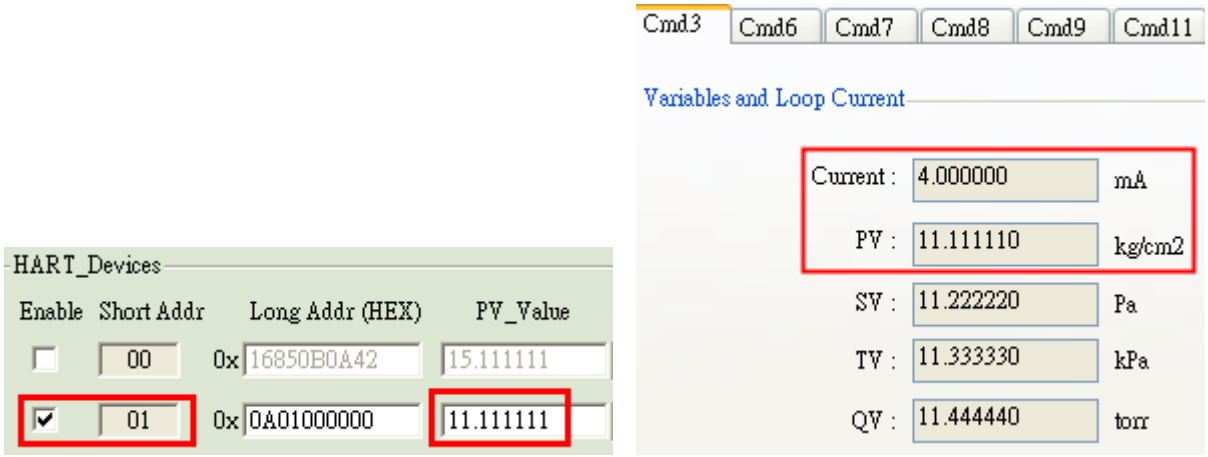
[Ex2：PV=15.11111 => Current=5.819850]



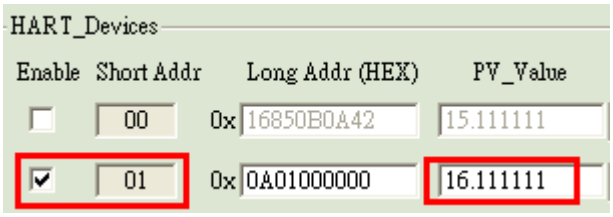
[2] “<u>Multi-Drop</u>”模式:

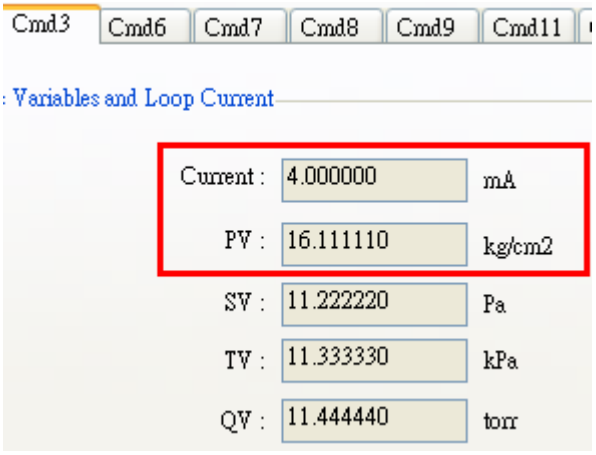
HART device address should be between 01 and 15. The current will be fixed to be 4 mA.

[Ex1：PV=0.11111 => Current=4.00000]



[Ex2：PV=16.11111 => Current=4.00000]


HART_Devices
Enable
Short Addr
Long Addr (HEX)
PV_Value
00
0x 16850B0A42
15.111111
01
0x 0A01000000
16.111111


Cmd3
Cmd6
Cmd7
Cmd8
Cmd9
Cmd11
Variables and Loop Current
Current :
4.000000
mA
PV :
16.111110
kg/cm2
SV :
11.222220
Pa
TV :
11.333330
kPa
QV :
11.444440
torr

Q03. How to use HDS to virtually transfer Modbus device to HART device?

A03 : (2018/11/08)

(1) Hardware required:

[1]. HART converter * 1 (I-7567 or I-7570 or I-7547)

<1> work with HDS software => simulate HART Slave device

[2]. Modbus instrument

[3]. PC * 1

<1> Need to write an nModbus program with following functions:

[1] Collect Modbus device data

[2] Keep updating the Modbus device data to HDS.ini file

<2> Execute HDS.exe software

(2) Software required:

[1]. **HDS** (HART Device Simulator), Download from:
ftp://ftp.icpdas.com/pub/cd/fieldbus_cd/hart/converter/hds/software/

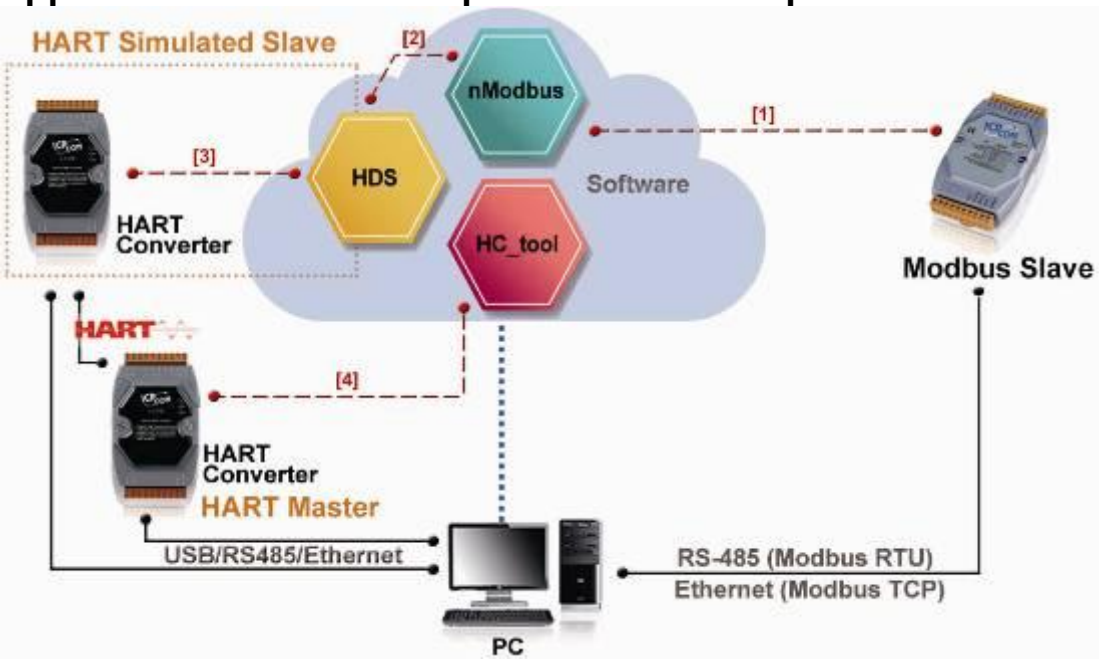
[2]. **HC_Tool** (converter utility), Download from:
ftp://ftp.icpdas.com.tw/pub/cd/fieldbus_cd/hart/converter/i-7547/software/

[3]. **nModbus** related information:

<1> introduction / example
http://www.icpdas.com/products/PAC/i-8000/modbus.htm

<2> nModbus_Demo program:
Reads AI data from Modbus device and modify HDS.ini file, download from:
ftp://ftp.icpdas.com/pub/cd/fieldbus_cd/hart/converter/hds/software/demo/

(3) Application structure and procedures description:

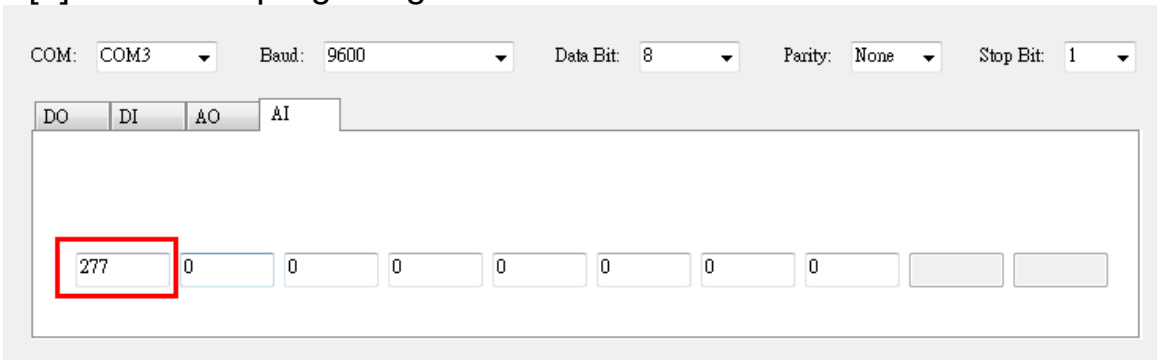


[1]. Write an nModbus program to read Modbus device data
(Please save the program to the same folder with HDS program)
[2]. nModbus program updating the HDS.ini file with the Modbus device data simultaneously.
[3]. Use a HART converter with HDS to simulate HART device
(The simulated HART device shares the same data with Modbus slave as the program keeps updating the HDS.ini file)
[4]. Use another HART converter with HC_Tool to test

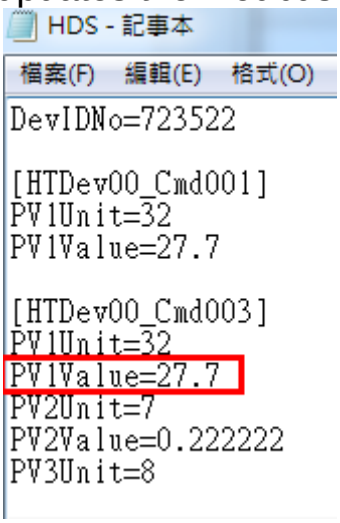
(4) Application function test:

[1]. HART Master setup:
<1> HART converter * 1 (I-7567 or I-7570 or I-7547)
<2> work with HC_Tool software => HART Master functions

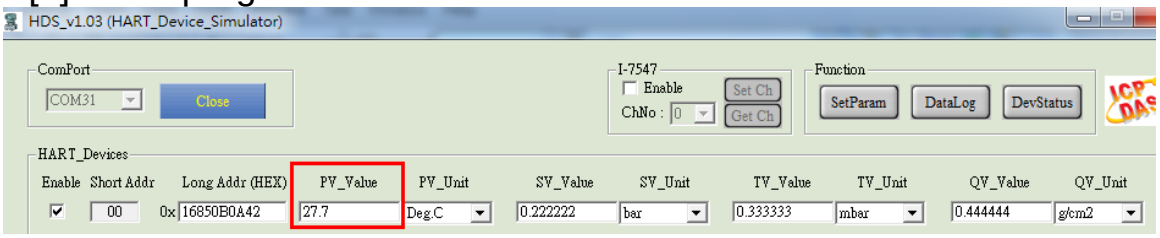
[2]. nModbus program gets data from Modbus device



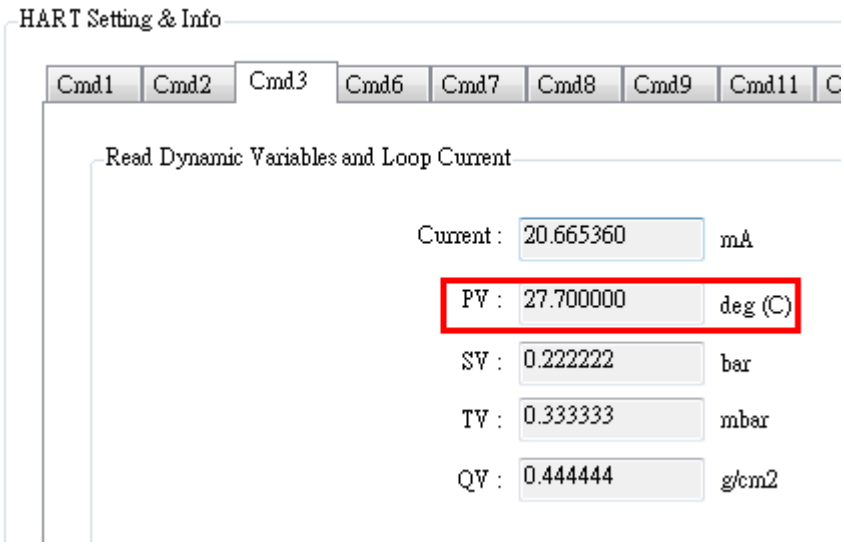
[3]. nModbus program updates the Modbus device data to HDS.ini file



[4]. HDS program shows value which same as Modbus device data



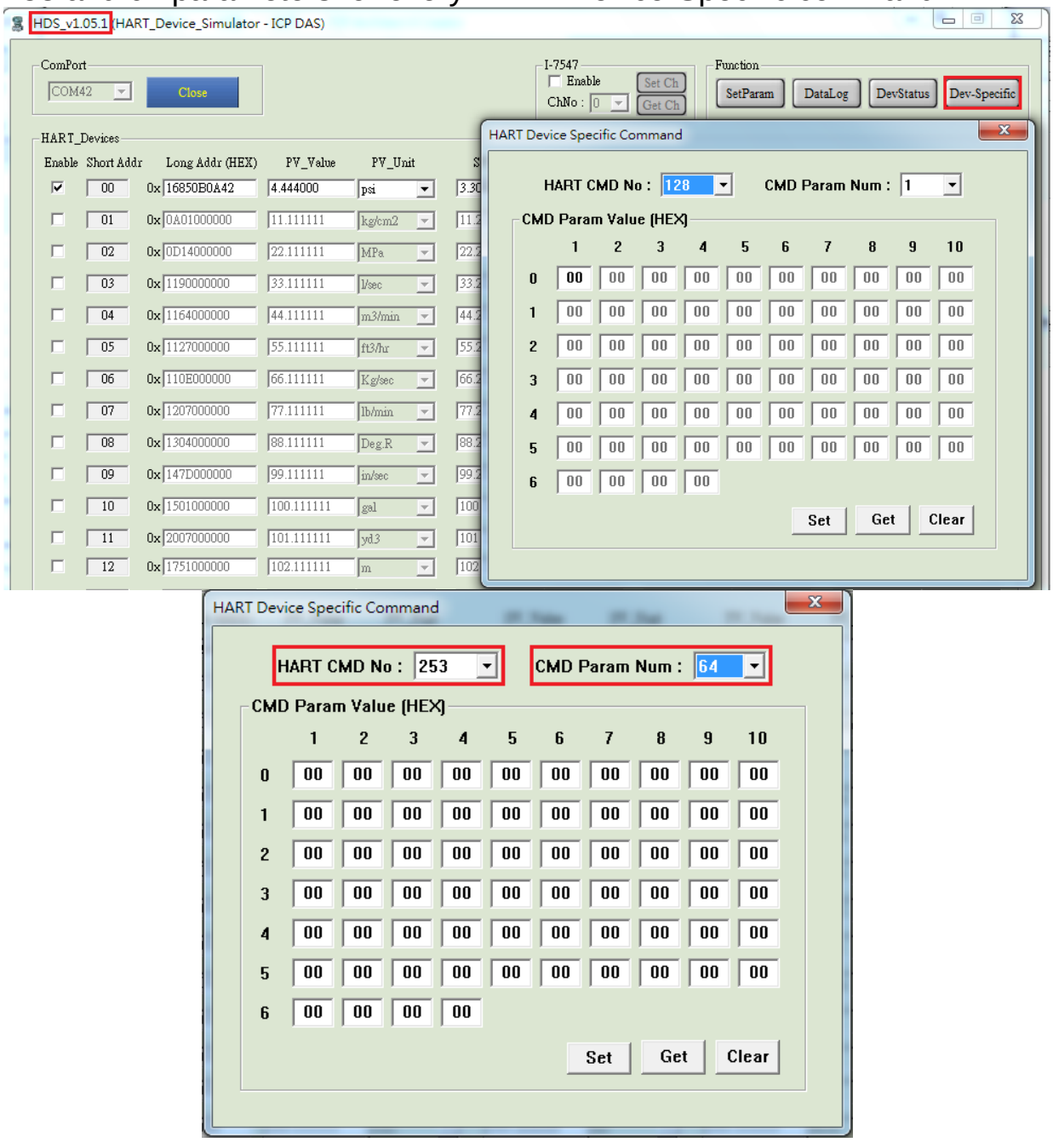
[5]. HC_Tool utility reads data from HDS Cmd3 values


HART Setting & Info
Cmd1
Cmd2
Cmd3
Cmd6
Cmd7
Cmd8
Cmd9
Cmd11
Read Dynamic Variables and Loop Current
Current : 20.665360 mA
PV : 27.700000 deg (C)
SV : 0.222222 bar
TV : 0.333333 mbar
QV : 0.444444 g/cm2

Q04. How to use HART Device-Specific commands

A04 : (2018/05/15)

HDS_v1.05.1 supports HART Device-Specific command from 128 to 253 and 64 parameters for every HART Device-Specific command.

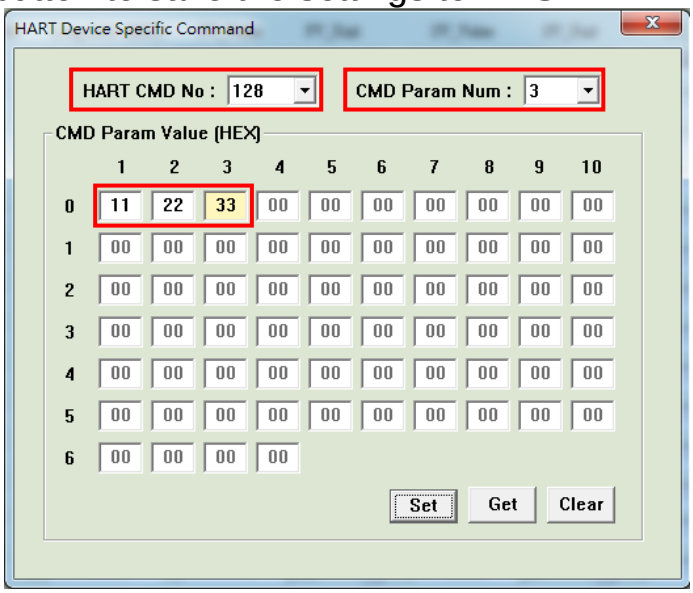


[For Example]

The user wants HDS to response HART device-specific command 128 with 3 parameters and these value are 0x11, 0x22 and 0x33. Please follow the below steps:

(1)Set the parameter of HART device-specific CMD 128 for HDS.

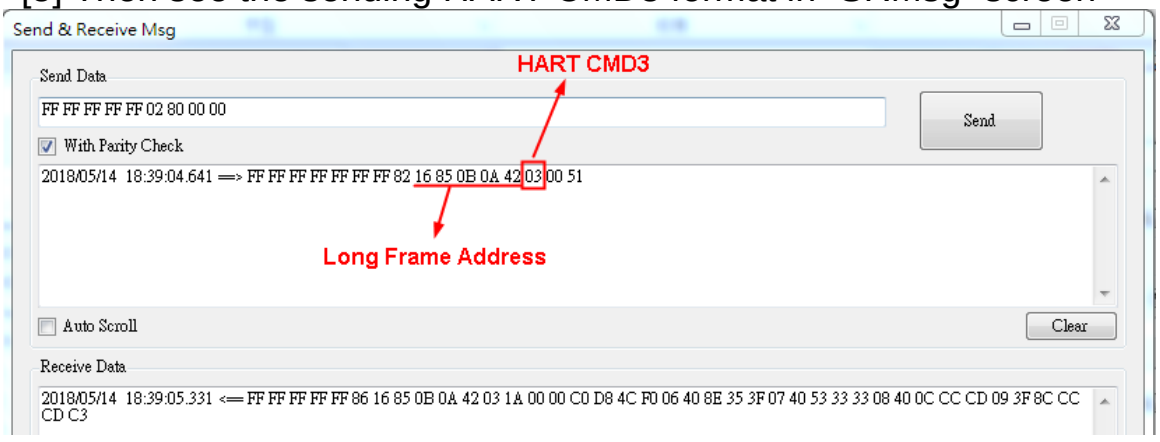
[1] Open “HART Device Specific Command” screen.
[2] Choose “**128**” in the “HART CMD No” option.
[3] Choose “**3**” in the “CMD Param Num” option.
[4] Type “**11**”, “**22**” and “**33**” in the “CMD Param Value (HEX)” field.
[5] Click “Set” button to save the settings to HDS.ini.



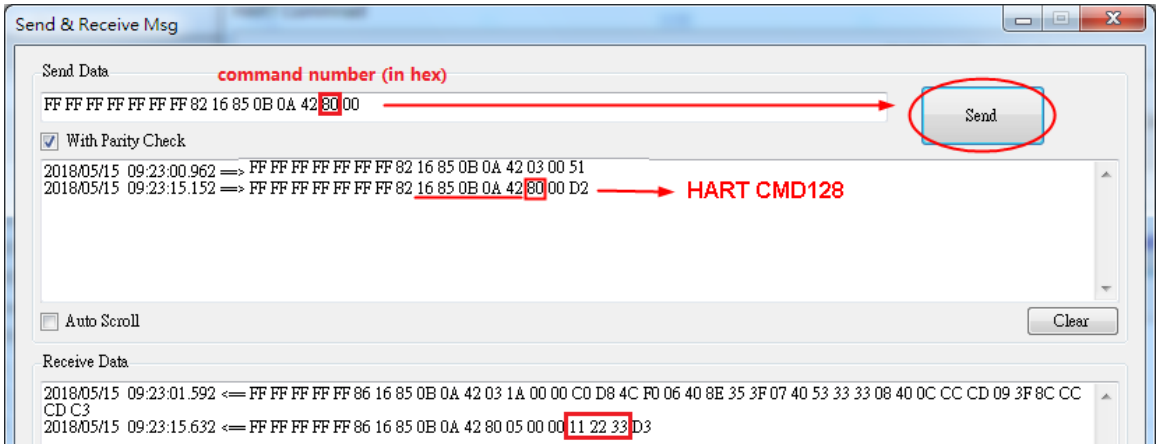
(2) Send HART master command 128.

[Method 1: Using ICP DAS HART converters with HC_Tool]

[1] By using ICP DAS HART converters (I-7567, I-7547 or I-7570) with HC_Tool.
[2] Click “SRMsg” option to open “Send & Receive Msg” screen.
[3] Search the HART device.
[4] Open “HTCfg” screen to send HART command 3.
[5] Then see the sending HART CMD3 format in “SRMsg” screen



[6] Send the HART command 128 with the same long frame address.
[7] In the “Receive Data” field, it will show the HART CMD128 response from HDS with 0x11, 0x22, 0x33 data.

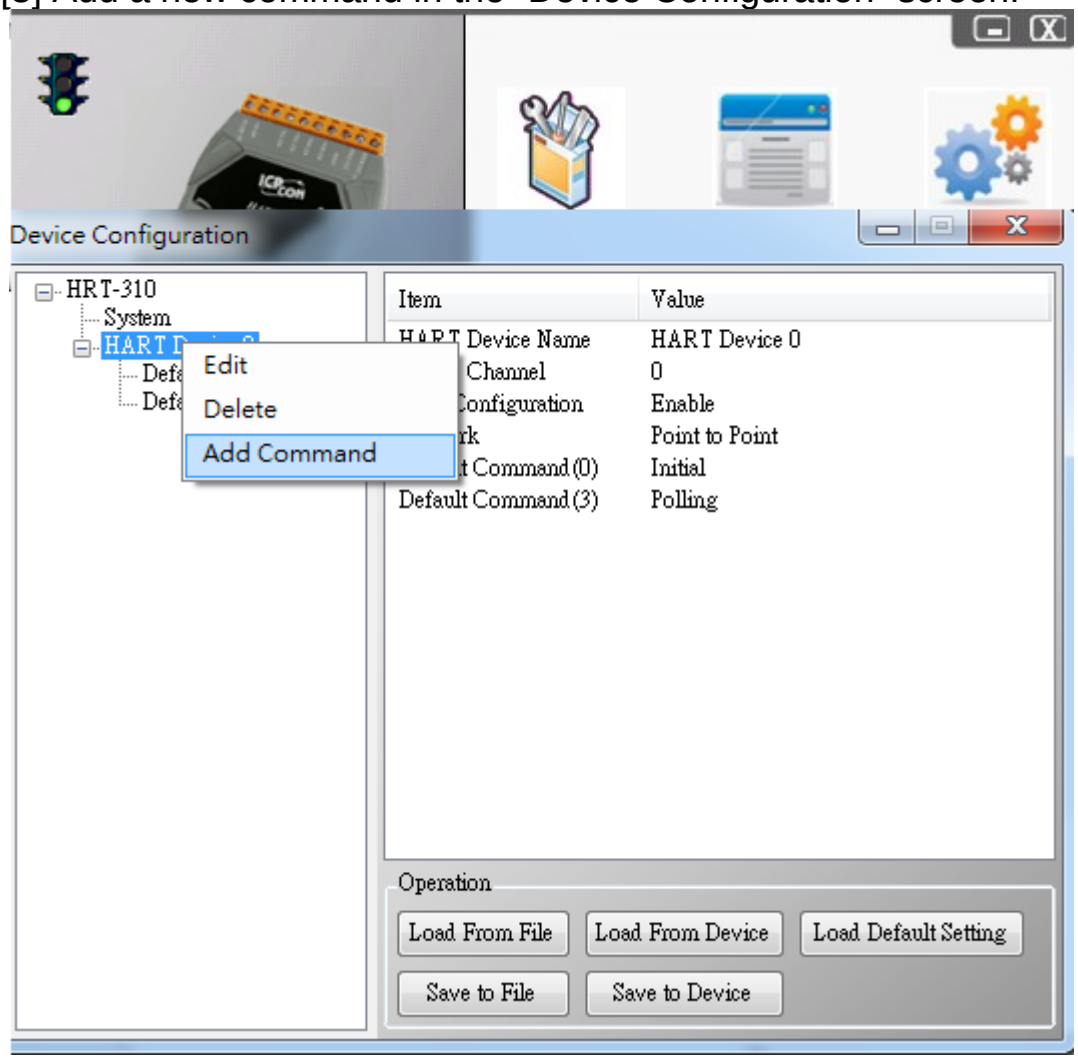


[Method 2: Using ICP DAS HART gateway with HG_Tool]

[1] By using ICP DAS HART gateway (HRT-710, HRT-310 or HRT-711) with HG_Tool.

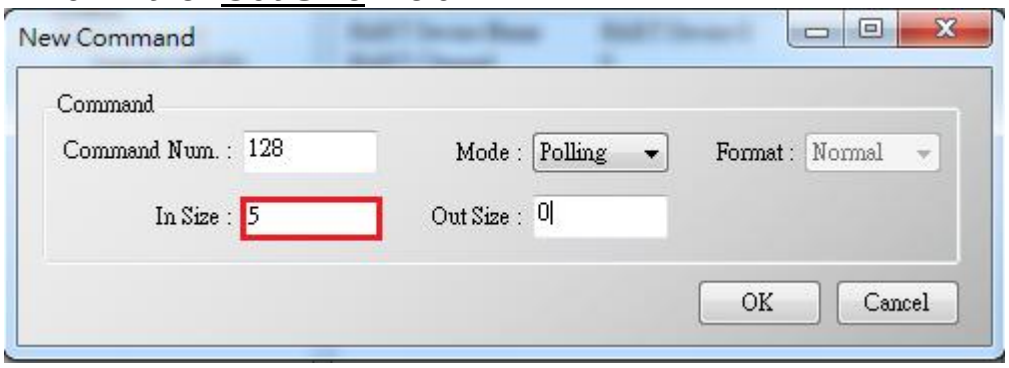
[2] Run the HG_Tool and connect to the HART gateway.

[3] Add a new command in the “Device Configuration” screen.



[4] Type “**128**” in the “Command Num” field and “**5**” in the “In Size” field (Response Code(2 bytes) + CMD128 Param Number (3 bytes)) and

"**0**" in the "Out Size" field.



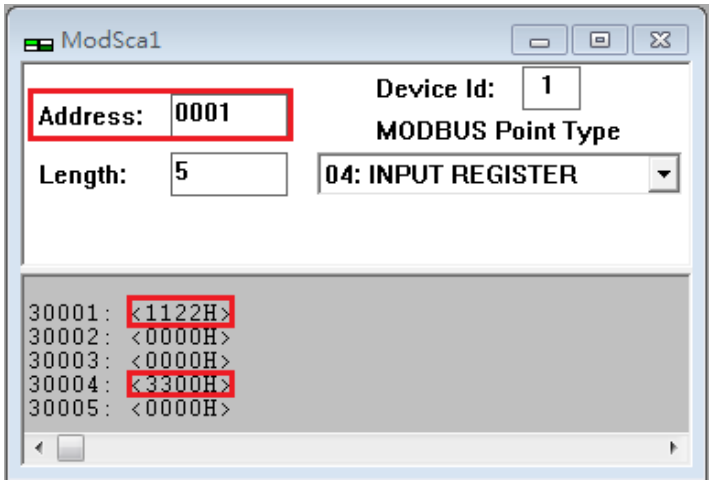
[5] Click "Save to Device" button.

[6] Using Modbus master tool (ModScan) to get the HART CMD 128 response data from HART gateway.

<1> The response data of HART CMD 128 will be as below.

=> 0x00 0x00 (Response Code) 0x11 0x22 0x33 (Data).

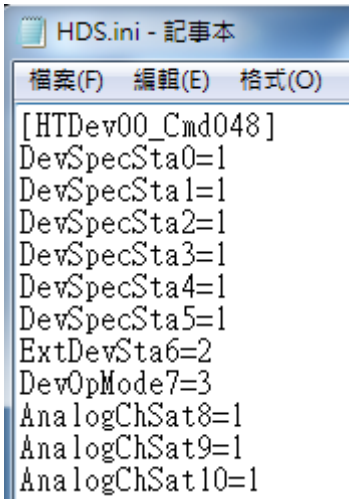
<2> Because the gateway has set the "WORD & BYTE" swap, so users will see the below data.



Q05. How to change CMD48 parameters setting

A05 : (2018/07/10)

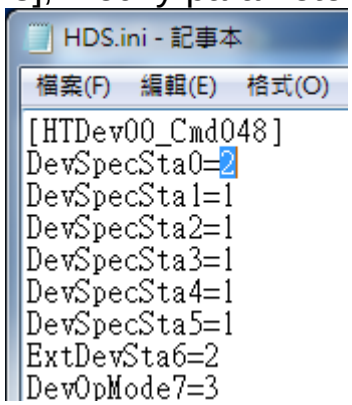
HDS_v1.05.1 supports HART command 48, all parameters setting stored in the .ini file of HDS.



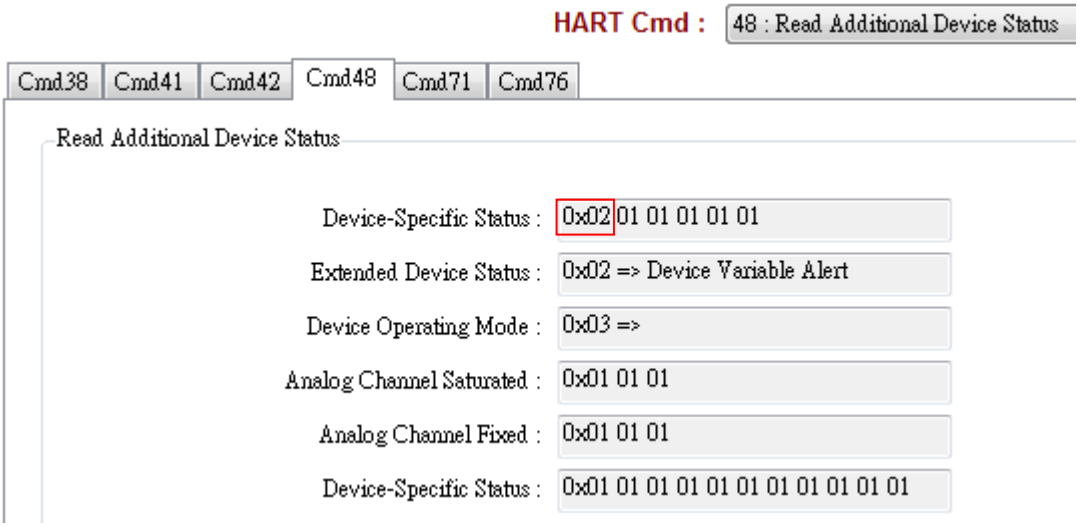
[Example: modify the CMD48 parameter of HART Device00]

(1) Open the HDS.ini file

(2) Find [HTDev00_Cmd048], modify parameter value and save (as below)



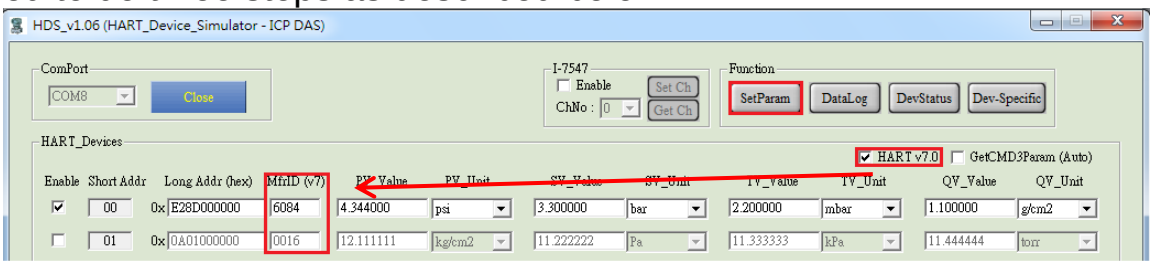
Send CMD48 to corresponding device, you can see the saved changes



Q06. How to simulate HART 7.0 device by HDS

A06 : (2019/02/13)

HDS supports simulating HART 7.0 devices after HDS_v1.06, users just need to do three steps as described below:



1. Tick the "**HART v7.0**" option to enable "**MfrID (v7)**" field editing
2. Fill in the correct parameters of HART 7.0 device to the "**MfrID (v7)**" and "**Long Address**" fields in HDS.
3. Click "**SetParam**" button.

Here is an example of simulating HART 7.0 device:

(1) Below is the information of MP100 HART 7.0 device from 3S Co., Ltd.

REGISTERED PRODUCT INFORMATION

Manufacturer: 3S Co., Ltd

Product Name: MP100

Product Description: Positioner

Protocol: HART

Category: Actuators, Regulators, Positioners

Profile: HART Field Device

REGISTERED PRODUCT DETAILS

Manufacturer ID (hex): 006084

Device Type ID (hex): E28D

DEV_REV (hex): 1

DD Revision: 1

Technology Version: 7

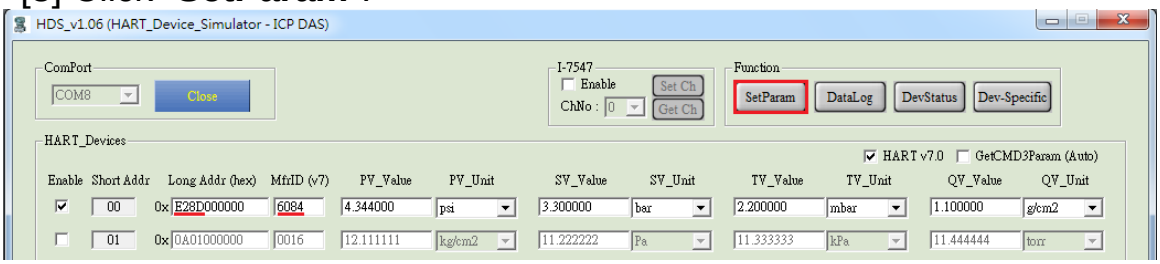
Wireless Product: No

(2) Simulate HART 7.0 device with HDS.

[1] Fill in the value of Manufacture ID (hex) – "6084" to the "**MfrID (v7)**" field of HDS.

[2] Fill in the value of Device Type ID (hex) – "E28D" and additional "000000" to the "**Long Addr**" field of HDS.

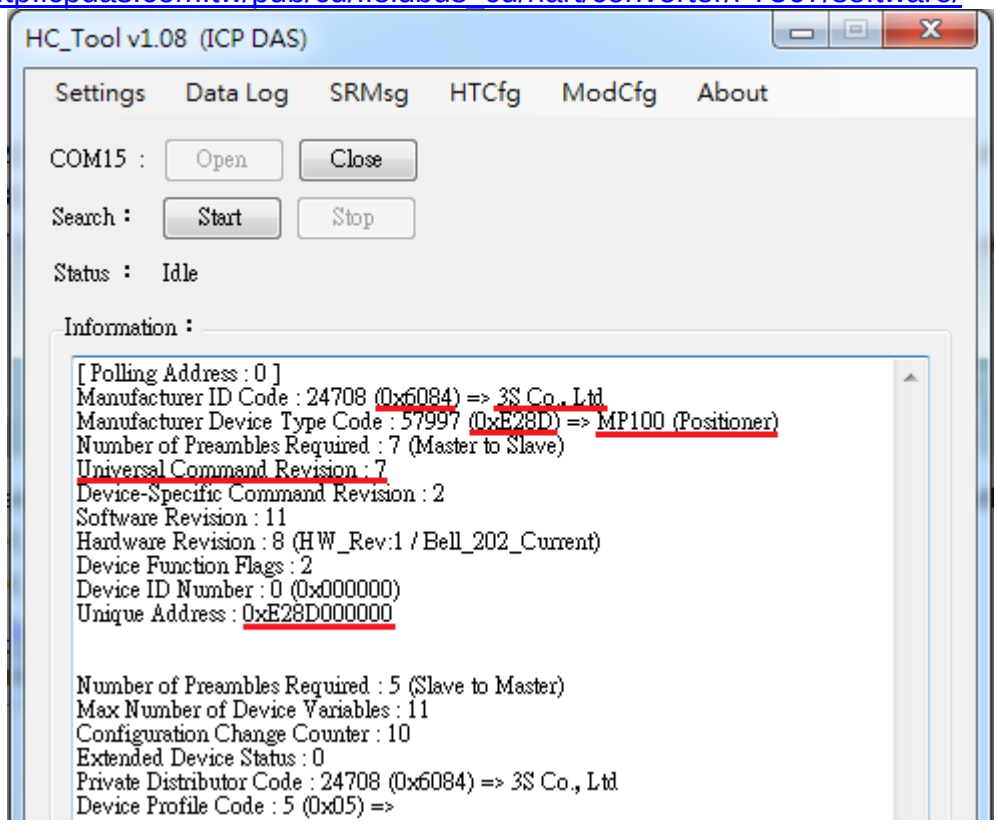
[3] Click “**SetParam**”:



(3) Test the simulated HART device by using a HART converter (I-7567/ I-7570/ I-7547) with HC_Tool (after version v1.08).

HC_Tool download :

ftp://ftp.icpdas.com.tw/pub/cd/fieldbus_cd/hart/converter/i-7567/software/



Q07. How to use Modbus to communicate with HDS ?

A06 : (2019/08/26)

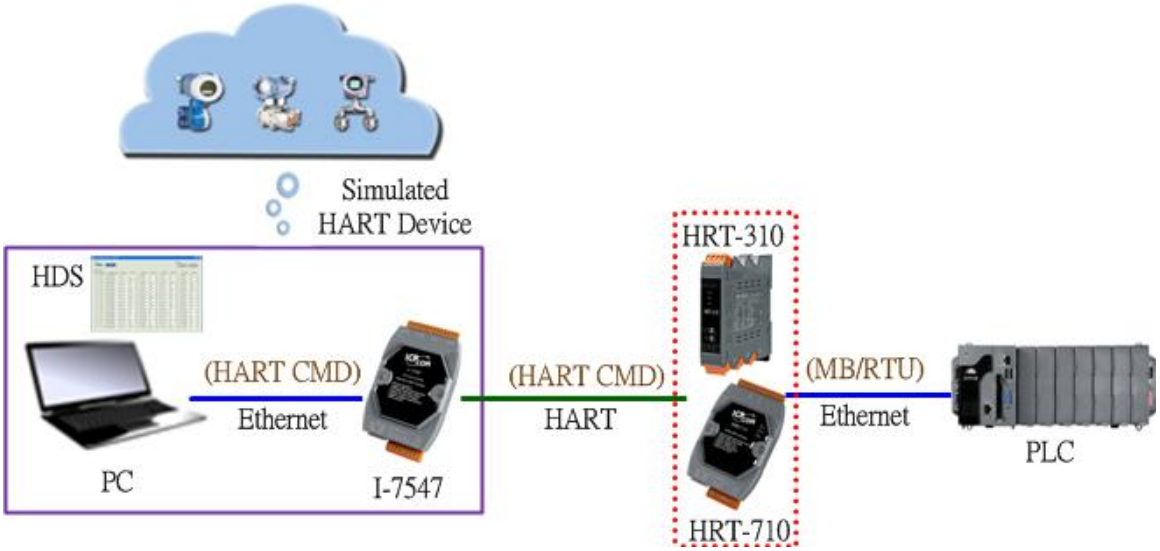
(1) **Using ICP DAS HART Converter with HDS to simulate HART device:**

[1] Refer to the steps of FAQ01.

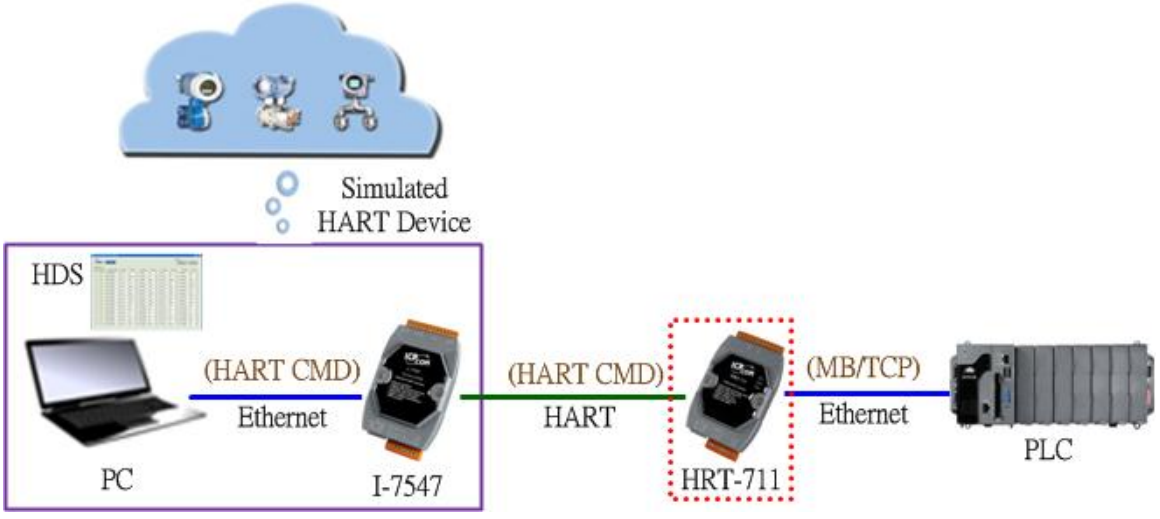
(2) **Additional to add ICP DAS Modbus/HART Gateway. So users can use Modbus to communicate with HDS in the PC or PLC side.:**

(Using the method, users don't need to know HART protocol. Just using Modbus communication and can access HDS data.)

[1] Adopt HRT-310 or HRT-710 structure : (For MB/RTU)



[2] Adopt HRT-711 structure : (For MB/TCP)



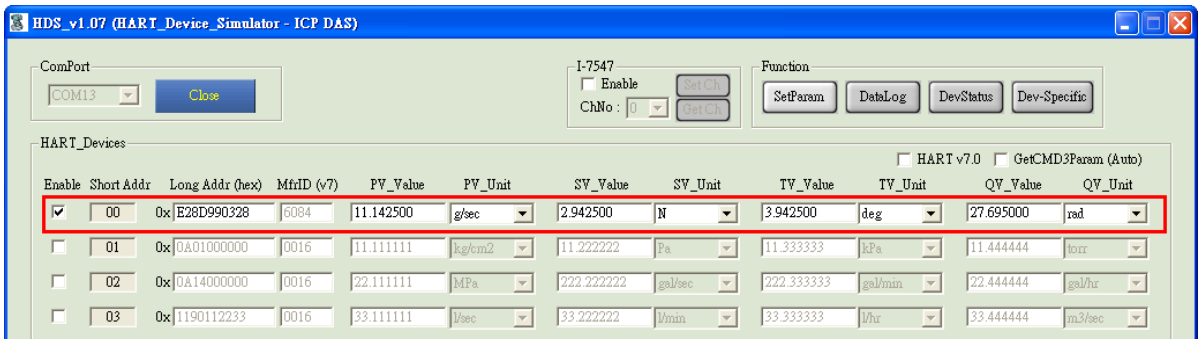
Q08. How to response HART specific command 158 in HDS ?

A08 : (2020/11/19)

[The setting steps of HDS]

(1) Using ICP DAS HART Converter with HDS to simulate HART slave device.

[1] Enable HART Device Address 0 (Long Address : 0xE28D990328) in HDS.



(2) For example, the response value of the specific command 158 in HDS is 103.518 (HEX value will be 0x 42CF0937):

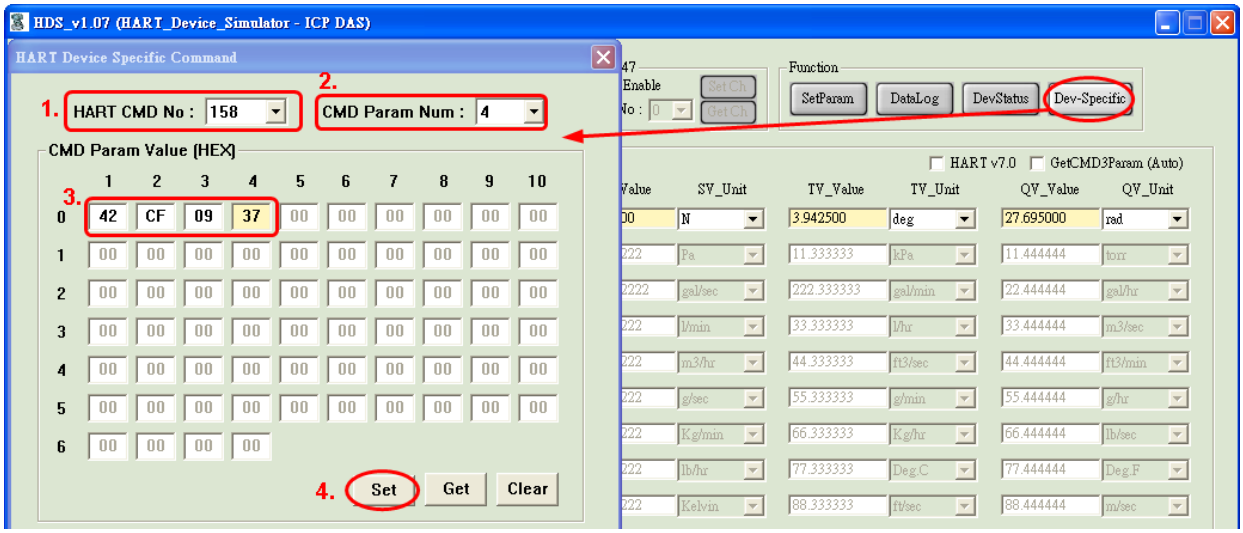
[1] In HDS, click the **"Dev-Specific"** button to open the setting screen of HART device specific command.

<1> HART CMD No. : choose **"158"**

<2> CMD Param Num : choose **"4"**

<3> CMD Param Value (HEX) : input 42, CF, 09, 37 in the field 1 to 4.

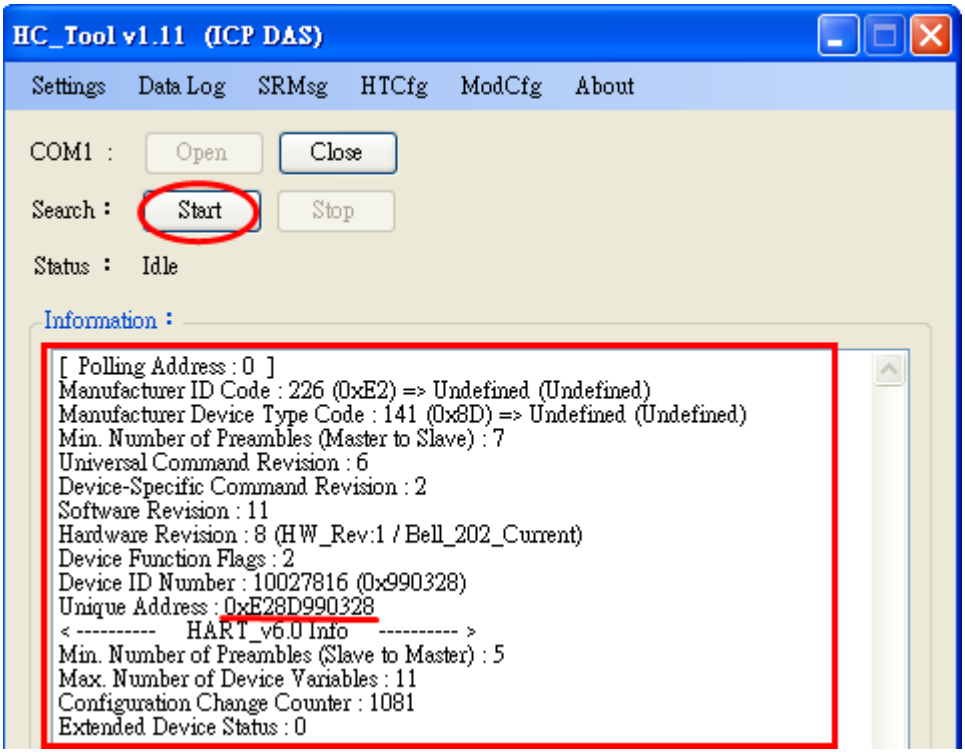
<4> Click the **"Set"** button to save the settings of the specific command 158.



[The testing steps of HC_Tool]

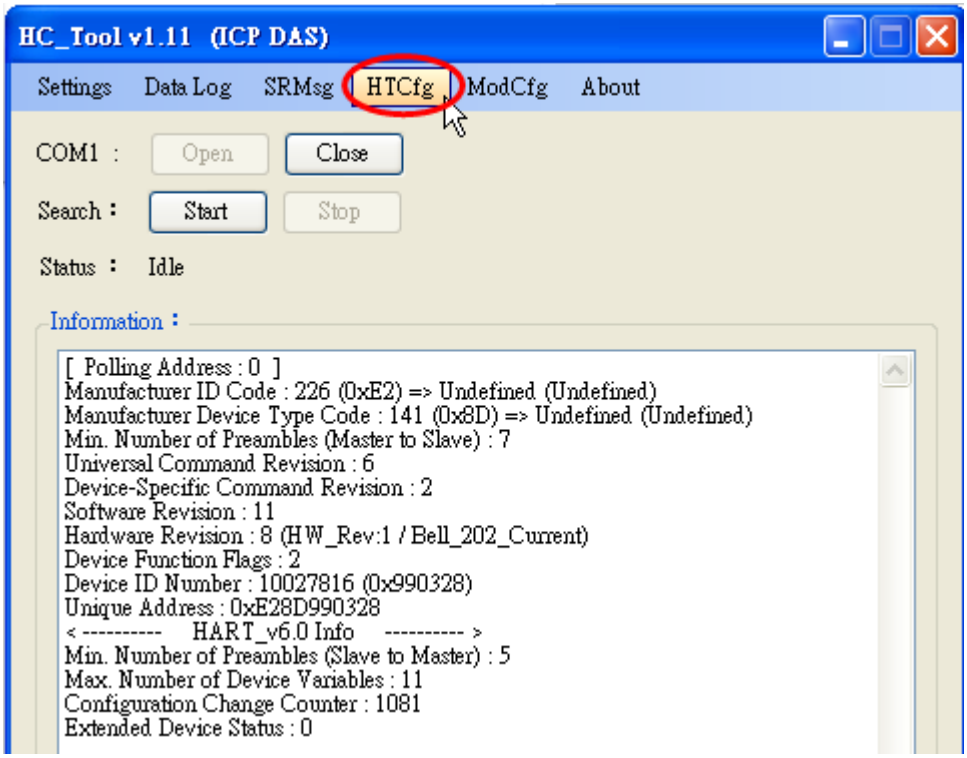
(3) Using ICP DAS HART converter with HC_Tool to simulate HART master tool:

[1] Click the **"Start"** button to search all HART device automatically and it will show HART devices found in the "**Information**" field.



(4) **Using the "Specific CMD" function of HC_Tool to get the value of the specific command 158 in HDS.**

[1] **In HC_Tool, click the "HTCfg"** item to open the screen of "**HART Command**".



[2] In the screen of **"HART Command" :**

<1> DevAddr : choose the HART device

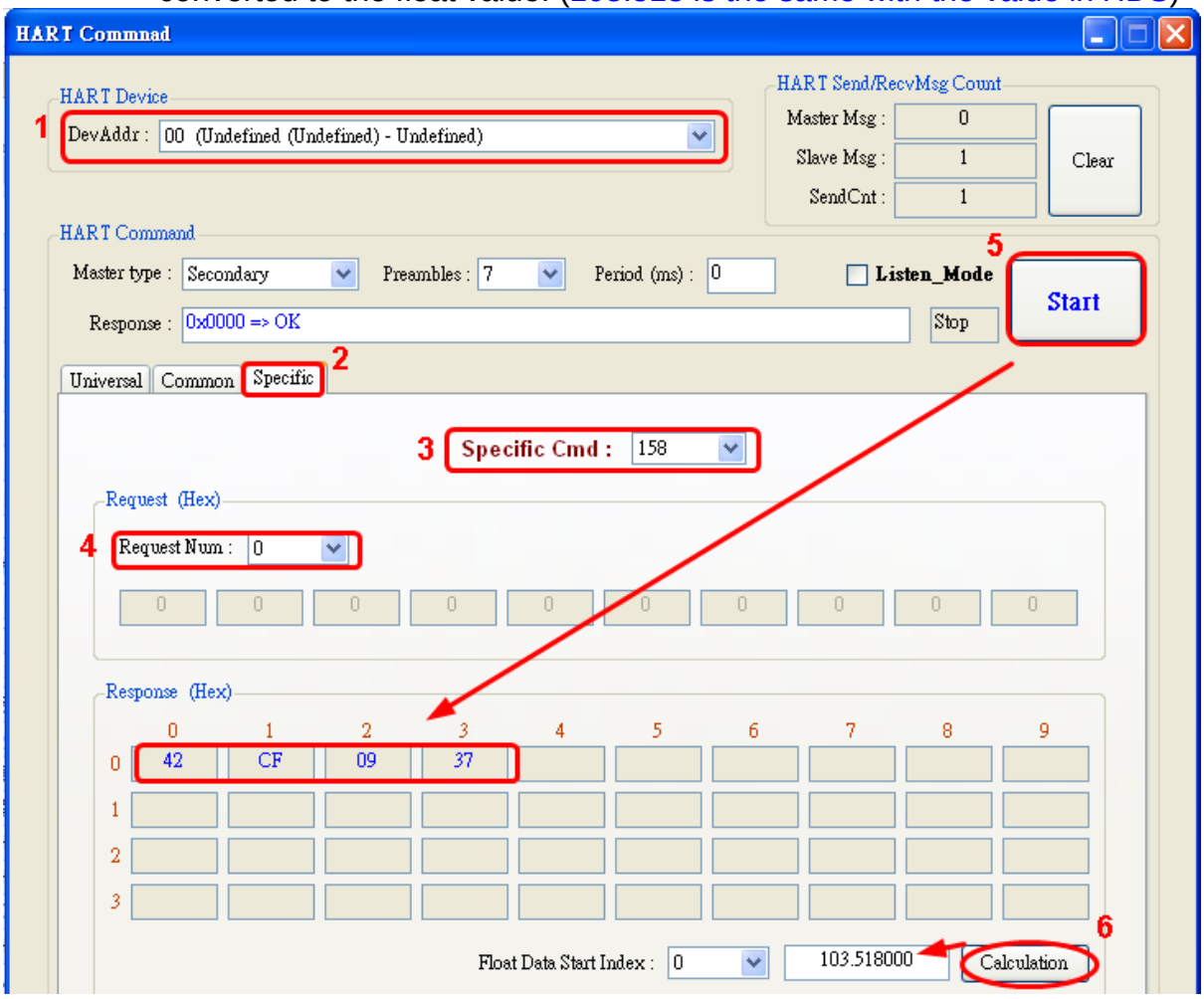
<2> click the "**Specific**" page

<3> Specific Cmd : choose **"158"**

<4> Request Num ： choose **“0”** (different according to each HART device)

<5> click the **”Start”** button to get the value of the specific command 158 of HDS and shown in the **Response (Hex)** field. (42 CF 09 37 is the same with the value in HDS)

<6> click the **”Calculation”** button and the assigned HEX value will be converted to the float value. (103.518 is the same with the value in HDS)

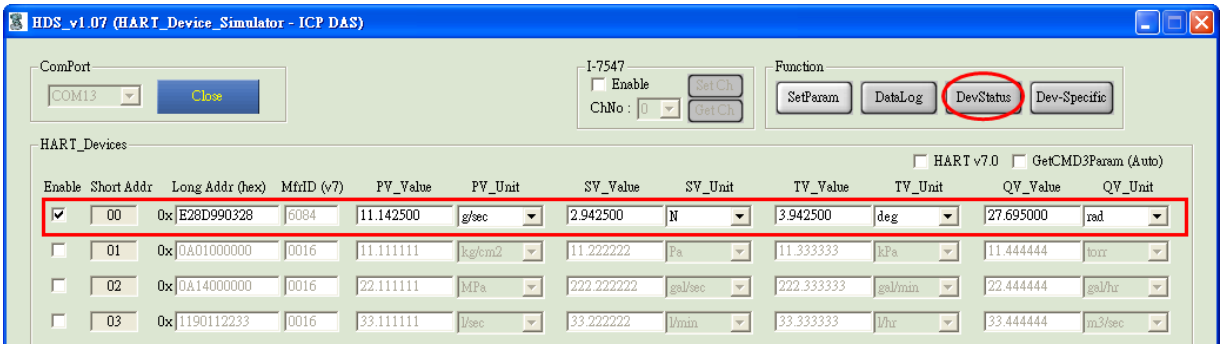


Q09. How to simulate the abnormal status of HDS ?

A09 : (2020/11/19)

[The setting steps of HDS]

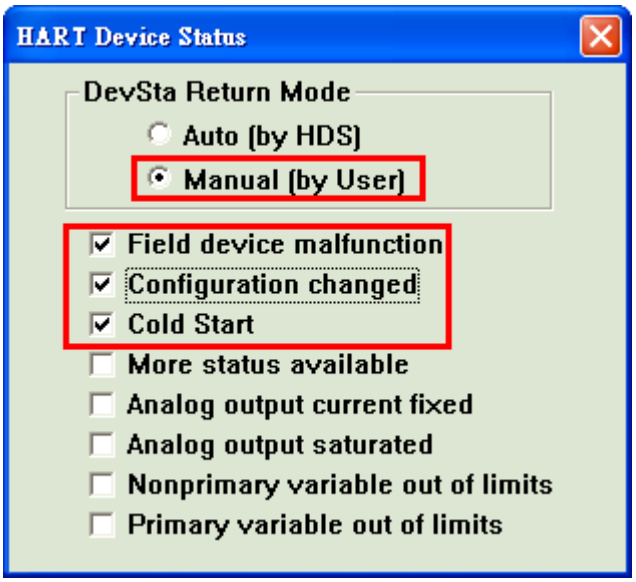
(1) **Using ICP DAS HART converter with HDS to simulate HART slave device.**



(2) In HDS, click the **"DevStatus"** button to open the screen of **"HART Device Status".**

[1] Click the **"Manual (by User)"** option to enable the setting parameters of " **HART Device Status".**

[2] For example, check the below three abnormal status for the current HART device status in HDS.

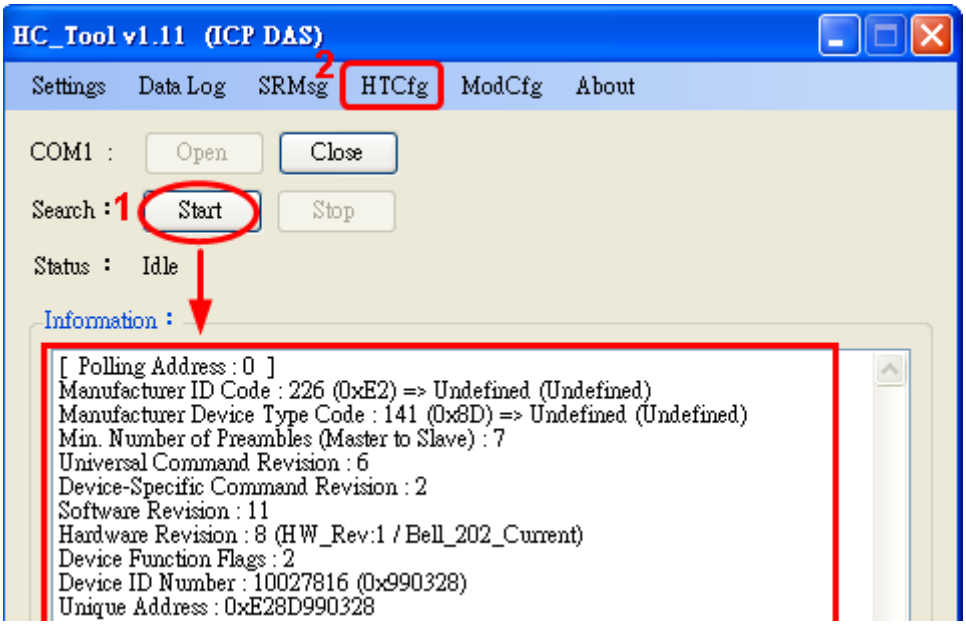


[The testing steps of HC_Tool]

(3) Using ICP DAS HART converter with HC_Tool to simulate HART master tool:

[1] Click the **"Start"** button to search all HART device automatically and it will show HART devices found in the "**Information**" field.

[2] Click the **"HTCfg"** item to open the screen of "**HART Command**".

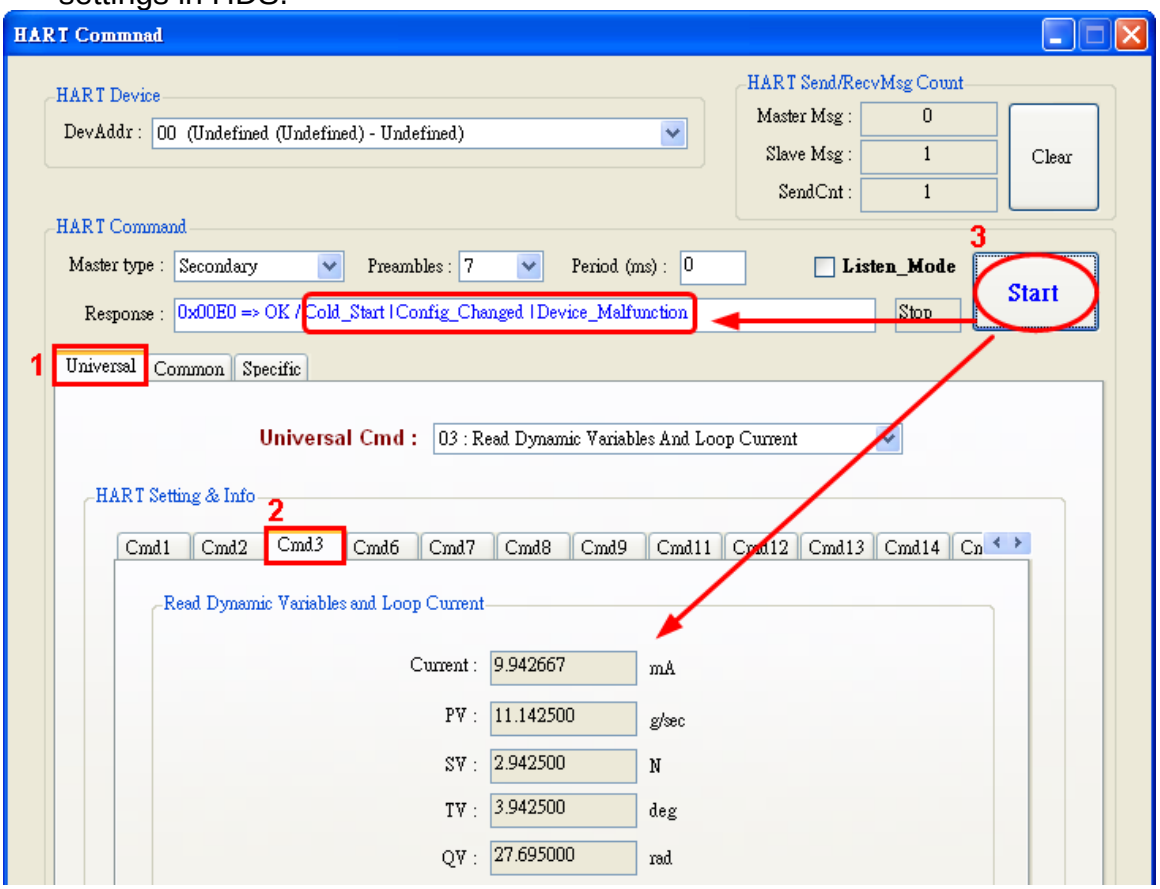


(4) **Using HART CMD3 of HC_Tool to get the current HART device status.**

[1] Click the **"Universal"** item.

[2] Click the **"Cmd3"** item.

[3] Click the **"Start"** button to send HART CMD3 and it will get the command result (status and value). In the "**Response**" field, the command status is "**Cold Start**", "**Config_Changed**", "**Device Malfunction**" and it is the same with the abnormal settings in HDS.



Q10. How to enable/disable the burst mode of HDS ?

A10 : (2020/11/19)

(1) According to HART spec., HART command 109 is used to control the burst mode of HART device to be enabled or disabled. The HDS software also adopts the same method.

Command 109 Burst Mode Control
This is a Burst Mode Command.

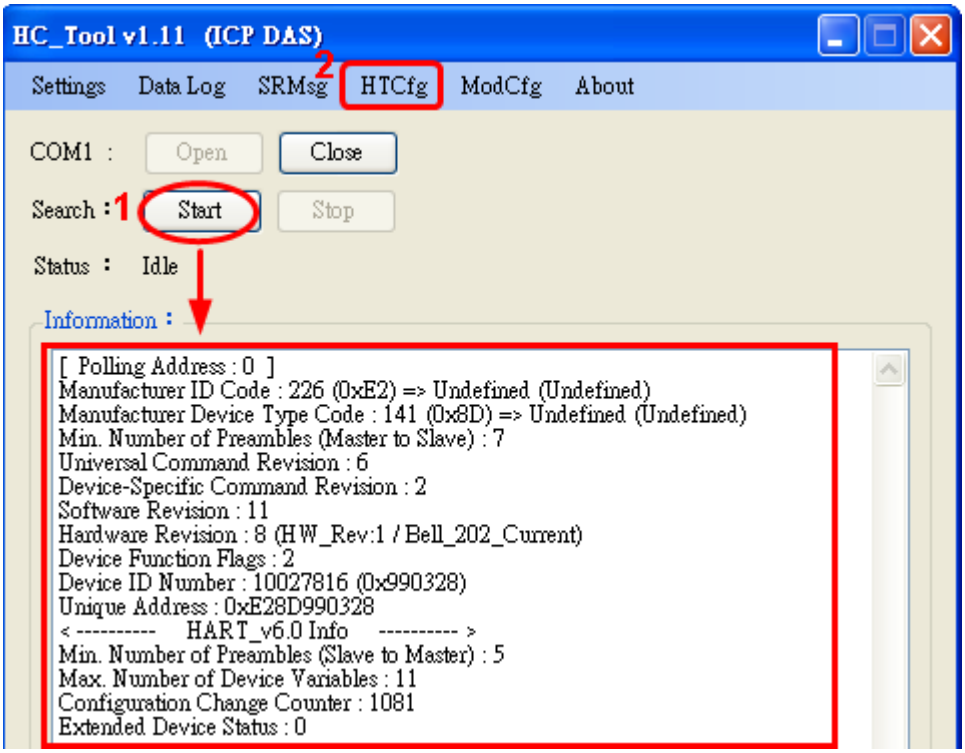
This command is used to enter and exit the Burst Mode. The response data bytes for Command 1, Read Primary Variable, or the command number selected with Command 108, Write Command Number To Burst, will be transmitted while in Burst Mode.

[The testing steps of HC_Tool]

(2) Using ICP DAS HART converter with HC_Tool to simulate HART master tool.

[1] Click the **"Start"** button to search all HART device automatically and it will show HART devices found in the "**Information**" field.

[2] Click the **"HTCfg"** item to open the screen of "**HART Command**".



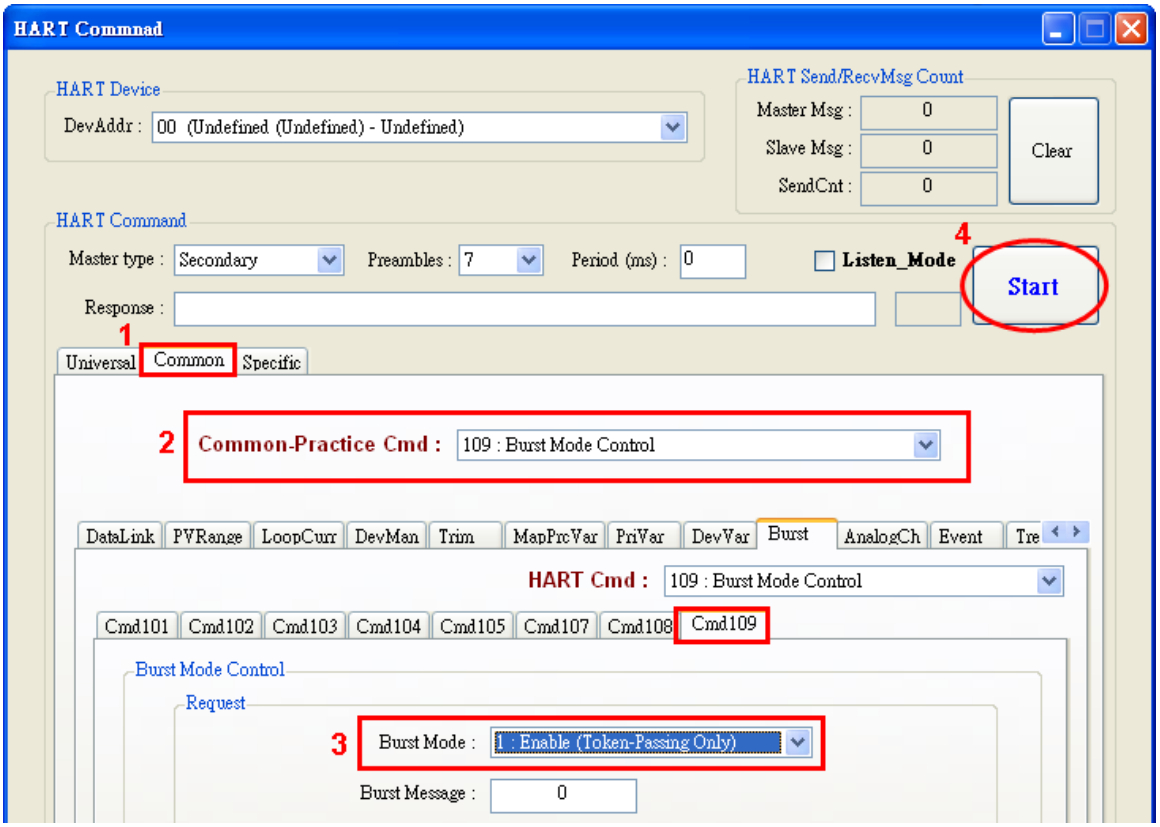
(3) Send HART command 109 to enable/disable the burst mode of HDS:

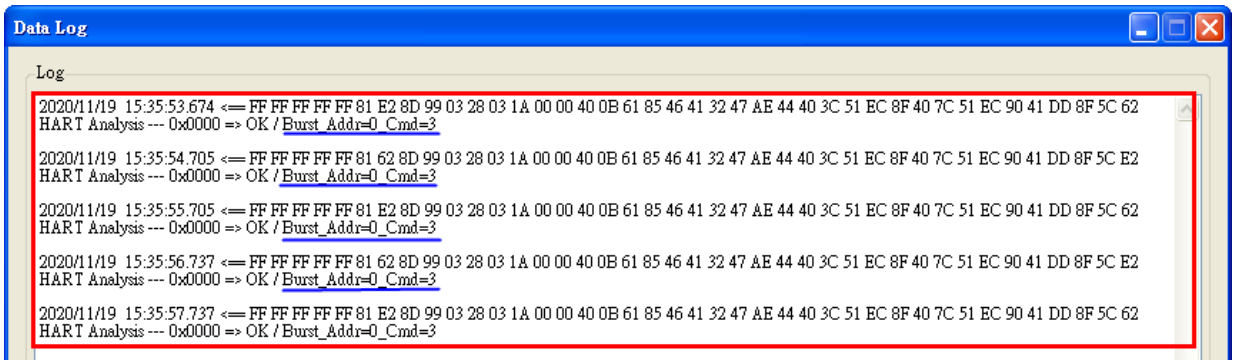
[1] Click the **"Common"** item

[2] **Common-Practice Cmd:** choose **"109: Burst Mode Control"**

[3] **Burst Mode:** choose **"1: Enable"**

[4] Click the **"Start"** button to send HART command 109 to enable the burst mode of HDS.





(In Data Log, the burst mode of HDS enabled)

[5] **Burst Mode: choose "0: Disable"**

[6] Click the **"Start"** button to send HART command 109 to disable the burst mode of HDS.

Q11. How to set HART burst command number of HDS ?

A11: (2020/11/19)

(1) According to HART spec., HART command 108 is used to set HART burst

command number. The HDS software also adopts the same method.

Command 108 Write Burst Mode Command Number
This is a Burst Mode Command.

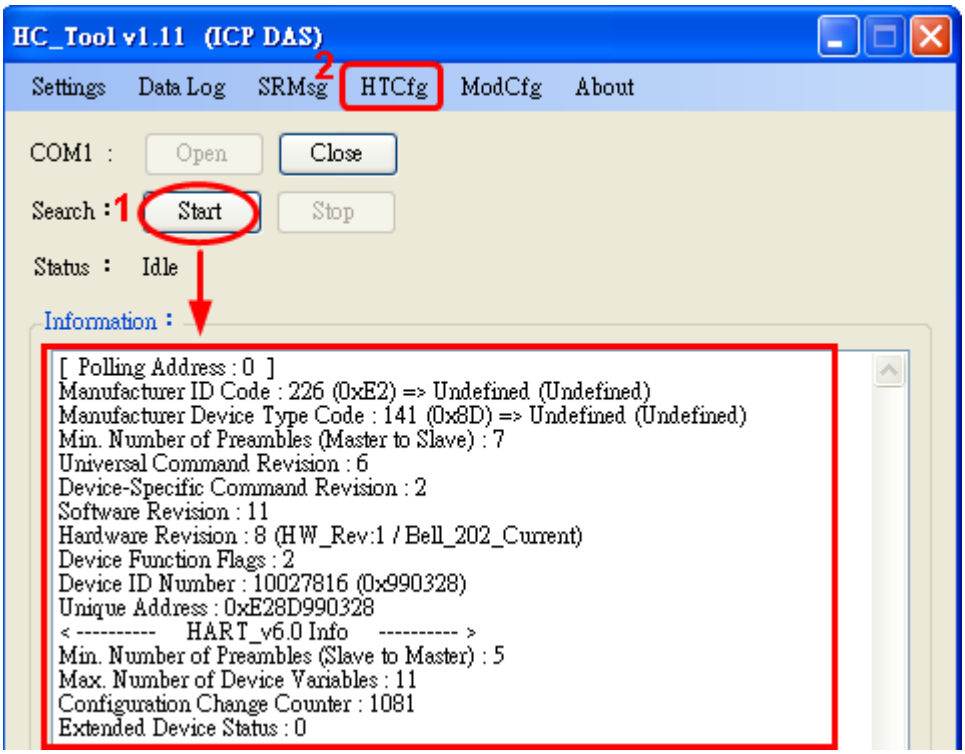
This command selects the response message that the device transmits while in Burst Mode. Command 1, 2, 3, and 9 must be supported in all devices implementing Burst Mode. Refer to the device-specific document to determine if additional commands are supported for a specific device type.

[The testing steps of HC_Tool]

(2) Using ICP DAS HART converter with HC_Tool to simulate HART master tool.

[1] Click the **"Start"** button to search all HART device automatically and it will show HART devices found in the "**Information**" field.

[2] Click the **"HTCfg"** item to open the screen of "**HART Command**".



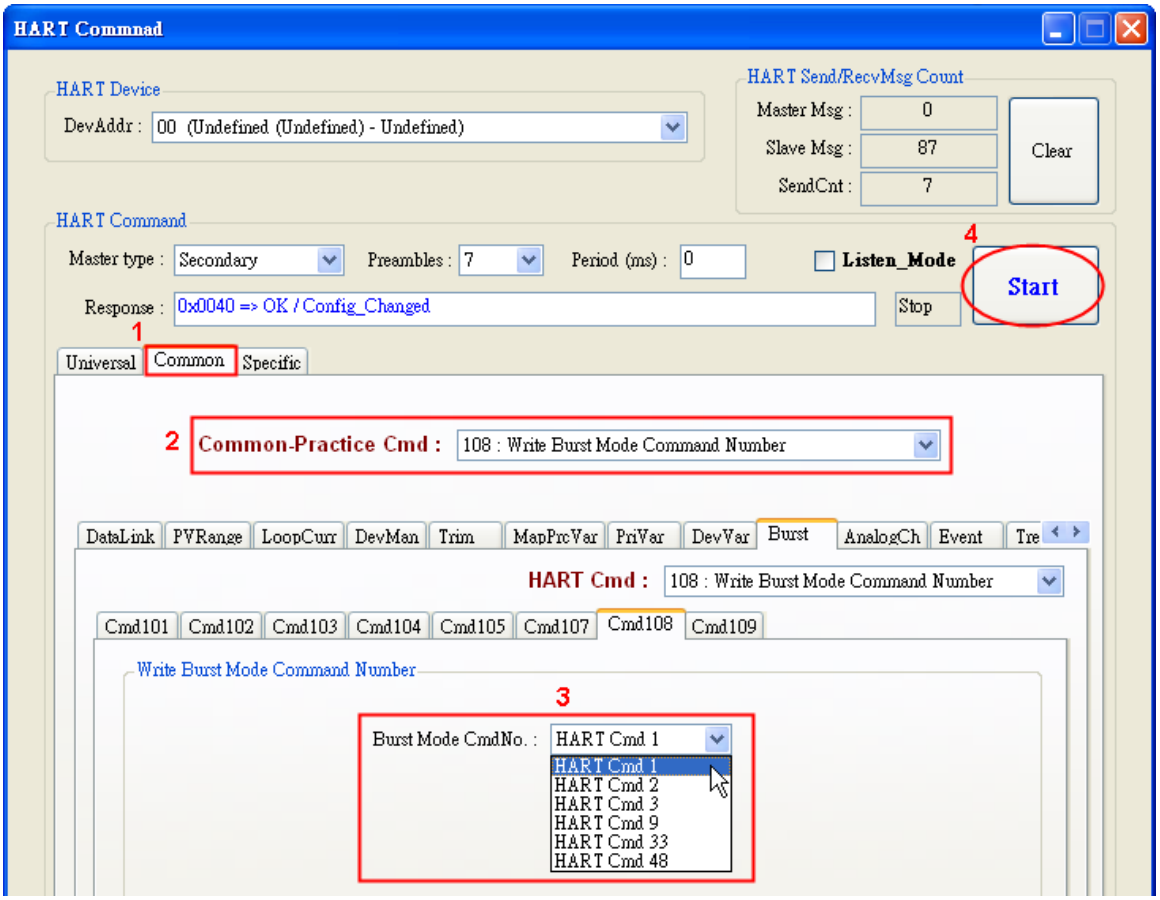
(3) Send HART command 108 to set HART burst command number of HDS:

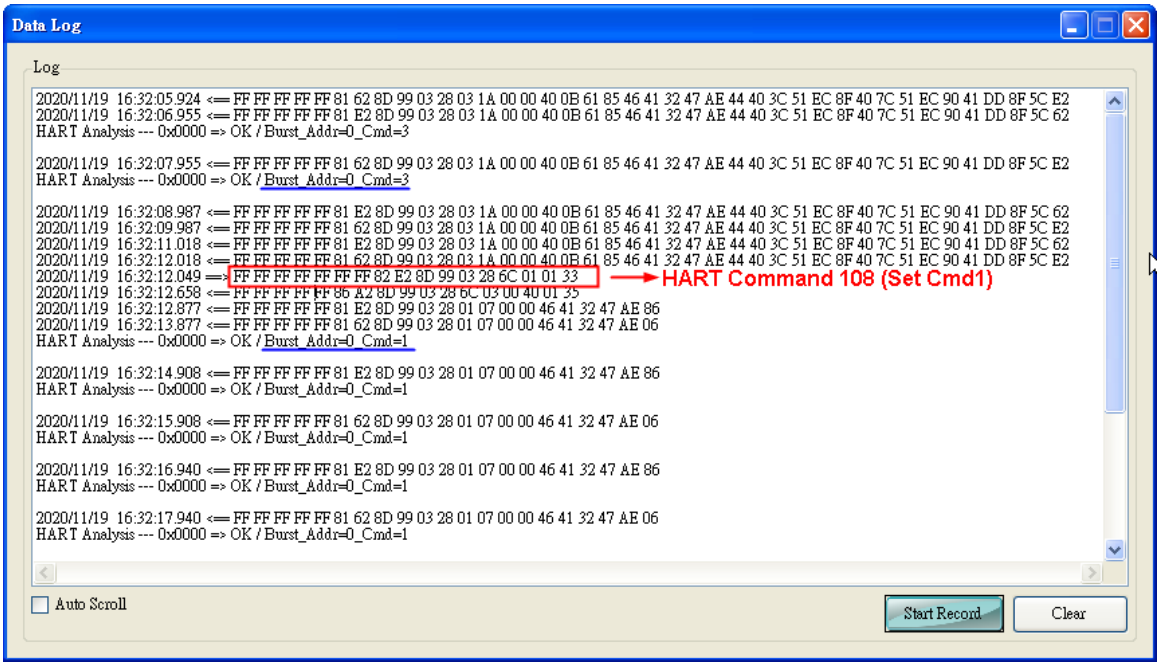
[1] Click the **"Common"** item

[2] **Common-Practice Cmd:** choose **"108: Write Burst Mode Command Number"**

[3] **Burst Mode CmdNo.:** choose **"HART Cmd1"**

[4] Click the **"Start"** button to send HART command 108 to set HART burst command number to be HART command 1.





(In Data Log, HART burst command number is changed to HART command 1)

Q12. How to set the current value of HART CMD3 in HDS ?

A11: (2021/11/09)

(1) When using HART converter (like : I-7567 / I-7570 / I-7547) and HDS software to simulate HART device. It just supports digital HART communication without real analog current output.

(2) In HDS, it supports the simulated current value in HART command 3. The current value follows the below rule.

[1] When polling HART data to HART device address >= 1 (like : 1~15), then the current value will be fixed to be 4mA for response in HART command 3.

[2] When polling HART data to HART device address = 0, then the current value will be decided as the below formula.

<1> The HART current formula is HDS :

Current = 16 * (PV value - LowerRange) / (UpperRange - LowerRange) + 4

<2> **PV value** :

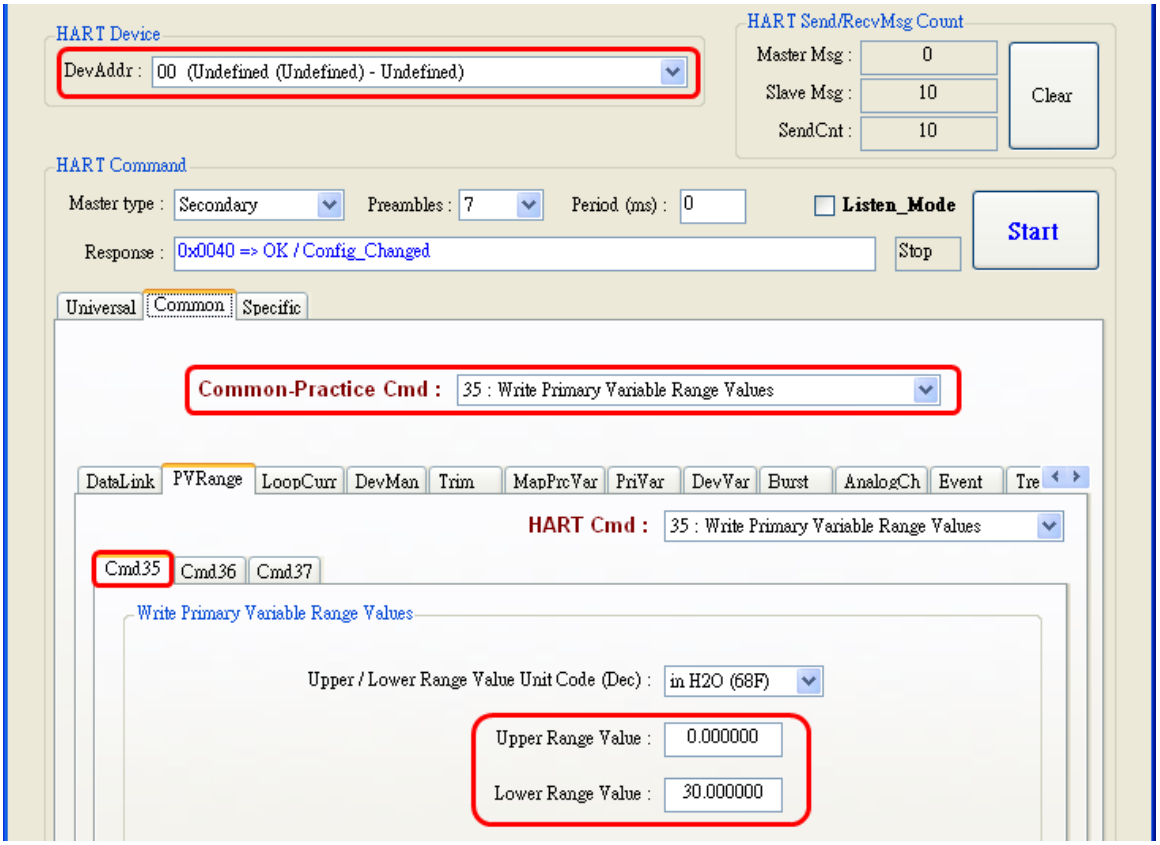
It can be get from HART CMD 3 and set in the operation interface of HDS.

<3> **LowerRange & UpperRange value** :

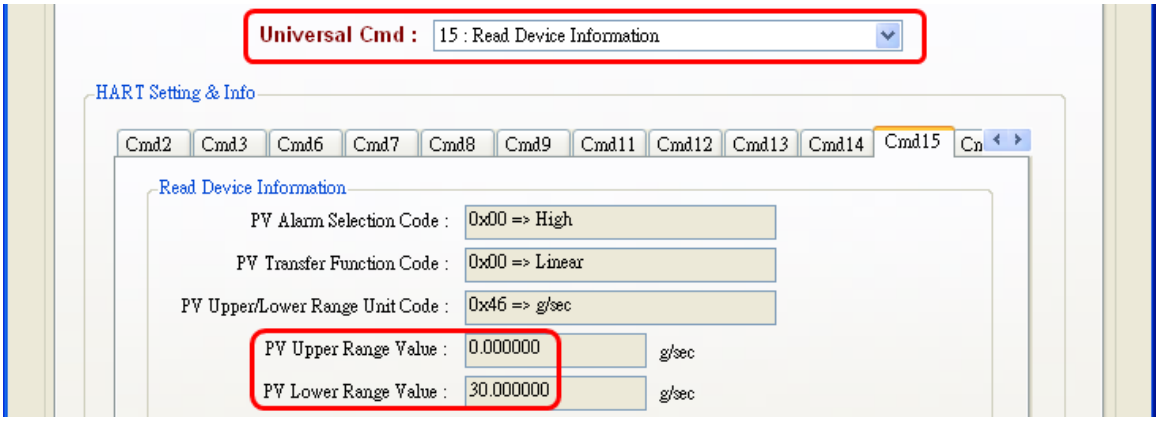
It can be get from HART CMD 15 and set from HART CMD 35.

(3) Please refer to the below steps to modify the current value in HDS.

[1] Using **HART CMD 35** to set the "**LowerRange**" and "**UpperRange**" value.

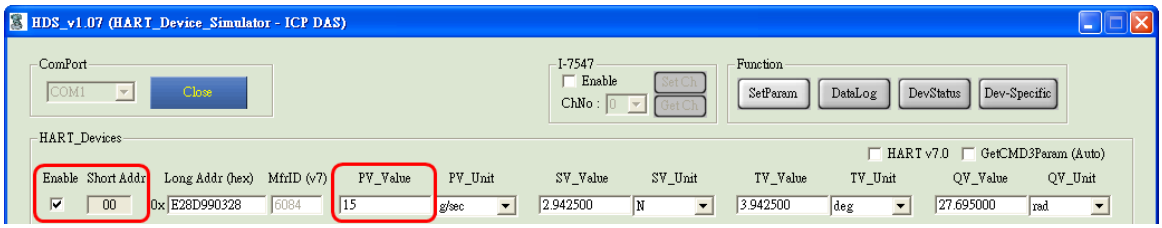


HART CMD 35



HART CMD 15

[2] Using the **operation interface of HDS** to set **PV value** of HART device address 0.

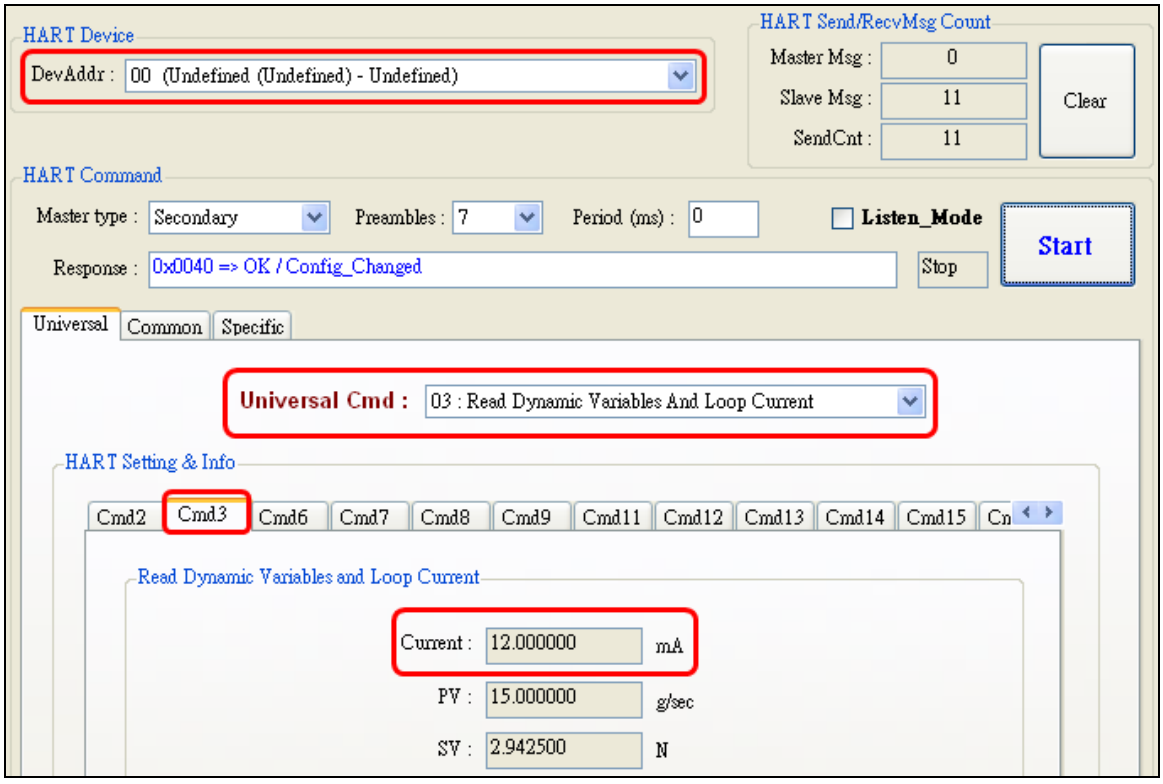


The operation interface of HDS

=>In the way, the current in HDS will be modified by the above formula.

[3] Ex : **LowerRange=0, UpperRange=30, PV_Value=15** :

=> The current in HART CMD3 will be 16 * (15-0) / (30-0) + 4 = 12.



HART CMD 3

4. Version History

Ver.	Author	Date	Description
1.00	Edward	2015/12/17	1. First version.
1.01	Edward	2016/07/28	1. Add the “DevStatus” button to set the status of the simulated HART device.
1.02	Edward	2016/11/10	1. Add the Q02 in FAQ. 2. Add the section 2.1.4 (I-7547 Function)
1.03	Peter	2017/06/30	1. Add the Q03 in FAQ
1.04	Peter	2018/05/15	1. Add the Q04 in FAQ 2. HDS_1.05.1 version new function: [1] New supported command (48, 128~253)
1.05	Peter	2018/11/01	1. Add the Q05 in FAQ
1.06	Peter	2018/11/30	1. Modify Q01 and Q03 in FAQ
1.07	Peter	2019/02/13	1. HDS_1.06 new function: (1) Support HART v7.0 protocol. (partial) (2) New supported command (8) 2. Section 2.1.2 add description of new functions 3. Add the Q06 in FAQ
1.08	Edward	2020/03/20	1. Add the Q07 in FAQ 2. HDS_1.07 new function: (1) New supported CMD (9, 11, 20~22, 33, 43, 44, 47, 50, 51, 71, 76, 89, 90, 95)
1.09	Edward	2020/11/19	1. Add the Q08~Q11 in FAQ.
1.10	Edward	2021/11/09	1. Add the Q12 in FAQ.