AH500 Module Manual

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Revision History

Version	Revision	Date
1st	The first version was published.	2013/03/15
2nd	1. Chapter 1: The information about AH08PTG-5A, AH10PFBM-5A, AH10PFBS-5A, AH10COPM-5A, AHRTU-DNET-5A, and AHRTU-PFBS-5A is added. 2. Chapter 2, Chapter 3, and Chapter 4: The information about high accuracy is updated. 3. Chapter 5: The information about AH08PTG-5A is added. 4. Chapter 7 and Chapter 10 in the first version are interchanged. 5. Chapter 7: The description of the channels which are supported is added to section 7.1. Section 7.2.8 is updated. The wiring diagram for an NPN encoder in section 7.2.9 is updated. Owing to the fact that channel 1~channel 4 is changed to channel 0~channel 3 in ISPSoft, the fourth figure in section 7.4 is changed. The description of a normal exchange area is added to section 7.6. Register names in section 7.7 are updated. The channel numbers and the descriptions of the registers in section 7.9 are updated. Section 7.10 is updated. 6. Chapter 8: The information about CR#4099~CR#32786 is added to section 8.4. The description of CR#37376~CR#37871 is corrected. Method 2 is added to section 8.7.1.2. 7. Chapter 9: Section 9.5 is added. 8. Chapter 10: The name given to AH10DNET-5A is updated. 9. Chapter 11, Chapter 12, Chapter 13, Chapter 14, and Chapter 15 are added.	2014/03/05
3rd	1. Chapter 1: the information about AH08AD-5A and AH08DA-5A is added; update information about AH10COPM-5A. 2. Chapter 2: the information about AH08AD-5A is added; update information about wiring. 3. Chapter 3: the information about AH08DA-5A is added; update information about wiring. 4. Chapter 4: update information about wiring. 5. Chapter 5: update information about isolation, conversion time for two-/three-wire configuration, and the software image of the setting the warning LED indicator. 6. Chapter 6: update information about isolation. 7. Chapter 7: update figures of the linear accumulation and circular accumulation in the section 7.9.5. 8. Chapter 10: update transmission speeds,	2016/08/15

Version	Revision	Date
	installation images and error codes. 9. Chapter 11: update the length W of AHBP06E1-5A 10. Chapter 12: update installaiton images 11. Chapter 13: update images in section 13.3.3 12. Chapter 14: update installation images 13. Chapter 15: update transmission speeds, images in section 15.4.4, the flowchart in section 15.4.5, function block descriptions in section 15.5.5.	
4th	1. Chapter 1: the information concerning AH15SCM-5A and AHRTU-ETHN-5A is added. 2. Chapter 8: the information concerning AH15SCM-5A is added. 3. Chapter 9: the information concerning AH15EN-5A is added. 4. Chapter 16: the information concerning AHRTU-ETHN-5A is added.	2017/03/31
5th	1. Update AH15SCM-5A information	2017/09/27
6th	1. Chapter 1: AH15EN-5A information is added. 2. Chapter 7: AH04HC-5A information is updated. 3. Chapter 9: AH15EN-5A information is added.	2018/04/12
7th	1. Chapter 2: added precautions on wiring and notes on external wiring for AH08AD-5A in section 2.3.3. 2. Chapter 3: added precautions on wiring in section 3.3.3. 3. Chapter 4: added precautions on wiring in section 4.3.3. 4. Chapter 5: added precautions on wiring in section 5.1.9. 5. Chapter 6: added precautions on wiring in section 6.3.3. 6. Chapter 8: added new function descriptions in section 8.1, added descriptions on input/output registers in section 8.4, updated contents in communication status and triggering the reading/writing of data in section 8.5, added contents in triggering the reading/writing of data in section 8.7.1.2, and added COMRS function in section 8.7.4. 7. Chapter 9: updated function description in section 9.1.1, updated AH10/15EN-5A Ethernet specification in section 9.1.2, updated contents in registers CR#11-#15 and CR#658-#666 in section 9.3, added function block description in	12/25/2020

Version	Revision	Date
	section 9.3.6, added application example in section 9.5, added error codes F4 and F5 in section 9.6.	
	8. Chapter 16: added function description in section 16.1.1, added description on serial communication module in section 16.3.2, updated descriptions on EIP Builder in section 16.5.2, added module description in section 16.5.2.2.	

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Chapter 9 Ethernet Communication Module AH10/15EN

Chapter 1   Introduction

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1.1 Overview

This manual introduces the usage of special modules. Analog input/output modules, temperature measurement modules, motion control modules, and network modules are special modules. They are described below.

Classification	Model Name	Description
Ana log input/output module	AH04AD-5A	Four-channel analog input module Hardware-resolution: 16 bits 0/1 V~5 V, -5 V~5 V, 0 V~10 V, -10 V~10 V, 0/4 mA~20 mA, and -20 mA~20 mA Conversion time: 150 us/channel
	AH08AD-5A	Eight-channel analog input module Hardware-resolution: 16 bits 0/1 V~5 V, -5 V~5 V, 0 V~10 V, -10 V~10 V, 0/4 mA~20 mA, and -20 mA~20 mA Conversion time: 150 us/channel
	AH08AD-5B	Eight-channel analog input module Hardware-resolution: 16 bits 0/1 V~5 V, -5 V~5 V, 0 V~10 V, and -10 V~10 V Conversion time: 150 us/channel
	AH08AD-5C	Eight-channel analog input module Hardware-resolution: 16 bits 0/4 mA~20 mA, and -20 mA~20 mA Conversion time: 150 us/channel
	AH04DA-5A	Four-channel analog output module Hardware-resolution: 16 bits 0/1 V~5 V, -5 V~5 V, 0 V~10 V, -10 V~10 V, and 0/4 mA~20 mA Conversion time: 150 us/channel
	AH08DA-5A	Eight-channel analog output module Hardware-resolution: 16 bits 0/1 V~5 V, -5 V~5 V, 0 V~10 V, -10 V~10 V, and 0/4 mA~20 mA Conversion time: 150 us/channel
	AH08DA-5B	Eight-channel analog output module Hardware-resolution: 16 bits 0/1 V~5 V, -5 V~5 V, 0 V~10 V, and -10 V~10 V Conversion time: 150 us/channel
	AH08DA-5C	Eight-channel analog output module Hardware-resolution: 16 bits 0/4 mA~20 mA Conversion time: 150 us/channel
	AH06XA-5A	Four-channel analog input module Hardware-resolution: 16 bits 0/1 V~5 V, -5 V~5 V, 0 V~10 V, -10 V~10 V, 0/4 mA~20 mA, and -20 mA~20 mA Conversion time: 150 us/channel Two-channel analog output module Hardware-resolution: 16 bits 0/1 V~5 V, -5 V~5 V, 0 V~10 V, -10 V~10 V, and 0/4 mA~20 mA Conversion time: 150 us/channel

Classification	Model Name	Description
Temperature measurement module	AH04PT-5A	Four-channel four-wire/three-wire RTD Sensor type: Pt100/Pt1000/Ni100/Ni1000 sensor, and 0~300 Ω input impedance Resolution: 0.1 ℃/0.1 ℉ (16 bits) Four-wire conversion time: 150 ms/channel Three-wire conversion time: 300 ms/channel
	AH08PTG-5A	Eight-channel four-wire/three-wire/two-wire RTD Sensor type: Pt100/Pt1000/Ni100/Ni1000, and 0~300 Ω input impedance Resolution: 0.1 ℃/0.1 ℉ (16 bits) Conversion time: 20 ms/4 channels and 200 ms/8 channels
	AH04TC-5A	Four-channel thermocouple temperature sensor Sensor type: J, K, R, S, T, E, N, and -150~+150 mV Resolution: 0.1 ℃/0.1 ℉ Conversion time: 200 ms/channel
	AH08TC-5A	Eight-channel thermocouple temperature sensor Sensor type: J, K, R, S, T, E, N, and -150~+150 mV Resolution: 0.1 ℃/0.1 ℉ Conversion time: 200 ms/channel
Motion control module	AH02HC-5A	Two-channel high-speed counter module (200 kHz)
	AH04HC-5A	Four-channel high-speed counter module (200 kHz)
Network module	AH10EN-5A	It is an Ethernet communication module. It can function as a mater or a slave. It is equipped with two Ethernet ports, and supports a Modbus TCP master and EtherNet/IP (V2.0).
	AH15EN-5A	It is an Ethernet communication module. It can function as a mater or a slave. It is equipped with two Ethernet ports, and supports a Modbus TCP master and IEC60870-5-104.
	AH10SCM-5A	It is a serial communication module with two RS-485/RS-422 ports, and supports Modbus and the UD Link protocol. There is isolation between two parts of communication, and there is isolation between two parts of power.
	AH15SCM-5A	It is a serial communication module with two RS-232 ports, and supports Modbus and the UD Link protocol. There is isolation between two parts of communication, and there is isolation between two parts of power.
	AH10DNET-5A	It is a DeviceNet communication module. It can function as a master or a slave. The maximum communication speed is 1 Mbps.
	AH10PFBM-5A	PROFIBUS-DP master module
	AH10PFBS-5A	PROFIBUS-DP slave module
	AH10COPM-5A	It is a CANopen communication module. It can function as a master or a slave.
Remote I/O module	AHRTU-DNET-5A	DeviceNet remote I/O module
	AHRTU-PFBS-5A	PROFIBUS-DP remote I/O module
	AHRTU-ETHN-5A	Ethernet remote I/O module

1.2 Specifications

1.2.1 General Specifications

Item	Specifications
Operating temperature	-20~60°C
Storage temperature	-40~70°C
Operating humidity	5~95% No condensation
Storage humidity	5~95% No condensation
Vibration/Shock resistance	International standards IEC61131-2, IEC 68-2-6 (TEST Fc)/IEC61131-2 & IEC 68-2-27 (TEST Ea)
Work environment	No corrosive gas exists.
Installation location	In a control box
Pollution degree	2

1.2.2 EMC Standards

1.2.2.1 EMI

Port	Frequency range	Level (Normative)	Reference standard
Enclosure port (radiated) (measured at a distance of 10 meters)	30-230 MHz	40 dB (µV/m) quasi-peak	IEC 61000-6-4
	230-1000 MHz	47 dB (µV/m) quasi-peak	
AC power port (conducted)	0.15-0.5 MHz	79 dB (µV) quasi-peak 66 dB (µV) average	IEC 61000-6-4
	0.5-30 MHz	73 dB (µV) quasi-peak 60 dB (µV) average	

1.2.2.2 EMS

Environmental phenomenon	Reference standard	Test		Test level
Electrostatic discharge	IEC 61000-4-2	Contact		±4 kV
		Air		±8 kV
Radio frequency electromagnetic field Amplitude modulated	IEC 61000-4-3	80% AM, 1 kHz sinusoidal	2.0-2.7 GHz	1 V/m
			1.4-2.0 GHz	3 V/m
			80-1000 MHz	10 V/m
Power frequency magnetic field	IEC 61000-4-8	60 Hz		30 A/m
		50 Hz		30 A/m

1.2.2.3 Conducted Immunity Test

Environmental phenomenon		Fast transient burst	High energy surge	Radio frequency interference
Reference standard		IEC 61000-4-4	IEC 61000-4-5	IEC 61000-4-6
Interface/Port	Specific interface/port	Test level	Test level	Test level
Data communication	Shielded cable	1 kV	1 kV CM	10 V
	Unshielded cable	1 kV	1 kV CM	10 V
Digital and analog I/O	AC I/O (unshielded)	2 kV	2 kV CM 1 kV DM	10 V
	Analog or DC I/O(unshielded)	1 kV	1 kV CM	10 V
	All shielded lines (to the earth)	1 kV	1 kV CM	10 V
Equipment power	AC power	2 kV	2 kV CM 1 kV DM	10 V
	DC power	2 kV	0.5 kV CM 0.5 kV DM	10 V
I/O power and auxiliary power output	AC I/O and AC auxiliary power	2 kV	2 kV CM 1 kV DM	10 V
	DC I/O and DC auxiliary power	2 kV	0.5 kV CM 0.5 kV DM	10 V

MEMO

Chapter 2   Analog Input Module AH04AD/AH08AD

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2.1 Overview

The specifications for analog-to-digital modules, the operation, and the programming are described in this chapter. AH04AD-5A, AH08AD-5A, AH08AD-5B, and AH08AD-5C are analog-to-digital modules.

2.1.1 Characteristics

(1) **A module is selected according to practical application.**

AH04AD-5A: There are four channels. Inputs received by a channel can be either voltages or currents.

AH08AD-5A: There are eight channels. Inputs received by a channel can be either voltages or currents.

AH08AD-5B: There are eight channels. Inputs received by these channels are voltages.

AH08AD-5C: There are eight channels. Inputs received by these channels are currents.

(2) **High-speed conversion**

An analog signal is converted into a digital signal at a speed of 150 μs a channel.

(3) **High accuracy**

Conversion accuracy: The error is ±0.1% of an input voltage, and ±0.1% of an input current. (The ambient temperature is 25°C. The number of input voltages/currents which are averaged is 100.)

(4) **A scale range can be set by means of software.**

Users can set a scale range in ISPSoft. A scale range is a range of digital values to which a range of analog values corresponds.

(5) **A module can be set by means of utility software.**

HWCONFIG is built-in utility software in ISPSoft. Users can set modes and parameters in HWCONFIG to complete hardware configuration without spending time writing a program to set registers corresponding to functions.

2.2 Specifications and Functions

2.2.1 Specifications

Electrical specifications

Module name	AH04AD-5A	AH08AD-5A	AH08AD-5B	AH08AD-5C
Number of inputs	4	8	8	8
Analog-to-digital conversion	Voltage input/ Current input	Voltage input/ Current input	Voltage input	Current input
Supply voltage	24 V DC (20.4 V DC~28.8 V DC) (-15%~+20%)			
Connector type	Removable terminal block			
Conversion time	150 μs/channel			
Isolation	An analog circuit is isolated from a digital circuit by a digital integrated circuit/an optocoupler, but the analog channels are not isolated from one another. Isolation between a digital circuit and the ground: 500 V DC Isolation between an analog circuit and the ground: 500 V DC Isolation between an analog circuit and a digital circuit: 500 V DC Isolation between the 24 V DC and the ground: 500 V DC			

Functional specifications

Analog-to-digital conversion	Voltage input				
Rated input range	-10 V~10 V	0 V~10 V	±5 V	0 V~5 V	1 V~5 V
Hardware input range	-10.1 V~10.1 V	-0.1 V~10.1 V	-5.05 V~5.05 V	-0.05 V~5.05 V	0.95 V~5.05 V
Fiducial error (Room temperature)	±0.1%				
Fiducial error (Full temperature range)	±0.45%				
Linearity error (Room temperature)	±0.07%				
Linearity error (Full temperature range)	±0.12%				
Hardware resolution	16 bits				
Input impedance	>1MΩ				
Absolute input range	±15 V				

Analog-to-digital conversion	Current input		
Rated input range	±20 mA	0 mA~20 mA	4 mA~20 mA
Hardware input range	-20.2 mA~20.2 mA	-0.2 mA~20.2 mA	3.8 mA~20.2 mA
Fiducial error (Room temperature)	±0.1%		
Fiducial error (Full temperature range)	±0.2%		
Linearity error (Room temperature) (Full temperature range)	±0.05%		
Linearity error	±0.23%		
Hardware resolution	16 bits		
Input impedance	250 Ω		
Absolute input range	±32 mA		

2.2.2 Profile

- **AH04AD-5A/AH08AD-5B/AH08AD-5C**
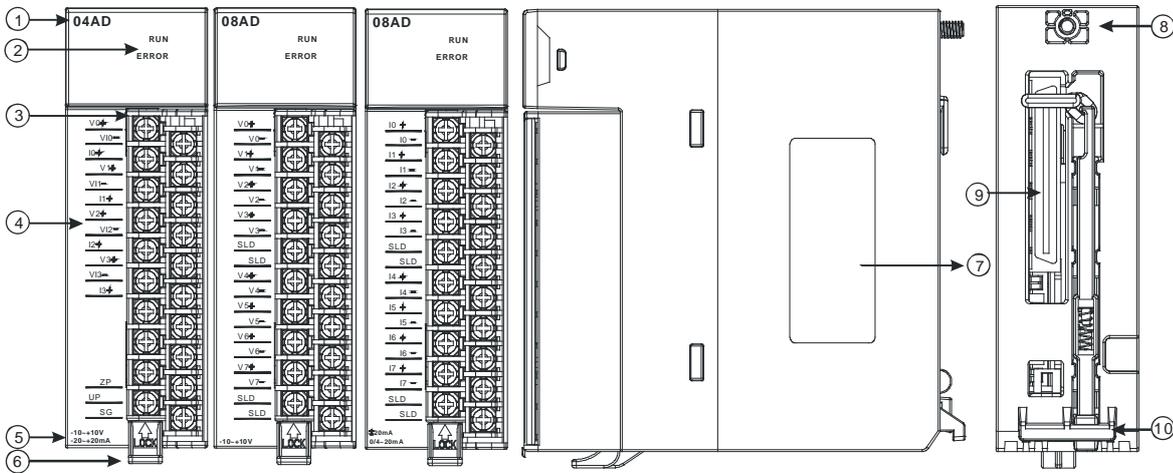
- **AH08AD-5A**

Number	Name	Description
1	Model name	Model name of the module
2	RUN LED indicator	Operating status of the module ON: The module is running. OFF: The module stops running.
2	ERROR LED indicator	Error status of the module ON: A serious error occurs in the module. OFF: The module is normal. Blink: A slight error occurs in the module.
3	Removable terminal block	The inputs are connected to transducers.
4	Arrangement of the input terminals	Arrangement of the terminals
5	Description of the inputs	Simple specifications for the module

Number	Name	Description
6	Clip	Removing the terminal block
7	Label	Nameplate
8	Set screw	Fixing the module
9	Connector	Connecting the module and a backplane
10	Projection	Fixing the module

2.2.3 Dimensions

● **AH04AD-5A/AH08AD-5B/AH08AD-5C**

● **AH08AD-5A**

35 | 103 | 110 | 123.4 | 6
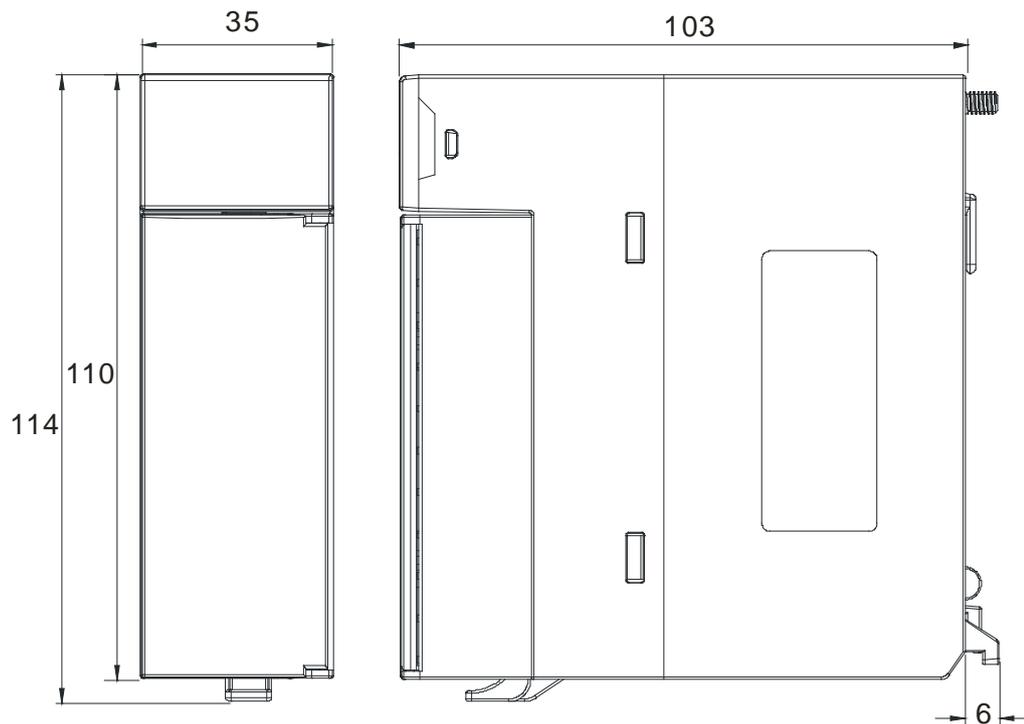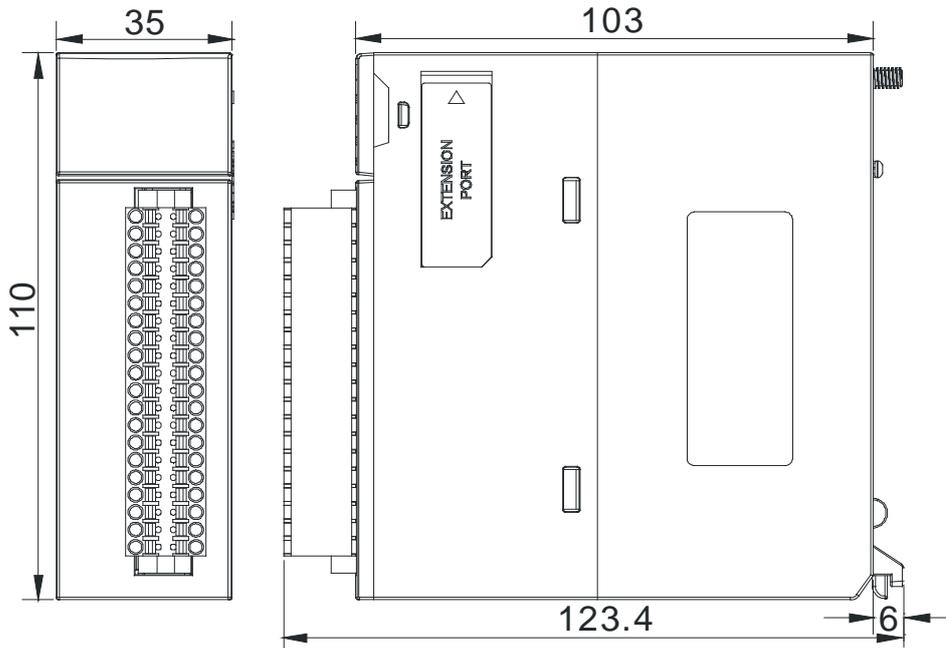
Unit: mm

2.2.4 Arrangement of Terminals

AH04AD-5A	AH08AD-5A	AH08AD-5B	AH08AD-5C

2.2.5 Functions

HWCONFIG, built-in utility software in ISPSoft, can be used to set a module. Users can set modes and parameters by means of HWCONFIG.

Item	Function	Description
1	Enabling/Disabling a channel	1. Users can enable or disable a channel. 2. If a channel is disabled, the total conversion time is decreased.
2	Calibration	Users can calibrate a linear curve.
3	Average	Conversion values are averaged and filtered.
4	Scale range	An analog range corresponds to a digital range.
5	Disconnection detection	Only if the analog rang is 4 mA~20 mA or 1 V~5 V does the disconnection detection function.
6	Channel detection	If an input signal exceeds a range of inputs which can be received by hardware, the module will give an alarm or a warning. a. Warning LED indicator: When a warning occurs, the ERROR LED indicator blinks or does not blink. b. Interrupt: An interrupt service routine is enabled.

1. Enabling/Disabling a channel

An analog signal is converted into a digital signal at a speed of 150 µs a channel. The total conversion time is 150 µs×(the number of channels). If a channel is not used, users can disable it to decrease the total conversion time.

2. Calibration

● To make a curve meet actual needs, users can calibrate the curve by changing an offset and a gain. A calibration range depends on a range of inputs which can be received by hardware.

● A volt is a unit of calibration for offsets if inputs received are voltages. A milliampere is a unit of calibration for offsets if inputs received are currents.

● The range of offsets used for calibration is -1.0~1.0, and the range of gains used for calibration is 0.9~1.1.

Example 1:

The inputs received by a channel are voltages in the range of -10.0 V to +10.0 V. The original signals are used. The gain is 1, and the offset is 0. The voltage received by the channel is 0 V, and the digital value is -0.05. The voltage received by the channel is 10.0 V, and the digital value is 9.95. Users can calibrate the channel by calibrating the gain and the offset.

The users can get the gain for the calibration by means of the equations below.
Gain=(Y2-Y1)/(X2-X1)=[9.95-(-0.05)]/(10-0)=1
Gain used for calibration=1/Gain=1/1=1

The users can get the offset for the calibration by means of the equations below.
Offset=Y1= -0.05
Offset used for calibration=0-Y1=0.05

(X: Analog signal; Y: Digital value)

Example 2:

The inputs received by a channel are voltages in the range of -10.0 V to +10.0 V. The original signals are used. The gain is 1, and the offset is 0. If the voltage received by the channel is 0 V, the digital value is 0.0. If the voltage received by the channel is 10.0 V, the digital value is 10.1. Users can calibrate the channel by calibrating the gain and the offset.

The users can get the gain for the calibration by means of the equations below.
Gain=(Y2-Y1)/(X2-X1)=[10.1-0]/(10-0)=1.01
Gain used for calibration=1/Gain=1/1.01=0.99

The users can get the offset for the calibration by means of the equations below.
Offset=Y1=0
Offset used for calibration=0-Y1=0

(X: Analog signal; Y: Digital value)

3. Average

Digital values are averaged. The number by which the sum of several digital values is divided is between 1 and 100. The sampled values are taken as a queue, and the length of the queue is N. Each time a new sampled value is put at the end of the queue, an original value at the start of the queue is removed. The N values are averaged so that the periodic noise is suppressed.

4. Scale range

The analog input mode of a channel has a corresponding digital range, that is, an analog range corresponds to a digital range. For example, if the analog range is -10 V~10 V and the digital range is -10.0~10.0, the analog values -10 V~10 V correspond to the digital values -10.0~10.0.

5. Disconnection detection

Only if the analog rang is 4 mA~20 mA or 1 V~5 V does the disconnection detection function. If a module which can receive inputs ranging from 4 mA to 20 mA or from1 V to 5V is disconnected, an input signal will exceed the range of inputs which can be received by the hardware, and the module will give an alarm or a warning. Please refer to the description below for more information.

6. Channel detection

If an input signal exceeds a range of inputs which can be received by hardware, an error message appears. Please refer to section 1.2.1 for more information.

a. Giving alarms or warnings

The procedure below explains how to set a module so that it gives an alarm or a warning.

```
                                              ┌─────────────┐
                                              │   Channel   │
                                              │  detection  │
                                              └──────┬──────┘
                                                     │
                                                     ▼
No (No detection)                            ╱───────────────╲
┌──────────────────┐                        ╱    Enabling      ╲
│ There are no error│ ◄─────────────────────  physical range
│ logs in the CPU  │                         ╲   detection     ╱
│ module and the   │                          ╲───────────────╱
│ analog module.   │                                  │ Yes
└──────────────────┘                                  ▼
                                             ╱───────────────╲
No (Warning)                                ╱                 ╲
                         ┌───────────────────   Giving alarms
                         │                   ╲                 ╱
                         │                    ╲───────────────╱
                         │                            │ Yes
                         ▼                            ▼
        No      ╱────────────────╲         ┌─────────────────────┐
  ┌─────────────  The warning      ╲        │ The BUS FAULT LED   │
  │            ╲ LED indicators    ╱        │ indicator on the CPU│
  │             ╲   blink         ╱         │ module and the ERROR│
  │              ╲───────────────╱          │ LED indicator on the│
  │                      │ Yes              │ analog module are ON│
  ▼                      ▼                  │ There are error logs│
```

The BUS FAULT LED indicator on the CPU module and the ERROR LED indicator on the analog module are not ON.
There are error logs in the CPU module and the analog module.

The BUS FAULT LED indicator on the CPU module and the ERROR LED indicator on the analog module blink.
There are error logs in the CPU module and the analog module.

The BUS FAULT LED indicator on the CPU module and the ERROR LED indicator on the analog module are ON.
There are error logs in the CPU module and the analog module.

b. Interrupt service routine

The procedure below explains how to trigger an interrupt service routine in a CPU module.

● The interrupt service routines are I40~I251.

2.3 Installation

2.3.1 Installing a Module

Insert a module into a slot, make sure that the module is installed on the backplane properly, and tighen the the screw, as illustrated below.

1. Insert the projection under the module into the hole in the backplane.
2. Push the module in the direction indicated by the arrow until it clicks.

   ● **AH04AD-5A/AH08AD-5B/AH08AD-5C**
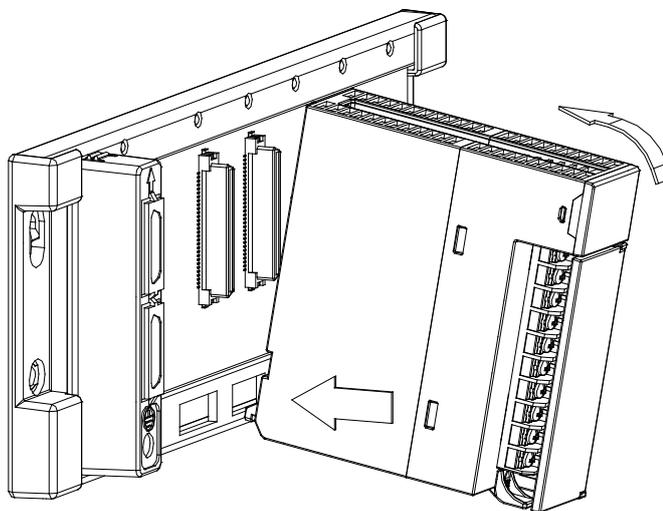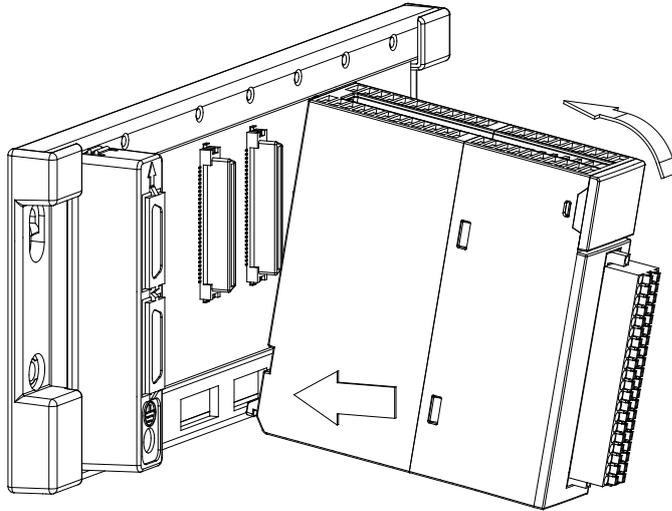
- **AH08AD-5A**

3. Tighten the screw on the module.
   - **AH04AD-5A/AH08AD-5B/AH08AD-5C**
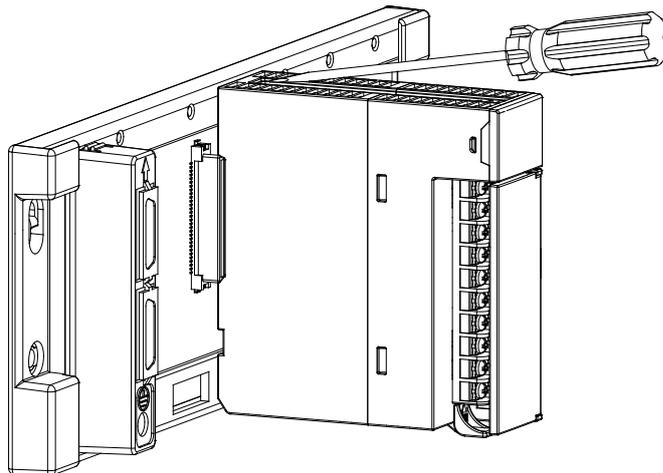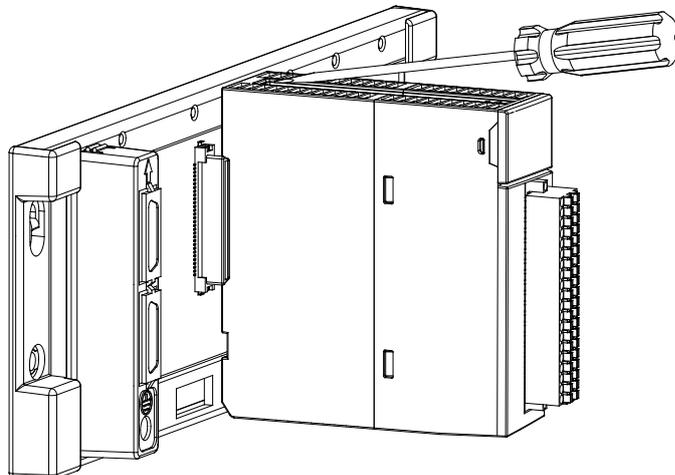
- **AH08AD-5A**

2.3.2 Installing a Removable Terminal Block

● **Installation**

1. Level a terminal block at the printed circuit board, and press it into the module.

● **AH04AD-5A/AH08AD-5B/AH08AD-5C**

● **AH08AD-5A**

2. Press the clip in the direction indicated by the arrow, or use a slotted screwdriver to tighten the screws on the two sides of the high-density terminal block.

● AH04AD-5A/AH08AD-5B/AH08AD-5C	● AH08AD-5A

● **Removal**

1. Pull the clip in the direction indicated by the arrow, or use a slotted screwdriver to loosen the screws on the two sides of the high-density terminal block.

● AH04AD-5A/AH08AD-5B/AH08AD-5C
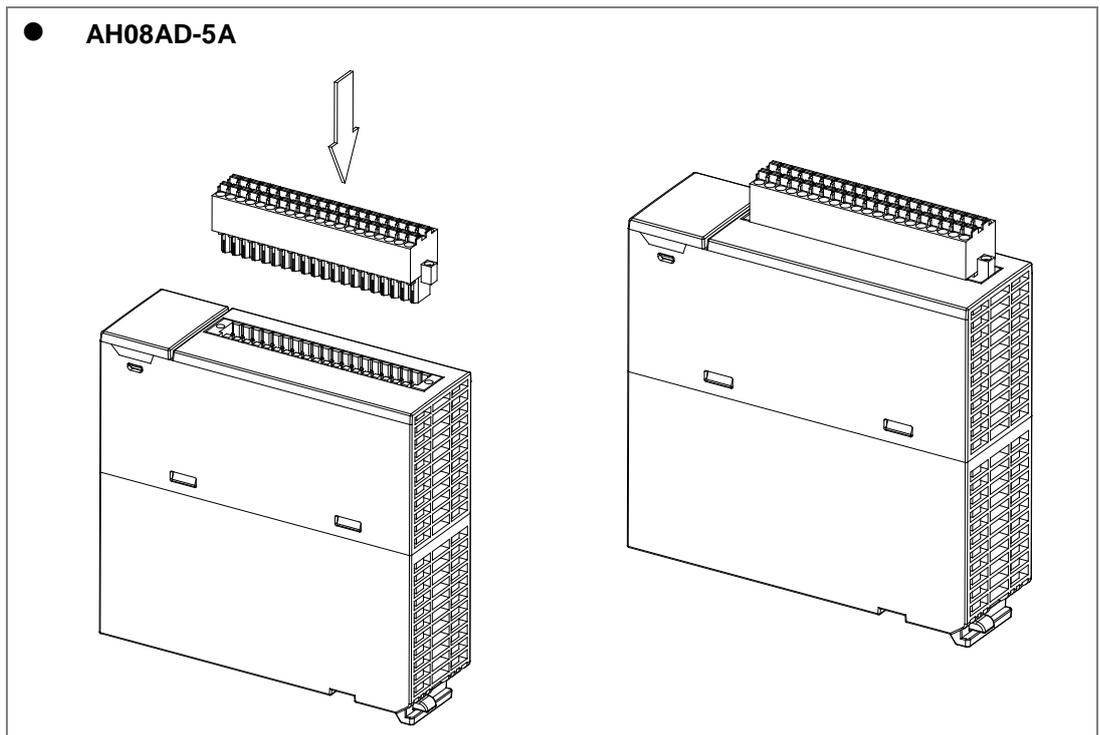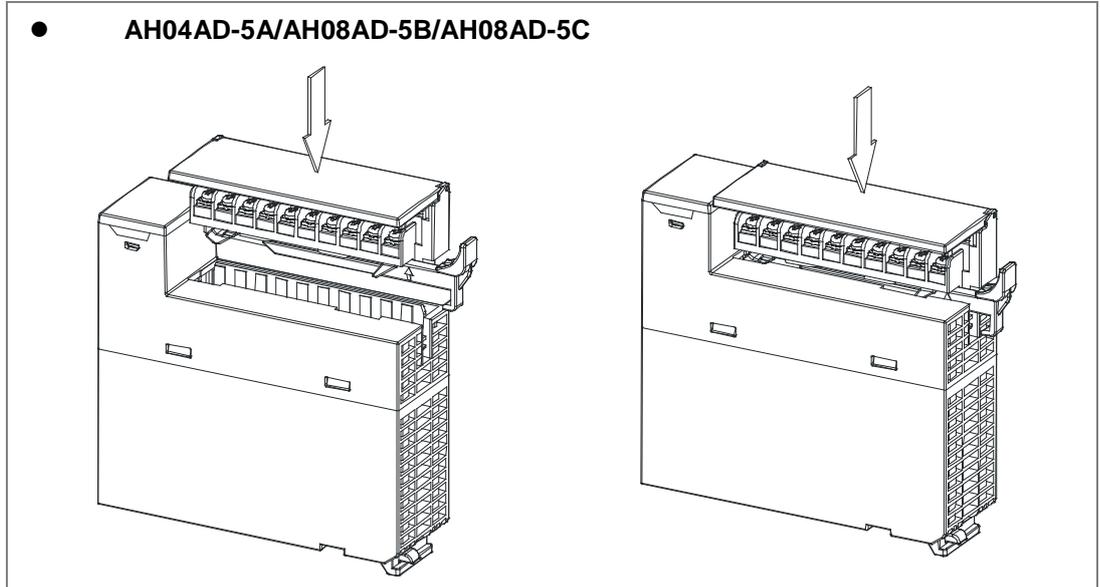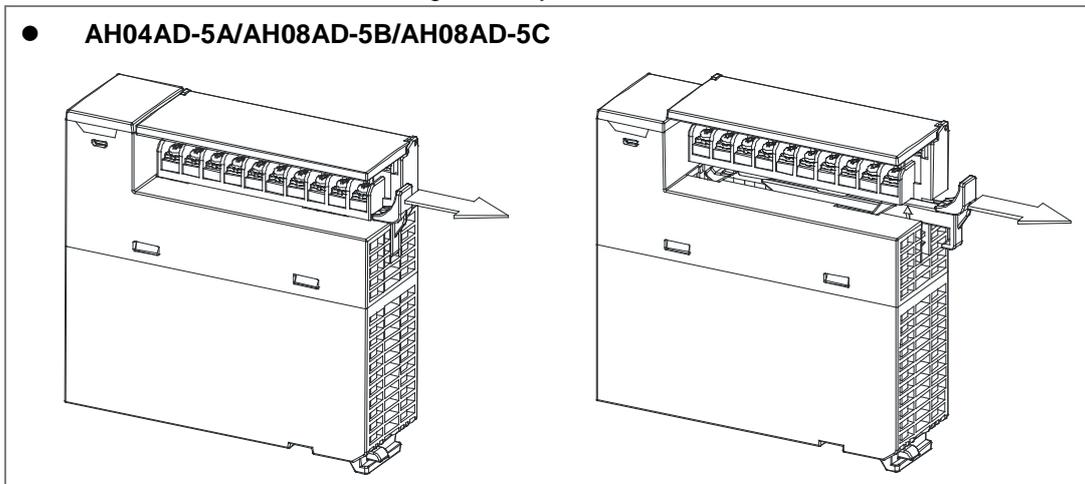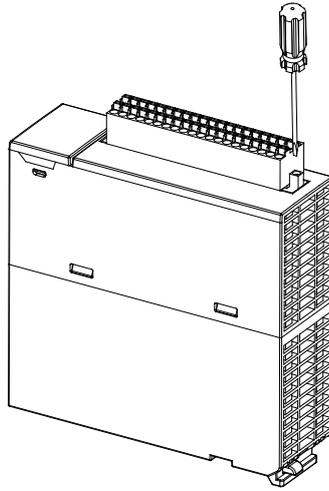
● **AH08AD-5A**

2. Pull up the clip.

● **AH04AD-5A/AH08AD-5B/AH08AD-5C**

● **AH08AD-5A**

3. The terminal block is removed.

● AH04AD-5A/AH08AD-5B/AH08AD-5C	● AH08AD-5A
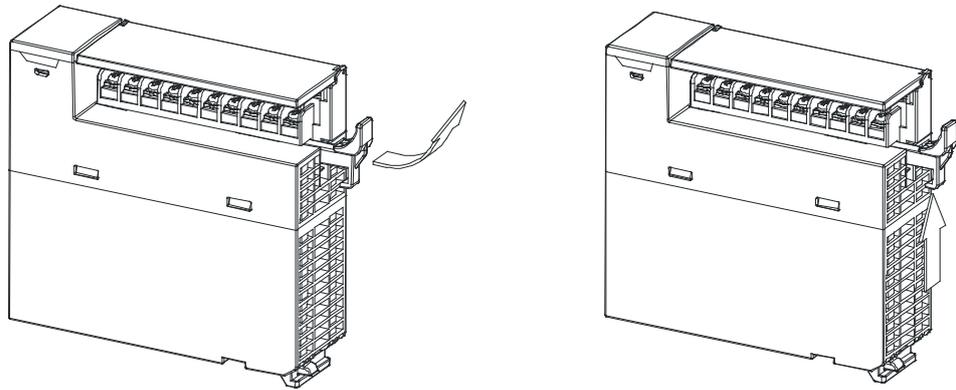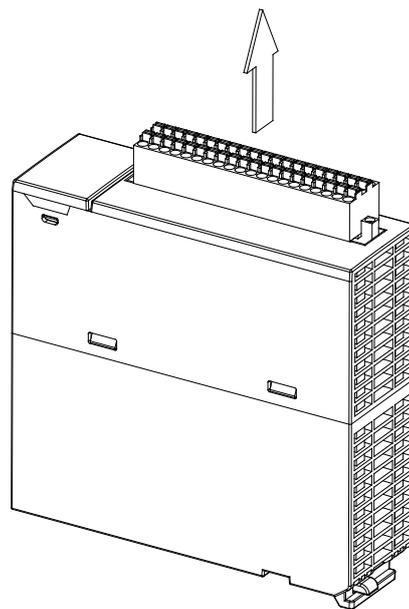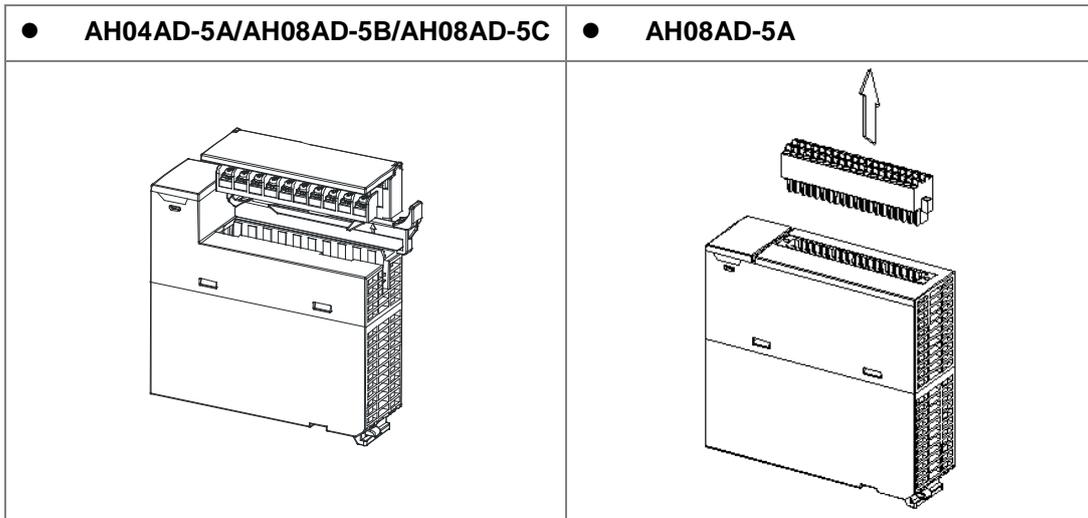
2.3.3 Wiring

● **Precautions**

In order to make the functions of an analog-to-digital module perfect and ensure the reliability of a system at the same time, external wiring which prevents noise is necessary. Before installing cables, users need to follow the precautions below.

(1) To prevent a surge and induction, an AC cable and input signal cables which are connected to AH04AD-5A/AH08AD-5A/AH08AD-5B/AH08AD-5C must be separate cables.

(2) A cable must not be installed near a main circuit, a high-voltage cable, or a cable connected to a load which is not a PLC. Besides, a cable must not be bound to a main circuit, a high-voltage cable, or a cable connected to a load which is not a PLC. Otherwise, effects that noise, induction, and a surge have will increase.

(3) Please connect a shielded cable and a hermetically sealed cable with the ground separately.

(4) Terminals with insulation sleeves can not be arranged as a terminal block. It is recommended that the terminals be covered with insulation tubes.

(5) Please connect 30 to 24 AWG (0.3 to 0.6 mm) wires to the input/output terminals. The lengths of the plastic jackets which are removed from the cables used should be in the range of 7 mm to 8 mm. The specifications for the terminals and the wiring of the terminals are shown below. Only copper leads which can resist the heat above 60°C can be used.

(6) Two-wire connection/Three-wire connection/Four-wire connection:

  ● Two-wire connection/Three-wire connection (Passive transducer): A transducer and an analog input module are connected to a power circuit collectively.

  ● Four-wire connection (Active transducer): A transducer uses an independent power supply. It is not connected to the power circuit which is connected to an analog input module.

(7) Use cables with the same length (less than 200 m) and use wire resistance of less than 100 ohm.

● **External wiring**

(1) AH04AD-5A/AH08AD-5A
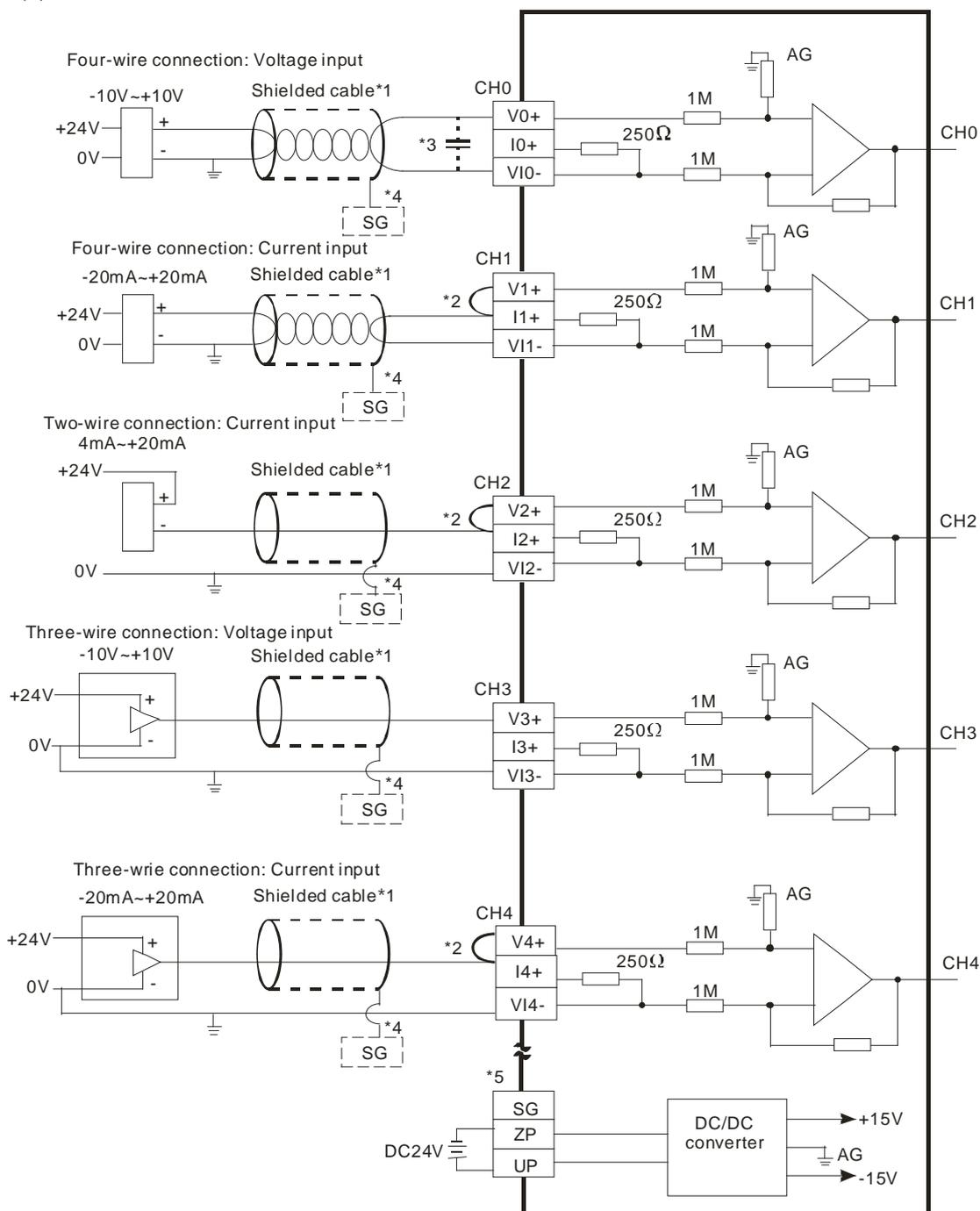
*1. Please use a shielded cable as an analog input cable, and isolate the shielded cable from other power cables.

*2. If current is connected, the connection between Vn+ and In+ needs to be a short circuit. (n is in the range of 0 to 7.)

*3. If ripple voltage results in interference with the wiring, please connect a 0.1~0.47 μF and 25 V capacitor.

*4. Please connect the ground in the shielded cable to the terminal SG.

*5. Once AH04AD-5A/AH08AD-5A is installed on a backplane, the connection between the terminal SG on AH04AD-5A/AH08AD-5A and the terminal ⊕ on the backplane will be a short circuit. Please connect the terminal ⊕ on the backplane to the ground terminal ⊕. Since AH08AD-5A does NOT require external power 24VDC, no need to connect to UP-ZP terminal.

(2) AH08AD-5B
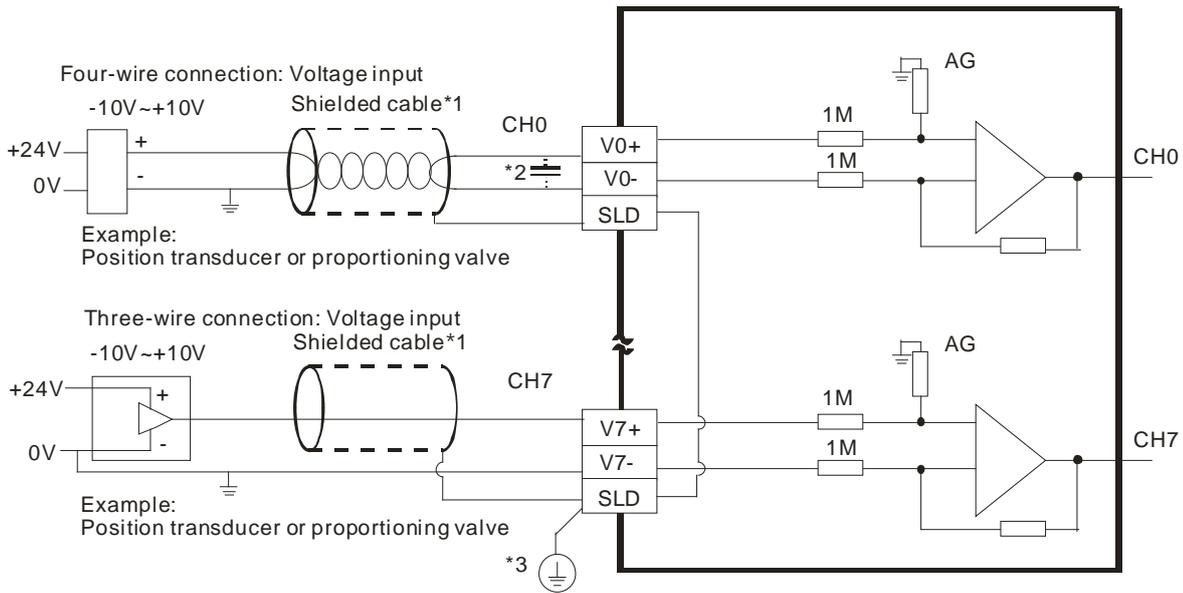
Four-wire connection: Voltage input
-10V~+10V
Shielded cable*1
Example:
Position transducer or proportioning valve

Three-wire connection: Voltage input
-10V~+10V
Shielded cable*1
Example:
Position transducer or proportioning valve

*1. Please use a shielded cable as an analog input cable, and isolate the shielded cable from other power cables.

*2. If ripple voltage results in interference with the wiring, please connect a 0.1~0.47 µF and 25 V capacitor.

*3. Please connect the terminal SLD to the ground terminal ⏚.

(3) AH08AD-5C
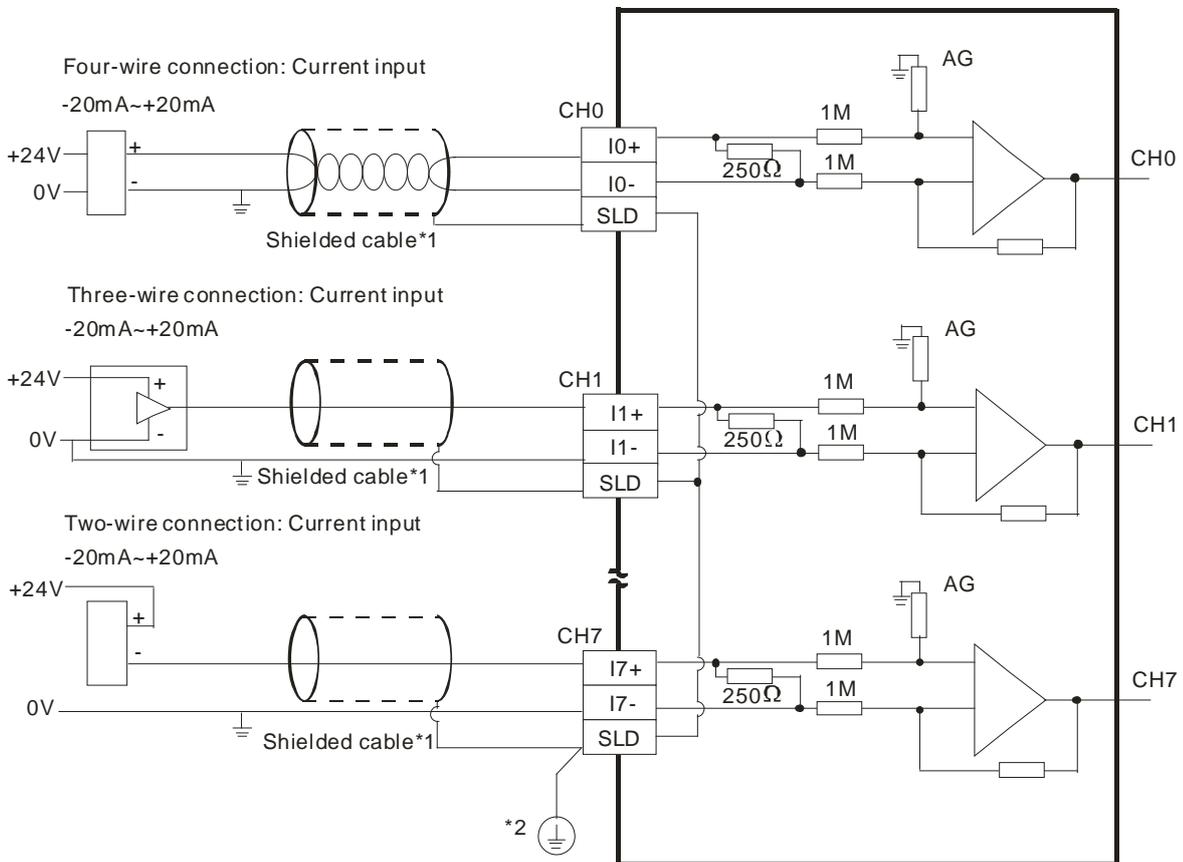
Four-wire connection: Current input
-20mA~+20mA
Shielded cable*1

Three-wire connection: Current input
-20mA~+20mA
Shielded cable*1

Two-wire connection: Current input
-20mA~+20mA
Shielded cable*1

*1. Please use a shielded cable as an analog input cable, and isolate the shielded cable from other power cables.

*2. Please connect the terminal SLD to the ground terminal ⊕.

2.3.4 LED Indicators

Number	Name	Description
1	RUN LED indicator	Operating status of the module ON: The module is running. OFF: The module stops running.
2	ERROR LED indicator	Error status of the module ON: A serious error occurs in the module. OFF: The module is normal. Blink: A slight error occurs in the module.

2.4 HWCONFIG in ISPSoft

2.4.1 Initial Setting
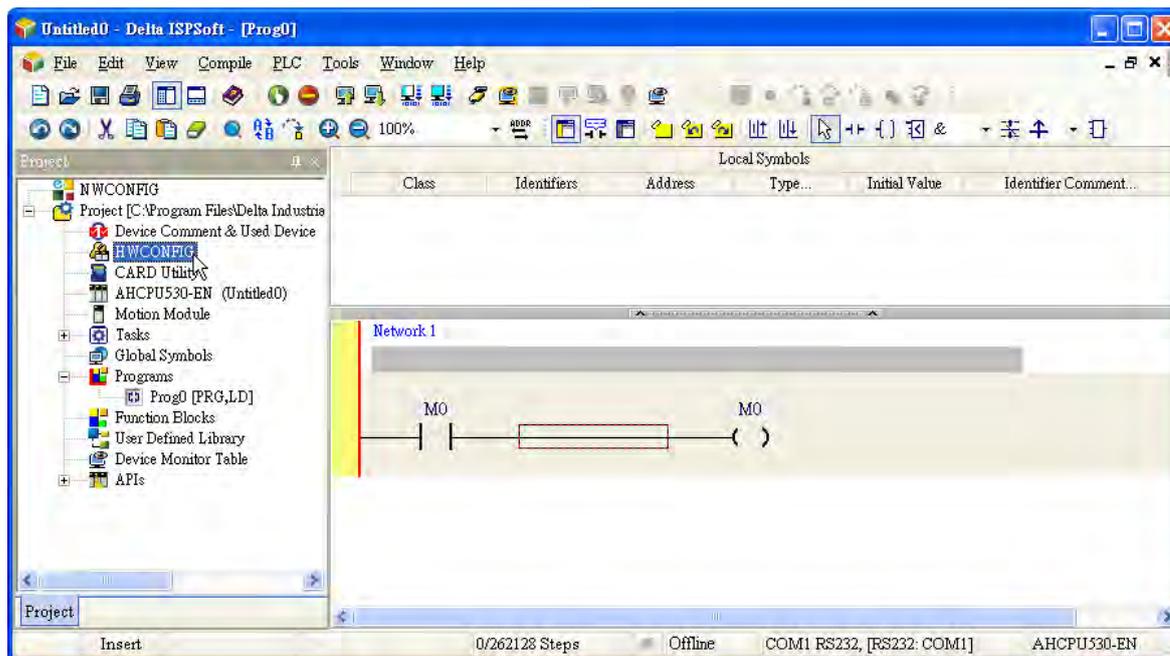
(1) Start ISPSoft, and then double-click **HWCONFIG**.

(2) Click **I/O scan** on the toolbar.

(3) ISPSoft is scanning the actual hardware configuration.

(4) After the scan of the actual hardware configuration is complete, the system automatically assigns the corresponding registers to the channels. Users can alter the input device range by themselves.

Note: Owing to the fact that values are floating-point numbers, every channel occupies two 16-bit registers.

Information: Rack 1

Slot No.	Label	Firmware Version	Descrption	Input Device Range	Output Device Ra...	Comment
-	AHPS05-5A	-	AH Power Suppl	None	None	
-	AHCPU510-E	1.00	Basic CPU modu	None	None	
0	AH08AD-5C	1.00	8 x AI 16 bit	D0 ~ D15		
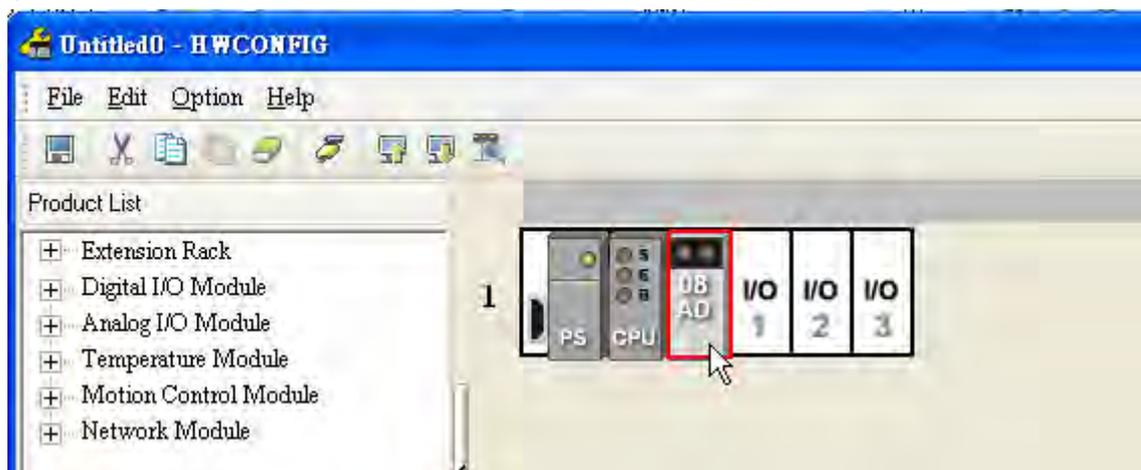
(5) Double-click the module.

(6) Open the **Parameter Setting** window.

(7) Set the parameters, and then click **OK**.
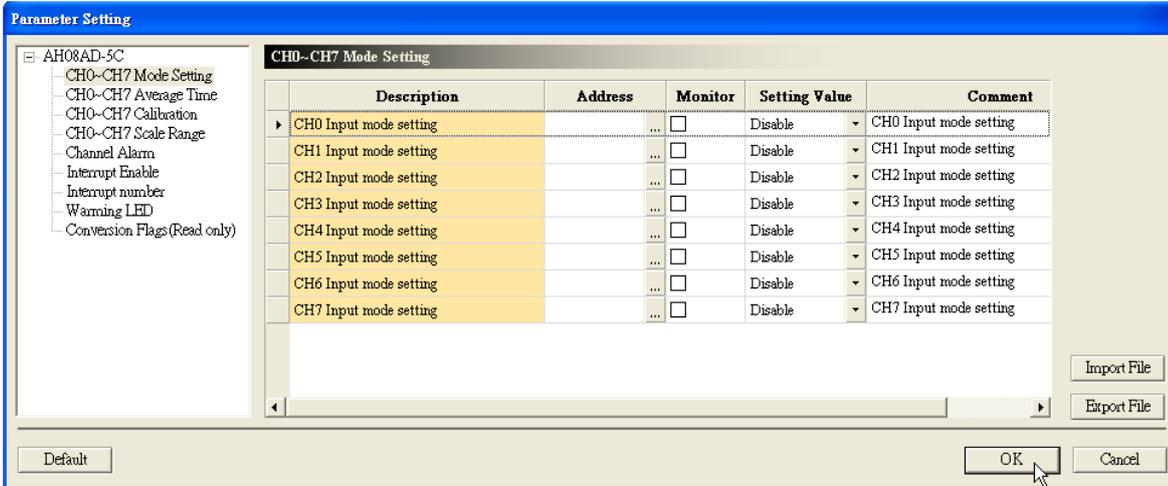
(8) Click **Download** on the toolbar to download the parameters. (The parameters can not be downloaded when the CPU module runs.)

2.4.2 Checking the Version of a Module
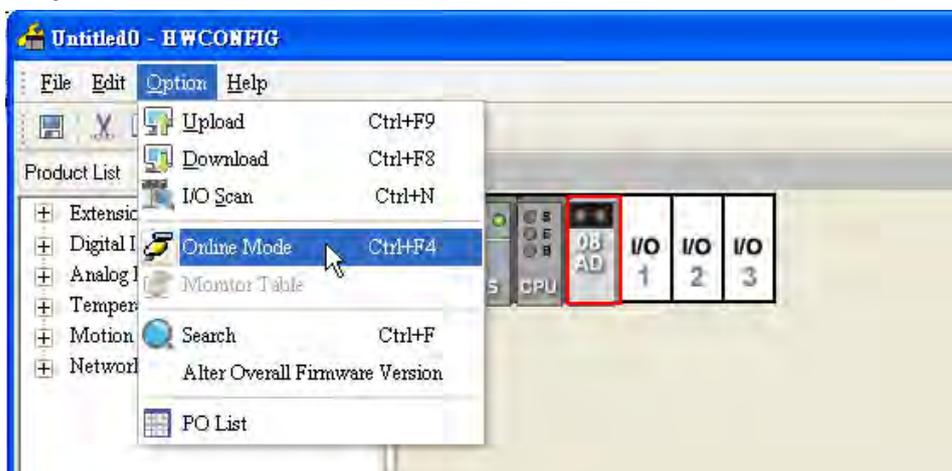
(1) On the **Option** menu, click **Online Mode**.

(2) Right-click the module, and then click **Module Information** on the context menu. The version of the firmware and that of the hardware are displayed.
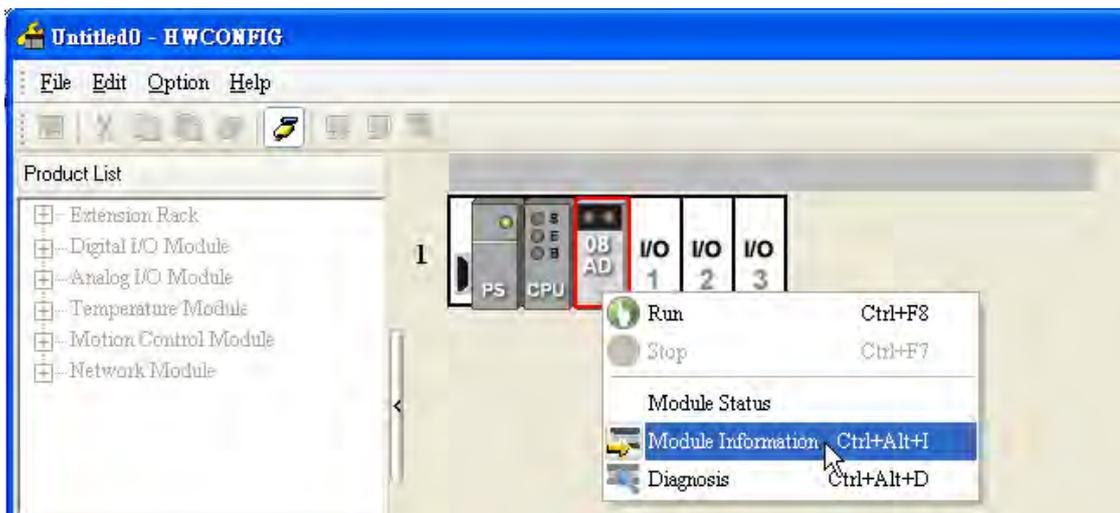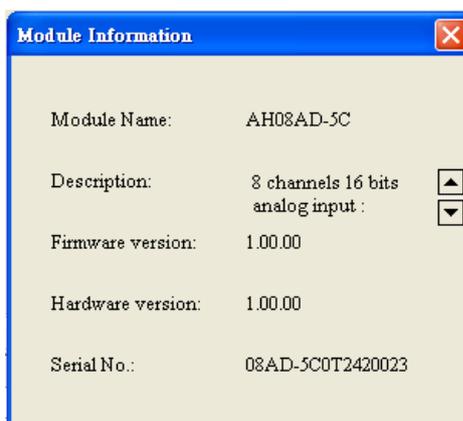
2.4.3 Monitoring Table

(1) Select the **Monitor** checkboxes at the right sides of the corresponding registers.
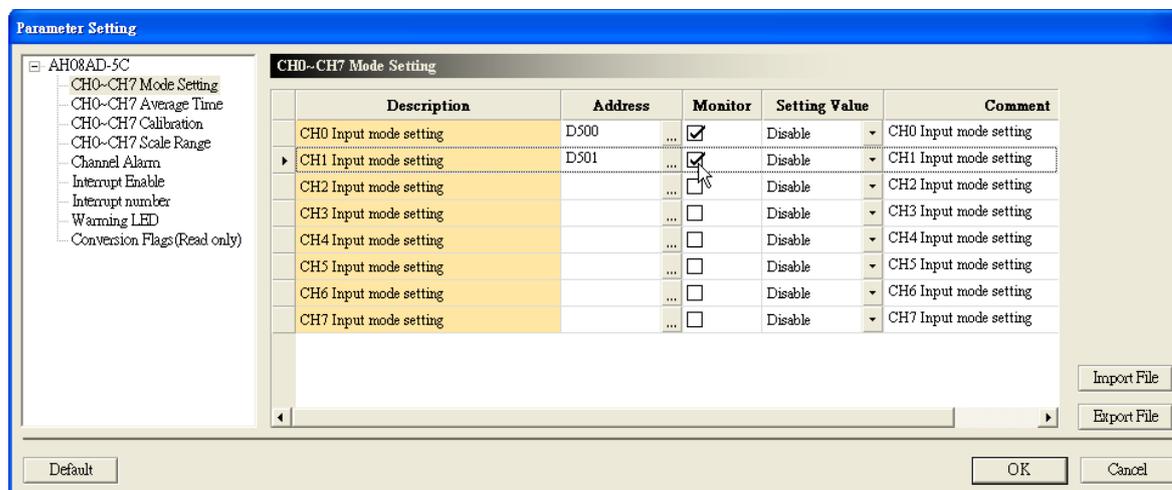
(2) On the **Option** menu, click **Online Mode**.
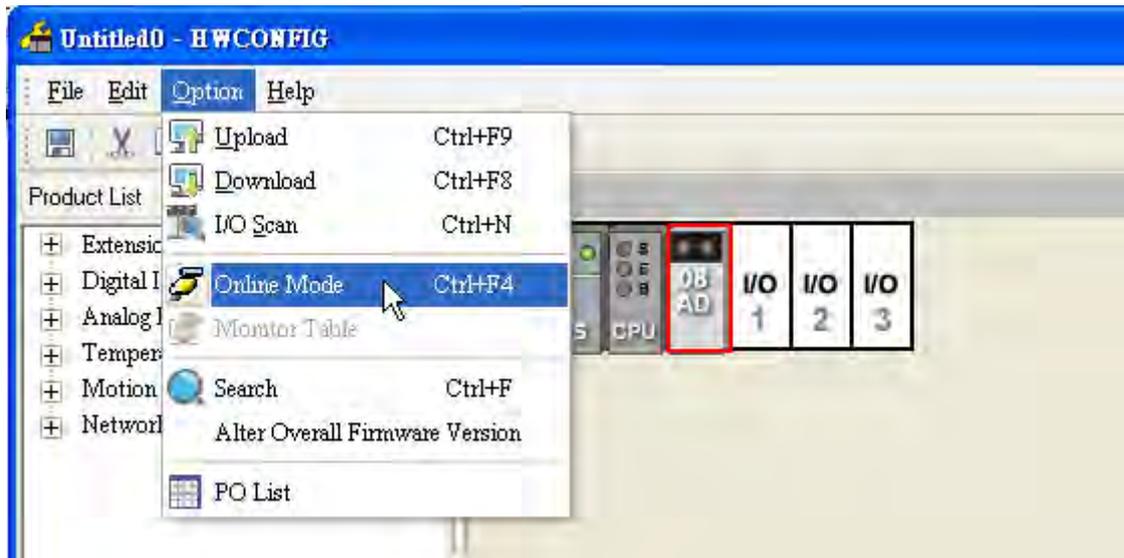
(3) On the **Option** menu, click **Monitor Table**. The registers are monitored.
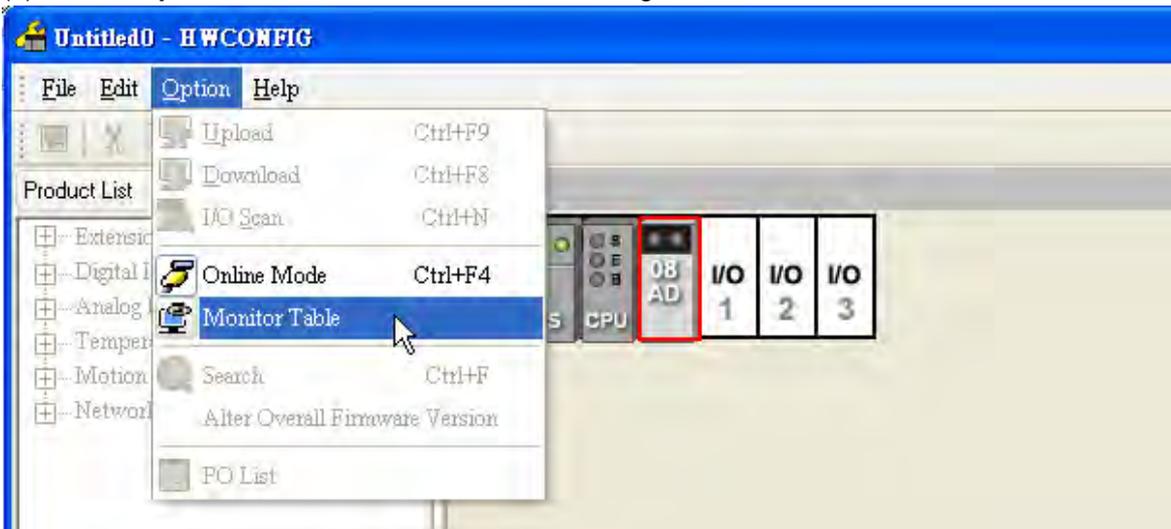
Rack No.	Slot No.	Module Name	Device Name	PV	Radix	Comment
1	0	AH08AD-5C	D500	0	Decimal	CH0 Input mode setting
1	0	AH08AD-5C	D501	0	Decimal	CH1 Input mode setting

2.4.4 Online Mode

(1) Click **Online Mode** on the toolbar.
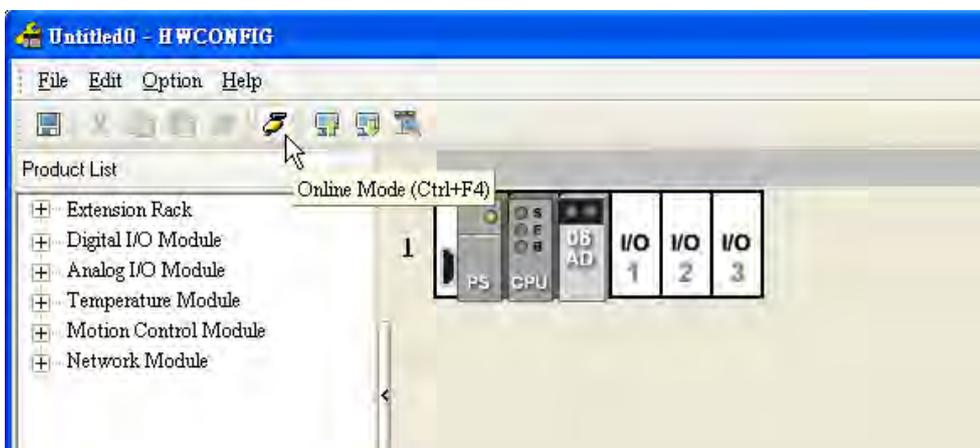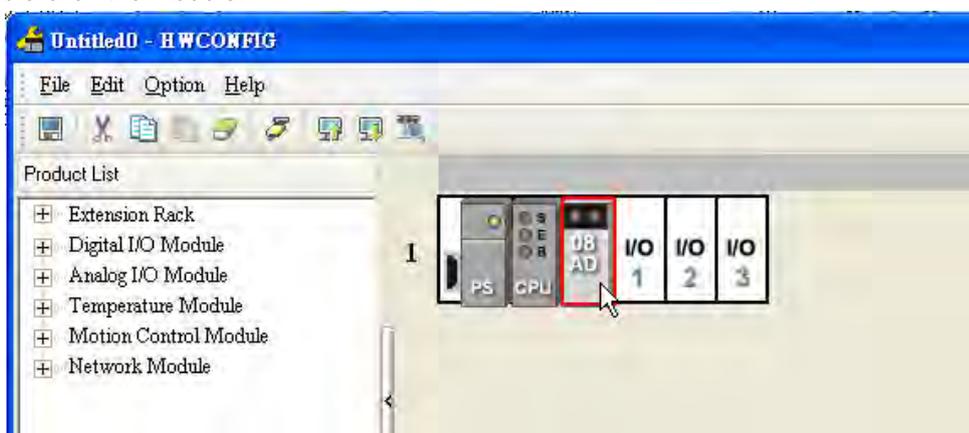
(2) Double-click the module.

(3) If some parameters are altered, users can click **SV→PV**. The new setting values are written into the CPU module and the I/O module. If users want to read the present values in the I/O module, they can click **Refresh**. The present values in the I/O module are sent to ISPSoft, and are monitored.

2.4.5 Importing/Exporting a Parameter File

(1) After **Export** is clicked, the parameters will be saved as a CSV file (.csv).

(2) Click **Import**, and then click the CSV file.

2.4.6 Parameters

(1) The input modes of the channels

Module name	AH04AD-5A	AH08AD-5A	AH08AD-5B	AH08AD-5C
Description	0: The channel is disabled. 1: -10 V~10 V 2: 0 V~10 V 3: -5 V~5 V 4: 0 V~5 V 5: 1 V~5 V 6: 0 mA ~20 mA 7: 4 mA~20 mA 8: -20 mA~20 mA	0: The channel is disabled. 1: -10 V~10 V 2: 0 V~10 V 3: -5 V~5 V 4: 0 V~5 V 5: 1 V~5 V 6: 0 mA ~20 mA 7: 4 mA~20 mA 8: -20 mA~20 mA	0: The channel is disabled. 1: -10 V~10 V 2: 0 V~10 V 3: -5 V~5 V 4: 0 V~5 V 5: 1 V~5 V	0: The channel is disabled. 1: 0 mA~20 mA 2: 4 mA~20 mA 3: -20 mA~20 mA

(2) The number of values averaged

(3) The offsets and the gains used for calibration

(4) The scale range

(5) The channel alarm

Description	Bit 0~bit 7: CH0~CH7 (The physical range detection) (ON: Enable; OFF: Disable) Bit 8~bit 15: CH0~CH7 (Giving an alarm or a warning) (ON: Alarm; OFF: Warning)

(6) Enabling the interrupts

Description	Bit 0~bit 7: CH0~CH7 (The interrupt service routines) (ON: Enable; OFF: Disable)

(7) The interrupt numbers

(8) Setting the warning LED indicator

	Description
Description	Bit 0~bit 7: CH0~CH7 (Warning LED indicator) (ON: Flash; OFF: Not flash)

(9) The conversion flags

	Description
Description	Bit 0~bit 7: The signals received by CH0~CH7 exceed the range of inputs which can be received by the hardware. Bit 15: The external voltage is abnormal.

2.5 Troubleshooting

2.5.1 Error Codes

Error Code	Type	Description	RUN LED indicator	ERROR LED indicator
16#A600	Alarm	Hardware failure	OFF	ON
16#A601	Alarm	The external voltage is abnormal.	OFF	ON
16#A603	Alarm	Internal error The factory correction is abnormal.	OFF	ON
16#A400	Alarm	The signal received by channel 0 exceeds the range of inputs which can be received by the hardware.	OFF	ON
16#A401	Alarm	The signal received by channel 1 exceeds the range of inputs which can be received by the hardware.	OFF	ON
16#A402	Alarm	The signal received by channel 2 exceeds the range of inputs which can be received by the hardware.	OFF	ON
16#A403	Alarm	The signal received by channel 3 exceeds the range of inputs which can be received by the hardware.	OFF	ON
16#A404	Alarm	The signal received by channel 4 exceeds the range of inputs which can be received by the hardware.	OFF	ON
16#A405	Alarm	The signal received by channel 5 exceeds the range of inputs which can be received by the hardware.	OFF	ON
16#A406	Alarm	The signal received by channel 6 exceeds the range of inputs which can be received by the hardware.	OFF	ON
16#A407	Alarm	The signal received by channel 7 exceeds the range of inputs which can be received by the hardware.	OFF	ON
16#A000	Warning	The signal received by channel 0 exceeds the range of inputs which can be received by the hardware.	ON	Blink
16#A001	Warning	The signal received by channel 1 exceeds the range of inputs which can be received by the hardware.	ON	Blink
16#A002	Warning	The signal received by channel 2 exceeds the range of inputs which can be received by the hardware.	ON	Blink
16#A003	Warning	The signal received by channel 3 exceeds the range of inputs which can be received by the hardware.	ON	Blink
16#A004	Warning	The signal received by channel 4 exceeds the range of inputs which can be received by the hardware.	ON	Blink
16#A005	Warning	The signal received by channel 5 exceeds the range of inputs which can be received by the hardware.	ON	Blink

Error Code	Type	Description	RUN LED indicator	ERROR LED indicator
16#A006	Warning	The signal received by channel 6 exceeds the range of inputs which can be received by the hardware.	ON	Blink
16#A007	Warning	The signal received by channel 7 exceeds the range of inputs which can be received by the hardware.	ON	Blink
16#A800	Warning	The signal received by channel 0 exceeds the range of inputs which can be received by the hardware.	ON	OFF
16#A801	Warning	The signal received by channel 1 exceeds the range of inputs which can be received by the hardware.	ON	OFF
16#A802	Warning	The signal received by channel 2 exceeds the range of inputs which can be received by the hardware.	ON	OFF
16#A803	Warning	The signal received by channel 3 exceeds the range of inputs which can be received by the hardware.	ON	OFF
16#A804	Warning	The signal received by channel 4 exceeds the range of inputs which can be received by the hardware.	ON	OFF
16#A805	Warning	The signal received by channel 5 exceeds the range of inputs which can be received by the hardware.	ON	OFF
16#A806	Warning	The signal received by channel 6 exceeds the range of inputs which can be received by the hardware.	ON	OFF
16#A807	Warning	The signal received by channel 7 exceeds the range of inputs which can be received by the hardware.	ON	OFF

2.5.2 Troubleshooting Procedure

Description	Procedure
Hardware failure	Return the module to the factory for repair.
The external voltage is abnormal.	Check whether the external 24 V power supply to the module is normal.
Internal error The factory correction is abnormal.	Please contact the factory.
The signal received by channel 0 exceeds the range of inputs which can be received by the hardware.	Check the signal received by channel 0.
The signal received by channel 1 exceeds the range of inputs which can be received by the hardware.	Check the signal received by channel 1
The signal received by channel 2 exceeds the range of inputs which can be received by the hardware.	Check the signal received by channel 2.
The signal received by channel 3 exceeds the range of inputs which can be received by the hardware.	Check the signal received by channel 3.

Description	Procedure
The signal received by channel 4 exceeds the range of inputs which can be received by the hardware.	Check the signal received by channel 4.
The signal received by channel 5 exceeds the range of inputs which can be received by the hardware.	Check the signal received by channel 5.
The signal received by channel 6 exceeds the range of inputs which can be received by the hardware.	Check the signal received by channel 6.
The signal received by channel 7 exceeds the range of inputs which can be received by the hardware.	Check the signal received by channel 7.

Chapter 3   Analog Output Module AH04DA/AH08DA

Table of Contents

3.1 Overview

An analog output module receives four/eight pieces of 16-bit digital data from a CPU module. The digital data is converted into analog signals (voltages or currents). The analog signals are sent by the four/eight channels on the analog output module.

3.1.1 Characteristics

(1) **A module is selected according to practical application.**

   AH04DA-5A: There are four channels. Outputs sent by a channel can be either voltages or currents.

   AH08DA-5A: There are eight channels. Outputs sent by a channel can be either voltages or currents.

   AH08DA-5B: There are eight channels. Outputs sent by these channels are voltages.

   AH08DA-5C: There are eight channels. Outputs sent by these channels are currents.

(2) **High-speed conversion**

   A digital signal is converted into an analog signal at a speed of 150 μs a channel.

(3) **High accuracy**

   Conversion accuracy: The error is ±0.02% of an output voltage, and ±0.06% of an output current. (The ambient temperature is 25°C. The number of output voltages/currents which are averaged is 100.)

(4) **A scale range can be set by means of software.**

   Users can set a scale range in ISPSoft. A scale range is a range of digital values corresponding to a range of analog values.

(5) **A module can be set by means of utility software.**

   HWCONFIG is built-in utility software in ISPSoft. Users can set modes and parameters in HWCONFIG to complete hardware configuration without spending time writing a program to set registers corresponding to functions.

3.2 Specifications and Functions

3.2.1 Specifications

Electrical specifications

Module name	AH04DA-5A	AH08DA-5A	AH08DA-5B	AH08DA-5C
Number of outputs	4	8	8	8
Analog-to-digital conversion	Voltage output/ Current output	Voltage output/ Current output	Voltage output	Current output
Supply voltage	24 V DC (20.4 V DC~28.8 V DC) (-15%~+20%)			
Connector type	Removable terminal block			
Conversion time	150 μs/channel			
Isolation	An analog circuit is isolated from a digital circuit by a digital integrated circuit/an optocoupler, but the analog channels are not isolated from one another. Isolation between a digital circuit and the ground: 500 V DC Isolation between an analog circuit and the ground: 500 V DC Isolation between an analog circuit and a digital circuit: 500 V DC Isolation between the 24 V DC and the ground: 500 V DC			

Functional specifications

Analog-to-digital conversion	Voltage output				
Rated output range	±10 V	0 V~10 V	±5 V	0 V~5 V	1 V~5 V
Hardware output range	-10.1 V~10.1 V	-0.1 V~10.1 V	-5.05 V~5.05 V	-0.05 V~5.05 V	0.95 V~5.05 V
Fiducial error (Room temperature)	±0.02%				
Fiducial error (Full temperature range)	±0.04%				
Linearity error (Room temperature)	±0.004%				
Linearity error (Full temperature range)	±0.004%				
Hardware resolution	16 bits				
Permissible load impedance	1 kΩ~2 MΩ: ±10 V and 0 V~10 V ≧500 Ω: 1 V~5 V				

Analog-to-digital conversion	Current output	
Rated output range	0 mA~20 mA	4 mA~20 mA
Hardware output range	-0.2 mA~20.2 mA	3.8 mA~20.2 mA
Fiducial error (Room temperature)	±0.06%	
Fiducial error (Full temperature range)	±0.07%	
Linearity error (Room temperature)	±0.01%	
Linearity error (Full temperature range)	±0.01%	
Hardware resolution	16 bits	
Permissible load impedance	≦550 Ω	

3.2.2 Profile

● **AH04DA-5A/AH08DA-5B/AH08DA-5C**

● **AH08DA-5A**

Number	Name	Description
1	Model name	Model name of the module
2	RUN LED indicator	Operating status of the module ON: The module is running. OFF: The module stops running.
2	ERROR LED indicator	Error status of the module ON: A serious error occurs in the module. OFF: The module is normal. Blink: A slight error occurs in the module.
3	Removable terminal block	The outputs are connected to loads which will be driven.
4	Arrangement of the output terminals	Arrangement of the terminals

Number	Name	Description
5	Description of the outputs	Simple specifications for the module
6	Clip	Removing the terminal block
7	Label	Nameplate
8	Set screw	Fixing the module
9	Connector	Connecting the module and a backplane
10	Projection	Fixing the module

3.2.3 Dimensions

● **AH04DA-5A/AH08DA-5B/AH08DA-5C**
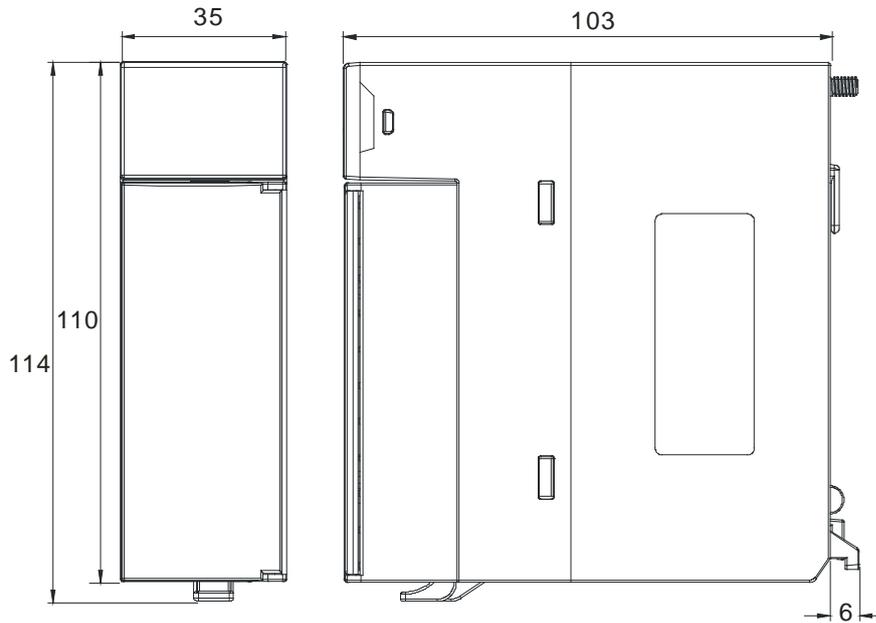
● **AH08DA-5A**
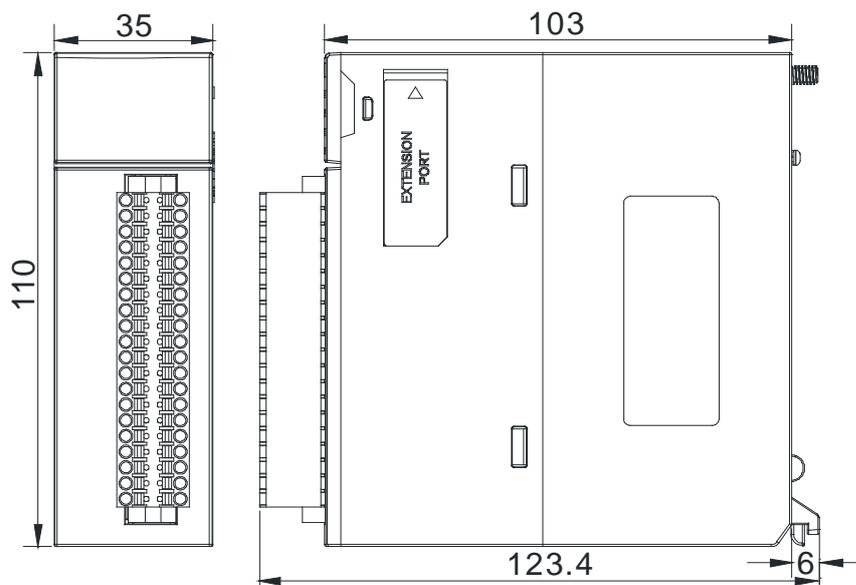
Unit: mm

3.2.4 Arrangement of Terminals

AH04DA-5A	AH08DA-5A	AH08DA-5B	AH08DA-5C

3.2.5 Functions

HWCONFIG, built-in utility software in ISPSoft, can be used to set a module. Users can set modes and parameters by means of HWCONFIG.

Item	Function	Description
1	Enabling/Disabling a channel	1. Users can enable or disable a channel. 2. If a channel is disabled, the total conversion time is decreased.
2	Calibration	Users can calibrate an analog output curve.
3	Scale range	A digital range corresponds to an analog range.
4	Retaining an output	When a module stops running, a signal sent by the module is retained.

1. Enabling/Disabling a channel

A digital signal is converted into an analog signal at a speed of 150 μs a channel. The total conversion time is 150 μs×(the number of channels). If a channel is not used, users can disable it to decrease the total conversion time.

2. Calibration

- To make a curve meet actual needs, users can calibrate the curve by changing an offset and a gain. A calibration range depends on a range of outputs which can be sent by hardware.
- A volt is a unit of calibration for offsets if outputs sent are voltages. A milliampere is a unit of calibration for offsets if outputs sent are currents.
- The range of offsets used for calibration is -1.0~1.0, and the range of gains used for calibration is 0.9~1.1.

Example 1:

The outputs sent by a channel are voltages in the range of -10.0 V to +10.0 V. The original signals are used. The gain is 1, and the offset is 0. The digital value received by the channel is 0, and the voltage measured is -0.05 V. The digital value received by the channel is 10, and the voltage measured is 9.95 V. Users can calibrate the channel by calibrating the gain and the offset.

The users can get the gain for the calibration by means of the equations below.
Gain=(Y2-Y1)/(X2-X1)=[9.95-(-0.05)]/(10-0)=1
Gain used for calibration=1/Gain=1/1=1

The users can get the offset for the calibration by means of the equations below.
Offset=Y1= -0.05
Offset used for calibration=0-Y1=0.05

(X: Digital value; Y: Analog signal)

Example 2:

The outputs sent by a channel are voltages in the range of -10.0 V to +10.0 V. The original signals are used. The gain is 1, and the offset is 0. The digital value received by the channel is 0, and the voltage measured is 0 V. The digital value received by the channel is 10, and the voltage measured is 10.1 V. Users can calibrate the channel by calibrating the gain and the offset.

The users can get the gain for the calibration by means of the equations below.
Gain=(Y2-Y1)/(X2-X1)=[10.1-0]/(10-0)=1.01
Gain used for calibration=1/Gain=1/1.01=0.99

The users can get the offset for the calibration by means of the equations below.
Offset=Y1=0
Offset used for calibration=0-Y1=0

(X: Digital value; Y: Analog signal)

3. Scale range

The analog output mode of a channel has a corresponding digital range. Digital values correspond to analog outputs sent by a module. For example, if the analog range is -10 V~10 V and the digital range is -10.0~10.0, the digital values -10.0~10.0 correspond to the analog values -10 V~10 V.

4. Retaining an output

When a module stops running, a signal sent by the module is retained.

The output is not retained:

Analog signal

Output signal

The module stops running.

Time

The output is retained:

Analog signal

Output signal

Time

The module stops running.

3.3 Installation

3.3.1 Installing a Module

Insert a module into a slot, make sure that the module is installed on the backplane properly, and tighen the the screw, as illustrated below.

1. Insert the projection under the module into the hole in the backplane.
2. Push the module in the direction indicated by the arrow until it clicks.

- **AH04DA-5A/AH08DA-5B/AH08DA-5C**
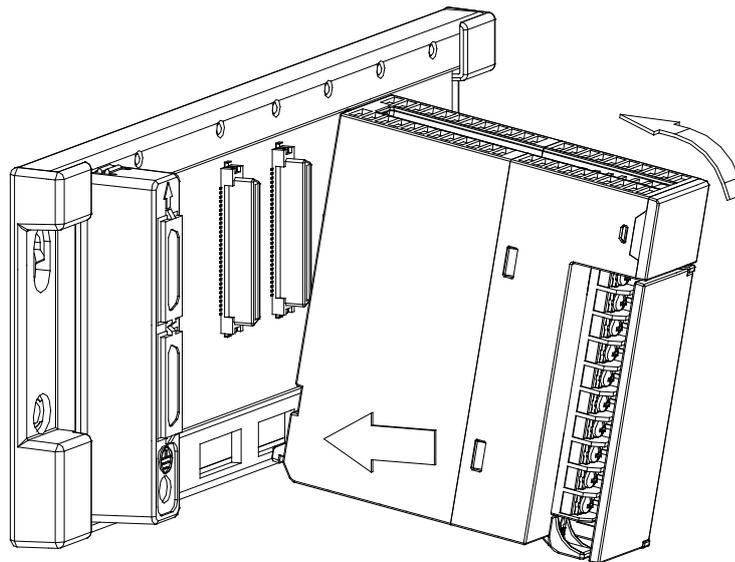
- **AH08DA-5A**

3. Tighten the screw on the module.

● **AH04DA-5A/AH08DA-5B/AH08DA-5C**
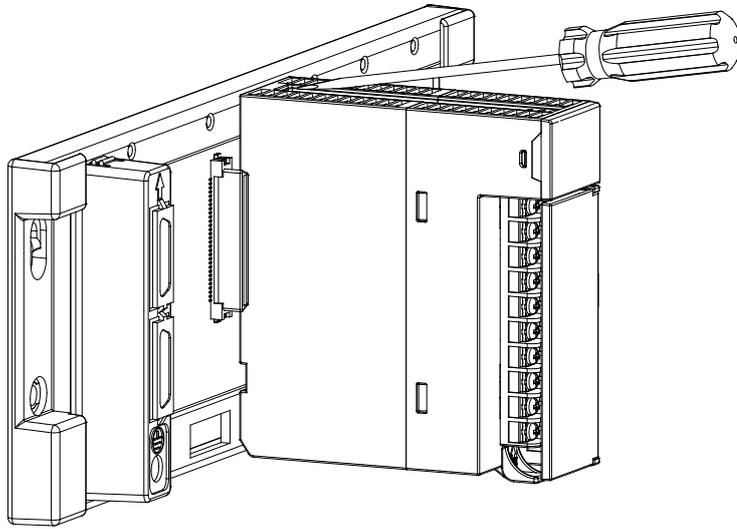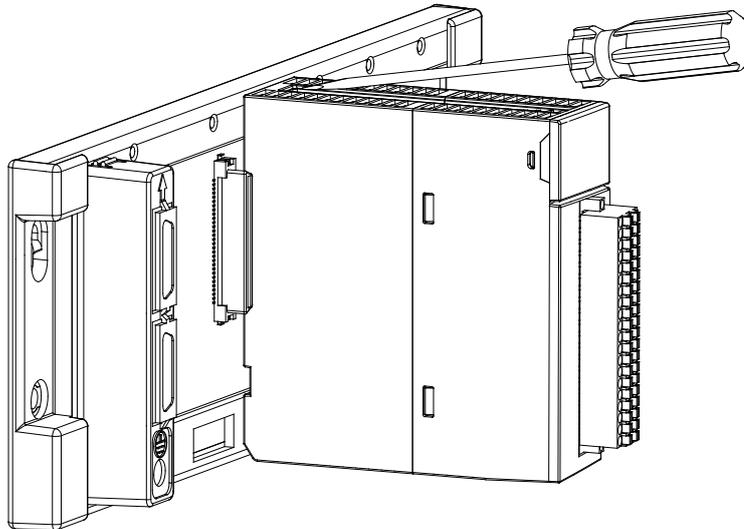
● **AH08DA-5A**

3.3.2 Installing a Removable Terminal Block

● **Installation**

   1. Level a terminal block at the printed circuit board, and press it into the module.

● **AH04DA-5A/AH08DA-5B/AH08DA-5C**

● **AH08DA-5A**

2. Press the clip in the direction indicated by the arrow, or use a slotted screwdriver to tighten the screws on the two sides of the high-density terminal block.

● **AH04DA-5A/AH08DA-5B/AH08DA-5C**	● **AH08DA-5A**

● **Removal**

1. Pull the clip in the direction indicated by the arrow, or use a slotted screwdriver to loosen the screws on the two sides of the high-density terminal block.

● **AH04DA-5A/AH08DA-5B/AH08DA-5C**

● **AH08DA-5A**

2. Pull up the clip.

● **AH04DA-5A/AH08DA-5B/AH08DA-5C**

● **AH08DA-5A**

3. The terminal block is removed.

● AH04DA-5A/AH08DA-5B/AH08DA-5C	● AH08DA-5A
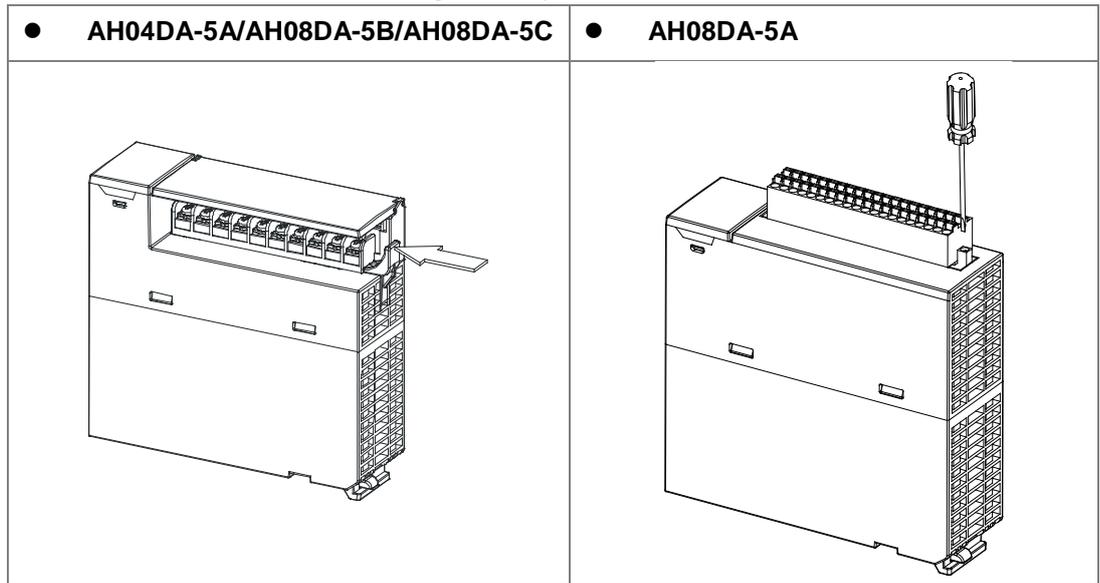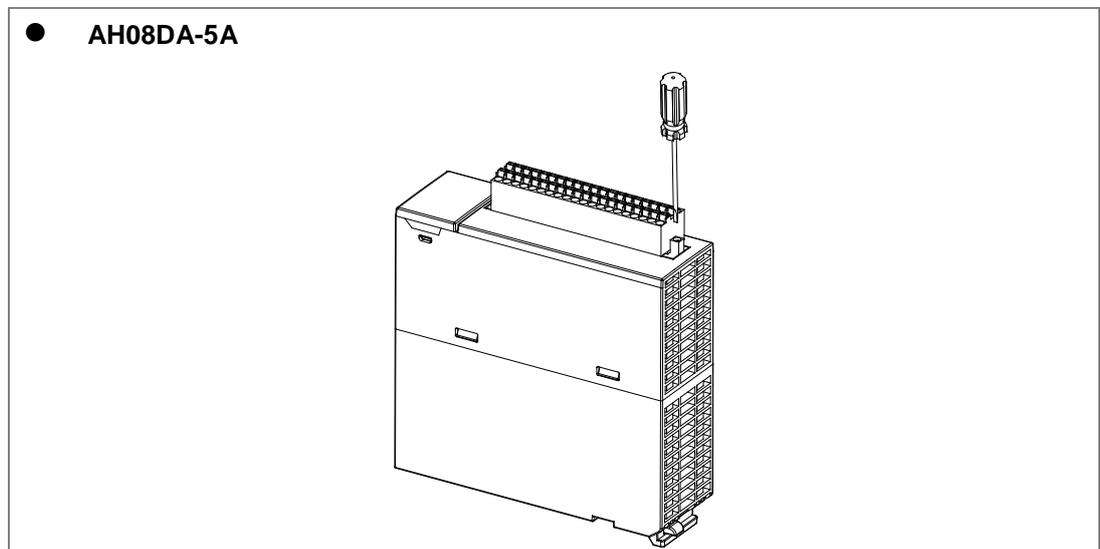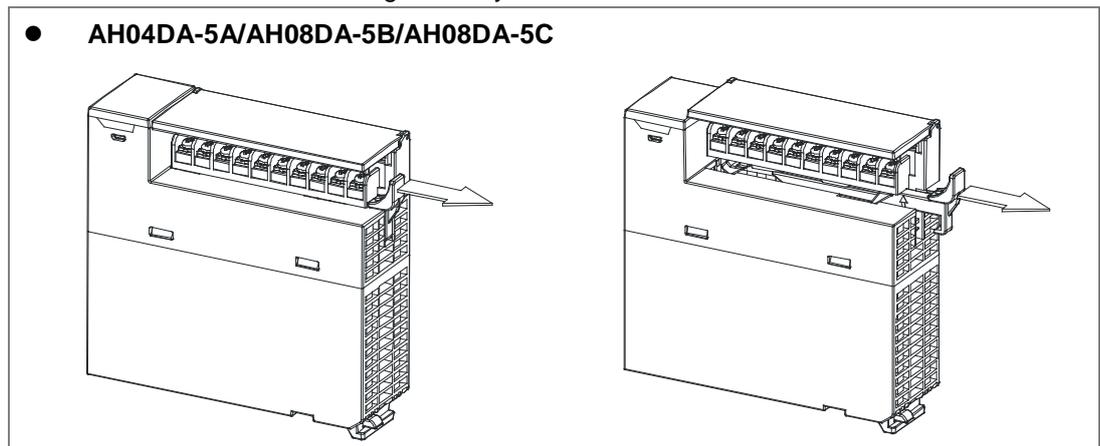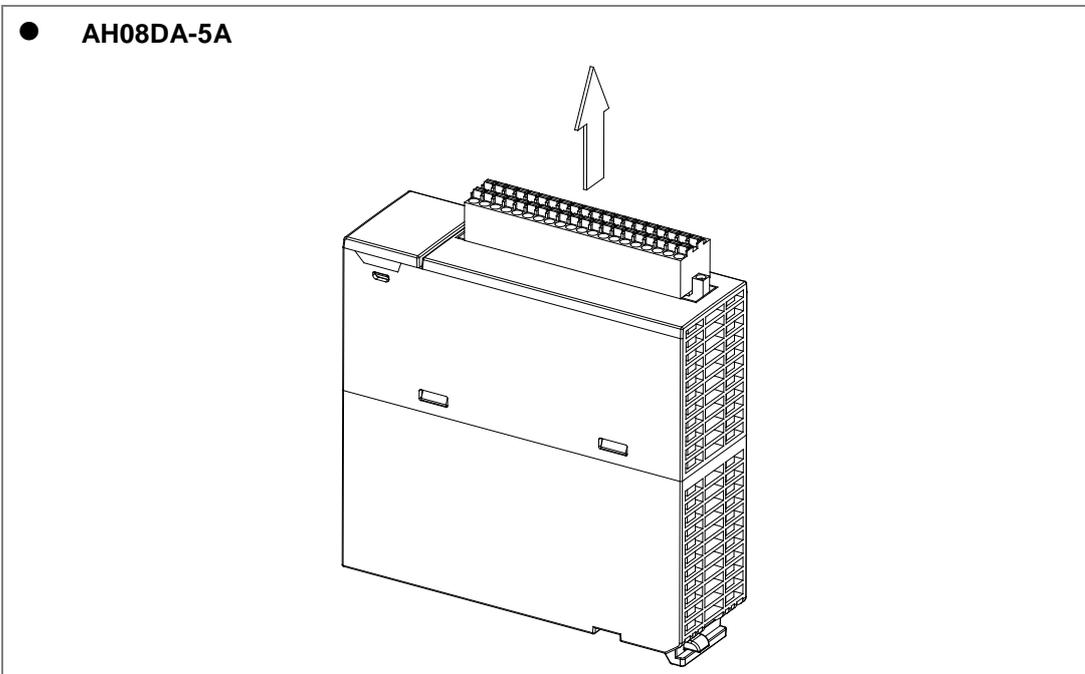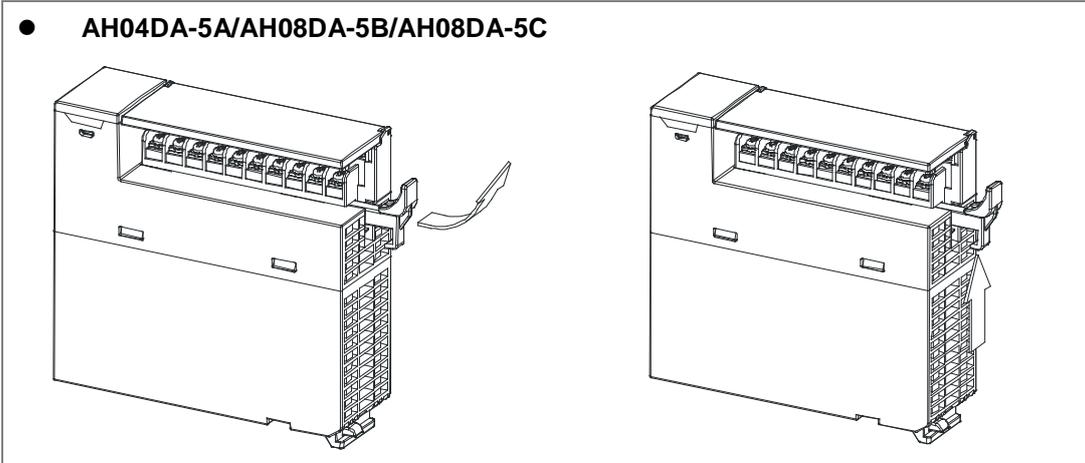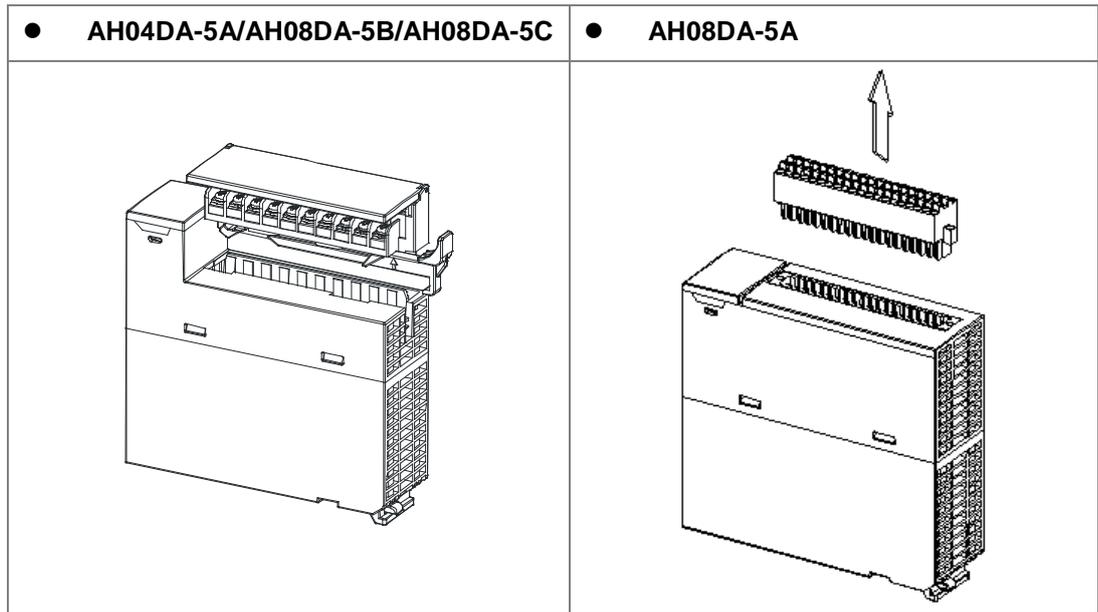
3.3.3 Wiring

● **Precautions**

In order to make the functions of a digital-to-analog module perfect and ensure the reliability of a system at the same time, external wiring which prevents noise is necessary. Before installing cables, users need to follow the precautions below.

(1) To prevent a surge and induction, an AC cable and the output signal cables which are connected to AH04DA-5A/AH08DA-5A/AH08DA-5B/AH08DA-5C must be separate cables.

(2) A cable must not be installed near a main circuit, a high-voltage cable, or a cable connected to a load which is not a PLC. Besides, a cable must not be bound to a main circuit, a high-voltage cable, or a cable connected to a load which is not a PLC. Otherwise, effects that noise, induction, and a surge have will increase.

(3) Please connect a shielded cable and a hermetically sealed cable with the ground separately.

(4) Terminals with insulation sleeves can not be arranged as a terminal block. It is recommended that the terminals be covered with insulation tubes.

(5) Please connect 30 to 24 AWG (0.3 to 0.6 mm) wires to the input/output terminals. The lengths of the plastic jackets which are removed from the cables used should be in the range of 7 mm to 8 mm. The specifications for the terminals and the wiring of the terminals are shown below. Only copper leads which can resist the heat above 60°C can be used.

(6) Use cables with the same length (less than 200 m) and use wire resistance of less than 100 ohm.

● **External wiring**
(1) AH04DA-5A/AH08DA-5A
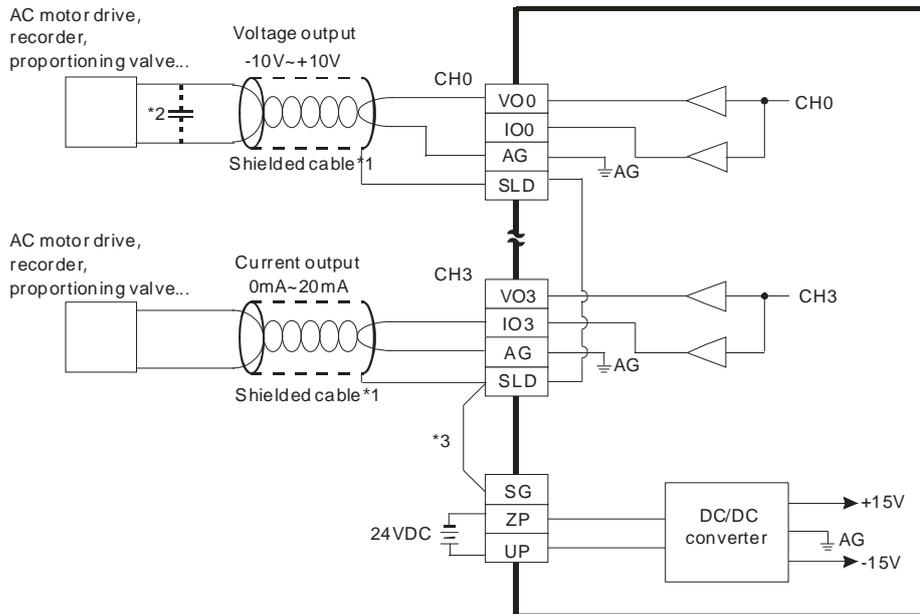
*1. Please use a shielded cable as an analog output cable, and isolate the shielded cable from other power cables.
*2. If the ripple voltage of the input terminal of the load connected is large, and results in interference with the wiring, please connect a 0.1~0.47 µF and 25 V capacitor.
*3. Please connect the terminal SLD to the terminal SG. Once AH04DA-5A/AH08DA-5A is installed on a backplane, the connection between the terminal SG on AH04DA-5A/AH08DA-5A and the terminal ⊕ on the backplane will be a short circuit. Please connect the terminal ⊕ on the backplane to the ground terminal ⊕.

(2) AH08DA-5B
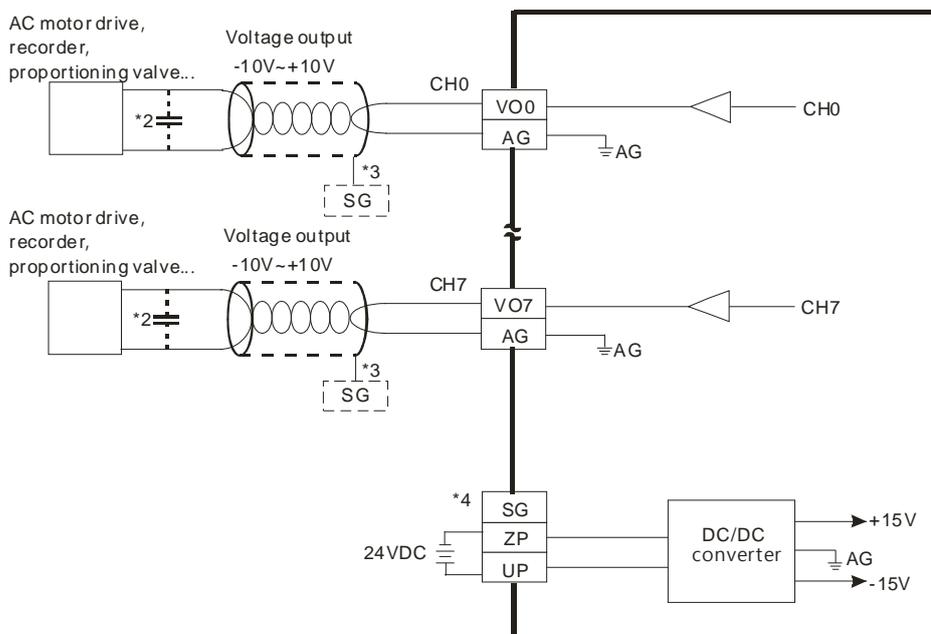
*1. Please use a shielded cable as an analog output cable, and isolate the shielded cable from other power cables.
*2. If the ripple voltage of the input terminal of the load connected is large, and results in interference with the wiring, please connect a 0.1~0.47 µF and 25 V capacitor.

*3. Please connect the ground in the shielded cable to the terminal SG.

*4. Once AH08DA-5B is installed on a backplane, the connection between the terminal SG on AH08DA-5B and the terminal ⊕ on the backplane will be a short circuit. Please connect the terminal ⊕ on the backplane to the ground terminal ⏚.

(3) AH08DA-5C
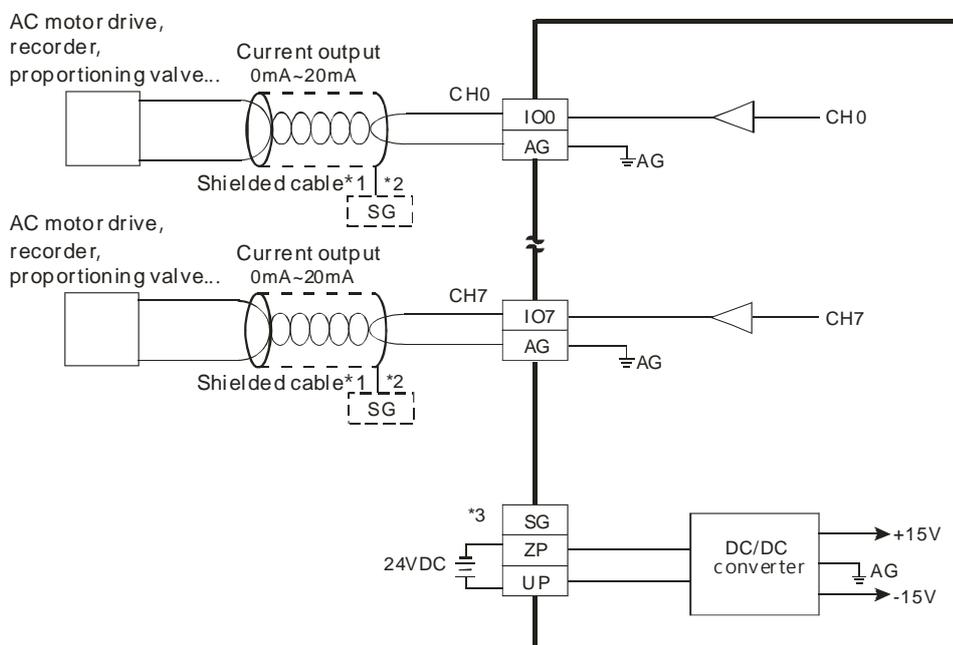
*1. Please use a shielded cable as an analog output cable, and isolate the shielded cable from other power cables.

*2. Please connect the ground in the shielded cable to the terminal SG.

*3. Once AH08DA-5C is installed on a backplane, the connection between the terminal SG on AH08DA-5C and the terminal ⊕ on the backplane will be a short circuit. Please connect the terminal ⊕ on the backplane to the ground terminal ⏚.

3.3.4 LED Indicators

Number	Name	Description
1	RUN LED indicator	Operating status of the module ON: The module is running. OFF: The module stops running.
2	ERROR LED indicator	Error status of the module ON: A serious error occurs in the module. OFF: The module is normal. Blink: A slight error occurs in the module.

3.4 HWCONFIG in ISPSoft

3.4.1 Initial Setting
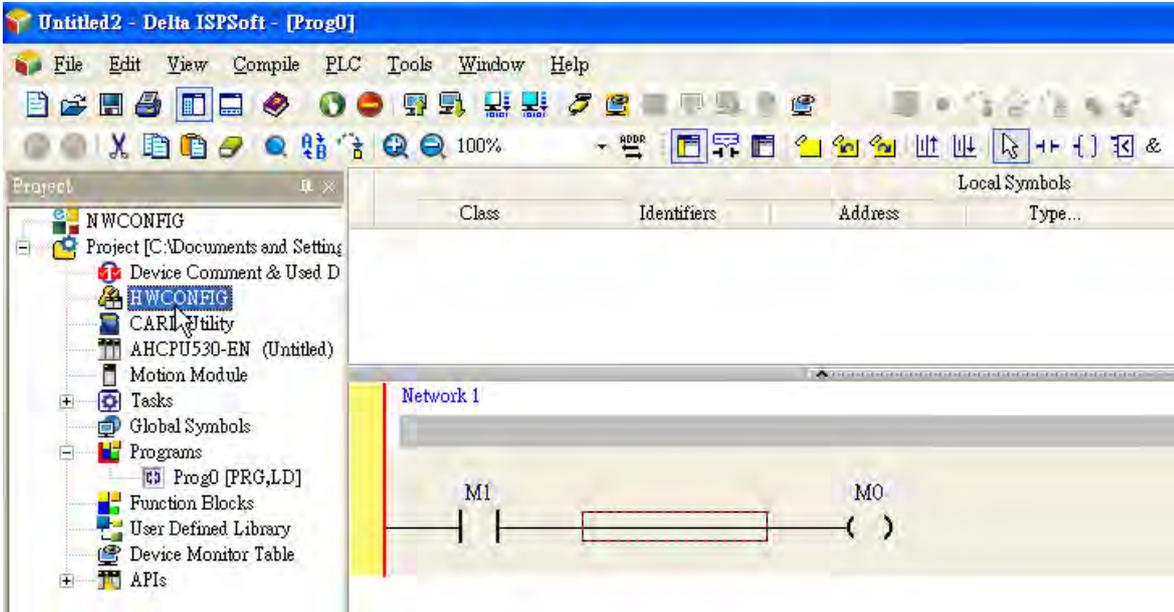
(1) Start ISPSoft, and then double-click **HWCONFIG**.

(2) Click **I/O scan** on the toolbar.
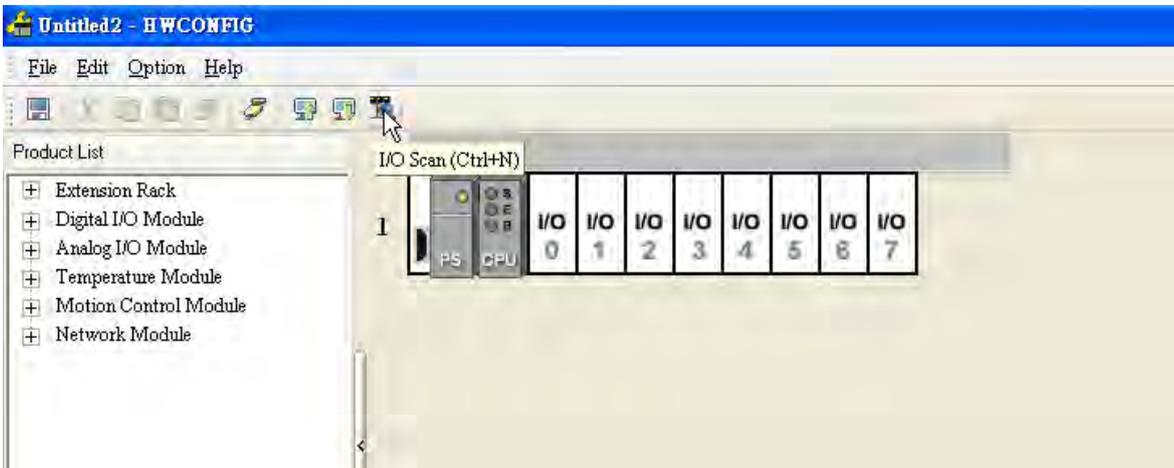
(3) ISPSoft is scanning the actual hardware configuration.
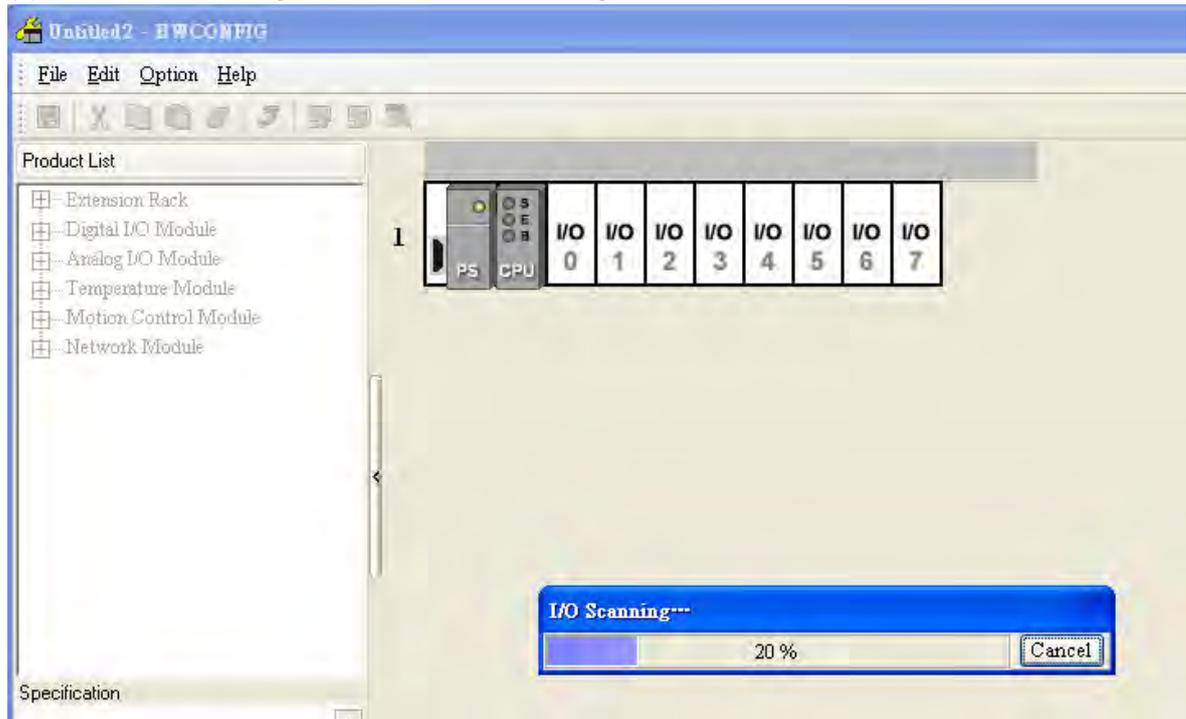
(4) After the scan of the actual hardware configuration is complete, the system automatically assigns the corresponding registers to the channels. Users can alter the output device range by themselves.

Note: Owing to the fact that values are floating-point numbers, every channel occupies two 16-bit registers.

Slot No.	Label	Firmware Versi...	Descrption	Input Device Ra...	Output Device R...	Comment
-	AHPS05-5A	-	AH Power Supply	None	None	
-	AHCPU530-EI	1.00	Basic CPU module	None	None	
0	AH08DA-5C	1.00	8 x AO 16 bit		D0 ~ D15	
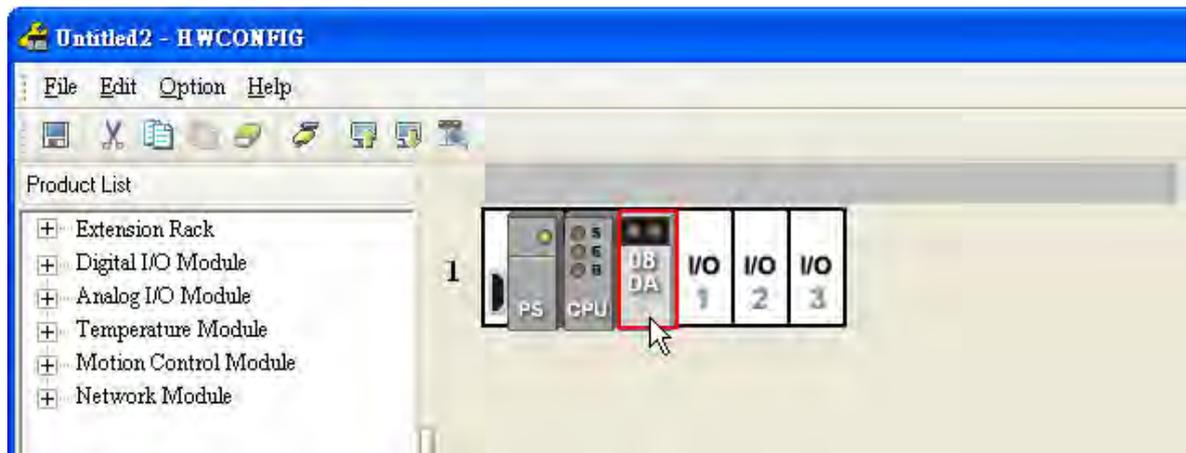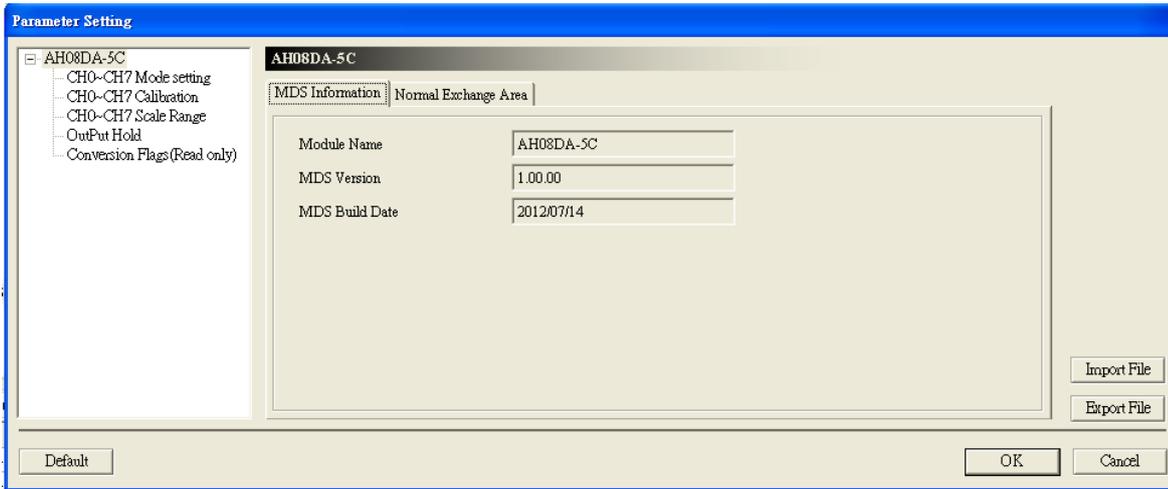
Information: Rack 1

(5) Double-click the module.

(6) Open the **Parameter Setting** window.

(7) Set the parameters, and then click **OK**.
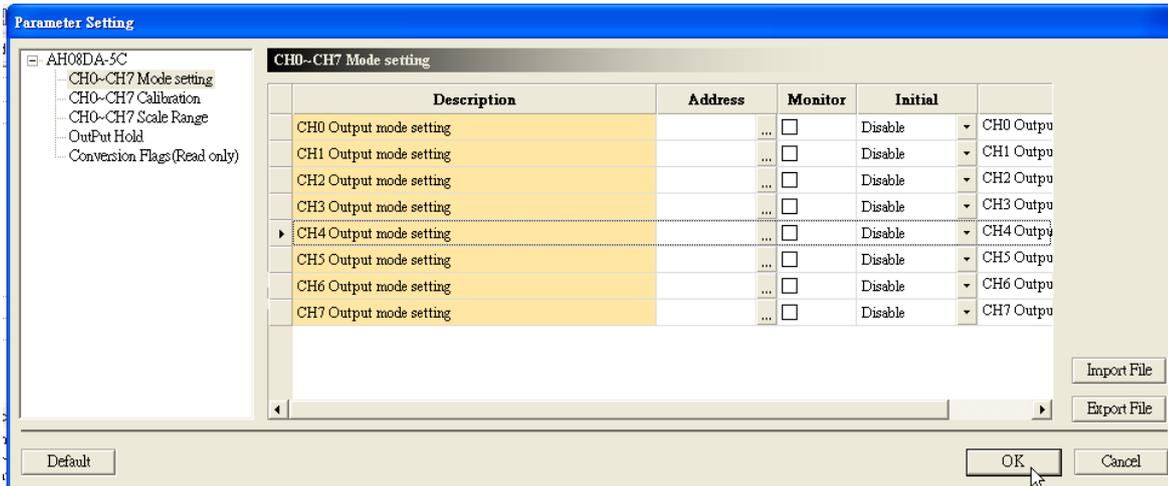
(8) Click **Download** on the toolbar to download the parameters. (The parameters can not be downloaded when the CPU module runs.)
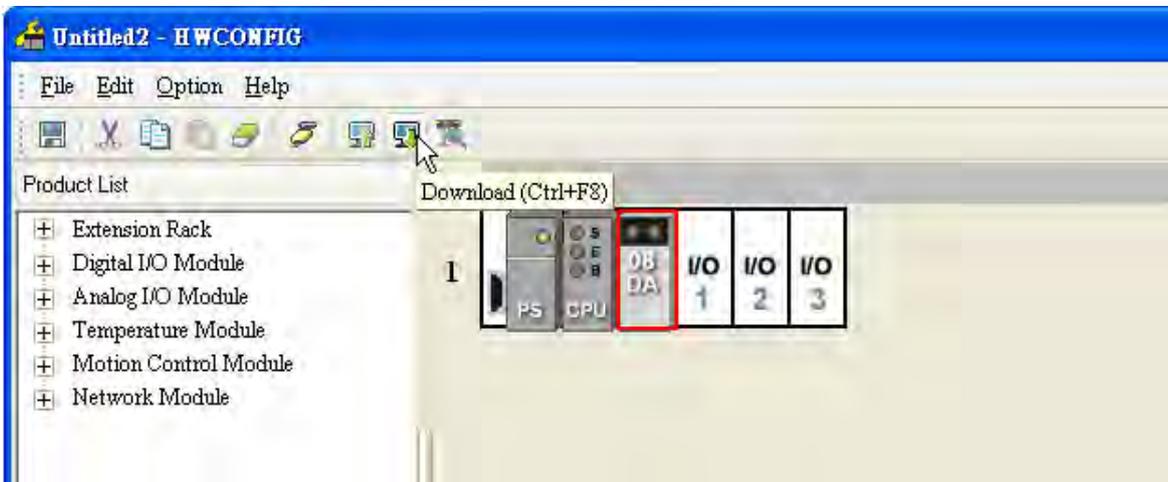
3.4.2 Checking the Version of a Module
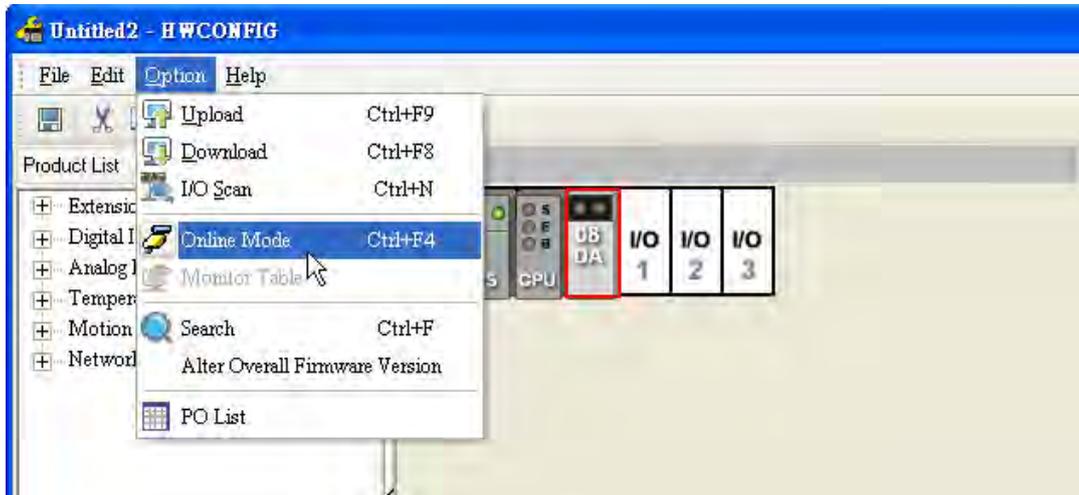
(1) On the **Option** menu, click **Online Mode**.

(2) Right-click the module, and then click **Module Information** on the context menu. The version of the firmware and that of the hardware are displayed.

3.4.3 Monitoring Table

(1) Select the **Monitor** checkboxes at the right sides of the corresponding registers.

(2) On the **Option** menu, click **Online Mode**.

(3) On the **Option** menu, click **Monitor Table**. The registers are monitored.

3.4.4 Online Mode

(1) Click **Online Mode** on the toolbar.

(2) Double-click the module.

(3) If some parameters are altered, users can click **SV➔PV**. The new setting values are written into the CPU module and the I/O module. If users want to read the present values in the I/O module, they can click **Refresh**. The present values in the I/O module are sent to ISPSoft, and are monitored.

3.4.5 Importing/Exporting a Parameter File

(1) After **Export** is clicked, the parameters will be saved as a CSV file (.csv).

08DA-5C.csv
Microsoft Office Excel Comma Separated Values File
1 KB

(2) Click **Import**, and then click the CSV file.

3.4.6 Parameters

(1) The output modes of the channels
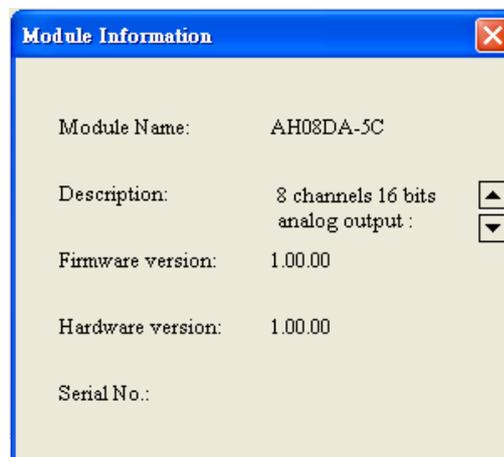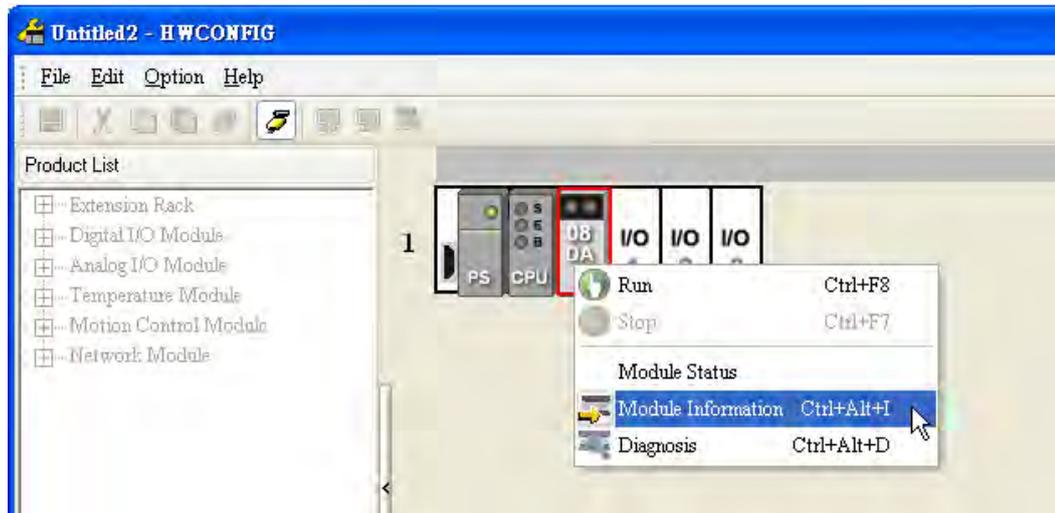
	Description	Address	Monitor	Initial	
	CH0 Output mode setting		☐	0mA~20mA ▾	CH0 Outpu
▸	CH1 Output mode setting		☐	Disable ▾	CH1 Outpu
	CH2 Output mode setting		☐	Disable ▾	CH2 Outpu
	CH3 Output mode setting		☐	Disable ▾	CH3 Outpu
	CH4 Output mode setting		☐	Disable ▾	CH4 Outpu
	CH5 Output mode setting		☐	Disable ▾	CH5 Outpu
	CH6 Output mode setting		☐	Disable ▾	CH6 Outpu
	CH7 Output mode setting		☐	Disable ▾	CH7 Outpu

Module name	AH04DA-5A	AH08DA-5A	AH08DA-5B	AH08DA-5C
Description	0: The channel is disabled. 1: -10 V~10 V 2: 0 V~10 V 3: -5 V~5 V 4: 0 V~5 V 5: 1 V~5 V 6: 0 mA~20 mA 7: 4 mA~20 mA	0: The channel is disabled. 1: -10 V~10 V 2: 0 V~10 V 3: -5 V~5 V 4: 0 V~5 V 5: 1 V~5 V 6: 0 mA~20 mA 7: 4 mA~20 mA	0: The channel is disabled. 1: -10 V~10 V 2: 0 V~10 V 3: -5 V~5 V 4: 0 V~5 V 5: 1 V~5 V	0: The channel is disabled. 1: 0 mA~20 mA 2: 4 mA~20 mA

(2) The offsets and the gains used for calibration

CH0~CH7 Calibration

Description	Address	Monitor	Initial	
▶ CH0 Cal. Offset (V/mA)	...	☐	0.000000	CH0 Ca
CH1 Cal. Offset (V/mA)	...	☐	0.000000	CH1 Ca
CH2 Cal. Offset (V/mA)	...	☐	0.000000	CH2 Ca
CH3 Cal. Offset (V/mA)	...	☐	0.000000	CH3 Ca
CH4 Cal. Offset (V/mA)	...	☐	0.000000	CH4 Ca
CH5 Cal. Offset (V/mA)	...	☐	0.000000	CH5 Ca
CH6 Cal. Offset (V/mA)	...	☐	0.000000	CH6 Ca
CH7 Cal. Offset (V/mA)	...	☐	0.000000	CH7 Ca
CH0 Cal. Gain	...	☐	1.000000	CH0 Ca
CH1 Cal. Gain	...	☐	1.000000	CH1 Ca
CH2 Cal. Gain	...	☐	1.000000	CH2 Ca

(3) The scale range

CH0~CH7 Scale Range

Description	Address	Monitor	Initial	
▶ CH0 Scale LSP	...	☐	0.000000	CH0 Sc
CH1 Scale LSP	...	☐	0.000000	CH1 Sc
CH2 Scale LSP	...	☐	0.000000	CH2 Sc
CH3 Scale LSP	...	☐	0.000000	CH3 Sc
CH4 Scale LSP	...	☐	0.000000	CH4 Sc
CH5 Scale LSP	...	☐	0.000000	CH5 Sc
CH6 Scale LSP	...	☐	0.000000	CH6 Sc
CH7 Scale LSP	...	☐	0.000000	CH7 Sc
CH0 Scale HSP	...	☐	100.000000	CH0 Sc
CH1 Scale HSP	...	☐	100.000000	CH1 Sc
CH2 Scale HSP	...	☐	100.000000	CH2 Sc

(4) Retaining the outputs

OutPut Hold					
	Description	Address	Monitor	Initial	
▶	CH0 Output Hold	...	☐	☐ Hold	CH0 Ou
	CH1 Output Hold		☐	☐ Hold	CH1 Ou
	CH2 Output Hold		☐	☐ Hold	CH2 Ou
	CH3 Output Hold		☐	☐ Hold	CH3 Ou
	CH4 Output Hold		☐	☐ Hold	CH4 Ou
	CH5 Output Hold		☐	☐ Hold	CH5 Ou
	CH6 Output Hold		☐	☐ Hold	CH6 Ou
	CH7 Output Hold		☐	☐ Hold	CH7 Ou
			☐	☐	
			☐	☐	
			☐	☐	

Description	Bit 0~bit 7: Retaining the outputs sent by CH0~CH7 (ON: The output is retained. OFF: The output is cleared.)

(5) The error codes

Conversion Flags(Read only)					
	Description	Address	Monitor	Initial	
▶	Conversion Flags(Read only)	...	☐	0	Conversion

Description	Bit 0~bit 14: Reserved Bit 15: The external voltage is abnormal.

3.5 Troubleshooting

3.5.1 Error Codes

Error Code	Type	Description	RUN LED indicator	ERROR LED indicator
16#A600	Error	Hardware failure	OFF	ON
16#A601	Error	The external voltage is abnormal.	OFF	ON

3.5.2 Troubleshooting Procedure

Description	Procedure
Hardware failure	Return the module to the factory for repair.
The external voltage is abnormal.	Check whether the external 24 V power supply to the module is normal.

MEMO

Chapter 4   Analog Input/Output Module AH06XA

Table of Contents

4.1 Overview

The specifications for an analog input/output module, the operation, and the programming are described in this chapter. Analog signals (voltages or currents) are received by four channels on an analog input/output module, and are converted into 16-bit digital signals. Besides, the analog input/output module receives two pieces of 16-bit digital data from a CPU module. The digital data is converted into analog signals (voltages or currents). The analog signals are sent by two channels on the analog input/output module.

4.1.1 Characteristics

(1) **AH06XA-5A, an analog input/output module, is used according to practical application.**
CH0~CH3: Inputs received by a channel can be either voltages or currents.
CH4~CH5: Outputs sent by a channel can be either voltages or currents.

(2) **High-speed conversion**
The conversion speed is 150 μs a channel.

(3) **High accuracy**
Conversion accuracy: (The ambient temperature is 25°C. The number of output voltages/currents which are averaged is 100.)
Input: The error is ±0.1% of an input voltage, and ±0.1% of an input current.
Output: The error is ±0.02% of an output voltage, and ±0.06% of an output current.

(4) **A scale range can be set by means of software.**
Users can set a scale range in ISPSoft. A scale range is a range of digital values to which a range of analog values corresponds, or a range of digital values corresponding to a range of analog values.

(5) **A module can be set by means of utility software.**
HWCONFIG is built-in utility software in ISPSoft. Users can set modes and parameters in HWCONFIG to complete hardware configuration without spending time writing a program to set registers corresponding to functions.

4.2 Specifications and Functions

4.2.1 Specifications

Electrical specifications

| Module name	AH06XA-5A
Number of analog inputs/outputs	4 inputs 2 outputs
Analog-to-digital conversion	Voltage input/Current input/Voltage output/Current output
Supply voltage	24 V DC (20.4 V DC~28.8 V DC) (-15%~+20%)
Connector type	Removable terminal block
Conversion time	150 us/channel
Isolation	An analog circuit is isolated from a digital circuit by a digital integrated circuit/an optocoupler, but the analog channels are not isolated from one another. Isolation between a digital circuit and the ground: 500 V DC Isolation between an analog circuit and the ground: 500 V DC Isolation between an analog circuit and a digital circuit: 500 V DC Isolation between the 24 V DC and the ground: 500 V DC

Functional specifications for the analog-to-digital conversion

Analog-to-digital conversion	Voltage input				
Rated input range	-10 V~10 V	0 V~10 V	±5 V	0 V~5 V	1 V~5 V
Hardware input range	-10.1 V~ 10.1 V	-0.1 V~ 10.1 V	-5.05 V~ 5.05 V	-0.05 V~ 5.05 V	0.95 V~ 5.05 V
Fiducial error (Room temperature)	±0.1%				
Fiducial error (Full temperature range)	±0.45%				
Linearity error (Room temperature)	±0.07%				
Linearity error (Full temperature range)	±0.12%				
Hardware resolution	16 bits				
Input impedance	>1MΩ				
Absolute input range	±15 V				

Analog-to-digital conversion	Current input		
Rated input range	±20 mA	0 mA~20 mA	4 mA~20 mA
Hardware input range	-20.2 mA~20.2 mA	-0.2 mA~20.2 mA	3.8 mA~20.2 mA
Fiducial error (Room temperature)	±0.1%		
Fiducial error (Full temperature range)	±0.2%		
Linearity error (Room temperature)	±0.05%		
Linearity error (Full temperature range)	±0.23%		
Hardware resolution	16 bits		
Input impedance	250 Ω		
Absolute input range	±32 mA		

Functional specifications for the digital-to-analog conversion

Digital-to-analog conversion	Voltage output				
Rated output range	±10 V	0V~10 V	±5 V	0 V~5 V	1 V~5 V
Hardware output range	-10.1 V~ 10.1 V	-0.1 V~ 10.1 V	-5.05 V~ 5.05 V	-0.05 V~ 5.05 V	0.95 V~ 5.05 V
Fiducial error (Room temperature)	±0.02%				
Fiducial error (Full temperature range)	±0.04%				
Linearity error (Room temperature)	±0.004%				
Linearity error (Full temperature range)	±0.004%				
Hardware resolution	16 bits				
Permissible load impedance	1 kΩ~2 MΩ: ±10 V and 0 V~10 V ≥500 Ω: 1 V~5 V				

Digital-to-analog conversion	Current output	
Rated output range	0 mA~20 mA	4 mA~20 mA
Hardware output range	-0.2 mA~20.2 mA	3.8 mA~20.2 mA
Fiducial error (Room temperature)	±0.06%	
Fiducial error (Full temperature range)	±0.07%	
Linearity error (Room temperature)	±0.01%	
Linearity error (Full temperature range)	±0.01%	
Hardware resolution	16 bits	
Permissible load impedance	≦550 Ω	

4.2.2 Profile

Number	Name	Description
1	Model name	Model name of the module
2	RUN LED indicator	Operating status of the module ON: The module is running. OFF: The module stops running.
2	ERROR LED indicator	Error status of the module ON: A serious error occurs in the module. OFF: The module is normal. Blink: A slight error occurs in the module.
3	Removable terminal block	The inputs are connected to transducers. The outputs are connected to loads which will be driven.
4	Arrangement of the input/output terminals	Arrangement of the terminals
5	Description of the inputs/outputs	Simple specifications for the module
6	Clip	Removing the terminal block
7	Label	Nameplate
8	Set screw	Fixing the module
9	Connector	Connecting the module and a backplane
10	Projection	Fixing the module

4.2.3 Dimensions

Unit: mm
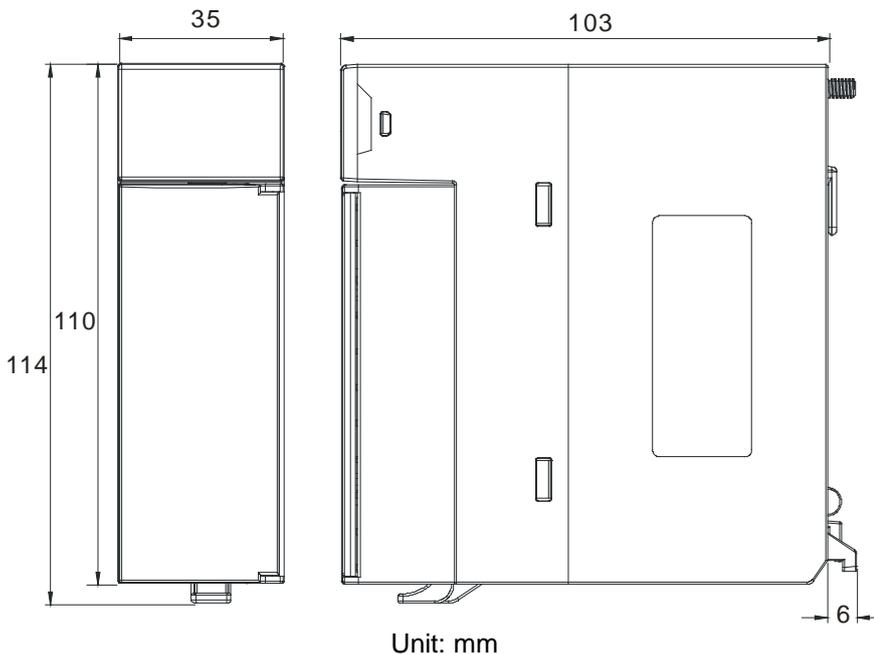
4.2.4 Arrangement of Terminals
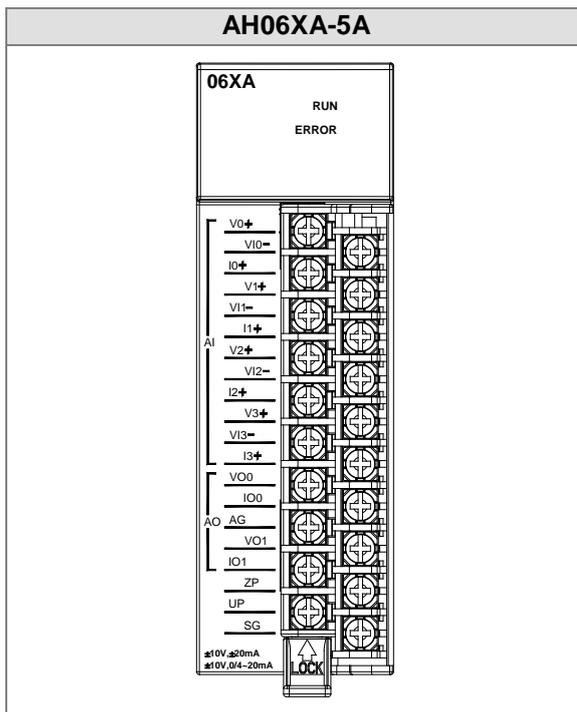
4.2.5 Functions

HWCONFIG, built-in utility software in ISPSoft, can be used to set a module. Users can set modes and parameters by means of HWCONFIG.

➢ **Analog input**

Item	Function	Description
1	Enabling/Disabling a channel	1. Users can enable or disable a channel. 2. If a channel is disabled, the total conversion time is decreased.
2	Calibration	Users can calibrate a linear curve.
3	Average	Conversion values are averaged and filtered.
4	Scale range	An analog range corresponds to a digital range.
5	Disconnection detection	Only if the analog rang is 4 mA~20 mA or 1 V~5 V does the disconnection detection function.
6	Channel detection	If an input signal exceeds a range of inputs which can be received by hardware, the module will give an alarm or a warning. a. Warning LED indicator: When a warning occurs, the ERROR LED indicator blinks or does not blink. b. Interrupt: An interrupt service routine is enabled.

1. Enabling/Disabling a channel

The conversion speed is 150 μs a channel, and the total conversion time is 150 μs×(the number of channels). If a channel is not used, users can disable it to decrease the total conversion time.

2. Calibration

● To make a curve meet actual needs, users can calibrate the curve by changing an offset and a gain. A calibration range depends on a range of inputs which can be sent by hardware.

● A volt is a unit of calibration for offsets if inputs received or outputs sent are voltages. A milliampere is a unit of calibration for offsets if inputs received or outputs sent are currents.

● The range of offsets used for calibration is -1.0~1.0, and the range of gains used for calibration is 0.9~1.1.

Example 1:

The inputs received by a channel are voltages in the range of -10.0 V to +10.0 V. The original signals are used. The gain is 1, and the offset is 0. If the voltage received by the channel is 0 V, the digital value is -0.05. If the voltage received by the channel is 10.0 V, the digital value is 9.95. Users can calibrate the channel by calibrating the gain and the offset.

The users can get the gain for the calibration by means of the equations below.
Gain=(Y2-Y1)/(X2-X1)=[9.95-(-0.05)]/(10-0)=1
Gain used for calibration=1/Gain=1/1=1

The users can get the offset for the calibration by means of the equations below.
Offset=Y1= -0.05
Offset used for calibration=0-Y1=0.05

(X: Analog signal; Y: Digital value)

Example 2:

The inputs received by a channel are voltages in the range of -10.0 V to +10.0 V. The original signals are used. The gain is 1, and the offset is 0. If the voltage received by the channel is 0 V, the digital value is 0.0. If the voltage received by the channel is 10.0 V, the digital value is 10.1. Users can calibrate the channel by calibrating the gain and the offset.

The users can get the gain for the calibration by means of the equations below.
Gain=(Y2-Y1)/(X2-X1)=[10.1-0]/(10-0)=1.01
Gain used for calibration=1/Gain=1/1.01=0.99
The users can get the offset for the calibration by means of the equations below.
Offset=Y1=0
Offset used for calibration=0-Y1=0

(X: Analog signal; Y: Digital value)

3. Average

Digital values are averaged. The number by which the sum of several digital values is divided is between 1 and 100. The sampled values are taken as a queue, and the length of the queue is N. Each time a new sampled value is put at the end of the queue, an original value at the start of the queue is removed. The N values are averaged so that the periodic noise is suppressed.

4. Scale range

The analog input mode of a channel has a corresponding digital range, that is, an analog range corresponds to a digital range. For example, if the analog range is -10V~10V and the digital range is -10.0~10.0, the analog values -10 V~10 V correspond to the digital values -10.0~10.0.

5. Disconnection detection

Only if the analog rang is 4 mA~20 mA or 1 V~5 V does the disconnection detection function. If a module which can receive inputs ranging from 4 mA to 20 mA or from1 V to 5V is disconnected, an input signal will exceed the range of inputs which can be received by the hardware, and the module will give an alarm or a warning. Please refer to the description below for more information.

6. Channel detection

If an input signal exceeds a range of inputs which can be received by hardware, an error message appears. Please refer to section 4.2.1 for more information.

a. Giving alarms or warnings

The procedure below explains how to set a module so that it gives an alarm or a warning.

4

```
                                    ┌─────────────┐
                                    │   Channel   │
                                    │  detection  │
                                    └──────┬──────┘
                                           │
                                           ▼
No (No detection)                    ┌───────────┐
┌───────────────────┐                │ Enabling  │
│ There are no error │◄──────────────│ physical  │
│ logs in the CPU    │               │   range   │
│ module and the     │               │ detection │
│ analog module.     │               └─────┬─────┘
└───────────────────┘                      │ Yes
                                           ▼
No (Warning)                         ┌───────────┐
                                     │  Giving   │
            ┌────────────────────────│  alarms   │
            │                        └─────┬─────┘
            │                              │ Yes
            ▼                              ▼
```

The warning LED indicators blink.

No / Yes

The BUS FAULT LED indicator on the CPU module and the ERROR LED indicator on the analog module are ON.
There are error logs in the CPU module and the analog module.

No branch:
The BUS FAULT LED indicator on the CPU module and the ERROR LED indicator on the analog module are not ON.
There are error logs in the CPU module and the analog module.

Yes branch:
The BUS FAULT LED indicator on the CPU module and the ERROR LED indicator on the analog module blink.
There are error logs in the CPU module and the analog module.

b. Interrupt service routine

The procedure below explains how to trigger an interrupt service routine in a CPU module.

```
          ┌─────────────────┐
          │    Channel      │
          │   detection     │
          │  Alarm/Warning  │
          └────────┬────────┘
                   │
                   ▼
No (No detection)  ◇ Enabling
◄──────────────────  physical range
                   │ detection
                   │
                   │ Yes
                   ▼
        No         ◇ Enabling
◄──────────────────  interrupts
                   │
                   │ Yes
                   ▼
┌──────────────┐   ┌──────────────────┐
│ No interrupt │   │ Selecting        │
│              │   │ interrupt numbers│
└──────────────┘   └──────────────────┘
```

- The interrupt service routines are I40~I251.

➢ **Analog output**

Item	Function	Description
1	Enabling/Disabling a channel	1. Users can enable or disable a channel. 2. If a channel is disabled, the total conversion time is decreased.
2	Calibration	Users can calibrate an analog output curve.
3	Scale range	A digital range corresponds to an analog range.
4	Retaining an output	When a module stops running, a signal sent by the module is retained.

1. Enabling/Disabling a Channel

The conversion speed is 150 μs a channel, and the total conversion time is 150 μs×(the number of channels). If a channel is not used, users can disable it to decrease the total conversion time.

2. Calibration

- To make a curve meet actual needs, users can calibrate the curve by changing an offset and a gain. A calibration range depends on a range of outputs which can be sent by hardware.
- A volt is a unit of calibration for offsets if inputs received or outputs sent are voltages. A milliampere is a unit of calibration for offsets if inputs received or outputs sent are currents.
- The range of offsets used for calibration is -1.0~1.0, and the range of gains used for calibration is 0.9~1.1.

Example 1:

The outputs sent by a channel are voltages in the range of -10.0 V to +10.0 V. The original signals are used. The gain is 1, and the offset is 0. The digital value received by the channel is 0, and the voltage measured is -0.05 V. The digital value received by the channel is 10, and the voltage measured is 9.95 V. Users can calibrate the channel by calibrating the gain and the offset.

The users can get the gain for the calibration by means of the equations below.
Gain=(Y2-Y1)/(X2-X1)=[9.95-(-0.05)]/(10-0)=1
Gain used for calibration=1/ Gain=1/1=1

The users can get the offset for the calibration by means of the equations below.
Offset=Y1=-0.05
Offset used for calibration=0-Y1=0.05

(X: Digital value; Y: Analog signal)

Example 2:

The outputs sent by a channel are voltages in the range of -10.0 V to +10.0 V. The original signals are used. The gain is 1, and the offset is 0. The digital value received by the channel is 0, and the voltage measured is 0 V. The digital value received by the channel is 10, and the voltage measured is 10.1 V. Users can calibrate the channel by calibrating the gain and the offset.

The users can get the gain for the calibration by means of the equations below.
Gain=(Y2-Y1)/(X2-X1)=[10.1-0]/(10-0)=1.01
Gain used for calibration=1/Gain=1/1.01=0.99

The users can get the offset for the calibration by means of the equations below.
Offset=Y1=0
Offset used for calibration=0-Y1=0

(X: Digital value; Y: Analog signal)

3. Scale range

The analog output mode of a channel has a corresponding digital range. Digital values correspond to analog outputs sent by a module. For example, if the analog range is -10 V~10 V and the digital range is -10.0~10.0, the digital values -10.0~10.0 correspond to the analog values -10 V~10 V.

4. Retaining an output

When a module stops running, a signal sent by the module is retained.

The output is not retained:

Analog signal

Output signal

Time

The module stops running.

The output is retained:

Analog signal

Output signal

Time

The module stops running.

4.3 Installation

4.3.1 Installing a Module

Insert a module into a slot, make sure that the module is installed on the backplane properly, and tighen the the screw, as illustrated below.

1. Insert the projection under the module into the hole in the backplane.
2. Push the module in the direction indicated by the arrow until it clicks.
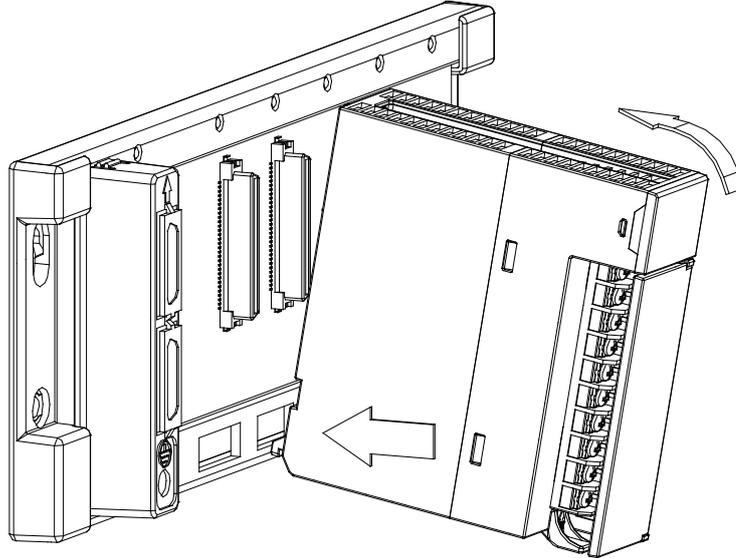
3. Tighten the screw on the module.
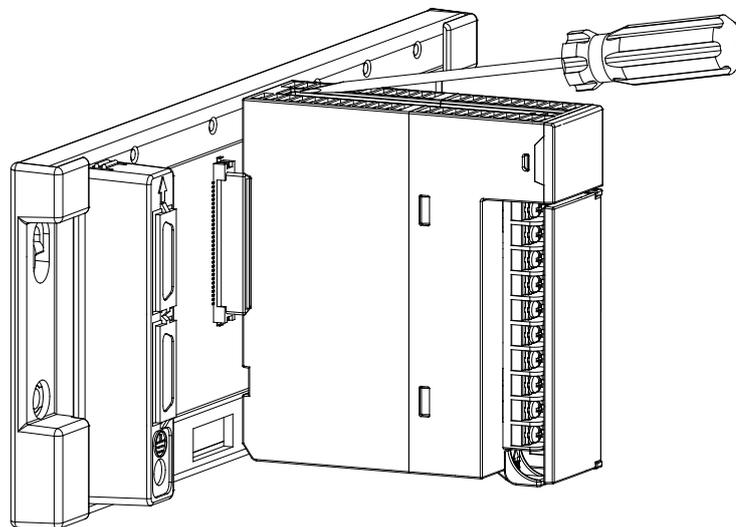
4.3.2 Installing a Removable Terminal Block

● **Installation**

   1. Level a terminal block at the printed circuit board, and press it into the module.
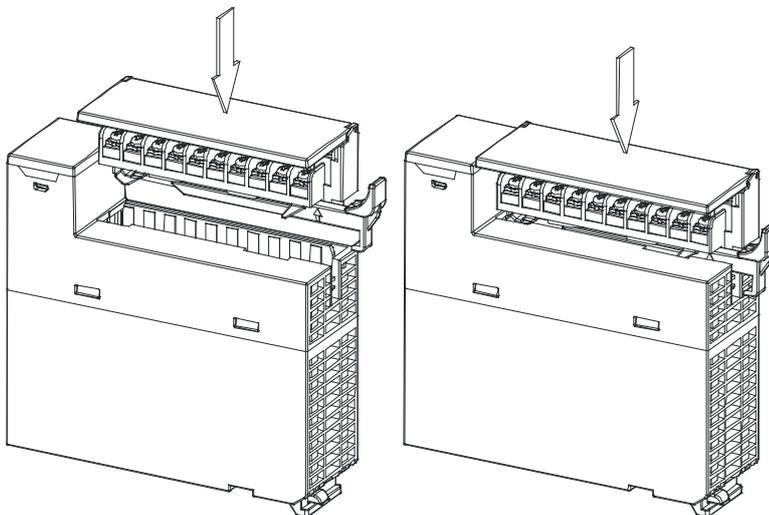
   2. Press the clip in the direction indicated by the arrow.
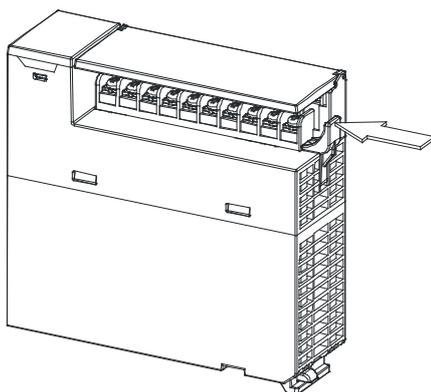
● **Removal**

   1. Pull the clip in the direction indicated by the arrow.
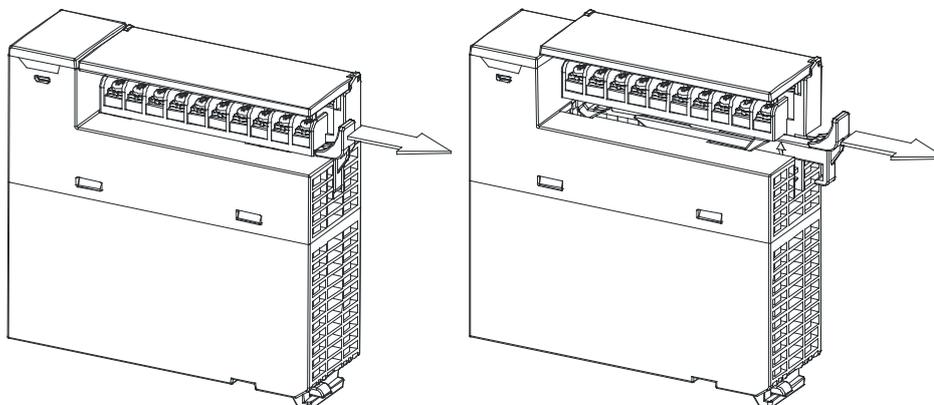
2. Pull up the clip.
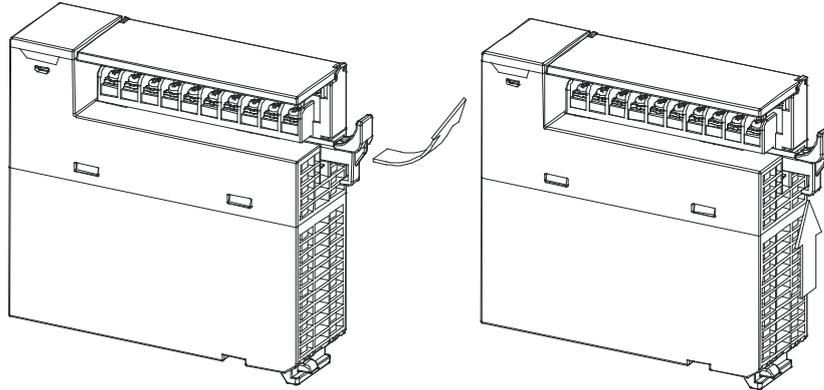
3. The terminal block is removed.

4.3.3 Wiring

● **Precautions**

In order to make the functions of AH06XA-5A perfect and ensure the reliability of a system at the same time, external wiring which prevents noise is necessary. Before installing cables, users need to follow the precautions below.

(1) To prevent a surge and induction, an AC cable and input/output signal cables which are connected to AH06XA-5A must be separate cables.

(2) A cable must not be installed near a main circuit, a high-voltage cable, or a cable connected to a load which is not a PLC. Besides, a cable must not be bound to a main circuit, a high-voltage cable, or a cable connected to a load which is not a PLC. Otherwise, effects that noise, induction, and a surge have will increase.

(3) Please connect a shielded cable and a hermetically sealed cable with the ground separately.

(4) Terminals with insulation sleeves can not be arranged as a terminal block. It is recommended that the terminals be covered with insulation tubes.

(5) Two-wire connection/Three-wire connection/Four-wire connection:

● Two-wire connection/Three-wire connection (Passive transducer): A transducer and an analog input module are connected to a power circuit collectively.

● Four-wire connection (Active transducer): A transducer uses an independent power supply. It is not connected to the power circuit which is connected to an analog input module.

(6) Use cables with the same length (less than 200 m) and use wire resistance of less than 100 ohm.

● **External wiring**
   (1) AH06XA-5A
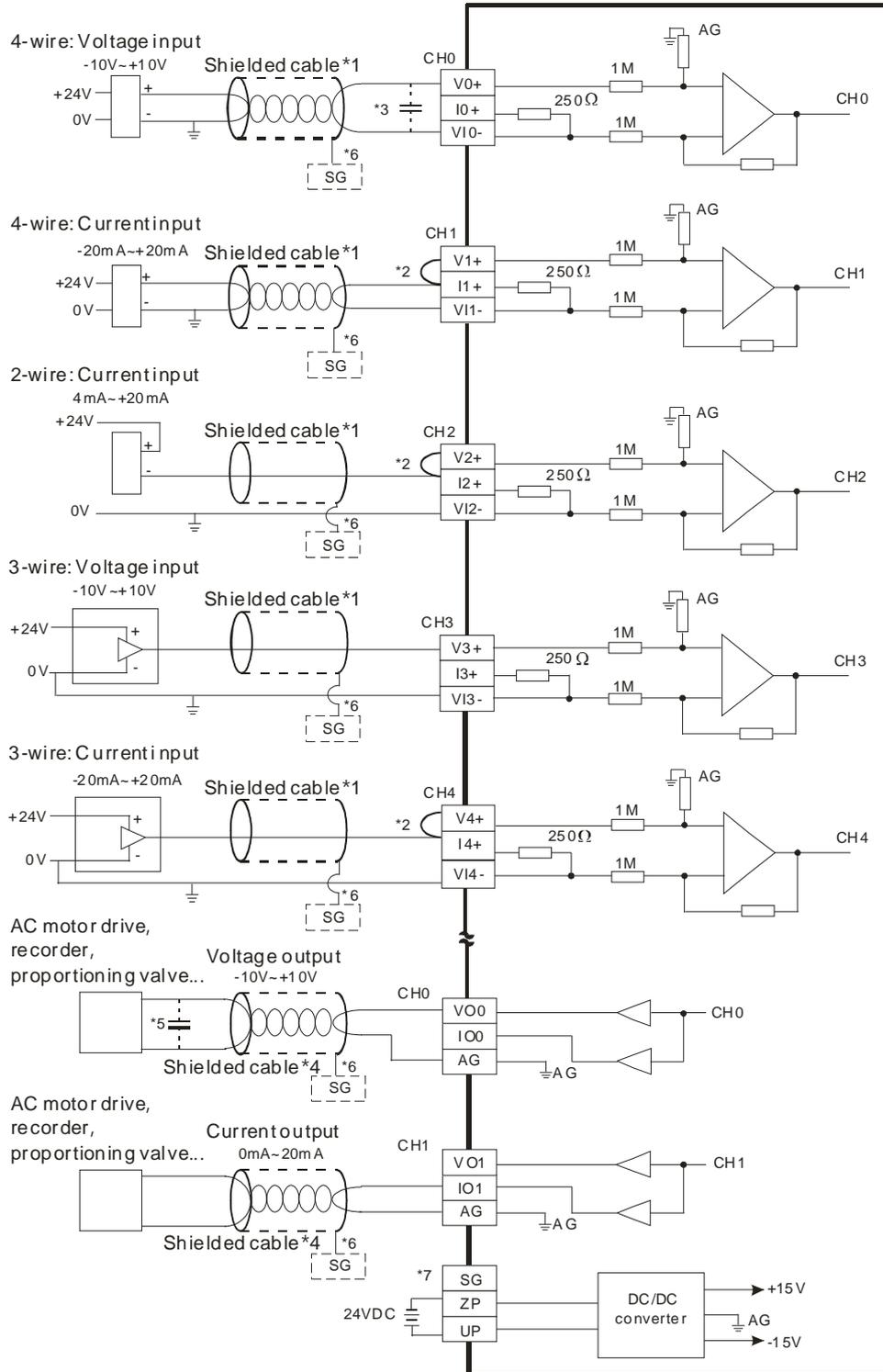
*1. Please use a shielded cable as an analog input cable, and isolate the shielded cable from other power cables.

*2. If current is connected, the connection between Vn+ and In+ needs to be a short circuit. (n is in the range of 0 to 7.)

*3. If ripple voltage results in interference with the wiring, please connect a 0.1~0.47 μF and 25 V capacitor.

*4. Please isolate the analog output cable from other power cables.

*5. If the ripple voltage of the input terminal of the load connected is large, and results in interference with the wiring, please connect a 0.1~0.47 μF and 25 V capacitor.

*6. Please connect the ground wire in the shielded cable to the terminal SG.

*7. Once AH06XA-5A is installed on a backplane, the connection between the terminal SG on

AH06XA-5A and the terminal ⏚ on the backplane will be a short circuit. Please connect the terminal ⏚ on the backplane to the ground terminal ⏚.

4.3.4 LED Indicators

Number	Name	Description
1	RUN LED indicator	Operating status of the module ON: The module is running. OFF: The module stops running.
2	ERROR LED indicator	Error status of the module ON: A serious error occurs in the module. OFF: The module is normal. Blink: A slight error occurs in the module.

4.4 HWCONFIG in ISPSoft

4.4.1 Initial Setting
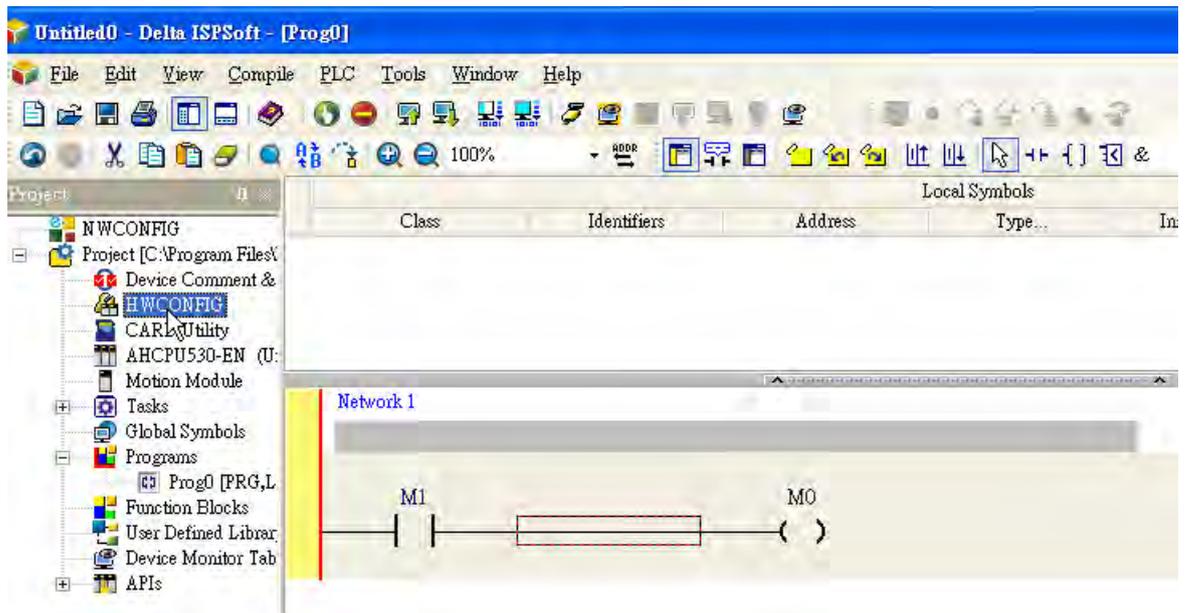
(1) Start ISPSoft, and then double-click **HWCONFIG**.

(2) Click **I/O scan** on the toolbar.
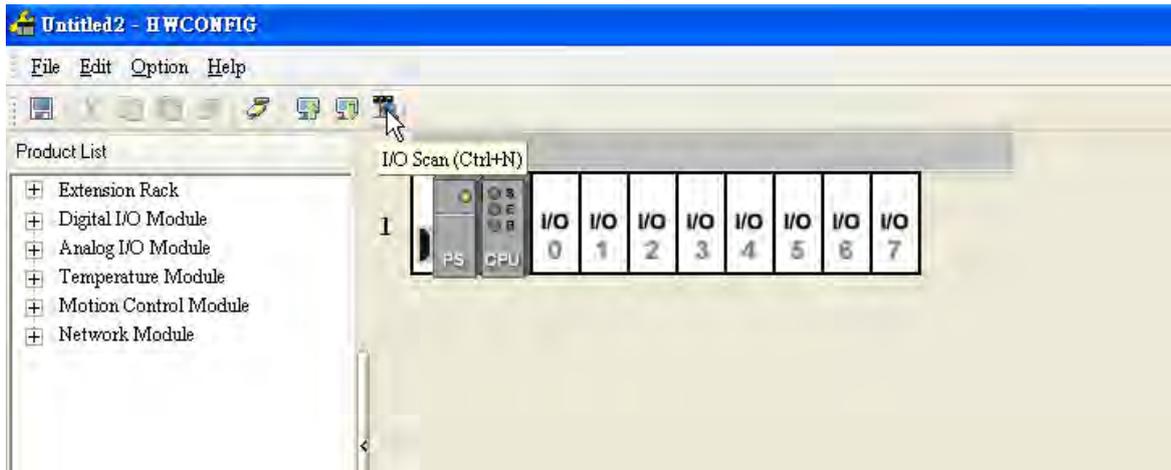
(3) ISPSoft is scanning the actual hardware configuration.
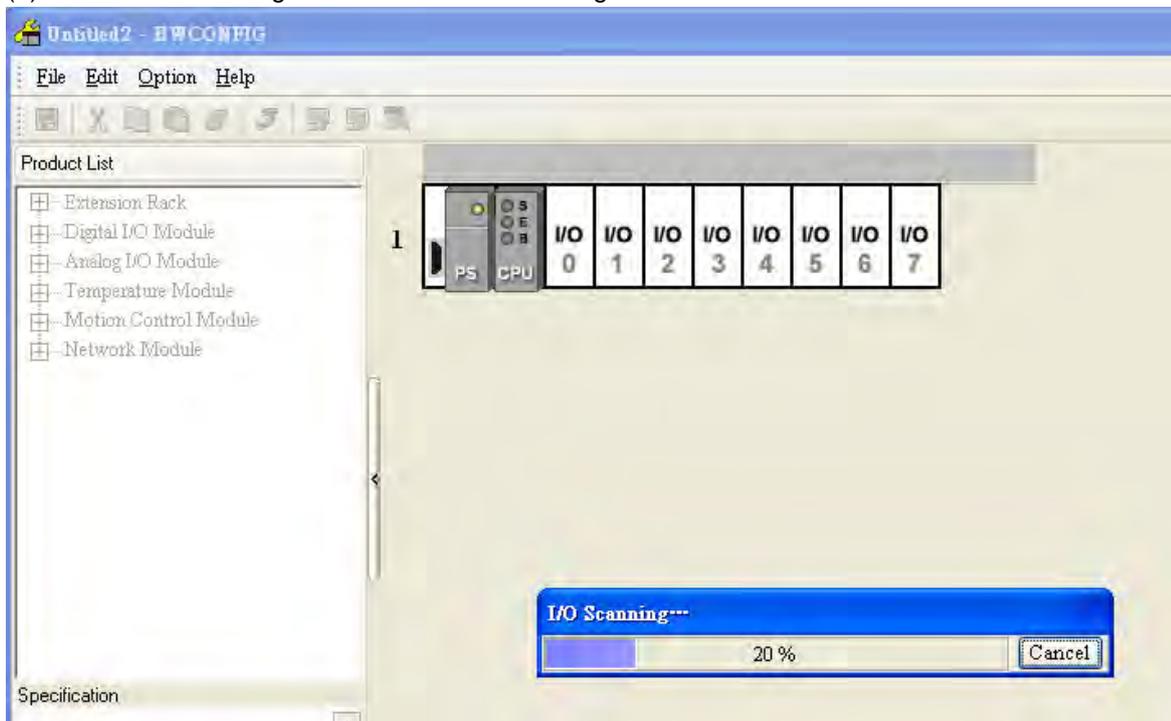
(4) After the scan of the actual hardware configuration is complete, the system automatically assigns the corresponding registers to the channels. Users can alter the input device range and the output device range by themselves.

Note: Owing to the fact that values are floating-point numbers, every channel occupies two 16-bit registers.

Information: Rack 1

Slot No.	Label	Firmware Version	Descrption	Input Device Range	Output Device Range
-	AHPS05-5A	-	AH Power Supply Modul	None	None
-	AHCPU530-EN	1.00	Basic CPU module buildir	None	None
0	AH06XA-5A	1.00	4 x 16 bit AI, 2 x 16bit AO	D0 ~ D7	D8 ~ D11

(5) Double-click the module AH06XA-5A.
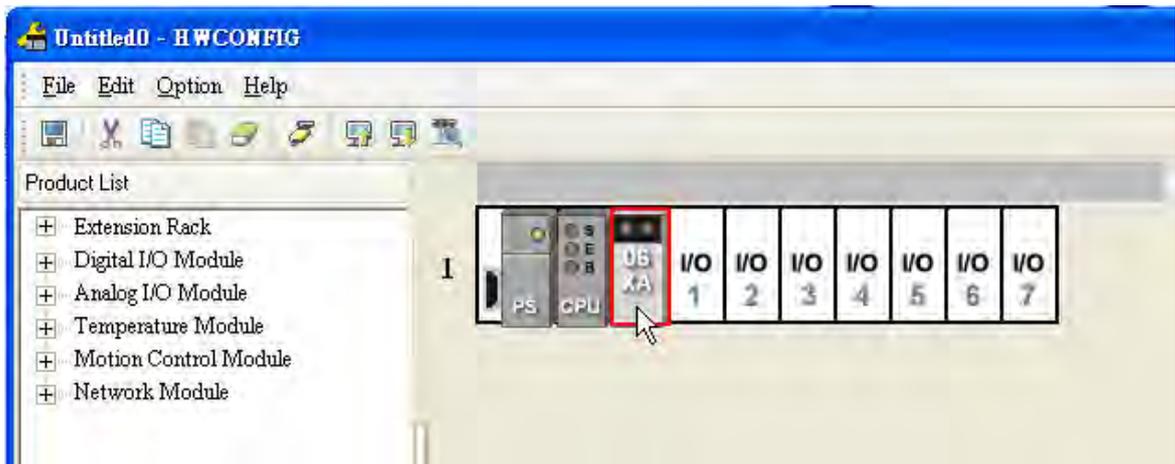
(6) Open the **Parameter Setting** window.
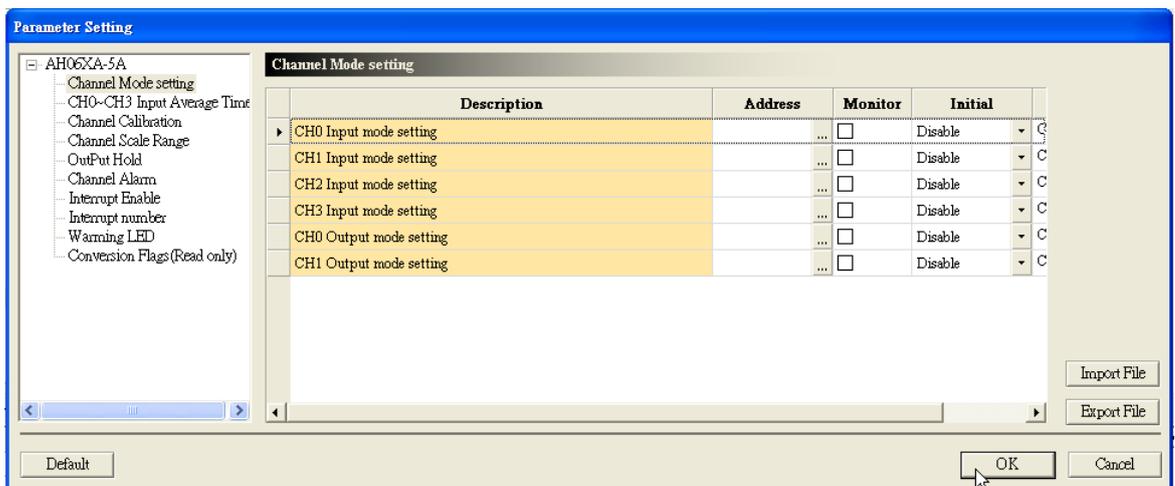
(7) Set the parameters, and then click **OK**.

(8) Click **Download** on the toolbar to download the parameters. (The parameters can not be downloaded when the CPU module runs.)
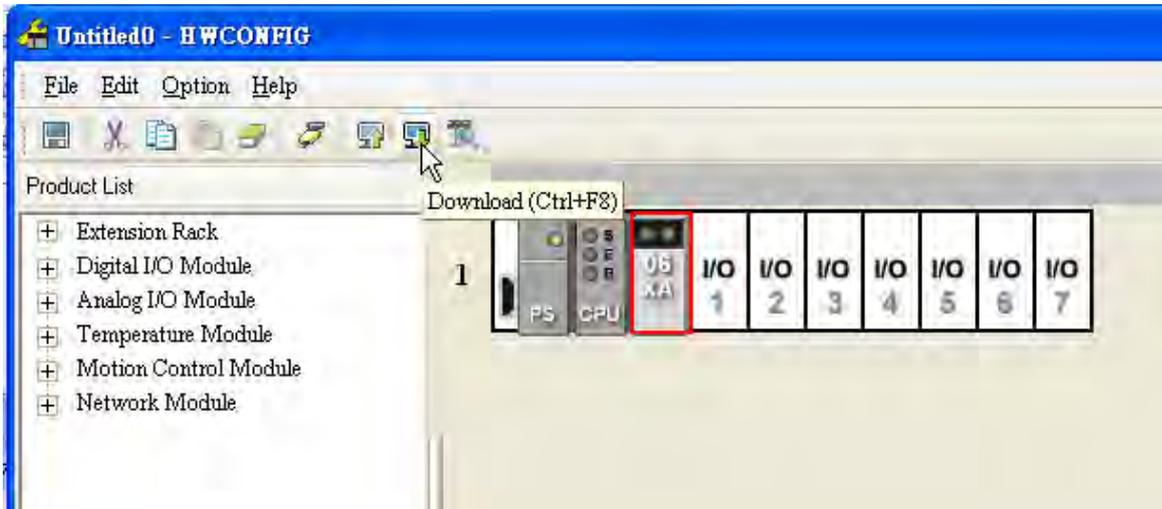
4.4.2 Checking the Version of a Module
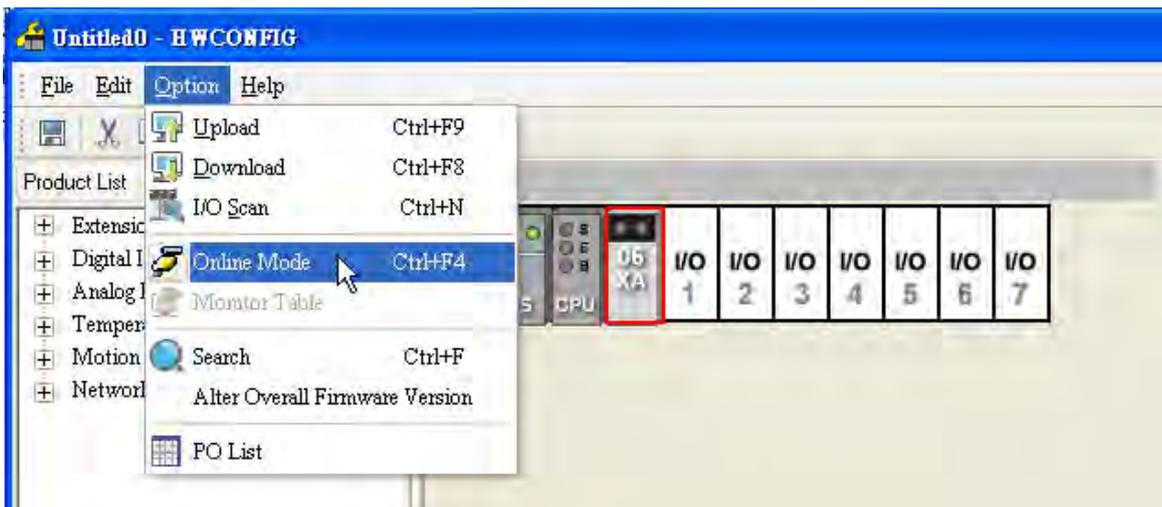
(1) On the **Option** menu, click **Online Mode**.

(2) Right-click the module, and then click **Module Information** on the context menu. The version of the firmware and that of the hardware are displayed.
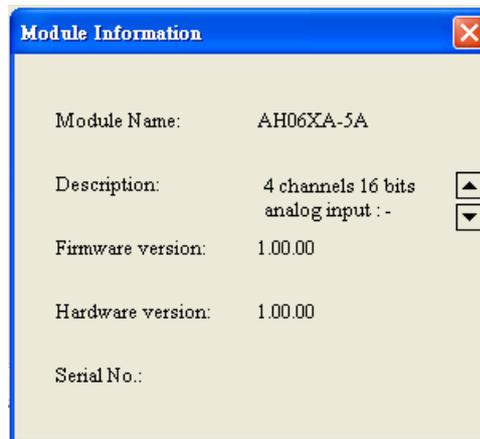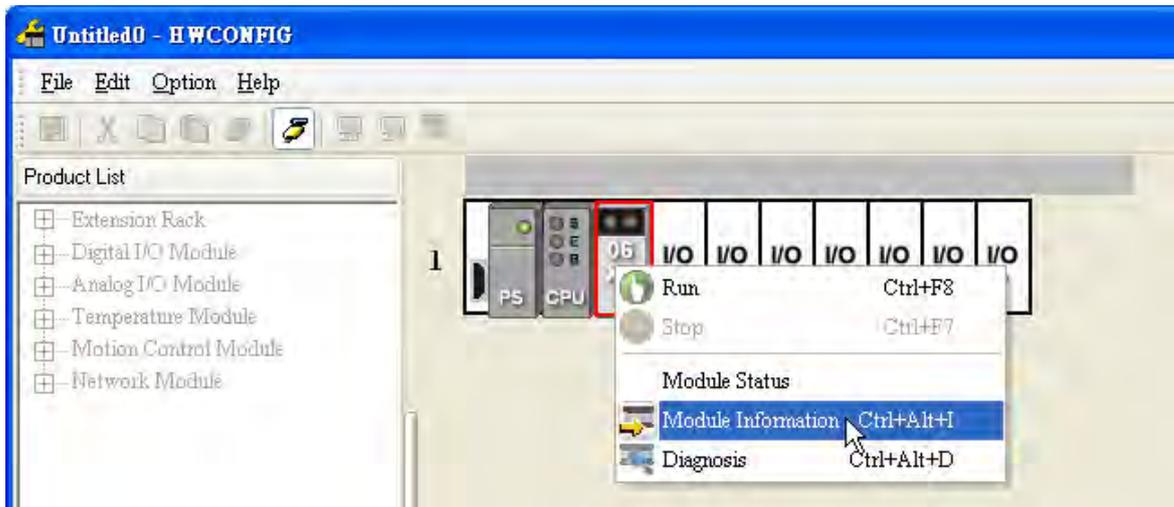
4.4.3 Monitoring Table

(1) Select the **Monitor** checkboxes at the right sides of the corresponding registers.

Channel Mode setting

	Description	Address	Monitor	Initial	Comment
▶	CH0 Input mode setting	D500 ...	☑	-10V~+10V ▼	CH0 Input mode setting
	CH1 Input mode setting	D501 ...	☑	-10V~+10V ▼	CH1 Input mode setting
	CH2 Input mode setting	...	☐	Disable ▼	CH2 Input mode setting
	CH3 Input mode setting	...	☐	Disable ▼	CH3 Input mode setting
	CH0 Output mode setting	...	☐	Disable ▼	CH0 Output mode setting
	CH1 Output mode setting	...	☐	Disable ▼	CH1 Output mode setting

(2) On the **Option** menu, click **Online Mode**.
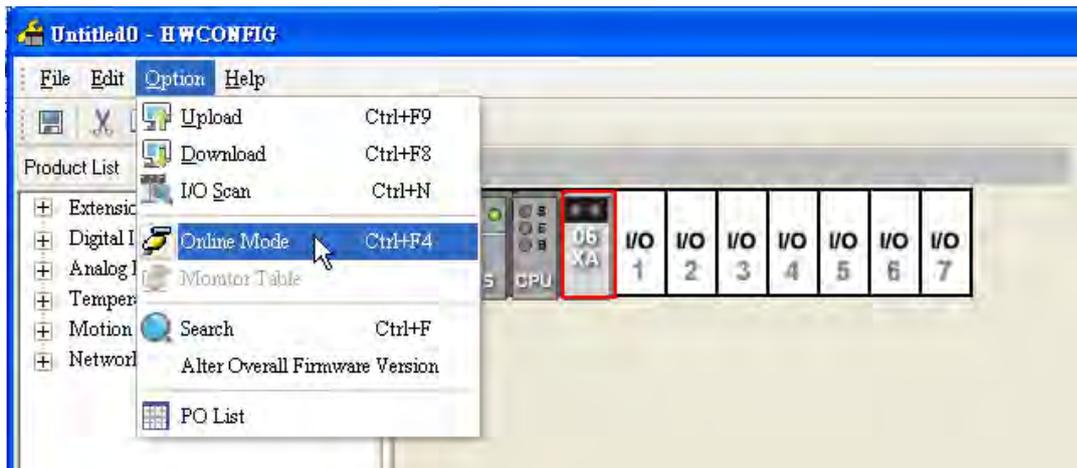
(3) On the **Option** menu, click **Monitor Table**. The registers are monitored.
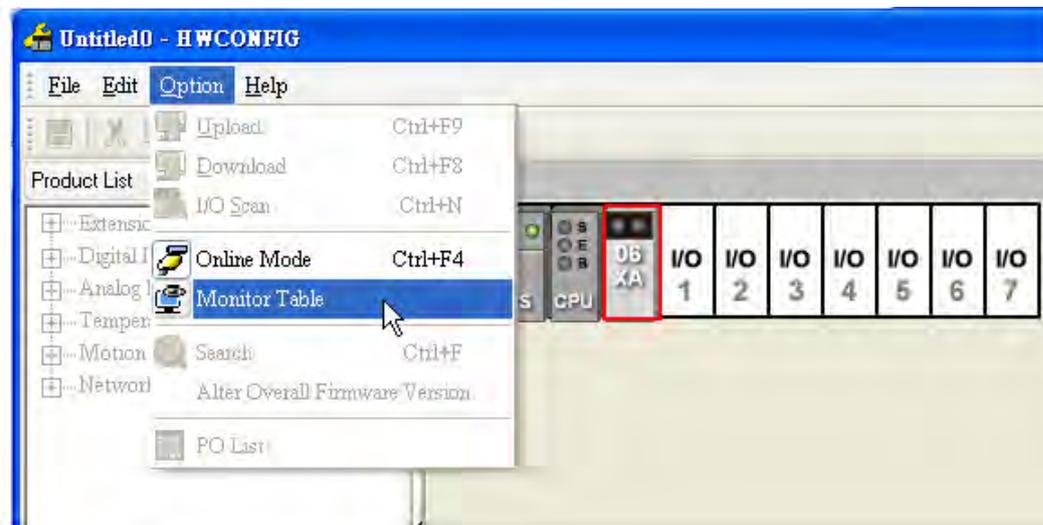
Rack No.	Slot No.	Module Name	Device Name	PV	Radix	Comment
1	0	AH06XA-5A	D500	1	Decimal	CH0 Input mode setting
1	0	AH06XA-5A	D501	1	Decimal	CH1 Input mode setting

4.4.4 Online Mode

(1) Click **Online Mode** on the toolbar.
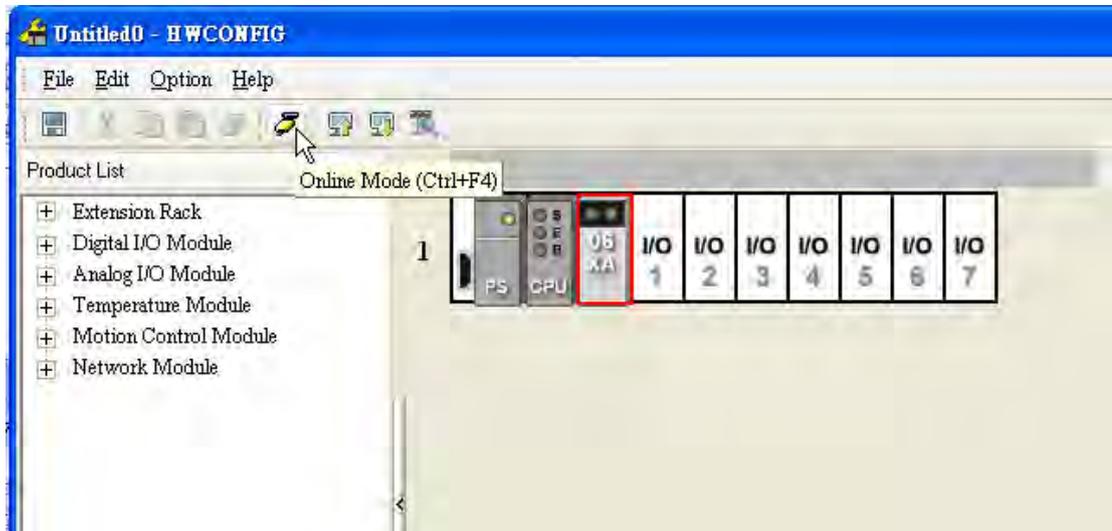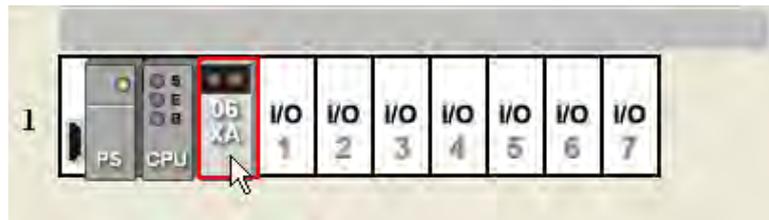
(2) Double-click the module AH06XA-5A.

(3) If some parameters are altered, users can click **SV→PV**. The new setting values are written into the CPU module and the I/O module. If users want to read the present values in the I/O module, they can click **Refresh**. The present values in the I/O module are sent to ISPSoft, and are monitored.
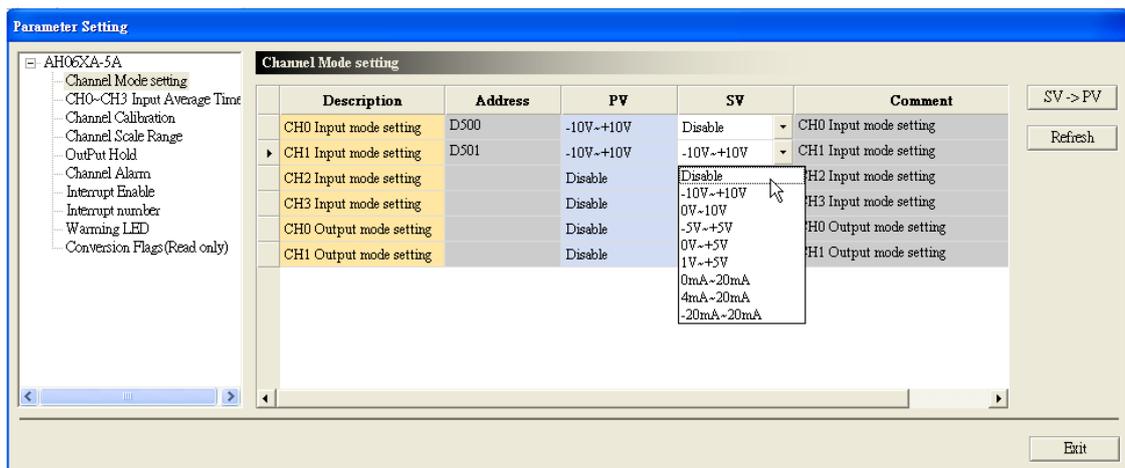
4.4.5 Importing/Exporting a Parameter File

(1) After **Export** is clicked, the parameters will be saved as a CSV file (.csv).
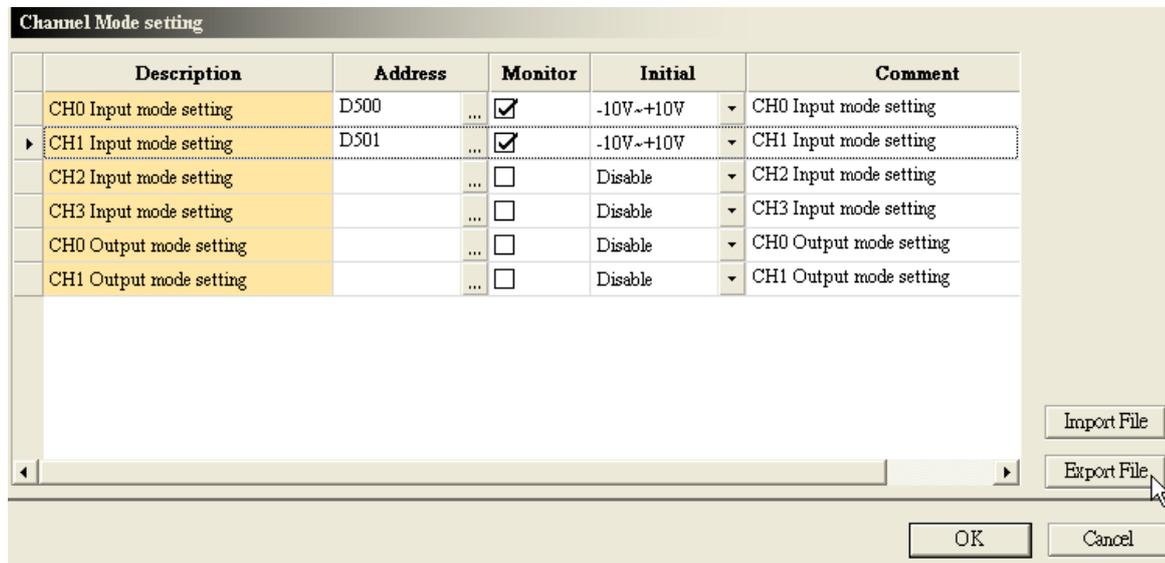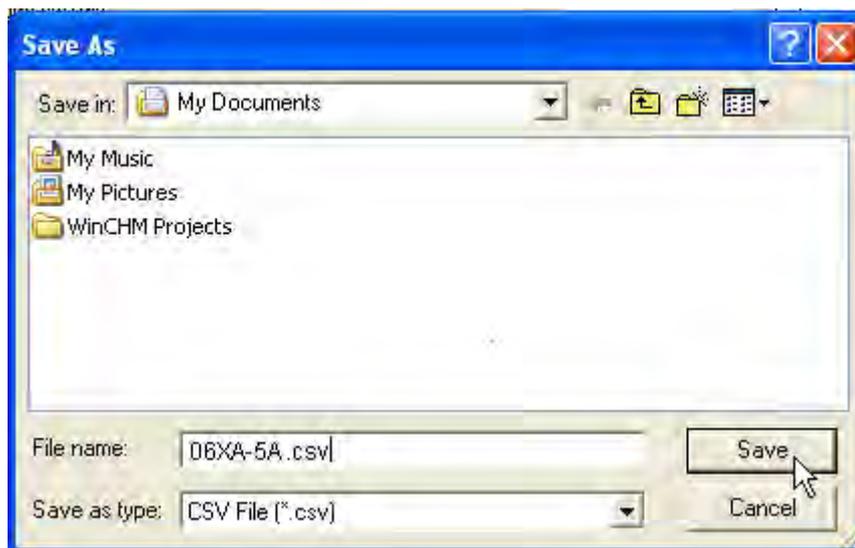
(2) Click **Import**, and then click the CSV file.
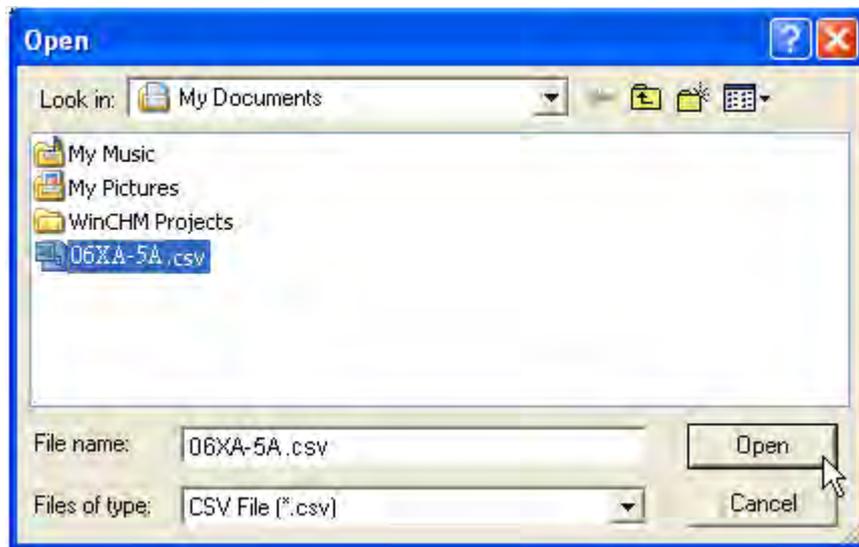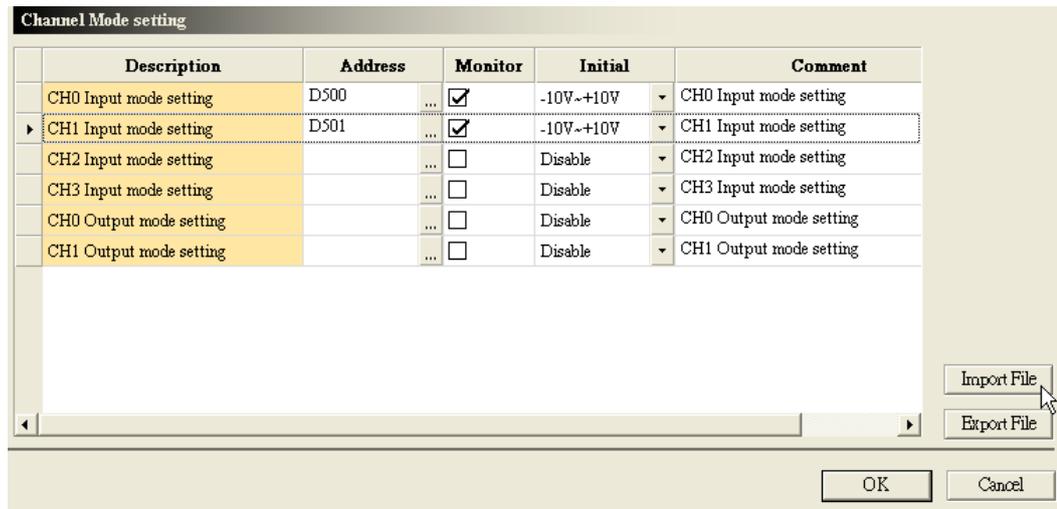
4.4.6 Parameters
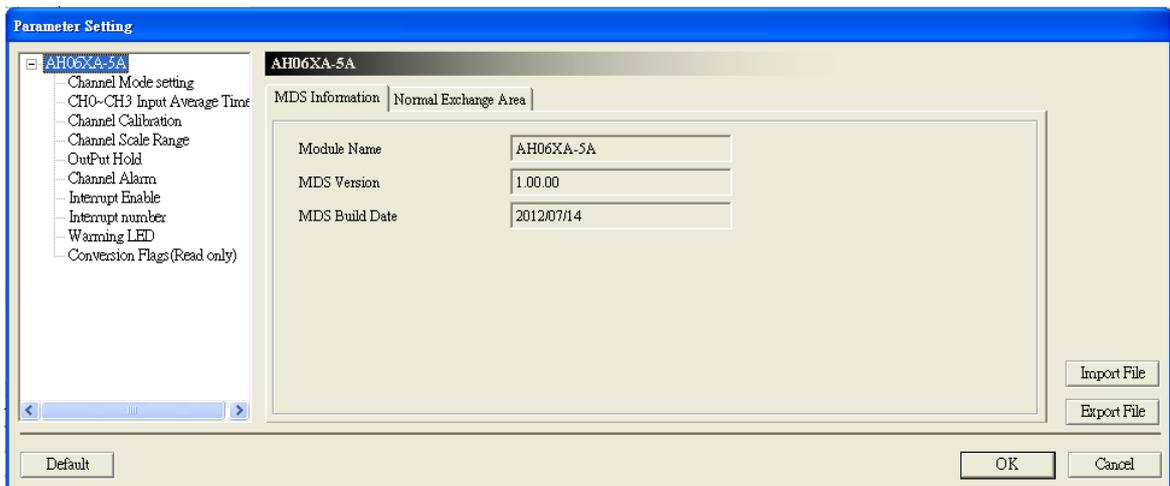
(1) The input modes of the channels, and the output modes of the channels

AH06XA-5A	Input channel	Output channel
Description	0: The channel is disabled. 1: -10 V~10 V 2: 0 V~10 V 3: -5 V~5 V 4: 0 V~5 V 5: 1 V~5 V 6: 0 mA ~20 mA 7: 4 mA~20 mA 8: -20 mA~20 mA	0: The channel is disabled. 1: -10 V~10 V 2: 0 V~10 V 3: -5 V~5 V 4: 0 V~5 V 5: 1 V~5 V 6: 0 mA~20 mA 7: 4 mA~20 mA

(2) The number of values averaged

(3) The offsets and the gains used for calibration

Channel Calibration				
Description	Address	Monitor	Initial	Comment
▶ CH0 Input Cal. Offset (V/mA)	... ☐		0.000000	CH0 Input Cal. Offset (V/mA)
CH1 Input Cal. Offset (V/mA)	... ☐		0.000000	CH1 Input Cal. Offset (V/mA)
CH2 Input Cal. Offset (V/mA)	... ☐		0.000000	CH2 Input Cal. Offset (V/mA)
CH3 Input Cal. Offset (V/mA)	... ☐		0.000000	CH3 Input Cal. Offset (V/mA)
CH0 Output Cal. Offset (V/mA)	... ☐		0.000000	CH0 Output Cal. Offset (V/mA)
CH1 Output Cal. Offset (V/mA)	... ☐		0.000000	CH1 Output Cal. Offset (V/mA)
CH0 Input Cal. Gain	... ☐		1.000000	CH0 Input Cal. Gain
CH1 Input Cal. Gain	... ☐		1.000000	CH1 Input Cal. Gain
CH2 Input Cal. Gain	... ☐		1.000000	CH2 Input Cal. Gain
CH3 Input Cal. Gain	... ☐		1.000000	CH3 Input Cal. Gain
CH0 Output Cal. Gain	... ☐		1.000000	CH0 Output Cal. Gain

(4) The scale range

Channel Scale Range				
Description	Address	Monitor	Initial	Comment
▶ CH0 Input Scale LSP	... ☐		0.000000	CH0 Input Scale LSP
CH1 Input Scale LSP	... ☐		0.000000	CH1 Input Scale LSP
CH2 Input Scale LSP	... ☐		0.000000	CH2 Input Scale LSP
CH3 Input Scale LSP	... ☐		0.000000	CH3 Input Scale LSP
CH0 Output Scale LSP	... ☐		0.000000	CH0 Output Scale LSP
CH1 Output Scale LSP	... ☐		0.000000	CH1 Output Scale LSP
CH0 Input Scale HSP	... ☐		100.000000	CH0 Input Scale HSP
CH1 Input Scale HSP	... ☐		100.000000	CH1 Input Scale HSP
CH2 Input Scale HSP	... ☐		100.000000	CH2 Input Scale HSP
CH3 Input Scale HSP	... ☐		100.000000	CH3 Input Scale HSP
CH0 Output Scale HSP	... ☐		100.000000	CH0 Output Scale HSP

(5) Retaining the outputs

OutPut Hold				
Description	Address	Monitor	Initial	Comment
▶ CH0 Output Hold	... ☐		☐ Hold	CH0 Output Hold
CH1 Output Hold		☐	☐ Hold	CH1 Output Hold

(6) The channel detection

	Description	Address	Monitor	Initial	Comment
▶	CH0 Physical Range Detect	...	☐	☑ Enable	CH0 Physical Range Detect
	CH1 Physical Range Detect		☐	☑ Enable	CH1 Physical Range Detect
	CH2 Physical Range Detect		☐	☑ Enable	CH2 Physical Range Detect
	CH3 Physical Range Detect		☐	☑ Enable	CH3 Physical Range Detect
	CH0 Detect is Alarm or warning		☐	☑ Alarm	CH0 Detect is Alarm or warning
	CH1 Detect is Alarm or warning		☐	☑ Alarm	CH1 Detect is Alarm or warning
	CH2 Detect is Alarm or warning		☐	☑ Alarm	CH2 Detect is Alarm or warning
	CH3 Detect is Alarm or warning		☐	☑ Alarm	CH3 Detect is Alarm or warning

Channel Alarm

(7) Enabling the interrupts

Interrupt Enable

	Description	Address	Monitor	Initial	Comment
▶	CH0 Interrupt of Over Physical Range	...	☐	☐ Enable	CH0 Interrupt of Over Physical
	CH1 Interrupt of Over Physical Range		☐	☐ Enable	CH1 Interrupt of Over Physical
	CH2 Interrupt of Over Physical Range		☐	☐ Enable	CH2 Interrupt of Over Physical
	CH3 Interrupt of Over Physical Range		☐	☐ Enable	CH3 Interrupt of Over Physical

(8) The interrupt numbers

Interrupt number

	Description	Address	Monitor	Initial	
▶	Interrupt number that CH0 input value Out of Physical Rang	...	☐	40	Interrupt nu
	Interrupt number that CH1 input value Out of Physical Rang	...	☐	40	Interrupt nu
	Interrupt number that CH2 input value Out of Physical Rang	...	☐	40	Interrupt nu
	Interrupt number that CH3 input value Out of Physical Rang	...	☐	40	Interrupt nu

(9) Setting the warning LED indicator

Warning LED				
Description	Address	Monitor	Initial	Comm
Warn of CH0 Input value Out of Physical Range	... ☐		☐ flashing	Warn of CH0 Input val
Warn of CH1 Input value Out of Physical Range		☐	☐ flashing	Warn of CH1 Input valu
Warn of CH2 Input value Out of Physical Range		☐	☐ flashing	Warn of CH2 Input valu
Warn of CH3 Input value Out of Physical Range		☐	☐ flashing	Warn of CH3 Input valu

(10) The error codes

Conversion Flags(Read only)				
Description	Address	Monitor	Initial	Comment
Conversion Flags(Read only)	... ☐		10	Conversion Flags(Read only)

4.5 Troubleshooting

4.5.1 Error Codes

Error Code	Type	Description	RUN LED indicator	ERROR LED indicator
16#A600	Alarm	Hardware failure	OFF	ON
16#A601	Alarm	The external voltage is abnormal.	OFF	ON
16#A603	Alarm	Internal error The factory correction is abnormal.	OFF	ON
16#A400	Alarm	The signal received by channel 0 exceeds the range of inputs which can be received by the hardware.	OFF	ON
16#A401	Alarm	The signal received by channel 1 exceeds the range of inputs which can be received by the hardware.	OFF	ON
16#A402	Alarm	The signal received by channel 2 exceeds the range of inputs which can be received by the hardware.	OFF	ON
16#A403	Alarm	The signal received by channel 3 exceeds the range of inputs which can be received by the hardware.	OFF	ON
16#A000	Warning	The signal received by channel 0 exceeds the range of inputs which can be received by the hardware.	ON	Blink
16#A001	Warning	The signal received by channel 1 exceeds the range of inputs which can be received by the hardware.	ON	Blink
16#A002	Warning	The signal received by channel 2 exceeds the range of inputs which can be received by the hardware.	ON	Blink
16#A003	Warning	The signal received by channel 3 exceeds the range of inputs which can be received by the hardware.	ON	Blink
16#A800	Warning	The signal received by channel 0 exceeds the range of inputs which can be received by the hardware.	ON	OFF
16#A801	Warning	The signal received by channel 1 exceeds the range of inputs which can be received by the hardware.	ON	OFF
16#A802	Warning	The signal received by channel 2 exceeds the range of inputs which can be received by the hardware.	ON	OFF
16#A803	Warning	The signal received by channel 3 exceeds the range of inputs which can be received by the hardware.	ON	OFF

4.5.2 Troubleshooting Procedure

Description	Procedure
Hardware failure	Return the module to the factory for repair.
The external voltage is abnormal.	Check whether the external 24 V power supply to the module is normal.
Internal error The factory correction is abnormal.	Please contact the factory.
The signal received by channel 0 exceeds the range of inputs which can be received by the hardware.	Check the signal received by channel 0.
The signal received by channel 1 exceeds the range of inputs which can be received by the hardware.	Check the signal received by channel 1
The signal received by channel 2 exceeds the range of inputs which can be received by the hardware.	Check the signal received by channel 2.
The signal received by channel 3 exceeds the range of inputs which can be received by the hardware.	Check the signal received by channel 3.

MEMO

Chapter 5   Temperature Measurement Module AH04PT/AH08PTG

Table of Contents

5.1 AH04PT-5A

5.1.1 Overview

The specifications for a temperature measurement module, the operation, and the programming are described in this section. AH04PT-5A is a temperature measurement module. It converts the temperatures received from its four thermocouples into digital signals. Users can select the degree Celsius or the degree Fahrenheit as a unit of measurement for temperature.

5.1.2 Characteristics

(1) **A sensor is selected according to practical application.**
   Pt100/Ni100/Pt1000/Ni1000 sensor
(2) **High-speed conversion**
   Two-wire/Four-wire configuration: 150 ms/channel
   Three-wire configuration: 300 ms/channel
(3) **High accuracy**
   Conversion accuracy: The error is ±0.5% of an input. (The ambient temperature is 25±5°C.)
(4) **Disconnection detection**
   When a sensor is disconnected, AH04PT-5A gives an alarm or a warning.
(5) **PID control**
   An object can be maintained at a desired temperature through a PID control action.
(6) **A module can be set by means of utility software.**
   HWCONFIG is built-in utility software in ISPSoft. Users can set modes and parameters in HWCONFIG to complete hardware configuration without spending time writing a program to set registers corresponding to functions.

5.1.3 Specifications

Electrical specifications

Number of analog inputs	4
Applicable sensor	Three-wire configuration: Pt100/Ni100/Pt1000/Ni1000 sensor, and 0~300 Ω input impedance Two-wire/Four-wire configuration: Pt100/Ni100/Pt1000/Ni1000 sensor, and 0~300 Ω input impedance Pt100: DIN 43760-1980 JIS C1604-1989; 100 Ω 3850 PPM/°C Pt1000: DIN EN60751; 1 kΩ 3850 PPM/°C Ni100/Ni1000: DIN 43760
Supply voltage	24 V DC (20.4 V DC~28.8 V DC) (-15%~+20%)
Connector type	Removable terminal block
Overall accuracy	25°C/77°F: The error allowed is ±0.5% of full scale. -20~60°C/-4~140°F: The error allowed is ±1% of full scale.
Conversion time	Two-wire/Four-wire Four-wire configuration: 150 ms/channel Three-wire configuration: 300 ms/channel
Isolation	An analog circuit is isolated from a digital circuit by a digital integrated circuit/an optocoupler, and the analog channels are isolated from one another by optocouplers. Isolation between a digital circuit and the ground: 500 V DC Isolation between an analog circuit and the ground: 500 V DC Isolation between an analog circuit and the digital circuit: 500 V DC Isolation between the 24 V DC and the ground: 500 V DC

Functional specifications

Analog-to-digital conversion	Centigrade (°C)	Fahrenheit (°F)	Input impedance
Rated input range	Pt100: -180°C~800°C Ni100: -80°C~170°C Pt1000: -180°C~800°C Ni1000: -80°C~170°C	Pt100: -292°F~1,472°F Ni100: -112°F~338°F Pt1000: -292°F~1,472°F Ni1000: -112°F~338°F	0~300 Ω
Average function	Range: 1~100		
Self-diagnosis	Disconnection detection		

5.1.4 Profile

Number	Name	Description
1	Model name	Model name of the module
2	RUN LED indicator	Operating status of the module ON: The module is running. OFF: The module stops running.
2	ERROR LED indicator	Error status of the module ON: A serious error occurs in the module. OFF: The module is normal. Blink: A slight error occurs in the module.
3	Removable terminal block	The inputs are connected to sensors.
4	Arrangement of the input terminals	Arrangement of the terminals
5	Description of the inputs	Simple specifications for the module
6	Clip	Removing the terminal block
7	Label	Nameplate
8	Set screw	Fixing the module
9	Connector	Connecting the module and a backplane
10	Projection	Fixing the module

5.1.5 Dimensions

Unit: mm
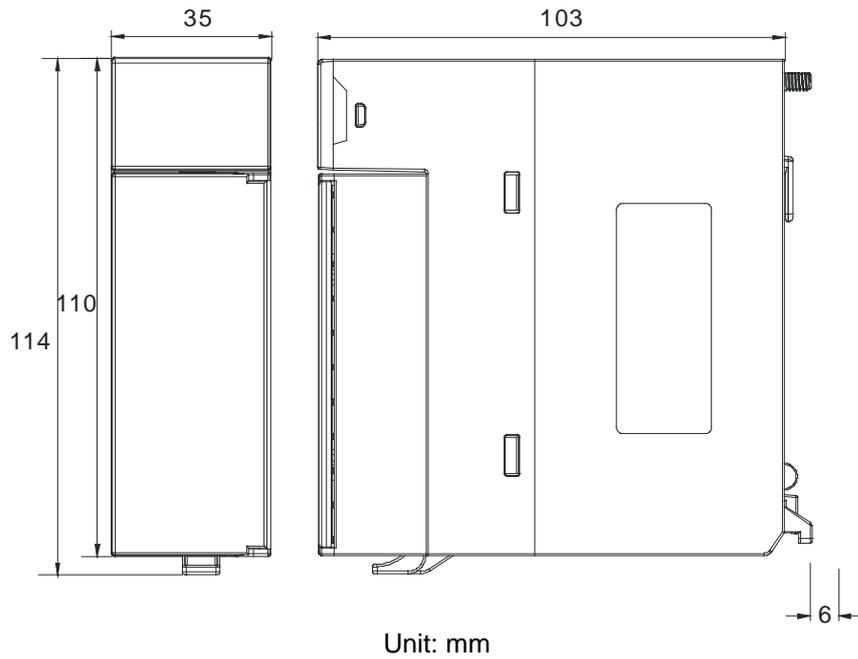
5.1.6 Arrangement of Terminals

5.1.7 Functions

Item	Function	Description
1	Enabling/Disabling a channel	1. Users can enable or disable a channel. 2. If a channel is disabled, the total conversion time is decreased.
2	Temperature unit	Users can select the degree Celsius (°C) or the degree Fahrenheit (°F) as a unit of measurement for temperature.
3	Calibration	Users can calibrate a linear curve.
4	Average	Conversion values are averaged and filtered.
5	Disconnection detection	When a sensor is disconnected, AH04PT-5A gives an alarm or a warning.
6	Channel detection	If an input signal exceeds a range of inputs which can be received by hardware, the module will give an alarm or a warning. a. Warning LED indicator: When a warning occurs, the ERROR LED indicator blinks or does not blink. b. Interrupt: An interrupt service routine is enabled.
7	PID control	An object can be maintained at a desired temperature through a PID control action.

1. Enabling/Disabling a channel

A temperature received from a two-wire/four-wire sensor is converted into a digital value at a speed of 150 ms a channel, and a temperature received from a three-wire sensor is converted into a digital value at a speed of 300 ms a channel. If a channel is not used, users can disable it to decrease the total conversion time.

2. Temperature unit

Users can select the degree Celsius (°C) or the degree Fahrenheit (°F) as a unit of measurement for temperature.

3. Calibration

● To make a curve meet actual needs, users can calibrate the curve by changing an offset and a gain. A calibration range depends on a range of inputs which can be received by hardware.

● The range of offsets used for calibration is -1.0~1.0, and the range of gains used for calibration is 0.9~1.1.

Example 1:

The temperatures -100℃~100℃correspond to the digital values-100~100. The original signals are used. The gain is 1, and the offset is 0. The temperature received by the channel is 0℃, and the digital value is -1. The temperature received by the channel is 100℃, and the digital value is 99. Users can calibrate the channel by calibrating the gain and the offset.

The users can get the gain for the calibration by means of the equations below.
Gain=(Y2-Y1)/(X2-X1)=[99-(-1)]/(100-0)=1
Gain used for calibration=1/Gain=1/1=1

The users can get the offset for the calibration by means of the equations below.
Offset=Y1=-1
Offset used for calibration=1-Y1=1

(X: Temperature; Y: Digital value)

Example 2:

The temperatures -100℃~100℃ correspond to the digital values -100~100. The original signals are used. The gain is 1, and the offset is 0. The temperature received by the channel is 0℃, and the digital value is 0. The temperature received by the channel is 100℃, and the digital value is 101. Users can calibrate the channel by calibrating the gain and the offset.

The users can get the gain for the calibration by means of the equations below.
Gain=(Y2-Y1)/(X2-X1)=[101-0]/(100-0)=1.01
Gain used for calibration=1/Gain=1/1.01=0.99

The users can get the offset for the calibration by means of the equations below.
Offset=Y1=0
Offset used for calibration=0-Y1=0

(X: Temperature; Y: Digital value)

4. Average

Digital values are averaged. The number by which the sum of several digital values is divided is between 1 and 100. The sampled values are taken as a queue, and the length of the queue is N. Each time a new sampled value is put at the end of the queue, an original value at the start of the queue is removed. The N values are averaged so that the periodic noise is suppressed.

5. Disconnection detection

If a channel is enabled, the module will check whether a sensor is disconnected. If an input circuit is an open circuit, the module will give an alarm. Please refer to description below for more information.

6. Channel detection

If an input signal exceeds a range of inputs which can be received by hardware, an error message appears. Please refer to section 5.2.1 for more information.

a. Giving alarms or warnings

The procedure below explains how to set a module so that it gives an alarm or a warning.

b. Interrupt service routine

The procedure below explains how to trigger an interrupt service routine in a CPU module.

```
                              ┌─────────────────┐
                              │     Channel     │
                              │    detection    │
                              │  Alarm/Warning  │
                              └─────────────────┘
                                       │
                                       ▼
                              ╱─────────────────╲
   No (No detection)         ╱     Enabling      ╲
  ◄────────────────────────── physical range
                              ╲   detection      ╱
                               ╲─────────────────╱
                                       │ Yes
                                       ▼
                              ╱─────────────────╲
        No                   ╱     Enabling      ╲
  ◄────────────────────────── interrupts
                              ╲                  ╱
                               ╲─────────────────╱
                                       │ Yes
         ▼                             ▼
  ┌─────────────────┐        ┌─────────────────┐
  │  No interrupt   │        │ Selecting interrupt │
  │                 │        │     numbers     │
  └─────────────────┘        └─────────────────┘
```

● The interrupt service routines are I40~I251.

7. PID control

a. KP/KI/KD

Proportional action: The operation amount acts proportionally to the error. When a temperature is lower than a proportional band, the operation amount is 100%. When a temperature is within a proportional band, the operation amount decreases proportionally to the error. When the setting value is the same as the present value, the operation amount is 0%. (Error=Setting value–Present value)

Heater: The setting value is 1000 (100°C), and K_P is 100 (10°C). The relation between the temperature and the operation amount is shown below.

```
     Operation amount
         ▲
         │
  100% ──┤─────────╲
         │          ╲
         │           ╲
         │            ╲
  Heater │             ╲
   0% ───┤..............╲........._____
         │              :        :            ► Temperature
         │              :◄──────►:
         │            Proportional
              90°C      band      100°C
```

Cooler: The setting value is 200 (20°C), and KP is 100 (10°C). The relation between the temperature and the operation amount is shown below.

Integral action: If temperature is controlled by a pure proportional action, there is difference between the temperature controlled and a setting value. Therefore, if an integral action is used with a proportional action, difference decreases as time goes by, and the temperature controlled is the same as the setting value.

Derivative action: With regard to violent environmental change, a derivative action provides more operation amount to make temperature return to its original controlled state.

Control diagram:

The instruction PID is inside the dotted line.

The PID algorithm is as follows.

$$MV = K_P E(t) + K_I \int_0^t E(t)dt + K_D * \frac{dE(t)}{dt}$$

Forward action: $E(t) = PV(t) - SV(t)$

Reverse action: $E(t) = SV(t) - PV(t)$

b. Control mode

Cyclic control mode: Users set a cycle according to a controlled environment. (If the ambient air temperature changes slowly, the cycle can be longer.)

The width of a pulse is defined below.

➢ Pulse width=Output value (MV)/(Maximal output value−Minimal output value)×Cycle

Users can set the width of a pulse and a cycle (sampling time) by means of the instruction GPWM.

Example:

The cycle is 2000 ms, the maximal output value is 100, and the minimal output value is 0. After the PID algorithm is performed, the output value gotten is 50.

➢ Width of a pulse=50/(100-0)×2000 ms=1000 ms

Therefore, the pulse width used in the instruction GPWM is 1000 ms, and the cycle used in the instruction GPWM is 2000 ms.

c. PID parameters

PID parameter		Description
Performing/Not performing the PID algorithm		Bit 0~bit 3: CH0~CH3 (Performing/Not performing the PID algorithm)
Manual/Automatic tuning		Bit 8~bit 11: CH0~CH3 (Manual/Automatic tuning)
Heating/Cooling mode		Bit 0~bit 3: CH0~CH3
Sampling time		One-word decimal format Unit: 10 ms
Automatic mode	Automatic tuning	Bit 0~bit 3: CH0~CH3
	Refreshing the manual output values automatically	Bit 0~bit 3: CH0~CH3
	Target value	One-double word floating-point format
	Proportional gain	One-double word floating-point format
	Integral gain	One-double word floating-point format
	Derivative gain	One-double word floating-point format
	Range within which the error values are count as 0	One-double word floating-point format When the setting value is 0, the function is not enabled. For example, if the setting value is 5, and the difference between the present value and the target value is in the range of -5 to 5, the output value is 0.
	Maximum output value	One-double word floating-point format
	Minimum output value	One-double word floating-point format
	Reading the output value	One-double word floating-point format
	Accumulated integral value	One-double word floating-point format
Manual mode	Manual output value	One-double word floating-point format

d. Additional remarks on PID control
   (1) If K_p, K_i, or K_d is 0, the corresponding function is disabled. For example, if users only want to use proportional control, K_i and K_d are 0.
   (2) If users do not know how to adjust the parameters K_p, K_i, and K_d under a controlled environment, they can use the automatic tuning function to set the parameters, and then finely adjust the parameters to the optimum values. When the automatic tuning function is enabled, the value in a register defined by the users is 1. After the automatic tuning of the parameters is complete, the value in the register becomes 0.
   (3) If users want to set the parameters K_p, K_i, and K_d by themselves, they need to set the K_p by experience, and set the K_i, and K_d to 0. After the tuning of the K_p is complete, the users can tune the K_i, and K_d in order.

5.1.8 Installation

5.1.8.1 Installing a Module

Insert a module into a slot, make sure that the module is installed on the backplane properly, and tighen the the screw, as illustrated below.

1. Insert the projection under the module into the hole in the backplane.
2. Push the module in the direction indicated by the arrow until it clicks.
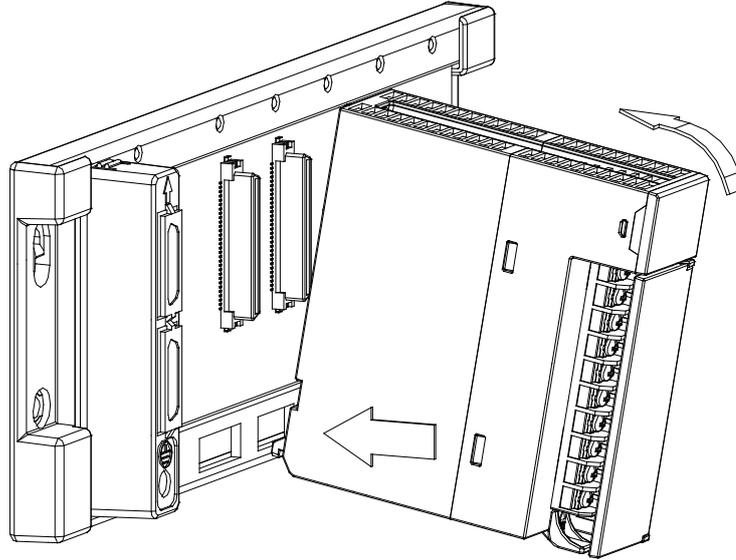
3. Tighten the screw on the module.

5.1.8.2 Installing a Removable Terminal Block

● **Installation**
   1. Level a terminal block at the printed circuit board, and press it into the module.
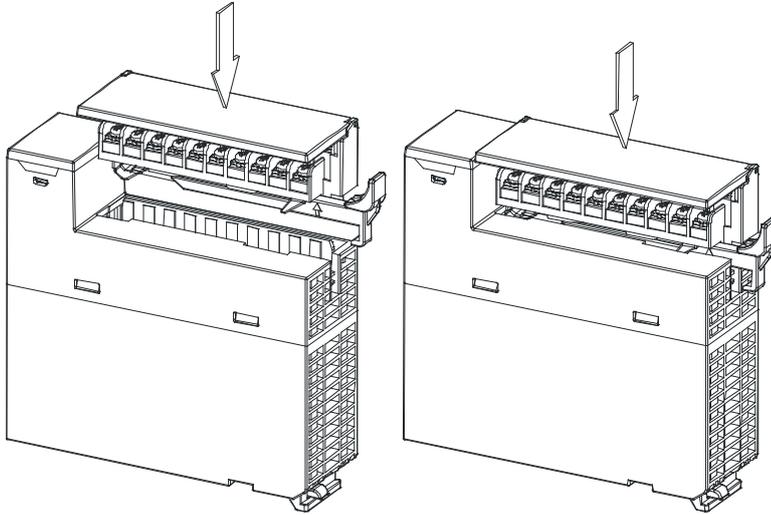
   2. Press the clip in the direction indicated by the arrow.
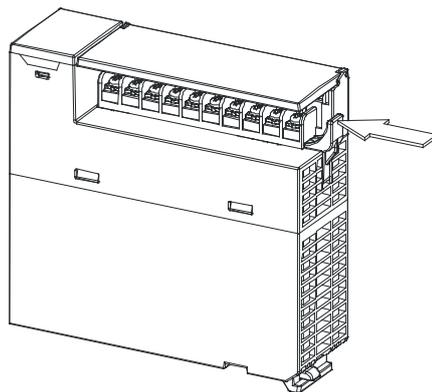
● **Removal**
   1. Pull the clip in the direction indicated by the arrow.
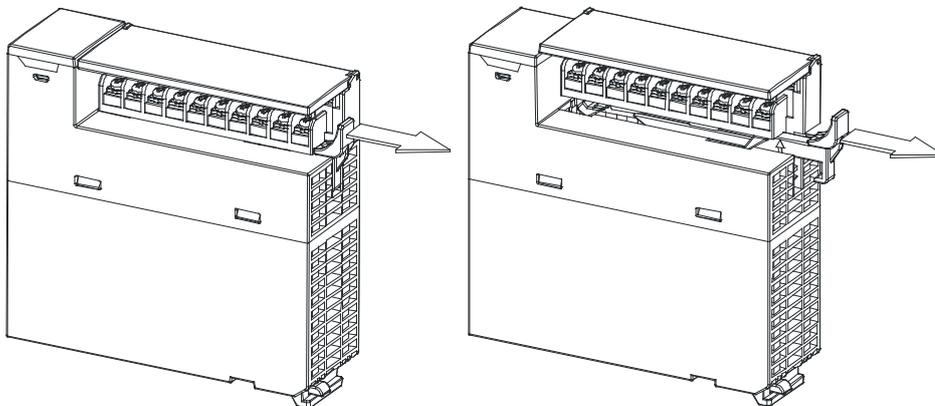
2. Pull up the clip.
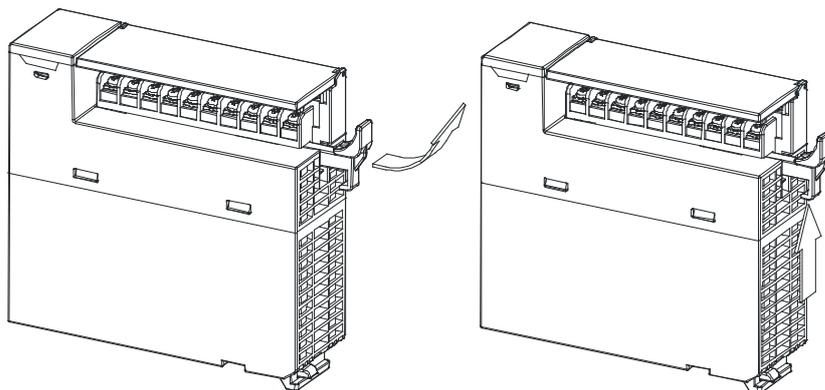
3. The terminal block is removed.
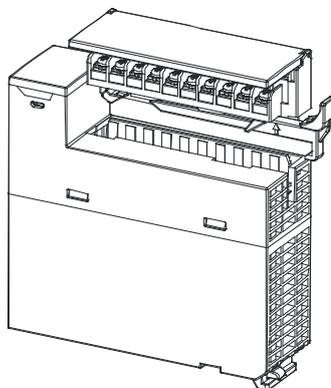
5.1.9 Wiring

● **Precautions**

In order to make the functions of a temperature measurement module perfect and ensure the reliability of a system at the same time, external wiring which prevents noise is necessary. Before installing cables, users need to follow the precautions below.

(1) To prevent a surge and induction, an AC cable and input signal cables which are connected to AH04PT-5A must be separate cables.

(2) A cable must not be installed near a main circuit, a high-voltage cable, or a cable connected to a load which is not a PLC. Besides, a cable must not be bound to a main circuit, a high-voltage cable, or a cable connected to a load which is not a PLC. Otherwise, effects that noise, induction, and a surge have will increase.

(3) Please connect a shielded cable and a hermetically sealed cable with the ground separately.

(4) Terminals with insulation sleeves can not be arranged as a terminal block. It is recommended that the terminals be covered with insulation tubes.

(5) Use cables with the same length (less than 200 m) and use wire resistance of less than 100 ohm.

● **External wiring**
   (1) AH04PT-5A
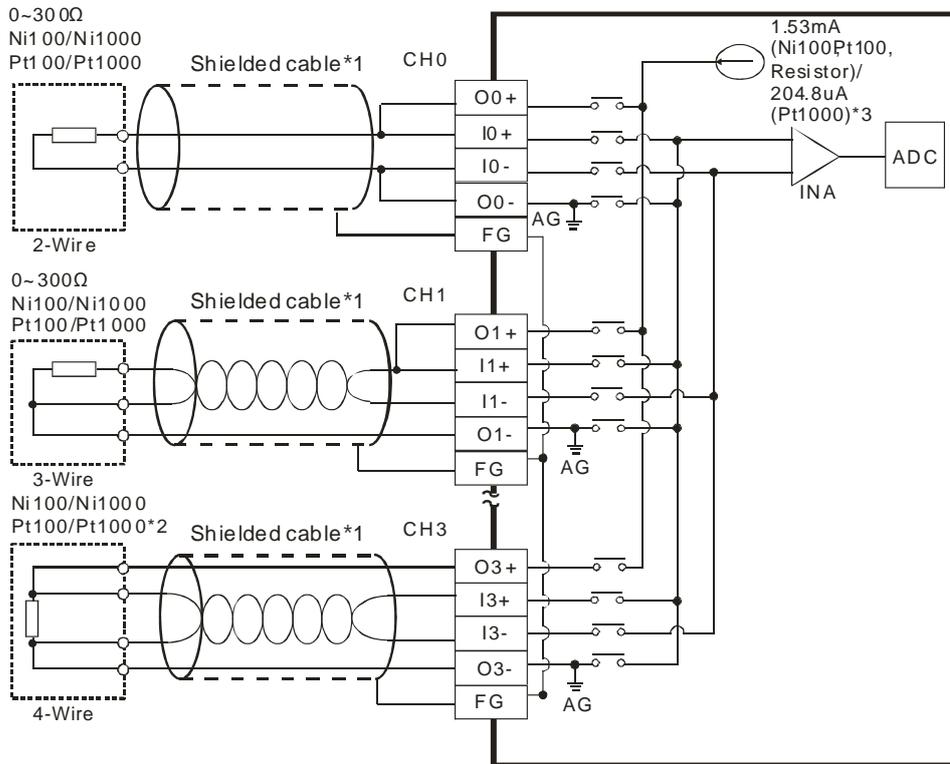
*1. The cables or the shielded twisted pair cables for Ni100/Ni1000/Pt100/Pt1000 temperature sensors are used, and should be kept separate from other power cables and cables which generate noise. Please use a three-wire temperature sensor. If users want to use a two-wire temperature sensor, O**n**+ and I**n**+ have to be short-circuited, and O**n**- and I**n**- have to be short-circuited. (**n** is in the range of 0 to 3.)

*2. If users want to measure the resistance in the range of 0 Ω to 300 Ω, they can use a two-wire or three-wire sensor instead of a four-wire sensor.

*3. User need to select an appropriate sensor. If a Ni100 temperature sensor, a Pt100 sensor, and a resistance sensor are used, the internal excitation current is 1.53 mA. If a Ni1000 temperature sensor, and a Pt1000 temperature sensor are used, the internal excitation current is 204.8 µA.

5.1.10 LED Indicators

Number	Name	Description
1	RUN LED indicator	Operating status of the module ON: The module is running. OFF: The module stops running.
2	ERROR LED indicator	Error status of the module ON: A serious error occurs in the module. OFF: The module is normal. Blink: A slight error occurs in the module.

5.1.11 HWCONFIG in ISPSoft

5.1.11.1 Initial Setting

(1) Start ISPSoft, and then double-click **HWCONFIG**.

(2) Click **I/O scan** on the toolbar.

(3) ISPSoft is scanning the actual hardware configuration.

(4) After the scan of the actual hardware configuration is complete, the system automatically assigns the corresponding registers to the channels. Users can alter the input device range by themselves.

Note: Owing to the fact that values are floating-point numbers, every channel occupies two 16-bit registers.

Slot No.	Label	Firmware Versi...	Descrption	Input Device Ra...	Output Device R...
-	AHPS05-5A	-	AH Power Supply	None	None
-	AHCPU530-EI	1.00	Basic CPU module	None	None
0	AH04PT-5A	1.00	4 x 3/4 wires RTD i	D0 ~ D7	
1					
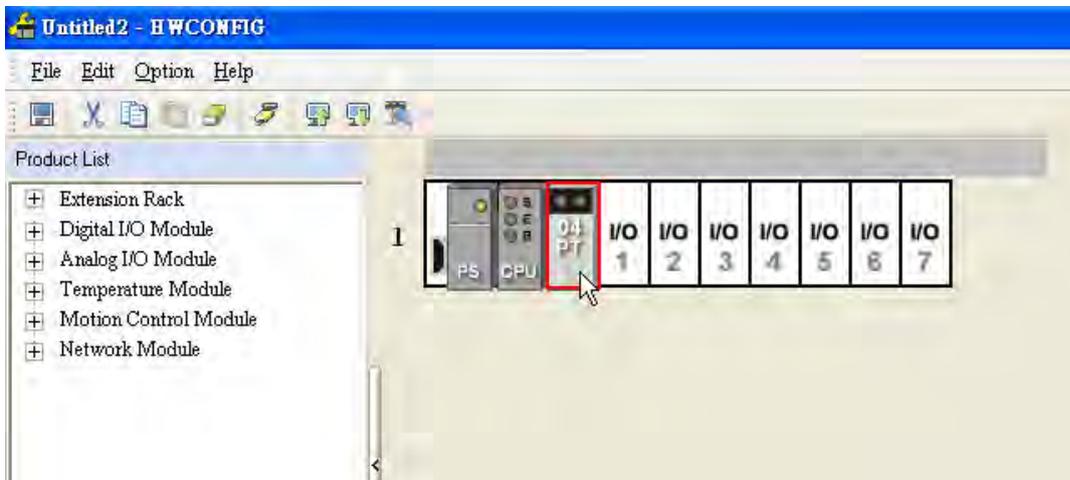
Information: Rack 1

(5) Double-click the module AH04PT-5A.

(6) Open the **Parameter Setting** window.
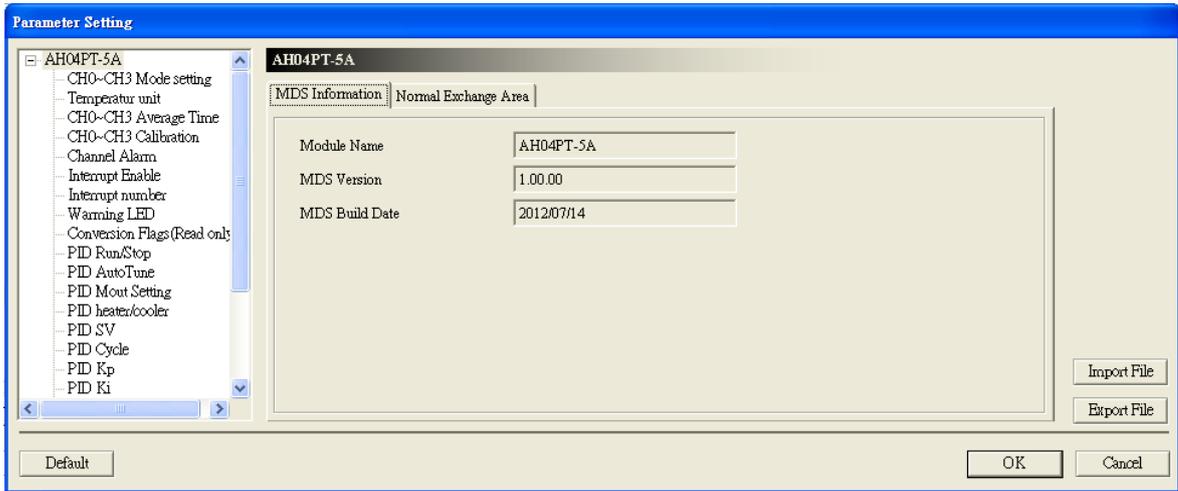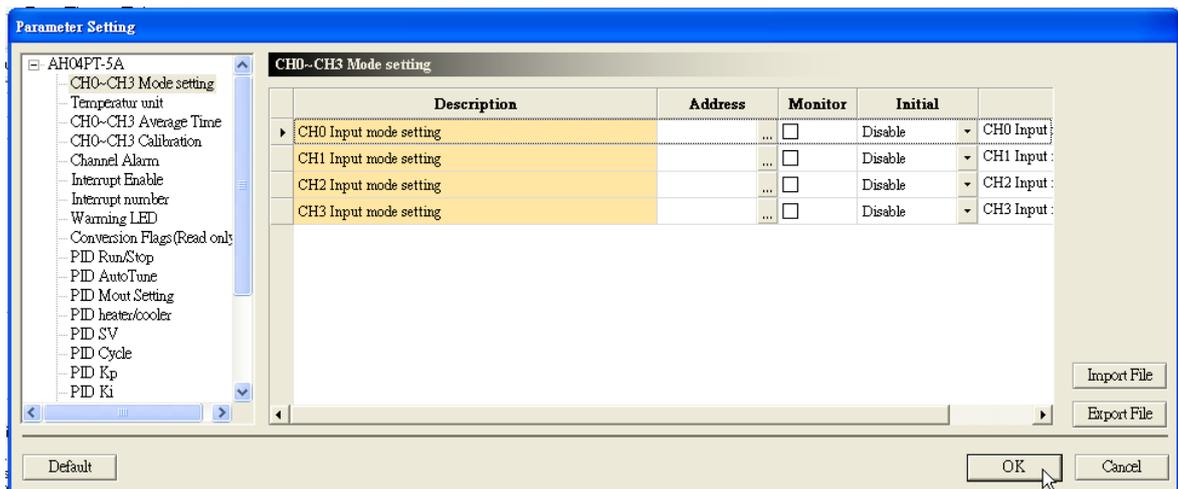
(7) Set the parameters, and then click **OK**.

(8) Click **Download** on the toolbar to download the parameters. (The parameters can not be downloaded when the CPU module runs.)

5.1.11.2 Checking the Version of a Module

(1) On the **Option** menu, click **Online Mode**.

(2) Right-click the module, and then click **Module Information** on the context menu. The version of the firmware and that of the hardware are displayed.

5.1.11.3 Monitoring Table

(1) Select the **Monitor** checkboxes at the right sides of the corresponding registers.
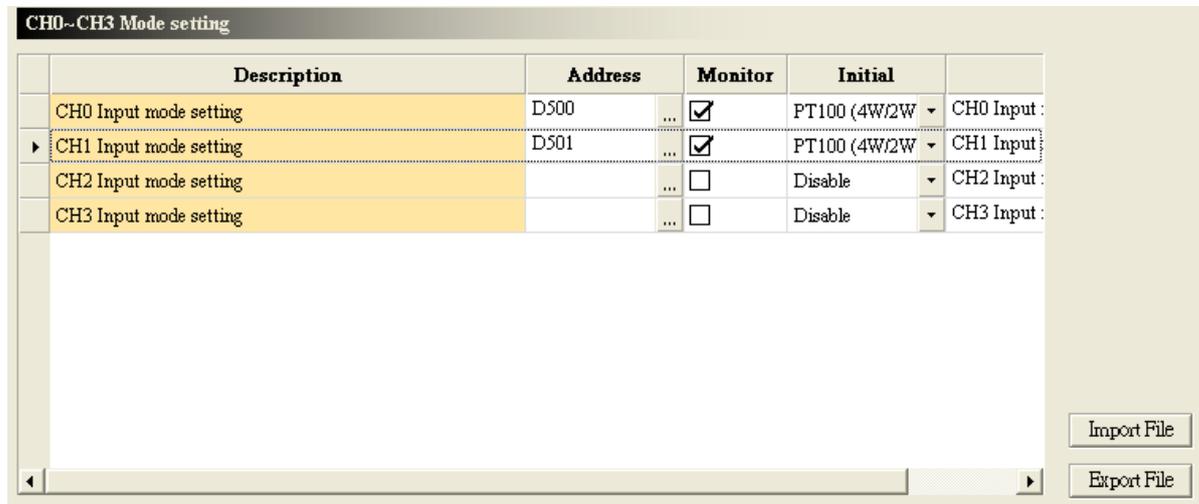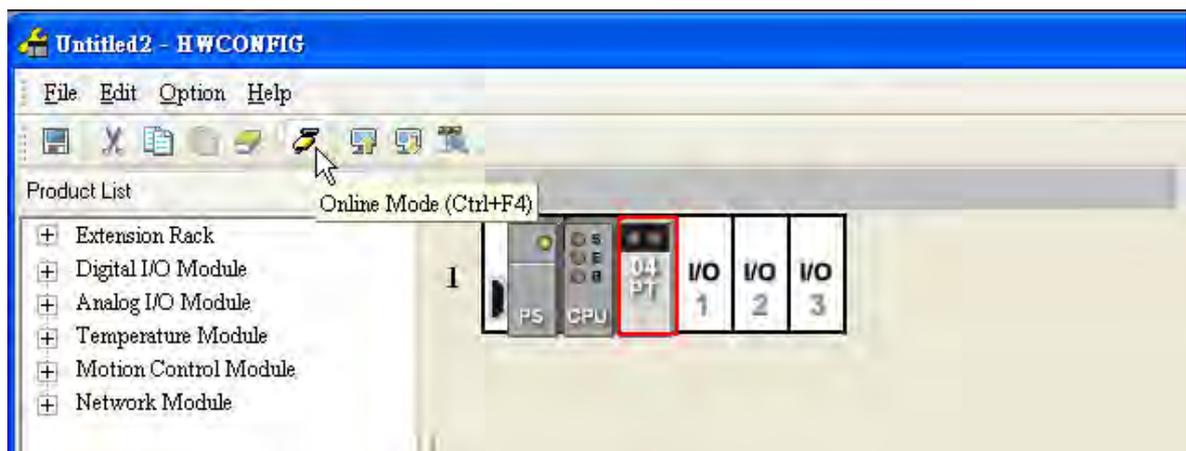
(2) On the **Option** menu, click **Online Mode**.

(3) On the **Option** menu, click **Monitor Table**. The registers are monitored.
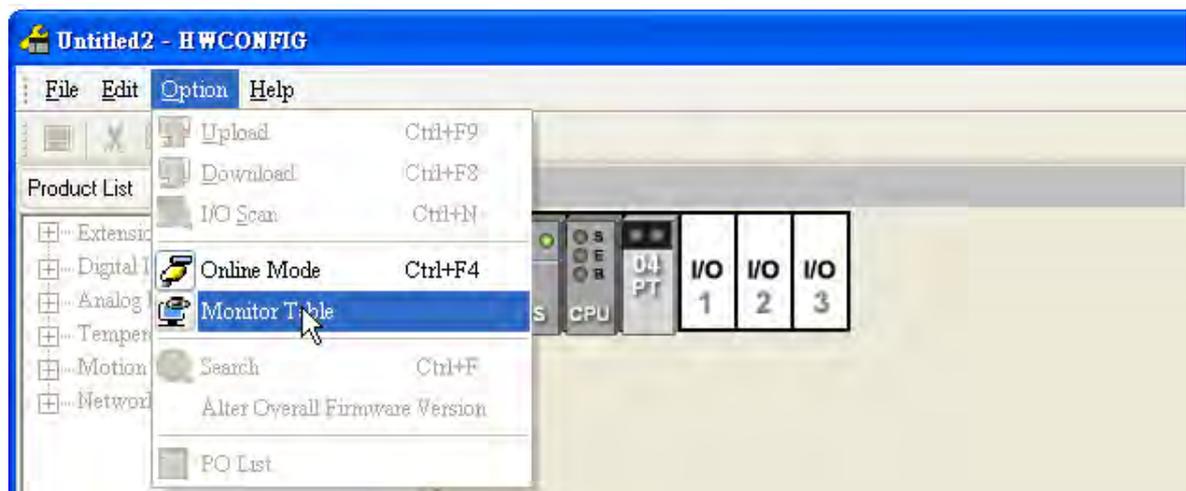
5.1.11.4 Online Mode

(1) Click **Online Mode** on the toolbar.

(2) Double-click the module AH04PT-5A.

(3) If some parameters are altered, users can click **SV➔PV**. The new setting values are written into the CPU module and the I/O module. If users want to read the present values in the I/O module, they can click **Refresh**. The present values in the I/O module are sent to ISPSoft, and are monitored.

5.1.11.5 Importing/Exporting a Parameter File

(1) After **Export** is clicked, the parameters will be saved as a CSV file (.csv).

(2) Click **Import**, and then click the CSV file.

5.1.11.6 Parameters

(1) The input modes of the channels
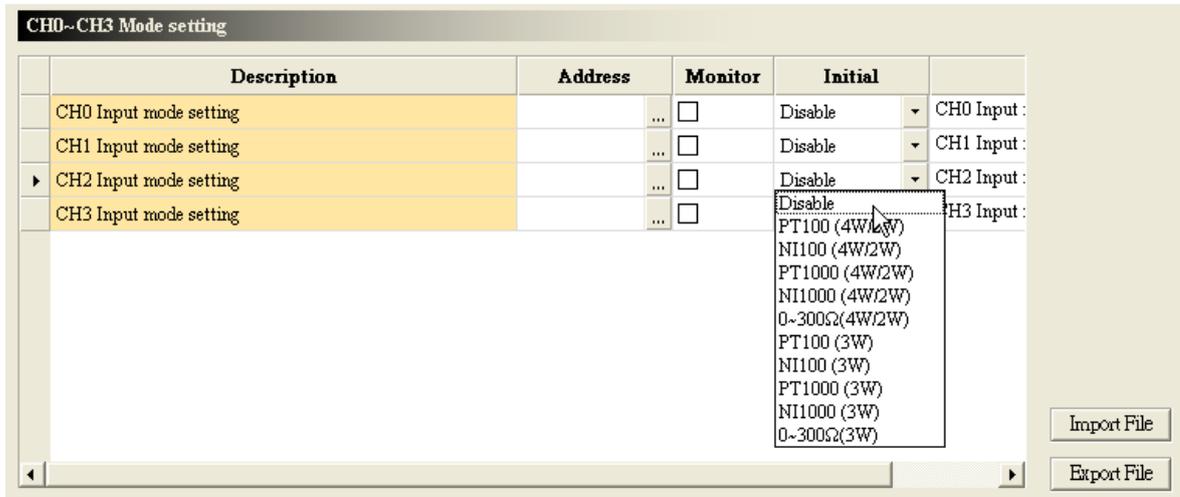
	Description	0: The channel is disabled.
		1: Pt100 sensor
		  (Four-wire/Two wire configuration)
		2: Ni100 sensor
		  (Four-wire/Two wire configuration)
		3: Pt1000 sensor
		  (Four-wire/Two wire configuration)
		4: Ni1000 sensor
		  (Four-wire/Two wire configuration)
		5: 0~300 Ω input impedance
		  (Four-wire/Two wire configuration)
			6: Pt100 sensor
			  (Three-wire configuration)
			7: Ni100 sensor
			  (Three-wire configuration)
			8: Pt1000 sensor
			  (Three-wire configuration)
			9: Ni1000 sensor
			  (Three-wire configuration)
			10: 0~300 Ω input impedance
			  (Three-wire configuration)

(2) Temperature unit (Celsius/Fahrenheit)

Description	K0: Celsius
	K1: Fahrenheit

(3) The number of values averaged

(4) The offsets and the gains used for calibration

(5) The channel detection

Channel Alarm 5-27

	Description	Address	Monitor	Initial	
▶	CH0 Physical Range Detect	...	☐	☑ Enable	CH0 Physi
	CH1 Physical Range Detect		☐	☑ Enable	CH0 Physic
	CH2 Physical Range Detect		☐	☑ Enable	CH0 Physic
	CH3 Physical Range Detect		☐	☑ Enable	CH0 Physic
	CH0 Detect is Alarm or warning		☐	☑ Alarm	CH0 Physic
	CH1 Detect is Alarm or warning		☐	☑ Alarm	CH0 Physic
	CH2 Detect is Alarm or warning		☐	☑ Alarm	CH0 Physic
	CH3 Detect is Alarm or warning		☐	☑ Alarm	CH0 Physic

(6) Enabling the interrupts

Interrupt Enable

	Description	Address	Monitor	Initial	
▶	CH0 Interrupt of Over Physical Range	...	☐	☐ Enable	CH0 Interr
	CH1 Interrupt of Over Physical Range		☐	☐ Enable	CH0 Interr
	CH2 Interrupt of Over Physical Range		☐	☐ Enable	CH0 Interr
	CH3 Interrupt of Over Physical Range		☐	☐ Enable	CH0 Interr

(7) The interrupt numbers

	Description	Address	Monitor	Initial	
▶	Interrupt number that CH0 input value Out of Physical Range	...	☐	40	Interrupt nt
	Interrupt number that CH1 input value Out of Physical Range	...	☐	40	Interrupt nu
	Interrupt number that CH2 input value Out of Physical Range	...	☐	40	Interrupt nu
	Interrupt number that CH3 input value Out of Physical Range	...	☐	40	Interrupt nu

(8) Setting the warning LED indicator

Warning LED

	Description	Address	Monitor	Initial	
▶	Warn of CH0 Input value Out of Physical Range	...	☐	☐ flashing	Warn of CH
	Warn of CH1 Input value Out of Physical Range		☐	☐ flashing	Warn of CH
	Warn of CH2 Input value Out of Physical Range		☐	☐ flashing	Warn of CH
	Warn of CH3 Input value Out of Physical Range		☐	☐ flashing	Warn of CH

Description	Bit 0~bit3: CH0~CH3 (Warning LED indicator) (ON: Flash; OFF: Not flash)

(9) The error codes

Conversion Flags(Read only)				5-29
Description	Address	Monitor	Initial	
▶ Conversion Flags(Read only)	... ☐		0	Conversion

	Bit 0~bit 3: The signals received by the CH0~CH3 exceed the range of
Description	inputs which can be received by the hardware.
	Bit 15: The external voltage is abnormal.

(10) Performing/Not performing the PID algorithm

PID Run/Stop				
Description	Address	Monitor	Initial	
▶ CH0 PID Run/Stop	... ☐		☐ Run	CH0 PID R
CH1 PID Run/Stop		☐	☐ Run	CH0 PID R
CH2 PID Run/Stop		☐	☐ Run	CH0 PID R
CH3 PID Run/Stop		☐	☐ Run	CH0 PID R
CH0 PID MAN		☐	☐ Manual	CH0 PID R
CH1 PID MAN		☐	☐ Manual	CH0 PID R
CH2 PID MAN		☐	☐ Manual	CH0 PID R
CH3 PID MAN		☐	☐ Manual	CH0 PID R

(11) The automatic tuning

	Description	Address	Monitor	Initial	
▶	CH0 PID AutoTune	...	☐	☐ Enable	CH0 PID A
	CH1 PID AutoTune		☐	☐ Enable	CH0 PID A
	CH2 PID AutoTune		☐	☐ Enable	CH0 PID A
	CH3 PID AutoTune		☐	☐ Enable	CH0 PID A

(12) Refreshing the manual output values automatically

	Description	Address	Monitor	Initial	
▶	CH0 PID MoutAuto	...	☐	☐ Enable	CH0 PID N
	CH1 PID MoutAuto		☐	☐ Enable	CH0 PID N
	CH2 PID MoutAuto		☐	☐ Enable	CH0 PID N
	CH3 PID MoutAuto		☐	☐ Enable	CH0 PID N

(13) The heating/cooling mode

	Description	Address	Monitor	Initial	
▶	CH0 PID Heater/Cooler	...	☐	☐ Cooler	CH0 PID H
	CH1 PID Heater/Cooler		☐	☐ Cooler	CH0 PID H
	CH2 PID Heater/Cooler		☐	☐ Cooler	CH0 PID H
	CH3 PID Heater/Cooler		☐	☐ Cooler	CH0 PID H

PID heater/cooler 5-31

(14) The target values

PID SV

	Description	Address	Monitor	Initial	
▶	CH0 SV	...	☐	0.000000	CH0 SV
	CH1 SV	...	☐	0.000000	CH1 SV
	CH2 SV	...	☐	0.000000	CH2 SV
	CH3 SV	...	☐	0.000000	CH3 SV

(15) The sampling time

PID Cycle					
Description		Address	Monitor	Initial	
▶	CH0 Cycle	... ☐		10	CH0 Cycle
	CH1 Cycle	... ☐		10	CH1 Cycle
	CH2 Cycle	... ☐		10	CH2 Cycle
	CH3 Cycle	... ☐		10	CH3 Cycle

(16) The proportional gains

PID Kp					
Description		Address	Monitor	Initial	
▶	CH0 Kp	... ☐		0.000000	CH0 Kp
	CH1 Kp	... ☐		0.000000	CH1 Kp
	CH2 Kp	... ☐		0.000000	CH2 Kp
	CH3 Kp	... ☐		0.000000	CH3 Kp

(17) The integral gains

PID Ki					5-33
	Description	Address	Monitor	Initial	
▶	CH0 Ki	...	☐	0.000000	CH0 Ki
	CH1 Ki	...	☐	0.000000	CH1 Ki
	CH2 Ki	...	☐	0.000000	CH2 Ki
	CH3 Ki	...	☐	0.000000	CH3 Ki

(18) The derivative gains

PID Kd					
	Description	Address	Monitor	Initial	
▶	CH0 Kd	...	☐	0.000000	CH0 Kd
	CH1 Kd	...	☐	0.000000	CH1 Kd
	CH2 Kd	...	☐	0.000000	CH2 Kd
	CH3 Kd	...	☐	0.000000	CH3 Kd

(19) The range within which the error values are count as 0

PID ERR_DBW					
Description		Address	Monitor	Initial	
▶	CH0 ERR_DBW	... ☐		0.000000	CH0 ERR_
	CH1 ERR_DBW	... ☐		0.000000	CH1 ERR_
	CH2 ERR_DBW	... ☐		0.000000	CH2 ERR_
	CH3 ERR_DBW	... ☐		0.000000	CH3 ERR_

(20) The manual output values

PID MOUT					
Description		Address	Monitor	Initial	
▶	CH0 MOUT	... ☐		0.000000	CH0 MOU
	CH1 MOUT	... ☐		0.000000	CH1 MOU
	CH2 MOUT	... ☐		0.000000	CH2 MOU
	CH3 MOUT	... ☐		0.000000	CH3 MOU

(21) The maximum output values

	Description	Address	Monitor	Initial	
▶	CH0 MV_MAX	...	☐	0.000000	CH0 MV_ℕ
	CH1 MV_MAX	...	☐	0.000000	CH1 MV_ℕ
	CH2 MV_MAX	...	☐	0.000000	CH2 MV_ℕ
	CH3 MV_MAX	...	☐	0.000000	CH3 MV_ℕ

PID MV_MAX

(22) The minimum output values

	Description	Address	Monitor	Initial	
▶	CH0 MV_MIN	...	☐	0.000000	CH0 MV_ℕ
	CH1 MV_MIN	...	☐	0.000000	CH1 MV_ℕ
	CH2 MV_MIN	...	☐	0.000000	CH2 MV_ℕ
	CH3 MV_MIN	...	☐	0.000000	CH3 MV_ℕ

PID MV_MIN

(23) Reading the output values

Description	Address	Monitor	Initial	
▶ CH0 MV(Read only)	...	☐	0.000000	CH0 MV(R
CH1 MV(Read only)	...	☐	0.000000	CH1 MV(R
CH2 MV(Read only)	...	☐	0.000000	CH2 MV(R
CH3 MV(Read only)	...	☐	0.000000	CH3 MV(R

PID MV(Read only)

(24) The accumulated integral values

Description	Address	Monitor	Initial	
▶ CH0 I_MV(Read only)	...	☐	0.000000	CH0 I_MV
CH1 I_MV(Read only)	...	☐	0.000000	CH1 I_MV
CH2 I_MV(Read only)	...	☐	0.000000	CH2 I_MV
CH3 I_MV(Read only)	...	☐	0.000000	CH3 I_MV

PID I_MV(Read only)

5.1.12 Troubleshooting

5.1.12.1 Error Codes

Error Code	Type	Description	RUN LED indicator	ERROR LED indicator
16#A600	Alarm	Hardware failure	OFF	ON
16#A601	Alarm	The external voltage is abnormal.	OFF	ON
16#A603	Alarm	Internal error The factory correction is abnormal.	OFF	ON
16#A400	Alarm	The signal received by channel 0 exceeds the range of inputs which can be received by the hardware.	OFF	ON
16#A401	Alarm	The signal received by channel 1 exceeds the range of inputs which can be received by the hardware.	OFF	ON
16#A402	Alarm	The signal received by channel 2 exceeds the range of inputs which can be received by the hardware.	OFF	ON
16#A403	Alarm	The signal received by channel 3 exceeds the range of inputs which can be received by the hardware.	OFF	ON
16#A000	Warning	The signal received by channel 0 exceeds the range of inputs which can be received by the hardware.	ON	Blink
16#A001	Warning	The signal received by channel 1 exceeds the range of inputs which can be received by the hardware.	ON	Blink
16#A002	Warning	The signal received by channel 2 exceeds the range of inputs which can be received by the hardware.	ON	Blink
16#A003	Warning	The signal received by channel 3 exceeds the range of inputs which can be received by the hardware.	ON	Blink
16#A800	Warning	The signal received by channel 0 exceeds the range of inputs which can be received by the hardware.	ON	OFF
16#A801	Warning	The signal received by channel 1 exceeds the range of inputs which can be received by the hardware.	ON	OFF
16#A802	Warning	The signal received by channel 2 exceeds the range of inputs which can be received by the hardware.	ON	OFF
16#A803	Warning	The signal received by channel 3 exceeds the range of inputs which can be received by the hardware.	ON	OFF

5.1.12.2 Troubleshooting Procedure

Description	Procedure
Hardware failure	Return the module to the factory for repair.
The external voltage is abnormal.	Check whether the external 24 V power supply to the module is normal.
Internal error The factory correction is abnormal.	Please contact the factory.
The signal received by channel 0 exceeds the range of inputs which can be received by the hardware.	Check the signal received by channel 0.
The signal received by channel 1 exceeds the range of inputs which can be received by the hardware.	Check the signal received by channel 1
The signal received by channel 2 exceeds the range of inputs which can be received by the hardware.	Check the signal received by channel 2.
The signal received by channel 3 exceeds the range of inputs which can be received by the hardware.	Check the signal received by channel 3.

5.2 AH08PTG-5A

5.2.1 Overview

The specifications for a temperature measurement module, the operation, and the programming are described in this section. AH08PTG-5A is a temperature measurement module. It converts the temperatures received from its eight thermocouples into digital signals. Users can select the degree Celsius or the degree Fahrenheit as a unit of measurement for temperature.

5.2.2 Characteristics

(1) **A sensor is selected according to practical application.**
Pt100/Ni100/Pt1000/Ni1000 sensor

(2) **The channels in a module are isolated from one another.**
Every two channels in a module form a group. There are four groups. The groups are isolated from one another by transformers. Every group has its independent power and analog-to-digital circuit. The speed at which the module converts analog signals into digital signals is increased. If a channel in a group is damaged, the operation of other channels will not be affected.

The channels in a group are isolated from each other by an optocoupler. They do not form a circuit.

(3) **Conversion speed**
The two channels in a group convert the temperatures they receive into digital signals. A fast mode can only be applied to one of the channel in a group. If users want to use the fast mode, it is suggested that they should use a four-wire/two-wire configuration. If a three-wire RTD is used in the quick mode, there will be a need for thermocouple compensating cables and reliability, and the conversion time required will be the same as that in a general mode.

- Quick mode:
  Four-wire/Two-wire configuration: 20 ms/channel
  Three-wire configuration: 200 ms/channel
- General mode: A conversion time will be gotten after the conversion time of the two channels in a group is added up.
  Two-wire/Four-wire configuration: 200 ms/channel
  Three-wire configuration: 400 ms/channel

(4) **High accuracy**

The error is ±1°C of a Pt100/Pt1000/Ni100/Ni1000 sensor's temperature.

The error is ±0.1% of a resistance in the range of 0 Ω to 300 Ω.

(5) **High stability**

High-level analog parts are used to strengthen the function of automatically filtering 50/60/400 Hz signals, and the function of suppressing noise.

(6) **Disconnection detection**

When a sensor is disconnected, AH08PTG-5A gives an alarm or a warning.

(7) **PID control**

An object can be maintained at a desired temperature through a PID control action.

(8) **A module can be set by means of utility software.**

HWCONFIG is built-in utility software in ISPSoft. Users can set modes and parameters in HWCONFIG to complete hardware configuration without spending time writing a program to set registers corresponding to functions.

5.2.3 Specifications

Electrical specifications

Number of analog inputs	8
Applicable sensor	Three-wire configuration: Pt100/Ni100/Pt1000/Ni1000 sensor, and 0~300 Ω input impedance Two-wire/Four-wire configuration: Pt100/Ni100/Pt1000/Ni1000 sensor, and 0~300 Ω input impedance Pt100: DIN 43760-1980 JIS C1604-1989; 100 Ω 3850 PPM/°C Pt1000: DIN EN60751; 1 kΩ 3850 PPM/°C Ni100/Ni1000: DIN 43760
Supply voltage	24 V DC (20.4 V DC~28.8 V DC) (-15%~+20%)
Connector type	Removable terminal block
Overall accuracy	The error allowed is ±1°C of a Pt100/Pt1000/Ni100/Ni1000 sensor's temperature. The error allowed is ±0.1% of 300 Ω.
Conversion time	● Quick mode: Four-wire/Two-wire configuration: 20 ms/channel Three-wire configuration: 200 ms/channel ● General mode: A conversion time will be gotten after the conversion time of the two channels in a group is added up. Two-wire/Four-wire configuration: 200 ms/channel Three-wire configuration: 400 ms/channel
Isolation	An analog circuit is isolated from a digital circuit by a digital integrated circuit, and the analog channels are isolated from one another by optocouplers. Isolation between a digital circuit and the ground: 500 V DC Isolation between an analog circuit and the ground: 500 V DC Isolation between an analog circuit and a digital circuit: 500 V DC Isolation between two group circuits: 500 V DC Isolation between the 24 V DC and the ground: 500 V DC

Functional specifications

Analog-to-digital conversion	Centigrade (°C)	Fahrenheit (°F)	Input impedance
Rated input range	Pt100: -180°C~800°C Ni100: -80°C~170°C Pt1000: -180°C~800°C Ni1000: -80°C~170°C	Pt100: -292°F~1,472°F Ni100: -112°F~338°F Pt1000: -292°F~1,472°F Ni1000: -112°F~338°F	0~300 Ω
Average function	Range: 1~100		
Self-diagnosis	Disconnection detection		

5.2.4 Profile

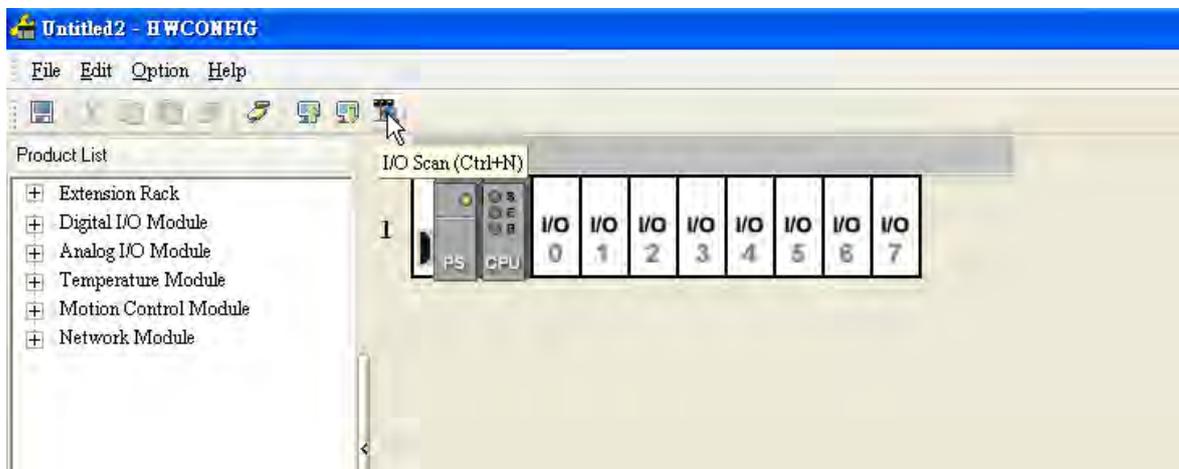| Number	Name	Description
1	Model name	Model name of the module
2	RUN LED indicator	Operating status of the module ON: The module is running. OFF: The module stops running.
2	ERROR LED indicator	Error status of the module ON: A serious error occurs in the module. OFF: The module is normal. Blink: A slight error occurs in the module.
3	Removable terminal block	The inputs are connected to sensors.
4	Arrangement of the input terminals	Arrangement of the terminals
5	Description of the inputs	Simple specifications for the module
6	Set screw	Fixing the module
7	Label	Nameplate
8	Projection	Fixing the module

5.2.5 Dimensions

Unit: mm
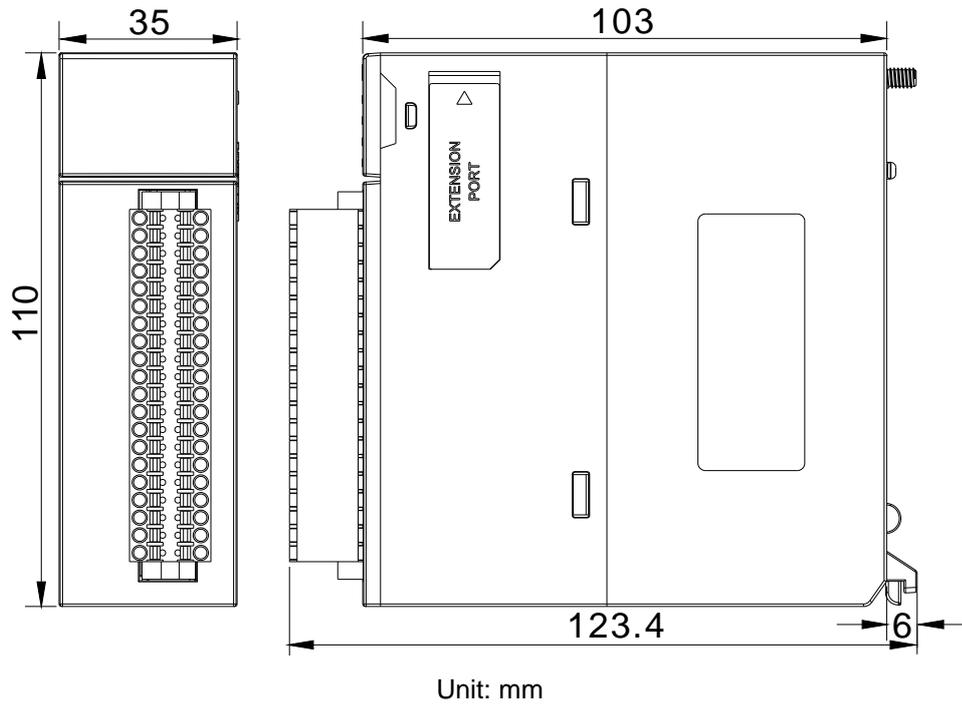
5.2.6 Arrangement of Terminals

5.2.7 Functions

Item	Function	Description
1	Enabling/Disabling a channel	1. Users can enable or disable a channel. 2. If a channel is disabled, the total conversion time is decreased.
2	Temperature unit	Users can select the degree Celsius (°C) or the degree Fahrenheit (°F) as a unit of measurement for temperature.
3	Calibration	Users can calibrate a linear curve.
4	Average	Conversion values are averaged and filtered.
5	Disconnection detection	When a sensor is disconnected, AH08PTG-5A gives an alarm or a warning.
6	Channel detection	If an input signal exceeds a range of inputs which can be received by hardware, the module will give an alarm or a warning. a. Warning LED indicator: When a warning occurs, the ERROR LED indicator blinks or does not blink. b. Interrupt: An interrupt service routine is enabled.
7	PID control	An object can be maintained at a desired temperature through a PID control action.

1. Enabling/Disabling a channel

The channels in AH08PTG-5A in a general mode are not disabled. The efficiency of the module is increased, and a feedback is given to a disconnection detection message.

2. Temperature unit

Users can select the degree Celsius (°C) or the degree Fahrenheit (°F) as a unit of measurement for temperature.

3. Calibration

- To make a curve meet actual needs, users can calibrate the curve by changing an offset and a gain. A calibration range depends on a range of inputs which can be received by hardware.
- The range of offsets used for calibration is -1.0~1.0, and the range of gains used for calibration is 0.9~1.1.

Example 1:

The temperatures -100℃~100℃ correspond to the digital values -100~100. The original signals are used. The gain is 1, and the offset is 0. The temperature received by the channel is 0℃, and the digital value is -1. The temperature received by the channel is 100℃, and the digital value is 99. Users can calibrate the channel by calibrating the gain and the offset.

The users can get the gain for the calibration by means of the equations below.

Gain=(Y2-Y1)/(X2-X1)=[99-(-1)]/(100-0)=1

Gain used for calibration=1/Gain=1/1=1

The users can get the offset for the calibration by means of the equations below.

Offset=Y1=-1

Offset used for calibration=1-Y1=1

(X: Temperature; Y: Digital value)

Example 2:

The temperatures -100℃~100℃ correspond to the digital values -100~100. The original signals are used. The gain is 1, and the offset is 0. The temperature received by the channel is 0℃, and the digital value is 0. The temperature received by the channel is 100℃, and the digital value is 101. Users can calibrate the channel by calibrating the gain and the offset.

The users can get the gain for the calibration by means of the equations below.
Gain=(Y2-Y1)/(X2-X1)=[101-0]/(100-0)=1.01
Gain used for calibration=1/Gain=1/1.01=0.99

The users can get the offset for the calibration by means of the equations below.
Offset=Y1=0
Offset used for calibration=0-Y1=0

(X: Temperature; Y: Digital value)

4. Average

Digital values are averaged. The number by which the sum of several digital values is divided is between 1 and 100. The sampled values are taken as a queue, and the length of the queue is N. Each time a new sampled value is put at the end of the queue, an original value at the start of the queue is removed. The N values are averaged so that the periodic noise is suppressed.

5. Disconnection detection

If a channel is enabled, the module will check whether a sensor is disconnected. If an input circuit is an open circuit, the module will give an alarm. Please refer to description below for more information.

A four-wire Pt100 sensor is taken for instance.

810: Maximum temperature

-190: Minimum temperature

n: 0~7

Disconnection	Result	Disconnection	Result
On+	-190 (Minimum temperature)	On- , In+	-190 (Minimum temperature)
On-	-190 (Minimum temperature)	On- , In-	-190 (Minimum temperature)
In+	810 (Maximum temperature)	In+ , In-	-190 (Minimum temperature)
In-	-190 (Minimum temperature)	On+ , On- , In+	-190 (Minimum temperature)
On+ , In+	810 (Maximum temperature)	On+ , On- , In-	-190 (Minimum temperature)
On+ , In-	-190 (Minimum temperature)	On+ , In+ , In-	-190 (Minimum temperature)
On+ , On-	-190 (Minimum temperature)	On- , In+ , In-	-190 (Minimum temperature)

A three-wire Pt100 sensor is taken for instance.

810: Maximum temperature

-190: Minimum temperature

n: 0~7

Disconnection	Result	Disconnection	Result
On+	-190 (Minimum temperature)	On- , In+	810 (Maximum temperature)
On-	-190 (Minimum temperature)	On- , In-	-190 (Minimum temperature)
In+	810 (Maximum temperature)	In+ , In-	810 (Maximum temperature)
In-	810 (Maximum temperature)	On+ , On- , In+	810 (Maximum temperature)
On+ , In+	810 (Maximum temperature)	On+ , On- , In-	810 (Maximum temperature)
On+ , In-	810 (Maximum temperature)	On+ , In+ , In-	810 (Maximum temperature)
On+ , On-	-190 (Minimum temperature)	On- , In+ , In-	810 (Maximum temperature)

6. Channel detection

If an input signal exceeds a range of inputs which can be received by hardware, an error message appears. Please refer to section 5.2.1 for more information.

a. Giving alarms or warnings

The procedure below explains how to set a module so that it gives an alarm or a warning.

```
                                                   ╱‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾╲
                                                  <    Channel       >
                                                   ╲   detection    ╱
                                                    ╲_____╱
                                                           │
                                                           ▼
  No (No detection)                                  ╱‾‾‾‾‾‾‾‾‾‾‾╲
┌────────────────────┐                              ╱  Enabling    ╲
│ There are no error │◄────────────────────────────◄ physical range ►
│ logs in the CPU    │                              ╲  detection   ╱
│ module and the     │                               ╲_____╱
│ temperature        │                                     │ Yes
│ measurement module.│                                     ▼
└────────────────────┘
                              No (Warning)              ╱‾‾‾‾‾‾‾‾╲
                       ┌───────────────────────────────◄ Giving   ►
                       │                                ╲ alarms  ╱
                       │                                 ╲_____╱
                       │                                    │ Yes
                       ▼                                    ▼
                  ╱‾‾‾‾‾‾‾‾╲                     ┌────────────────────┐
         No      ╱ The warning╲                  │ The BUS FAULT LED  │
    ┌───────────◄ LED indicators►                │ indicator on the   │
    │            ╲  blink.    ╱                   │ CPU module and the │
    │             ╲_____╱                     │ ERROR LED indicator│
    │                 │ Yes                       │ on the temperature │
    ▼                 ▼                           │ measurement module │
```

| No → | The warning LED indicators blink. | Yes → | The BUS FAULT LED indicator on the CPU module and the ERROR LED indicator on the temperature measurement module are ON. There are error logs in the CPU module and the temperature measurement module. |

The BUS FAULT LED indicator on the CPU module and the ERROR LED indicator on the temperature measurement module are not ON.
There are error logs in the CPU module and the temperature measurement module.

The BUS FAULT LED indicator on the CPU module and the ERROR LED indicator on the temperature measurement module blink.
There are error logs in the CPU module and the temperature measurement module.

b. Interrupt service routine

The procedure below explains how to trigger an interrupt service routine in a CPU module.

```
                           ╭─────────────╮
                           │   Channel   │
                           │  detection  │
                           │Alarm/Warning│
                           ╰──────┬──────╯
                                  │
                                  ▼
No (No detection)          ╱───────────╲
◄──────────────────────────  Enabling
│                            physical range
│                            detection
│                          ╲───────────╱
│                                  │ Yes
│                                  ▼
│           No              ╱───────────╲
│◄──────────────────────────  Enabling
│                             interrupts
│                          ╲───────────╱
│                                  │ Yes
▼                                  ▼
┌─────────────┐            ┌──────────────────┐
│No interrupt │            │Selecting interrupt│
│             │            │     numbers      │
└─────────────┘            └──────────────────┘
```

● The interrupt service routines are I40~I251.

7. PID control

a. KP/KI/KD

Proportional action: The operation amount acts proportionally to the error. When a temperature is lower than a proportional band, the operation amount is 100%. When a temperature is within a proportional band, the operation amount decreases proportionally to the error. When the setting value is the same as the present value, the operation amount is 0%. (Error=Setting value–Present value)

Heater: The setting value is 1000 (100°C), and K_P is 100 (10°C). The relation between the temperature and the operation amount is shown below.

Cooler: The setting value is 200 (20°C), and KP is 100 (10°C). The relation between the temperature and the operation amount is shown below.

Integral action: If temperature is controlled by a pure proportional action, there is difference between the temperature controlled and a setting value. Therefore, if an integral action is used with a proportional action, difference decreases as time goes by, and the temperature controlled is the same as the setting value.

Derivative action: With regard to violent environmental change, a derivative action provides more operation amount to make temperature return to its original controlled state.

Control diagram:

The instruction PID is inside the dotted line.

The PID algorithm is as follows.

$$MV = K_P E(t) + K_I \int_0^t E(t)dt + K_D * \frac{dE(t)}{dt}$$

Forward action: $E(t) = PV(t) - SV(t)$

Reverse action: $E(t) = SV(t) - PV(t)$

b. Control mode

Cyclic control mode: Users set a cycle according to a controlled environment. (If the ambient air temperature changes slowly, the cycle can be longer.)

The width of a pulse is defined below.

➢ Pulse width=Output value (MV)/(Maximal output value–Minimal output value)×Cycle

Users can set the width of a pulse and a cycle (sampling time) by means of the instruction GPWM.

Example:

The cycle is 2000 ms, the maximal output value is 100, and the minimal output value is 0. After the PID algorithm is performed, the output value gotten is 50.

➢ Width of a pulse=50/(100-0)×2000 ms=1000 ms

Therefore, the pulse width used in the instruction GPWM is 1000 ms, and the cycle used in the instruction GPWM is 2000 ms.

c. PID parameters

PID parameter		Description
Performing/Not performing the PID algorithm		Bit 0~bit 7: CH0~CH7 (Performing/Not performing the PID algorithm)
Manual/Automatic tuning		Bit 8~bit 15: CH0~CH7 (Manual/Automatic tuning)
Heating/Cooling mode		Bit 0~bit 7: CH0~CH7
Sampling time		One-word decimal format Unit: 10 ms
Automatic mode	Automatic tuning	Bit 0~bit 7: CH0~CH7
	Refreshing the manual output values automatically	Bit 0~bit 7: CH0~CH7
	Target value	One-double word floating-point format
	Proportional gain	One-double word floating-point format
	Integral gain	One-double word floating-point format
	Derivative gain	One-double word floating-point format
	Range within which the error values are count as 0	One-double word floating-point format When the setting value is 0, the function is not enabled. For example, if the setting value is 5, and the difference between the present value and the target value is in the range of -5 to 5, the output value is 0.
	Maximum output value	One-double word floating-point format
	Minimum output value	One-double word floating-point format
	Reading the output value	One-double word floating-point format
	Accumulated integral value	One-double word floating-point format
Manual mode	Manual output value	One-double word floating-point format

d. Additional remarks on PID control

(1)   If K_p, K_i, or K_d is 0, the corresponding function is disabled. For example, if users only want to use proportional control, K_i and K_d are 0.

(2)   If users do not know how to adjust the parameters K_p, K_i, and K_d under a controlled environment, they can use the automatic tuning function to set the parameters, and then finely adjust the parameters to the optimum values. When the automatic tuning function is enabled, the value in a register defined by the users is 1. After the automatic tuning of the parameters is complete, the value in the register becomes 0.

(3)   If users want to set the parameters K_p, K_i, and K_d by themselves, they need to set the K_p by experience, and set the K_i, and K_d to 0. After the tuning of the K_p is complete, the users can tune the K_i, and K_d in order.

5.2.8 Installation

5.2.8.1 Installing a Module

Insert a module into a slot, make sure that the module is installed on the backplane properly, and tighen the the screw, as illustrated below.

1. Insert the projection under the module into the hole in the backplane.
2. Push the module in the direction indicated by the arrow until it clicks.
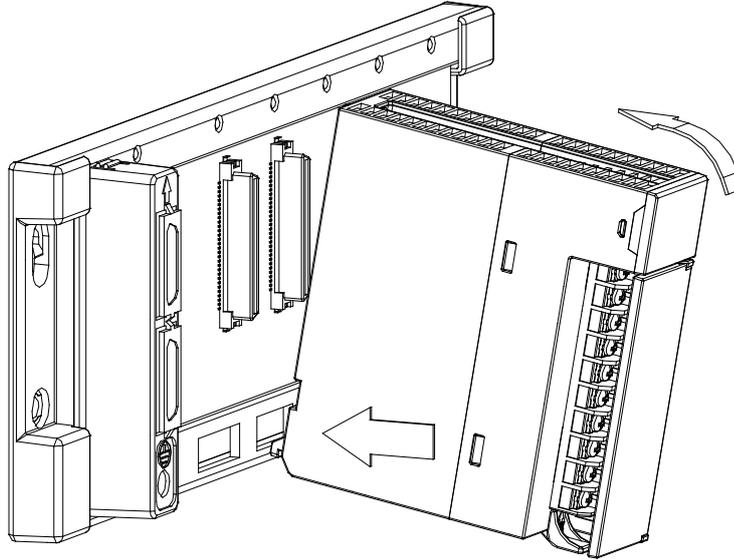
3. Tighten the screw on the module.
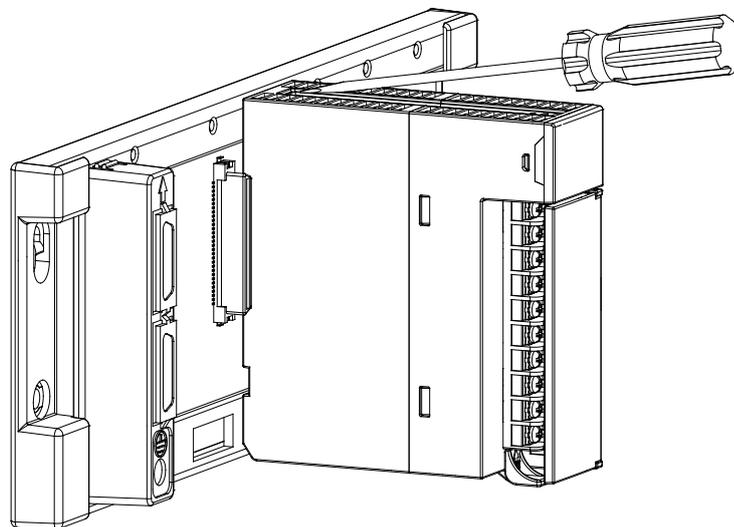
5.2.8.2 Installing a Removable Terminal Block

● **Installation**

1. Level a terminal block at the printed circuit board, and press it into the module.
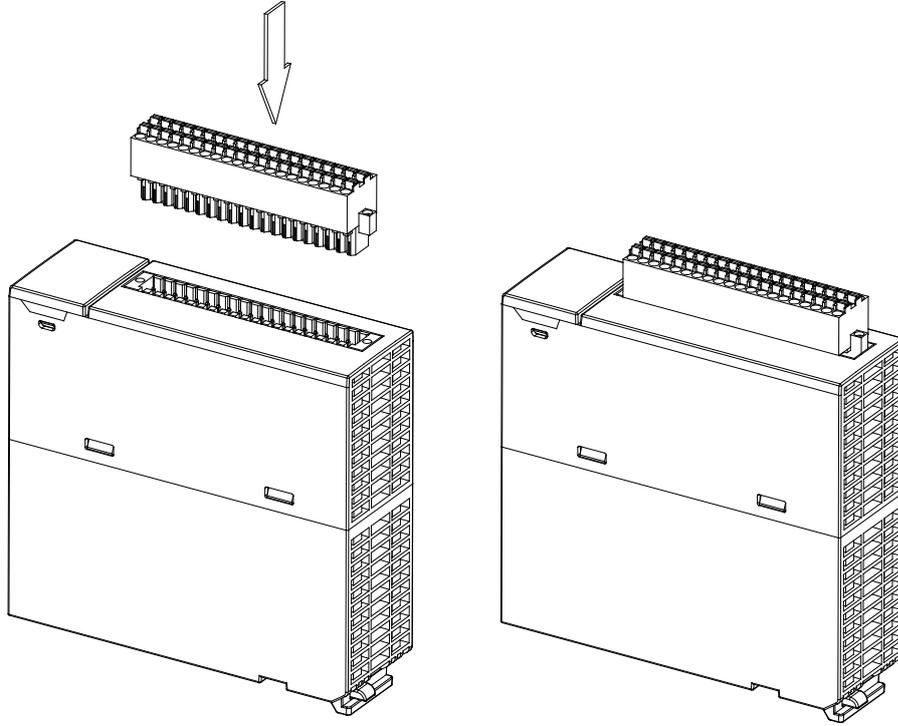
2. Tighten the screws on the removable terminal block by means of a screwdriver.
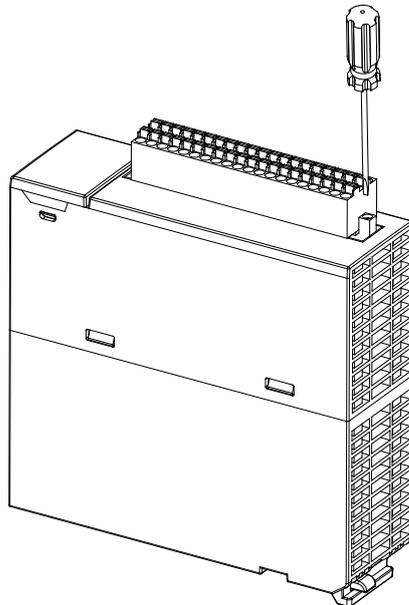
● **Removal**

    1.   Loosen the screws on the removable terminal block by means of a screwdriver.
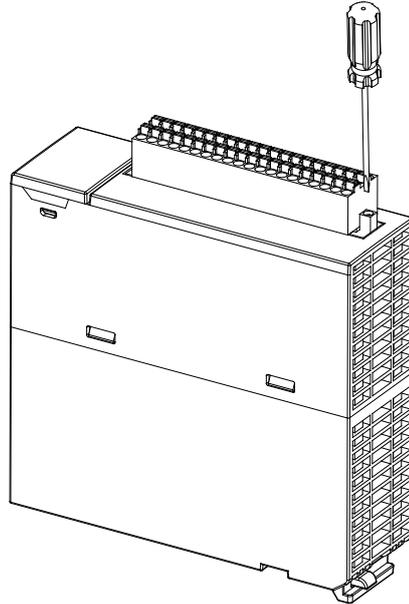
    2.   Pull up the removable terminal block.
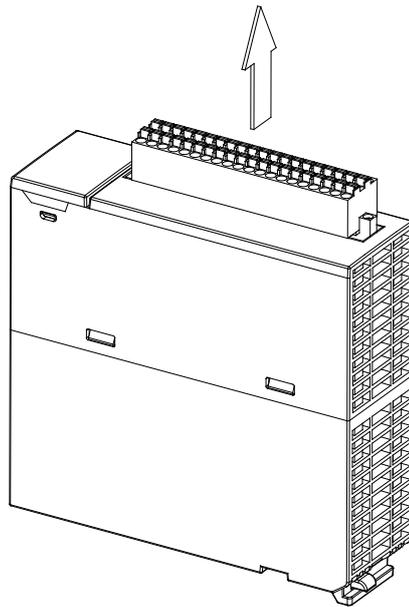
5.2.9 Wiring

● **Precautions**

In order to make the functions of a temperature measurement module perfect and ensure the reliability of a system at the same time, external wiring which prevents noise is necessary. Before installing cables, users need to follow the precautions below.

(1) To prevent a surge and induction, an AC cable and input signal cables which are connected to AH08PTG-5A must be separate cables.

(2) A cable must not be installed near a main circuit, a high-voltage cable, or a cable connected to a load which is not a PLC. Besides, a cable must not be bound to a main circuit, a high-voltage cable, or a cable connected to a load which is not a PLC. Otherwise, effects that noise, induction, and a surge have will increase.

(3) Please connect a shielded cable and a hermetically sealed cable with the ground separately.

(4) Terminals with insulation sleeves can not be arranged as a terminal block. It is recommended that the terminals be covered with insulation tubes.

(5) The diameters of the input/output cables used should be in the range of 30 AWG to 24 AWG (0.3 mm to 0.6 mm). The lengths of the plastic jackets removed should be in the range of 7 mm to 8 mm. The specifications for the terminals on AH08PTG-5A and the wiring of the terminals are shown below. The temperature of the copper lead wires used should be 60/75°C.
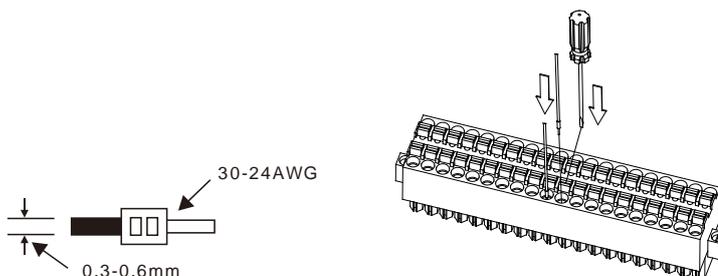
● **External wiring**
   (1) AH08PTG-5A
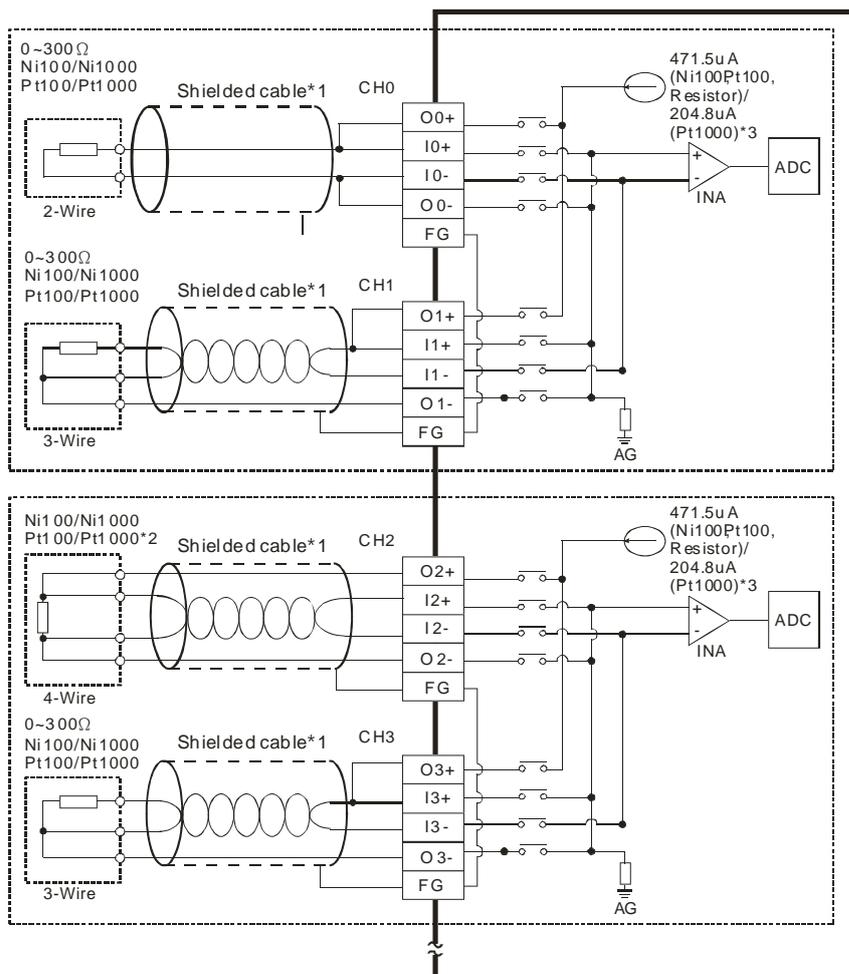
*1. The cables or the shielded twisted pair cables for Ni100/Ni1000/Pt100/Pt1000 temperature sensors are used, and should be kept separate from other power cables and cables which generate noise. Please use a three-wire temperature sensor. If users want to use a two-wire

temperature sensor, O**n**+ and I**n**+ have to be short-circuited, and O**n**- and I**n**- have to be short-circuited. (**n** is in the range of 0 to 7.)

*2. If users want to measure the resistance in the range of 0 Ω to 300 Ω, they can use a two-wire or three-wire sensor instead of a four-wire sensor.

*3. User need to select an appropriate sensor. If a Ni100 temperature sensor, a Pt100 sensor, and a resistance sensor are used, the internal excitation current is 471.5 µA. If a Ni1000 temperature sensor, and a Pt1000 temperature sensor are used, the internal excitation current is 204.8 µA.

5.2.10 LED Indicators

Number	Name	Description
1	RUN LED indicator	Operating status of the module ON: The module is running. OFF: The module stops running.
2	ERROR LED indicator	Error status of the module ON: A serious error occurs in the module. OFF: The module is normal. Blink: A slight error occurs in the module.

5.2.11 HWCONFIG in ISPSoft

5.2.11.1 Initial Setting

(1) Start ISPSoft, and then double-click **HWCONFIG**.

(2) Click **I/O scan** on the toolbar.

(3) ISPSoft is scanning the actual hardware configuration.

(4) After the scan of the actual hardware configuration is complete, the system automatically assigns the corresponding registers to the channels. Users can alter the input device range by themselves.

Note: Owing to the fact that values are floating-point numbers, every channel occupies two 16-bit registers.

Slot No.	Label	Firmware Version	Descrption	Input Device Range	Output Device Range	Comment
-	AHPS05-5A	-	AH Power Suppl	None	None	
-	AHCPU530-EN	1.00	Basic CPU modu	None	None	
0	AH08PTG-5A	1.00	8 x 3/4 wires RTI	D0 ~ D15		

(5) Double-click the module AH08PTG-5A.
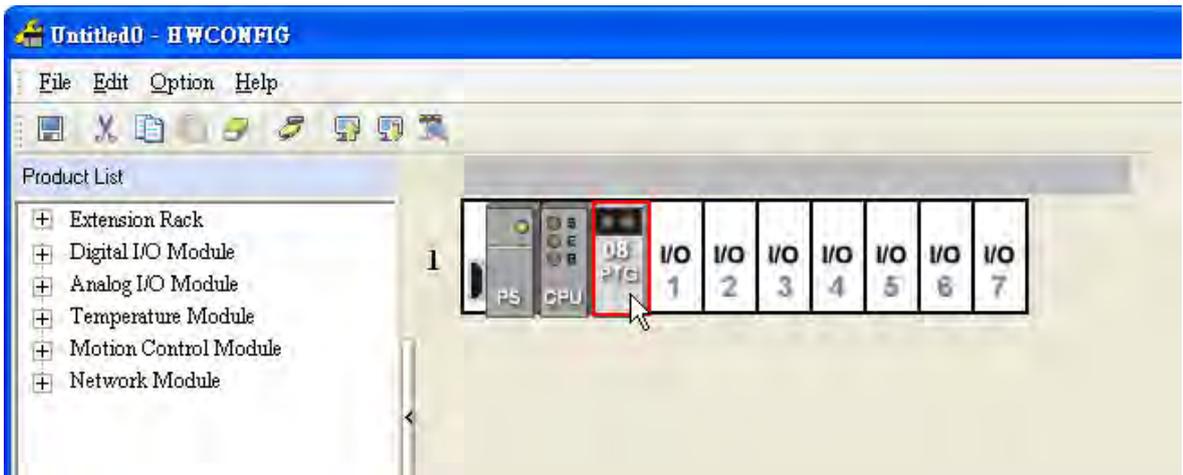
(6) Open the **Parameter Setting** window.
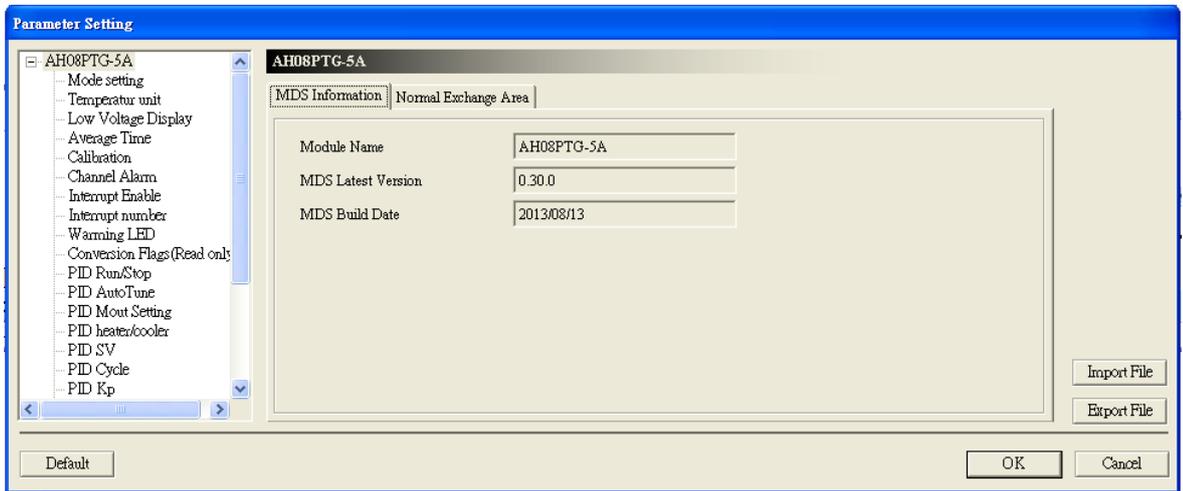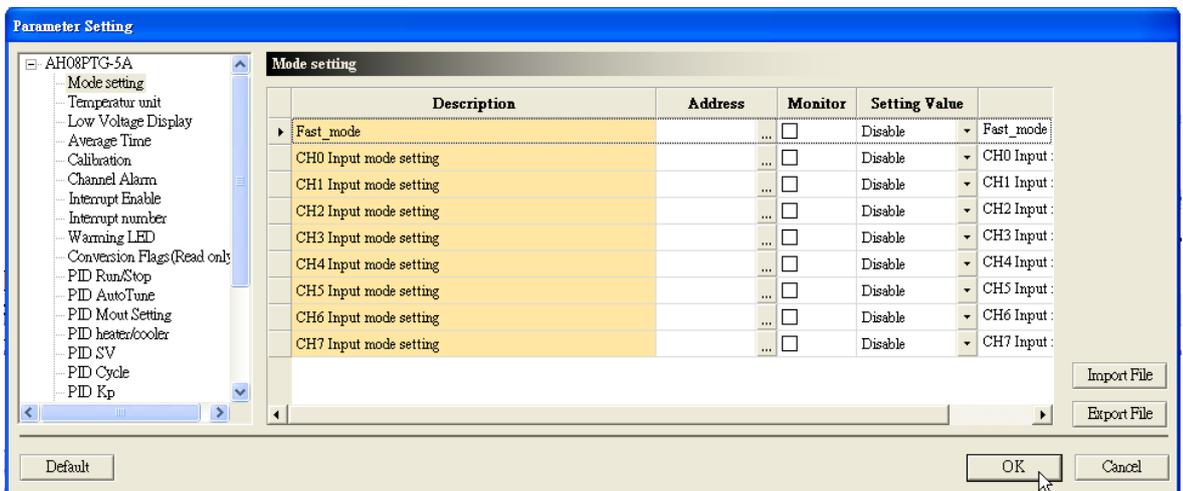
(7) Set the parameters, and then click **OK**.

(8) Click **Download** on the toolbar to download the parameters. (The parameters can not be downloaded when the CPU module runs.)

5.2.11.2 Checking the Version of a Module

(1) On the **Option** menu, click **Online Mode**.

(2) Right-click the module, and then click **Module Information** on the context menu. The version of the firmware and that of the hardware are displayed.

5.2.11.3 Monitoring Table

(1) Select the **Monitor** checkboxes at the right sides of the corresponding registers.

(2) On the **Option** menu, click **Online Mode**.

(3) On the **Option** menu, click **Monitor Table**. The registers are monitored.

5.2.11.4 Online Mode

(1) Click **Online Mode** on the toolbar.

(2) Double-click the module AH08PTG-5A.

(3) If some parameters are altered, users can click **SV➔PV**. The new setting values are written into the CPU module and the I/O module. If users want to read the present values in the I/O module, they can click **Refresh**. The present values in the I/O module are sent to ISPSoft, and are monitored.

5.2.11.5 Importing/Exporting a Parameter File

(1) After **Export** is clicked, the parameters will be saved as a CSV file (.csv).

(2) Click **Import**, and then click the CSV file.

5.2.11.6 Parameters

(1) Quick mode

(2) The input modes of the channels

Description	0: The channel is disabled.	6: Pt100 sensor
	1: Pt100 sensor (Four-wire/Two wire configuration)	(Three-wire configuration) 7: Ni100 sensor
	2: Ni100 sensor (Four-wire/Two wire configuration)	(Three-wire configuration) 8: Pt1000 sensor
	3: Pt1000 sensor (Four-wire/Two wire configuration)	(Three-wire configuration) 9: Ni1000 sensor
	4: Ni1000 sensor (Four-wire/Two wire configuration)	(Three-wire configuration) 10: 0~300 Ω input impedance
	5: 0~300 Ω input impedance (Four-wire/Two wire configuration)	(Three-wire configuration)

(3) Temperature unit (Celsius/Fahrenheit)

Description	K0: Celsius
	K1: Fahrenheit

(4) The number of values averaged
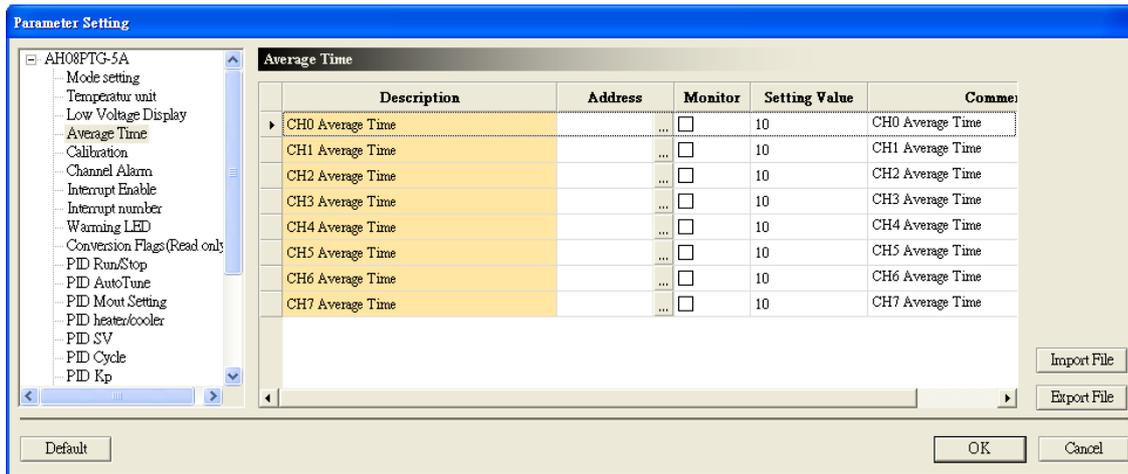
(5) Setting the temperature corresponding to a low voltage
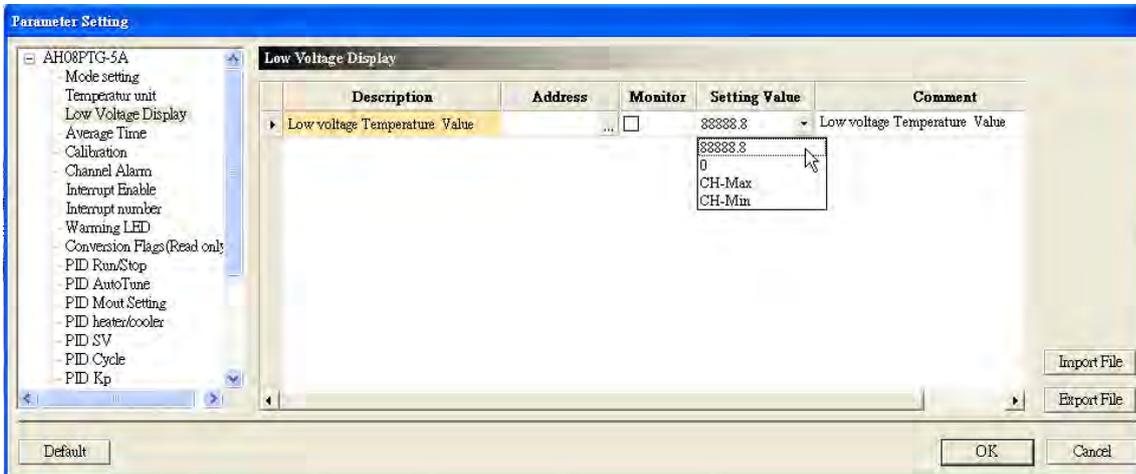
(6) The offsets and the gains used for calibration
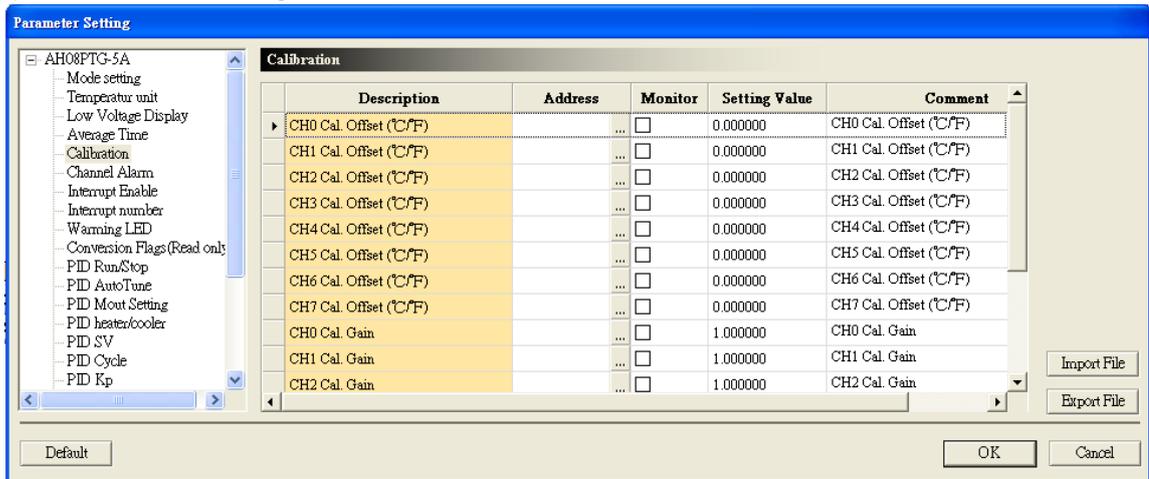
(7) The channel detection
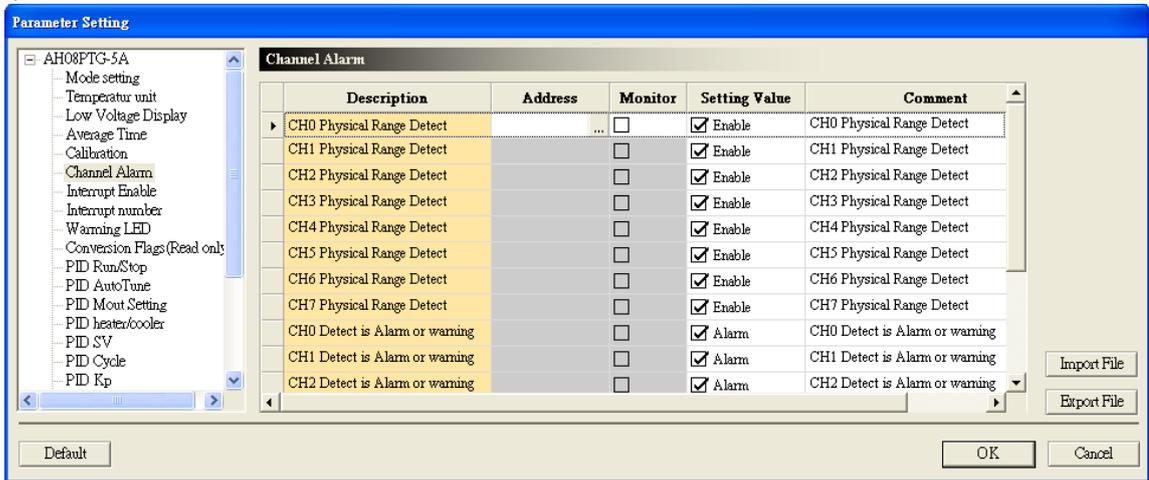
(8) Enabling the interrupts
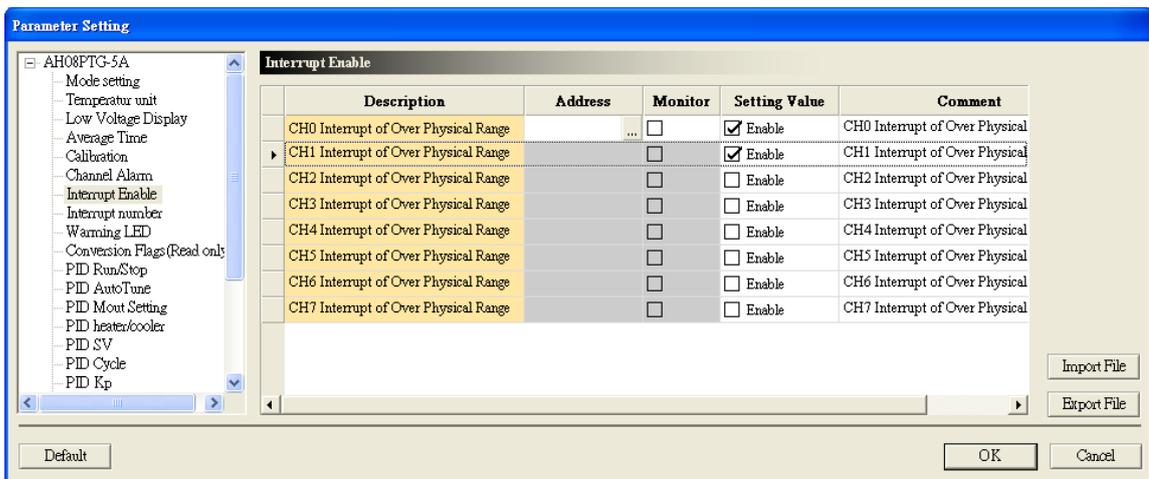
(9) The interrupt numbers
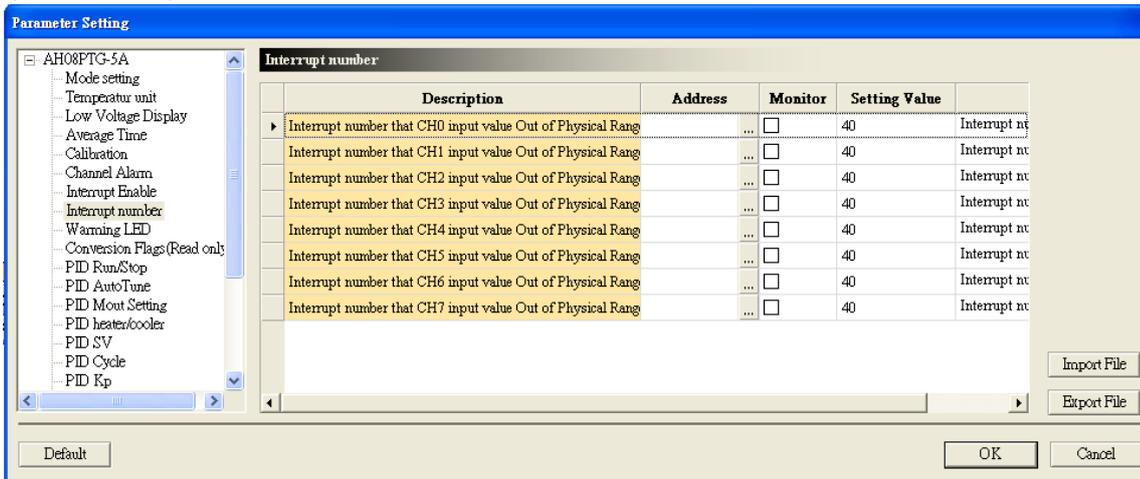
(10) Setting the warning LED indicator
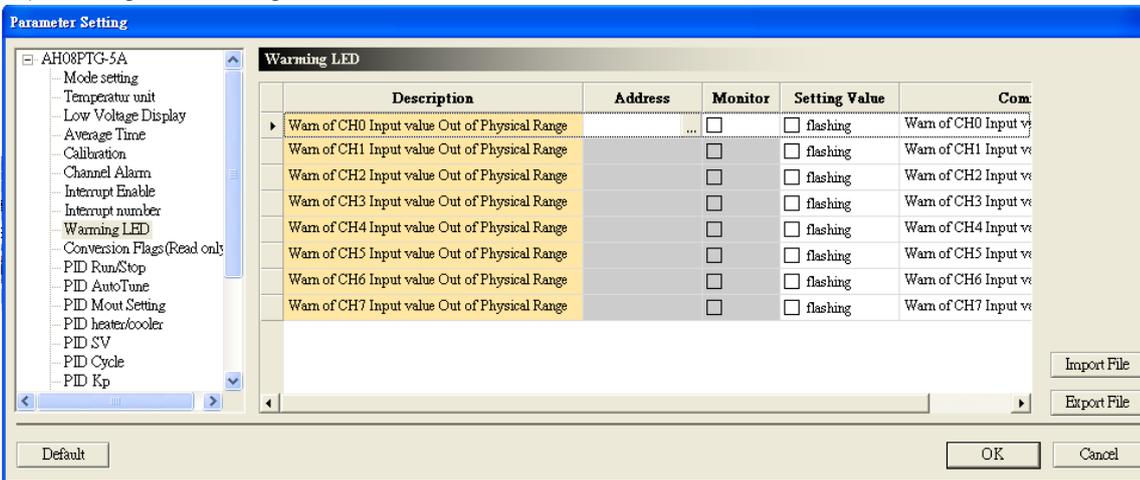
Description	Bit 0~bit 7: CH0~CH7 (Warning LED indicator) 　　　　　(ON: Flash; OFF: Not flash)

(11) The error codes
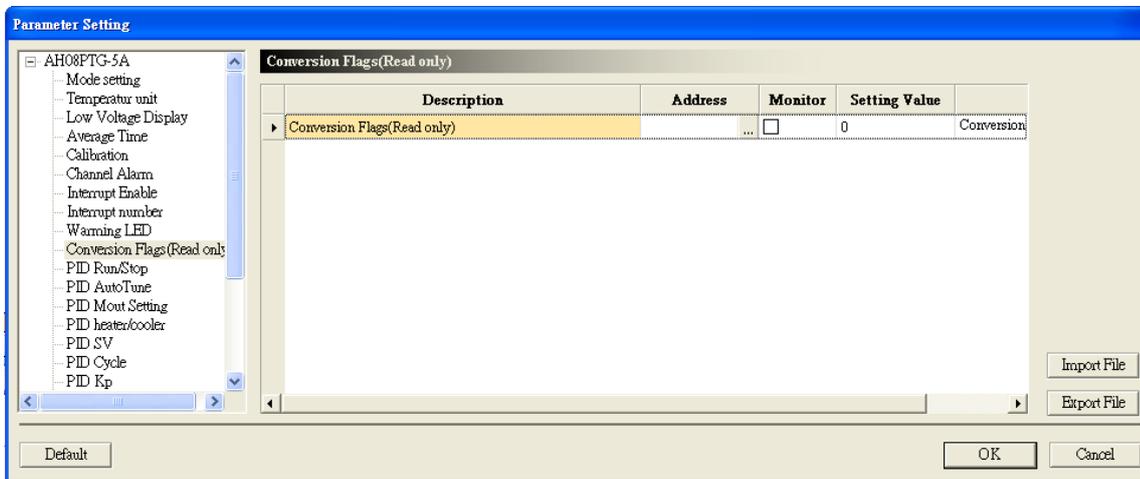
Description	Bit 0~bit 7: The signals received by the CH0~CH7 exceed the range of inputs which can be received by the hardware.
	Bit 15: The external voltage is abnormal.

(12) Performing/Not performing the PID algorithm
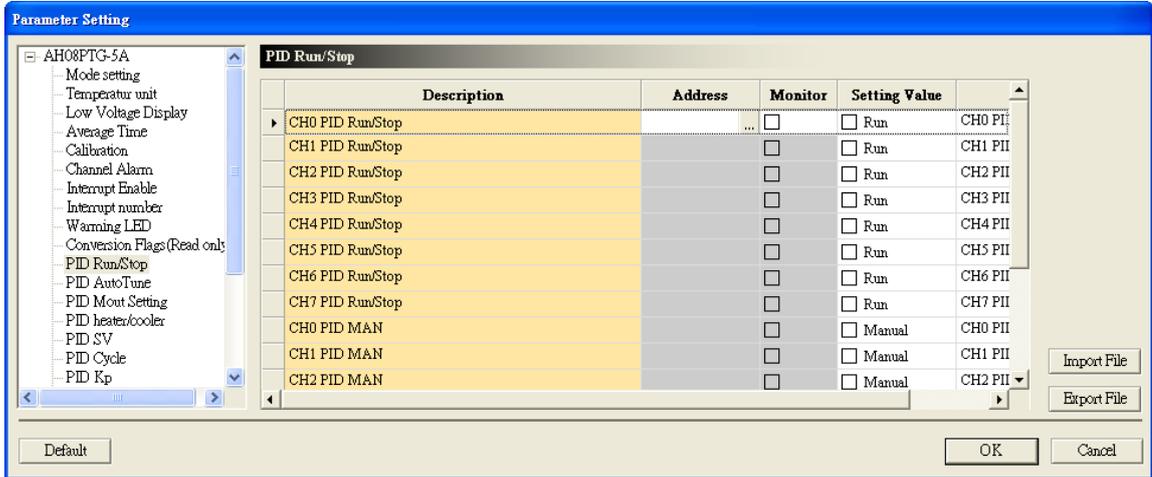
(13) The automatic tuning
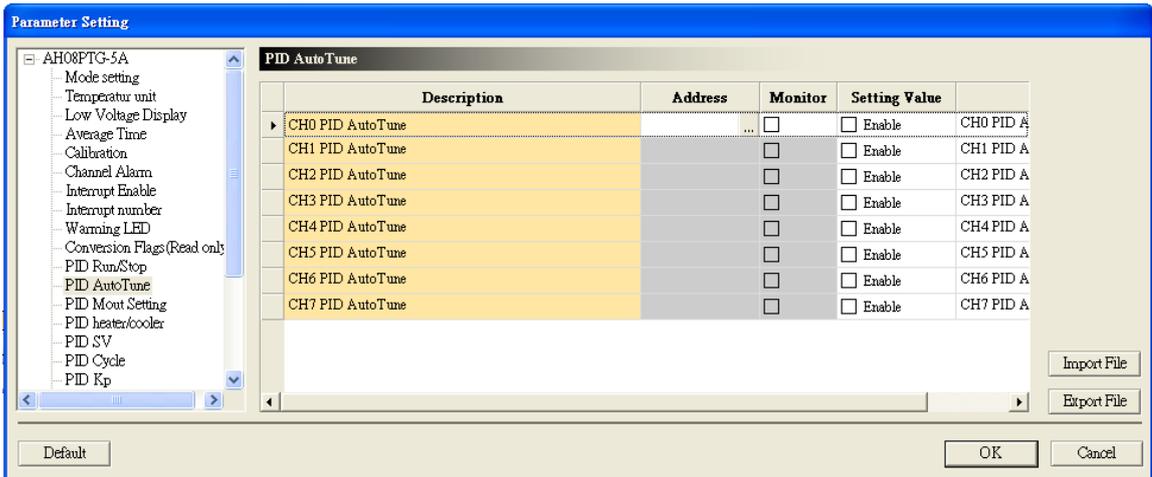
(14) Refreshing the manual output values automatically
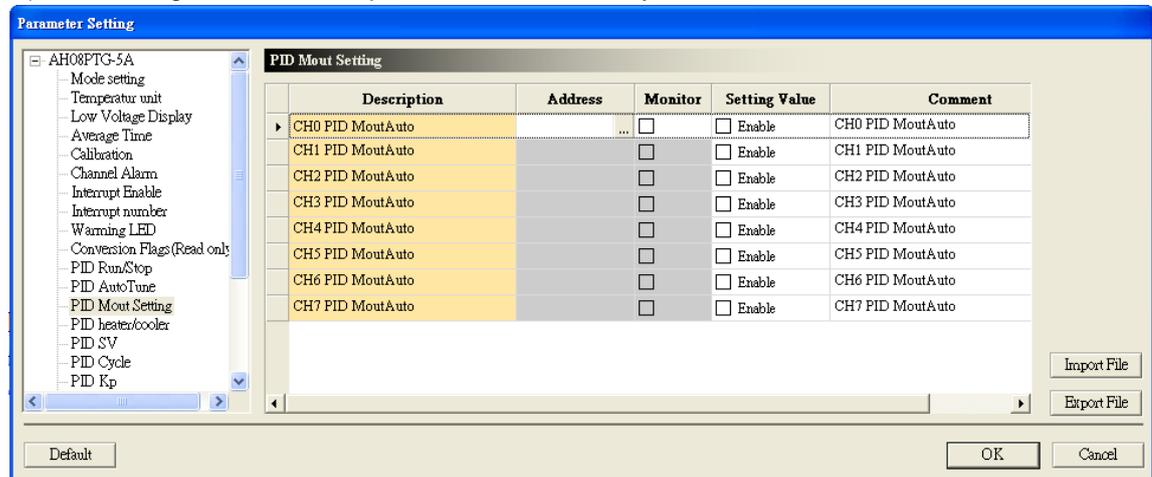
(15) The heating/cooling mode
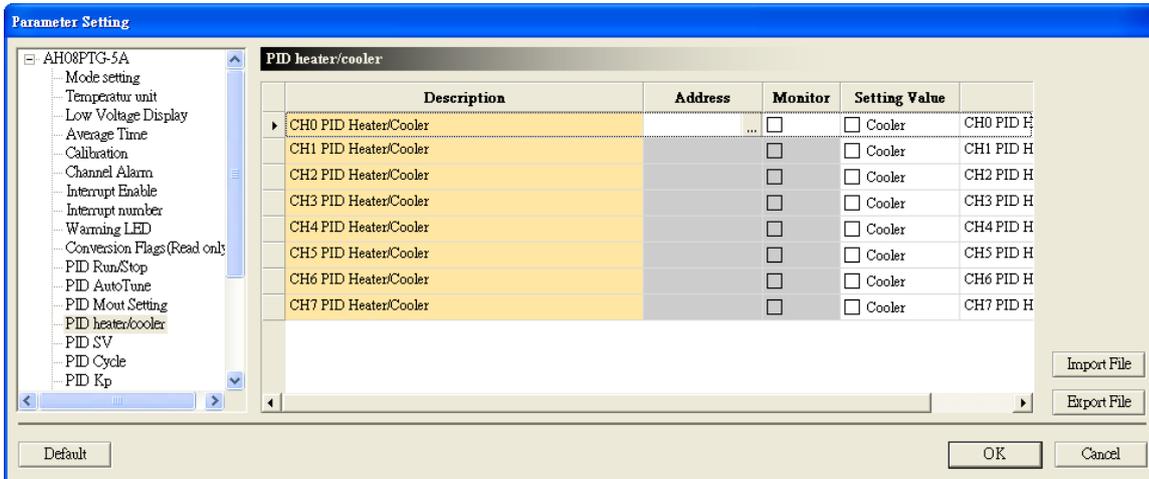
(16) The target values
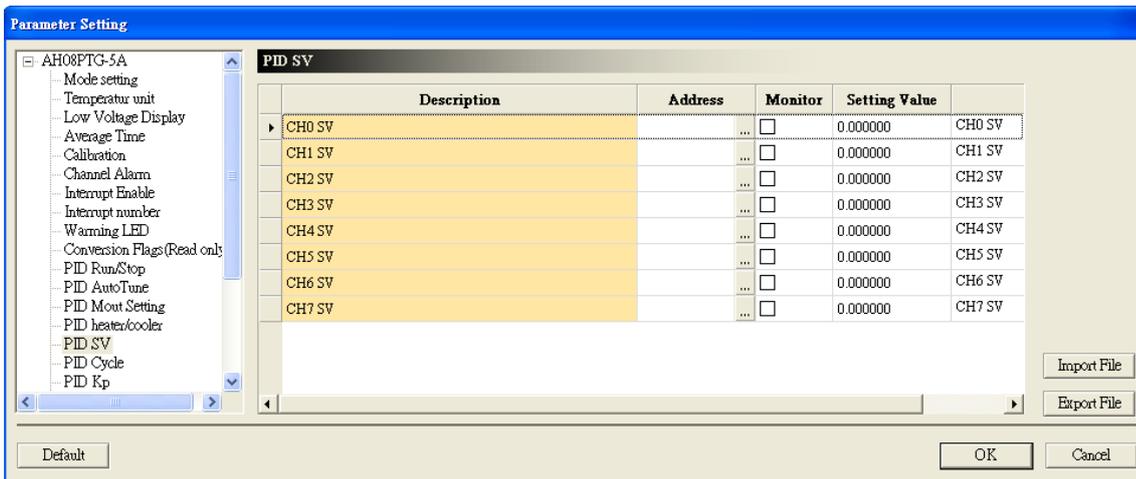
(17) The sampling time
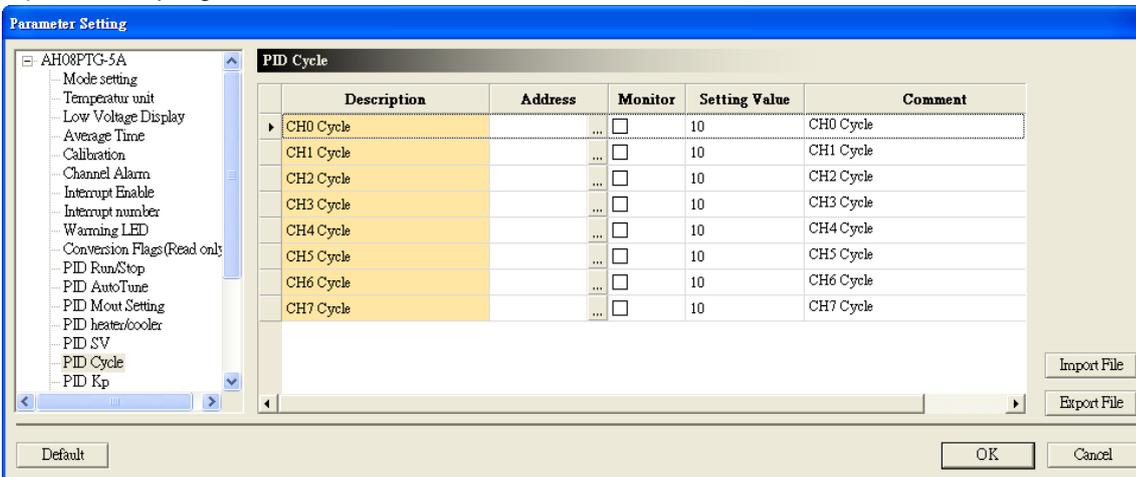
(18) The proportional gains
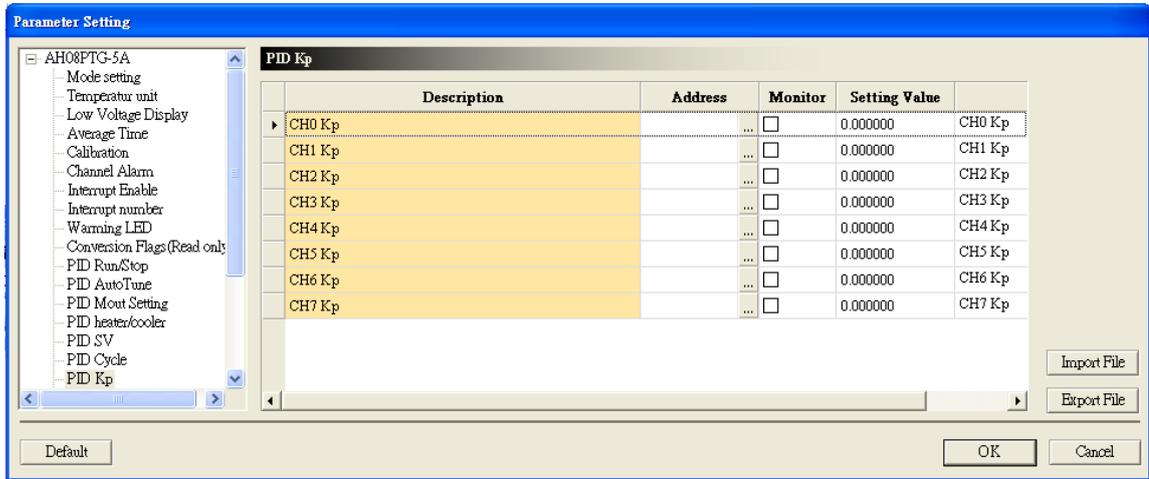
(19) The integral gains
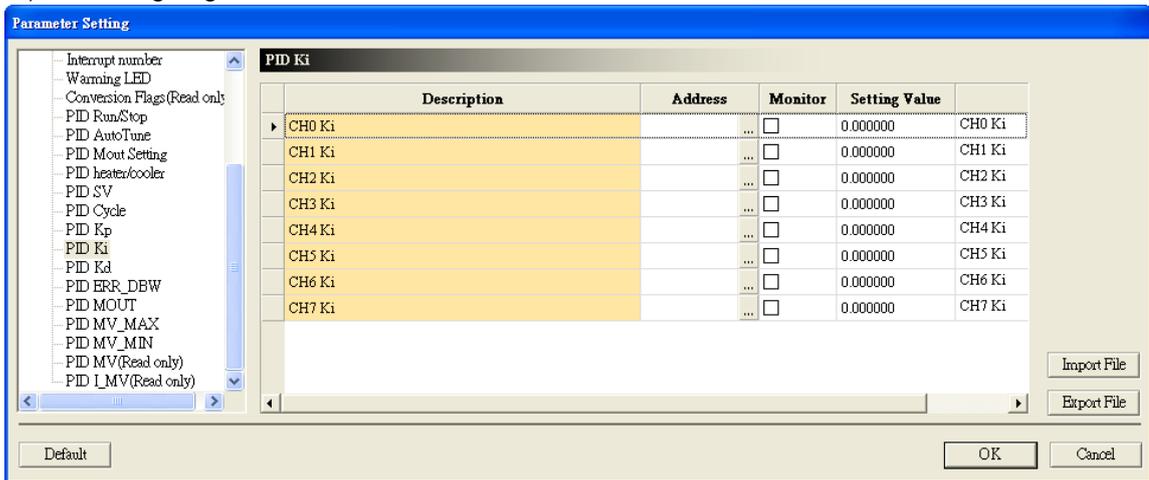
(20) The derivative gains
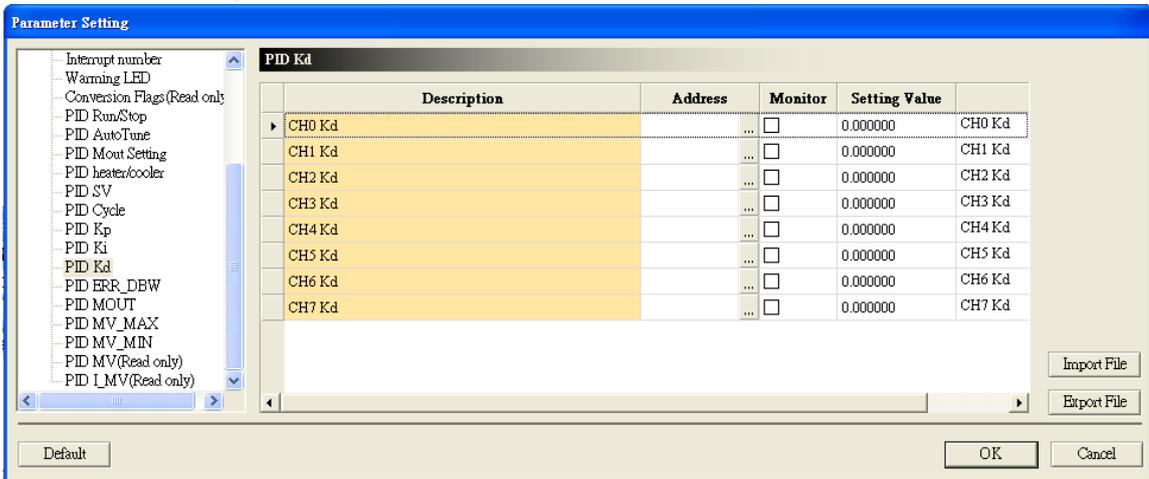
(21) The range within which the error values are count as 0
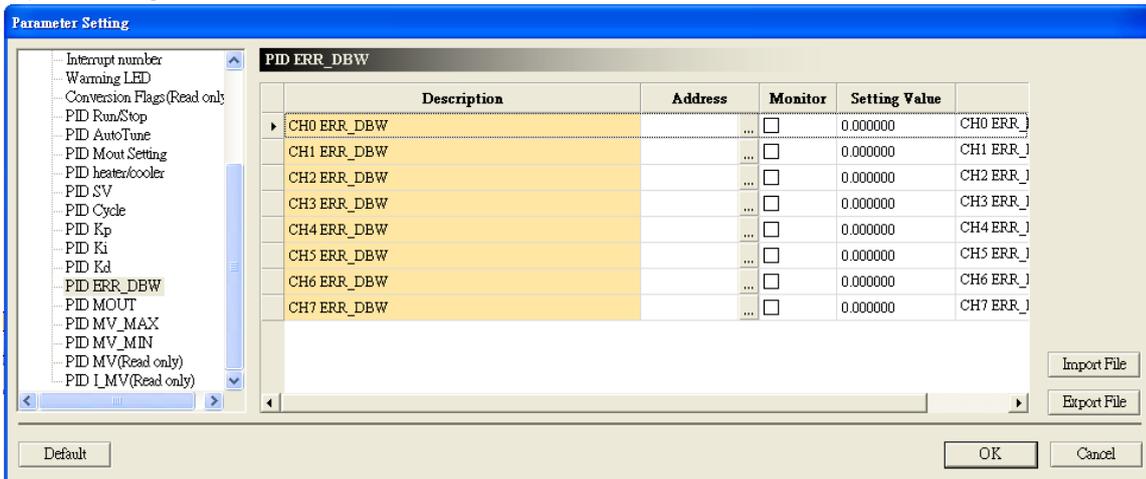
(22) The manual output values
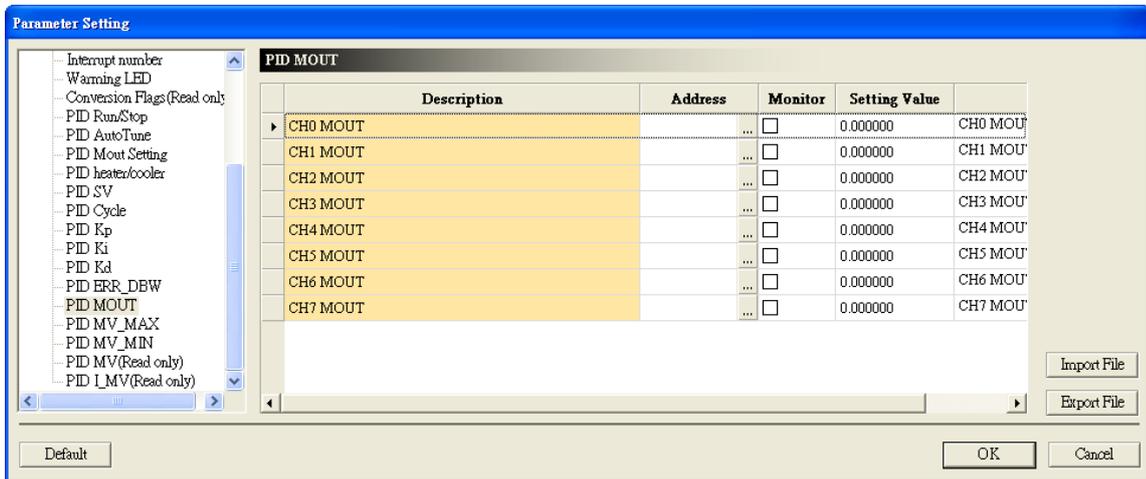
(23) The maximum output values
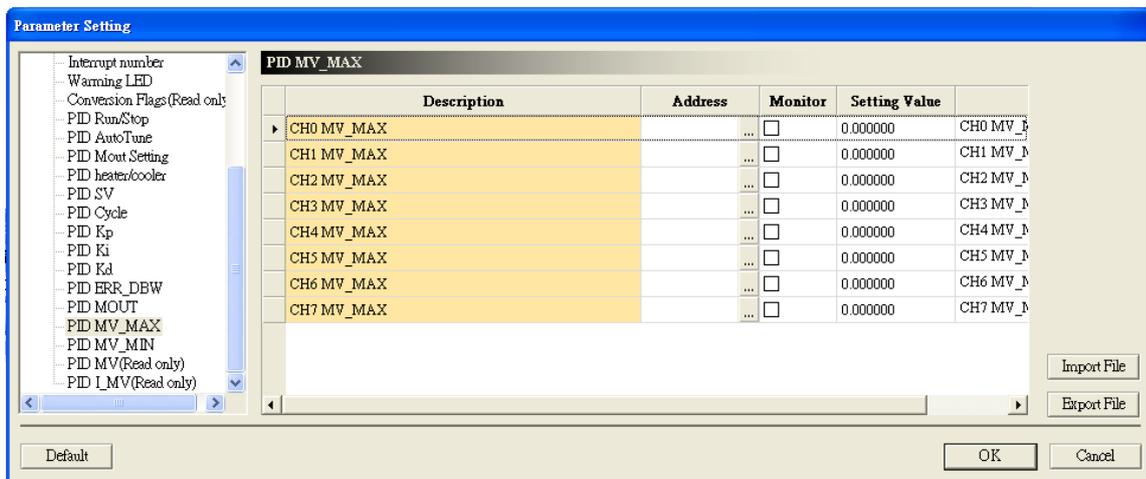
(24) The minimum output values
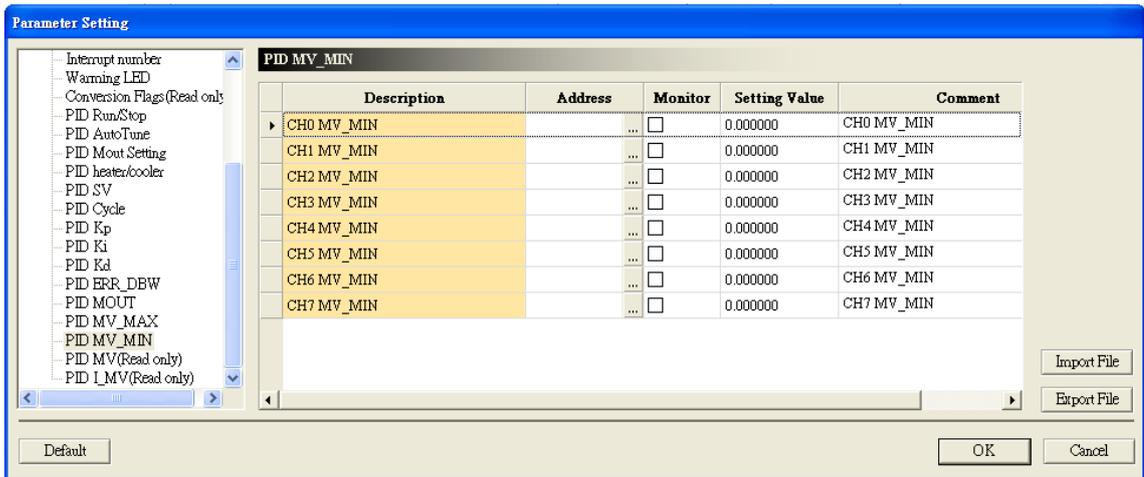
(25) Reading the output values
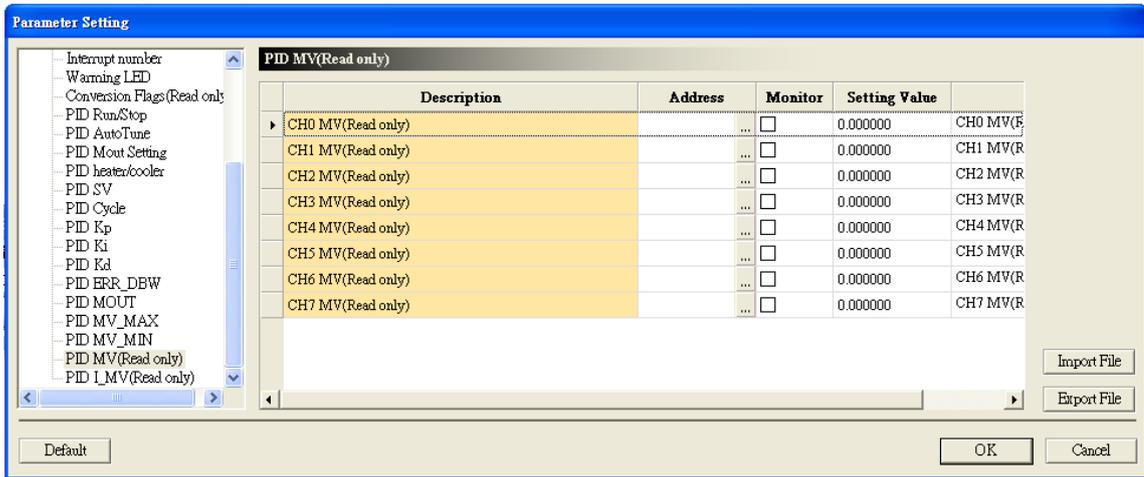
(26) The accumulated integral values
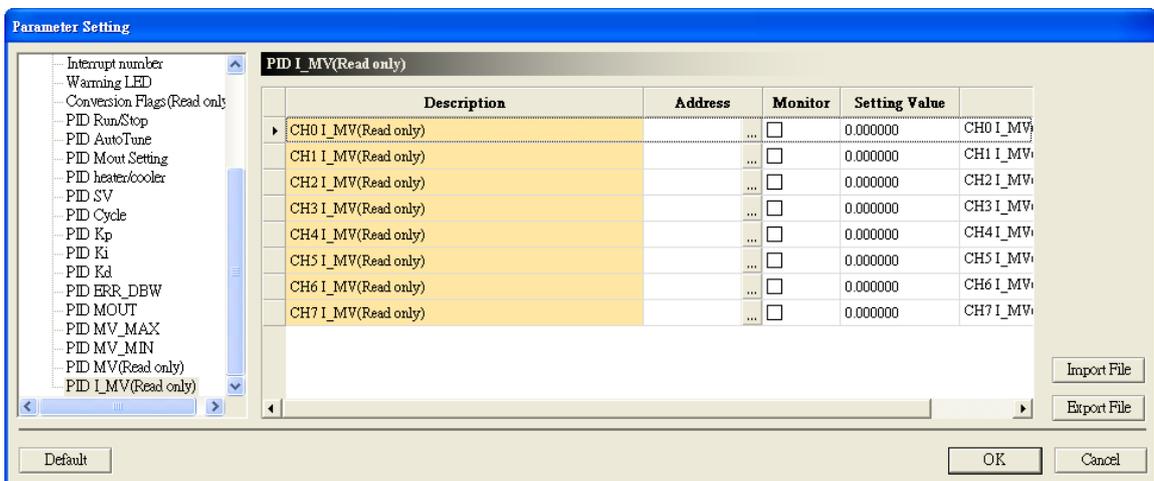
5.2.12 Troubleshooting

5.2.12.1 Error Codes

Error Code	Type	Description	RUN LED indicator	ERROR LED indicator
16#A600	Alarm	Hardware failure	OFF	ON
16#A601	Alarm	The external voltage is abnormal.	OFF	ON
16#A603	Alarm	Internal error The factory correction is abnormal.	OFF	ON
16#A400	Alarm	The signal received by channel 0 exceeds the range of inputs which can be received by the hardware.	OFF	ON
16#A401	Alarm	The signal received by channel 1 exceeds the range of inputs which can be received by the hardware.	OFF	ON
16#A402	Alarm	The signal received by channel 2 exceeds the range of inputs which can be received by the hardware.	OFF	ON
16#A403	Alarm	The signal received by channel 3 exceeds the range of inputs which can be received by the hardware.	OFF	ON
16#A404	Alarm	The signal received by channel 4 exceeds the range of inputs which can be received by the hardware.	OFF	ON
16#A405	Alarm	The signal received by channel 5 exceeds the range of inputs which can be received by the hardware.	OFF	ON
16#A406	Alarm	The signal received by channel 7 exceeds the range of inputs which can be received by the hardware.	OFF	ON
16#A407	Alarm	The signal received by channel 8 exceeds the range of inputs which can be received by the hardware.	OFF	ON
16#A000	Warning	The signal received by channel 0 exceeds the range of inputs which can be received by the hardware.	ON	Blink
16#A001	Warning	The signal received by channel 1 exceeds the range of inputs which can be received by the hardware.	ON	Blink
16#A002	Warning	The signal received by channel 2 exceeds the range of inputs which can be received by the hardware.	ON	Blink
16#A003	Warning	The signal received by channel 3 exceeds the range of inputs which can be received by the hardware.	ON	Blink
16#A004	Warning	The signal received by channel 4 exceeds the range of inputs which can be received by the hardware.	ON	Blink
16#A005	Warning	The signal received by channel 5 exceeds the range of inputs which can be received by the hardware.	ON	Blink

Error Code	Type	Description	RUN LED indicator	ERROR LED indicator
16#A006	Warning	The signal received by channel 6 exceeds the range of inputs which can be received by the hardware.	ON	Blink
16#A007	Warning	The signal received by channel 7 exceeds the range of inputs which can be received by the hardware.	ON	Blink
16#A800	Warning	The signal received by channel 0 exceeds the range of inputs which can be received by the hardware.	ON	OFF
16#A801	Warning	The signal received by channel 1 exceeds the range of inputs which can be received by the hardware.	ON	OFF
16#A802	Warning	The signal received by channel 2 exceeds the range of inputs which can be received by the hardware.	ON	OFF
16#A803	Warning	The signal received by channel 3 exceeds the range of inputs which can be received by the hardware.	ON	OFF
16#A804	Warning	The signal received by channel 4 exceeds the range of inputs which can be received by the hardware.	ON	OFF
16#A805	Warning	The signal received by channel 5 exceeds the range of inputs which can be received by the hardware.	ON	OFF
16#A806	Warning	The signal received by channel 6 exceeds the range of inputs which can be received by the hardware.	ON	OFF
16#A807	Warning	The signal received by channel 7 exceeds the range of inputs which can be received by the hardware.	ON	OFF

5.2.12.2 Troubleshooting Procedure

Description	Procedure
Hardware failure	Return the module to the factory for repair.
The external voltage is abnormal.	Check whether the external 24 V power supply to the module is normal.
Internal error The factory correction is abnormal.	Please contact the factory.
The signal received by channel 0 exceeds the range of inputs which can be received by the hardware.	Check the signal received by channel 0.
The signal received by channel 1 exceeds the range of inputs which can be received by the hardware.	Check the signal received by channel 1
The signal received by channel 2 exceeds the range of inputs which can be received by the hardware.	Check the signal received by channel 2.
The signal received by channel 3 exceeds the range of inputs which can be received by the hardware.	Check the signal received by channel 3.

Description	Procedure
The signal received by channel 4 exceeds the range of inputs which can be received by the hardware.	Check the signal received by channel 4.
The signal received by channel 5 exceeds the range of inputs which can be received by the hardware.	Check the signal received by channel 5.
The signal received by channel 6 exceeds the range of inputs which can be received by the hardware.	Check the signal received by channel 6.
The signal received by channel 7 exceeds the range of inputs which can be received by the hardware.	Check the signal received by channel 7.

5

Chapter 6   Temperature Measurement Module AH04TC/AH08TC

Table of Contents

6.1 Overview

The specifications for AH04TC-5A and AH08TC-5A, the operation, and the programming are described in this chapter. AH04TC-5A and AH08TC-5A are temperature measurement modules. They convert temperatures received from thermocouples into digital signals. Users can select the degree Celsius or the degree Fahrenheit as a unit of measurement for temperature.

An introduction of thermocouples

The Seebeck effect is used in a thermocouple to measure a temperature difference. Generally speaking, a thermocouple consists of two conductors of different materials that produce a voltage in the vicinity of the point where the two conductors are in contact. The voltage produced is dependent on the difference of temperature of the junction to other parts of those conductors, and is in the range of several ten microvolts to several thousand microvolts. Therefore, the voltage produced needs to be amplified.

A thermocouple creates a voltage when there is a temperature difference. When a differential operation is performed on two pieces of data, external noise is eliminated. The stability of thermocouples is better than thermistors, resistance thermometers, and thermal resistors. Therefore, thermocouples are widely used in industry.

A thermocouple consists of a circuit having two wires of different metals or metal alloys welded together or joined at both ends. One of the junctions—normally the cold junction—is maintained at a known reference temperature, and the other junction is at the temperature to be sensed. A temperature gradient across the junction of the wires gives rise to an electric potential by the Seebeck effect. The voltage produced is proportional to the difference of temperature of the junction to other parts of those conductors.

The voltage can be derived from:

$$V = \int_{T_1}^{T_2} (Q_A - Q_B)\, dT$$

(A)

where Q_A and Q_B are the thermopowers (Seebeck coefficient) of the metals A and B, and T_1 and T_2 are the temperatures of the two junctions.
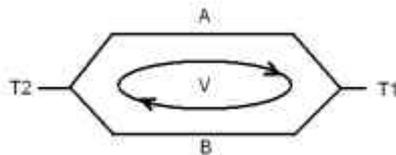
Principle of operation

In fact, Q_A and Q_B are almost unrelated to temperature. Therefore, formula (A) above can be approximated as (B) below.

$V = \alpha(T_2 - T_1)$ (B)

There are two types of thermocouple thermometers. They are wrapped thermocouples and bare thermocouples. A wrapped thermocouple is wrapped in protective metal, and is similar to an electric spoon in appearance. Wrapped thermocouples are used to measure temperature of liquid, and bare thermocouples are used to measure temperature of gas.

6.1.1 Characteristics

(1) **A sensor is selected according to practical application.**

Type J thermocouples, type K thermocouples, type R thermocouples, type S thermocouples, type T thermocouples, type E thermocouples, type N thermocouples, and ±150 mV voltage inputs

(2) **A module is selected according to practical application.**

AH-04TC-5A: There are four channels. Inputs received by a channel are temperatures.

AH-08TC-5A: There are eight channels. Inputs received by a channel are temperatures.

(3) **High-speed conversion**

A temperature is converted into a digital signal at a speed of 200 μs a channel.

(4) **High accuracy**

Conversion accuracy: The error is ±0.5% of an input. (The ambient temperature is 25±5°C.)

(5) **Disconnection detection**

When a sensor is disconnected, the module gives an alarm or a warning.

(6) **PID control**

An object can be maintained at a desired temperature through a PID control action.

(7) **A module can be set by means of utility software.**

HWCONFIG is built-in utility software in ISPSoft. Users can set modes and parameters in HWCONFIG to complete hardware configuration without spending time writing a program to set registers corresponding to functions.

6.2 Specifications and Functions

6.2.1 Specifications

Electrical specifications

Module name	AH04TC-5A	AH08TC-5A
Number of analog inputs	4	8
Applicable sensor	Type J, type K, type R, type S, type T, type E, and type N thermocouples ±150 mV voltage inputs	
Supply voltage	24 V DC (20.4 V DC~28.8 V DC) (-15%~+20%)	
Connector type	Removable terminal block	
Overall accuracy	25°C/77°F: The error allowed is ±0.5% of full scale. -20~60°C/-4~140°F: The error allowed is ±1% of full scale.	
Conversion time	200 ms/channel	
Isolation	An analog circuit is isolated from a digital circuit by a digital integrated circuit/an optocoupler, and the analog channels are isolated from one another by optocouplers. Isolation between a digital circuit and the ground: 500 V DC Isolation between an analog circuit and the ground: 500 V DC Isolation between an analog circuit and a digital circuit: 500 V DC Isolation between the 24 V DC and the ground: 500 V DC Isolation between analog channels: 120 V AC	

Functional specifications

Analog-to-digital conversion	Centigrade (°C)	Fahrenheit (°F)	Voltage input
Rated input range	Type J: -100°C~1,150°C Type K: -100°C~1,350°C Type R: 0°C~1,750°C Type S: 0°C~1,750°C Type T: -150°C~390°C Type E: -150°C~980°C Type N: -150°C~1,280°C	Type J: -148°F~2,102°F Type K: -148°F~2,462°F Type R: 32°F~3,182°F Type S: 32°F~3,182°F Type T: -238°F~734°F Type E: -238°F~1,796°F Type N: -238°F~2,336°F	±150 mV
Average function	Range: 1~100		
Self-diagnosis	Disconnection detection		

6.2.2 Profile

Number	Name	Description
1	Model name	Model name of the module
2	RUN LED indicator	Operating status of the module ON: The module is running. OFF: The module stops running.
2	ERROR LED indicator	Error status of the module ON: A serious error occurs in the module. OFF: The module is normal. Blink: A slight error occurs in the module.
3	Removable terminal block	The inputs are connected to sensors.
4	Arrangement of the input terminals	Arrangement of the terminals
5	Description of the inputs	Simple specifications for the module
6	Clip	Removing the terminal block
7	Label	Nameplate
8	Set screw	Fixing the module
9	Connector	Connecting the module and a backplane
10	Projection	Fixing the module

6.2.3 Dimensions

Unit: mm

6.2.4 Arrangement of Terminals

AH04TC-5A	AH08TC-5A

6.2.5 Functions

Item	Function	Description
1	Enabling/Disabling a channel	1. Users can enable or disable a channel. 2. If a channel is disabled, the total conversion time is decreased.
2	Temperature unit	Users can select the degree Celsius (°C) or the degree Fahrenheit (°F) as a unit of measurement for temperature.
3	Calibration	Users can calibrate a linear curve.
4	Average	Conversion values are averaged and filtered.
5	Disconnection detection	When a sensor is disconnected, the module gives an alarm or a warning.
6	Channel detection	If an input signal exceeds a range of inputs which can be received by hardware, the module will give an alarm or a warning. a. Warning LED indicator: When a warning occurs, the error LED indicator blinks or does not blink. b. Interrupt: An interrupt service routine is enabled.
7	PID control	An object can be maintained at a desired temperature through a PID control action.

1. Enabling/Disabling a channel

A temperature received from a thermocouple sensor is converted into a digital value at a speed of 200 ms a channel. If a channel is not used, users can disable it to decrease the total conversion time.

2. Temperature unit

Users can select the degree Celsius (°C) or the degree Fahrenheit (°F) as a unit of measurement for temperature.

3. Calibration

- To make a curve meet actual needs, users can calibrate the curve by changing an offset and a gain. A calibration range depends on a range of inputs which can be received by hardware.
- The range of offsets used for calibration is -1.0~1.0, and the range of gains used for calibration is 0.9~1.1.

Example 1:

The temperatures -100℃~100℃ correspond to the digital values -100~100. The original signals are used. The gain is 1, and the offset is 0. The temperature received by the channel is 0℃, and the digital value is -1. The temperature received by the channel is 100℃, and the digital value is 99. Users can calibrate the channel by calibrating the gain and the offset.

The users can get the gain for the calibration by means of the equations below.
Gain=(Y2-Y1)/(X2-X1)=[99-(-1)]/(100-0)=1
Gain used for calibration=1/Gain=1/1=1

The users can get the offset for the calibration by means of the equations below.
Offset=Y1=-1
Offset used for calibration=1-Y1=1

(X: Temperature; Y: Digital value)

Example 2:

The temperatures -100℃~100℃ correspond to the digital values -100~100. The original signals are used. The gain is 1, and the offset is 0. The temperature received by the channel is 0℃, and the digital value is 0. The temperature received by the channel is 100℃, and the digital value is 101. Users can calibrate the channel by calibrating the gain and the offset.

The users can get the gain for the calibration by means of the equations below.
Gain=(Y2-Y1)/(X2-X1)=[101-0]/(100-0)=1.01
Gain used for calibration=1/Gain=1/1.01=0.99

The users can get the offset for the calibration by means of the equations below.
Offset=Y1=0
Offset used for calibration=0-Y1=0

(X: Temperature; Y: Digital value)

4. Average

Digital values are averaged. The number by which the sum of several digital values is divided is between 1 and 100. The sampled values are taken as a queue, and the length of the queue is N. Each time a new sampled value is put at the end of the queue, an original value at the start of the queue is removed. The N values are averaged so that the periodic noise is suppressed.

5. Disconnection detection

If a channel is enabled, the module will check whether a sensor is disconnected. If an input circuit is an open circuit, the module will give an alarm. Please refer to description below for more information.

6. Channel detection

If an input signal exceeds a range of inputs which can be received by hardware, an error message appears. Please refer to section 6.2.1 for more information.

a. Giving alarms or warnings

The procedure below explains how to set a module so that it gives an alarm or a warning.

b. Interrupt service routine

The procedure below explains how to trigger an interrupt service routine in a CPU module.

● The interrupt service routines are I40~I251.

7. PID control

a. KP/KI/KD

Proportional action: The operation amount acts proportionally to the error. When a temperature is lower than a proportional band, the operation amount is 100%. When a temperature is within a proportional band, the operation amount decreases proportionally to the error. When the setting value is the same as the present value, the operation amount is 0%. (Error=Setting value–Present value)

Heater: The setting value is 1000 (100°C), and K_P is 100 (10°C). The relation between the temperature and the operation amount is shown below.

Cooler: The setting value is 200 (20°C), and KP is 100 (10°C). The relation between the temperature and the operation amount is shown below.

Integral action: If temperature is controlled by a pure proportional action, there is difference between the temperature controlled and a setting value. Therefore, if an integral action is used with a proportional action, difference decreases as time goes by, and the temperature controlled is the same as the setting value.

Derivative action: With regard to violent environmental change, a derivative action provides more operation amount to make temperature return to its original controlled state.

Control diagram:

The instruction PID is inside the dotted line.

The PID algorithm is as follows.

$$MV = K_P E(t) + K_I \int_0^t E(t)dt + K_D * \frac{dE(t)}{dt}$$

Forward action: $E(t) = PV(t) - SV(t)$

Reverse action: $E(t) = SV(t) - PV(t)$

b. Control mode

Cyclic control mode: Users set a cycle according to a controlled environment. (If the ambient air temperature changes slowly, the cycle can be longer.)

The width of a pulse is defined below.

➢ Pulse width=Output value (MV)/(Maximal output value−Minimal output value)×Cycle

Users can set the width of a pulse and a cycle (sampling time) by means of the instruction GPWM.

Example:

The cycle is 2000 ms, the maximal output value is 100, and the minimal output value is 0. After the PID algorithm is performed, the output value gotten is 50.

➢ Width of a pulse=50/(100-0)×2000 ms=1000 ms

Therefore, the pulse width used in the instruction GPWM is 1000 ms, and the cycle used in the instruction GPWM is 2000 ms.

c. PID parameters

PID parameter		Description
Performing/Not performing the PID algorithm		Bit 0~bit 3: CH0~CH3 (Performing/Not performing the PID algorithm)
Manual/Automatic tuning		Bit 4~bit 7: CH4~CH7(Performing/Not performing the PID algorithm) (AH08TC-5A)
		Bit 8~bit 11: CH0~CH3 (Manual/Automatic tuning)
		Bit 12~bit 15: CH4~CH7(Manual/Automatic tuning) (AH08TC-5A)
Heating/Cooling mode		Bit 0~bit 3: CH0~CH3
		Bit 4~bit 7 : CH4~CH7 (AH08TC-5A)
Sampling time		One-word decimal format Unit: 10 ms
Automatic mode	Automatic tuning	Bit 0~bit 3: CH0~CH3 Bit 4~bit 7: CH4~CH7 (AH08TC-5A)
	Refreshing the manual output values automatically	Bit 0~bit 3: CH0~CH3 Bit 4~bit 7: CH4~CH7 (AH08TC-5A)
	Target value	One-double word floating-point format
	Proportional gain	One-double word floating-point format
	Integral gain	One-double word floating-point format
	Derivative gain	One-double word floating-point format
	Range within which the error values are count as 0	One-double word floating-point format When the setting value is 0, the function is not enabled. For example, if the setting value is 5, and the difference between the present value and the target value is in the range of -5 to 5, the output value is 0.
	Maximum output value	One-double word floating-point format
	Minimum output value	One-double word floating-point format
	Reading the output value	One-double word floating-point format
	Accumulated integral value	One-double word floating-point format
Manual mode	Manual output value	One-double word floating-point format

d. Additional remarks on PID control
   (1) If K_p, K_i, or K_d is 0, the corresponding function is disabled. For example, if users only want to use proportional control, K_i and K_d are 0.
   (2) If users do not know how to adjust the parameters K_p, K_i, and K_d under a controlled environment, they can use the automatic tuning function to set the parameters, and then finely adjust the parameters to the optimum values. When the automatic tuning function is enabled, the value in a register defined by the users is 1. After the automatic tuning of the parameters is complete, the value in the register becomes 0.
   (3) If users want to set the parameters K_p, K_i, and K_d by themselves, they need to set the K_p by experience, and set the K_i, and K_d to 0. After the tuning of the K_p is complete, the users can tune the K_i, and K_d in order.

6.3 Installation

6.3.1 Installing a Module

Insert a module into a slot, make sure that the module is installed on the backplane properly, and tighen the the screw, as illustrated below.

1. Insert the projection under the module into the hole in the backplane.
2. Push the module in the direction indicated by the arrow until it clicks.
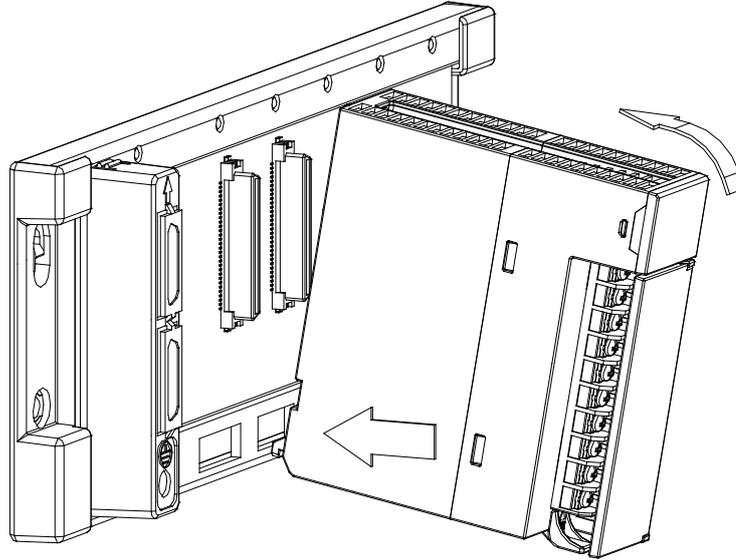
3. Tighten the screw on the module.
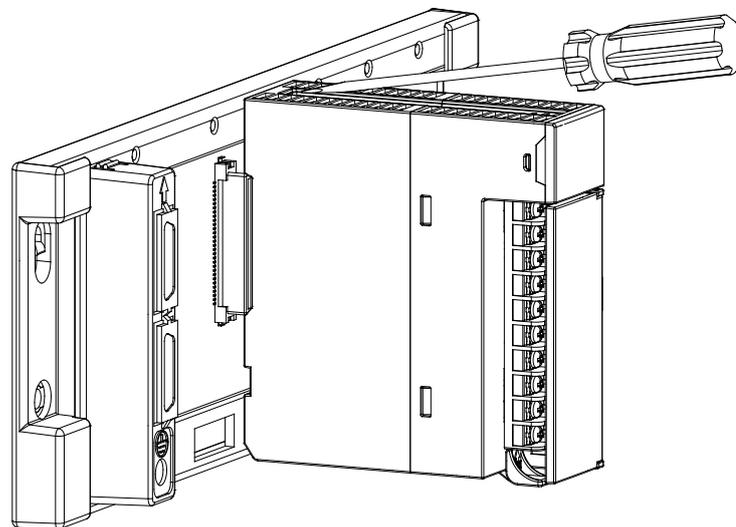
6.3.2 Installing a Removable Terminal Block

● **Installation**

1. Level a terminal block at the printed circuit board, and press it into the module.
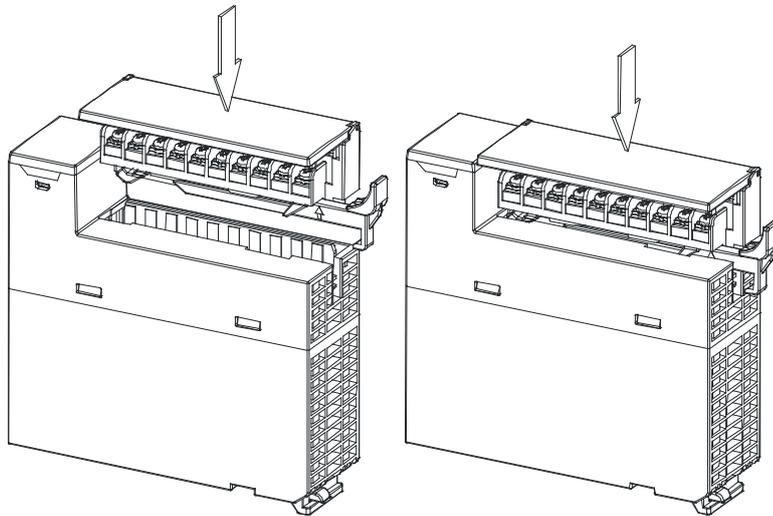
2. Press the clip in the direction indicated by the arrow.
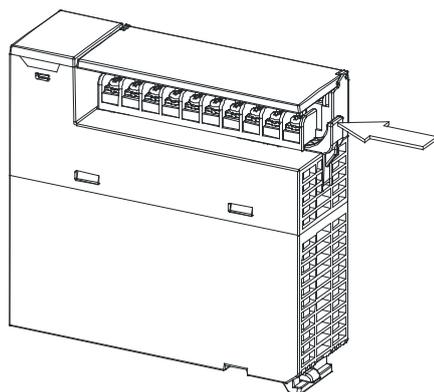
● **Removal**

1. Pull the clip in the direction indicated by the arrow.
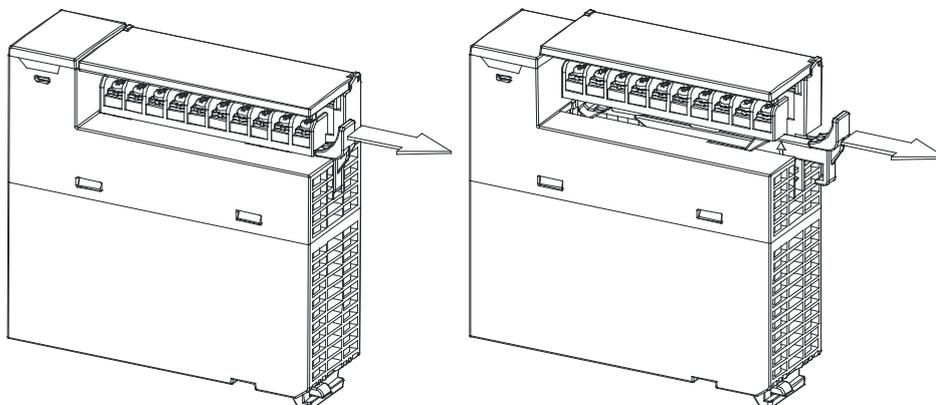
2. Pull up the clip.
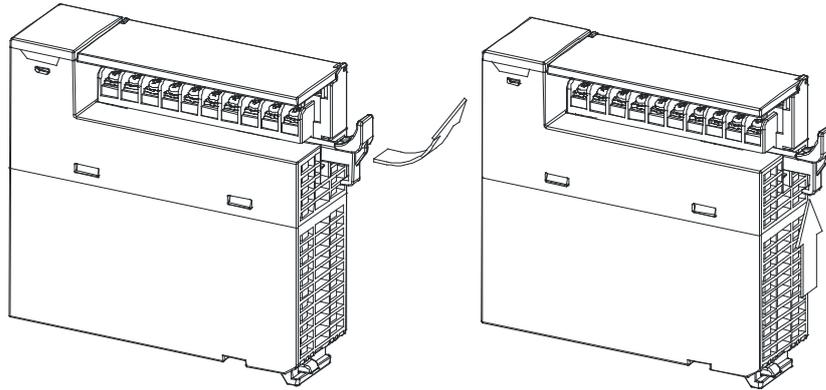
3. The terminal block is removed.

6.3.3 Wiring

● **Precautions**

In order to make the functions of a temperature measurement module perfect and ensure the reliability of a system at the same time, external wiring which prevents noise is necessary. Before installing cables, users need to follow the precautions below.

(1) To prevent a surge and induction, an AC cable and input signal cables which are connected to AH04TC-5A/AH08TC-5A must be separate cables.

(2) A cable must not be installed near a main circuit, a high-voltage cable, or a cable connected to a load which is not a PLC. Besides, a cable must not be bound to a main circuit, a high-voltage cable, or a cable connected to a load which is not a PLC. Otherwise, effects that noise, induction, and a surge have will increase.

(3) Please connect a shielded cable and a hermetically sealed cable with the ground separately.

(4) Terminals with insulation sleeves can not be arranged as a terminal block. It is recommended that the terminals be covered with insulation tubes.

(5) Do not wire empty terminals.

(6) Only use copper conducting wires with a temperature rating of 60/75°C and the length must be less than 50 m.

(7) TC modules must run for 30 minutes before they start to take any temperature measurement.

● **External wiring**
  (1) AH04TC-5A
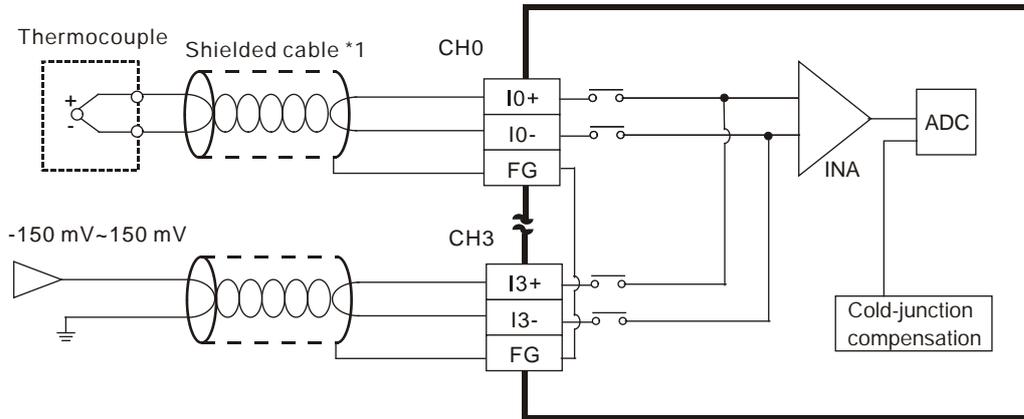
  (2) AH08TC-5A
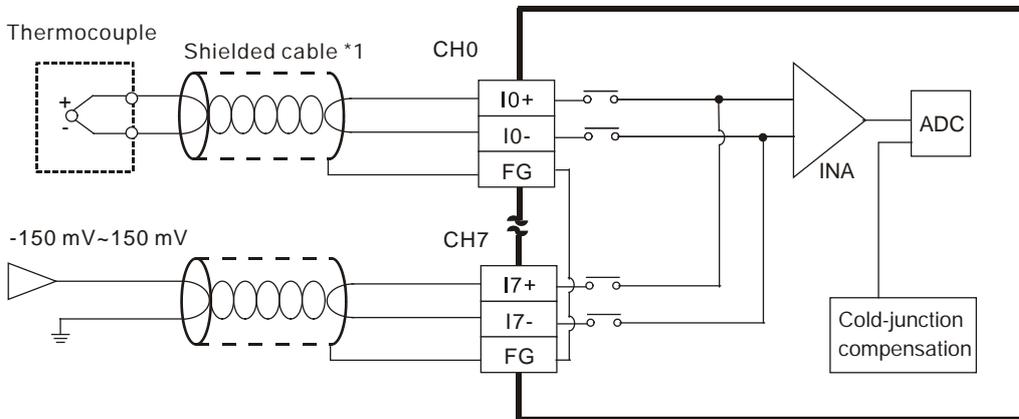
*1. The cables or the shielded twisted pair cables for Type J, type K, type R, type S, type T, type E, and type N thermocouples are used, and should be kept separate from other power cables and cables which generate noise.

6.3.4 LED Indicators

Number	Name	Description
1	RUN LED indicator	Operating status of the module ON: The module is running. OFF: The module stops running.
2	ERROR LED indicator	Error status of the module ON: A serious error occurs in the module. OFF: The module is normal. Blink: A slight error occurs in the module.

6.4 HWCONFIG in ISPSoft

6.4.1 Initial Setting

(1) Start ISPSoft, and then double-click **HWCONFIG**.

(2) Click **I/O scan** on the toolbar.

(3) ISPSoft is scanning the actual hardware configuration.

(4) After the scan of the actual hardware configuration is complete, the system automatically assigns the corresponding registers to the channels. Users can alter the input device range by themselves.

Note: Owing to the fact that values are floating-point numbers, every channel occupies two 16-bit registers.

Information: Rack 1

Slot No.	Label	Firmware Versi...	Descrption	Input Device Ra...	Output Device R...
-	AHPS05-5A	-	AH Power Supply	None	None
-	AHCPU530-El	1.00	Basic CPU module	None	None
0	AH08TC-5A	1.00	8 x 24 bit TC input	D0 ~ D15	

(5) Double-click the module.
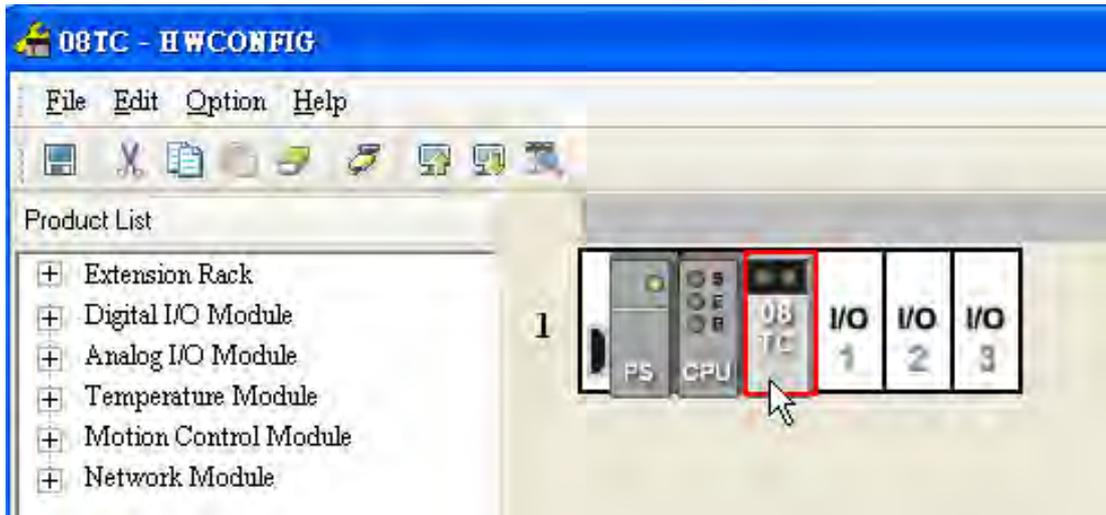
(6) Open the **Parameter Setting** window.

(7) Set the parameters, and then click **OK**.
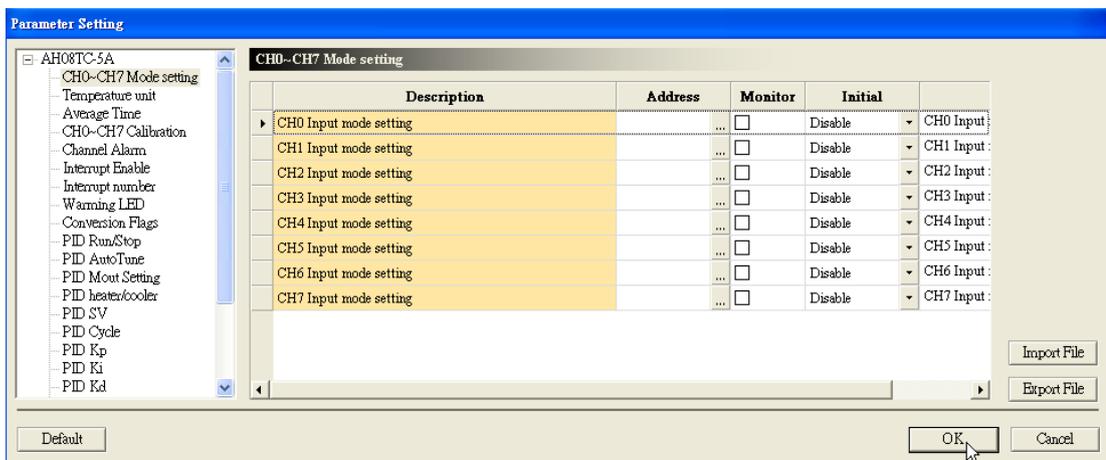
(8) Click **Download** on the toolbar to download the parameters. (The parameters can not be downloaded when the CPU module runs.)

6.4.2 Checking the Version of a Module

(1) On the **Option** menu, click **Online Mode**.

(2) Right-click the module, and then click **Module Information** on the context menu. The version of the firmware and that of the hardware are displayed.

6.4.3 Monitoring Table

(1) Select the **Monitor** checkboxes at the right sides of the corresponding registers.

(2) On the **Option** menu, click **Online Mode**.

(3) On the **Option** menu, click **Monitor Table**. The registers are monitored.

6.4.4 Online Mode

(1) Click **Online Mode** on the toolbar.

(2) Double-click the module.

(3) If some parameters are altered, users can click **SV➔PV**. The new setting values are written into the CPU module and the I/O module. If users want to read the present values in the I/O module, they can click **Refresh**. The present values in the I/O module are sent to ISPSoft, and are monitored.

6.4.5 Importing/Exporting a Parameter File

(1) After **Export** is clicked, the parameters will be saved as a CSV file (.csv).

(2) Click **Import**, and then click the CSV file.

6.4.6 Parameters

(1) The input modes of the channels

Description	0: The channel is disabled. 1: Type J thermocouple 2: Type K thermocouple 3: Type R thermocouple 4: Type S thermocouple 5: Type T thermocouple 6: Type E thermocouple 7: Type N thermocouple 8: ±150 mV voltage input

(2) Temperature unit (Celsius/Fahrenheit)
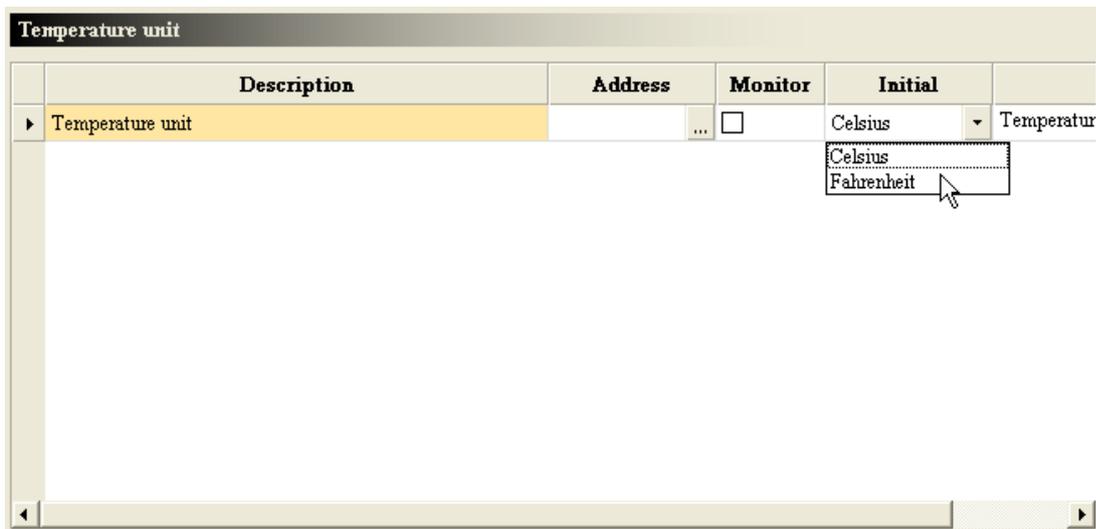
Description	K0: Celsius K1: Fahrenheit

(3) The number of values averaged

Average Time

	Description	Address	Monitor	Initial	
▶	CH0 Average Time	...	☐	10	CH0 Avera
	CH1 Average Time	...	☐	10	CH1 Averag
	CH2 Average Time	...	☐	10	CH2 Averag
	CH3 Average Time	...	☐	10	CH3 Averag
	CH4 Average Time	...	☐	10	CH4 Averag
	CH5 Average Time	...	☐	10	CH5 Averag
	CH6 Average Time	...	☐	10	CH6 Averag
	CH7 Average Time	...	☐	10	CH7 Averag

(4) The offsets and the gains used for calibration

CH0~CH7 Calibration

	Description	Address	Monitor	Initial	
▶	CH0 Cal. Offset (℃/℉)	...	☐	0.000000	CH0 Ca
	CH1 Cal. Offset (℃/℉)	...	☐	0.000000	CH1 Ca
	CH2 Cal. Offset (℃/℉)	...	☐	0.000000	CH2 Ca
	CH3 Cal. Offset (℃/℉)	...	☐	0.000000	CH3 Ca
	CH4 Cal. Offset (℃/℉)	...	☐	0.000000	CH4 Ca
	CH5 Cal. Offset (℃/℉)	...	☐	0.000000	CH5 Ca
	CH6 Cal. Offset (℃/℉)	...	☐	0.000000	CH6 Ca
	CH7 Cal. Offset (℃/℉)	...	☐	0.000000	CH7 Ca
	CH0 Cal. Gain	...	☐	1.000000	CH0 Ca
	CH1 Cal. Gain	...	☐	1.000000	CH1 Ca
	CH2 Cal. Gain	...	☐	1.000000	CH2 Ca

(5) The channel detection

Channel Alarm

	Description	Address	Monitor	Initial	
▶	CH0 Physical Range Detect	...	☐	☑ Enable	CH0 Ph
	CH1 Physical Range Detect		☐	☑ Enable	CH0 Ph
	CH2 Physical Range Detect		☐	☑ Enable	CH0 Ph
	CH3 Physical Range Detect		☐	☑ Enable	CH0 Ph
	CH4 Physical Range Detect		☐	☑ Enable	CH0 Ph
	CH5 Physical Range Detect		☐	☑ Enable	CH0 Ph
	CH6 Physical Range Detect		☐	☑ Enable	CH0 Ph
	CH7 Physical Range Detect		☐	☑ Enable	CH0 Ph
	CH0 Detect is Alarm or warning		☐	☑ Alarm	CH0 Ph
	CH1 Detect is Alarm or warning		☐	☑ Alarm	CH0 Ph
	CH2 Detect is Alarm or warning		☐	☑ Alarm	CH0 Ph

(6) Enabling the interrupts

(7) The interrupt numbers

(8) Setting the warning LED indicator

Description	Bit 0~bit 7: CH0~CH7 (Warning LED indicator) (ON: Flash; OFF: Not flash)

(9) The error codes

	Description	Address	Monitor	Initial	
▶	Conversion Flags(Read only)	...	☐	0	Conversion

Description	Bit 0~bit 7: The signals received by CH0~CH7 exceed the range of inputs which can be received by the hardware.
	Bit 15: The external voltage is abnormal.

(10) Performing/Not performing the PID algorithm

	Description	Address	Monitor	Initial	
▶	CH0 PID Run/Stop	...	☐	☐ Run	CH0 PID
	CH1 PID Run/Stop		☐	☐ Run	CH0 PID
	CH2 PID Run/Stop		☐	☐ Run	CH0 PID
	CH3 PID Run/Stop		☐	☐ Run	CH0 PID
	CH4 PID Run/Stop		☐	☐ Run	CH0 PID
	CH5 PID Run/Stop		☐	☐ Run	CH0 PID
	CH6 PID Run/Stop		☐	☐ Run	CH0 PID
	CH7 PID Run/Stop		☐	☐ Run	CH0 PID
	CH0 PID MAN		☐	☐ Manual	CH0 PID
	CH1 PID MAN		☐	☐ Manual	CH0 PID
	CH2 PID MAN		☐	☐ Manual	CH0 PID

(11) The automatic tuning

	Description	Address	Monitor	Initial	
▶	CH0 PID AutoTune	...	☐	☐ Enable	CH0 PID A
	CH1 PID AutoTune		☐	☐ Enable	CH0 PID A
	CH2 PID AutoTune		☐	☐ Enable	CH0 PID A
	CH3 PID AutoTune		☐	☐ Enable	CH0 PID A
	CH4 PID AutoTune		☐	☐ Enable	CH0 PID A
	CH5 PID AutoTune		☐	☐ Enable	CH0 PID A
	CH6 PID AutoTune		☐	☐ Enable	CH0 PID A
	CH7 PID AutoTune		☐	☐ Enable	CH0 PID A

(12) Refreshing the manual output values automatically

(13) The heating/cooling mode

(14) The target values

(15) The sampling time

PID Cycle					
	Description	Address	Monitor	Initial	
▶	CH0 Cycle	... □		10	CH0 Cycle
	CH1 Cycle	... □		10	CH1 Cycle
	CH2 Cycle	... □		10	CH2 Cycle
	CH3 Cycle	... □		10	CH3 Cycle
	CH4 Cycle	... □		10	CH4 Cycle
	CH5 Cycle	... □		10	CH5 Cycle
	CH6 Cycle	... □		10	CH6 Cycle
	CH7 Cycle	... □		10	CH7 Cycle

(16) The proportional gains

PID Kp					
	Description	Address	Monitor	Initial	
▶	CH0 Kp	... □		0.000000	CH0 Kp
	CH1 Kp	... □		0.000000	CH1 Kp
	CH2 Kp	... □		0.000000	CH2 Kp
	CH3 Kp	... □		0.000000	CH3 Kp
	CH4 Kp	... □		0.000000	CH4 Kp
	CH5 Kp	... □		0.000000	CH5 Kp
	CH6 Kp	... □		0.000000	CH6 Kp
	CH7 Kp	... □		0.000000	CH7 Kp

(17) The integral gains

PID Ki					
	Description	Address	Monitor	Initial	
▶	CH0 Ki	... □		0.000000	CH0 Ki
	CH1 Ki	... □		0.000000	CH1 Ki
	CH2 Ki	... □		0.000000	CH2 Ki
	CH3 Ki	... □		0.000000	CH3 Ki
	CH4 Ki	... □		0.000000	CH4 Ki
	CH5 Ki	... □		0.000000	CH5 Ki
	CH6 Ki	... □		0.000000	CH6 Ki
	CH7 Ki	... □		0.000000	CH7 Ki

(18) The derivative gains

	Description	Address	Monitor	Initial	
▸	CH0 Kd	...	☐	0.000000	CH0 Kd
	CH1 Kd	...	☐	0.000000	CH1 Kd
	CH2 Kd	...	☐	0.000000	CH2 Kd
	CH3 Kd	...	☐	0.000000	CH3 Kd
	CH4 Kd	...	☐	0.000000	CH4 Kd
	CH5 Kd	...	☐	0.000000	CH5 Kd
	CH6 Kd	...	☐	0.000000	CH6 Kd
	CH7 Kd	...	☐	0.000000	CH7 Kd

(19) The range within which the error values are count as 0

	Description	Address	Monitor	Initial	
▸	CH0 ERR_DBW	...	☐	0.000000	CH0 ERR_
	CH1 ERR_DBW	...	☐	0.000000	CH1 ERR_
	CH2 ERR_DBW	...	☐	0.000000	CH2 ERR_
	CH3 ERR_DBW	...	☐	0.000000	CH3 ERR_
	CH4 ERR_DBW	...	☐	0.000000	CH4 ERR_
	CH5 ERR_DBW	...	☐	0.000000	CH5 ERR_
	CH6 ERR_DBW	...	☐	0.000000	CH6 ERR_
	CH7 ERR_DBW	...	☐	0.000000	CH7 ERR_

(20) The manual output values

	Description	Address	Monitor	Initial	
▸	CH0 MOUT	...	☐	0.000000	CH0 MOU'
	CH1 MOUT	...	☐	0.000000	CH1 MOU'
	CH2 MOUT	...	☐	0.000000	CH2 MOU'
	CH3 MOUT	...	☐	0.000000	CH3 MOU'
	CH4 MOUT	...	☐	0.000000	CH4 MOU'
	CH5 MOUT	...	☐	0.000000	CH5 MOU'
	CH6 MOUT	...	☐	0.000000	CH6 MOU'
	CH7 MOUT	...	☐	0.000000	CH7 MOU'

(21) The maximum output values

PID MV_MAX					
Description	Address		Monitor	Initial	
▶ CH0 MV_MAX		...	☐	0.000000	CH0 MV_M
CH1 MV_MAX		...	☐	0.000000	CH1 MV_M
CH2 MV_MAX		...	☐	0.000000	CH2 MV_M
CH3 MV_MAX		...	☐	0.000000	CH3 MV_M
CH4 MV_MAX		...	☐	0.000000	CH4 MV_M
CH5 MV_MAX		...	☐	0.000000	CH5 MV_M
CH6 MV_MAX		...	☐	0.000000	CH6 MV_M
CH7 MV_MAX		...	☐	0.000000	CH7 MV_M

(22) The minimum output values

PID MV_MIN					
Description	Address		Monitor	Initial	
▶ CH0 MV_MIN		...	☐	0.000000	CH0 MV_M
CH1 MV_MIN		...	☐	0.000000	CH1 MV_M
CH2 MV_MIN		...	☐	0.000000	CH2 MV_M
CH3 MV_MIN		...	☐	0.000000	CH3 MV_M
CH4 MV_MIN		...	☐	0.000000	CH4 MV_M
CH5 MV_MIN		...	☐	0.000000	CH5 MV_M
CH6 MV_MIN		...	☐	0.000000	CH6 MV_M
CH7 MV_MIN		...	☐	0.000000	CH7 MV_M

(23) Reading the output values

PID MV(Read only)					
Description	Address		Monitor	Initial	
▶ CH0 MV(Read only)		...	☐	0.000000	CH0 MV(R
CH1 MV(Read only)		...	☐	0.000000	CH1 MV(R
CH2 MV(Read only)		...	☐	0.000000	CH2 MV(R
CH3 MV(Read only)		...	☐	0.000000	CH3 MV(R
CH4 MV(Read only)		...	☐	0.000000	CH4 MV(R
CH5 MV(Read only)		...	☐	0.000000	CH5 MV(R
CH6 MV(Read only)		...	☐	0.000000	CH6 MV(R
CH7 MV(Read only)		...	☐	0.000000	CH7 MV(R

(24) The accumulated integral values

6.5 Troubleshooting

6.5.1 Error Codes

Error Code	Type	Description	RUN LED indicator	ERROR LED indicator
16#A600	Alarm	Hardware failure	OFF	ON
16#A601	Alarm	The external voltage is abnormal.	OFF	ON
16#A602	Alarm	Internal error The CJC is abnormal.	OFF	ON
16#A603	Alarm	Internal error The factory correction is abnormal.	OFF	ON
16#A400	Alarm	The signal received by channel 0 exceeds the range of inputs which can be received by the hardware.	OFF	ON
16#A401	Alarm	The signal received by channel 1 exceeds the range of inputs which can be received by the hardware.	OFF	ON
16#A402	Alarm	The signal received by channel 2 exceeds the range of inputs which can be received by the hardware.	OFF	ON
16#A403	Alarm	The signal received by channel 3 exceeds the range of inputs which can be received by the hardware.	OFF	ON
16#A404	Alarm	The signal received by channel 4 exceeds the range of inputs which can be received by the hardware.	OFF	ON
16#A405	Alarm	The signal received by channel 5 exceeds the range of inputs which can be received by the hardware.	OFF	ON
16#A406	Alarm	The signal received by channel 6 exceeds the range of inputs which can be received by the hardware.	OFF	ON

Error Code	Type	Description	RUN LED indicator	ERROR LED indicator
16#A407	Alarm	The signal received by channel 7 exceeds the range of inputs which can be received by the hardware.	OFF	ON
16#A000	Warning	The signal received by channel 0 exceeds the range of inputs which can be received by the hardware.	ON	Blink
16#A001	Warning	The signal received by channel 1 exceeds the range of inputs which can be received by the hardware.	ON	Blink
16#A002	Warning	The signal received by channel 2 exceeds the range of inputs which can be received by the hardware.	ON	Blink
16#A003	Warning	The signal received by channel 3 exceeds the range of inputs which can be received by the hardware.	ON	Blink
16#A004	Warning	The signal received by channel 4 exceeds the range of inputs which can be received by the hardware.	ON	Blink
16#A005	Warning	The signal received by channel 5 exceeds the range of inputs which can be received by the hardware.	ON	Blink
16#A006	Warning	The signal received by channel 6 exceeds the range of inputs which can be received by the hardware.	ON	Blink
16#A007	Warning	The signal received by channel 7 exceeds the range of inputs which can be received by the hardware.	ON	Blink
16#A800	Warning	The signal received by channel 0 exceeds the range of inputs which can be received by the hardware.	ON	OFF
16#A801	Warning	The signal received by channel 1 exceeds the range of inputs which can be received by the hardware.	ON	OFF
16#A802	Warning	The signal received by channel 2 exceeds the range of inputs which can be received by the hardware.	ON	OFF
16#A803	Warning	The signal received by channel 3 exceeds the range of inputs which can be received by the hardware.	ON	OFF
16#A804	Warning	The signal received by channel 4 exceeds the range of inputs which can be received by the hardware.	ON	OFF
16#A805	Warning	The signal received by channel 5 exceeds the range of inputs which can be received by the hardware.	ON	OFF
16#A806	Warning	The signal received by channel 6 exceeds the range of inputs which can be received by the hardware.	ON	OFF
16#A807	Warning	The signal received by channel 7 exceeds the range of inputs which can be received by the hardware.	ON	OFF

6.5.2 Troubleshooting Procedure

Description	Procedure
Hardware failure	Return the module to the factory for repair.
The external voltage is abnormal.	Check whether the external 24 V power supply to the module is normal.
Internal error The CJC is abnormal.	Please contact the factory.
Internal error The factory correction is abnormal.	Please contact the factory.
The signal received by channel 0 exceeds the range of inputs which can be received by the hardware.	Check the signal received by channel 0.
The signal received by channel 1 exceeds the range of inputs which can be received by the hardware.	Check the signal received by channel 1
The signal received by channel 2 exceeds the range of inputs which can be received by the hardware.	Check the signal received by channel 2.
The signal received by channel 3 exceeds the range of inputs which can be received by the hardware.	Check the signal received by channel 3.
The signal received by channel 4 exceeds the range of inputs which can be received by the hardware.	Check the signal received by channel 4.
The signal received by channel 5 exceeds the range of inputs which can be received by the hardware.	Check the signal received by channel 5.
The signal received by channel 6 exceeds the range of inputs which can be received by the hardware.	Check the signal received by channel 6.
The signal received by channel 7 exceeds the range of inputs which can be received by the hardware.	Check the signal received by channel 7.

Chapter 7   High-speed Counter Module AH02HC/AH04HC

Table of Contents

7.1 Introduction

An AH500 series high-speed counter module has several bidirectional high-speed counters. It can update the number of input pulses instantly. It can also cyclically update, prescale, and average the number of sampled pulses. If the number of sampled pulses is monitored, an alarm can be generated. The number of sampled pulses is added to the number of accumulated pulses. Users can detect whether the number of accumulated pulses overflows, and compares the number of accumulated pulses with a value.

- AH02HC-5A: There are two bidirectional high-speed counters. Only channel 0 and channel 1 are supported. Channel 2 and channel 3 are not supported.
- AH04HC-5A: There are four bidirectional high-speed counters. Channel 0~channel 3 are supported.

7.1.1 Characteristics
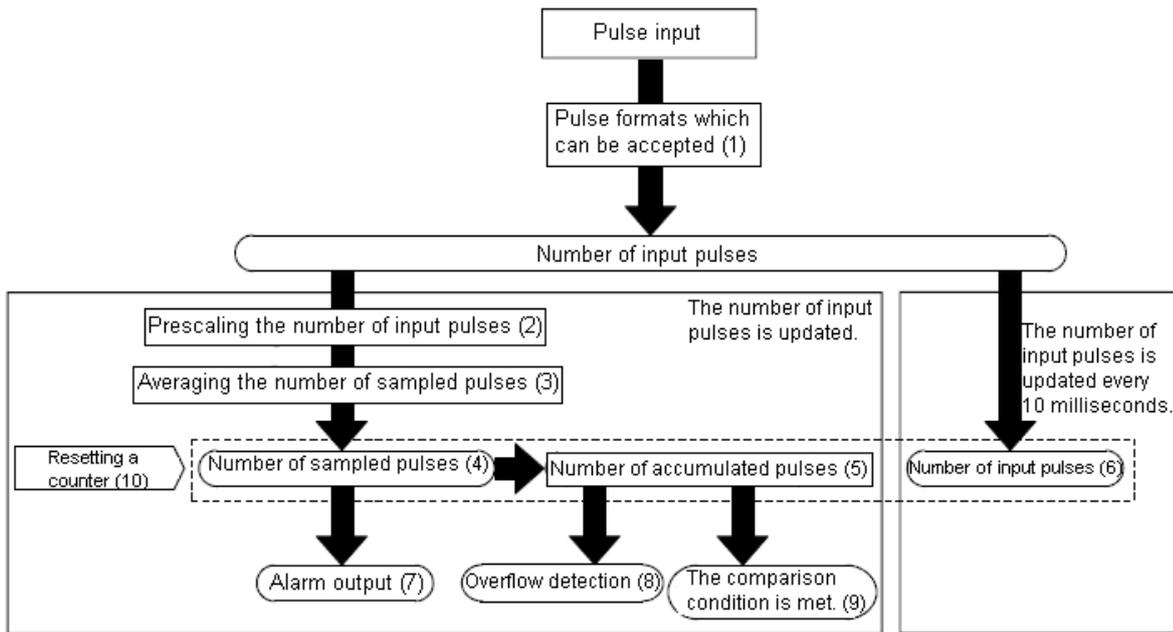
1. Pulse formats which can be accepted

   Single pulse, double pulse, one time the frequency of A/B-phase inputs, and four times the frequency of A/B-phase inputs
2. Prescaling the number of input pulses

   After the number of input pulses is multiply by a certain value, it will become a value which has a specific significance.
3. Averaging the number of sampled pulses

   The number of sampled pulses is divided by the number of cycles set by users.
4. Number of sampled pulses

   The number of pulses sampled during the cycle can be prescaled. If the number of input pulses is not even every time, it can be averaged. The number of sampled pulses is in the range of -200000 to 200000.
5. Number of accumulated pulses

   The number of pulses sampled during every cycle is accumulated. The number of accumulated pulses is in the range of -999999999 to 999999999. The number of pulses sampled during every cycle can be accumulated linearly or circularly.
6. Number of input pulses

   The number of input pulses is updated every 10 milliseconds. The number of input pulses is in the range of -2147483648 to 2147483647.
7. Alarm output

   Users can set an upper-upper limit value, an upper-lower limit value, a lower-upper limit value, and a lower-lower limit value. If the number of sampled pulses is larger than the upper-upper

limit value set, or less than the lower-lower limit value set, an alarm will be generated.

8. Detecting the number of accumulated pulses overflows

   If linear accumulation is used, users can detect whether the number of accumulated pulses overflows. If the number of accumulated pulses overflows, the overflow flag will be turned ON.

9. Comparing the number of accumulated pulses with a value

   If the number of accumulated pulses is larger than or equal to the comparison value set, the comparison flag will be turned ON.

10. Resetting a counter

    A counter can be reset by means of software or an external trigger.

    The number of sampled pulses, the number of accumulated pulses, and the number of input pulses can be reset at any time.

7.2 Specifications

7.2.1 Dimensions of AH02HC-5A

Unit: mm
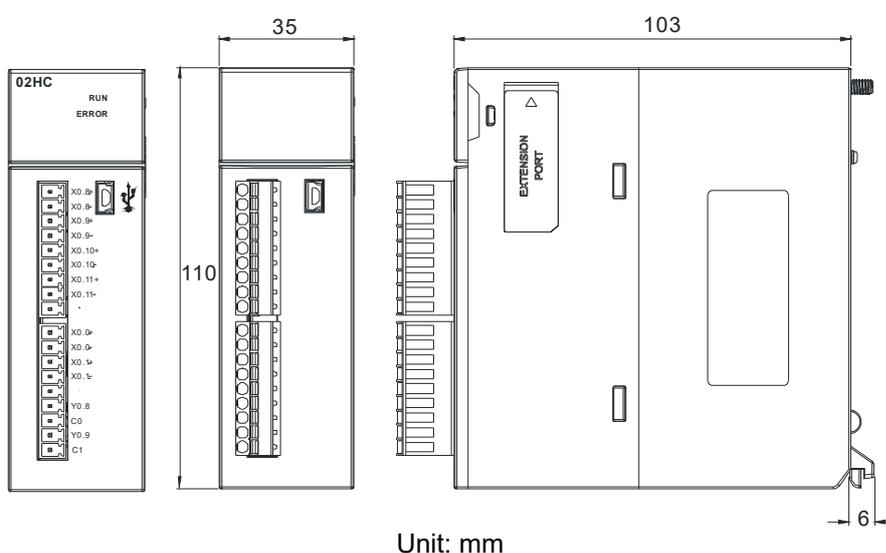
7.2.2 Specifications for AH02HC-5A

Item		Specifications
Number of channels		2 channels
Input signal	**Input (differential signal)**	Channel 0: X0.8+, X0.8-, X0.9+, and X0.9- Channel 1: X0.10+, X0.10-, X0.11+, and X0.11-
	Pulse format	Pulse/Direction (one phase and one input) Counting up/Counting down (one phase and two inputs) One time the frequency of A/B-phase inputs (two phases and two inputs) Four times the frequency of A/B-phase inputs (two phases and two inputs)
	Signal level	5~24 V DC
Specifications	**Maximum frequency of counting**	The maximum frequency is 200 kHz.
	Range	The number of sampled pulses is in the range of -200000 to 200000. The number of accumulated pulses is in the range of -999999999 to 999999999. The number of input pulses is in the range of -2147483648 to 2147483648.

Item		Specifications
RESET input	Type	General count Circular count
	Input (differential signal)	CH0: X0.0+ and X0.0- CH1: X0.1+ and X0.1-
	Signal level	5~24 V DC
	Maximum current	15 mA
Comparison output	Output type	Channel 0: The high-speed pulse output Y0.8 is a transistor whose collector is an open collector. Channel 1: The high-speed pulse output Y0.9 is a transistor whose collector is an open collector.
	Signal level	24 V DC
	Maximum current	15 mA

7.2.3 Dimensions of AH04HC-5A
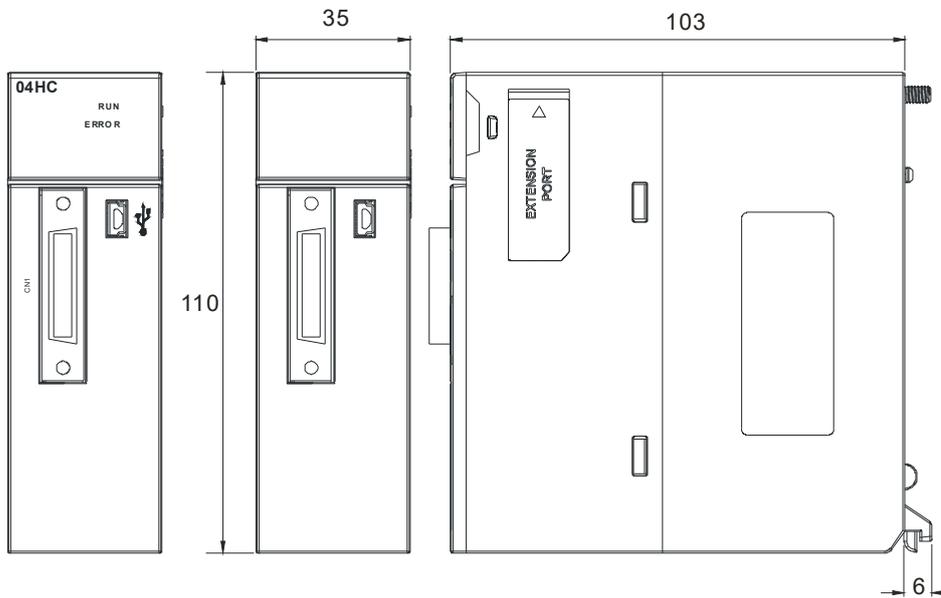
Unit: mm

7.2.4 Specifications for AH04HC-5A

Item		Specifications
Connector		A connector made with great precision is used. It has to be connected to an external terminal module.
Number of channels		4 channels
Input signal	Input (differential signal)	Channel 0: X0.8+, X0.8-, X0.9+, and X0.9- Channel 1: X0.10+, X0.10-, X0.11+, and X0.11- Channel 2: X0.12+, X0.12-, X0.13+, and X0.13- Channel 3: X0.14+, X0.14-, X0.15+, and X0.15-
	Pulse format	Pulse/Direction (one phase and one input) Counting up/Counting up (one phase and two inputs) One time the frequency of A/B-phase inputs (two phases and two inputs) Four times the frequency of A/B-phase inputs (two phases and two inputs)
	Signal level	5~24 V DC

Item		Specifications
Specifications	**Maximum frequency of counting**	The maximum frequency is 200 kHz.
	Range	The number of sampled pulses is in the range of -200000 to 200000. The number of accumulated pulses is in the range of -999999999 to 999999999. The number of input pulses is in the range of -2147483648 to 2147483648.
	Type	Linear count Circular count
RESET input	**Input (differential signal)**	CH0: X0.0+ and X0.0- CH1: X0.1+ and X0.1- CH2: X0.2+ and X0.2- CH3: X0.3+ and X0.3-
	Signal level	5~24 V DC
	Maximum current	15 mA
Comparison output	**Output type**	Channel 0: The high-speed pulse output Y0.8 is a transistor whose collector is an open collector. Channel 1: The high-speed pulse output Y0.9 is a transistor whose collector is an open collector. Channel 2: The high-speed pulse output Y0.10 is a transistor whose collector is an open collector. Channel 3: The high-speed pulse output Y0.11 is a transistor whose collector is an open collector.
	Signal level	24 V DC
	Maximum current	15 mA

7.2.5 Functions of AH02HC-5A/AH04HC-5A

Function		Description
Enabling/Disabling a count		1. Users can enable or disable a channel. 2. If unnecessary channels are disabled, the internal operation will become more efficient.
Accumulation counter	**Linear count**	The number of accumulated pulses is in the range of -999999999 to 999999999. If the number of accumulated pulses is not within the range, the overflow flag will be turned ON.
	Circular count	The number of accumulated pulses is in the range of -999999999 to 0, or in the range of 0 to 999999999.
	Comparison	If the number of accumulated pulses meets the comparison condition set, the comparison flag will be turned ON, and a signal will be output. Users can reset the comparison condition.
Sampling counter	**Setting a cycle**	Users can change the cycle of updating the number of sampled pulses or the cycle of updating the number of accumulated pulses.
	Averaging the number of sampled pulses	The number of sampled pulses is divided by the number of cycles set by users.
	Prescaling	The number of input pulses is multiplied by a scale.

Function		Description
	the number of input pulses	
	Alarm	If the number of sampled pulses is larger than the upper-upper limit value set, or less than the lower-lower limit value set, an alarm will be generated. If the number of sampled pulses is between the upper-lower limit value set and the lower-upper limit value set, the alarm will stop.
Resetting a counter		The number of pulses received by a channel is reset.

7.2.6 Profile of AH02HC-5A

Number	Name	Description
1	Model name	Model name of the module
2	RUN LED indicator (green)	Operating status of the module ON: The module is running. OFF: The module stops running.
3	ERROR LED indicator (red)	Error status of the module Blink: The module is abnormal.
4	USB port	Providing the mini USB communication interface
5	Terminals	Input/Output terminals
6	Arrangement of the input/output terminals	Arrangement of the terminals
7	Extension port	Updating the firmware
8	Label	Nameplate
9	Set screw	Fixing the module
10	Connector	Connecting the module and a backplane
11	Projection	Fixing the module

7.2.7 Profile of AH04HC-5A

Number	Name	Description
1	Model name	Model name of the module
2	RUN LED indicator (green)	Operating status of the module ON: The module is running. OFF: The module stops running.
3	ERROR LED indicator (red)	Error status of the module Blink: The module is abnormal.
4	USB port	Providing the mini USB communication interface
5	Connector	Connecting the module and an I/O extension cable
6	Extension port	Updating the firmware
7	Label	Nameplate
8	Set screw	Fixing the module
9	Connector	Connecting the module and a backplane
10	Projection	Fixing the module

7.2.8 Arrangement of Input/Output Terminals

● AH02HC-5A
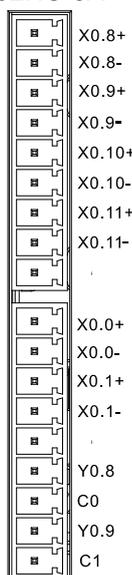
Terminal	Function	Terminal	Function
	Count		Count
X0.8+	CntA0+	X0.0+	Rst0+
X0.8-	CntA0-	X0.0-	Rst0-
X0.9+	CntB0+	X0.1+	Rst1+
X0.9-	CntB0-	X0.1-	Rst1-
X0.10+	CntA1+	Y0.8	Out0
X0.10-	CntA1-	C0	COM0
X0.11+	CntB1+	Y0.9	Out1
X0.11-	CntB1-	C1	COM1

● AH04HC-5A
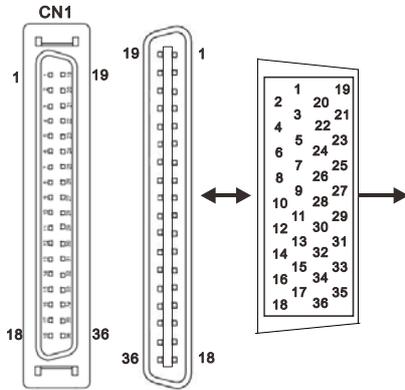
Pin	Terminal	Function Count	Pin	Terminal	Function Count
1	C3	COM3	2	Y0.11	Out3
3	C2	COM2	4	Y0.10	Out2
5	C1	COM1	6	Y0.9	Out1
7	C0	COM0	8	Y0.8	Out0
9	·	·	10	·	·
11	·	·	12	·	·
13	X0.3-	Rst3-	14	X0.3+	Rst3+
15	X0.15-	CntB3-	16	X0.15+	CntB3+
17	X0.14-	CntA3-	18	X0.14+	CntA3+
19	X0.2-	Rst2-	20	X0.2+	Rst2+
21	X0.13-	CntB2-	22	X0.13+	CntB2+
23	X0.12-	CntA2-	24	X0.12+	CntA2+
25	X0.1-	Rst1-	26	X0.1+	Rst1+
27	X0.11-	CntB1-	28	X0.11+	CntB1+
29	X0.10-	CntA1-	30	X0.10+	CntA1+
31	X0.0-	Rst0-	32	X0.0+	Rst0+
33	X0.9-	CntB0-	34	X0.9+	CntB0+
35	X0.8-	CntA0-	36	X0.8+	CntA0+

7.2.9 External Wiring

1. A PNP encoder is used.
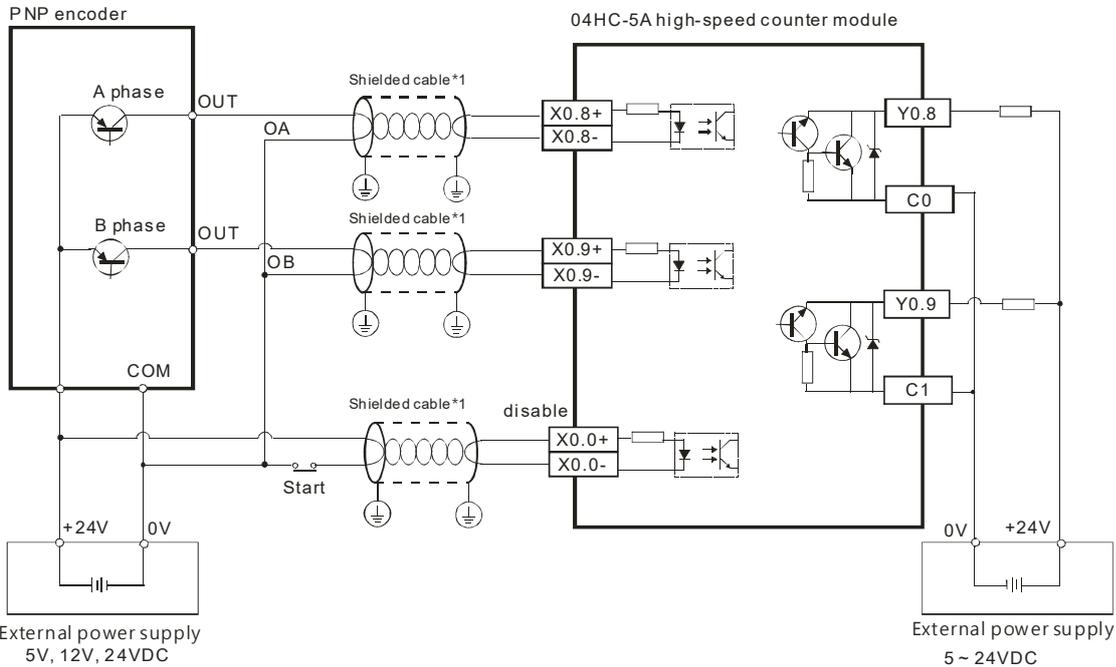
2. An NPN encoder is used.
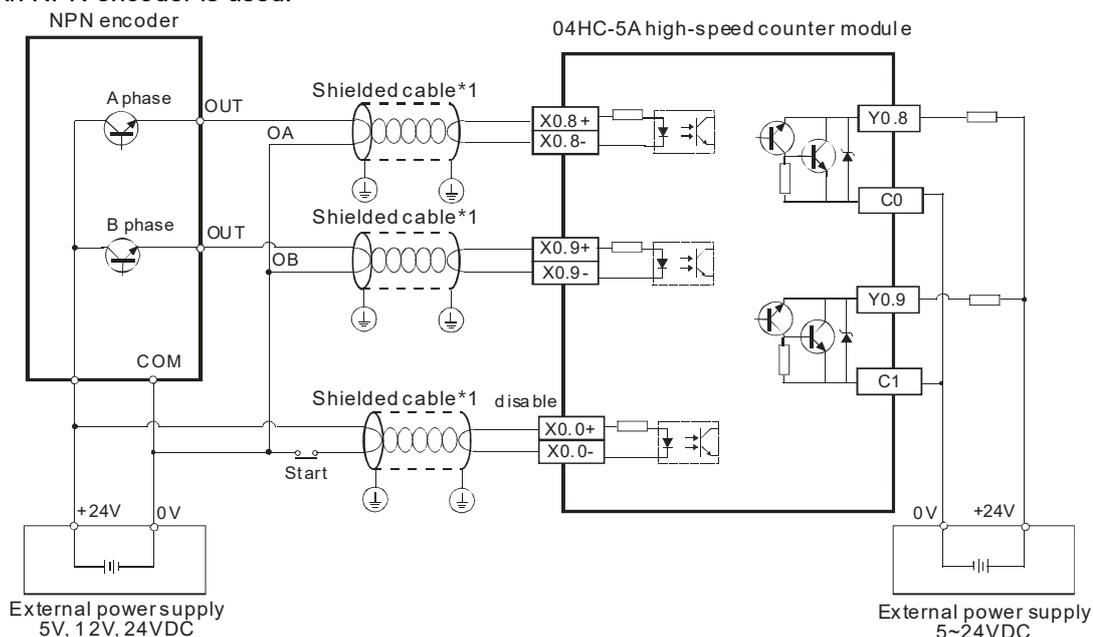
7.3 HWCONFIG in ISPSoft

AH04HC-5A is taken for instance. If the AH500 series high-speed counter module that users use is AH02HC-5A, it is operated in the same way as AH04HC-5A is operated.

7.3.1 Checking the Firmware Version of a Module

Users can check the firmware version of a module through HWCONFIG in ISPSoft.
(1) Start ISPSoft, and then double-click **HWCONFIG** in the project management area.
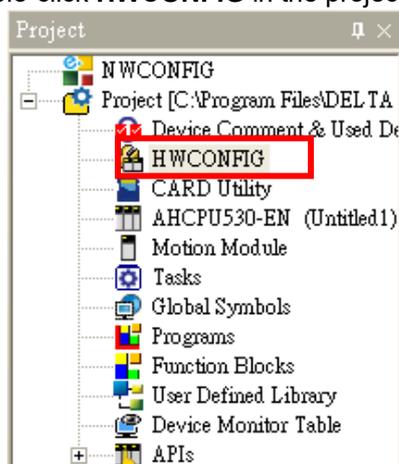
(2) The **HWCONFIG** window is shown below.
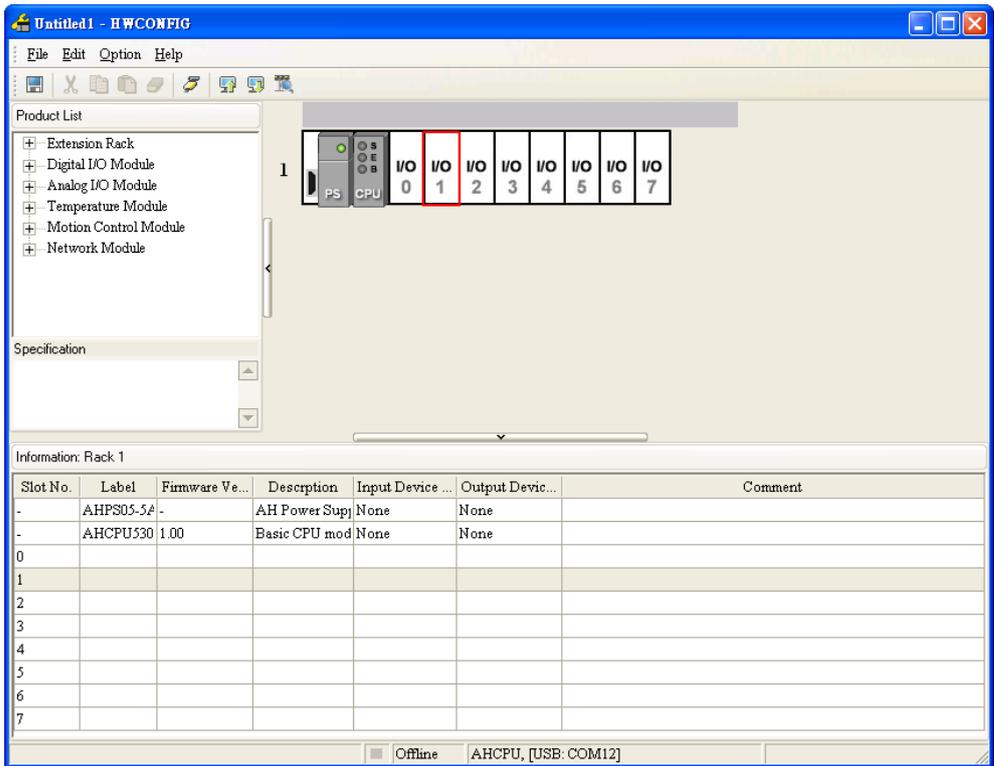
(3) After users click **I/O Scan** on the **Option** menu, the modules installed on the present backplane will be scanned.
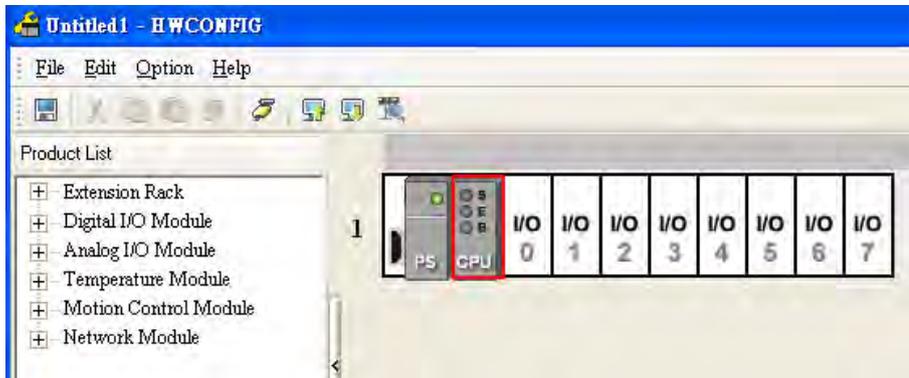
(4) The scan result is shown below. AH04HC-5A is installed in the second slot on the main backplane.
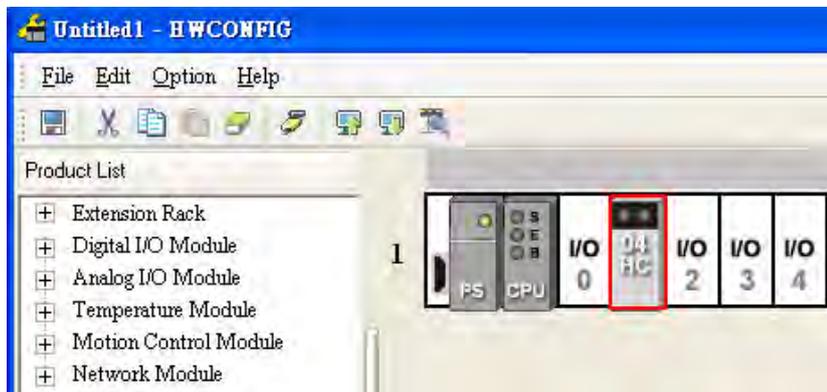
(5) Click **Online Mode** on the toolbar.
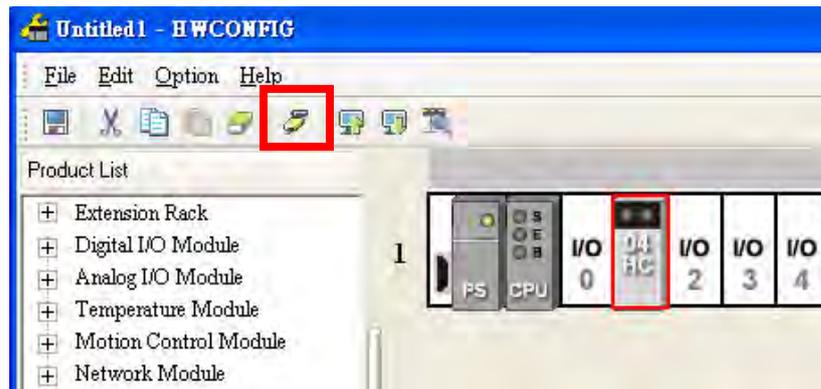
(6) After the users right-click the module AH04HC-5A, a context menu will appear.
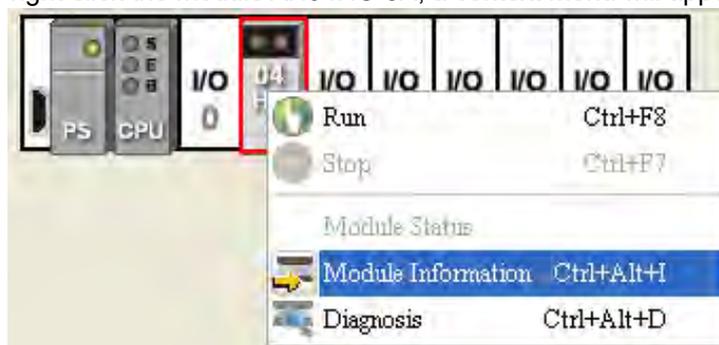
(7) After the users click **Module Information** on the context menu, the **Module Information** window will appear. The firmware version in the red frame in the window below is the firmware version of the module AH04HC-5A.
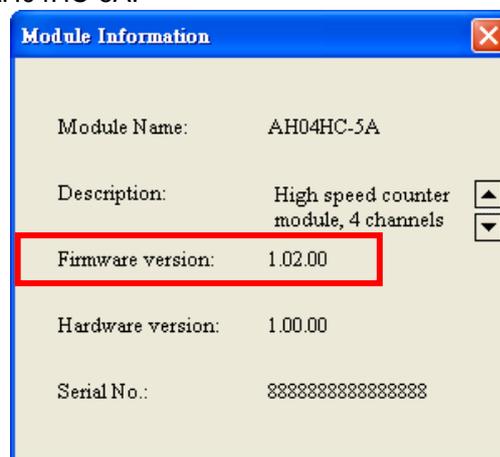
7.4　Initial Setting

Users can set the parameters in a module through ISPSoft. After the parameters are set, they can be downloaded to the module. The steps of setting the parameters in the module AH04HC-5A are as follows.

(1) Start ISPSoft, and then double-click **HWCONFIG** in the project management area.
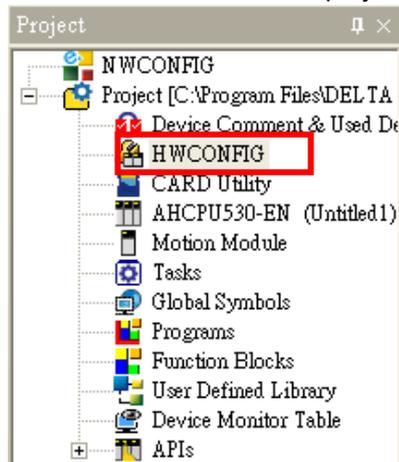
(2) Click **I/O Scan** on the **Option** menu in the **HWCONFIG** window.
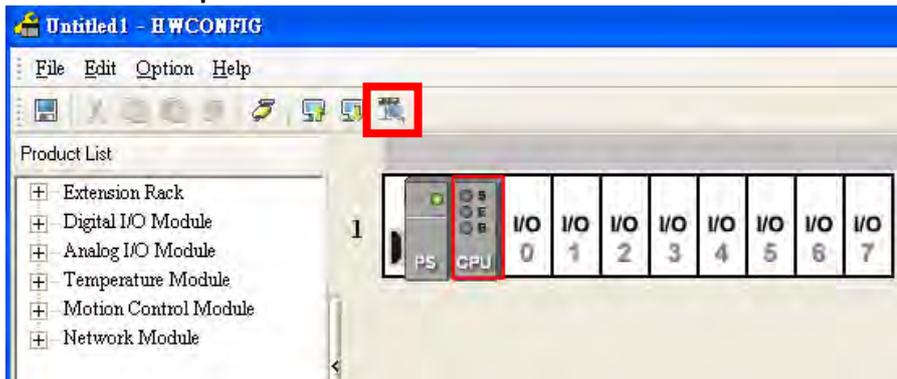
(3) Double-click the module AH04HC-5A.
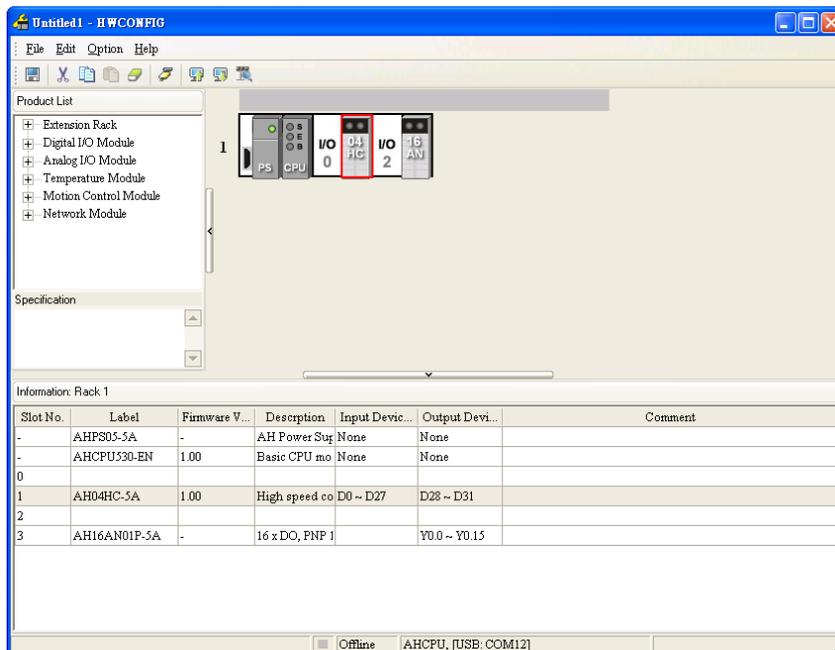
(4) Set the parameters.
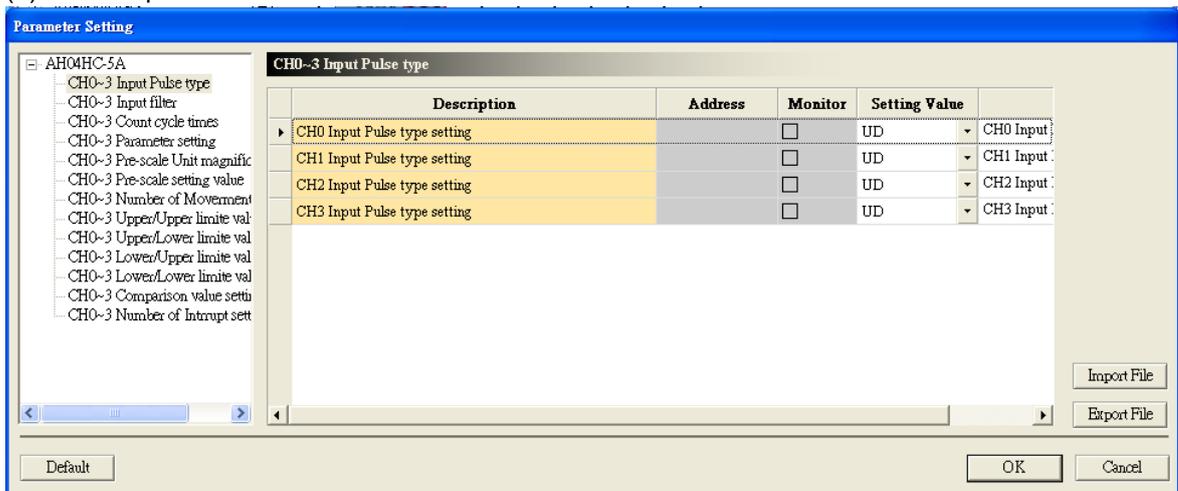
(5) After the setting of the parameters is complete, users can click **Download** on the toolbar to download the parameters to the module.
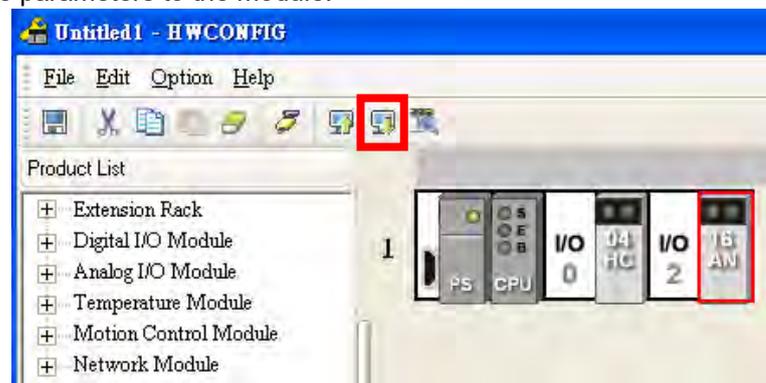
7.5 Updating Parameters

If users click **Upload** on the toolbar in the **HWCONFIG** window, the parameters in the modules will be uploaded. After the users modify the parameters uploaded, they can download the parameters to the modules.
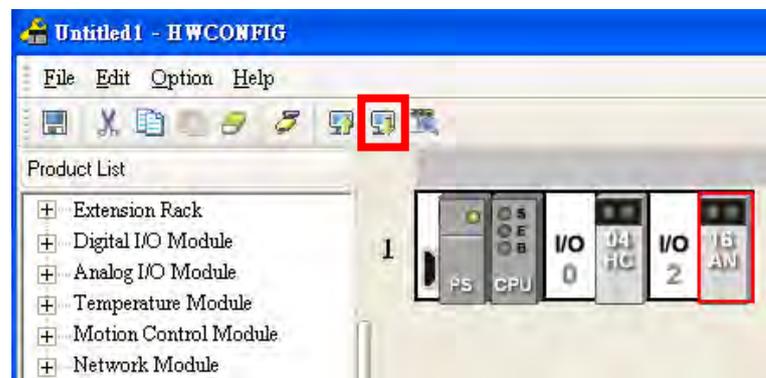
7.6 Monitoring Parameters

(1) Registers are assigned to the modules by means of ISPSoft.
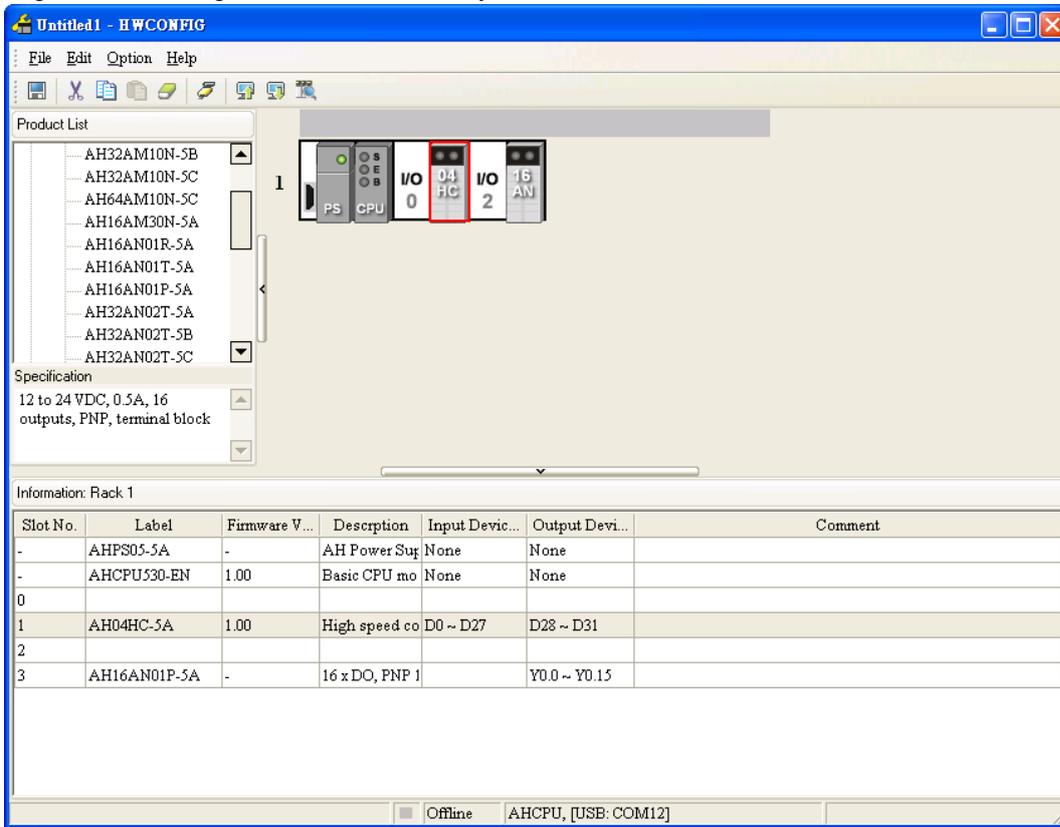
AH04HC-5A has four channels, and uses thirty-two registers in a CPU module. The CPU module reads the values in twenty-eight registers periodically. The commands that the CPU module sends to AH04HC-5A are stored in the remaining four registers. Twenty-eight input data registers are assigned to AH04HC-5A by means of ISPSoft. In the figure above, D0~D27 are assigned to AH04HC-5A by means of ISPSoft. The twenty-eight registers assigned to AH04HC-5A can be changed manually.

After users double-click AH04HC-5A in the **HWCONFIG** window, they can click the **Normal Exchange Area** tab in the **Parameter Setting** window.
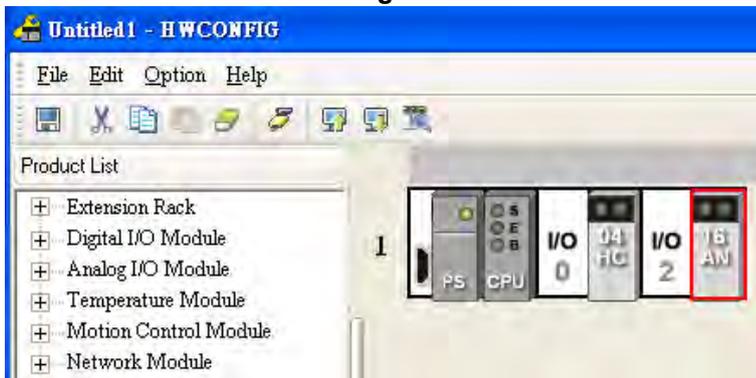
The relation between D0~D27 and the four channels that AH04HC-5A has is shown below. The values in the twenty-eight registers are updated every millisecond.

Input devices

	Description	Address
	CH2 Accumlating count value data Device	D17 ~ D18
	CH2 Input pulse value data Device	D19 ~ D20
	CH3 Operation Status Device	D21
	CH3 Sampling pulse number data Device	D22 ~ D23
	CH3 Accumlating count value data Device	D24 ~ D25
	CH3 Input pulse value data Device	D26 ~ D27
	CH0 Operation Setting Device	D28
	CH1 Operation Setting Device	D29
	CH2 Operation Setting Device	D30
	CH3 Operation Setting Device	D31

Register	CH0	Register	CH1	Register	CH2	Register	CH3	Parameter
D0	#19	D7	#47	D14	#75	D21	#103	Operating state of a counter
D1	#20	D8	#48	D15	#76	D22	#104	Number of sampled pulses (Low word)
D2	#21	D9	#49	D16	#77	D23	#105	Number of sampled pulses (high word)
D3	#22	D10	#50	D17	#78	D24	#106	Number of accumulated pulses (Low word)
D4	#23	D11	#51	D18	#79	D25	#107	Number of accumulated pulses (High word)
D5	#24	D12	#52	D19	#80	D26	#108	Number of input pulses (Low word)
D6	#25	D13	#53	D20	#81	D27	#109	Number of input pulses (High word)

Users can monitor the operation of AH04HC-5A by means of a monitoring table. In the figure below, the parameters corresponding to D0~D27 are monitored.

Output devices

Register	CH0	Register	CH1	Register	CH2	Register	CH3	Parameter
D28	#0	D29	#28	D30	#56	D31	#84	Operation of a counter (*1)

*1: CR0, CR28, CR56, and CR84 can only be used as normal exchange registers. They can not be set by means of the instruction TO.
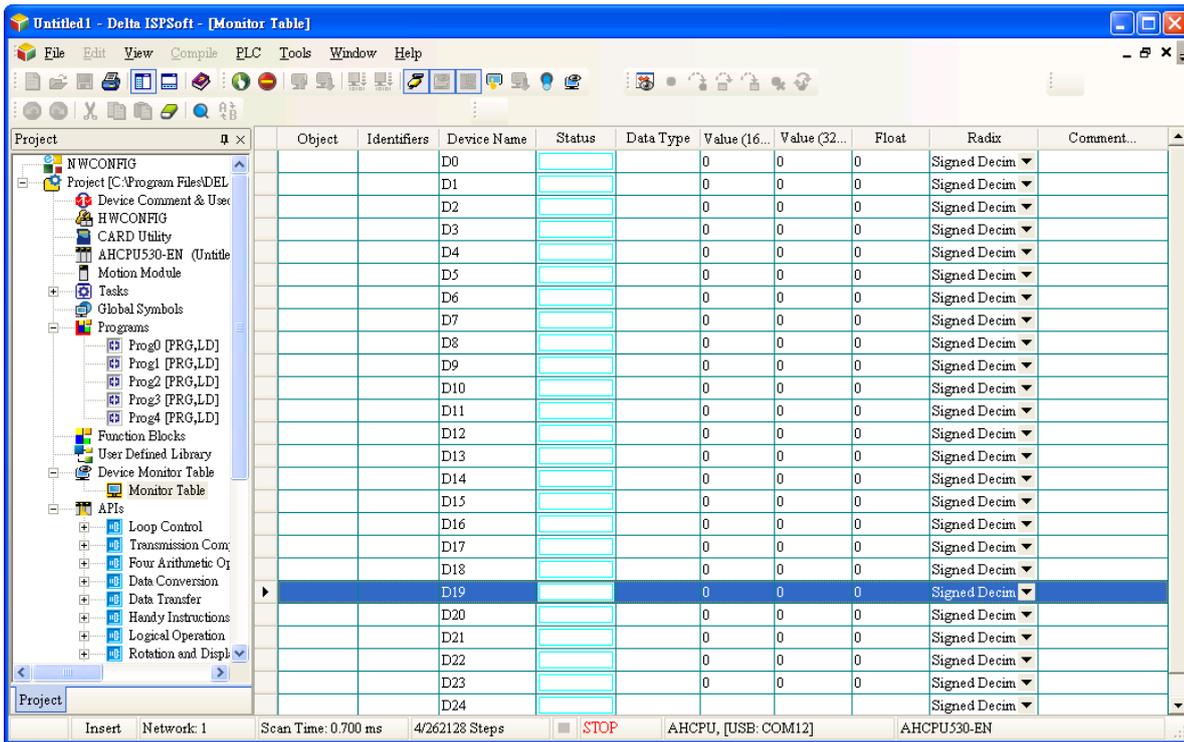
(2) Using the instruction FROM

Please refer to AH500 Programming Manual for more information. Users can read parameters in AH04HC-5A by means of the instruction FROM. The parameters read are stored in the data registers specified. If the users add the data registers to the monitoring table in ISPSoft, they can monitor the parameters when the program is executed.

7.7   Parameter Table

CH0	CH1	CH2	CH3	Attribute	Register name	Default value	Remark
#0	#28	#56	#84	R/W	Operation of a counter (*1)	16#0000	Bit 0~bit 6
#1	#29	#57	#85	R/W	Input pulse type	0	0~3
#2	#2	#2	#2	R/W	Frequency of an input pulse	0	0 (The setting of the frequency of an input pulse is disabled.), or 4~19
#3	#31	#59	#87	R/W	Cycle of reading the number of pulses	10	1~1000 (Unit: ms)
#4	#32	#60	#88	R/W	Counting parameters	0	Bit 0~bit 10
#5	#33	#61	#89	R/W	Selecting a prescale function	0	0~4
#6	#34	#62	#90	R/W	Setting a prescale value	0	0~32767
#7	#35	#63	#91	R/W	Number of cycles	0	2~60
#8	#36	#64	#92	R/W	Upper-upper limit value (Low word)	0	-200000~200000
#9	#37	#65	#93	R/W	Upper-upper limit value (High word)	0	
#10	#38	#66	#94	R/W	Upper-lower limit	0	-200000~200000

CH0	CH1	CH2	CH3	Attribute	Register name	Default value	Remark
					value (Low word)		
#11	#39	#67	#95	R/W	Upper-lower limit value (High word)	0	
#12	#40	#68	#96	R/W	Lower-upper limit value (Low word)	0	-200000~200000
#13	#41	#69	#97	R/W	Lower-upper limit value (High word)	0	
#14	#42	#70	#98	R/W	Lower-lower limit value (Low word)	0	-200000~200000
#15	#43	#71	#99	R/W	Lower-lower limit value (High word)	0	
#16	#44	#72	#100	R/W	Comparison value (Low word)	0	-999999999~999999999
#17	#45	#73	#101	R/W	Comparison value (High word)	0	
#18	#46	#74	#102	R/W	Interrupt triggered by a comparison	0	0~31
#19	#47	#75	#103	R	Operating state of a counter	16#0000	Bit 0~bit 6
#20	#48	#76	#104	R	Number of sampled pulses (Low word)	0	-200000~200000
#21	#49	#77	#105	R	Number of sampled pulses (High word)	0	
#22	#50	#78	#106	R	Number of accumulated pulses (Low word)	0	-999999999~999999999
#23	#51	#79	#107	R	Number of accumulated pulses (High word)	0	
#24	#52	#80	#108	R	Number of input pulses (Low word)	0	-2147483648~2147483647
#25	#53	#81	#109	R	Number of input pulses (High word)	0	
#26	#54	#82	#110	R	Error code	0	Six error codes
#27	#55	#83	#111		Reserved		

*1: CR0, CR28, CR56, and CR84 can only be used as normal exchange registers. They can not be set by means of the instruction TO.

7.8 Writing Parameters

Users can set the parameters in AH02HC-5A/AH04HC-5A by means of ISPSoft, and set CR0/CR28/CR56/CR84 by means of the output devices assigned to AH02HC-5A/AH04HC-5A. The users can also set the parameters in AH02HC-5A/AH04HC-5A by means of the instruction TO or DTO.

(1) Software: ISPSoft

After AH02HC-5A/AH04HC-5A is installed, HWCONFIG in ISPSoft can be used to set the parameters in AH02HC-5A/AH04HC-5A. Users can not start AH02HC-5A/AH04HC-5A by means of HWCONFIG in ISPSoft. However, CR0, CR28, CR56, and CR84 can be set by the output devices assigned to AH02HC-5A/AH04HC-5A in the program written in ISPSoft.

(2) Instruction: TO or DTO

Parameters can be changed by means of the instruction TO or DTO. When AH02HC-5A/AH04HC-5A counts, users can not change parameters. The change of parameters

will be valid if AH02HC-5A/AH04HC-5A stops counting. If the users want to write parameters by means of TO, the maximum data length is 128 words. If the users want to write parameters by means of DTO, the maximum data length is 64 double words.

7.9 Descriptions of the Control Registers
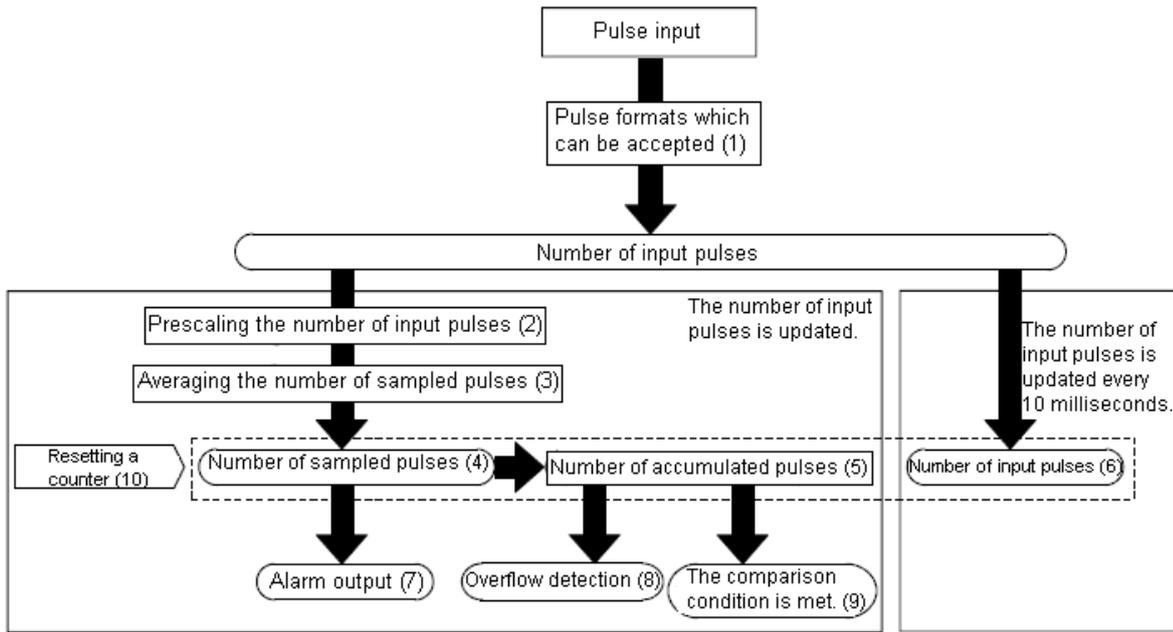
7.9.1 Operation of a Counter

CH0		CH*1		CH2		CH3	
High word	Low word	High word	Low word	High word	Low word	High word	Low word
-	#0	-	#28	-	#56	-	#84

*1: CR0, CR28, CR56, and CR84 can only be used as normal exchange registers. They can not be set by means of the instruction TO.

[Description]
Bit 0~bit 15 are described below.

bit#	Description
0	Starting the count
1	Resetting the sampling register/accumulation register/pulse input register Resetting bit 1 in CR19/CR47/CR75/CR103
2	Resetting bit 2 in CR19/CR47/CR75/CR103
3	Resetting bit 3 in CR19/CR47/CR75/CR103
4-5	Reserved
6	Clearing the error flag
7~15	Reserved

*. Bit 1~bit3 and bit6 will be turned OFF automatically after the related functions are fulfilled.

1. Bit 0 in CR0/CR28/CR56/CR84: ON: Starting the count; OFF: Stopping the count
    a. Starting the count: If bit 0 in CR0/CR28/CR56/CR84 is turned from OFF to ON, and the parameters are set correctly, the system will start the count. If the parameters are set incorrectly, bit 0 in CR0/CR28/CR56/CR84 will be turned OFF immediately, and bit 6 in CR19/CR47/CR75/CR103 will be turned ON. Users can read the error code in CR26/CR54/CR82/CR110.
    b. Stopping the count: If bit 0 in CR0/CR28/CR56/CR84 is turned from ON to OFF, the system will stop the count.

2. Bit 1 in CR0/CR28/CR56/CR84: If bit 1 in CR0/CR28/CR56/CR84 is turned ON, the sampling register/accumulation register/pulse input register, and bit 1 in CR19/CR47/CR75/CR103 will be reset. After the sampling register/accumulation register/pulse input register, and bit 1 in CR19/CR47/CR75/CR103 is reset, bit 1 in CR0/CR28/CR56/CR84 will be turned OFF automatically.
   a. If bit 1 in CR0/CR28/CR56/CR84 is turned ON, the sampling register/accumulation register/pulse input register will be reset to 0 immediately.
   b. If the linear accumulation is larger than the maximum value 999999999 or less than the minimum value -999999999, the accumulation register will stop counting, the value in the accumulation register will be 999999999 or -999999999, and bit 1 in CR19/CR47/CR75/CR103 will be turned ON. If bit 1 in CR0/CR28/CR56/CR84 is turned ON, the accumulation counter will be reset, bit 1 in CR19/CR47/CR75/CR103 will be turned OFF, and the linear accumulation can be executed.
3. Bit 2 in CR0/CR28/CR56/CR84: If bit 2 is turned ON, bit 2 in CR19/CR47/CR75/CR103 will be reset. After the circular accumulation is reset, bit 2 in CR0/CR28/CR56/CR84 will be turned OFF automatically.

   If the circular accumulation is larger than the maximum value 999999999 or less than the minimum value -999999999, bit 2 in CR19/CR47/CR75/CR103 will be turned ON. If bit 2 in CR0/CR28/CR56/CR84 is turned ON, the value in the accumulation register will be cleared, and bit 2 in CR19/CR47/CR75/CR103 will be turned OFF.
4. Bit 3 in CR0/CR28/CR56/CR84: If bit 3 in CR0/CR28/CR56/CR84 is turned ON, bit 3 in CR19/CR47/CR75/CR103 will be reset. After bit 3 in CR19/CR47/CR75/CR103 is reset, bit 3 in CR0/CR28/CR56/CR84 will be turned OFF automatically.

   If the value in the accumulation register meets the comparison condition set, bit 3 in CR19/CR47/CR75/CR103 will be turned ON. If bit 3 in CR0/CR28/CR56/CR84 is turned ON, bit 3 in CR19/CR47/CR75/CR103 will be turned OFF.
5. Bit 6 in CR0/CR28/CR56/CR84: If bit 6 in CR0/CR28/CR56/CR84 is turned ON, the error flag will be cleared. After the error flag is cleared, bit 6 in CR0/CR28/CR56/CR84 will be turned OFF.

   If bit 0 in CR0/CR28/CR56/CR84 is turned from OFF to ON, and related parameters are set incorrectly, the system will automatically judge that there is an error, and bit 6 in CR19/CR47/CR75/CR103 will be turned ON immediately. Users can read the error code in CR26/CR54/CR82/CR110. If bit 6 in CR0/CR28/CR56/CR84 is turned ON, bit 6 in CR19/CR47/CR75/CR103 will be turned OFF.

7.9.2 Input Pulse Type

CH0		CH1		CH2		CH3	
High word	Low word	High word	Low word	High word	Low word	High word	Low word
-	#1	-	#29	-	#57	-	#85

Bit 1	Bit 0	Description
0	0	Double pulse (counting up/counting down)
0	1	Single pulse (pulse/direction)
1	0	One time the frequency of A/B-phase inputs
1	1	Four times the frequency of A/B-phase inputs

7.9.3 Frequency of an Input Pulse

CH0		CH1		CH2		CH3	
High word	Low word	High word	Low word	High word	Low word	High word	Low word
-	#2	-	#2	-	#2	-	#2

[Description]
The function is used to set the frequency of an input pulse which needs to filtered.

1. Filter coefficient $= \dfrac{85000}{2^{N+4}}$ (kHz); N=0~19

The conversion results are shown in the following table.

N	kHz	N	kHz
0	The setting of the frequency of an input pulse is disabled.	10	5.187988
1	2656.2504	11	2.593994
2	1328.1252	12	1.296997
3	664.0626	13	0.648499
4	332.0313	14	0.324249
5	166.0156	15	0.162125
6	83.00781	16	0.081062
7	41.50391	17	0.040531
8	20.75195	18	0.020266
9	10.37598	19	0.010133

2. If the value in CR#2 is 0, the external input terminals do not filter pulses. If the value in CR#2 is larger than 19, the value will be counted as 0. For example, if the value in CR#2 is 10, the filter coefficient is $\dfrac{85000}{2^{10+4}} = 5.187988$ (KHz). That is, the input signals whose frequencies are larger than 5.187988 kHz are filtered out.

3.

7.9.4 Cycle of Reading the Number of Pulses

CH0		CH1		CH2		CH3	
High word	Low word	High word	Low word	High word	Low word	High word	Low word
-	#3	-	#31	-	#59	-	#87

[Description]
If bit 0 in CR0/CR28/CR56/CR84 is turned from OFF to ON, the number of pulses received by the input terminals will be read according to the cycle set. The setting of a cycle is shown below.

Item	Setting value
Cycle of reading the number of pulses	1~1000 (Unit: ms)

If the setting value is larger than 1000, the cycle will be counted as 1000 milliseconds. If the setting value is less than 1, the cycle will be counted as 1 millisecond.

7.9.5 Counting Parameters

CH0		CH1		CH2		CH3	
High word	Low word	High word	Low word	High word	Low word	High word	Low word
-	#4	-	#32	-	#60	-	#88

[Description]
Bit 0~bit 15 are described below.

bit#	Description
0	Setting the polarities of the input contacts OFF: Normally-open contacts ON: Normally-closed contacts
1	Setting the function of prescaling the number of input pulses OFF: The function is disabled. ON: The function is enabled.
2	Setting the function of averaging the number of sampled pulses OFF: The function is disabled. ON: The function is enabled.
3	Setting the alarm function

bit#	Description
	OFF: The function is disabled.
	ON: The function is enabled.
4	Setting the accumulation register
	OFF: The accumulation register counts linearly.
	ON: The accumulation register counts circularly.
5	Setting the function of comparing the number of accumulated pulses with the comparison value set
	OFF: The function is disabled.
	ON: The function is enabled.
6	Selecting a type of comparison condition
	OFF: $\geqq$
	ON: $\leqq$
	(*. Bit 5 in CR4/CR32/CR60/CR88 must be turned ON.)
7	Setting the function of outputting a hardware signal
	OFF: The function is disabled.
	ON: The function is enabled.
	(*. Bit 5 in CR4/CR32/CR60/CR88 must be turned ON.)
8	Setting the function of sending a message which asks the CPU module to execute the interrupt subroutine specified to the CPU module
	OFF: The function is disabled.
	ON: The function is enabled.
	(*. Bit 5 in CR4/CR32/CR60/CR88 must be turned ON.)
9	Setting the function of clearing the number of sampled pulses, the number of accumulated pulses, and the number of input pulses
	OFF: The function is disabled.
	ON: The function is enabled.
10	Setting the polarity of the input contact of the external signal
	OFF: Normally-open contacts
	ON: Normally-closed contacts
11~15	Reserved

1. Bit 0 in CR4/CR32/CR60/CR88: If bit 0 in CR4/CR32/CR60/CR88 is turned ON, the input contacts will be normally-closed contacts. If bit 0 in CR4/CR32/CR60/CR88 is turned OFF, the input contacts are normally-open contacts.
2. Bit 1 in CR4/CR32/CR60/CR88: If bit 1 in CR4/CR32/CR60/CR88 is turned ON, the function of prescaling the number of input pulses will be enabled. If bit 1 in CR4/CR32/CR60/CR88 is turned OFF, the function of prescaling the number of input pulses will be disabled.

The function of prescaling the number of input pulses converts the number of input pulses into the corresponding physical quantity.

Number of sampled pulses
=Number of pulses count during a cycle x Prescale value x Unit magnification

Item	Setting value	Parameter			
		CH0	CH1	CH2	CH3
Selecting a prescale function (Unit magnification)	0: x1 1: x0.1 2: x0.01 3: x0.001 4: x0.0001	#5	#33	#61	#89
Setting a prescale value	0~32767	#6	#34	#62	#90

(Number of input pulses count during a cycle)
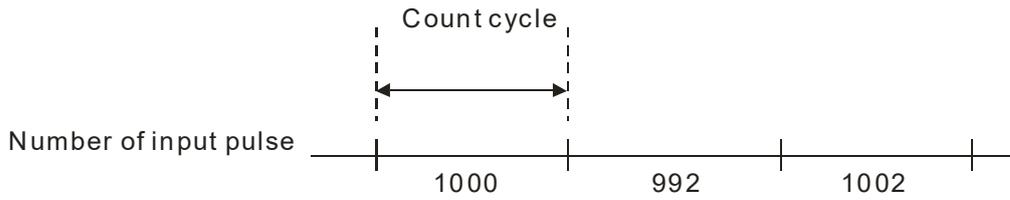
Example:

A flow counter is used. A pulse represents a flow of 5 cm^3. The unit magnitude set is 1.

Prescale value set: 5

Prescale function selected: 0 (x1)

Count cycle: 0 (1 second)

The figure above shows that the number of input pulses count during the first cycle is 1000.

Number of sampled pulses

=Number of pulses count during a cycle x Scale set by users x Magnification

=1000x5x1=5000 (cm^3/s)

3. Bit 2 in CR4/CR32/CR60/CR88: If bit 2 in CR4/CR32/CR60/CR88 is turned ON, the function of averaging the number of sampled pulses will be enabled. If bit 2 in CR4/CR32/CR60/CR88 is turned OFF, the function of averaging the number of sampled pulses will be disabled.

The function of averaging the number of sampled pulses prevents the number of pulses sampled in a cycle form being abnormal. Then number of pulses sampled in N cycles is divided by N. In the figure below, the number of pulses sampled in 3 cycles is divided by 3.
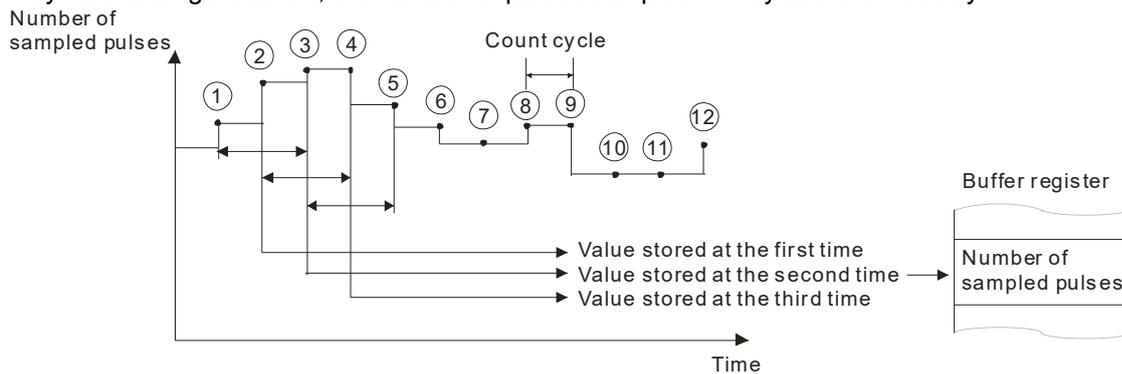
Buffer register for data conversion:
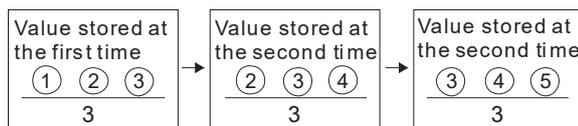
Note: The number of pulses sampled in N cycles is divided by N.

Item	Value/Setting value	Parameter			
		CH0	CH1	CH2	CH3
Number of sampled pulses (Low word)	-200000~200000	#20	#48	#76	#104
Number of sampled pulses (High word)		#21	#49	#77	#105
Number of cycles	2~60	#7	#35	#63	#91

4. Bit 3 in CR4/CR32/CR60/CR88: If bit 3 in CR4/CR32/CR60/CR88 is turned ON, the alarm function is enabled. If bit 3 in CR4/CR32/CR60/CR88 is turned OFF, the alarm function is disabled. After the alarm function is enabled, bit 4 or bit 5 in CR19/CR47/CR75/CR103 will be turned ON if the number of pulses sampled in a cycle is larger than the upper-upper limit value set or less than the lower-lower limit value set. If the number of sampled pulses is between the upper-lower limit value set and the lower-upper limit value set, bit 4 or bit 5 in CR19/CR47/CR75/CR103 will be turned OFF. If users want to use the alarm function, they have to set an upper-upper limit value, an upper-lower limit value, a lower-upper limit value, and a lower-lower limit value.

Item	Setting value	Parameter			
		CH0	CH1	CH2	CH3
Upper-upper limit value (Low word)	-200000~200000	#8	#36	#64	#92
Upper-upper limit value (High word)		#9	#37	#65	#93
Upper-lower limit value (Low word)	-200000~200000	#10	#38	#66	#94
Upper-lower limit value (High word)		#11	#39	#67	#95
Lower-upper limit value (Low word)	-200000~200000	#12	#40	#68	#96
Lower-upper limit value (High word)		#13	#41	#69	#97
Lower-lower limit value (Low word)	-200000~200000	#14	#42	#70	#98
Lower-lower limit value (High word)		#15	#43	#71	#99

The setting of the four limit values must comply with the rules listed below.

(1) The four limit values must be in the range of -200000 to 200000.

(2) Upper-upper limit value $\geq$ Upper-lower limit value > Lower-upper limit value $\geq$ Lower-lower limit value

If the setting of the four limit values does not comply with the rules listed above, and the alarm function is enabled, bit 6 in CR19/CR47/CR75/CR103 is turned ON when bit 0 in CR0/CR28/CR56/CR84 is turned from OFF to ON. Users can read the error code 16#A0n5 in CR26/CR54/CR82/CR110. (n is a channel number. n: 0~3 (i.e. channel 0~channel 3))

The alarm flags are described below.

Item	Value	Parameter			
		CH0	CH1	CH2	CH3
Operating state of a counter	Bit 4: Exceeding the upper limit set Bit 5: Exceeding the lower limit set	#19	#47	#75	#103

The operation of the upper limit alarm and the operation of the lower limit alarm are as shown below.
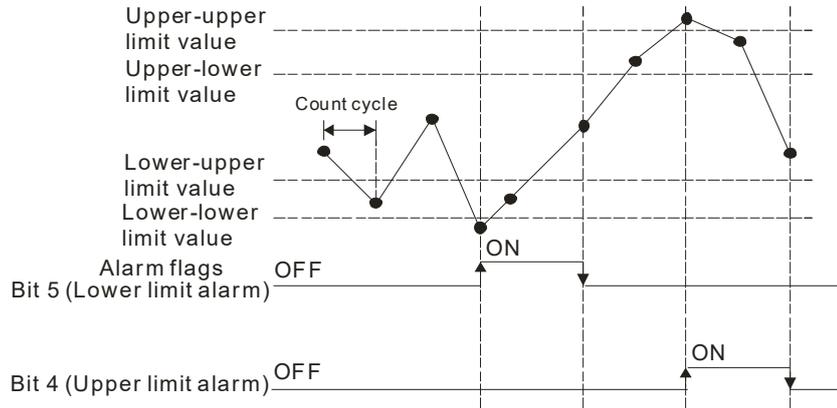
If the upper-upper limit value is equal to the upper-lower limit value, and the lower-upper limit value is equal to the lower-lower limit value, the operation of the upper limit alarm and the operation of the lower limit alarm are as shown below.
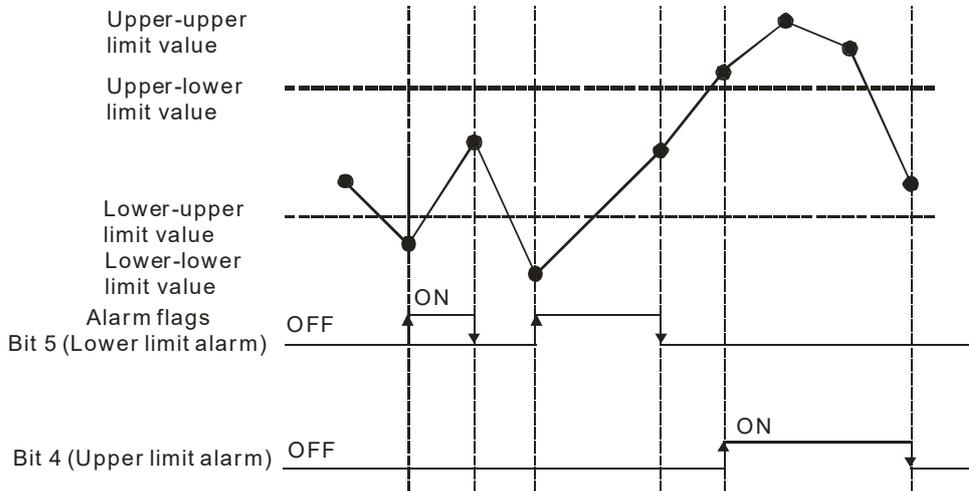
5. Bit 4 in CR4/CR32/CR60/CR88: If bit 4 in CR4/CR32/CR60/CR88 is turned OFF, the accumulation register counts linearly. If bit 4 in CR4/CR32/CR60/CR88 is turned ON, the accumulation register counts circularly.

(1) Linear accumulation:

If an accumulation register counts up, it counts from 0 to 999999999. If an accumulation register counts down, it counts from 0 to -999999999.

If the value in an accumulation register is larger than the maximum value 999999999 or less than the minimum value -999999999, the value in the accumulation register will be 999999999 or -999999999, and bit 1 in CR19/CR47/CR75/CR103 will be turned ON. Users can read the error code 16#A0n1 in CR26/CR54/CR82/CR110. (n is a channel number. n: 0~3 (i.e. channel 0~channel 3))
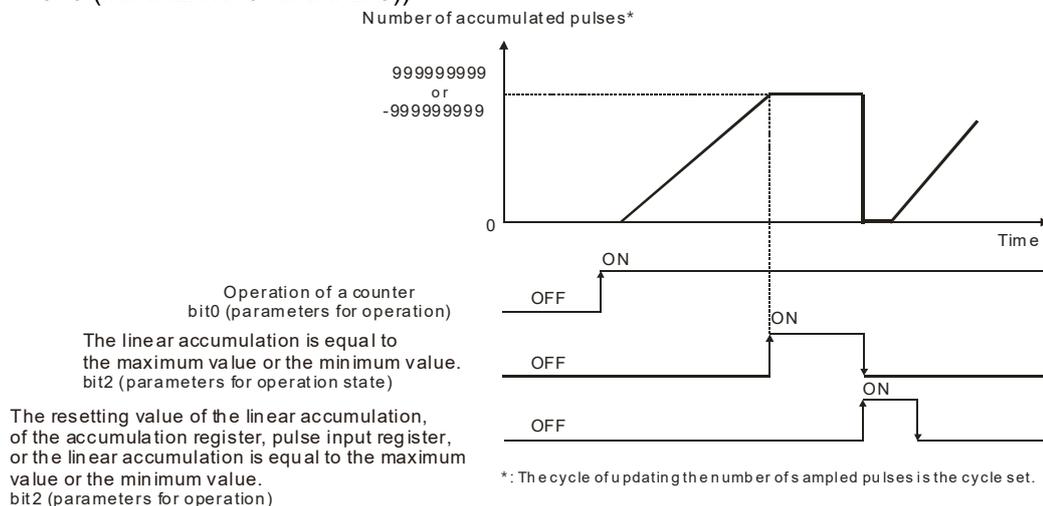
If the linear accumulation is larger than the maximum value 999999999 or less than the minimum value -999999999 in the count cycle, the value stored in the accumulation register will be 999999999 or -999999999, bit 1 in CR19/CR47/CR75/CR103 will be turned ON. Users can read the error code 16#A0n1 in CR26/CR54/CR82/CR110. (n is a channel number. n: 0~3 (i.e. channel 0~channel 3)) If bit 1 in CR0/CR28/CR56/CR84 is turned ON, the sampling register/accumulation register/pulse input register, and bit 1 in CR19/CR47/CR75/CR103 will be reset. After the sampling register/accumulation register/pulse input register, and bit 1 in CR19/CR47/CR75/CR103 is reset, bit 1 in CR0/CR28/CR56/CR84 will be turned OFF automatically.

The related parameters are described below.

Item	Value/Setting value	Parameter			
		CH0	CH1	CH2	CH3
Number of accumulated pulses (Low word)	-999999999~999999999	#22	#50	#78	#106
Number of accumulated pulses (High word)		#23	#51	#79	#107
Operating state of a counter	Bit 1: The linear accumulation is larger than the maximum value or less than the minimum value.	#19	#47	#75	#103
Operation of a counter	Bit 1: Resetting the sampling register/accumulation register/pulse input register, and bit 1 in CR19/CR47/CR75/CR103	#0	#28	#56	#84

(2) Circular accumulation:

If an accumulation register counts up, it counts from 0 to 999999999. If an accumulation register counts down, it counts from 0 to -999999999.

If the circular accumulation is larger than the maximum value 999999999 or less than the minimum value -999999999, bit 2 in CR19/CR47/CR75/CR103 will be turned ON, and the value in the accumulation register will become 0. If bit 2 in CR19/CR47/CR75/CR103 is not reset to OFF, it will still be turned ON. If bit 2 in CR19/CR47/CR75/CR103 is reset to OFF, it will be turned ON next time the circular accumulation is larger than 999999999 or less than -999999999.

*: The cycle of updating the number of sampled pulses is the cycle set.

The related parameters are described below.

Item	Value/Setting value	Parameter			
		CH0	CH1	CH2	CH3
Number of accumulated pulses (Low word)	-999999999~999999999	#22	#50	#78	#106
Number of accumulated pulses (High word)		#23	#51	#79	#107
Operating state of a counter	Bit 2: The circular accumulation is equal to the maximum value or the minimum value.	#19	#47	#75	#103
Operation of a counter	Bit 2: Resetting bit 2 in CR19/CR47/CR75/CR103	#0	#28	#56	#84

6. Bit 5 in CR4/CR32/CR60/CR88: If bit 5 in CR4/CR32/CR60/CR88 is turned ON, the function of comparing the number of accumulated pulses with the comparison value set is enabled. If bit 5 in CR4/CR32/CR60/CR88 is turned OFF, the function of comparing the number of accumulated pulses with the comparison value set is disabled.

The number of accumulated pulses is compared with the comparison value set. If the number of accumulated pulses meets the comparison condition set, bit 3 in CR19/CR47/CR75/CR103 will be turned ON. If bit 3 in CR0/CR28/CR56/CR84 is turned ON, bit 3 in CR19/CR47/CR75/CR103 will be turned OFF. There are two types of comparison conditions. One is $\geq$, and the other is $\leq$. If an accumulation register counts up, $\geq$ can be used. If an accumulation register counts down, $\leq$ can be used. Users can select a comparison condition according to their needs.
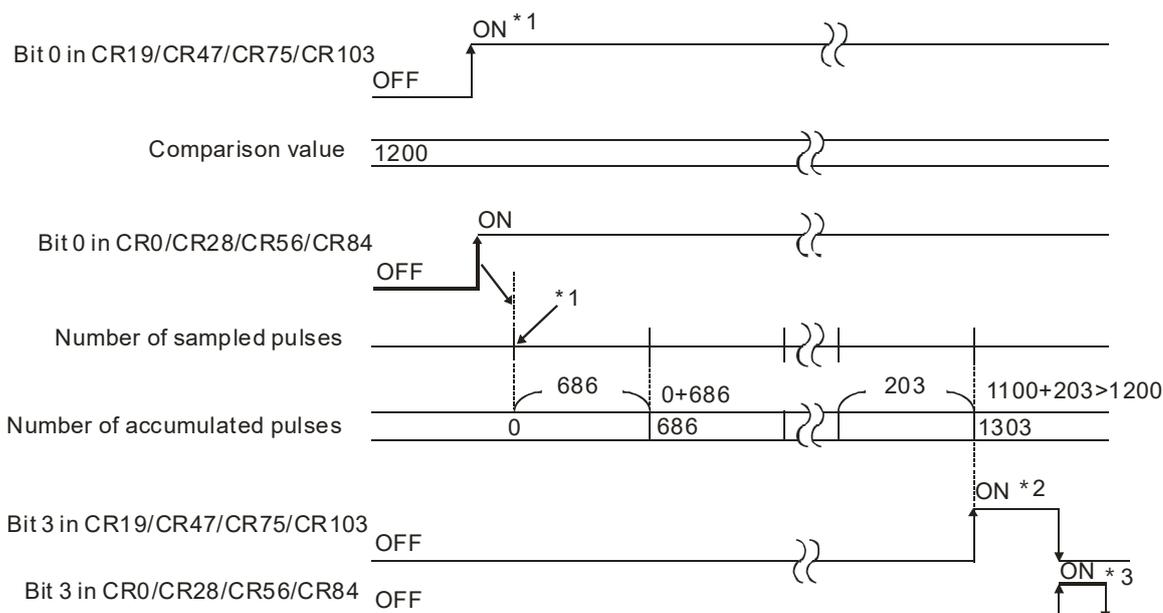
*1: If bit 0 in CR0/CR28/CR56/CR84 is turned ON, bit 0 in CR19/CR47/CR75/CR103 will be turned ON, and the system will start the count.

*2: If the number of accumulated pulses is larger than or equal to the comparison value, bit 3 in CR19/CR47/CR75/CR103 will be turned ON. If bit 3 in CR0/CR28/CR56/CR84 is turned ON, bit 3 in CR19/CR47/CR75/CR103 will be turned OFF.

*3: If bit 3 in CR0/CR28/CR56/CR84 is turned ON, bit 3 in CR19/CR47/CR75/CR103 will be reset to OFF. If bit 3 in CR19/CR47/CR75/CR103 is turned OFF, bit 3 in CR0/CR28/CR56/CR84 will be turned OFF automatically.

The related parameters are described below.

Item	Value/Setting value	Parameter			
		CH0	CH1	CH2	CH3
Counting parameters	Bit 4: Setting the accumulation register (OFF: The accumulation register counts linearly. ON: The accumulation register counts circularly.) Bit 6: Selecting a type of comparison condition (OFF: $\geqq$; ON: $\leqq$)	#4	#32	#60	#88
Number of accumulated pulses (Low word)	-999999999~999999999	#22	#50	#78	#106
Number of accumulated pulses (High word)		#23	#51	#79	#107
Comparison value (Low word)	-999999999~999999999	#16	#44	#72	#100
Comparison value (High word)		#17	#45	#73	#101
Operating state of a counter	Bit 3: The number of accumulated pulses meets the comparison condition set.	#19	#47	#75	#103
Operation of a counter	Bit 3: Resetting bit 3 in CR19/CR47/CR75/CR103	#0	#28	#56	#84

7. Bit 6 in CR4/CR32/CR60/CR88: If bit 6 in CR4/CR32/CR60/CR88 is turned OFF, $\geq$ is selected. If bit 6 in CR4/CR32/CR60/CR88 is turned ON, $\leq$ is selected. Before users select a type of comparison condition, bit 5 in CR4/CR32/CR60/CR88 must be turned ON.

8. Bit 7 in CR4/CR32/CR60/CR88: After bit 7 in CR4/CR32/CR60/CR88 is turned OFF, AH04HC-5A will not output any hardware signal if the number of accumulated pulses meets the comparison condition set. After bit 7 in CR4/CR32/CR60/CR88 is turned ON, AH04HC-5A will output a hardware signal if the number of accumulated pulses meets the comparison condition set. Before users setting bit 7 in CR4/CR32/CR60/CR88, bit 5 in CR4/CR32/CR60/CR88 must be turned ON. The related hardware signals are described below.

Item	CH0	CH1	CH2	CH3
Hardware signal	Y0.8	Y0.9	Y0.10	Y0.11

9. Bit 8 in CR4/CR32/CR60/CR88:
   - After bit 8 in CR4/CR32/CR60/CR88 is turned OFF, AH04HC-5A will not send a message which asks the CPU module to execute the interrupt subroutine specified to the CPU module if bit 3 in CR19/CR47/CR75/CR103 is turned from OFF to ON.
   - After bit 8 in CR4/CR32/CR60/CR88 is turned ON, AH04HC-5A will immediately send a message which asks the CPU module to execute the interrupt subroutine specified to the CPU module if bit 3 in CR19/CR47/CR75/CR103 is turned from OFF to ON. Bit 5 in CR4/CR32/CR60/CR88 needs to be turned ON before bit 8 in CR4/CR32/CR60/CR88 is turned ON.

   The related parameter is described below.

Item	Value/Setting value	Parameter			
		CH0	CH1	CH2	CH3
Interrupt number	0~31	#18	#46	#74	#102

10. Bit 9 in CR4/CR32/CR60/CR88:
   - After bit 9 in CR4/CR32/CR60/CR88 is turned OFF, the number of sampled pulses, the number of accumulated pulses, and the number of input pulses will not be cleared if X0.0+ and X0.0–/X0.1+ and X0.1–/X0.2+ and X0.2–/X0.3+ and X0.3– are turned ON.
   - After bit 9 in CR4/CR32/CR60/CR88 is turned ON, the number of sampled pulses, the number of accumulated pulses, and the number of input pulses will be cleared if the external signals X0.0+ and X0.0–/X0.1+ and X0.1–/X0.2+ and X0.2–/X0.3+ and X0.3– are turned ON.

   The related parameter is described below.

Item	CH0	CH1	CH2	CH3
External signal	X0.0+ and X0.0–	X0.1+ and X0.1–	X0.2+ and X0.2–	X0.3+ and X0.3–

11. Bit 10 in CR4/CR32/CR60/CR88: If bit 10 in CR4/CR32/CR60/CR88 is turned ON, the input contact of the external signal is a normally-closed contact. If bit 10 in CR4/CR32/CR60/CR88 is turned OFF, the input contact of the external signal is a normally-open contact.

7.9.6 Operating State of a Counter

CH0		CH1		CH2		CH3	
High word	Low word	High word	Low word	High word	Low word	High word	Low word
-	#19	-	#47	-	#75	-	#103

[Description]
Bit 0~bit 15 are described below.

bit#	Described
0	The setting of the counting function is complete.
1	The linear accumulation is larger than the maximum value or less than the minimum value.
2	The circular accumulation is equal to the maximum value or the minimum value.

bit#	Described
3	The number of accumulated pulses meets the comparison condition set.
4	Upper limit alarm
5	Lower limit alarm
6	Error flag
7~15	Reserved

7.9.7 Number of Input Pulses

CH0		CH1		CH2		CH3	
High word	Low word	High word	Low word	High word	Low word	High word	Low word
#25	#24	#53	#52	#81	#80	#109	#108

[Description]
The number of input pulses is stored in a pulse input register. If bit 0 in CR0/CR28/CR56/CR84 is turned ON, and the parameters are set correctly, the system will start the count. The number of input pulses is neither prescaled nor averaged. The input pulses are count circularly. The number of input pulses is in the range of -2147483648 to 2147483647.
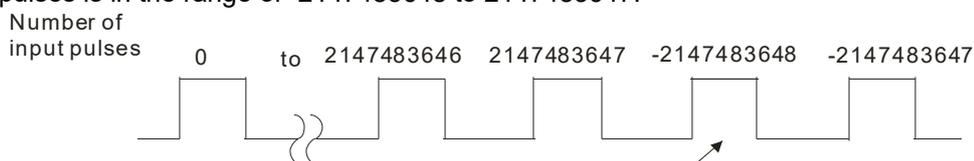
Item	Value	Parameter			
		CH0	CH1	CH2	CH3
Number of input pulses (Low word)	-2147483648~2147483647	#24	#52	#80	#108
Number of input pulses (High word)		#25	#53	#81	#109

7.9.8 Error Codes

CH0		CH1		CH2		CH3	
High word	Low word	High word	Low word	High word	Low word	High word	Low word
-	#26	-	#54	-	#82	-	#110

[Description]
The error messages are shown below.

Item	Error code			
	CH0	CH1	CH2	CH3
The linear accumulation exceeds the range.	16#A001	16#A011	16#A021	16#A031
The prescale value set exceeds the range.	16#A002	16#A012	16#A022	16#A032
The number of cycles set exceeds the range.	16#A003	16#A013	16#A023	16#A033
The comparison value set exceeds the range.	16#A004	16#A014	16#A024	16#A034
A limit value set is incorrect.	16#A005	16#A015	16#A025	16#A035
The interrupt number set exceeds the range.	16#A006	16#A016	16#A026	16#A036

7.10 Troubleshooting

7.10.1 Error Codes

Code	Description	REN LED indicator	ERROR LED indicator
16#A001	Channel 0: The linear accumulation exceeds the range.	ON	Blinking
16#A002	Channel 0: The prescale value set exceeds the range.	ON	Blinking
16#A003	Channel 0: The number of cycles set exceeds the range.	ON	Blinking
16#A004	Channel 0: The comparison value set exceeds the range.	ON	Blinking
16#A005	Channel 0: A limit value set is incorrect.	ON	Blinking
16#A006	Channel 0: The interrupt number set exceeds the range.	ON	Blinking
16#A011	Channel 1: The linear accumulation exceeds the range.	ON	Blinking
16#A012	Channel 1: The prescale value set exceeds the range.	ON	Blinking
16#A013	Channel 1: The number of cycles set exceeds the range.	ON	Blinking
16#A014	Channel 1: The comparison value set exceeds the range.	ON	Blinking
16#A015	Channel 1: A limit value set is incorrect.	ON	Blinking
16#A016	Channel 1: The interrupt number set exceeds the range.	ON	Blinking
16#A021	Channel 2: The linear accumulation exceeds the range.	ON	Blinking
16#A022	Channel 2: The prescale value set exceeds the range.	ON	Blinking
16#A023	Channel 2: The number of cycles set exceeds the range.	ON	Blinking
16#A024	Channel 2: The comparison value set exceeds the range.	ON	Blinking
16#A025	Channel 2: A limit value set is incorrect.	ON	Blinking
16#A026	Channel 2: The interrupt number set exceeds the range.	ON	Blinking
16#A031	Channel 3: The linear accumulation exceeds the range.	ON	Blinking
16#A032	Channel 3: The prescale value set exceeds the range.	ON	Blinking
16#A033	Channel 3: The number of cycles set exceeds the range.	ON	Blinking
16#A034	Channel 3: The comparison value set exceeds the range.	ON	Blinking
16#A035	Channel 3: A limit value set is incorrect.	ON	Blinking
16#A036	Channel 3: The interrupt number set exceeds the range.	ON	Blinking

7.10.2 Descriptions of the LED Indicators

LED Indicator	Status		Description	Remedy
RUN LED indicator	Green	ON	The module runs.	No action is needed.
		OFF	The module stops running.	No action is needed.
ERROR LED indicator	Red	Blinking	The parameter is set incorrectly.	Read the module error code through ISPSoft.
		OFF	No error	No action is needed.

Chapter 8   Serial Communication Module AH10/15SCM

Table of Contents

8.1 Introduction

Thanks for using AH10/15SCM-5A, a serial communication module. To ensure that AH10/15SCM-5A is installed and operated correctly, please read this manual carefully before using the module.

AH10/15SCM-5A is a serial communication module. It supports the Modbus UD Link (user-defined format). It can function as a BACnet MS/TP slave. A BACnet MS/TP master can read an analog value/binary value from AH10/15SCM-5A, and can write an analog value/binary value into AH10/15SCM-5A. Besides, it can be used as a RS-485/RS-422/RS-232 communication port through which a program is downloaded to or uploaded from a CPU module. AH10/15SCM-5A is set by SCMSoft in DCISoft. Please download DCISoft from *Delta | Download Center (deltaww.com)*

Functions:
- It is equipped with two RS-485/RS-422 ports (COM1 & COM2) (application for AH10SCM-5A).
- It is equipped with two RS-232 ports (COM1 & COM2) (applicable for AH15SCM-5A).
- There is isolation between two parts of RS-485/RS-422 communication, and there is isolation between two parts of power (application for AH10SCM-5A).
- There are two built-in switches of 120 Ω terminal resistors (application for AH10SCM-5A).
- Every communication port can be connected to 32 devices at most.
- It can function as COM3 through which a program is downloaded or uploaded.
- Modbus Advance provides a means of exchanging data through Modbus.
- The UD Link and COMRS (available for AH15SCM-5A V1.02 or later) provide a user-defined communication protocol, and a sequence-planning function.
- It can function as a BACnet MS/TP slave, and can be connected to a master.
- It supports AHCPU560 redundant function (available for AH10SCM-5A FW V1.06 or later and AH15SCM-5A FW V1.02 or later)
- It supports AHRTU-ETHN-5A and its extension backplane (available for AH10SCM-5A FW V1.06 or later, AH15SCM-5A FW V1.02 or later and should work with AHRTU-ETHN-5A FW V1.02 or later)
- Software: ISPSoft V3.06 or later and DCISoft V1.20 or later

The functional specifications
- **RS-485/RS-422 communication interface** (application for AH10SCM-5A)

Item	Specifications
Connector type	European-style terminal block
Transmission speed	1,200, 2,400, 4,800, 9,600, 19,200, 38,400, 57,600, 76,800, 115,200, 230,400, and 460,800 bps
Communication format	Stop bit: 1 bit and 2 bits Parity bit: none, an odd parity bit, and an even parity bit Data bit: 7 bits and 8 bits
Communication protocol	Modbus ASCII/RTU UD Link BACnet MS/TP slave stations

- **RS-232 communication interface** (application for AH15SCM-5A)

Item	Specifications
Connector type	DB9
Transmission speed	1200, 2400, 4800, 9600, 19200, 38400, 57600, 76800, 115200 bps
Communication format	Stop bit: 1 bit and 2 bits Parity bit: none, an odd parity bit, and an even parity bit Data bit: 7 bits and 8 bits
Communication protocol	Modbus ASCII/RTU UD Link COMRS BACnet MS/TP slave stations

■ **Electrical specifications**

Item	Specifications
Supply voltage	5 V DC
Electric energy consumption	1.5 W
Insulation voltage	2,500 V DC
Weight	150 g

■ **BACnet Protocol Implementation Statement**
   ◆ **Standard BACnet device**

Model	Device
AH10/15SCM-5A	BACnet Application Specific Controller (B-ASC)

   ◆ **BIBBs which are supported**

Model	BIBBs	BIBB
AH10/15SCM-5A	DS-RP-B	Data Sharing-ReadProperty-B
	DS-WP-B	Data Sharing-WriteProperty-B
	DM-DDB-B	Device Management-DynamicDeviceBinding-B
	DM-DOB-B	Device Management-DynamicObjectBinding-B
	DM-DCC-B	Device Management-DeviceCommunicationControl-B
	DS-RPM-B	Data Sharing-ReadPropertyMultiple-B
	DS-WPM-B	Data Sharing-WritePropertyMultiple-B

   ◆ **The objects which are supported**

Model	Object	Creation	Deletion
AH10/15SCM-5A	Analog Value	Not supported	Not supported
	Binary Value	Not supported	Not supported
	Device	Not supported	Not supported

   ◆ **Data Link Layer Options**

Model	Data link	Data transmission speed supported
AH10/15SCM-5A	MS/TP Slave	9600, 19200, 38400, and 76800 bps

   ◆ **Character set which is supported**

Model	Character set
AH10/15SCM-5A	ANSI X3.4

8.2 Dimensions and Profile

8.2.1 Dimensions

● **AH10SCM-5A**
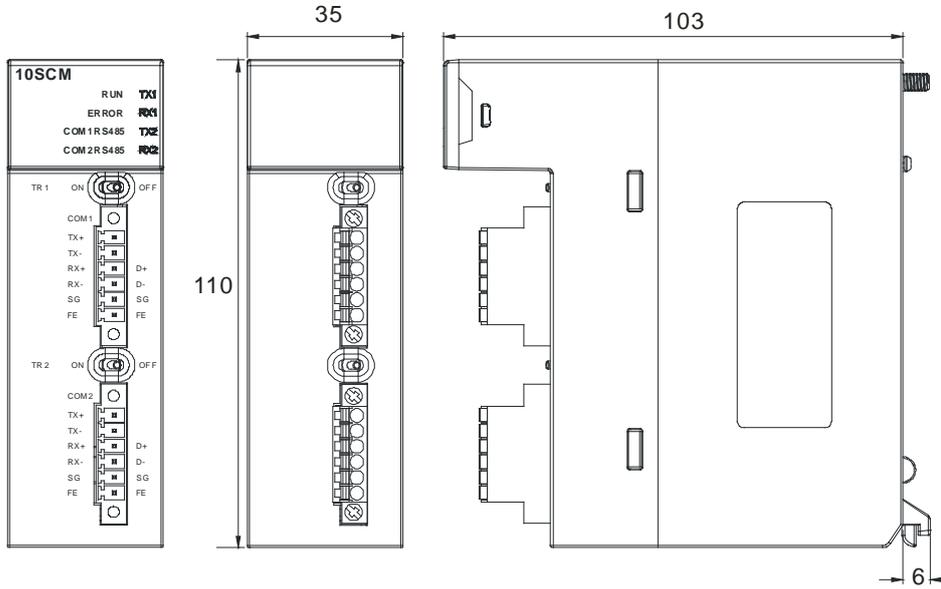
Unit: mm

● **AH15SCM-5A**
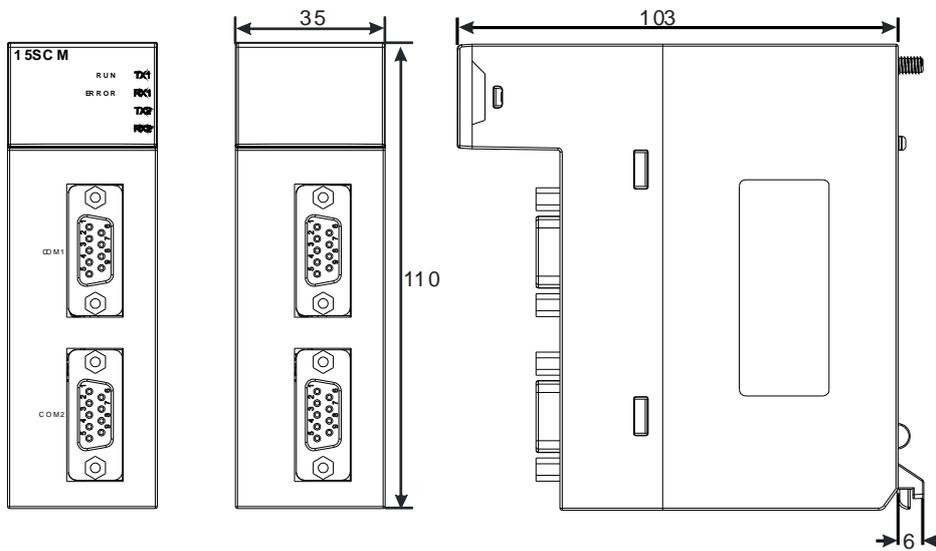
Unit: mm

8.2.2 Profile

● **AH10SCM-5A**

Number	Name	Description
1	Model name	Model name of the module
2	RUN LED indicator (green)	Operating status of the module ON: The module is running. OFF: The module stops running.
	ERROR LED indicator (red)	Error status of the module ON: There is a hardware error. OFF: The module is normal. Blink: 1. The setting of the module is incorrect, or there is a communication error. 　　　2. Restoring the module to the default factory value
	COM1 (RS-485) LED indicator (green)	ON: RS-485 mode OFF: RS-422 mode
	COM2 (RS-485) LED indicator (green)	ON: RS-485 mode OFF: RS-422 mode
	TX1/TX2 LED indicator (orange)	Blink: The data is being transmitted through the RS-485/RS422 port. OFF: The data is not being transmitted through the RS-485/RS422 port.
	RX1/RX2 LED indicator (orange)	Blink: The data is being reveived through the RS-485/RS422 port. OFF: The data is not being reveived through the RS-485/RS422 port.
3	Switch of terminal resistor 1	Switching terminal resistor 1 ON/OFF
4	Terminals	Terminals for COM1 (RS-422)
5	Terminals	Terminals for COM1 (RS-485)
6	Switch of terminal resistor 2	Switching terminal resistor 2 ON/OFF
7	Terminals	Terminals for COM2 (RS-422)
8	Terminals	Terminals for COM2 (RS-485)
9	European-style terminal	Terminals for wiring

Number	Name	Description
	block	
10	Label	Nameplate
11	Set screw	Fixing the module
12	Connector	Connecting the module and a backplane
13	Projection	Fixing the module

● **AH15SCM-5A**

Number	Name	Description
1	Model name	Model name of the module
2	RUN LED indicator (green)	Operating status of the module ON: The module is running. OFF: The module stops running.
	ERROR LED indicator (red)	Error status of the module ON: There is a hardware error. OFF: The module is normal. Blink: 1. The setting of the module is incorrect, or there is a communication error. 2. Restoring the module to the default factory value
	TX1/TX2 LED indicator (orange)	Blink: The data is being transmitted through the RS-232 port. OFF: The data is not being transmitted through the RS-232 port.
	RX1/RX2 LED indicator (orange)	Blink: The data is being reveived through the RS-232 port. OFF: The data is not being reveived through the RS-232 port.
3	COM1 (RS-232)	RS-232 mode
4	COM2 (RS-232)	RS-232 mode
5	Set screw	Fixing the module
6	Label	Nameplate
7	Projection	Fixing the module
8	Set screw	Fixing the module
9	Connector	Connecting the module and a backplane
10	Projection	Fixing the module

8.2.3 Communication Port

● **RS-485 / RS-422**

Terminal number	RS-485	RS-422	European-style terminal block
1	N/C	TX+	
2	N/C	TX-	
3	D+	RX+	
4	D-	RX-	
5	SG	SG	
6	FE	FE	
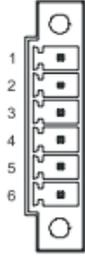
● **RS-232**

Terminal number	RS-232	
1	N/C	
2	TX	
3	RX	
4	N/C	
5	GND	
6	N/C	
7	N/C	
8	N/C	
9	N/C	

8.3 Installation and Wiring

This section introduces the installation of AH10/15SCM-5A.

8.3.1 Installation

Insert a module into a slot, make sure that the module is installed on the backplane properly, and tighen the the screw, as illustrated below.

1. Insert the projection under the module into the hole in the backplane.
2. Push the module in the direction indicated by the arrow until it clicks.
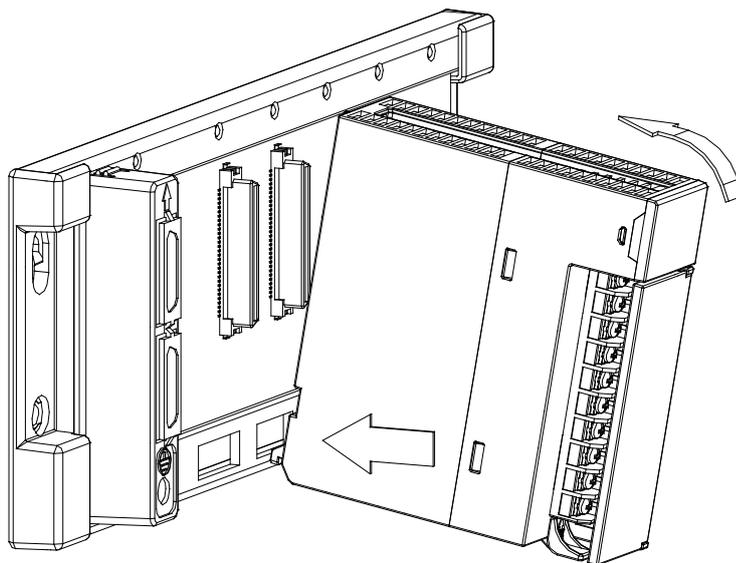
3. Tighten the screw on the module.
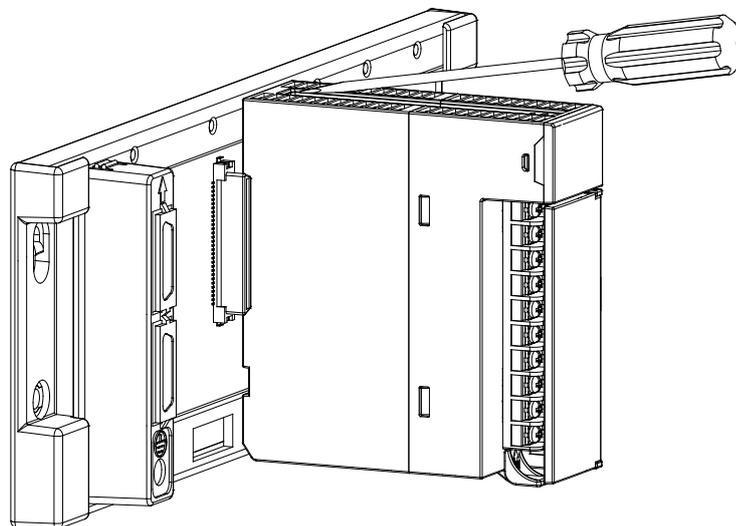
8.4 Registers

AH10/15SCM-5A provides users with input registers and for AH10SCM-5A with FW V1.06 or later versions, and AH15SCM-5A with FW V1.02 or later, users are offered with output registers and control registers. Make sure HWCONFIG V3.10 or later version is used while setting up the registers. Users can use input registers to read the status of AH10/15SCM-5A, use output registers to trigger actions and use control registers to set up communication related parameters. All the input / output registers have their own correpsonding data registers (D devices). You can check the register settings in HWCONFIG. (Edit Area -> General tab -> Normal Exchange Area). You can also set up the starting address of the D device, where to start data exchange with the input registers and output registers. As for the control registers, you need to use the instructions FROM/TO to read and write. Find the detailed descriptions on the input registers, output registers, control registers in the following sections.

8.4.1 Input Registers

Number		Attr.	Register Name	Description
HW	LW			
-	#0	R	Error code	
-	#1	R	Hardware error flag	
-	#2	R	COM1 UD Link error flag	
-	#3	R	COM2 UD Link error flag	
-	#4	R	COM1 Modbus error flag	
-	#5	R	COM2 Modbus error flag	Refer to section 8.8 for more details.
-	#6	R	COM1 communication error flag	
-	#7	R	COM2 communication error flag	
-	#8	R	Internal communication error flag	
-	#9	R	Group number of COM1 UD Link in operation	Here shows the group number of UD Link in COM1 that is currently running
-	#10	R	Group number of COM2 UD Link in operation	Here shows the group number of UD Link in COM2 that is currently running
-	#11	R	Command number of COM1 UD Link	Here shows the current running command number of UD Link in COM2
-	#12	R	Command number of COM2 UD Link	Here shows the current running command number of UD Link in COM2
-	#13	R	Packet number of COM1 UD Link	Here shows the current running packet number of UD Link in COM1
-	#14	R	Packet number of COM2 UD Link	Here shows the current running packet number of UD Link in COM2
-	#15	R	Reserved	
-	#16	R	Reserved	
-	#17	R	Reserved	

8.4.2 Output Registers

(Available for AH10SCM-5A FW V1.06 or later and AH15SCM-5A FW V1.02 or later)

Number		Attr.	Register Name	Description
HW	LW			
-	#0	W	COM1 Modbus triggered to be read (advanced)	High byte: bit; low byte: word 00: not to trigger
-	#1	W	COM1 Modbus triggered to be written (advanced)	01: to trigger once 02: to stay triggered
-	#2	W	COM1 UD Link group number to be triggered	Here shows the current triggered group number of UD Link in COM1
-	#3	W	COM1 UD Link [Base+Offset] data source	When the data source of UD Link in COM1 is [Base+Offset], refer to +Offset of D device as its actual register source to be read.
-	#4	R	COM1 UD Link [Base+Offset] targeted area	When the target of UD Link in COM 1 is [Base+Offset], refer to +Offset of D device as where the actual registers to be stored.
-	#5	R	COM1 UD Link Sequence triggered number	0: : not to trigger 1~254: number of triggered times 255: to stay triggered
-	#6	R	Reserved	
-	#7	R	Reserved	
-	#8	R	Reserved	
-	#9	R	Reserved	
-	#10	W	COM2 Modbus triggered to be read (advanced)	High byte: bit; low byte: word 00: not to trigger
-	#11	W	COM2 Modbus triggered to be written (advanced)	01: to trigger once 02: to stay triggered
-	#12	W	COM2 UD Link group number to be triggered	Here shows the current triggered group number of UD Link in COM2
-	#13	W	COM2 UD Link [Base+Offset] data source	When the data source of UD Link in COM2 is [Base+Offset], refer to +Offset of D device as its actual register source to be read.
-	#14	W	COM2 UD Link [Base+Offset] targeted area	When the target of UD Link in COM 2 is [Base+Offset], refer to +Offset of D device as where the actual registers to be stored.
-	#15	W	COM2 UD Link Sequence triggered number	0: : not to trigger 1~254: number of triggered times 255: to stay triggered
-	#16	R	Reserved	
-	#17	R	Reserved	
-	#18	R	Reserved	
-	#19	R	Reserved	

8.4.3 Control Registers

CR#	Attribute	Register name	Description
0~6	Reserved		
7	R/W	Triggering the reading of data through COM1	High byte: Reading data from bit devices Low byte: Reading data from word devices 00: Not triggering it 01: Triggering it once 02: Always triggering it
8	R/W	Triggering the writing of data through COM1	High byte: Writing data into bit devices Low byte: Writing data into word devices 00: Not triggering it 01: Triggering it once 02: Always triggering it
9~16	Reserved		
17	R/W	Triggering the reading of data through COM2	High byte: Reading data from word devices Low byte: Reading data from word devices 00: Not triggering it 01: Triggering it once 02: Always triggering it
18	R/W	Triggering the writing of data through COM2	High byte: Writing data into bit devices Low byte: Writing data into word devices 00: Not triggering it 01: Triggering it once 02: Always triggering it
19	Reserved		
20	Reserved		
21	R/W	Triggering the sending/receiving of the packets in a group through COM1	Triggering the sending/receiving of the packets in a group through COM1
22	R/W	Base register used for the sending of data through COM1	The communication protocol for exchanging data through COM1 must be UD Link. Users have to select **Base+Offset** in the **Mapping Register** box in the **Message Variable Edit** window in SCMSoft. Data register from which data is read=Value in CR#22+Offset
23	R/W	Base register used for the receiving of data through COM1	The communication protocol for exchanging data through COM1 must be UD Link. Users have to select **Base+Offset** in the **Mapping Register** box in the **Message Variable Edit** window in SCMSoft. Data register into which data is written=Value in CR#23+Offset
24	Reserved		
25	R/W	Triggering the sending/receiving of the packets in a group through COM2	Triggering the sending/receiving of the packets in a group through COM2
26	R/W	Base register used for the sending of data through COM2	The communication protocol for exchanging data through COM2 must be UD Link. Users have to select **Base+Offset** in the **Mapping Register**

CR#	Attribute	Register name	Description
			box in the **Message Variable Edit** window in SCMSoft. Data register from which data is read=Value in CR#26+Offset
27	R/W	Base register used for the receiving of data through COM2	The communication protocol for exchanging data through COM2 must be UD Link. Users have to select **Base+Offset** in the **Mapping Register** box in the **Message Variable Edit** window in SCMSoft. Data register into which data is written=Value in CR#27+Offset
28	R/W	Triggering the sending/receiving of groups of packets in sequence	0: Not triggering it 1~254: Number of times the sending/receiving of groups of packets is triggered in sequence 255: The sending/receiving of groups of packets is continually triggered in sequence.
29~52	Reserved		
53~64	COMRS function codes only available for AH15SCM-5A FWV1.02 or later; refer to section 8.7.4 for more information		
65~72	Reserved		
73~84	COMRS function codes only available for AH15SCM-5A FWV1.02 or later; refer to section 8.7.4 for more information		
85~4098	Reserved		
4099~4114	R/W	Selecting **Enable** boxes to enable the reading of data from bit devices through COM1 (256 values/16 words)	Bit=0: Disabling the reading of data from a bit device through COM1 Bit=1: Enabling the reading of data from a bit device through COM1
8195~8210	R/W	Selecting **Enable** boxes to enable the reading of data from word devices through COM1 (256 values/16 words)	Bit=0: Disabling the reading of data from a word device through COM1 Bit=1: Enabling the reading of data from a word device through COM1
12291~12306	R/W	Selecting **Enable** boxes to enable the writing of data into bit devices through COM1 (256 values/16 words)	Bit=0: Disabling the writing of data into a bit device through COM1 Bit=1: Enabling the writing of data into a bit device through COM1
16387~16402	R/W	Selecting **Enable** boxes to enable the writing of data into word devices through COM1 (256 values/16 words)	Bit=0: Disabling the writing of data into a word device through COM1 Bit=1: Enabling the writing of data into a word device through COM1
20483~20498	R/W	Selecting **Enable** boxes to enable the reading of data from bit devices through COM2 (256 values/16 words)	Bit=0: Disabling the reading of data from a bit device through COM2 Bit=1: Enabling the reading of data from a bit device through COM2
24579~24594	R/W	Selecting **Enable** boxes to enable the reading of data from word devices through COM2 (256 values/16 words)	Bit=0: Disabling the reading of data from a word device through COM1 (256 values/16 words) Bit=1: Enabling the reading of data from a word device through COM2 (256 values/16 words)

CR#	Attribute	Register name	Description
28675~ 28690	R/W	Selecting **Enable** boxes to enable the writing of data into bit devices through COM2 (256 values/16 words)	Bit=0: Disabling the writing of data into a bit device through COM1 (256 values/16 words) Bit=1: Enabling the writing of data into a bit device through COM2 (256 values/16 words)
32771~ 32786	R/W	Selecting **Enable** boxes to enable the writing of data into word devices through COM2 (256 values/16 words)	Bit=0: Disabling the writing of data into a word device through COM2 Bit=1: Enabling the writing of data into a word device through COM2
36864	R/W	Status of sending a command through COM1	1: The sending of a command is executed. 0: The sending of a command is complete.
36865	R/W	Status of receiving a command through COM1	0: A command has not been received. 1: The receiving of a command is being processed. 2: A command is received successfully. 3: A command fails to be received. 4: Checksum error 5: Communication timeout
36866	R/W	Communication protocol for exchanging data through COM1	0: Modbus 1: RS
36867	R/W	Sending/Receiving a command through COM1	0: After a command is sent, a command is received. 1: A command is sent, but no command is received. 2: No command is sent, but a command is received.
36868	R/W	Timeout period after which no data is received through COM1	0: No timeout 1~65535 ms
36869	R/W	Number of times the sending of a command through COM1 is retried	0~255
36870	R/W	Length of a packet which is sent through COM1	Length of a packet which is sent
36871	R/W	Length of a packet which is expected to be received through COM1	Length of a packet which is expected to be received
36872~ 37367	R/W	Contents of a packet sent through COM1	Contents of a packet which is sent
37368	R/W	Status of sending a command through COM2	1: The sending of a command is executed. 0: The sending of a command is complete.
37369	R/W	Status of receiving a command through COM2	0: A command has not been received. 1: The receiving of a command is being processed. 2: A command is received successfully. 3: A command fails to be received. 4: Checksum error 5: Communication timeout
37370	R/W	Communication protocol for exchanging data through COM2	0: Modbus 1: RS
37371	R/W	Sending/Receiving a command through COM2	0: After a command is sent, a command is received. 1: A command is sent, but no command is received.

CR#	Attribute	Register name	Description
			2: No command is sent, but a command is received.
37372	R/W	Timeout period after which no data is received through COM2	0: No timeout 1~65535 ms
37373	R/W	Number of times the sending of a command through COM2 is retried	0~255
37374	R/W	Length of a packet which is sent through COM2	Length of a packet which is sent
37375	R/W	Length of a packet which is expected to be received through COM2	Length of a packet which is expected to be received
37376~ 37871	R/W	Contents of a packet sent through COM2	Contents of a packet which is sent

8.4.3.1 Descriptions of the Control Registers

CR#7: Triggering the reading of data through COM1

[Description]
High byte: Reading data from bit devices; Low byte: Reading data from word devices
0: Not triggering it; 1: Triggering it once; 2: Always triggering it
After 1 or 2 is written into CR#7, the reading of data through COM1 will be triggered. After 0 is written into CR#7, the reading of data through COM1 will stop.

		COM1 Word		
		Not triggering it	Triggering it once	Always triggering it
COM1 Bit	**Not triggering it**	16#0000	16#0001	16#0002
	Triggering it once	16#0100	16#0101	16#0102
	Always triggering it	16#0200	16#0201	16#0202

CR#8: Triggering the writing of data through COM1

[Description]
High byte: Writing data into bit devices; Low byte: Writing data into word devices
0: Not triggering it; 1: Triggering it once; 2: Always triggering it
After 1 or 2 is written into CR#8, the writing of data through COM1 will be triggered. After 0 is written into CR#8, the writing of data through COM1 will stop.
Please refer to the table in the description of CR#7.

CR#17: Triggering the reading of data through COM2

[Description]
High byte: Reading data from bit devices; Low byte: Reading data from word devices
0: Not triggering it; 1: Triggering it once; 2: Always triggering it
After 1 or 2 is written into CR#17, the reading of data through COM2 will be triggered. After 0 is written into CR#17, the reading of data through COM2 will stop.
Please refer to the table in the description of CR#7.

CR#18: Triggering the writing of data through COM2

[Description]
High byte: Bit; Low byte: Word

0: Not triggering it; 1: Triggering it once; 2: Always triggering it
Please refer to the table in the description of CR#7.

CR#21: Triggering the sending/receiving of the packets in a group through COM1

[Description]
After a group number is written into CR#21, the packets in a group will be sent/received through COM1.
After 1 is written in CR#21, the sending/receiving of the packets in group 1 will be triggered. After the sending/receiving of the packets in group 1 is triggered, the value in CR#21 will become 0.
Default: 0 (Not triggering the sending/receiving of the packets in any group.)

CR#22: Base register used for the sending of data through COM1

[Description]
The communication protocol for exchanging data through COM1 must be UD Link. Users have to select **Base+Offset** in the **Mapping Register** box in the **Message Variable Edit** widow in SCMSoft.
Data register from which data is read=Value in CR#22+Offset
Example:
The value in CR#22 is 1.→D1
Base+Offset in the **Mapping Register** box in the **Message Variable Edit** widow in SCMSoft is selected. The offset is 10, and the length is 2.→(R (Base+Offset [10]), 2)
D (1+10)→Two-byte data is read from D11.

CR#23: Base register used in the receiving of data through COM2

[Description]
The communication protocol for exchanging data through COM1 must be UD Link. Users have to select **Base+Offset** in the **Mapping Register** box in the **Message Variable Edit** widow in SCMSoft.
Data register into which data is written=Value in CR#23+Offset

CR#25: Triggering the sending/receiving of the packets in a group through COM2

[Description]
Please refer to the description of CR#21.

CR#26: Base register used for the sending of data through COM2

[Description]
Please refer to the description of CR#22.

CR#27: Base register used for the receiving of data through COM2

[Description]
Please refer to the description of CR#23.

CR#28: Triggering the sending/receiving of groups of packets in sequence

[Description]
High byte: COM1; Low byte: COM2
The number of times the sending/receiving of groups of packets is triggered in sequence is written into CR#28. If the value in CR#28 is 0, the sending/receiving of groups of packets is not triggered.
The number of times the sending/receiving of groups of packets is triggered in sequence is in the range of 1 to 254. If the value in CR#28 is 255 (16#FF), the sending/receiving of groups of packets is continually triggered in sequence.

CR#4099~CR#4114: Selecting **Enable** boxes to enable the reading of data from bit devices through COM1

[Description]

Users can select **Enable** boxes to enable the reading of data from bit devices through COM1. They can set 256 values (No. 1~No. 256) in bit devices in AH10/15SCM-5A.

CR#	CR4099															
Bit	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
No.	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

CR#4099: No. 16~No. 1; CR#4100: No. 32~No. 17; CR#4101: No. 48~No. 33; CR#4102: No. 64~No. 49; CR#4103: No. 80~No. 65; CR#4104: No. 96~No. 81; CR#4105: No. 112~No. 97; CR#4106: No. 128~No. 113; CR#4107: No. 144~No. 129; CR#4108: No. 160~No. 145; CR#4109: No. 176~No. 161; CR#4110: No. 192~No. 177; CR#4111: No. 208~No. 193; CR#4112: No. 224~No. 209; CR#4113: No. 240~No. 225; CR#4114: No. 256~No. 241

0: Disabling the reading of data from a bit device through COM1; 1: Enabling the reading of data from a bit device through COM1

CR#8195~CR#8210: Selecting **Enable** boxes to enable the reading of data from word devices through COM1

[Description]

Users can select **Enable** boxes to enable the reading of data from word devices through COM1. They can set 256 values (No. 1~No. 256) in word devices in AH10/15SCM-5A.

CR#8195: No. 16~No. 1; CR#8196: No. 32~No. 17; CR#8197: No. 48~No. 33; CR#8198: No. 64~No. 49; CR#8199: No. 80~No. 65; CR#8200: No. 96~No. 81; CR#8201: No. 112~No. 97; CR#8202: No. 128~No. 113; CR#8203: No. 144~No. 129; CR#8204: No. 160~No. 145; CR#8205: No. 176~No. 161; CR#8206: No. 192~No. 177; CR#8207: No. 208~No. 193; CR#8208: No. 224~No. 209; CR#8209: No. 240~No. 225; CR#8210: No. 256~No. 241

0: Disabling the reading of data from a word device through COM1; 1: Enabling the reading of data from a word device through COM1

CR#12291~CR#12306: Selecting **Enable** boxes to enable the writing of data into bit devices through COM1

[Description]

Users can select **Enable** boxes to enable the writing of data into bit devices through COM1. They can set 256 values (No. 1~No. 256) in bit devices in AH10/15SCM-5A.

CR#	CR12291															
Bit	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
No.	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

CR#12291: No. 16~No. 1; CR#12292: No. 32~No. 17; CR#12293: No. 48~No. 33; CR#12294: No. 64~No. 49; CR#12295: No. 80~No. 65; CR#12296: No. 96~No. 81; CR#12297: No. 112~No. 97; CR#12298: No. 128~No. 113; CR#12299: No. 144~No. 129; CR#12300: No. 160~No. 145; CR#12301: No. 176~No. 161; CR#12302: No. 192~No. 177; CR#12303: No. 208~No. 193; CR#12304: No. 224~No. 209; CR#12305: No. 240~No. 225; CR#12306: No. 256~No. 241

0: Disabling the writing of data into a bit device through COM1; 1: Enabling the writing of data into a bit device through COM1

CR#16387~CR#16402: Selecting **Enable** boxes to enable the writing of data into word devices through COM1

[Description]

Users can select **Enable** boxes to enable the writing of data into word devices through COM1. They can set 256 values (No. 1~No. 256) in word devices in AH10/15SCM-5A.

CR#16387: No. 16~No. 1; CR#16388: No. 32~No. 17; CR#16389: No. 48~No. 33; CR#16390: No. 64~No. 49; CR#16391: No. 80~No. 65; CR#16392: No. 96~No. 81; CR#16393: No. 112~No. 97;

CR#16394: No. 128~No. 113; CR#16395: No. 144~No. 129; CR#16396: No. 160~No. 145;
CR#16397: No. 176~No. 161; CR#16398: No. 192~No. 177; CR#16399: No. 208~No. 193;
CR#16400: No. 224~No. 209; CR#16401: No. 240~No. 225; CR#16402: No. 256~No. 241
0: Disabling the writing of data into a word device through COM1; 1: Enabling the writing of data
into a word device through COM1

CR#20483~CR#20498: Selecting **Enable** boxes to enable the reading of data from bit
devices through COM2

[Description]
Users can select **Enable** boxes to enable the reading of data from bit devices through COM2.
They can set 256 values (No. 1~No. 256) in bit devices in AH10/15SCM-5A.
CR#20483: No. 16~No. 1; CR#20484: No. 32~No. 17; CR#20485: No. 48~No. 33; CR#20486: No.
64~No. 49; CR#20487: No. 80~No. 65; CR#20488: No. 96~No. 81; CR#20489: No. 112~No. 97;
CR#20490: No. 128~No. 113; CR#20491: No. 144~No. 129; CR#20492: No. 160~No. 145;
CR#20493: No. 176~No. 161; CR#20494: No. 192~No. 177; CR#20495: No. 208~No. 193;
CR#20496: No. 224~No. 209; CR#20497: No. 240~No. 225; CR#20498: No. 256~No. 241
0: Disabling the reading of data from a bit device through COM2; 1: Enabling the reading of data
from a bit device through COM2

CR#24579~CR#24594: Selecting **Enable** boxes to enable the reading of data from word
devices through COM2

[Description]
Users can select **Enable** boxes to enable the reading of data from word devices through COM2.
They can set 256 values (No. 1~No. 256) in word devices in AH10/15SCM-5A.
CR#24579: No. 16~No. 1; CR#24580: No. 32~No. 17; CR#24581: No. 48~No. 33; CR#24582: No.
64~No. 49; CR#24583: No. 80~No. 65; CR#24584: No. 96~No. 81; CR#24585: No. 112~No. 97;
CR#24586: No. 128~No. 113; CR#24587: No. 144~No. 129; CR#24588: No. 160~No. 145;
CR#24589: No. 176~No. 161; CR#24590: No. 192~No. 177; CR#24591: No. 208~No. 193;
CR#24592: No. 224~No. 209; CR#24593: No. 240~No. 225; CR#24594: No. 256~No. 241
0: Disabling the reading of data from a word device through COM2; 1: Enabling the reading of data
from a word device through COM2

CR#28675~CR#28690: Selecting **Enable** boxes to enable the writing of data into bit devices
through COM1

[Description]
Users can select **Enable** boxes to enable the writing of data into bit devices through COM2. They
can set 256 values (No. 1~No. 256) in bit devices in AH10/15SCM-5A.
CR#28675: No. 16~No. 1; CR#28676: No. 32~No. 17; CR#28677: No. 48~No. 33; CR#28678: No.
64~No. 49; CR#28679: No. 80~No. 65; CR#28680: No. 96~No. 81; CR#28681: No. 112~No. 97;
CR#28682: No. 128~No. 113; CR#28683: No. 144~No. 129; CR#28684: No. 160~No. 145;
CR#28685: No. 176~No. 161; CR#28686: No. 192~No. 177; CR#28687: No. 208~No. 193;
CR#28688: No. 224~No. 209; CR#28689: No. 240~No. 225; CR#28690: No. 256~No. 241
0: Disabling the writing of data into a bit device through COM2; 1: Enabling the writing of data into
a bit device through COM2

CR#32771~CR#32786: Selecting **Enable** boxes to enable the writing of data into word
devices through COM2

[Description]
Users can select **Enable** boxes to enable the writing of data into word devices through COM2.
They can set 256 values (No. 1~No. 256) in word devices in AH10/15SCM-5A.
CR#32771: No. 16~No. 1; CR#32772: No. 32~No. 17; CR#32773: No. 48~No. 33; CR#32774: No.
64~No. 49; CR#32775: No. 80~No. 65; CR#32776: No. 96~No. 81; CR#32777: No. 112~No. 97;
CR#32778: No. 128~No. 113; CR#32779: No. 144~No. 129; CR#32780: No. 160~No. 145;
CR#32781: No. 176~No. 161; CR#32782: No. 192~No. 177; CR#32783: No. 208~No. 193;
CR#327840: No. 224~No. 209; CR#32785: No. 240~No. 225; CR#32786: No. 256~No. 241

0: Disabling the writing of data into a word device through COM2; 1: Enabling the writing of data into a word device through COM2

CR#36864: Status of sending a command through COM1

[Description]
A command is sent from AH10/15SCM-5A.
1: The sending of a command is executed.
0: The sending of a command is complete.

CR#36865: Status of receiving a command through COM1

[Description]
0: A command has not been received.
1: The receiving of a command is being processed.
2: A command is received successfully.
3: A command fails to be received.
4: Checksum error
5: Communication timeout

CR#36866: Communication protocol for exchanging data through COM1

[Description]
0: Modbus
1: RS

CR#36867: Sending/Receiving a command through COM1

[Description]
0: After a command is sent, a command is received.
1: A command is sent, but no command is received.
2: No command is sent, but a command is received.

CR#36868: Timeout period after which no data is received through COM1

[Description]
0~65535 ms

CR#36869: Number of times the sending of a command through COM1 is retried

[Description]
If communication fails, the sending of a command can be retried.
The number of times the sending of a command through COM1 is retried is in the range of 0 to 255.

CR#36870: Length of a packet which is sent through COM1 (Unit: Byte)

[Description]
0~900 bytes

CR#36871: Length of a packet which is expected to be received through COM1 (Unit: Byte)

[Description]
0~900 bytes

CR#36872~CR#37367: Contents of a packet sent through COM1

[Description]
A packet which users want to send

CR#37368: Status of sending a command through COM2

[Description]
Please refer to the description of CR#36864.

CR#37369: Status of receiving a command through COM2

[Description]
Please refer to the description of CR#36865.

CR#37370: Communication protocol for exchanging data through COM2

[Description]
Please refer to the description of CR#36866.

CR#37371: Sending/Receiving a command through COM2

[Description]
Please refer to the description of CR#36867.

CR#37372: Timeout period after which no data is received through COM2

[Description]
Please refer to the description of CR#36868.

CR37373#: Number of times the sending of a command through COM2 is retried

[Description]
Please refer to the description of CR#36869.

CR#37374: Length of a packet which is sent through COM2 (Unit: Byte)

[Description]
Please refer to the description of CR#36870.

CR#37375: Length of a packet which is expected to be received through COM2 (Unit: Byte)

[Description]
Please refer to the description of CR#36871.

CR#37376~CR#37871: Contents of a packet sent through COM2

[Description]
Please refer to the description of CR#36872~CR#37367.

8.4.3.2 Introduction of the Related Instructions

After AH10/15SCM-5A is installed, users need to write a program to control the related functions of AH10/15SCM-5A. The users can read data from a control register in AH10/15SCM-5A by means of the instruction FROM, and write data into a control register AH10/15SCM-5A by means of the instruction TO.

API		Instruction code		Operand	Function
1400	D	FROM	P	m_1, m_2, m_3, D_1, D_2, n	Reading the data from the control register in the special module

Device	X	Y	M	S	T	C	HC	D	L	SM	SR	E	PR	K	16#	"$"	DF
m_1	●	●			●	●	●	●	●				●	○	○		
m_2	●	●			●	●	●	●	●				●	○	○		
m_3	●	●			●	●	●	●	●				●	○	○		
D_1	●	●			●	●	●	●	●				●				
D_2	●	●			●	●	●	●	●				●				
n	●	●			●	●	●	●	●				●	○	○		

Pulse instruction	16-bit instruction (13 steps)	32-bit instruction (13 steps)
AH500	AH500	AH500

Symbol:

m_1	:	Rack code	Word/Double word
m_2	:	Slot code	Word/Double word
m_3	:	Control register number	Word/Double word
D_1	:	Device in which the data is stored	Word/Double word
D_2	:	Device in which the error code is stored	Word/Double word
n	:	Data length	Word/Double word

Explanation:

1. Users can use this instruction to read the data from the control register in the special module into the AH500 series PLC.
2. The operand m_1 should be in the range of 1 to 8. 1 represents a main rack, and 2~8 represent extension racks.
3. The operand m_2 should be in the range of 0 to 11. If the rack code is 1, the slot code should be in the range of 0 to 11. If the rack code is in the range of 2 to 8, the slot code should be in the range of 0 to 7.
4. The operand m_3 specifies the control register number.
5. When the instruction FROM is executed, D_2 is set to 0. When an error occurs, D_2 is not set to 0. Please refer to the additional remark below for more information about the error codes.
6. The operand n used in the 16-bit instruction should be in the range of 1 to 256, and the operand n used in the 32-bit instruction should be in the range of 1 to 128.
7. Only the 32-bit instructions can use the 32-bit counter.
8. Please refer to the regulation of the operands in the instruction TO for more information about the numbering of the special modules.

Example:

Suppose the first special module at the right side of the CPU module is AH10/15SCM-5A. When X0.0 is switched from OFF to ON, the instruction FROM is executed. The mode of the data exchange through COM1 on AH10/15SCM-5A stored in CR#7 is read into D100. Owing to the fact that no error occurs, the code stored in D110 is 16#0000.

The use of the parameters:

- The module is placed on the main rack. Therefore, the rack code stored in D40 is 16#0001.
- The module is inserted in the first slot. Therefore, the slot code stored in D41 is 16#0000.
- The mode of the data exchange through COM1 is stored in CR#7. Therefore, the control register number stored in D42 is 16#0007.
- Owing to the fact that the mode of the data exchange through COM1 occupies one register, the value in D43 is 1.
- The data which is read from CR#7 is stored in D100.

Additional remark:

1. If the values in m_1 and m_2 exceed the range, the operation error occurs, the instruction is not executed, SM0 is ON, and the error code in SR0 is 16#2003.
2. If D_1~D_1+n-1 exceed the device range, the instruction is not executed, SM0 is ON, and the error code in SR0 is 16#2003.
3. If the value in n exceeds the range, the operation error occurs, the instruction is not executed, SM0 is ON, and the error code in SR0 is 16#200B.
4. Due to the fact that the use of the instruction FROM decreases the execution efficiency of the CPU module and that of the I/O module, users should use it less often.
5. The descriptions of the error codes:

Error code	Description
16#2003	Please refer to point 1 and point 2 in the additional remark.
16#200B	Please refer to point 3 in the additional remark.
16#1400	An error occurs when the data is accessed through the auxiliary processor.
16#1401	An error occurs when the data in the I/O module is accessed.
16#1402	The arrangement of the I/O modules is not consistent with the module table.
16#1407	A communication error occurs when the data is accessed through the auxiliary processor.

API	Instruction code			Operand	Function
1401	D	TO	P	m₁, m₂, m₃, S, D, n	Writing the data into the control register in the special module

Device	X	Y	M	S	T	C	HC	D	L	SM	SR	E	PR	K	16#	"$"	DF
m₁	●	●			●	●	●	●	●				●	○	○		
m₂	●	●			●	●	●	●	●				●	○	○		
m₃	●	●			●	●	●	●	●				●	○	○		
S	●	●			●	●	●	●	●				●	○	○		
D	●	●			●	●	●	●	●				●				
n	●	●			●	●	●	●	●				●	○	○		

Pulse instruction	16-bit instruction (13 steps)	32-bit instruction (13 steps)
AH500	AH500	AH500

Symbol:

m₁	:	Rack code	Word/Double word
m₂	:	Slot code	Word/Double word
m₃	:	Control register number	Word/Double word
S	:	Data which is written into the control register	Word/Double word
D	:	Device in which the error code is stored	Word/Double word
n	:	Data length	Word/Double word

Explanation:

1. Users can use this instruction to write the data in the AH500 series PLC into the control register in the special module.
2. The operand **m₁** should be in the range of 1 to 8. 1 represents a main rack, and 2~8 represent extension racks.
3. The operand **m₂** should be in the range of 0 to 11. If the rack code is 1, the slot code should be in the range of 0 to 11. If the rack code is in the range of 2 to 8, the slot code should be in the range of 0 to 7.
4. The operand **m₃** specifies the control register number.
5. When the instruction TO is executed, **D** is set to 0. When an error occurs, **D** is not set to 0. Please refer to the additional remark below for more information about the error codes.
6. The operand **n** used in the 16-bit instruction should be in the range of 1 to 256, and the operand **n** used in the 32-bit instruction should be in the range of 1 to 128.
7. Only the 32-bit instructions can use the 32-bit counter.
8. When **S** is a decimal value or a hexadecimal value, **n** decimal values or **n** hexadecimal values are transmitted to the I/O module. Suppose **S** is 16#0001 and **n** is 3. Three 16#0001s are transmitted to the I/O module.

Example:

Suppose the first special module at the right side of the CPU module is AH10/15SCM-5A. When X1.1 is switched from OFF to ON, the instruction TO is executed. The mode of the data exchange through COM1 on AH10/15SCM-5A stored in CR#7 changes from being disabled to being enabled. Owing to the fact that no error occurs, the code stored in D110 is 16#0000.
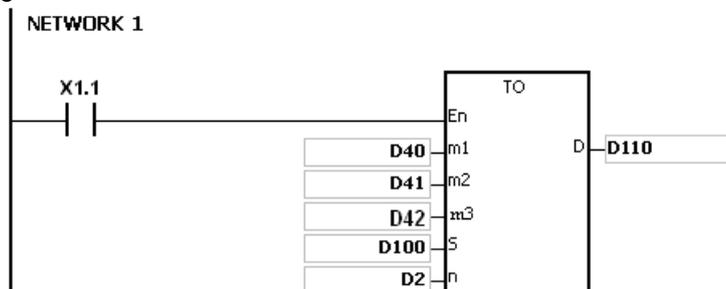
The use of the parameters:

- The module is placed on the main rack. Therefore, the rack code stored in D40 is 16#0001.
- The module is inserted in the first slot. Therefore, the slot code stored in D41 is 16#0000.
- The mode of the data exchange through COM1 is stored in CR#7. Therefore, the control register number stored in D42 is 16#0007.
- Owing to the fact that the mode of the data exchange through COM1 occupies one register, the value in D2 is 1.
- The data which is written into CR#7 is stored in D100. Therefore, the value in D100 is 16#0002.

The regulation of the operands in the instruction:

- The operand m_1 specifies the rack code. It should be in the range of 1 to 8. 1 represents a main rack, and 2~8 represent extension racks.
- The operand m_2 specifies the slot code. It should be in the range of 0 to 11. If the rack code is 1, the slot code should be in the range of 0 to 11. If the rack code is in the range of 2 to 8, the slot code should be in the range of 0 to 7.
- The operand m_3 specifies the control register number. The 16-bit memories built in the special modules are called the control registers. The control register numbers are decimal numbers #0~#N, and the number of control registers varies with the module. The operating conditions of the special module and the setting values are stored in the control registers.
- At most 68 special modules can be placed on the rack, and they do not occupy inputs/outputs.
- If the instruction FROM/TO is used, one control register is taken as a unit for the reading/writing of the data. If the instruction DFROM/DTO is used, two control registers are taken as a unit for the reading/writing of the data.

- The **n** which is 2 in the 16-bit instruction has the same meaning as the **n** which is 1 in the 32-bit instruction.
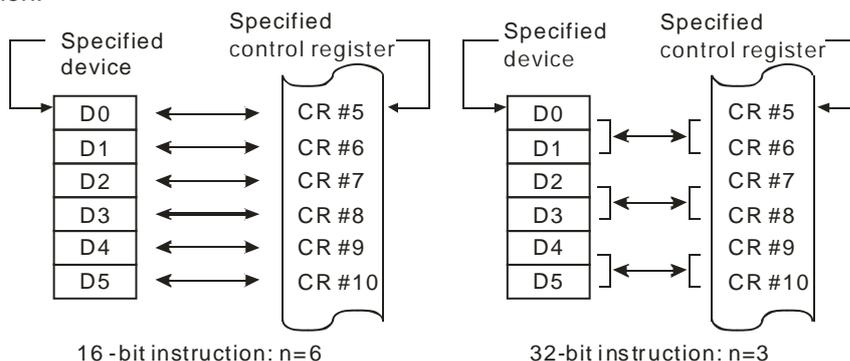
Additional remark:

1. If the values in m_1 and m_2 exceed the range, the operation error occurs, the instruction is not executed, SM0 is ON, and the error code in SR0 is 16#2003.
2. If **S~S+n**-1 exceed the device range, the instruction is not executed, SM0 is ON, and the error code in SR0 is 16#2003.
3. If the value in **n** exceeds the range, the operation error occurs, the instruction is not executed, SM0 is ON, and the error code in SR0 is 16#200B.
4. Due to the fact that the use of the instruction TO decreases the execution efficiency of the CPU module and that of the I/O module, users should use it less often.
5. The descriptions of the error codes:

Error code	Description
16#2003	Please refer to point 1 and point 2 in the additional remark.
16#200B	Please refer to point 3 in the additional remark.
16#1400	An error occurs when the data is accessed through the auxiliary processor.
16#1401	An error occurs when the data in the I/O module is accessed.
16#1402	The arrangement of the I/O modules is not consistent with the module table.
16#1407	A communication error occurs when the data is accessed through the auxiliary processor.

8.5 Quick Start

This section introduces how to carry out the Modbus RS-485/RS-422/RS-232 communication through a communication port on AH10/15SCN-5A.

● **Setting communication**

After users double-click the module AH10/15SCM-5A in the **HWCONFIG** window, they can set COM1 and COM2 in the **Parameter Setting** window
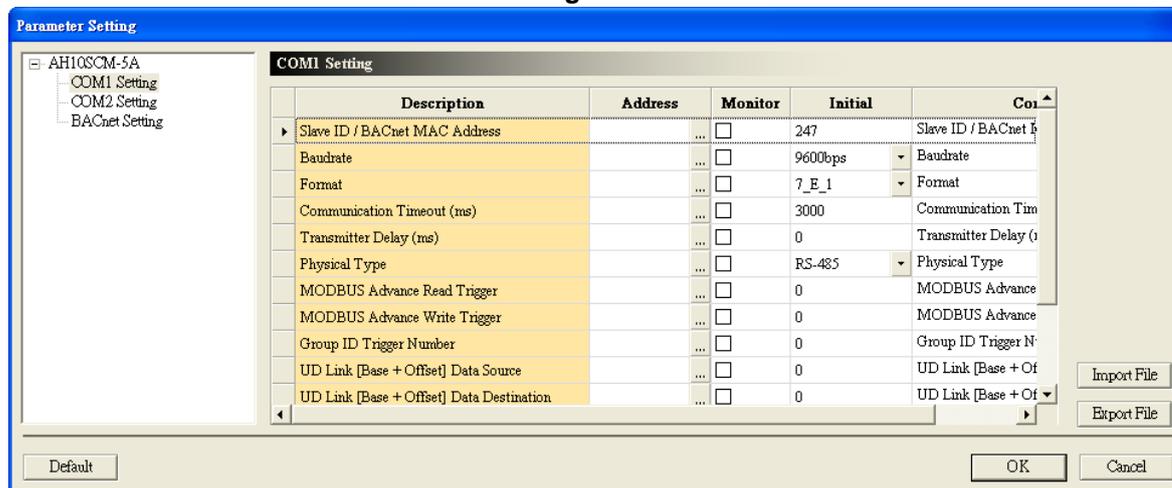
Start ISPSoft, right-click the module in the **HWCONFIG** window, click **Intelligent Module Configuration** on the context menu, and click **Yes**. SCMSoft is started.
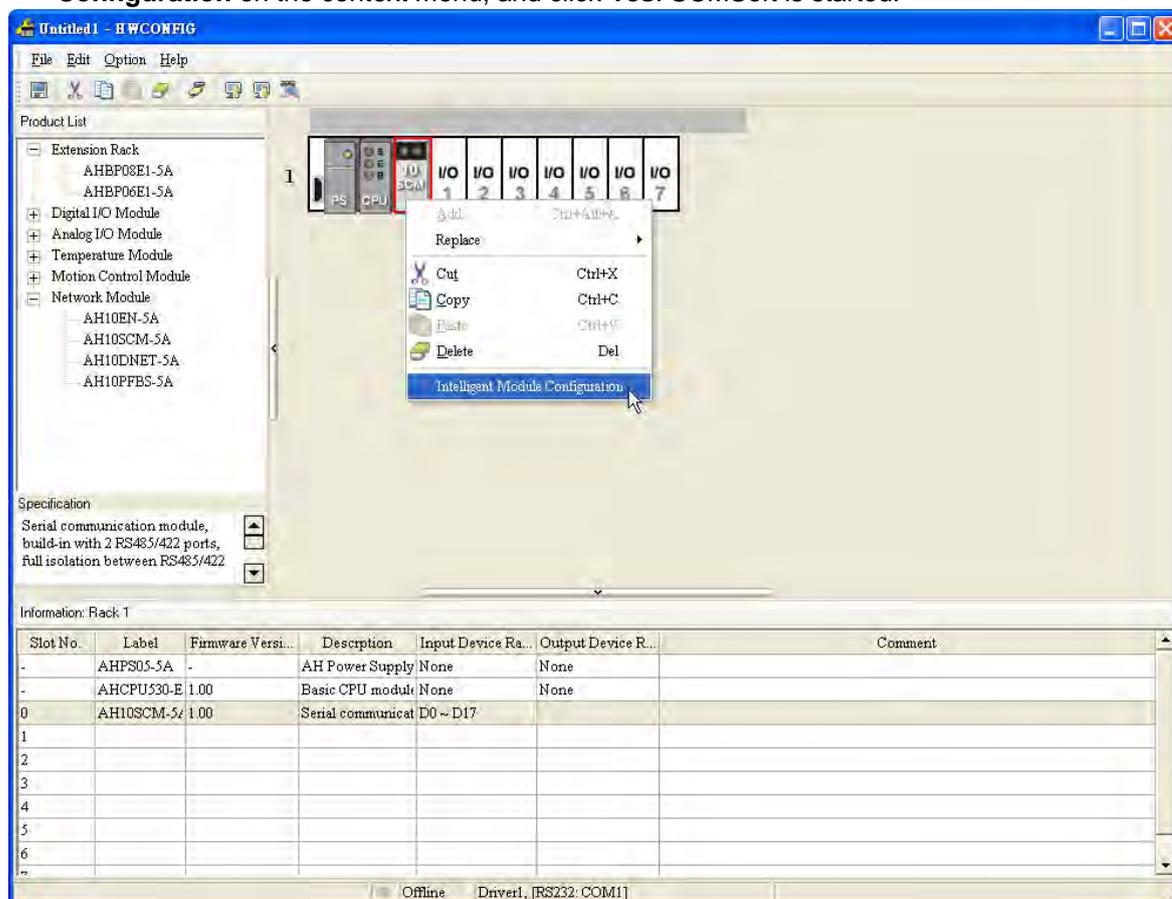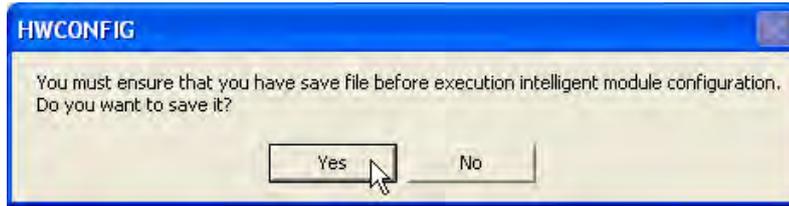
- **Modbus Advance**

  Start SCMSoft, and then click **Modbus　Advance Wizard** on the toolbar.
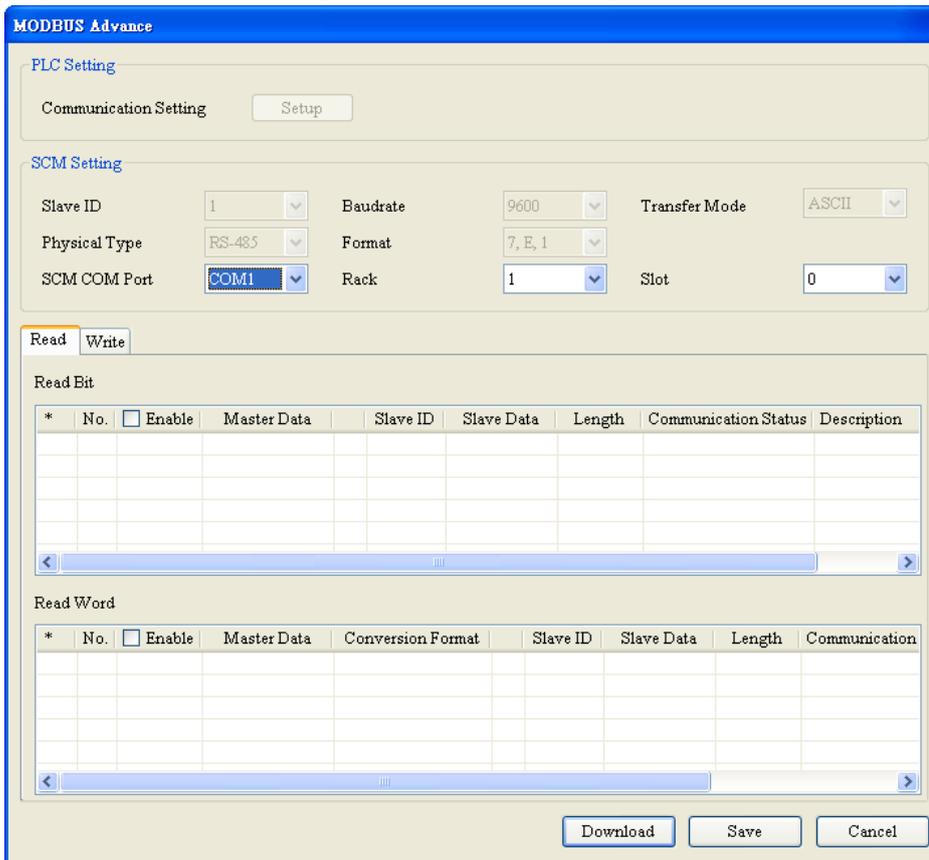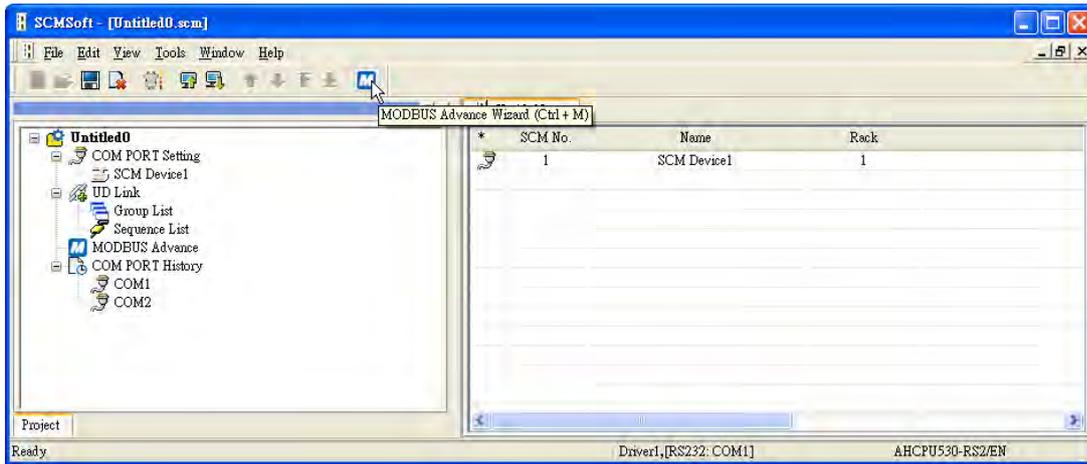
● **Setting Modbus Advance**

To speed up standard Modbus communication, SCMSoft provides the Modbus Advance wizard. Users only need to specify registers or absolute positions from which data is read, specify registers or absolute positions into which data is written, select a communication port, and download the setting to AH10/15SCM-5A. After flags are enabled, the reading of the data, and the writing of the data are complete. The steps of setting the wizard are as follows.

(1) SCM setting

Users can specify a backplane, a slot, and a communication port. Besides, they can set a slave ID, a transmission speed, a communication interface, a transmission mode, and a format.

(2) Modbus Advance—Reading and writing

Reading data from bit devices/word devices, and writing data into bit devices/word devices

Reading data from bit devices/word devices: Right-click a blank, and click **Add Item**.
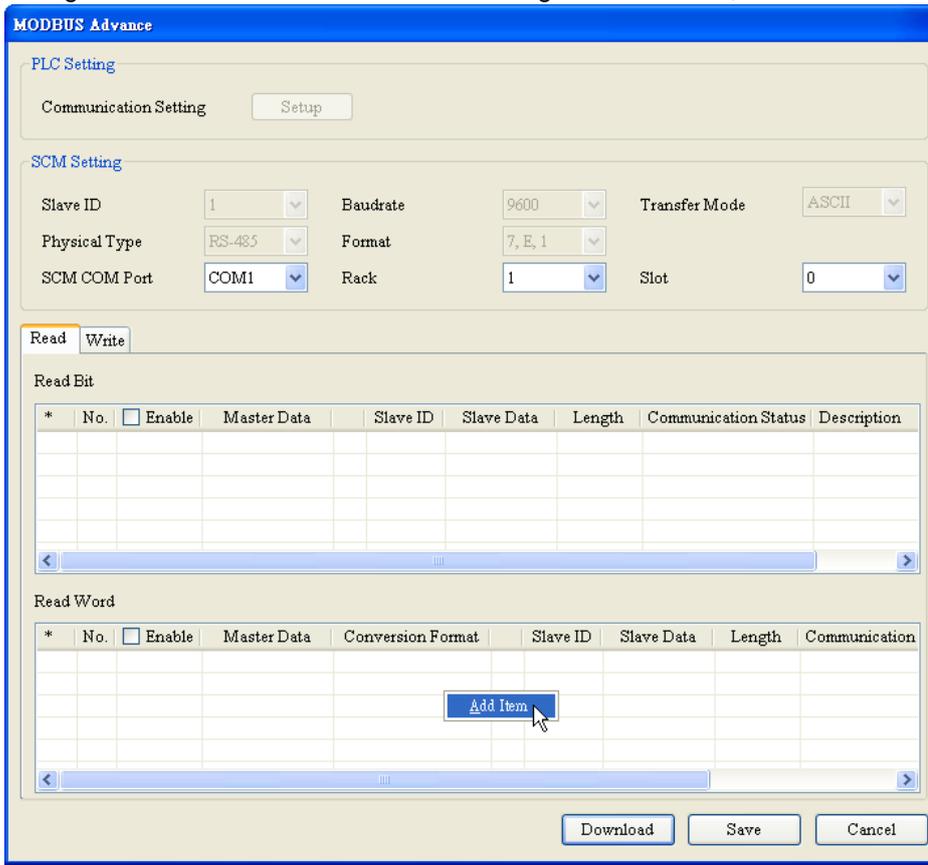
After users double-click the item which is added, the **Parameter Edit** window appears.
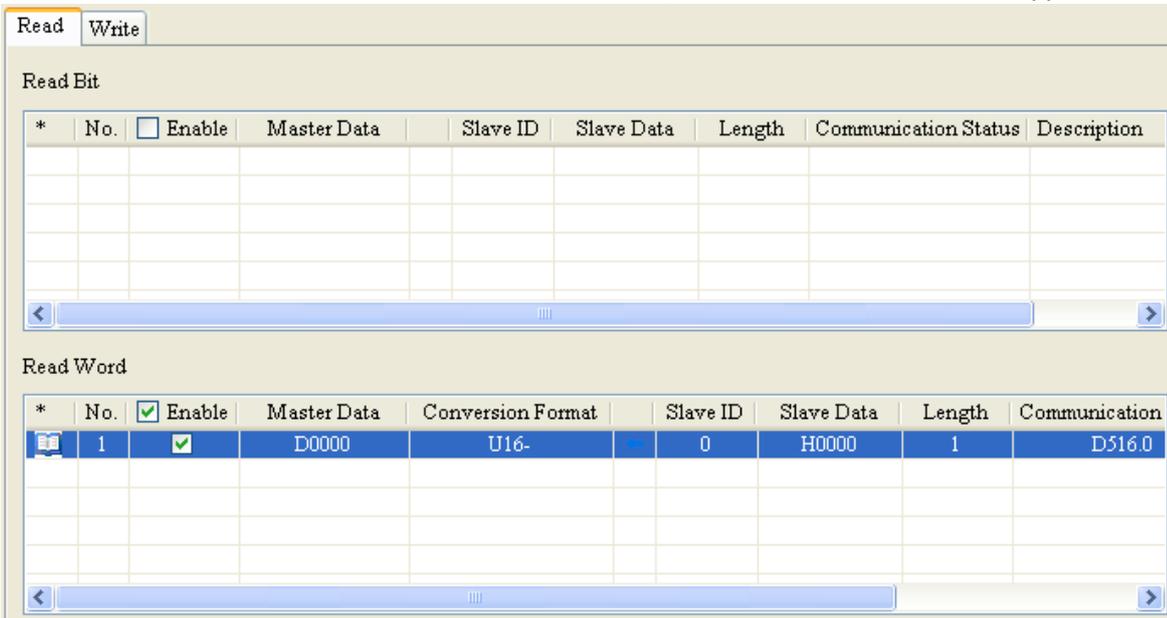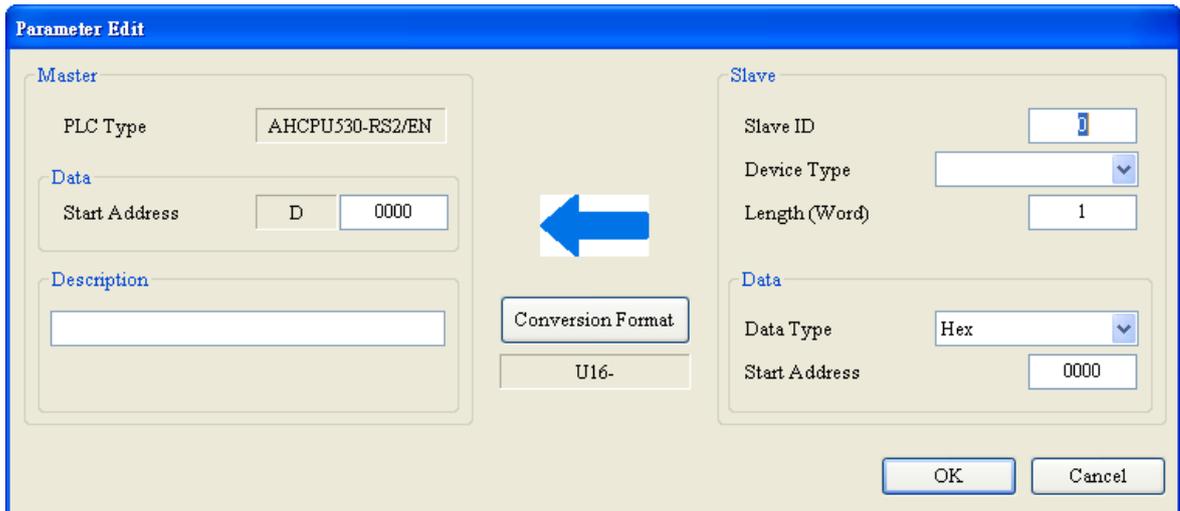
Master:

PLC type: A default PLC type is displayed. Users can change the PLC type by means of clicking **Change PLC Type** on the **Tools** menu in SCMSoft.

Data: Users can set an initial data register into which data is written.

Description: Users can enter a description of a device into which data is written. (Length: 30 bytes at most)

Slave:

Slave ID: A slave from which data is read

Device type: Users can select a Delta PLC. Leave the **Device Type** box blank if a device used is not a Delta PLC.

Length: The length of data read is 100 words at most.

Data type: Users can select **Hex** or **Modbus 6 digit**. If **Hex** is selected, a data type is represented by a four-digit hexadecimal value. If **Modbus 6 digit** is selected, a data type is represented by a six-digit decimal value. If a device used is a Delta PLC, **D** automatically appears in the **Data Type** box.

Start address: Users can set an initial register from which data is read

Example: There is a present value stored in 16#4700 in a Delta DTA series temperature controller. The slave ID is 10. The present value can be read into D100 in a CPU module through COM1 on AHSCM-5A. The setting is as follows.
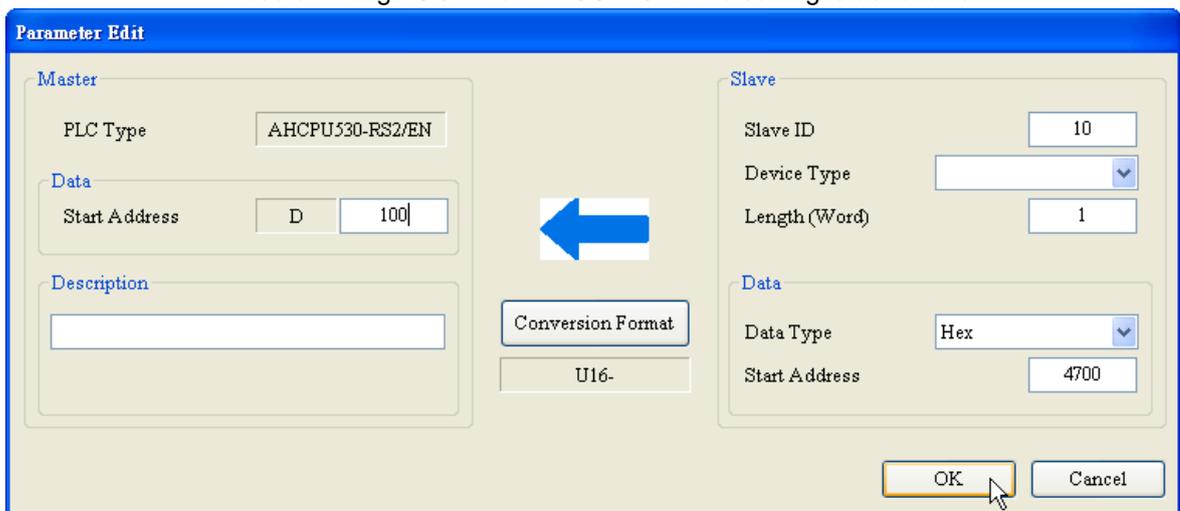
● **Downloading the parameters**

After the setting is complete, check whether the setting of other parameters conforms to the setting of the slave. Click **Download**.
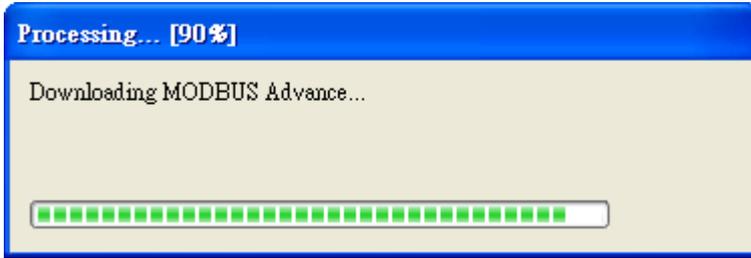
● **Communication status**

AH10/15SCM-5A provides the status of Modbus communication. Data exchanges include reading data from bit devices/word devices, and writing data into bit devices/word devices. The status of executing a data exchange is represented by the state of a bit in a data register. For example, if D100 is an initial register in which the states of the bits represent the statuses of data exchanges, the status of exchanging data 1 is represented by the state of bit0 in D100, and the status of exchanging data 2 is represented by the state of bit1 in D100, and so on. If the communication is a success, the flag is set to ON automatically. If the communication is a failure, the flag is set to OFF automatically. The communication is a failure if all the retries you have set are without success, then the communication is failed. For example the default is 3 retries, if all 3 retries are experiencing timeout, then the communication is failed.

Dn															
Bit	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
No.	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

D (n+1)															
Bit	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
No.	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17
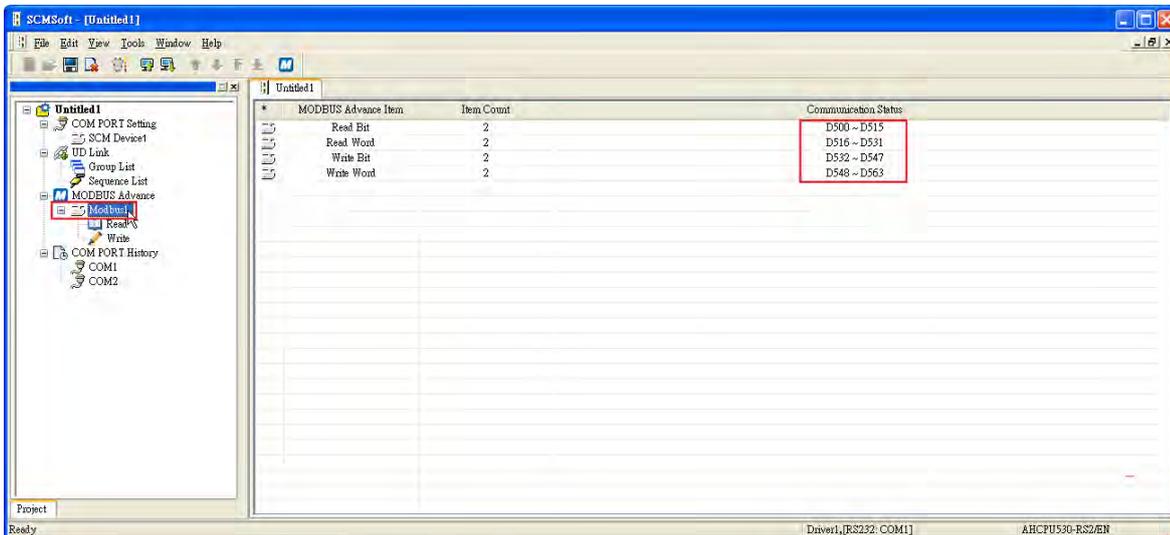
The TCP keepalive period by default is set to 30 seconds. D500 is an initial register in which statuses of data exchanges are stored. Users can enter **Modbus Advance** to alter the initial register.
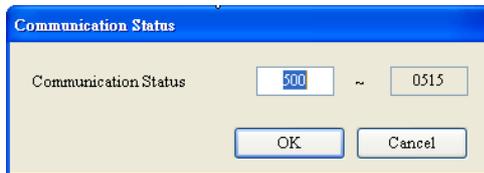
- **Triggering the reading/writing of data**

When it is installed on the right-side of the PLC CPU, users can use the instruction TO in ISPSoft or use output registers to trigger the reading of data from bit devices/word devices, and the writing of data into bit devices/word devices. Available for AH10SCM-5A FW V1.06 or later and AH15SCM-5A FW V1.02 or later: when installed on the right-side of AHRTU-ETHN-5A (FW V1.02), you can only use output register to trigger the data exchange function.

CR#	Attribute	Register name	Description
7	R/W	Triggering the reading of data through COM1	High byte: Reading data from bit devices Low byte: Reading data from word devices 00: Not triggering it 01: Triggering it once 02: Always triggering it
17	R/W	Triggering the reading of data through COM2	
8	R/W	Triggering the writing of data through COM1	
18	R/W	Triggering the writing of data through COM2	

If users want to continually trigger the reading of data from word devices via COM1, they can write 16#0002 into CR#7.
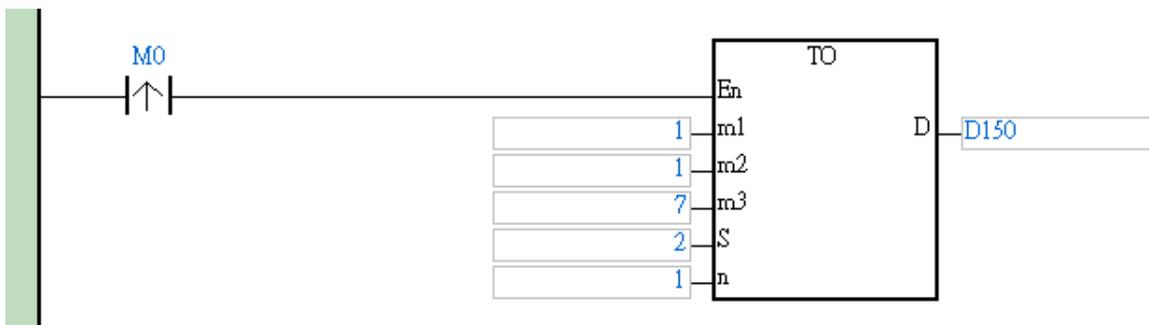
This is a PLC programming example: triggering M0 to have S=16#0002 to write into CR#7 of SCM and data exchange can start via COM1, reading data from the slave and storing data in D100, till 0 is written into CR#7 manually.
If you only need data reading for one time, you can write 16#0001 into CR#7. Write 0 into CR#7 and write 16#0001 again to start another reading.

If you use output registers to trigger data exchange (only available for AH10/15SCM-5A + AHRTU-ETHN-5A), you can write the corresponding D device in the instruction for trigger. Use EIP Builder to open HWCONFIG (make sure the mds file version of the SCM is consistent to the module version) to check the data exchange details as the example shown below. If you need COM1 to perform reading in words and bytes, just write 16#0202 into D68.
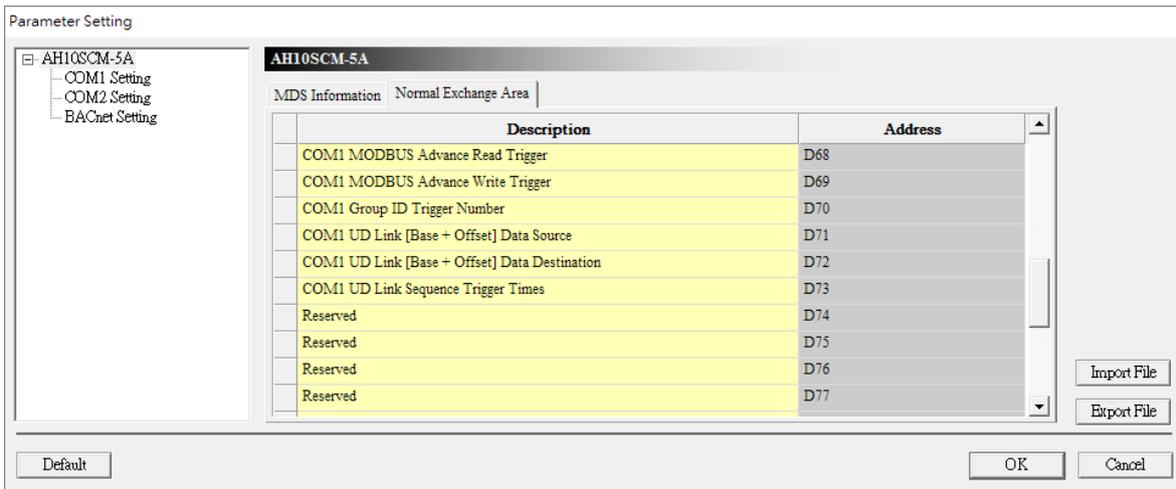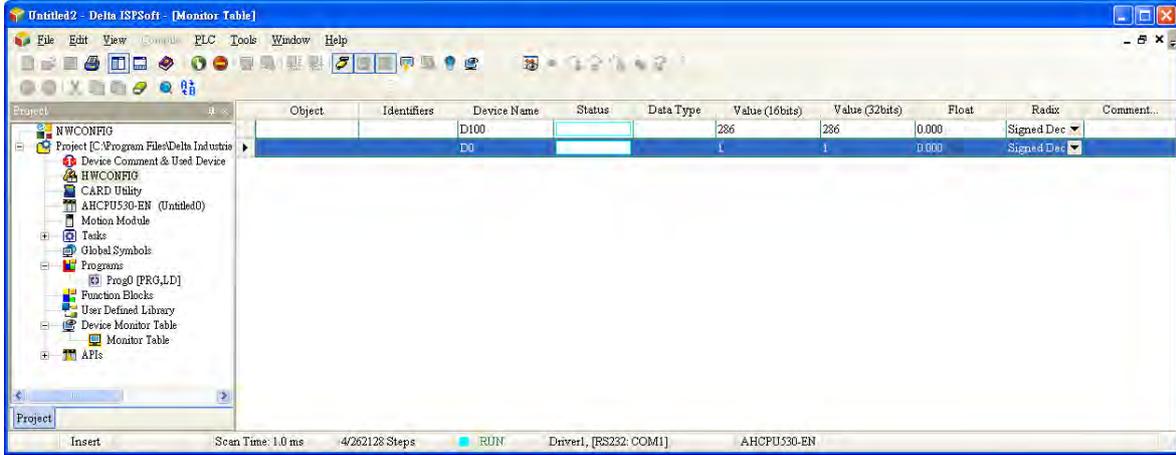
8.6 Software

This section introduces SCMSoft, which is used to set AH10/15SCM-5A.

8.6.1 SCM Project

Users can make an SCM project for COM1 and COM2 on AH10/15SCM-5A. An SCM project is composed of four parts.

COM Port setting: Users can set communication protocols for exchanging data through COM1 and COM2. (See section 8.6.2.)

UD Link: RS-485/RS-422/RS-232 communication can be used. Users can define the contents of a packet by themselves. (See section 8.6.3.)

Modbus Advance: A standard Modbus RS-485/RS-422/RS-232 device can use this function. Other Delta automation products and other standard Modbus communication devices can also use this function. (See section 8.6.4.)

COM port history: The communication history of AH10/15SCM-5A can be recorded. (See section 8.6.5.)

8.6.2 COM Port Setting

Setting a communication protocol: Modbus, UD Link (user-defined RS-485/RS-422/RS-232 format), and BACnet MS/TP slave
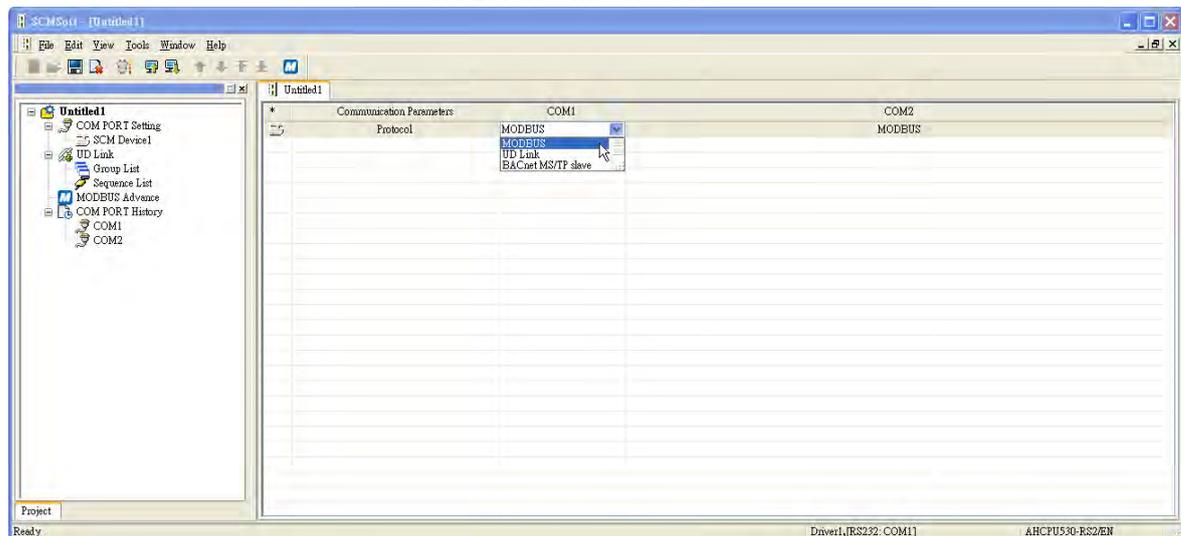
8.6.3 UD Link (User-defined Communication)

The UD Link provides non-Modbus RS-485/RS-422/RS-232 communication. A packet can be edited according to a communication format. The steps of creating an UD Link are as follows.

(1) Creating a group→Editing TX packets and RX packets→Creating commands→Downloading the group, and then triggering the sending/receiving of the packets
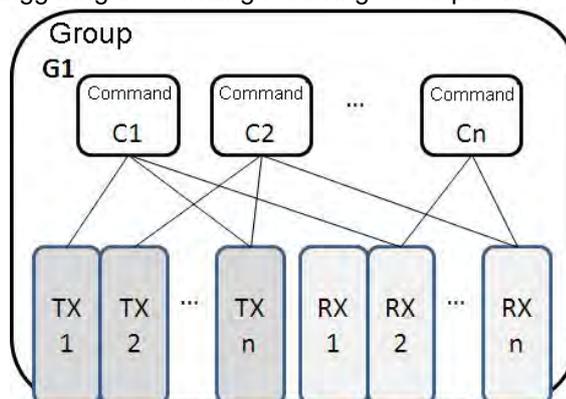
(2) Creating a group➔Editing TX packets and RX packets➔Creating commands➔Creating other groups➔Creating sequences➔Downloading the sequences, and then triggering the sending/receiving of the packets
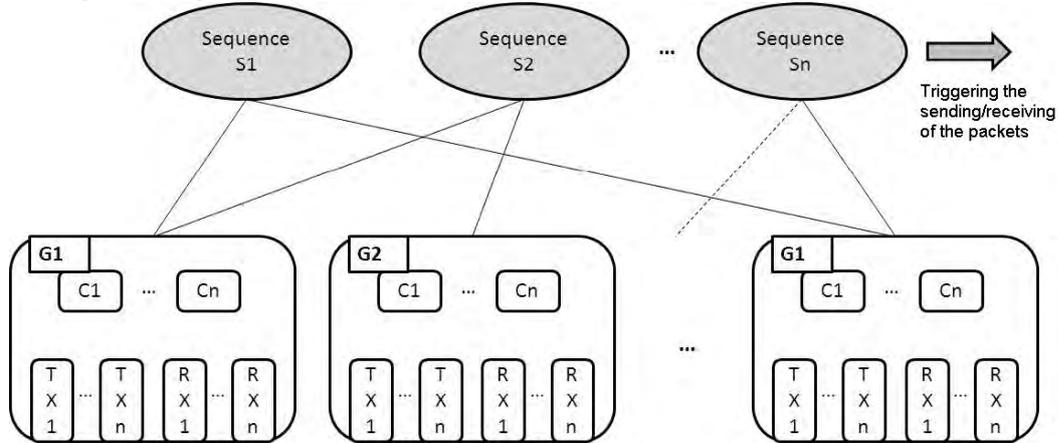
First, create TX packets and RX packets in a group. Then, set the sequence of sending/receiving the packets, and the number of times the packets are sent/received through commands. Finally, the sending/receiving of the packets in the group is triggered. Besides, if several different types of packets are required in a larger system, users can arrange several groups in sequence, and set the sequence of sending/receiving the packets in the groups.

8.6.3.1 TX Packets and RX Packets

Several TX packets and RX packets can be created in a group. A TX packet/RX packet is composed of messages, an address, a length, and a checksum.
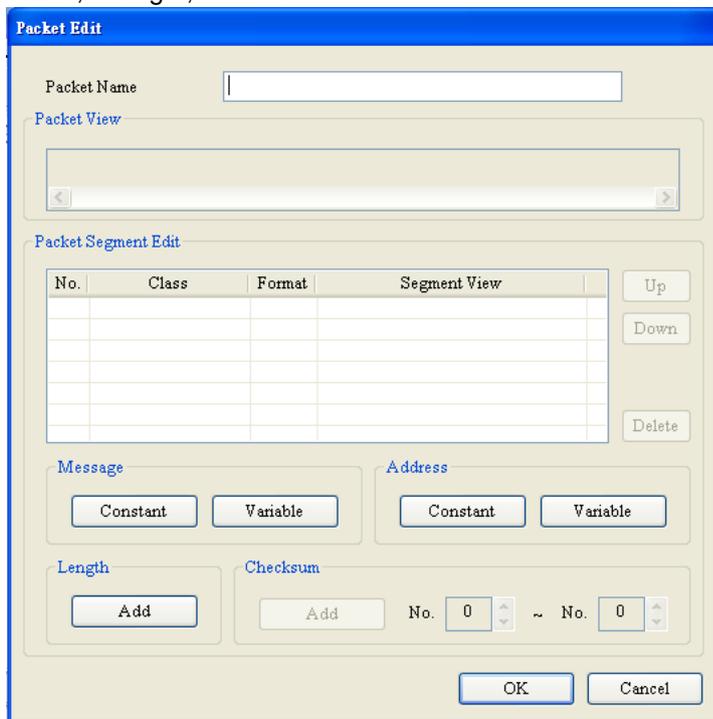
- Packet name: Users can edit a packet name.
- Packet view: The contents of a packet are displayed.
- Packet segment edit: Users can adjust the sequence of segments, and add/delete segments.
  No.: A segment number is displayed. Users can edit 64 segments at most.
  Class: A segment class is displayed. A message, an address, a length, and a checksum are classes.

Format: The data format of a segment is displayed. A hexadecimal value, an ASCII code, and a code are data formats.

Segment view: The contents of a segment are displayed.

● Message: Users can edit "constant" messages and "variable" messages. Messages can be applied to a header segment, a start bit segment, an end bit segment, and a data segment. There can be several messages in a packet.

● Address: Users can edit a "constant" address, and a "variable" address. There is only one address segment in a packet.

● Length: Users can edit the length of a packet. There is only one length segment in a packet.

● Checksum: Users can edit a checksum. There is only one checksum segment in a packet.
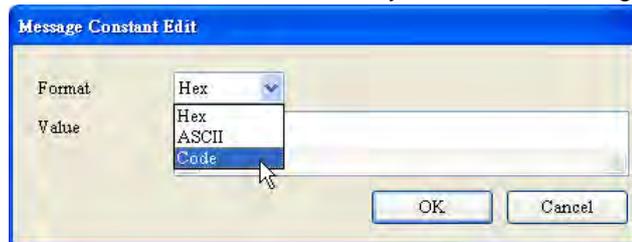
● Constant: Data is a constant.

Format: Users can select **Hex**, **ASCII**, or **Code** in the **Format** box. If **Code** is selected, data used is a control code.

Value: User can enter a constant.
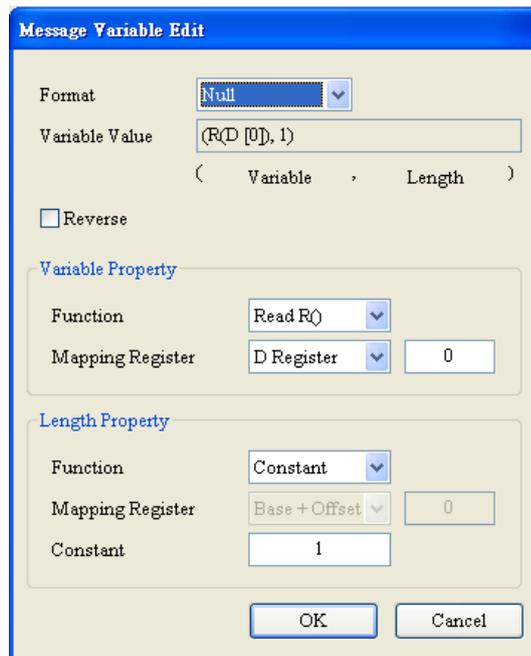
● Variable: Data is a variable. Users can specify an internal register in AH10/15SCM-5A, or a register in a CPU module.

● Format: Users can set the format of data

Null: Data is not processed.

Hex: ASCII data is converted into hexadecimal data. ASCII data which can not be converted into hexadecimal data will be converted into 0.

ASCII: Hexadecimal data is converted into ASCII data. Hexadecimal data which can not be converted into ASCII data will be converted into 0.

● Variable property

Function: For a TX packet, users can select Read R () in the **Functio**n box. For a RX packet, the users can select **Read R ()**, **Write W ()**, or * in the **Function** box.

Mapping register: Users can select an internal register in AH10/15SCM-5A, or a register in a CPU module. I1, I2, O1, and, O2 are internal registers in AH10/15SCM-5A. For a CPU module, **D Register** or **Base+Offset** can be selected.

Register	Definition	Register	Definition
D	Internal data register in a CPU module	Base+Offset	Used with a control register
I1	Used for the receiving/sending of data through COM1	O1	Used for the sending of data through COM1
I2	Used for the receiving/sending of data through COM2	O2	Used for the sending of data through COM2

● Length
Class: Users can select **1 Byte** or **2 Bytes** in the **Class** box.
Format: Users can select **Hex** or **ASCII** in the **Format** box.
Value: Users can enter a length.

● Checksum
Class: Users can select a class.
Format: Users can select the format of a checksum
Initial value: Users can set an initial value.
Reverse: The high byte of a one-word checksum which is calculated, and the low byte of the checksum are reversed.

8.6.3.2 Command

After several TX packets and RX packets are created, users can select packets which will be sent and packets which will be received by creating commands. Besides, the users can set the sequence of executing the commands.

Command number: Every command is numbered. Command numbers indicate execution sequence.
Command type: Users can select **Send**, **Receive**, or **Send** & **Receive** in the **Command Type** box.
Send packet: Users can select a packet which has been created.
Receive packet: Users can select a packet which has been created.
Success: Users can specify an action which follows the execution of a command. They can select **Next**, **Goto**, or **End**.
  Next: The next command is executed. If the command which is being executed is command 1, the next command which will be executed is command 2.
  Goto: Users can specify a command which should be executed much later.

End: Coming to and end

Fail: Users can specify an action which follows the execution of a command. They can select **Next**, **Goto**, or **Abort**.

Next: The next command is executed. If the command which is being executed is command 1, the next command which will be executed is command 2.

Goto: Users can specify a command which should be executed much later.

Abort: Coming to and end

Retry: The sending of a command can be retried after the sending of the command fails. Users can set the number of times the sending of a command is retried.

Repeat: After a command is executed successfully, it can be executed repeatedly. Users can set the number of times the execution of a command is repeated.

Send wait: Users can set an interval between commands. The default is 0 milliseconds, that is, the next command is sent after a reply is received.

Timeout: If no reply is received after a specific period of time, there is communication timeout. The default is 50 milliseconds.

8.6.3.3 Sequence

After users right-click a blank and click **Add Group**, they can select groups and set the sequence of executing the groups. After the sequence is downloaded, the packets in the groups will be sent/received through a communication port. Besides, the users can select groups which will be executed if errors occur by clicking the **Error Execute Group** column. If an error occurs when a group is executed, a group which is specified will be executed.
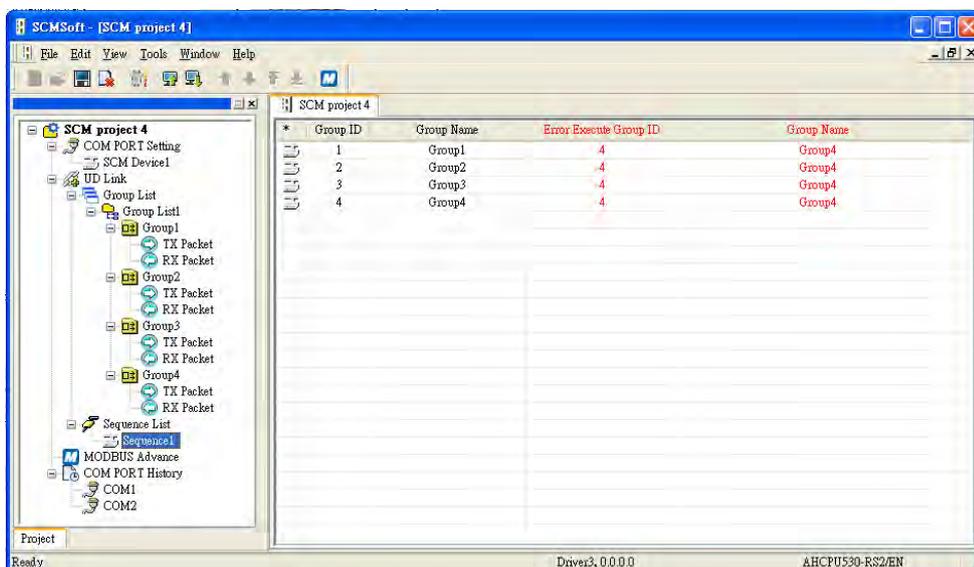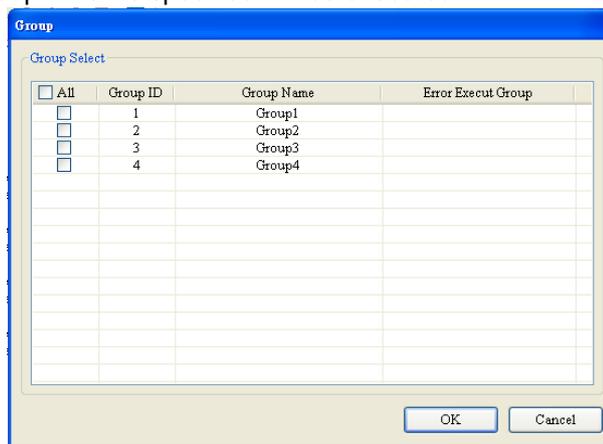
8.6.4 Modbus Advance

Please refer to the introduction in section 8.5 for more information.

8.6.5 COM Port History

During communication, all packets are recorded in a buffer zone in AH10/15SCM-5A. The COM port history helps users debug a program. Packets which are sent/received are recorded in this buffer zone. The capacity of the buffer zone is 2048 bytes. Only the latest communication data is recorded. The older communication data is discarded. Besides, the buffer zone is a non-latched area. Data in the buffer zone will disappear if there is a power failure. The COM port history function can be enabled and disabled. The data in the buffer zone can also be uploaded to SCMSoft.

After users right-click **COM PORT History**, they can select **Start COM PORT History**, **Stop COM PORT History**, or **Upload COM PORT History Data**. If **Start COM PORT History** is selected, all communication through COM1 and COM2 will be recorded. If **Stop COM PORT History** is selected, the recording of all communication through COM1 and COM2 will stop. If **Upload COM PORT History Data** is selected, all communication data in AH10/15SCM-5A will be uploaded to SCMSoft. Please notice that the recording of all communication data stops before the data is uploaded to SCMSoft. If users want resume the recording of communication data, they must enable the COM port history function again.
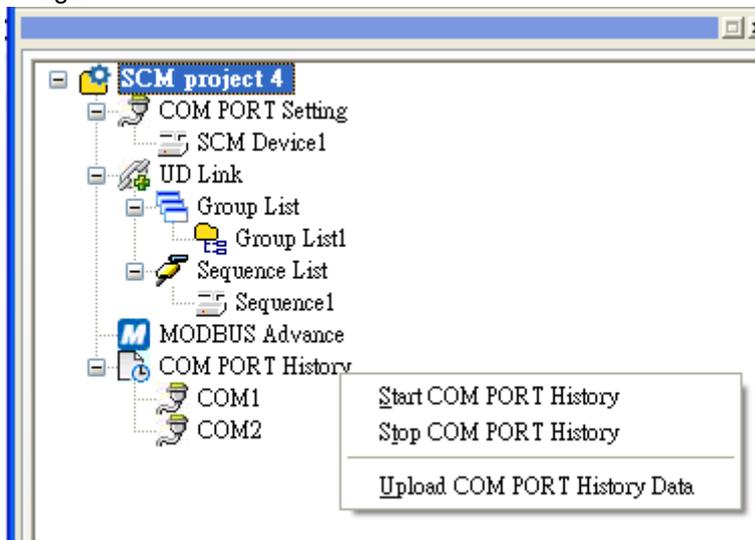
8.7 Application

8.7.1 Modbus

This section introduces the how AH10/15SCM-5A is connected to other Delta industrial products such as a human-machine interface, a temperature controller, a programmable logic controllers, an AC motor drive, and a servo motor through Modbus. The connection framework is as follows.
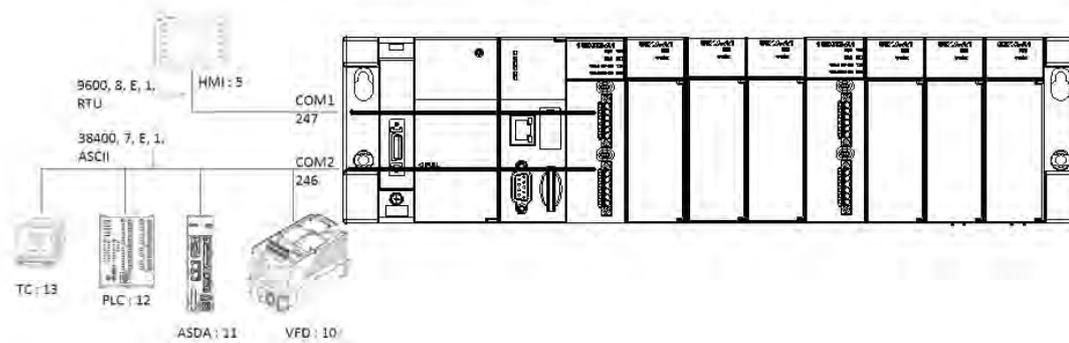
Product	Slave ID	Communication protocol	Device from which data is read	Register in the CPU module	Device into which data is written	Register in the CPU module
HMI	5	9600, RTU, 8, E, 1	-	-	-	-
VFD	10	38400, ASCII, 7, E, 1	16#2103	D100	16#2000 16#2001	D150~ D151
ASDA	11	38400, ASCII, 7, E, 1	16#0101 16#020A	D200 D201	16#0101 16#020A	D250 D251
PLC	12	38400, ASCII, 7, E, 1	D100~ D109	D300~ D309	D200~ D204	D350~ D354
TC	13	38400, ASCII, 7, E, 1	16#1000 (Present value)	D400	16#1001 (Setting value)	D451

8.7.1.1 Modbus Slave─Connection with Delta Products

If AH10/15SCM-5A functions as a Modbus slave, users only need to set a slave ID and a transmission speed.
After the users double-click AH10/15SCM-5A in the **HWCONFIG** window, they can set communication parameters.
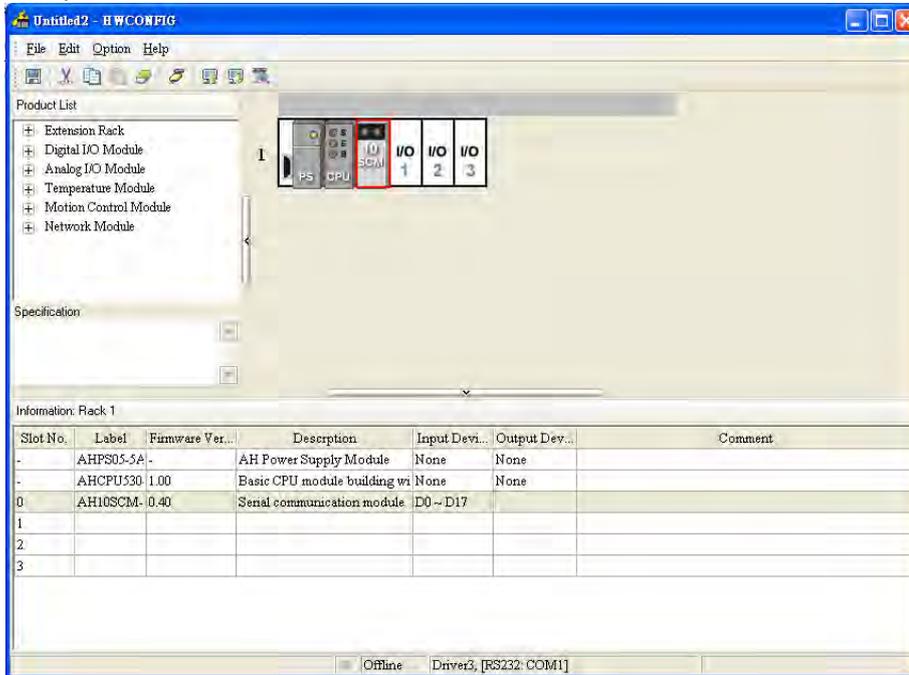
After the users click **AH10/15SCM-5A** in the **Parameter Setting** window, they can see the version of MDS, and the date when MDS is built.

After the users click **COM1 Setting** in the **HWCONFIG** window, they can set communication parameters for COM1.
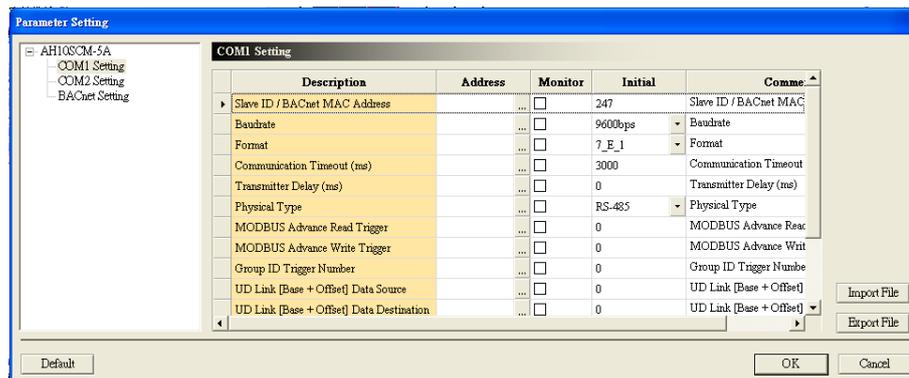
Right-click AH10/15SCM-5A in the **HWCONFIG** window, click **Intelligent Module Configuration** on the context menu, and click **Yes**. SCMSoft is started.
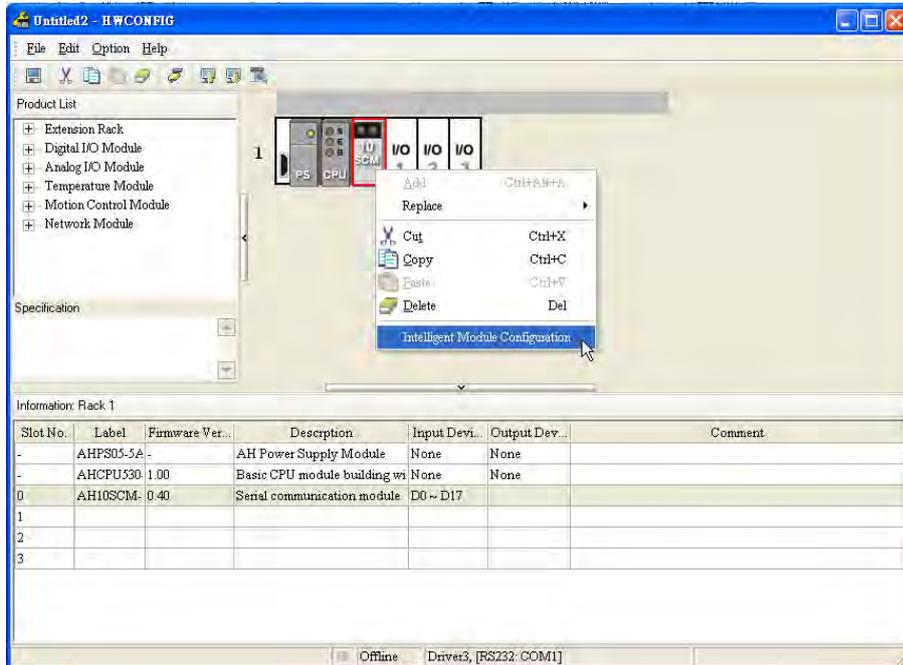
Start SCMSoft.→**COM PORT Setting**: **SCM Device1**→Set communication protocols.
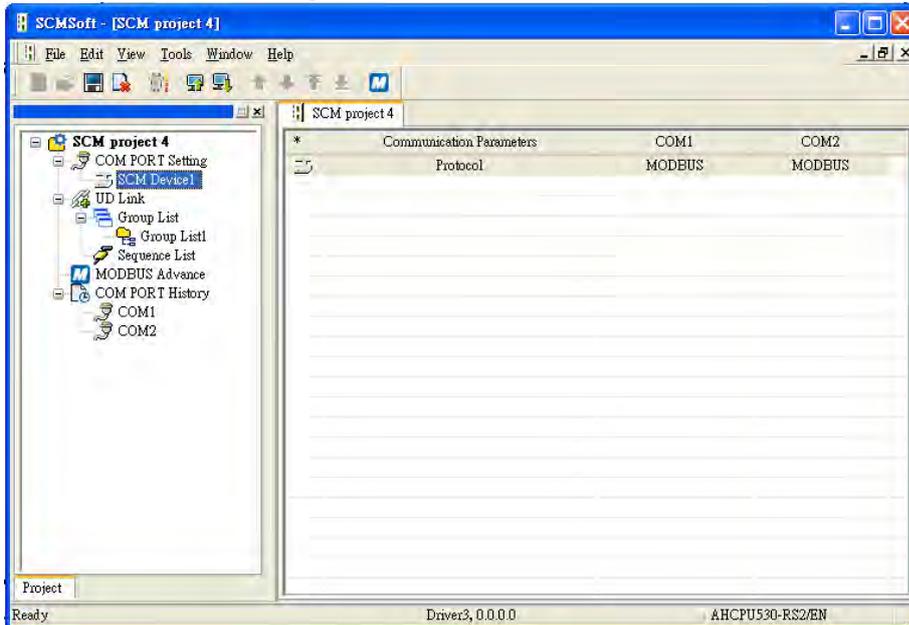
8.7.1.2 Modbus Master─Connection with Delta Products

(1) Setting communication parameters for COM2:
Slave ID: 246 (default)
Transmission mode: ASCII
Transmission speed: 38400 bps
Communication format: 7_E_1
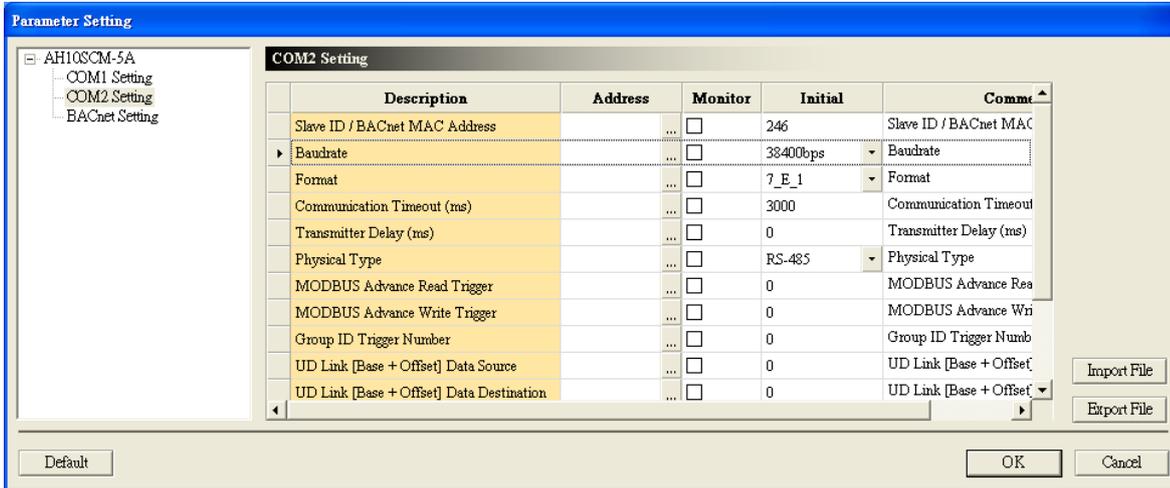
(2) Start SCMSoft, right-click **Modbus　Advance**, and click **Add Modbus　Advance**.
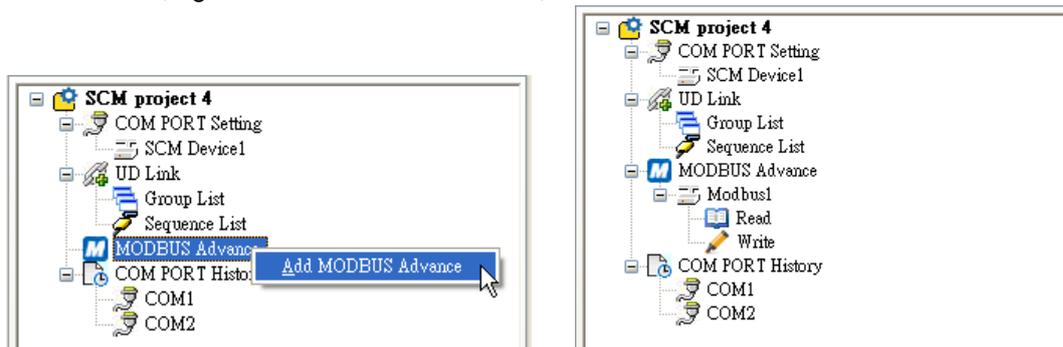
(3) Setting data exchange: Right-click a blank, and then click **Add Item**.→After users double-click the item which is added, the **Parameter Edit** window appears.
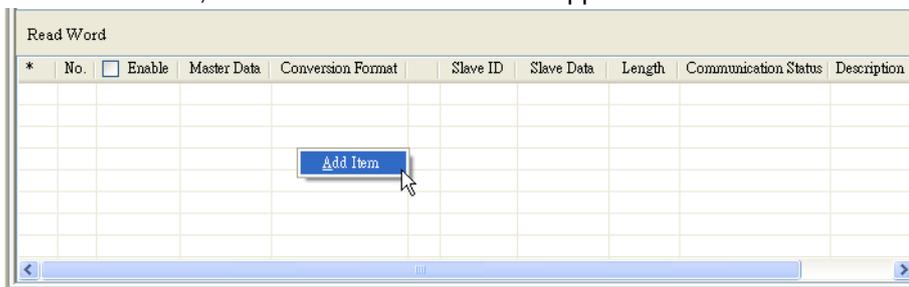
VFD: (D100←16#2103); (D150 and D151→16#2000 and 16#2001)

ASDA: (D200←16#0101; D201←16#020A)

(D250→16#0101; D251→16#020A)

PLC: (Master: D300~D309←Slave: D100~D109); (Master: D350~D354→Slave: D200~D204)

TC: (D400←16#1000); (D451→16#1001)

Click **Modbus Advance**, and double click **Modbus1**. Select **2** in the **SCM COM Port** box, select **1** in the **Rack** box, and select **1** in the **Slot** box.
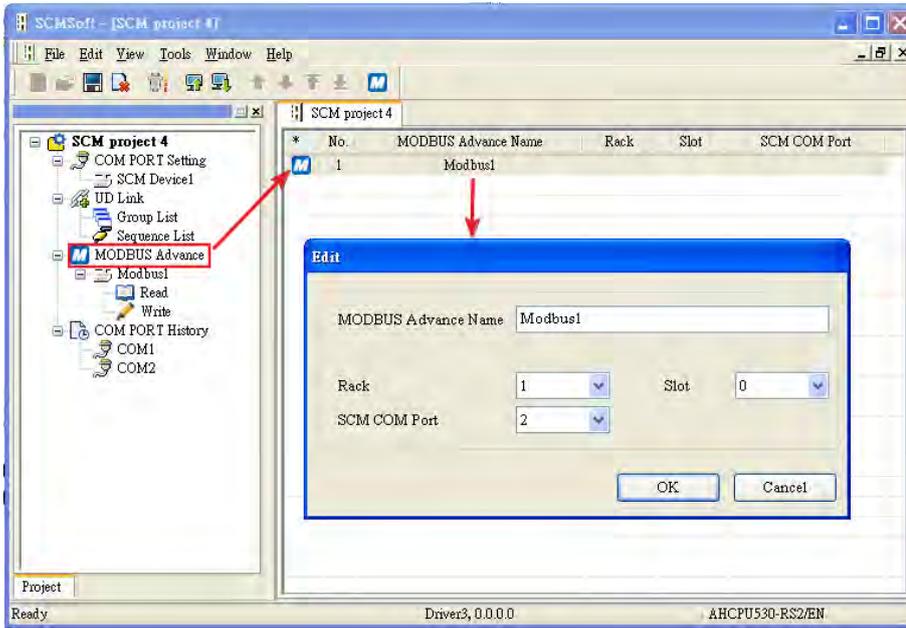
(4) Downloading parameters

Click **Download** on the toolbar, click a module which will be downloaded, and click **OK**. If only one module is connected, users can click **OK** directly.
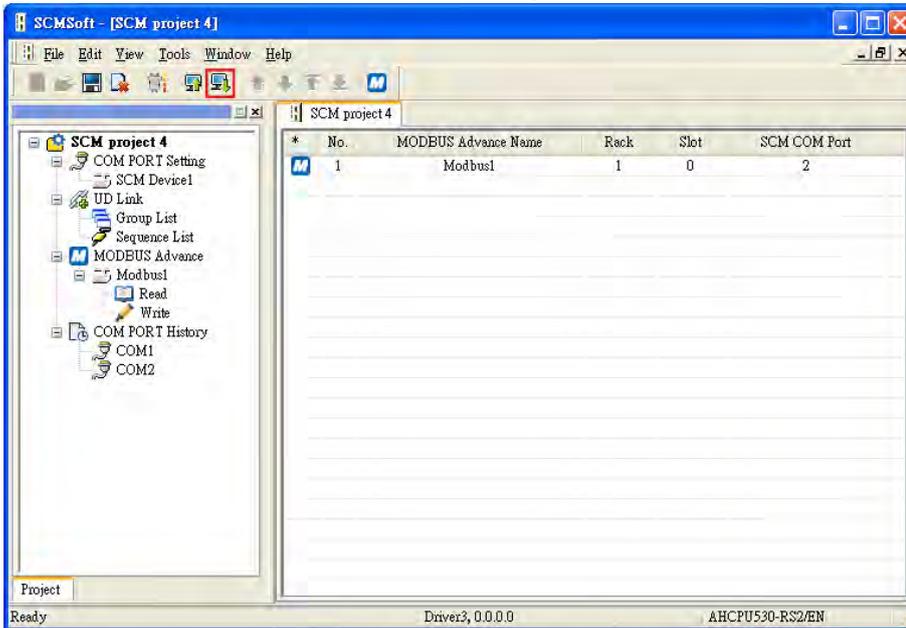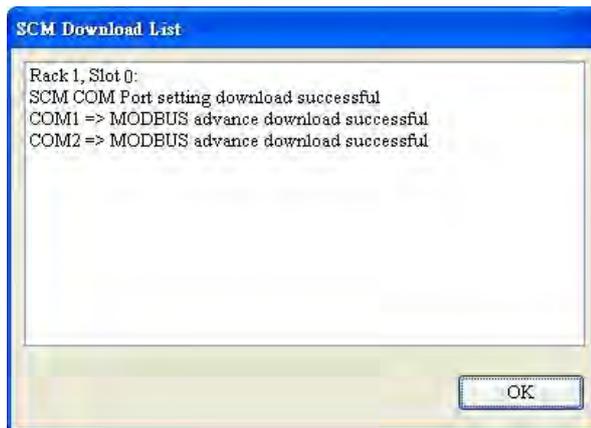
(5) Triggering the reading/writing of data

Method 1:

Users can use the instruction TO in ISPSoft to trigger the reading of data from bit devices/word devices, and the writing of data into bit devices/word devices. (CR#7,CR#8, CR#17, and CR#18)

CR#	Attribute	Register name	Description
7	R/W	Triggering the reading of data through COM1	
17	R/W	Triggering the reading of data through COM2	High byte: Reading data from bit devices Low byte: Reading data from word devices 00: Not triggering it 01: Triggering it once 02: Always triggering it
8	R/W	Triggering the writing of data through COM1	
18	R/W	Triggering the writing of data through COM2	

If users want to continually trigger the reading of data from word devices, they can write 16#0002 into CR#17. If users wan to trigger the reading of data from word devices once, they can write 16#0001 into CR#17.

If users want to continually trigger the writing of data into word devices, they can write 16#0002 into CR#18. If users wan to trigger the writing of data into word devices once, they can write 16#0001 into CR#18.
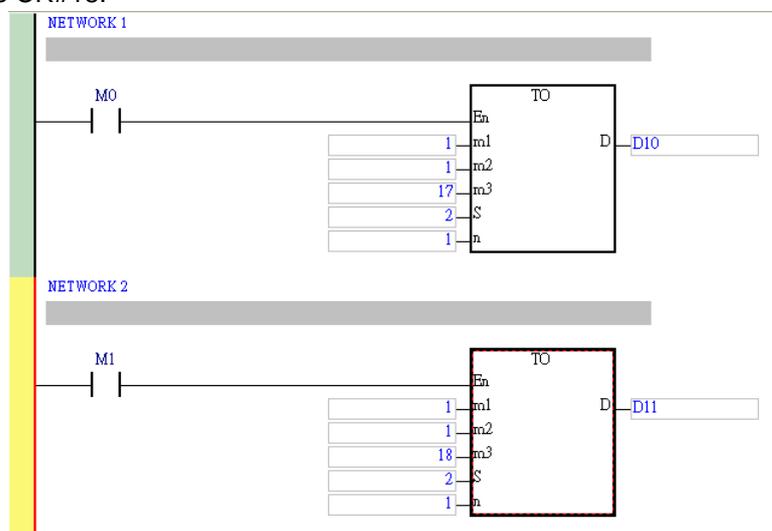
After M0 is triggered, data will be read from a device in a slave thorough COM2.

After M1 is triggered, data will be written into a device in a slave through COM2.

Method 2:

In addition to using the instruction TO to trigger data exchange, users can use HWCONFIG in ISPSoft to trigger data exchange. After the users set data registers in HWCONFIG, they can use the data registers to trigger the data exchanges through COM1 and COM2. Data registers and control registers can be used simultaneously. Please see the description of method 1.

The parameter **Modbus   Advance Read Trigger** is taken for instance. After the users double-click AH10/15SCM-5A in HWCONFIG, the **Parameter Setting** window will appear.
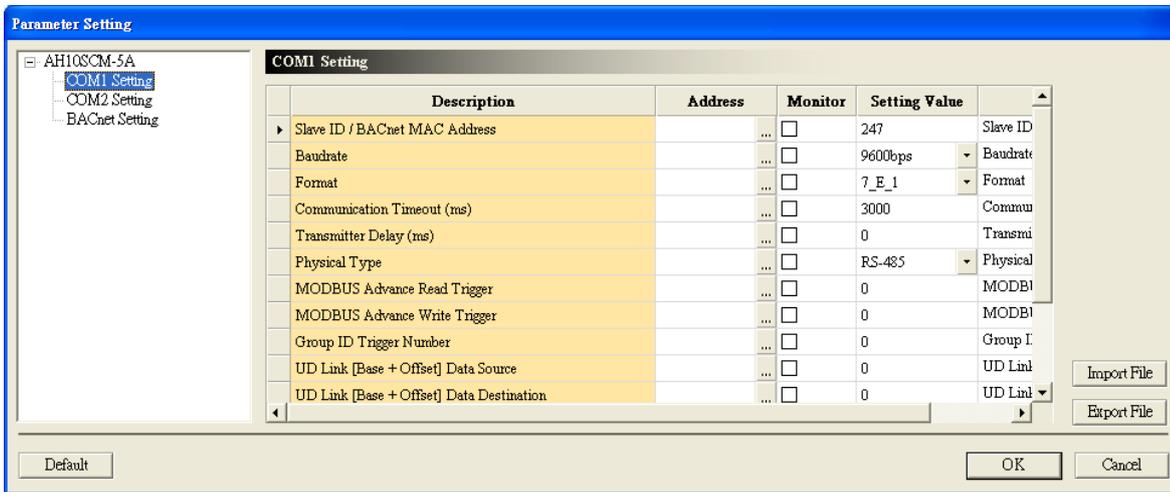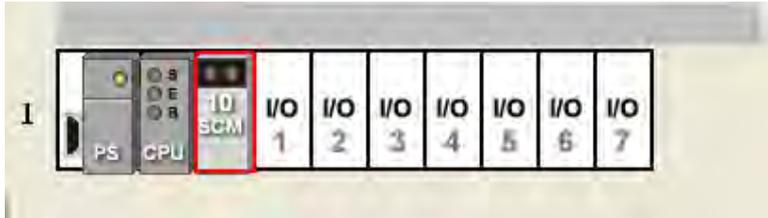
The users have to click **COM1 Setting**. After the users click [...] in the Address cell for **Modbus Advance Read Trigger**, the **Address** window will appear. The users have to type a register number in the **Address** window, and then click **OK**. If the register number typed is 1, the register specified will be D1.
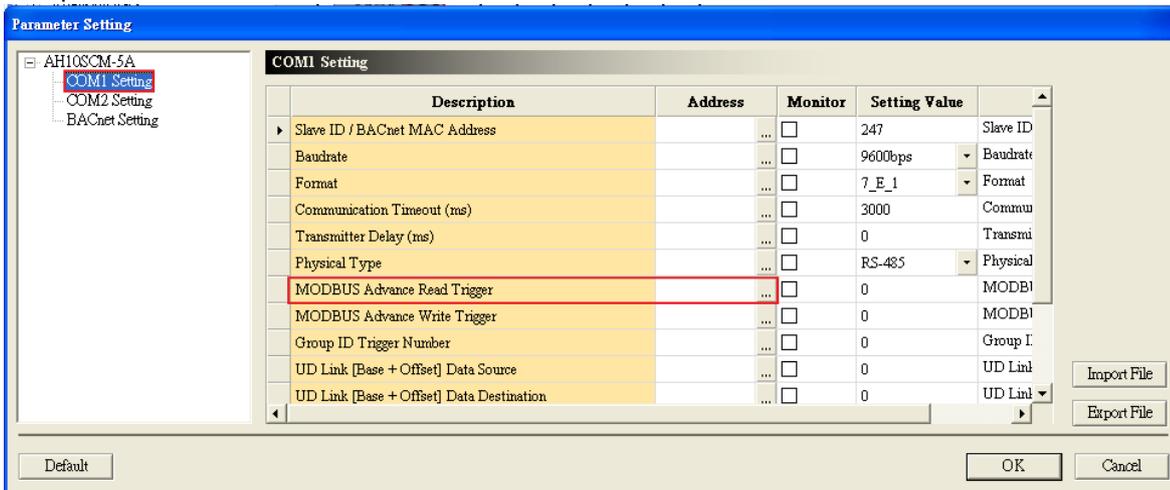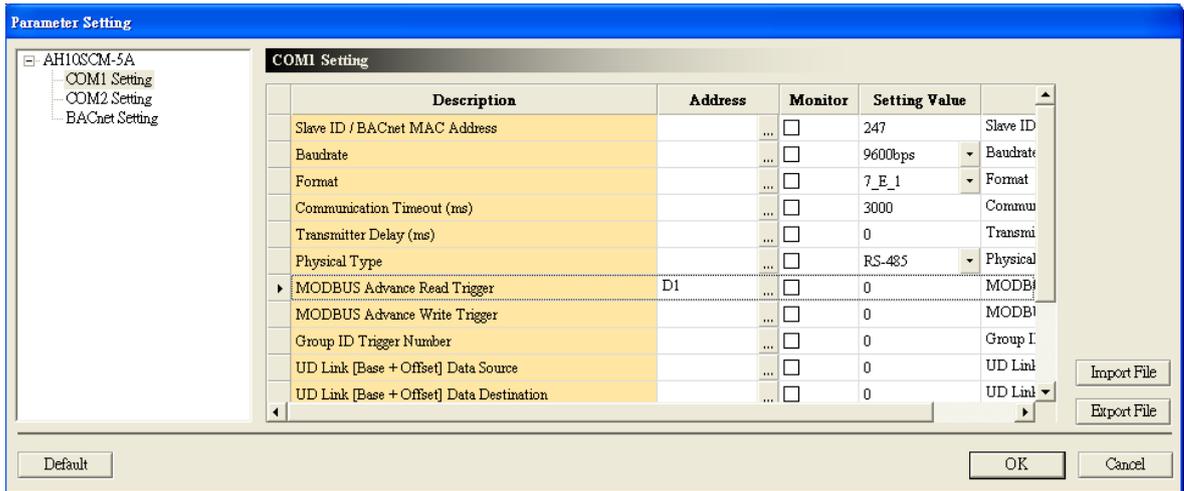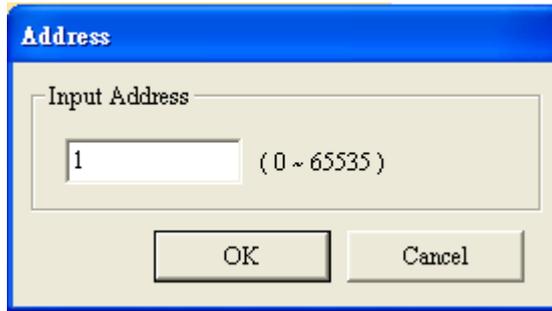
The data register D1 can be used to trigger the data exchanges through COM1.

8.7.2 Connecting to ISPSoft

AH10/15SCM-5A can be used as an additional communication port for an AH500 series CPU module. ISPSoft can be connected to the AH500 series CPU module through a communication port on AH10/15SCM-5A. The default communication format of COM1 on AH10/15SCM-5A is "9600, 7, Even, 1". The slave ID is 247.

(1) Setting ISPSoft

Start ISPSoft, and click **Communication Settings...** on the **Tools** menu.
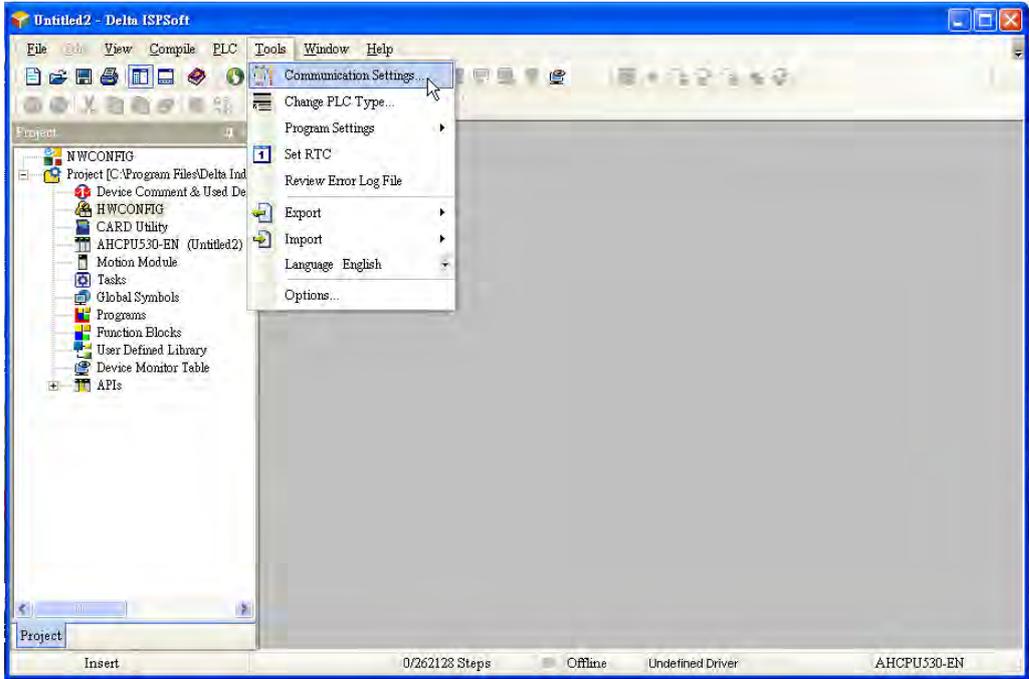
(2) Select **Driver1** in the **Driver** box. (The communication format of COM1 set by COMMGR is "9600, 7, Even, 1".) Please notice that the station address in the **Communication Setting** window must be the same as the slave ID set for COM1. The station address is not the station address of the AH500 series CPU module.

(3) After users click OK, a program can be downloaded to or uploaded from the AH500 series CPU module.

8.7.3 RS-485/RS232

This section introduces how AH10/15SCM-5A is connected to other industrial products through a non-Modbus RS-485/RS-232 communication port on AH10/15SCM-5A.

8.7.3.1 Connecting to a Power Meter

A power meter can be connected through Modbus, or through a RS-485/RS-232 port. This section introduces how AH10/15SCM-5A is connected to a power meter through a UD Link RS-485/RS-232 port on AH10/15SCM-5A.

(1) Starting SCMSoft

Open HWCONFIG.→**COM1 Setting**→Set communication parameters.
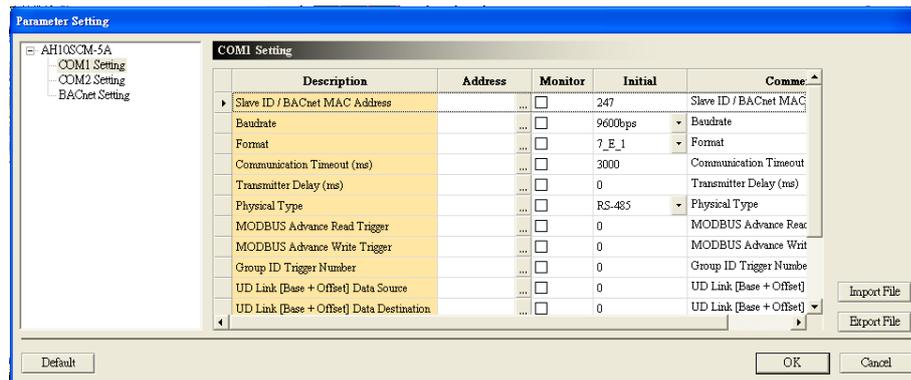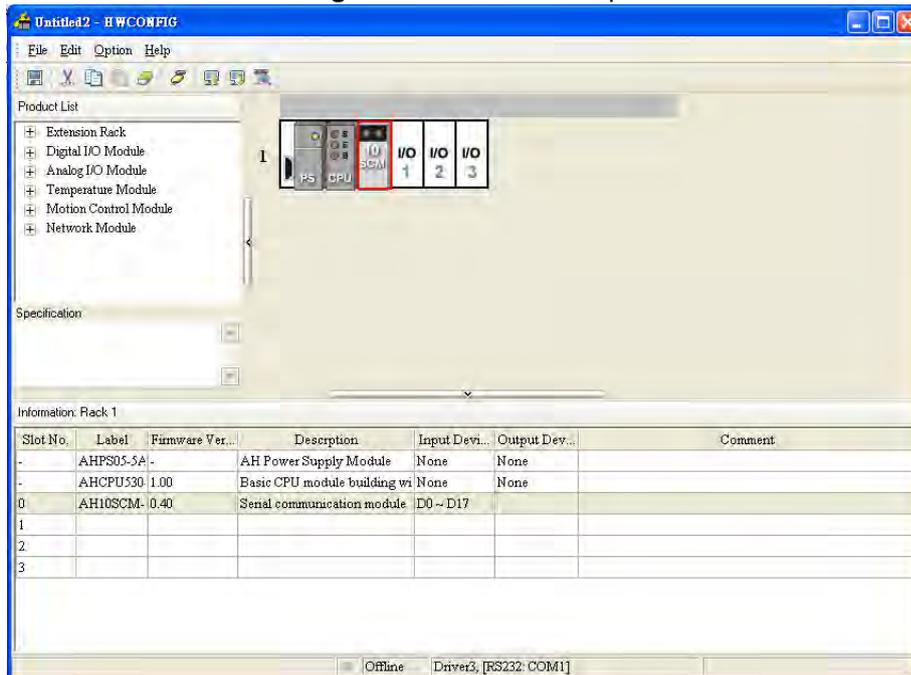
Open HWCONFIG.→Right-click AH10/15SCM-5A.→Click **Intelligent Module Configuration**.
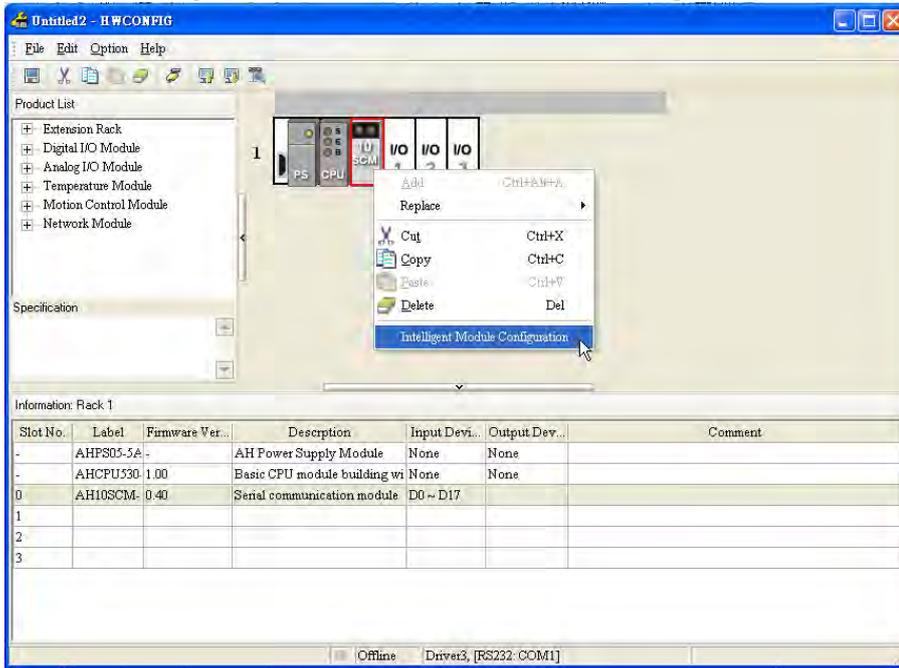
Start SCMSoft.→**COM PORT Setting**→Set communication protocols.
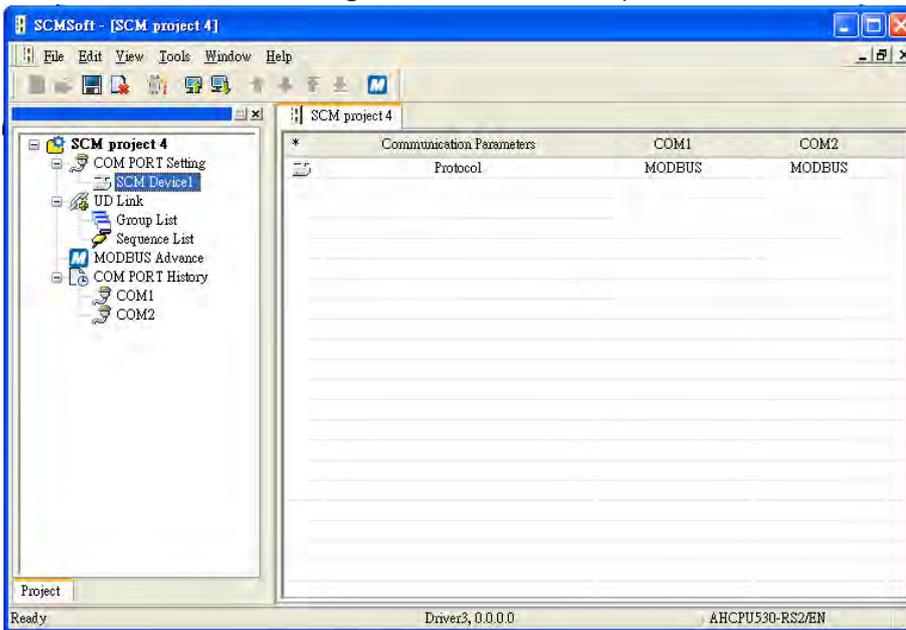
(2) Record types

The slave ID of the power meter is 5. All telegrams consist of one of three types of records. These types of records are abbreviated records, control records, and full records. The use of these record types is described below.

〈Abbreviated record〉

Character number	Contents	Description
1	16#10	Start bit
2	16#00…16#FA, 16#FF	Instrument address (IA)
3		Function field (FF)
4		Checksum (CS) (CS=IA+FF)
5	16#16	End mark

〈Control record〉

Character number	Contents	Description
1	16#68	Start bit
2	16#03	Length
3	16#03	Length (repeat)
4	16#68	Start bit (repeat)
5	16#00…16#FA, 16#FF	Instrument address (IA)
6		Function field (FF)
7		Parameter index (PI)
8		Checksum (CS) (Summation of the characters starting from IA to PI)
9	16#16	End mark

〈Full record〉

Character number	Contents	Description
1	16#68	Start bit
2		Length
3		Length (repeat)
4	16#68	Start bit (repeat)
5	16#00…16#FA, 16#FF	Instrument address (IA)
6		Function field (FF)
7		Parameter index (PI)
…		n character, data block (DB)
Length+5		Checksum (CS) (Summation of the characters starting from IA to the last data type)
Length+6	16#16	End mark

(3) Usage

AH10/15SCM-5A can communicate with the power meter through the three types of records.

Type	Telegram to the power meter	Response (via a record type)
1	Resetting the instrument (via an abbreviated record)	None
2	Querying the status of the instrument (via an abbreviated record)	Abbreviated record
3	Most important measured values and errors (cyclic data) (via an abbreviated record)	Full record
4	Event data for error analysis (via an abbreviated record)	Full record

Type	Telegram to the power meter	Response (via a record type)
5	All measured values (via a control record)	Full record
6	Output parameters (via a control record)	Full record
7	Statuses (via a control record)	Full record
8	Instrument specifications (via a control record)	Full record
9	Real-time clock values (via a control record)	Full record

(4) Editing UD Link

   Type 1: Sending an abbreviated record

   『Start bit』+『Instrument address (IA)』+『Function field (FF)』+『Checksum (CS)』+『End mark』

   →16#10+D0+16#09+(IA+FF)+16#16

   Start bit: 16#10

   The instrument address (IA) is read from D0.

   Function field (FF): 16#09

   Checksum (1 byte): IA+FF

End mark: 16#16

Message Constant Edit

Format: Hex

Value: 16

OK   Cancel

The editing is complete.

Packet Edit

Packet Name: TX Packet1

Packet View

[10] + (R(D [0]), 1) + [09] + <Checksum-SUM (1Byte)> + [16]

Packet Segment Edit

No.	Class	Format	Segment View
1	Message Constant	Hex	[10]
2	Message Variable	Null	(R(D [0]), 1)
3	Message Constant	Hex	[09]
4	Checksum	Hex	<Checksum-SUM (1Byte)>
5	Message Constant	Hex	[16]

Up   Down   Delete

Message
Constant   Variable

Address
Constant   Variable

Length
Add

Checksum
Add   No. 2 ~ No. 3

OK   Cancel
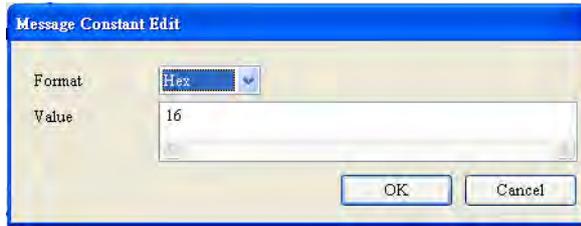
No response is needed. Users do not need to edit a RX packet.
Editing a command: TX packet 1 is sent. No response is needed.

Command Edit

Command No.	1
Command Type	Send
Send Packet	TX Packet1
Recv Packet	
Success	End
Fail	Abort
Retry	0 (0 - 255)
Repeat	0 (0 - 255)
Send Wait	0 (0 - 65535 ms)
Timeout	50 (50 - 65535 ms)

OK   Cancel
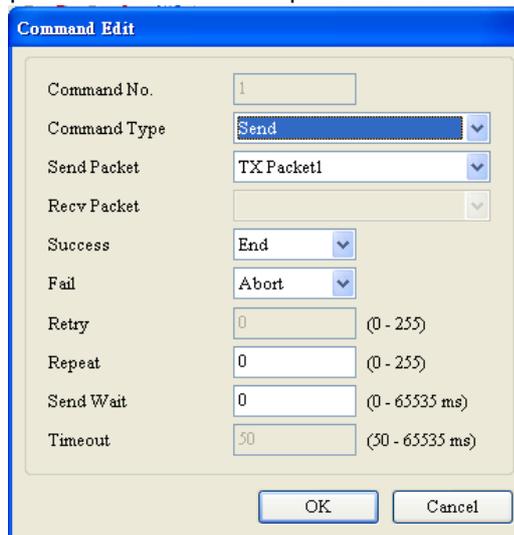
Type 2: Sending an abbreviated record, and receiving an abbreviated record

Sending an abbreviated record: The packet which will be sent is the same as TX packet 1 in type 1. The function field is 16#29.

Copy TX packet 1 in the **Reset** Group.
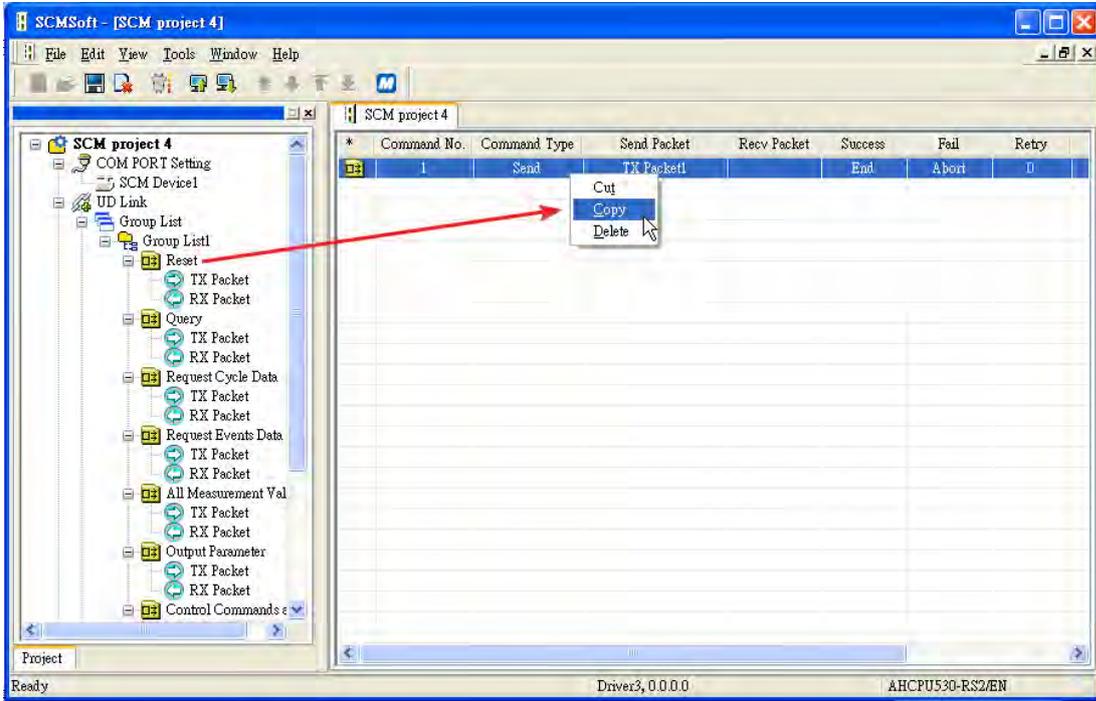
Paste TX packet 1 in the **Query** group.
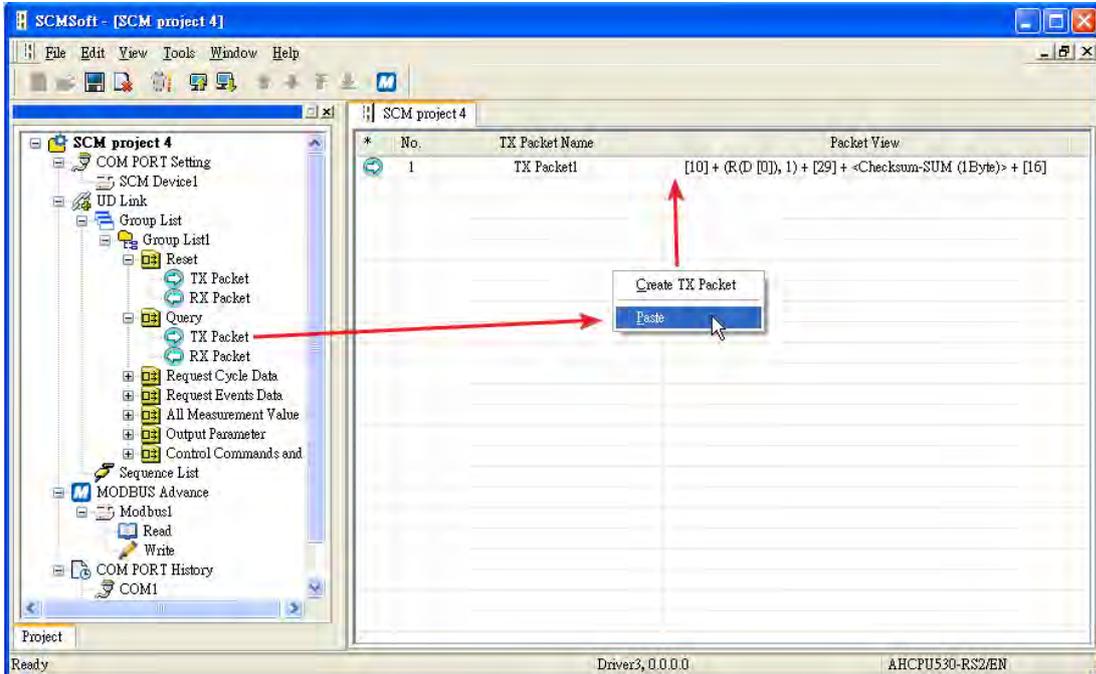
Receiving an abbreviated record:

『Start bit』+『Instrument address (IA)』+『Function field (FF)』+『Checksum (CS)』+『End mark』

→16#10+D0+16#09+(IA+FF)+16#16

Start bit: 16#10
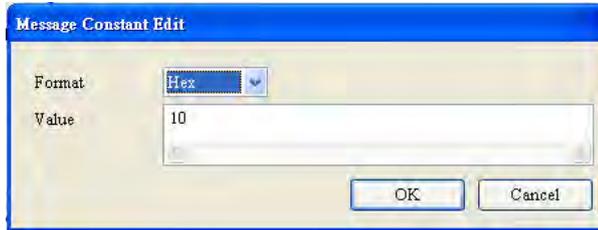
Instrument (IA): Check whether the instrument address received and the instrument address sent previously are the same.
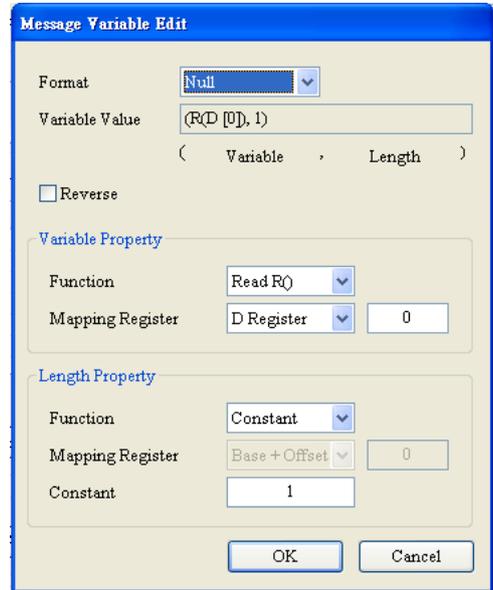
Function field (FF): (*, 1)

1 byte is ignored. If users wan to store the function field, they can store it in a data register.
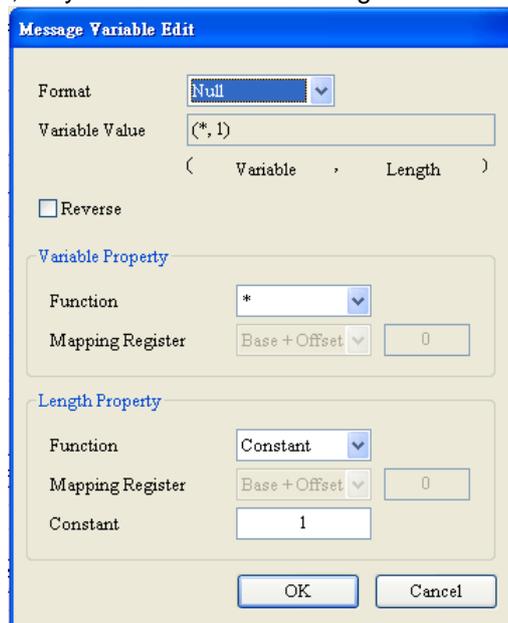
Checksum (1 byte): IA+FF
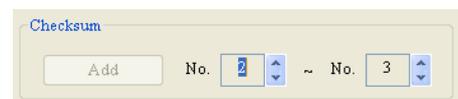
End mark: 16#16
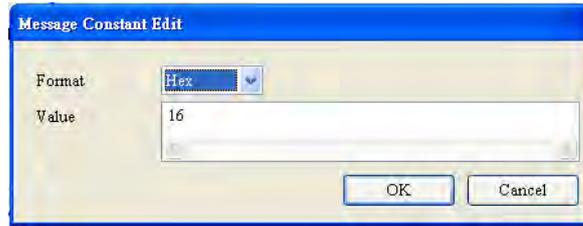
The editing is complete.

Editing a command: TX packet 1 is sent, and RX packet 1 is received.

Type 3: Sending an abbreviated record, and receiving a full record

Sending an abbreviated record: The packet which will be sent is the same as TX packet 1 in type 1 or TX packet 1 in type 2. The function field is 16#89.

Receiving a full record:

『Start bit』+『Length』+『Length (repeat)』+『Start bit (repeat)』+『Instrument (IA)』+『Function field (FF)』 + 『Parameter index (PI)』 + 『Data block (DB)』 + 『Checksum (CS)』 + 『End mark』 →16#68+(Null)+(Null)+16#68+D0+(Null)+D100

Start bit: 16#68

Length+Length (repeat): 2 bytes are ignored. Users can ignore the length or store the length.

Start bit (repeat): 16#68

Function field (FF): 1 byte is ignored.

Instrument (IA): Check whether the instrument address received and the instrument address sent previously are the same.

The data types following the function field are stored in the data registers starting from D100. (*)

The editing is complete.

*: Users can ignore some unimportant bytes, and store data they need in data registers. Besides, if the length of data received is unknown, the users can store the data in data registers.

Editing a command: TX packet 1 is sent, and RX packet 1 is received.

Type 4: Sending an abbreviated record, and receiving a full record:

Sending an abbreviated record: The packet which will be sent is the same as TX packet 1 in type 1 or TX packet 1 in type 2. The function field is 16#A9.
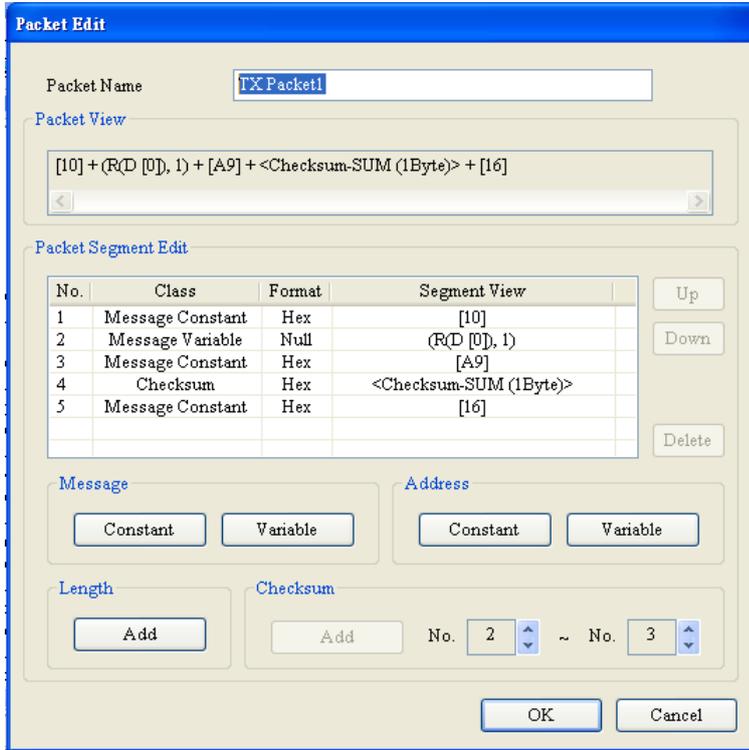
Receiving a full record:

『Start bit』+『Length』+『Length (repeat)』+『Start bit (repeat)』+『Instrument (IA)』+『Function field (FF)』+『Parameter index (PI)』+『Data block (DB)』+『Checksum (CS)』+『End mark』

→16#68+16#06+16#06+16#68+D0+(Null)+(Null)+(Summation of the characters starting from IA to the last data type)+16#16

Start bit—Length—Length (repeat)—Start bit (repeat)

Instrument (IA): Check whether the instrument address received and the instrument address sent previously are the same.
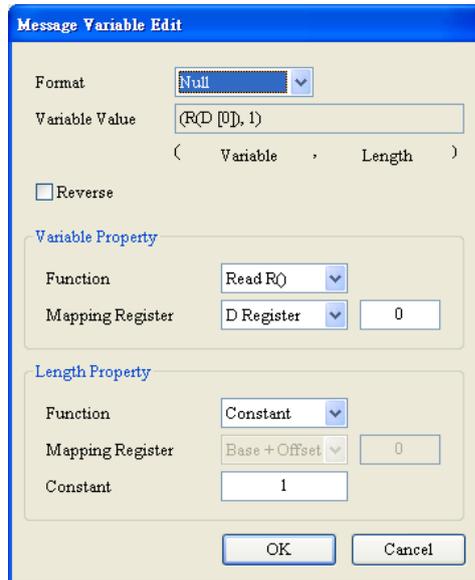
Function field (FF): 1 byte is ignored.

The parameter index and the data block are stored in the data registers starting from D100.

Checksum (CS)

End mark: 16#16

Editing a command: TX packet 1 is sent, and RX packet 1 is received.

Type 5: Sending a control record, and receiving a full record:

Sending a control record: The function field is 16#89.

『Start bit』 + 『Length』 + 『Length (repeat)』 + 『Start bit (repeat)』 + 『Instrument address (IA)』

+ 『Function field (FF)』 + 『Parameter index (PI)』 + 『Checksum (CS)』 + 『End mark』

→16#68+16#03+16#03+16#68+D0+16#89+D1+(Summation of the characters starting from IA to PI)+16#16

Start bit─Length─Length (repeat)─Start bit (repeat)

The instrument address (IA) is read from D0.
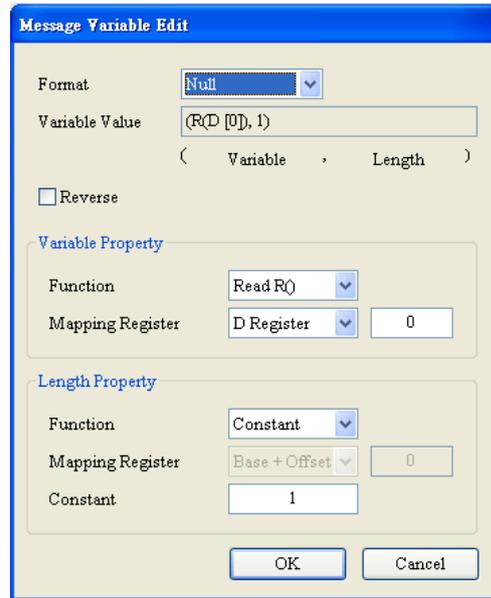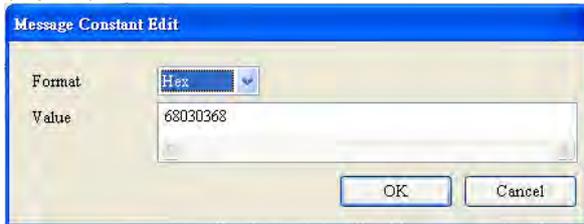
Function field (FF): 16#89

The parameter index (PI) is read from D1.

Checksum (CS)

End mark: 16#16

Receiving a full record:

『Start bit』+『Length』+『Length (repeat)』+『Start bit (repeat)』+『Instrument (IA)』+『Function field (FF)』+『Parameter index (PI)』+『Data block (DB)』+『Checksum (CS)』+『End mark』
→16#68+(Null)+(Null)+16#68+D0+(Null)+D1+D100+(Summation of the characters starting from IA to the last data type)+16#16

Start bit: 16#68

Length─Length (repeat): 2 bytes are ignored.

Start bit (repeat): 16#68
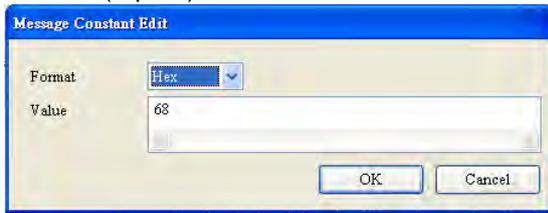
Instrument (IA): Check whether the instrument address received and the instrument address sent previously are the same.
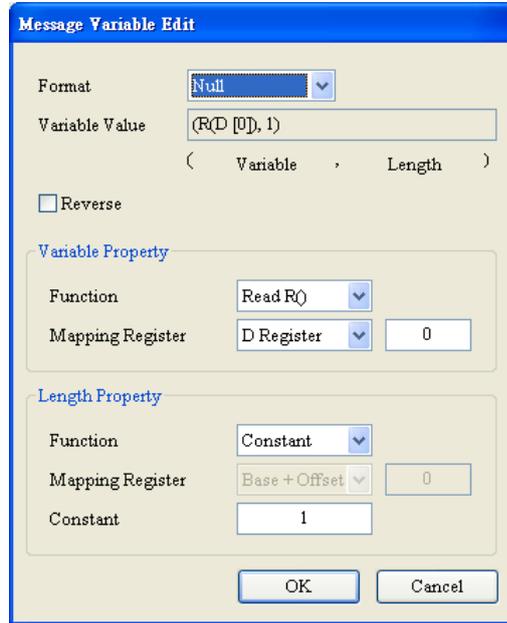
Function field (FF)
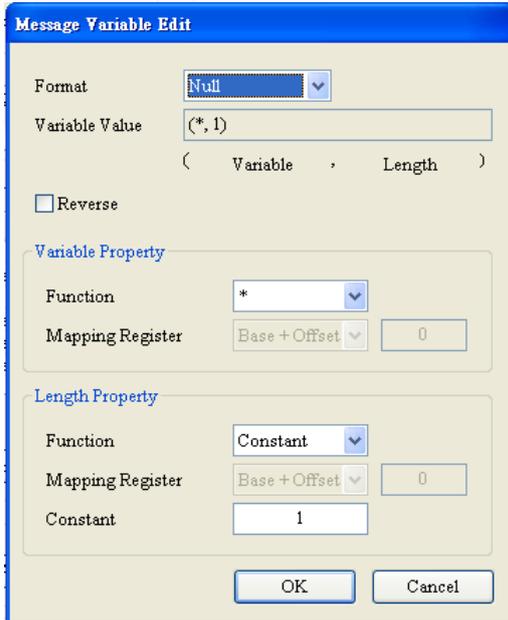
The parameter index received must be the same as the parameter index sent previously.
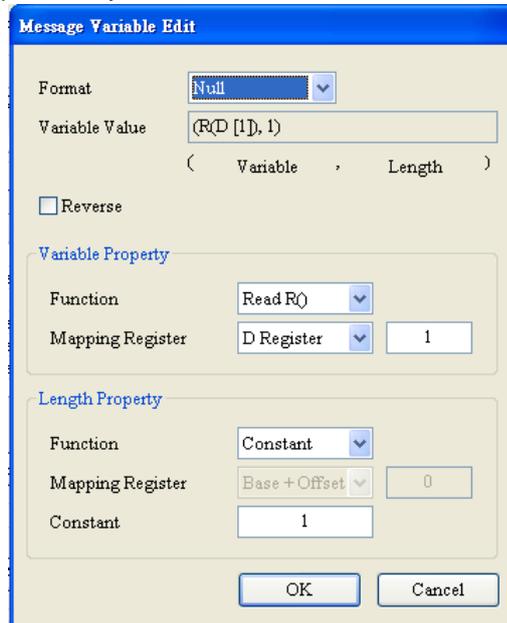
Data block (DB): The data received is stored in the registers starting from D100.

(5) Downloading a group list

Users can click **Download** on the toolbar in SCMSoft.

(6) Triggering UD Link through ISPSoft

UD Link is triggered through ISPSoft. The sending/receiving of the packets in a group is triggered by the instruction TO. After 1 is written in CR#21, the sending/receiving of the packets in group 1 will be triggered. After 2 is written in CR#21, the sending/receiving of the packets in group 1 will be triggered.

CR#	Attribute	Register name	Description
21	R/W	Triggering the sending/receiving of the packets in a group through COM1	Triggering the sending/receiving of the packets in a group through COM1

The sending/receiving of the packets in type 1~type 5 is controlled by M1~M5. The slave ID of the power meter is written into D0, and the parameter index is written into D1. If users want to write a value in a register, the low byte is in front of the high byte. For example, if the salve ID of the power meter is 5, the value written into D0 is 16#0500. The value stored in D100 is read in the same way.
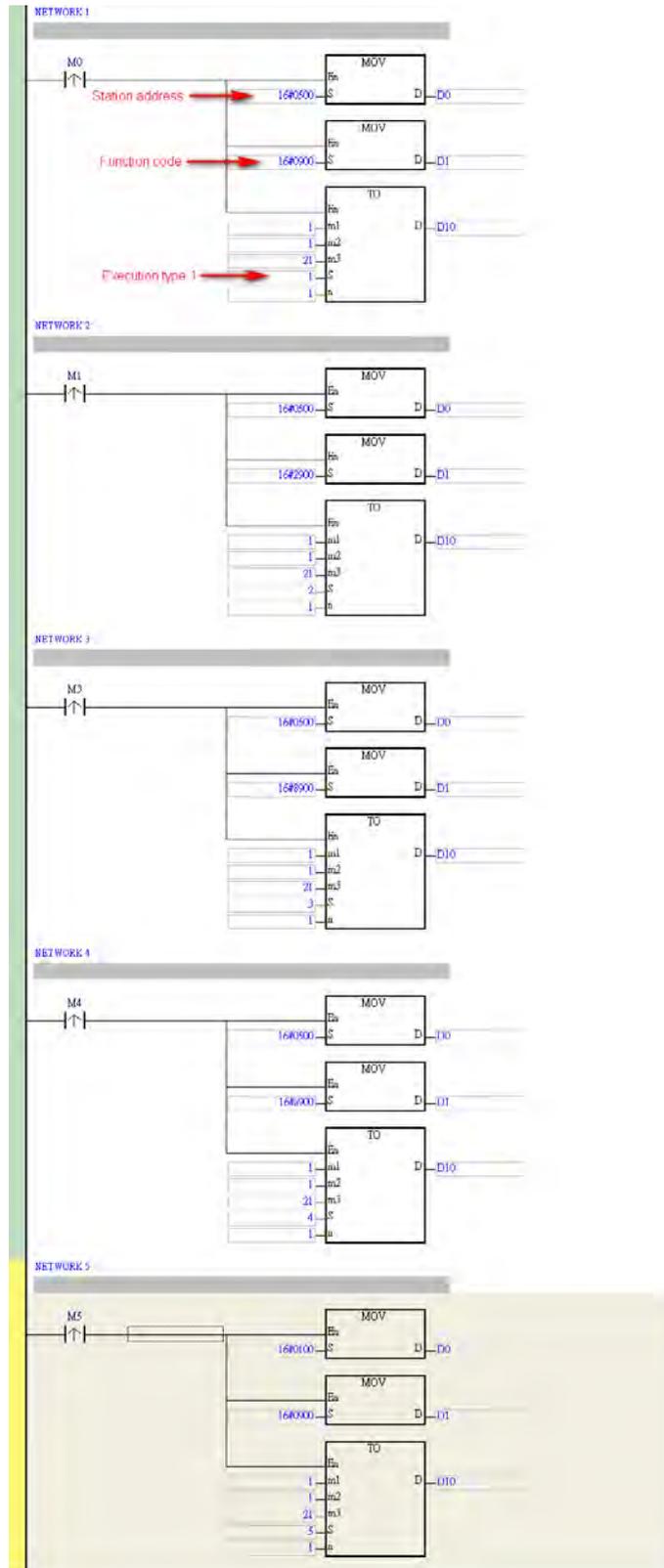
8.7.4 COMRS Function

This COMRS function works the same as the instruction COMRS (API1812) does. It is only available for AH15SCM-5A FW V1.02 or later, HWCONFIF V3.06 or later, SCMSoft V1.24.06 and DCISoft V1.20 or later. You can use control registers or use D devices via PLC program to trigger data exchange. This function supports two independent communication ports.

CR#		HWCONFIG	Description
COM1	COM2		
53	73	The starting address where the data sending begins (D device) via COM1/2	Setting range is defined by PLC CPU
54	74	The length of data (byte) to be sent via COM1/2	Setting range: 0~800
55	75	The starting address where the data receiving begins (D device) via COM1/2	Setting range is defined by PLC CPU
56	76	The maximum length of data (byte) to be received via COM1/2	Setting range: 0~800 When the mode is in 2 or 3, this setting is invalid.
57	77	Modes of data receiving via COM1/2	Mode 0: Reserved Mode 1: Reserved Mode 2: 1 ending words Mode 3: 2 ending words in a row Mode 4: Reserved Mode 5: Reserved Mode 6: Reserved
58	78	Parameters for data receiving via COM1/2	Work with the receiving modes
59	79	Receiving time out via COM1/2; unit: ms	Setting range: 0~30000 0: disable timeout When the mode is in 2 or 3, this setting is invalid.
60	80	Modes of data handling via COM1/2	0: 16-bit 1: 8-bit
61	81	Buffer zone in COM1/2	0: Disable buffer zone 1: Enable buffer zone
62	82	Enable/disable transmission via COM1/2	0: Disable; reset the communication status, error code and clear the buffer zone 1: Enabled
63	83	Communication status of COM1/2	Status flag
64	84	Error codes of COM1/2	Refer to the following descriptions

CR#58, 78: Receiving parameter via COM1/2

[Description]

Currently mode 2 and mode 3 are available.

Receiving mode		Contents in the receiving parameter	Remark
2	Receiving data contains one special word as the ending word	Setting value of the ending word	If the special word is 16#0A, the receiving parameter is 16#000A.
3	Receiving data contains 2 special consecutive words as the ending word	Setting value of the 2 ending words	If the 2 special words are 16#0D and 16#0A, the receiving parameter is 16#0D0A.
Others	Not supported		

CR#62, 82: Enabling transmission via COM1/2

[Description]

You need to enter the setting value 1 in the control registers manually to enable transmission and enter the setting value 0 after transmission is done. If during execution, you set the setting value to 0, it will not stop transmitting immediately. It stops only after the one is under transmitting is done. Once PLC switches from RUN to STOP, the value here will be reset to 0.

0	1) Not executing transmission 2) Set the status flag to 0 3) Set the error code to 0 4) Clear data in the receiving's buffer zone
1	Enable sending/receiving

CR#63, 83: Communication status of COM1/2

[Description]

You can use the setting values Bit0~Bit2 in the control registers to read the communication status and control the communication procedure. If you reset the value in Bit0 manually, the system will execute COMRS again and after the execution is done, SCM will set the value in Bit0 to 1. Once PLC switches from RUN to STOP, the value here will be reset to 0.

	Name	SCM control	User define	Description
Bit0	Completion flag	V	V (set to 0)	0: Start transmission 1: Transmission done; stop sending/receiving
Bit1	Error flag	V	V (set to 0)	
Bit2	Data-receiving flag	V		
Bit3~15	Reserved			

CR#64, 84: Error codes of COM1/2

[Description]
SCM generates the error codes. When the enabling transmission flag is reset to 0, the error codes here will also be reset simultaneously. Once PLC switches from RUN to STOP, the value here will be reset to 0.

Error Code	Description
1	Invalid sending length setting
2	Invalid receiving length setting
3	Invalid setting mode
4	Invalid timeout setting
5	Communication error between PLC CPU and module
6	Buffer zone overloaded
7	Communication timeout

The following example uses control registers to start COMRS mode 3, with 2 special ending words:

◆ Software: SCMSoft
   Open HWCONFIG from ISPSoft, right click on the image of AH15SCM to select the option "Intelligent Module Configuration" to start SCMSoft.
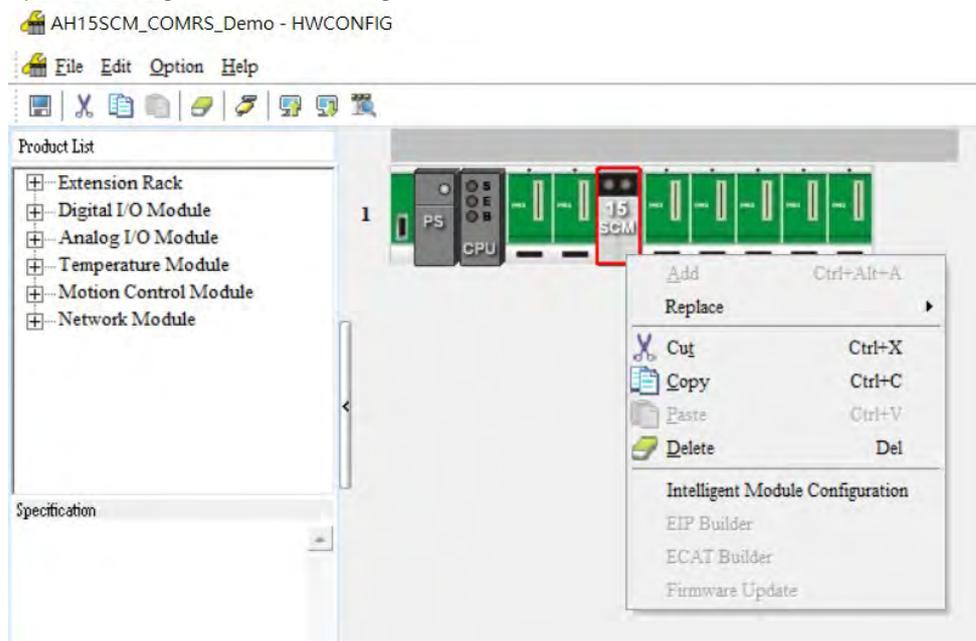
Select SCM Device1 (can be rename in the settings of COM port) from the treeview on the left window and set the protocol of COM1 and COM2 to COMRS. After that click the download icon from the tool bar.
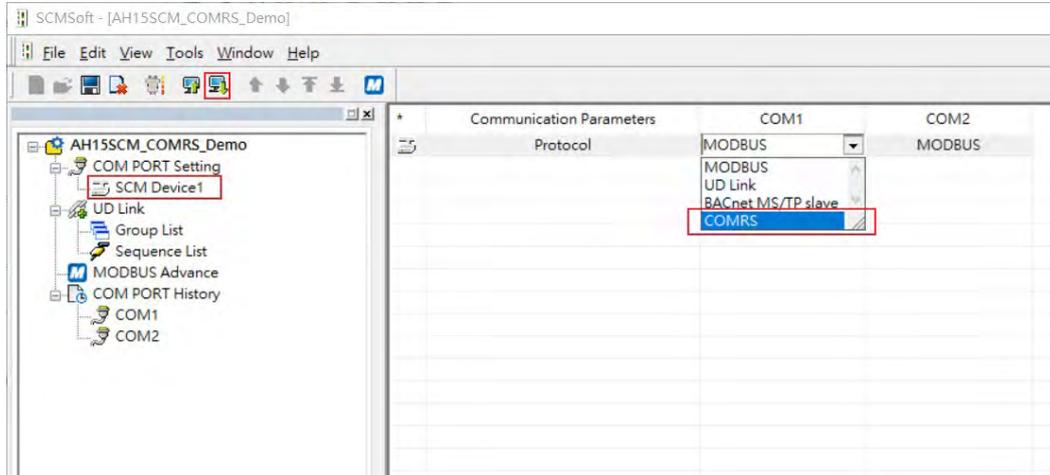
◆ Software: HWCONFIG

Double-click the module image to open the module setting page. Select COM1/2 Setting and set the format to 8 bytes, e.g. 8_E_1 to help ensure data integrity. After the setting is complete, click the download icon from the tool bar.
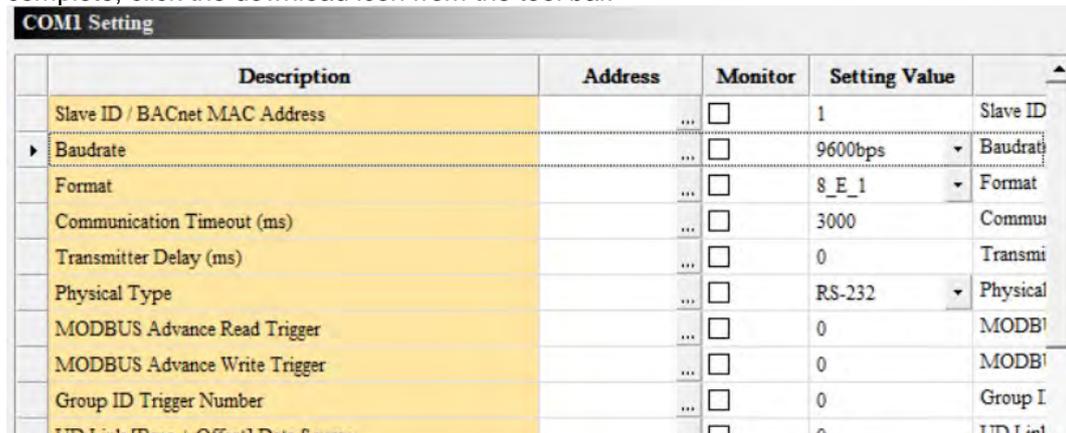
Use control registers to execute COMRS function. If you want to use D devices, you can enter the corresponding D devices in the COMRS setting of the SCM module in HWCONFIG.
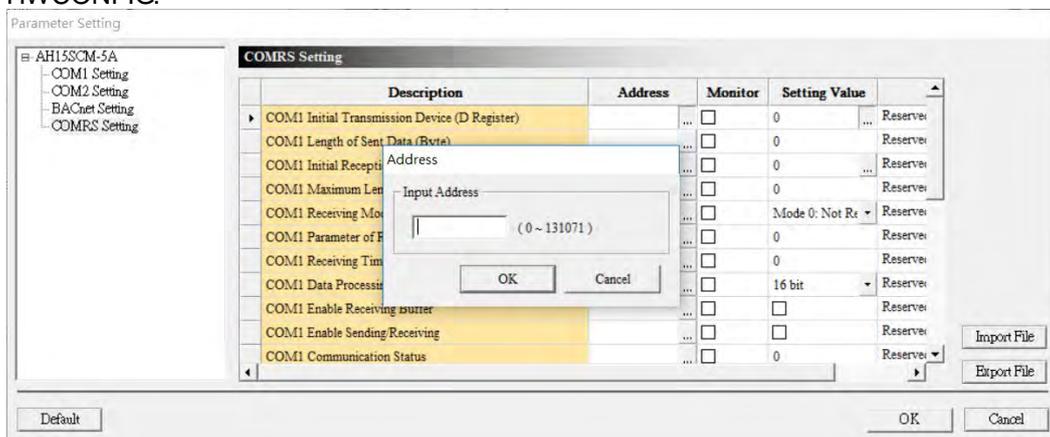
◆ PLC Program

This example only shows SCM receiving multiple data via COM1. Each data length is 20 bytes and ending with 0x0D0A. COMRS mode 3 uses special words to determine data type and stores them into PLC registers. If data sending is also one of the task, SCM will only start sending data after all the data is received.

It is suggested to create corresponding relationships between the control registers and the data registers first. Write all the needed control registers into the PLC program at one go to avoid written errors caused by executing too many TO instructions on the modules; that can happen when you need use more instructions to add more control registers in.

Control Register (CR#)	Data Registers (D)	Setting Value	Description
53	-	0	NOT transmitting
54	-	0	
55	1055	200	D200 as the starting address to store the received data. If using mode 2 or mode 3, no limitation on the data length to be stored. 接收到的資料存放起始位址為 D200。使用模式 2 與模式 3 時，長度限制設定無效
56	1056	0	
57	1057	3	Mode 3: Receiving data contains 2 special consecutive words as the ending word
58	1058	16#0D0A	0x0D0A is considered as the ending of the data.
59	1059	0	When using mode 2 and mode3, the communication timeout setting is invalid.
60	1060	0	Use 16-bit mode
61	1061	1	Enabling the buffer zone
62	1062	0	Reset the communication status

PLC program:

After M100 is triggered, the setting value here is reset and you can write new COMRS parameters.
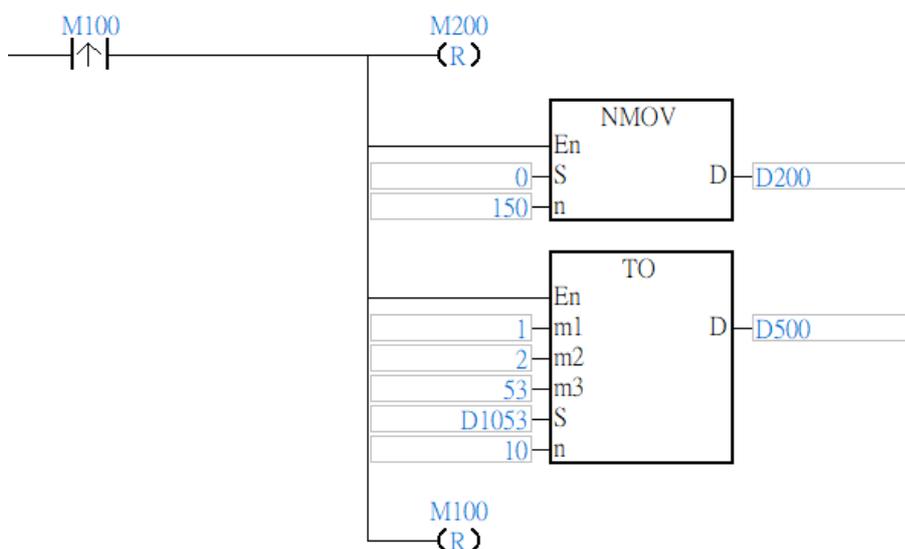
Keep reading the communication status and write the result in D1062~D1064.
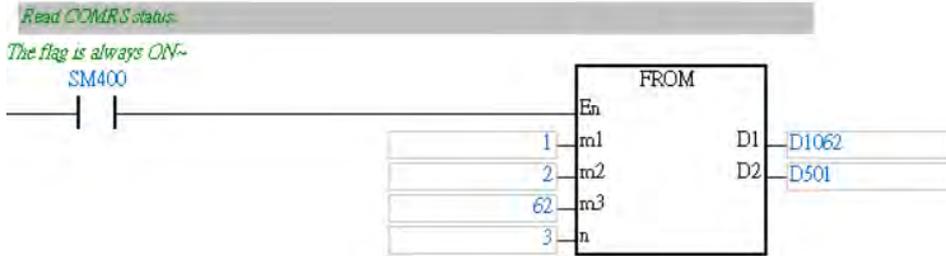
M200 is triggered, reset the counter (D900) and write "1" in CR#62 to enable transmission. When the value in CR#63 is 1, it indicates the receiving is complete. Add 1 in D900 and write the value "0" in CR#63 to start receiving again.
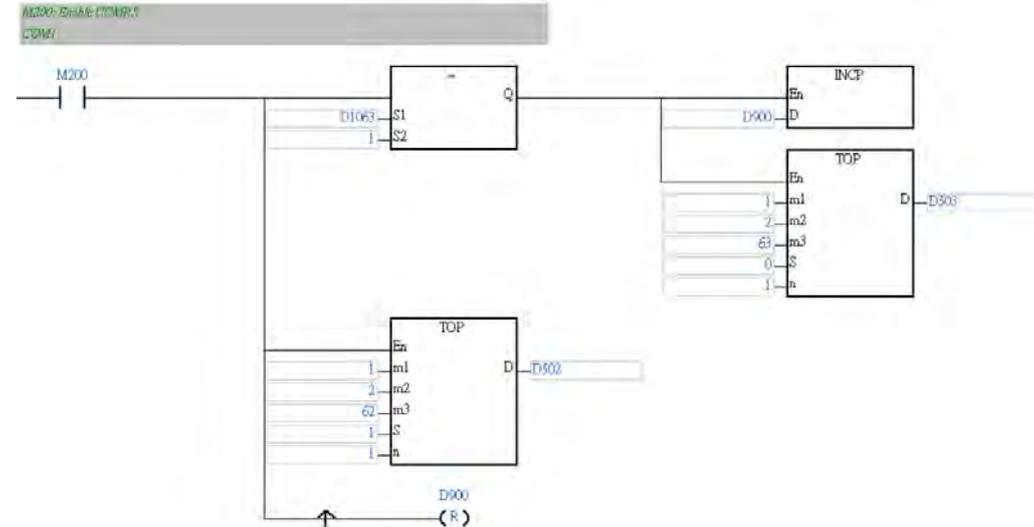
The received data will be stored from D200 and so forth. The first word stores the data length (ending word included) in byte. When SCM needs to manage storing and receiving at the same time, it is possible that some packets may be lost. It is suggested to add data length comparisons to ensure no packet will go missing. As the example below shows when the data length is confirmed to be 20 in D200, the system can start storing 10 words from D2001 and on.

Now let's have a look at the device monitoring table in ISPSoft to see the progress.
M100 was set to ON and after the setting was done, M100, M200 were reset automatically. M200 was set to ON again to start receiving. PC or other device sent ASCII string "123456789123456789\x0D\x0A" to SCM and the data registers of the PLC received the data. The received data was stored from D200 and so forth. The first word stores the data length. And after that data was stored in low byte and high byte. The received data is overwritten by the data that keeps coming to be received. Thus it will be safer if using PLC program to make sure the data length is right before storing data in D2001 and so forth.

M100		
M200		
D200		20
D201		3231
D202		3433
D203		3635
D204		3837
D205		3139
D206		3332
D207		3534
D208		3736
D209		3938
D210		0A0D
D211		0000
D212		0000
D213		0000
D214		0000
D2001		3231
D2002		3433
D2003		3635
D2004		3837
D2005		3139
D2006		3332
D2007		3534
D2008		3736
D2009		3938
D2010		0A0D

8.8 Error Flags

The error flags and the UD Link statuses are stored in data registers. Users can modify the input device range by themselves.
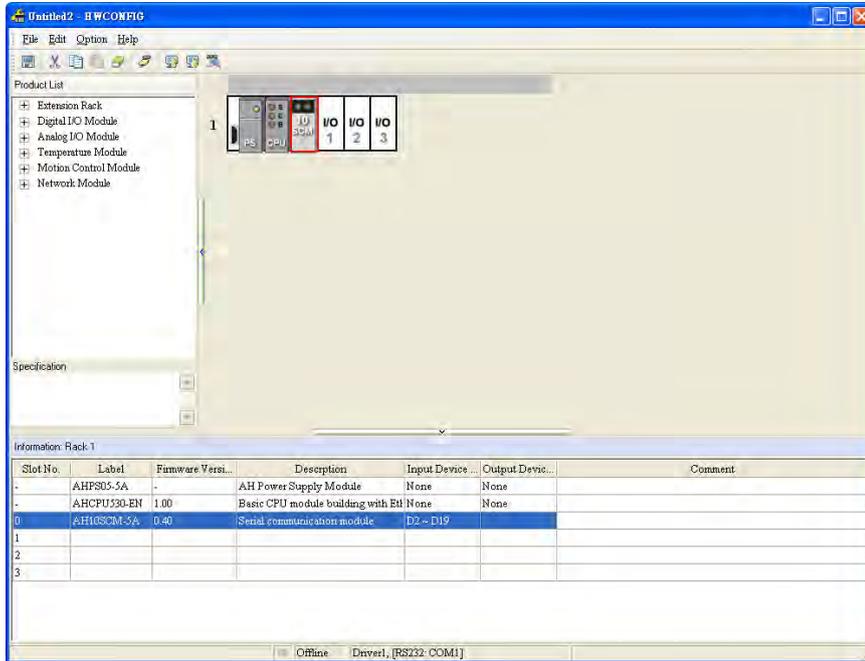
Data register	Description
D0	Error code
D1	Hardware failure
D2	An error occurs when the communication protocol for exchanging data through COM1 is UD Link.
D3	An error occurs when the communication protocol for exchanging data through COM2 is UD Link.
D4	An error occurs when the communication protocol for exchanging data through COM1 is Modbus.
D5	An error occurs when the communication protocol for exchanging data through COM2 is Modbus.
D6	An error occurs when data is exchanged through COM1.
D7	An error occurs when data is exchanged through COM12
D8	Internal communication error
D9	The group which is triggered when the communication protocol for exchanging data through COM1 is Modbus
D10	The group which is triggered when the communication protocol for exchanging data through COM2 is Modbus
D11	The command which is executed when the communication protocol for exchanging data through COM1 is UD Link
D12	The command which is executed when the communication protocol for exchanging data through COM2 is UD Link
D13	The packet which is sent/received when the communication protocol for exchanging data through COM1 is UD Link
D14	The packet which is sent/received when the communication protocol for exchanging data through COM2 is UD Link
D15	Reserved
D16	Reserved
D17	Reserved

Contents of the error flags:

D0

Error code	Description
16#0001	Hardware failure
16#0002	An error occurs when the communication protocol for exchanging data through a communication port is UD Link.
16#0004	An error occurs when data is exchanged through a communication port.
16#0008	An error occurs when the communication protocol for exchanging data through a communication port is Modbus.
16#0010	AH10/15SCM-5A is restored to the factory setting.
16#0020	Internal communication error

D1

Bit	15~4	3	2	1	0
Description	Reserved	The voltage is low.	The SRAM is damaged.	The GPIO is damaged.	The flash memory is damaged.

D2 and D3

Bit	3	2	1	0
Description	The data received is not the same as the data which should be received.	The packet is edited incorrectly.	The command number can not be found.	The group number can not be found.
Bit	7	6	5	4
Description	The data received is more than the data expected to be received.	The data received is insufficient. The data comparison can not be performed.	Reserved	Checksum error
Bit	11	10	9	8
Description	Reserved	Reserved	Reserved	The group list downloaded to AH10/15SCM-5A is incomplete.
Bit	15	14	13	12
Description	Reserved	Reserved	The number of data which will be written exceeds the device range.	The number of data which will be read exceeds the device range.

D4 and D5

Error code	Name	Description
16#0001	Illegal function	The function code is not supported.
16#0002	Illegal data address	The address is not supported.
16#0003	Illegal data value	The data value is not supported.
16#0004	Slave device failure	The salve fails.
16#0005	Transform failure	The value is transformed incorrectly.

D6, D7, and D8

Bit	3	2	1	0
Description	Communication timeout error	Buffer overrun	Parity check error	Framing error
Bit	7	6	5	4
Description	Reserved	Internal communication error	Internal communication timeout	Checksum error
Bit	11	10	9	8
Description	Reserved		The buffer zone in which packets received are recorded overflows.	The buffer zone in which packets sent are recorded overflows.
Bit	15	14	13	12
Description	Reserved			

MEMO

Chapter 9 Ethernet Communication Module AH10/15EN-5A

Table of Contents

9.1 Introduction

AH10/15EN-5A is an AH500 series Ethernet module. The data in an AH500 series PLC CPU can be transmitted to a remote device through Ethernet. Besides, the PLC CPU can control the remote device through ISPSoft, and a program can be downloaded to the PLC CPU through ISPSoft.

9.1.1 Functions

■ There are two Ethernet ports. They can automatically detect whether the transmission speed is 10 Mbps or 100 Mbps.
■ Auto-MDI/MDIX
■ It supports the Modbus TCP protocol. (It supports master mode and slave mode simultaneously.)
■ It supports the IEC60870-5-104 protocol (available for AH15EN-5A FW V2.00 or later)
■ It supports EtherNet/IP protocol (available for AH10EN-5A FW V2.00 or later)
■ Sending emails (not protected by cryptographic protocols, such as SSL or TSL)
■ It supports SNMPv1 and SNMPv2.
■ It automatically adjusts the real-time clock in an AH500 series PLC CPU through the Network Time Protocol (NTP).

9.1.2 Specifications

■ **Network interface**

Item	Specifications
Connector type	RJ-45 with auto-MDI/MDIX
Transmission interface	802.3 and 802.3u
Transmission cable	Category 5e cable The maximum length is 100 meters.
Transmission speed	10/100 Mbps auto-detection
Number of Ethernet ports	2 (switchable between single IP address and two IP addresses)

■ **Ethernet Specification: AH10EN-5A**

Communication protocol		MODBUS TCP, EtherNet/IP
Type of IP Address		BOOTP, DHCP, NTP, SNMP, SMTP
MODBUS TCP	Topology type	Star, linear topologies
	Max. connection number (Client)	64
	Max. connection number (Server)	128
	Max. data length per transmission (Read/Write counted separately)	100 words
EtherNet/IP IO Connection	Topology type	Star, linear, ring (DLR Ring Node only)
	Max. TCP connection number	64 (number of Server and Client connections are counted together.)
	Max. CIP connection number (number of data exchange table)	64 (number of Server and Client connections are counted together.)
EtherNet/IP Explicit Message	Requested Packet Interval (RPI)	1~1000ms
	Max. Transmission Speed	6400 pps
	Max. Data Length/per transmission	500 bytes
	Class 3 (Connected Type)	32 (Clients + Servers)
	UCMM (Unconnected Type)	
	CIP Objects	Identity Object (16#01) Message Router Object (16#02) Assembly Object (16#04) Connection Manager Object (16#06) DLR Object (16#47) QoS Object (16#48) Port Object (16#F4) TCP/IP Interface Object (16#F5) Ethernet Link Object (16#F6) Vendor specific object： X Register (16#350) Y Register (16#351) D Register (16#352) M Register (16#353) S Register (16#354) T Register (16#355) C Register (16#356) HC Register (16#357) SM Register (16#358) SR Register (16#359) Control Register (16#370) Input Register (16#371) Output Register (16#372) For more details on explanation, refer to Chapter 8 in EtherNet/IP manual.

■ **Ethernet Specification: AH15EN-5A**

Communication protocol		MODBUS TCP, IEC60870-5-104
Type of IP Address		DHCP, NTP, SNMP, SMTP
MODBUS TCP	Topology type	Star, linear topologies
	Max. connection number (Client)	64
	Max. connection number (Server)	128
	Max. data length per transmission (Read/Write counted separately)	100 words
IEC60870-5-104	Max. connection number (Client)	16
	Max. connection number (Server)	16
	Max. data point (IOA)	1000 /Type

■ **Electrical Specification: AH10/15EN-5A**

Item	Specifications
Supply voltage	5 V DC
Electric energy consumption	1.5 W
Insulation voltage	2,500 V DC
Weight	Approximately 139 g

9.1.3 Dimensions
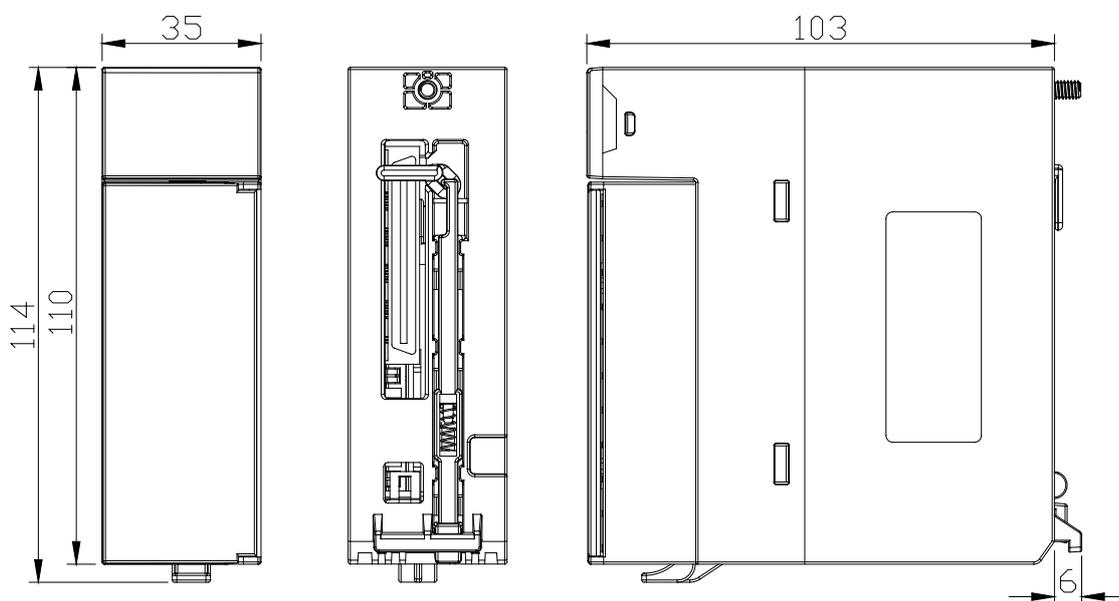
Unit: mm

9.1.4 Profile
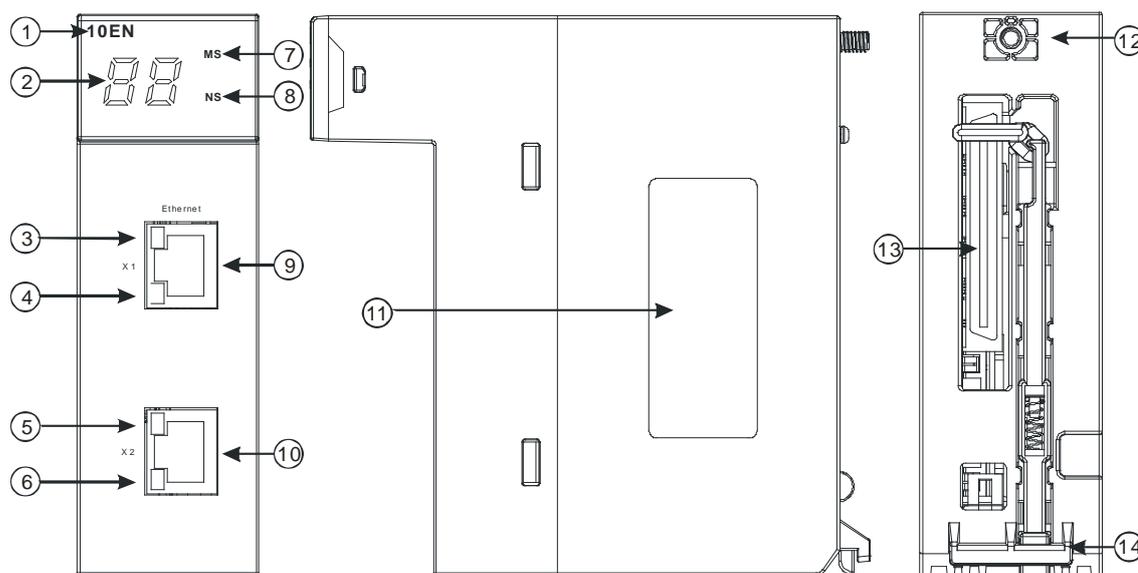
Number	Name	Description
1	Model name	Model name of the module
2	Seven-segment display	Display
3	LINK LED indicator	LINK LED indicator for RJ45 port 1
4	ACK LED indicator	ACK LED indicator for RJ45 port 1
5	LINK LED indicator	LINK LED indicator for RJ45 port 2
6	ACK LED indicator	ACK LED indicator for RJ45 port 2
7	NS LED indicator	LED indicator
8	MS LED indicator	LED indicator
9	RJ45 port 1	RJ45 port 1
10	RJ45 port 2	RJ45 port 2
11	Label	Nameplate
12	Set screw	Fixing the module
13	Connector	Connecting the module and a backplane
14	Projection	Fixing the module

9.1.5 RJ-45 Port

Pin	Definition	Description
1	Tx+	Transmitting data +
2	Tx-	Transmitting data -
3	Rx+	Receiving data +
4	--	N/C
5	--	N/C
6	Rx-	Receiving data -
7	--	N/C
8	--	N/C

9.2 Installation and Wiring

This section introduces the installation of AH10/15EN-5A, and the connection of AH10/15EN-5A to the network.

9.2.1 Installation

∎ **Installing AH10/15EN-5A on a main backplane:**

Insert a module into a slot, make sure that the module is installed on the backplane properly, and tighen the the screw, as illustrated below.

1. Insert the projection under the module into the hole in the backplane.
2. Push the module in the direction indicated by the arrow until it clicks.
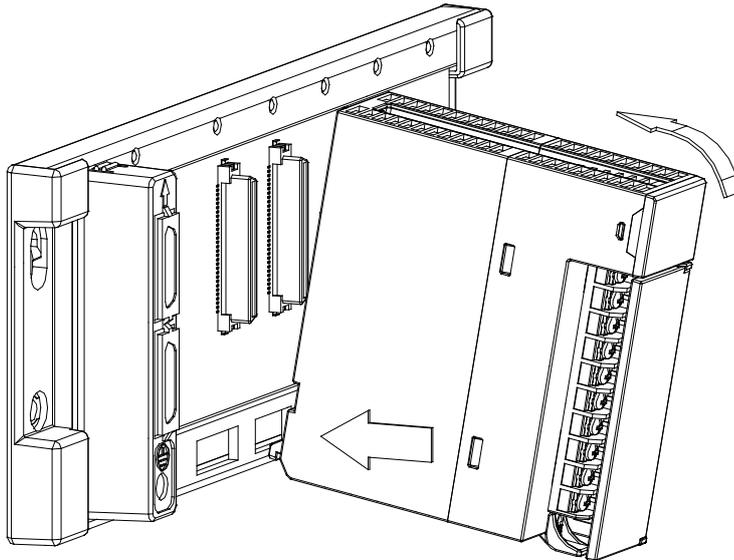
3. Tighten the screw on the module.
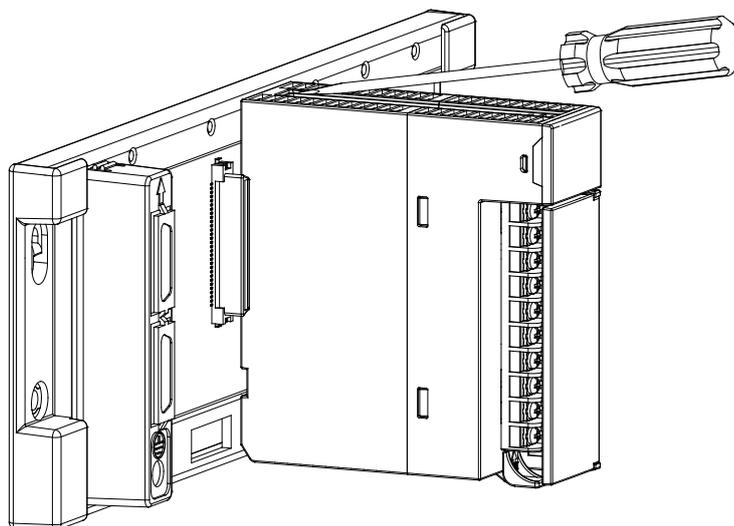
9.2.2 Connecting to the Network

After an AH500 series PLC CPU is set through HWCONFIG in ISPSoft, AH10/15EN-5A can carry out communication. The basic setting of the PLC CPU is accomplished through the RS-232/USB/Ethernet port. After IP addresses and subnet masks are assigned to AH10/15EN-5A, and a network cable is connected to AH10/15EN-5A, AH10/15EN-5A can carry out the communication. Users can choose a Cat 5e twisted pair cable as the network cable, and does not need a jumper wire.
AH10/15EN-5A is equipped with two RJ45 ports. The ports function as a switching hub that connects network segments. If users want to use these ports, they must assign a single IP address. If AH10/15EN-5A is connected to two different networks, the users must disable the switching hub function through HWCONFIG, and assign two IP addresses and two subnet masks to AH10/15EN-5A so that AH10/15EN-5A connects to a wide area network　(WAN) and a local area network　(LAN).

9.3 Registers

There are input registers, output registers, and control registers in AH10/15EN-5A. Data is sent from or is sent to the PLC CPU determines if the register is an input or output one.

When the data is sent to PLC CPU from AH10/15EN-5A, the registers used are input registers and they are often used for storing the status value. You can use the input registers to read the status of AH10/15EN-5A. When the data is sent from PLC CPU to AH10/15EN-5A, the registers used are output registers and they are often used for storing commands. You can use the output registers to activate executions. For input and output registers, you need to use HWCONFIG to assign and the input/output registers to the corresponding data registers and use PLC program to execute. Control registers are used for setting communication related parameters, you need to use FROM / TO instructions to read and write the control registers.

The functions of the registers are described below.

9.3.1 Functions of the Input Registers

Number		Attribute	Register name	Description
HW	LW			
-	#0	R	Status of the product	Displaying the status of the system 0: The system is normal.
-	#1	R	Version of the system	The version of the system is represented by a hexadecimal value. For example, if the version of the software is 1.02, it is represented by 16#1020.
-	#2	R	Status of port 1	Displaying the status of port 1
-	#3	R	Status of port 2	Displaying the status of port 2
-	#4	R	Reserved	
-	#5	R	Reserved	
-	#6	R	Statuses of the Modbus TCP clients	Number of Modbus TCP clients which are connected
-	#7	R	Statuses of the Modbus TCP servers	Number of Modbus TCP servers which are connected
-	#8	R	Reserved	
-	#9	R	Reserved	
-	#10	R	Reserved	
-	#11	R	Statuses of the TCP connections	Number of TCP connections

Number		Attribute	Register name	Description
HW	LW			
-	#12	R	Status of transmitting data 1~data 16	Every bit represents a remote device. 0: The data exchange is executed successfully. 1: The data exchange is not executed successfully.
-	#13	R	Status of transmitting data 17~data 32	Every bit represents a remote device. 0: The data exchange is executed successfully. 1: The data exchange is not executed successfully.
-	#14	R	Status of transmitting data 33~data 48	Every bit represents a remote device. 0: The data exchange is executed successfully. 1: The data exchange is not executed successfully.
-	#15	R	Status of transmitting data 49~data 64	Every bit represents a remote device. 0: The data exchange is executed successfully. 1: The data exchange is not executed successfully.
-	#16	R	Time it takes to transmit the input data in AH10/15EN-5A to the devices in the CPU module	Time it takes to transmit the input data in AH10/15EN-5A to the devices in the CPU module (Unit: Millisecond)
-	#17	R	Time it takes to transmit the data in the PLC CPU to the output memory in AH10/15EN-5A	Time it takes to transmit the data in the PLC CPU to the output memory in AH10/15EN-5A
-	#18	R	Time it takes to transmit the data between the input/output registers in AH10/15EN-5A and the devices in the PLC CPU.	Time it takes to transmit the data between the input/output registers in AH10/15EN-5A and the input/output devices in the PLC CPU (Unit: Millisecond)
-	#19	R	Time it takes to scan the system	Time it takes to scan the system (Unit: Microsecond)

9.3.2 Functions of the Output Registers

Number		Attribute	Register name	Description
HW	LW			
-	#0	R	Reserved	
-	#1	R	Reserved	
-	#2	R	Reserved	
-	#3	R	Reserved	
-	#4	R	Reserved	
-	#5	R	Reserved	
-	#6	R	Reserved	
-	#7	R	Reserved	
-	#8	R	Reserved	
-	#9	R	Reserved	
-	#10	W	Trigger for the sending of the email	Every bit represents a trigger. 1: The email is sent.

Number		Attribute	Register name	Description
HW	LW			
-	#11	W	Mode of the data exchange	Make sure the corresponding registers for data exchanged are enabled before executing the following modes. 0: The execution of the data exchange stops. 1: The data exchange is executed once, and then stops. Enter the value "0" before entering "1" for another execution. 2: The data exchange is executed continually.
-	#12	W	Triggering the transmission of data 1~data 6	Select the data exchange table; every bit represents a remote device. 0: The data exchange is not triggered. 1: The data exchange is triggered.
-	#13	W	Triggering the transmission of data 17~data 32	
-	#14	W	Triggering the transmission of data 33~data 48	
-	#15	W	Triggering the transmission of data 49~data 64	
-	#16	R	Reserved	
-	#17	R	Reserved	
-	#18	R	Reserved	
-	#19	R	Reserved	

9.3.3 Functions of the Control Registers

CR number		Attribute	Register name	Description
HW	LW			
-	#0	R	Model code	The model code is a default value. The model code of AH10EN-5A is 16#5881. The model code of AH15EN-5A is 16#5882.
-	#1	R	Version of the system	The version of the system is represented by a hexadecimal value. For example, if the version of the software is 1.02, it is represented by 16#1020.
-	#3	R/W	Operation mode	0: A single IP address is assigned, and the two ports function as a switching hub. 1: Two IP addresses are assigned, and the two ports operate individually.
#5	#4	R/W	IP address of port 1	IP address of port 1
#7	#6	R/W	Subnet mask of port 1	Subnet mask of port 1
#9	#8	R/W	Gateway address of port 1	Gateway address of port 1
-	#10	R/W	Assigning an IP address to port 1 by a DHCP server	0: Static IP address 1: An IP address is assigned by a DHCP server.
-	#11	R/W	Triggering the setting of the IP parameters for port 1	0: The assignment of an IP address is complete. 1: The setting of the IP parameters (in CR#4~CR#10) for port 1 is triggered.

CR number HW	CR number LW	Attribute	Register name	Description
-	#12	R/W	Status of assigning an IP address to port 1	0: The assignment of an IP address is complete. 1: An IP address is being assigned. 2: The assignment of an IP address by a DHCP server has not been complete. 3: The IP parameters are incorrect.
#15	#14	R/W	IP address of port 2	IP address of port 2
#17	#16	R/W	Subnet mask of port 2	Subnet mask of port 2
-	#20	R/W	Assigning an IP address to port 2 by a DHCP server	0: Static IP address 1: An IP address is assigned by a DHCP server.
-	#21	R/W	Triggering the setting of the IP parameters for port 2	0: The assignment of an IP address is complete. 1: The setting of the IP parameters (in CR#14~CR#20) for port 2 is triggered.
-	#22	R/W	Status of assigning an IP address to port 2	0: The assignment of an IP address is complete. 1: An IP address is being assigned. 2: The assignment of an IP address by a DHCP server has not been complete. 3: The IP parameters are incorrect.
#47	#23		Reserved	
-	#48	R/W	Execution state of email 1	Execution state of email 1
-	#49	R/W	Execution state of email 2	Execution state of email 2
-	#50	R/W	Execution state of email 3	Execution state of email 3
-	#51	R/W	Execution state of email 4	Execution state of email 4
-	#52	R/W	Execution state of email 5	Execution state of email 5
-	#53	R/W	Execution state of email 6	Execution state of email 6
-	#54	R/W	Execution state of email 7	Execution state of email 7
-	#55	R/W	Execution state of email 8	Execution state of email 8

The definitions of the symbols:
R: Users can read the data from the register by means of the instruction FROM.
W: Users can write the data into the register by means of the instruction TO.

- **Basic setting and functions**
    - CR#0: The value in CR#0 is a model code. Users can read the model code by means of a program to judge whether the module exists.
    - CR#1: The value in CR#1 represents the version of the system.
- **Email functions**
    - CR#48~CR#55: Please refer to the following table.

Setting Value	Execution state of the email
0	The email is not sent.
1	The email is being processed.
2	The email is sent successfully.
3~9	Reserved
10	AH10/15EN-5A cannot connect to an SMTP server.

Setting Value	Execution state of the email
11	The email address of a receiver is incorrect.
12	An error occurs when AH10/15EN-5A communicates with an SMTP server.
13~255	Reserved

● **Network functions**
  ■ CR#10: If the value in CR#10 is 0, a static IP address is used. If the value in CR#10 is 1, a DHCP server assigns an IP address. (A dynamic IP address is used.)
  ■ CR#4~CR#5: The IP address of AH10/15EN-5A is composed of the values in CR#4 and CR#5. The values in CR#4 and CR#5 are hexadecimal values. If a dynamic IP address is used, users can read data from CR#4 and CR#5, but they can not write data into CR#4 and CR#5.
    Example: If the IP address is 192.168.0.2, 16#0002 is written into CR#4, and 16#C0A8 is written into CR#5. (K192=16#C0, K168=16#A8, K0=16#00, and K2=16#02.)
  ■ CR#6~CR#7: The subnet mask of AH10/15EN-5A is composed of the values in CR#6 and CR#7. The values in CR#6 and CR#7 are hexadecimal values. If a dynamic IP address is used, users can read data from CR#6 and CR#7, but they can not write data into CR#6 and CR#7.
    Example: If the subnet mask is 255.255.255.0, 16#FF00 is written into CR#6, and 16#FFFF is written into CR#7.
  ■ CR#8~CR#9: The gateway address of AH10/15EN-5A is composed of the values in CR#8 and CR#9. The values in CR#8 and CR#9 are hexadecimal values. If a dynamic IP address is used, users can read data from CR#8 and CR#9, but they can not write data into CR#8 and CR#9.
  ■ CR#11: Triggering the setting of the IP parameters for port 1
    0: The assignment of an IP address is complete.
    1: The setting of the IP parameters (in CR#4~CR#10) for port 1 is triggered.
  ■ CR#12: Status of assigning an IP address to port 1
    0: The assignment of an IP address is complete.
    1: An IP address is being assigned.
    2: The assignment of an IP address by a DHCP server has not been complete.
    3: The IP parameters are incorrect.
  ■ **IEC60870-5-104 Protocol (Available for AH15EN-5A)**

CR Number		Attribute	Register name	Description
HW	LW			
#513	#512	R/W	Connection 1 IP Address	IP address of the 1st slave connection
	#514	R/W	Connection 1 Common ASDU Address	Common ASDU Address of the 1st slave connection
#516	#515	R/W	Connection 2 IP Address	IP address of the 2nd slave connection
	#517	R/W	Connection 2 Common ASDU Address	Common ASDU Address of the 2nd slave connection
#519	#518	R/W	Connection 3 IP Address	IP address of the 3rd slave connection
	#520	R/W	Connection 3 Common ASDU Address	Common ASDU Address of the 3rd slave connection
#522	#521	R/W	Connection 4 IP Address	IP address of the 4th slave connection
	#523	R/W	Connection 4 Common ASDU Address	Common ASDU Address of the 4th slave connection
#525	#524	R/W	Connection 5 IP Address	IP address of the 5th slave connection
	#526	R/W	Connection 5 Common ASDU Address	Common ASDU Address of the 5th slave connection

#528	#527	R/W	Connection 6 IP Address	IP address of the 6th slave connection
	#529	R/W	Connection 6 Common ASDU Address	Common ASDU Address of the 6th slave connection
#531	#530	R/W	Connection 7 IP Address	IP address of the 7th slave connection
	#532	R/W	Connection 7 Common ASDU Address	Common ASDU Address of the 7th slave connection
#534	#533	R/W	Connection 8 IP Address	IP address of the 8th slave connection
	#535	R/W	Connection 8 Common ASDU Address	Common ASDU Address of the 8th slave connection
#537	#536	R/W	Connection 9 IP Address	IP address of the 9th slave connection
	#538	R/W	Connection 9 Common ASDU Address	Common ASDU Address of the 9th slave connection
#540	#539	R/W	Connection 10 IP Address	IP address of the 10th slave connection
	#541	R/W	Connection 10 Common ASDU Address	Common ASDU Address of the 10th slave connection
#543	#542	R/W	Connection 11 IP Address	IP address of the 11th slave connection
	#544	R/W	Connection 11 Common ASDU Address	Common ASDU Address of the 11th slave connection
#546	#545	R/W	Connection 12 IP Address	IP address of the 12th slave connection
	#547	R/W	Connection 12 Common ASDU Address	Common ASDU Address of the 12th slave connection
#549	#548	R/W	Connection 13 IP Address	IP address of the 13th slave connection
	#550	R/W	Connection 13 Common ASDU Address	Common ASDU Address of the 13th slave connection
#552	#551	R/W	Connection 14 IP Address	IP address of the 14th slave connection
	#553	R/W	Connection 14 Common ASDU Address	Common ASDU Address of the 14th slave connection
#555	#554	R/W	Connection 15 IP Address	IP address of the 15th slave connection
	#556	R/W	Connection 15 Common ASDU Address	Common ASDU Address of the 15th slave connection
#558	#557	R/W	Connection 16 IP Address	IP address of the 16th slave connection
	#559	R/W	Connection 16 Common ASDU Address	Common ASDU Address of the 16th slave connection
#560 ~ #607			Reserved	
	#608	W	Triggering the connection 1~16	Every bit represents a remote device. 0: to disconnect the connection 1: to establish a connection
	#609		Reserved	
	#610	R	Statuses of the connection 1~16	Every bit represents a remote device. 0: The connection is active. 1: The connection is inactive.
	#611		Reserved	
#612 ~ #627		W	Sending commands to the connection 1~16	One WORD represents one connection of a remote device.

				Input a command code to send the command and work with CR#644~CR#649 to write the parameters in.
#628 ~ #643			Reserved	
#645	#644	W	Command information object address (IOA)	Information object address (IOA) of the connection to be written with a command
#647	#646	W	Command value	The value of the connection to be written with a command
#649	#648	W	Command SV	The 2nd value of the connection to be written with a command (according to the requirement of the data type; if there's no requirement, leave it blank.)
	#650	W	Data point number of the slave station	Data point number of the data type to be created
	#651	W	Data point type identification of the slave station	The data point type to be created
#653	#652	W	Data point Information object address (IOA) of the slave station	The IOA of the to be created data point
	#654	W	Data point group mask of the slave station	The mask of the to be created data point
	#655	W	Data point flags of the slave station	The flags of the to be created data point
#657	#656	W	Data point value of the slave station	The default value of the to be created data point
	#658	W	Device register number that is corresponding to the data point of the slave station for data mapping	The corresponding register number (D or M) of the PLC to the data point to be created
	#659	W	Data point of the slave station for data mapping	Complete the settings of CR#650~664 before using this register. 1: enable the settings of the data point for one time; after it is done, resets it to 0.
#661	#660	W	Data point up bound of the slave station	The upper limit of the data point to be created
#663	#662	W	Data point low bound of the slave station	The lower limit of the data point to be created
#664	#664	W	Data point deadband of the slave station	The not responding deadband of the data point to be created
	#666	W	Enabling the database of the slave station	Complete the settings of data point before using this register. 0: reset this setting 1: enable the settings of the database; after it is done, reset it to 0.
	#667		Reserved	
	#668	R	Counter register for the data point of the slave station	The number of the already used data point
	#669	R	The status of remote device	The number of connected master devices
	#670	W	Data point update cycle (ms)	Time to update data point
	#671		Reserved	
#672 ~ #684		R/W	CPU register number	One WORD represents one data

		corresponding to the master connection 1	type; the written code is the corresponding register number of the data type
#697 ~ #685	R/W	CPU register number corresponding to the master connection 2	
#710 ~ #698	R/W	CPU register number corresponding to the master connection 3	
#723 ~ #711	R/W	CPU register number corresponding to the master connection 4	
#736 ~ #724	R/W	CPU register number corresponding to the master connection 5	
#749 ~ #737	R/W	CPU register number corresponding to the master connection 6	
#762 ~ #750	R/W	CPU register number corresponding to the master connection 7	
#775 ~ #763	R/W	CPU register number corresponding to the master connection 8	
#788 ~ #776	R/W	CPU register number corresponding to the master connection 9	
#801 ~ #789	R/W	CPU register number corresponding to the master connection 10	
#814 ~ #802	R/W	CPU register number corresponding to the master connection 11	
#827 ~ #815	R/W	CPU register number corresponding to the master connection 12	
#840 ~ #828	R/W	CPU register number corresponding to the master connection 13	
#853 ~ #841	R/W	CPU register number corresponding to the master connection 14	
#866 ~ #854	R/W	CPU register number corresponding to the master connection 15	
#879 ~ #867	R/W	CPU register number corresponding to the master connection 16	

IEC60870-5-104 Functions

- CR#512~CR#513: set up the IP address of the 1st remote device in hexadecimal. The same rule applies to 2nd ~ 16th remote devices.
- CR#514: set up the common ASDU address of the 1st remote device in hexadecimal.
  Example: to set up the IP address as 192.168.0.2, users need to write 16#0002 in CR#512, 16#C0A8 in CR#513. (K192=16#C0, K168=16#A8, K0=16#00 and K2=16#02)
- CR#608: one bit represents one connection of a remote device; input value 0: to disconnect and input value 1: to connect.
- CR#612: one WORD represents one connection of a remote device. Input a command code to send the command and work with CR#644~CR#649 to write the parameters in. The same rule

applies to 2nd ~ 16th remote devices.

Example: to send command C_SC_NA_1 ON to the IOA 100 (information object address) of first connection for a remote device, users can input the corresponding value to trigger and send the command. Refer to section 9.3.5 for details on type id parameters and codes.

CR Number	Setting Value	Description
#645	K100	IOA 100 (information object address) of the remote device
#646	K1	1：ON，0：OFF
#647	K0	
#620	K45	Single command code

- CR#650 ~ CR#665: Setting up the data point for the database of the slave station
- Example: AH15EN-5A as a slave, when creating data M_SP IOA 100 ~ IOA 104 to the database and corresponding to M100 ~ M104 of the CPU register, users can input the values according to the table below and trigger to create. The same rule applies to 2nd ~ 16th remote devices. Refer to section 9.3.5 for details on type id parameters and codes.

CR Number	Setting value	Description
#650	5	Add 5 data points
#651	1	Type identification, 1: M_SP_NA_1
#652	100	The starting position of IOA is 100.
#653	0	
#654	1	Group mask, 1: group 1 station interrogation
#655	0	Flags = 0
#656~#657	0	Default value = 0
#658	100	The starting position of CPU register is M100.
#660~#661	1	Upper limit = 1
#662~#663	0	Lower limit = 0
#664~#665	0	Not responding deadband = 0
#659	1	1: trigger to create

- CR#672 ~ CR#684: Setting up the starting position of the corresponding CPU register for the 1st connection of the type id of the remote device. One WORD represents one type id.

CR Number	Description
#672	Single-point information corresponds to the starting position of M device
#673	Double-point information corresponds to the starting position of M device
#674	Step position information corresponds to the starting position of D device
#675	Bitstring of 32 bit corresponds to the starts position of D device
#676	Measured value, normalized value corresponds to the starting position from D500
#677	Measured value, scaled value corresponds to the starting position of D device
#678	Measured value, short floating point value corresponds to the starting position of D device
#679	Integrated totals corresponds to the starting position of D device
#680	Event of protection equipment corresponds to the starting position of D device
#681	Packed start events of protection equipment corresponds to the starting position of D device

#682	Packed output circuit information of protection equipment corresponds to the starting position of D device
#683	Packed single-point information with status change detection corresponds to the starting position of D device
#684	Measured value, normalized value without quality descriptor corresponds to the starting position of D device

■ Example: when AH15EN-5A is as a master, it will scan and obtain the IOA of the remote device. Create type ids to correspond to the CPU registers as the starting position for data mapping and the obtained value will be stored to the specific register. Users can input the values according to the table below and trigger to create. Take Single-point information as an example: IOA100 corresponds to M100, IOA101 and M101 and so on. The same rule applies to 2nd ~ 16th remote devices. Refer to section 9.3.5 for details on type id parameters and codes.

CR Number	Setting Value	Description
#672	100	Single-point information corresponds to the starting position from M100
#673	200	Double-point information corresponds to the starting position from M200
#674	300	Step position information corresponds to the starting position from D300
#675	400	Bitstring of 32 bit corresponds to the starting position from D400
#676	500	Measured value, normalized value corresponds to the starting position from D500
#677	600	Measured value, scaled value corresponds to the starting position from D600
#678	700	Measured value, short floating point value corresponds to the starting position from D700
#679	800	Integrated totals corresponds to the starting position from D800
#680	900	Event of protection equipment corresponds to the starting position from D900
#681	1000	Packed start events of protection equipment corresponds to the starting position from D1000
#682	1100	Packed output circuit information of protection equipment corresponds to the starting position from D1100
#683	1200	Packed single-point information with status change detection corresponds to the starting position from D1200
#684	1300	Measured value, normalized value without quality descriptor corresponds to the starting position from D1300

9.3.4 Introduction of the Related Instructions

After AH10/15EN-5A is installed, users need to write a program to control the related functions of AH10/15EN-5A. The users can read data from a control register in AH10/15EN-5A by means of the instruction FROM, and write data into a control register in AH10/15EN-5A by means of the instruction TO.

API	Instruction code			Operand	Function
1400	D	FROM	P	m_1, m_2, m_3, D_1, D_2, n	Reading the data from the control register in the special module

Device	X	Y	M	S	T	C	HC	D	L	SM	SR	E	PR	K	16#	"$"	DF
m_1	●	●			●	●	●	●	●				●	○	○		
m_2	●	●			●	●	●	●	●				●	○	○		
m_3	●	●	●		●	●	●	●	●				●	○	○		
D_1	●	●			●	●	●	●	●				●				
D_2	●	●			●	●	●	●	●				●				
n	●	●			●	●	●	●	●				●	○	○		

Pulse instruction	16-bit instruction (13	32-bit instruction (13 steps)
AH500	AH500	AH500
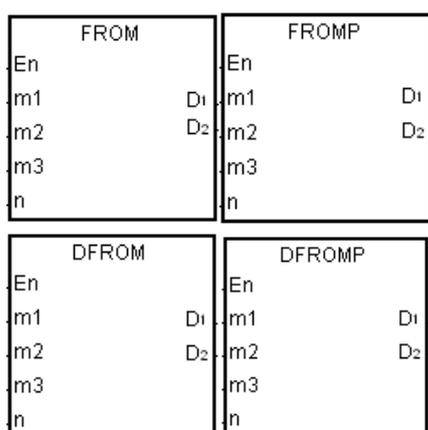
Symbol:

m_1	:	Backplane code	Word/Double word
m_2	:	Slot code	Word/Double word
m_3	:	Control register number	Word/Double word
D_1	:	Device in which the data is stored	Word/Double word
D_2	:	Device in which the error code is stored	Word/Double word
n	:	Data length	Word/Double word

Explanation:

1. Users can use this instruction to read data from a control register in a network module into an AH500 series PLC.
2. The operand m_1 should be in the range of 1 to 8. 1 represents a main backplane, and 2~8 represent extension backplanes.
3. The operand m_2 should be in the range of 0 to 11. If the backplane code is 1, the slot code should be in the range of 0 to 11. If the backplane code is in the range of 2 to 8, the slot code should be in the range of 0 to 7.
4. The operand m_3 specifies the control register number.
5. When the instruction FROM is executed, D_2 is set to 0. When an error occurs, D_2 is not set to 0. Please refer to the additional remark below for more information about the error codes.
6. The operand n used in the 16-bit instruction should be in the range of 1 to 256, and the operand n used in the 32-bit instruction should be in the range of 1 to 128.
7. Only the 32-bit instructions can use the 32-bit counter.
8. Please refer to the regulation of the operands in the instruction TO for more information about the numbering of network modules.

Example:

Suppose the first special module at the right side of the PLC CPU is AH10/15EN-5A. When X0.0 is switched from OFF to ON, the instruction FROM is executed. The operation mode stored in CR#3 in AH10/15EN-5A is read into D100. Owing to the fact that no error occurs, the code stored in D110 is 16#0000.
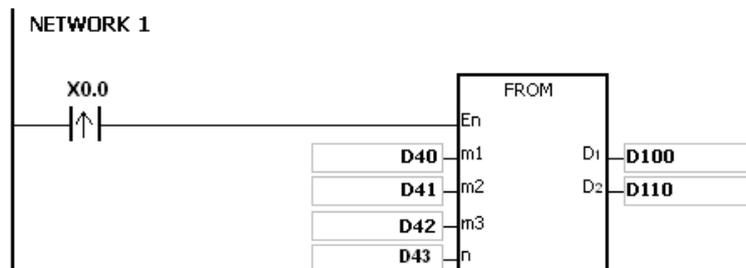
```
NETWORK 1

    X0.0                           ┌─────── FROM ───────┐
    ─┤↑├──                         ─┤En                 │
                                    │                    │
                       D40 ────────┤m1        D₁├─ D100 │
                       D41 ────────┤m2        D₂├─ D110 │
                       D42 ────────┤m3                  │
                       D43 ────────┤n                   │
                                    └────────────────────┘
```

The use of the parameters:

- The module is placed on the main backplane. Therefore, the backplane code stored in D40 is 16#0001.
- The module is inserted in the first slot. Therefore, the slot code stored in D41 is 16#0000.
- The operation mode is stored in CR#3. Therefore, the control register number stored in D42 is 16#0003.
- Owing to the fact that the operation mode occupies one register, the value in D43 is 1.
- The data which is read from CR#3 is stored in D100.

Additional remark:

1. If the values in m_1 and m_2 exceed the range, the operation error occurs, the instruction is not executed, SM0 is ON, and the error code in SR0 is 16#2003.
2. If $D_1 \sim D_1 + n - 1$ exceed the device range, the instruction is not executed, SM0 is ON, and the error code in SR0 is 16#2003.
3. If the value in n exceeds the range, the operation error occurs, the instruction is not executed, SM0 is ON, and the error code in SR0 is 16#200B.
4. Due to the fact that the use of the instruction FROM decreases the execution efficiency of the PLC CPU and that of the I/O module, users should use it less often.
5. The descriptions of the error codes:

Error code	Description
16#2003	Please refer to point 1 and point 2 in the additional remark.
16#200B	Please refer to point 3 in the additional remark.
16#1400	An error occurs when the data is accessed through the auxiliary processor.
16#1401	An error occurs when the data in the I/O module is accessed.
16#1402	The arrangement of the I/O modules is not consistent with the module table.
16#1407	A communication error occurs when the data is accessed through the auxiliary processor.

API	Instruction code			Operand	Function
1401	D	TO	P	**m₁, m₂, m₃, S, D, n**	Writing the data into the control register in the special module

Device	X	Y	M	S	T	C	HC	D	L	SM	SR	E	PR	K	16#	"$"	DF
m₁	●	●			●	●	●	●	●				●	○	○		
m₂	●	●			●	●	●	●	●				●	○	○		
m₃	●	●			●	●	●	●	●				●	○	○		
S	●	●			●	●	●	●	●				●	○	○		
D	●	●			●	●	●	●	●				●				
n	●	●			●	●	●	●	●				●	○	○		

Pulse instruction	16-bit instruction (13 steps)	32-bit instruction (13 steps)
AH500	AH500	AH500

Symbol:

m₁	:	Backplane code	Word/Double word
m₂	:	Slot code	Word/Double word
m₃	:	Control register number	Word/Double word
S	:	Data which is written into the control register	Word/Double word
D	:	Device in which the error code is stored	Word/Double word
n	:	Data length	Word/Double word

Explanation:

1. Users can use this instruction to write data in an AH500 series PLC into a control register in a network module.
2. The operand **m₁** should be in the range of 1 to 8. 1 represents a main backplane, and 2~8 represent extension backplanes.
3. The operand **m₂** should be in the range of 0 to 11. If the backplane code is 1, the slot code should be in the range of 0 to 11. If the backplane code is in the range of 2 to 8, the slot code should be in the range of 0 to 7.
4. The operand **m₃** specifies the control register number.
5. When the instruction TO is executed, **D** is set to 0. When an error occurs, **D** is not set to 0. Please refer to the additional remark below for more information about the error codes.
6. The operand **n** used in the 16-bit instruction should be in the range of 1 to 256, and the operand **n** used in the 32-bit instruction should be in the range of 1 to 128.
7. Only the 32-bit instructions can use the 32-bit counter.
8. When **S** is a decimal value or a hexadecimal value, **n** decimal values or **n** hexadecimal values are transmitted to the I/O module. Suppose **S** is 16#0001 and **n** is 3. Three 16#0001s are transmitted to the I/O module.

Example:

Suppose the first special module at the right side of the PLC CPU is AH10/15EN-5A. When X1.1 is switched from OFF to ON, the instruction TO is executed. The value stored in CR#3 in AH10/15EN-5A changes from 0 to 1. Owing to the fact that no error occurs, the code stored in D110 is 16#0000.
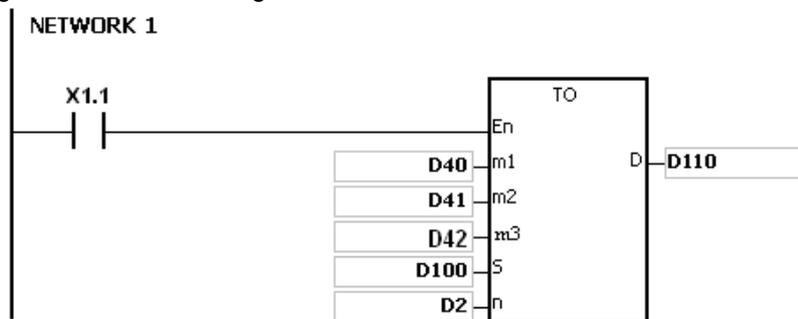
The use of the parameters:

- The module is placed on the main backplane. Therefore, the backplane code stored in D40 is 16#0001.
- The module is inserted in the first slot. Therefore, the slot code stored in D41 is 16#0000.
- The operation mode is stored in CR#3. Therefore, the control register number stored in D42 is 16#0003.
- Owing to the fact that the operation mode occupies one register, the value in D2 is 1.
- The data which is written into CR#3 is stored in D100. Therefore, the value in D100 is 16#0001.

The regulation of the operands in the instruction:

- The operand m_1 specifies the backplane code. It should be in the range of 1 to 8. 1 represents a main backplane, and 2~8 represent extension backplanes.
- The operand m_2 specifies the slot code. It should be in the range of 0 to 11. If the backplane code is 1, the slot code should be in the range of 0 to 11. If the backplane code is in the range of 2 to 8, the slot code should be in the range of 0 to 7.
- The operand m_3 specifies the control register number. The 16-bit memories built in the network modules are called the control registers. The control register numbers are decimal numbers #0~#N, and the number of control registers varies with the module. The operating conditions of the network module and the setting values are stored in the control registers.
- At most 68 special modules can be placed on the backplane, and they do not occupy inputs/outputs.
- If the instruction FROM/TO is used, one control register is taken as a unit for the reading/writing of the data. If the instruction DFROM/DTO is used, two control registers are taken as a unit for the reading/writing of the data.
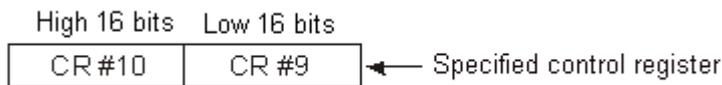
- The **n** which is 2 in the 16-bit instruction has the same meaning as the **n** which is 1 in the 32-bit instruction.
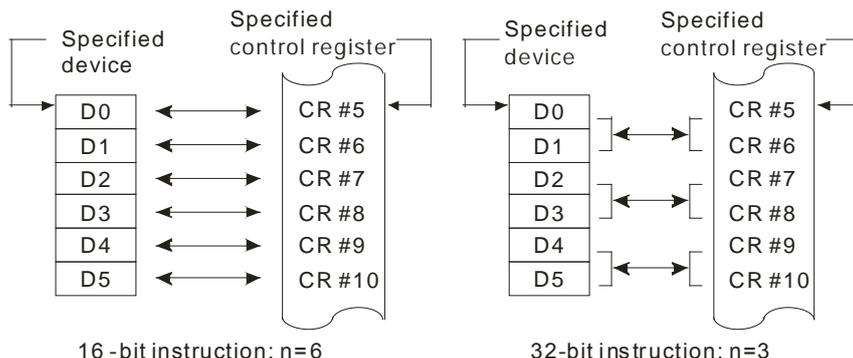
Additional remark:

1. If the values in m_1 and m_2 exceed the range, the operation error occurs, the instruction is not executed, SM0 is ON, and the error code in SR0 is 16#2003.
2. If **S**~**S+n**-1 exceeds the device range, the instruction is not executed, SM0 is ON, and the error code in SR0 is 16#2003.
3. If the value in **n** exceeds the range, the operation error occurs, the instruction is not executed, SM0 is ON, and the error code in SR0 is 16#200B.
4. Due to the fact that the use of the instruction TO decreases the execution efficiency of the PLC CPU and that of the I/O module, users should use it less often.
5. The descriptions of the error codes:

Error code	Description
16#2003	Please refer to point 1 and point 2 in the additional remark.
16#200B	Please refer to point 3 in the additional remark.
16#1400	An error occurs when the data is accessed through the auxiliary processor.
16#1401	An error occurs when the data in the I/O module is accessed.
16#1402	The arrangement of the I/O modules is not consistent with the module table.
16#1407	A communication error occurs when the data is accessed through the auxiliary processor.

9.3.5 Introduction of the IEC60870-5-104 protocol

■ The IEC60870-5-104 protocol is only available for AH15EN-5A.
■ The supported data type ID:

Type id	Description
M_SP_NA_1 (1)	Single-point information
M_DP_NA_1 (3)	Double-point information
M_ST_NA_1 (5)	Step position information
M_BO_NA_1 (7)	Bit string of 32 bit
M_ME_NA_1 (9)	Measured value, normalized value
M_ME_NB_1 (11)	Measured value, scaled value
M_ME_NC_1 (13)	Measured value, short floating point value
M_IT_NA_1 (15)	Integrated totals
M_PS_NA_1 (20)	Packed single-point information with status change detection
M_ME_ND_1 (21)	Measured value, normalized value without quality descriptor
M_SP_TB_1 (30)	Single-point information with time tag CP56Time2a
M_DP_TB_1 (31)	Double-point information with time tag CP56Time2a
M_ST_TB_1 (32)	Step position information with time tag CP56Time2a
C_BO_NA_1 (33)	Bit string of 32 bit with time tag CP56Time2a
M_ME_TD_1 (34)	Measured value, normalized value with time tag CP56Time2a
M_ME_TE_1	Measured value, scaled value with time tag CP56Time2a

(35)	
M_ME_TC_1 (36)	Measured value, short floating point value with time tag CP56Time2a
M_IT_TB_1 (37)	Integrated totals with time tag CP56Time2a
M_EP_TD_1 (38)	Event of protection equipment with time tag CP56Time2a
M_EP_TE_1 (39)	Packed start events of protection equipment with time tag CP56time2a
M_EP_TF_1 (40)	Packed output circuit information of protection equipment with time tag CP56Time2a
C_SC_NA_1 (45)	Single command
C_DC_NA_1 (46)	Double command
C_RC_NA_1 (47)	Regulating step command
C_SE_NA_1 (48)	Set-point command, normalized value
C_SE_NB_1 (49)	Set-point command, scaled value
C_SE_NC_1 (50)	Set-point command, short floating point value
C_BO_NA_1 (51)	Bit string of 32 bit
C_SC_TA_1 (58)	Single command with time tag CP56Time2a
C_DC_TA_1 (59)	Double command with time tag CP56Time2a
C_RC_TA_1 (60)	Regulating step command with time tag CP56Time2a
C_SE_TA_1 (61)	Set-point command, normalized value with time tag CP56Time2a
C_SE_TB_1 (62)	Set-point command, scaled value with time tag CP56Time2a
C_SE_TC_1 (63)	Set-point command, short floating point value with time tag CP56Time2a
C_BO_TA_1 (64)	Bit string of 32 bit with time tag CP56Time2a
M_EI_NA_1 (70)	End of initialization
C_IC_NA_1 (100)	Interrogation command
C_CI_NA_1 (101)	Counter interrogation command
C_RD_NA_1 (102)	Read command
C_CS_NA_1 (103)	Clock synchronization command
C_RP_NA_1 (105)	Reset process command
C_TS_TA_1 (107)	Test command with time tag CP56time2a

■ The supported data type ID, its corresponding data type and CPU register type :

Type id	Data type	CPU corresponding register type	Value
M_SP_NA_1 (1)	Bit	M	SCS: 0: OFF

M_SP_TB_1 (30)			1: ON
M_DP_NA_1 (3)	Double bit	M	DCS : 0: Indeterminate 1: OFF 2: ON 3: Indeterminate
M_DP_TB_1 (31)			
M_ST_NA_1 (5)	Dword	D	Possible values are -64 to +63. Supports the Transient sub-type.
M_ST_TB_1 (32)			
M_BO_NA_1 (7)	Dword	D	BSI: Bit string of 32 bits
C_BO_NA_1 (33)			
M_ME_NA_1 (9)	Dword	D	NVA: Normalized value.
M_ME_TD_1 (34)			
M_ME_NB_1 (11)	Dword	D	SVA: Scaled value
M_ME_TE_1 (35)			
M_ME_NC_1 (13)	Dword	D	R32: Short floating point value
M_ME_TC_1 (36)			
M_IT_NA_1 (15)	Dword	D	Binary counter reading
M_IT_TB_1 (37)			
M_PS_NA_1 (20)	Dword	D	Status and status change detection (32 bit)
M_ME_ND_1 (21)	Dword	D	NVA: Normalized value
M_EP_TD_1 (38)	Dword	D	SEP Refer to the section of information elements for more details.
M_EP_TE_1 (39)	Dword	D	SEP QDP Refer to the section of information elements for more details.
M_EP_TF_1 (40)	Dword	D	OCI QDP Refer to the section of information elements for more details.

■ Command and parameters

Type id	Data Type	Value
C_SC_NA_1 (45)	Bit	SCO: Refer to the section of information elements for more details.
C_SC_TA_1 (58)		
C_DC_NA_1 (46)	Double bit	DCO: Refer to the section of information elements for more details.
C_DC_TA_1 (59)		
C_RC_NA_1 (47)	Dword	RCO: Refer to the section of information elements for more details.
C_RC_TA_1 (60)		
C_SE_NA_1 (48)	Dword	NVA: Normalized value.
C_SE_TA_1 (61)		
C_SE_NB_1 (49)	Dword	SVA: Scaled value
C_SE_TB_1 (62)		
C_SE_NC_1 (50)	Dword	R32: Short floating point value
C_SE_TC_1 (63)		
C_BO_NA_1 (51)	Dword	BSI: Bit string of 32 bits.
C_BO_TA_1 (64)		
C_IC_NA_1 (100)	Byte	QOI: UI[1…8]<0…255> 0: Not used 20: Global station interrogation 21: Group 1 station interrogation 22: Group 2 station interrogation 23: Group 3 station interrogation 24: Group 4 station interrogation 25: Group 5 station interrogation 26: Group 6 station interrogation 27: Group 7 station interrogation 28: Group 8 station interrogation 29: Group 9 station interrogation 30: Group 10 station interrogation 31: Group 11 station interrogation 32: Group 12 station interrogation 33: Group 13 station interrogation 34: Group 14 station interrogation 35: Group 15 station interrogation 36: Group 16 station interrogation
C_CI_NA_1 (101)	Byte	QCC: Refer to the section of information elements for more details.
C_RD_NA_1 (102)	None	NA
C_CS_NA_1 (103)	Byte	Time tag CP56Time2a
C_RP_NA_1 (105)	Byte	QRP: UI8[1…8]<0…255> 0: Not used

		1: General reset of process
		2: Reset pending events with time tag
		3…127: Reserved for future norm definitions
		128…255: Reserved for user definitions (private range)

■ **Information elements**

◆ **Single command**

SCO: CP8{SCS, BS1, QU, S/E}

bit	8	7	6	5	4	3	2	1
	S/E			QU			RES	SCS

	SCS: Single command state
Description	0: OFF
	1: ON

	QU: Qualifier for the commands
Description	0: Unspecified
	1: Short pulse
	2: Long pulse
	3: Persistent output
	4…8：Reserved for standard definitions of companion standard (compatible range)
	9…15：Reserved for the selection of other predefined functions
	16...31：Reserved for special use (private range)

	S/E: Select/execute state
Description	0: Execute
	1: Select

◆ **Double command**

DCO：CP8{DCS, QU, S/E}

bit	8	7	6	5	4	3	2	1
	S/E			QU			DCS	

	DCS: Double command state
Description	0: Indeterminate
	1: OFF
	2: ON
	3: Indeterminate

Refer to the SCO section for more details on S/E and QU.

◆ **Regulating step command**

RCO: CP8{RCS, QU, S/E}

bit	8	7	6	5	4	3	2	1
	S/E			QU			RCS	

	RCS：Status information of the step command
Description	0: Not allowed
	1: Step decrement
	2: Step increment
	3: Not allowed

Refer to the SCO section for more details on S/E and QU.

◆ **Qualifier of counter interrogation**
QCC: CP8{RQT, FRZ}

bit	8	7	6	5	4	3	2	1
	FRZ		RQT					
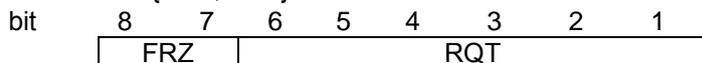
	RQT: Request qualifier of counter interrogation command
Description	0: No counter read
	1: Request counter group 1
	2: Request counter group 2
	3: Request counter group 3
	4: Request counter group 4
	5: General request counter
	6~31: Reserved for future norm definitions
	32~63: Reserved for user definitions (private range)

	FRZ: Freeze/reset qualifier of counter interrogation command
Description	0: Read only (no freeze or reset)
	1: Counter freeze without reset (value frozen represents integrated total)
	2: Counter freeze with reset (value frozen represents incremental information
	3: Counter reset

◆ **Single event of protection equipment**
SEP: CP8{ES, RES, EI, BL, SB, NT, IV}

bit	8	7	6	5	4	3	2	1
	IV	NT	SB	BL	EI	RES	ES	
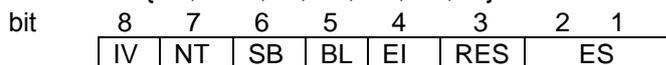
	IV: Invalid quality flag
Description	0: Valid
	1: Invalid

	NT: Topical quality flag
Description	0: Topical
	1: Not topical

	SB: Substituted quality flag
Description	0: Not substituted
	1: Substituted

	BL: Blocked quality flag
Description	0: Not blocked
	1: Blocked

	EI: Elapsed flag
Description	0: Elapsed time valid
	1: Elapsed time not valid

	ES: Event state (single event of protection equipment)
Description	0: Indeterminate
	1: OFF
	2: ON
	3: Indeterminate

◆ **Quality descriptor for events of protection equipment**
QDP: CP8{ RES, EI, BL, SB, NT, IV}

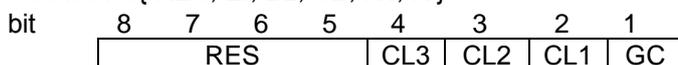| bit	8	7	6	5	4	3	2	1
	IV	NT	SB	BL	EI	RES		

Refer to section of SEP for more details.

◆ **Output cirquit information of protection equipment**
OCI: CP8{ RES, EI, BL, SB, NT, IV}

bit	8	7	6	5	4	3	2	1
	RES				CL3	CL2	CL1	GC

9.3.6 Delta Function Block, DFB_EIP_EXP

Use the function block, DFB_EIP_EXP to send explicit message to EtherNet/IP Adapter (available for AH10EN-5A FW V2.02 or later.)

Symbol:

|			
Execute	:	Execute (one time)	Bit
BID	:	Backplane code	Word
SID	:	Slot code	Word
IP1~IP4	:	IP address of the target device	Word
ConnMode	:	Connection mode of explicit message	Word
Service	:	Setting of the service code	Word
Class	:	Class ID	Word
Instance	:	Instance ID	Word
AttDisable	:	Disable attribute column	Bit
Attribute	:	Attribute ID	Word
DataSize	:	Data size	Word
Data	:	Data starting address	Word
Done	:	Execution done	Bit
Busy	:	Under execution	Bit
Error	:	An error occurs	Bit
ErrCode	:	Error code	DWord
DataLen	:	Data length	Word

Explanation:
1. AH10EN-5A can use the function block DFB_EIP_EXP to read / write data of the target device through Ethernet/IP.
2. Set **Execute** to ON to execute the function block DFB_EIP_EXP. After execution is done, **Execute** switches to OFF automatically.
3. BID: Backplane code; m_1=1~8. m_1=1 (main backplane), m_1=2~8 (extension backplane).
4. SID: Slot code; m_2=0~11. m_1=1 (main backplane), m_2 (slot)=0~11; if m_1=2~8 (extension backplane), m_2=0~7.
5. IP1~IP4 is where you enter the IP address of the target device in decimal format. For example, if the IP address of the target device is 192.168.1.5, then IP1=192, IP2=168, IP3=1, and IP4=5.

6. ConnMode: connection mode; 0: UCMM, 1: stop connecting once it's complete, 2: keep connected ever after it's complete.

7. Service code supported:

    ◆ 0x01 ：Get Attribute All

    ◆ 0x0E ：Get Attribute Single

    ◆ 0x10 ：Set Attribute Single

8. Write the value of Class ID, Instance ID, Attribute ID according to the objects of Ethernet/IP.

9. Starting address to store the written data; Data size (byte), up to 100 WORDs (200 bytes).

10. Operation status: DONE, BUSY and ERROR. DataLen: the data length of the output target device.

11. Error codes

Error Code		Desctiption
D+1	D	
Reserved	16#E000	Function block parameter invalid
Reserved	16#E001	The module in the slot is NOT AH10EN-5A.
Reserved	16#E002	Failed to write data into AH10EN-5A.
Reserved	16#E003	Failed to read data from AH10EN-5A.
Reserved	16#E004	Connection of EtherNet/IP Adapter failed
Reserved	Others	EtherNet/IP Adapter responds with communication error code

Example:

When M100 is set to ON, the function block, DFB_EIP_EXP is executed. AH PLC CPU use AH10EN-A installed on the slot number 0 of the main backplane to execute data exchange with the target device of IP address 192.168.1.19.
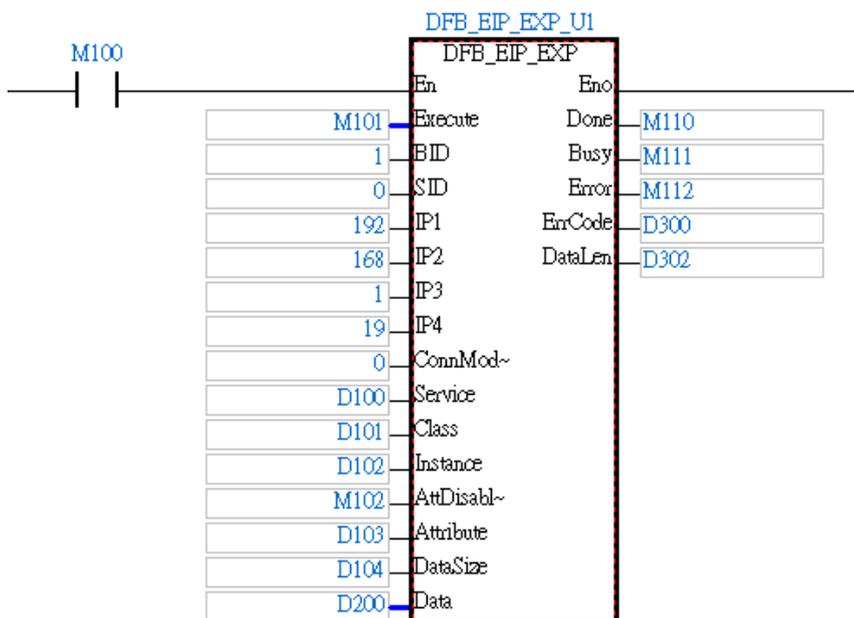
The use of the parameters:

- Set the value in D100 as 16#0010 to write into the target device. Set the value in D100 as 16#0001 or #16000E to read data from the target device.
- Set the value in D101, D102, D103 and M102 according to the objects of Ethernet/IP.
- Set the value in D104 as 2, if you need the data length of 1 WORD. D200 is the register address to execute data exchange.
- Set M101 to ON to execute data exchange. After execution is done, M101 switches to OFF automatically.
- During data exchange, M111 is ON. After data exchange is done, M112 is ON. If there is any error, its error code is stored in D300 and D301.
- D302 shows the data length of the output target device to be read and written; unit: byte.

9.4 Setting AH10/15EN-5A through ISPSoft

This section introduces the setting of AH10/15EN-5A through ISPSoft. There are three configurations in ISPSoft.

1. Hardware configuration: Setting the basic parameters
2. Network configuration: Setting the Ether Link
3. Intelligent module configuration: Setting the exclusive parameters

Please refer to ISPSoft User Manual for more information about scanning a module, and opening HWCONFIG and NWCONFIG.

9.4.1 HWCONFIG—Network Parameters

All network devices which will be connected to networks need Internet Protocol addresses (IP addresses). The IP addresses are like numbers, and are used to identify the identities of these network devices on the networks.
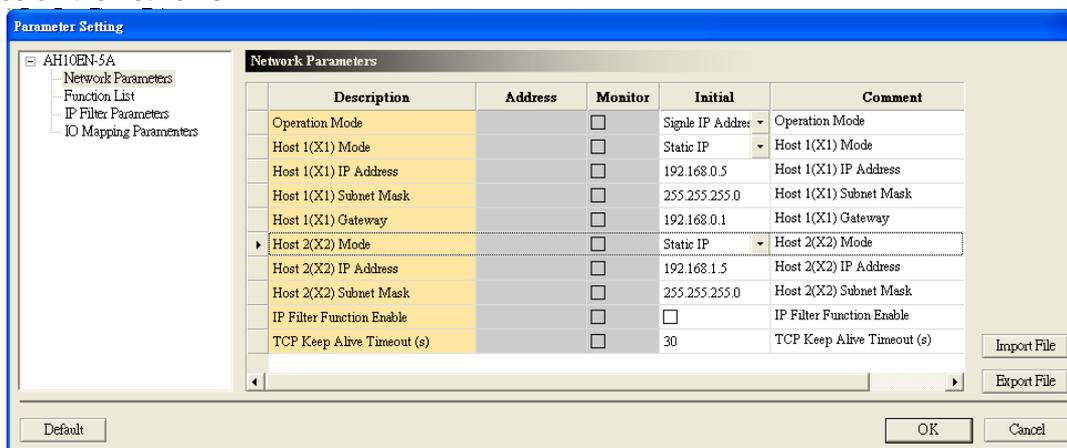
■ **Operation mode**

Users can select an operation mode of AH10/15EN-5A. They can assign a single IP address to AH10/15EN-5A and make AH10/15EN-5A support a switching hub, or they can assign two IP addresses to AH10/15EN-5A and make the two ports operate individually.

■ **IP address assignment**

There are two ways to assign IP addresses.

Static IP address: An IP address is manually assigned.

DHCP: An IP address is assigned by a slave. There must be a slave existing on a local area network.

Option	Description
Static IP address	Users assign an IP address, a subnet mask, and a default gateway.
DHCP	A DHCP slave assigns an IP address, a subnet mask, and a gateway.

■ **IP address**

An IP address is the address of a device on a network. Every device connected to a network needs an IP address. If a wrong IP address is used, the device can not connect to a network, even other devices can not connect to the network. Please contact a network administrator to get more information about assigning an IP address. The default IP address of AH10/15EN-5A is 192.168.0.5. When using the mode of two IP addresses, the two IP addresses cannot be under the same subnet mask, or an IP conflict may occur.

■ **Subnet mask**

A subnet mask is an important parameter for setting a subnet, and is used to judge whether the IP address of a destination device and the IP address of a local device are in the same subnet. If the IP address of a destination device and the IP address of a local device are not in the same subnet, the local device will send a packet to a gateway, and the gateway will send the packet to another subnet. If the setting is incorrect, a destination device can not communicate with AH10/15EN-5A normally. Users can judge whether the IP address of a destination device and the IP address of a local device are in the same subnet by performing a bitwise AND operation between the IP address of the local device and the subnet mask, and a bitwise AND operation between the IP address of the destination device and the subnet mask. If the two values are the same, the IP address of the destination device and the IP address of the local device are in the same subnet. The default subnet mask of AH10/15EN-5A is 255.255.255.0.

■ **Default gateway**

A gateway is a network point that acts as an entrance to another network. For example, in order to connect a local area network and a wide area network, a gateway is needed. The IP address that a gateway uses and the IP address of AH10/15EN-5A must be in the same subnet. The default gateway of AH10/15EN-5A is 192.168.1.1.

■ **IP filter**

AH10/15EN-5A provides a firewall service, and adopts an IP filter. To prevent errors from occurring, an IP filter is used to limit network connections. Only devices whose IP addresses are within the range set by users can connect to AH10/15EN-5A, and other devices whose IP addresses are not within the range can not connect to AH10/15EN-5A. After the IP filter function is enabled, IP addresses are filtered according to data which are set.

■ **TCP keepalive period**

The TCP keepalive period by default is set to 30 seconds.

9.4.2 HWCONFIG─Function List
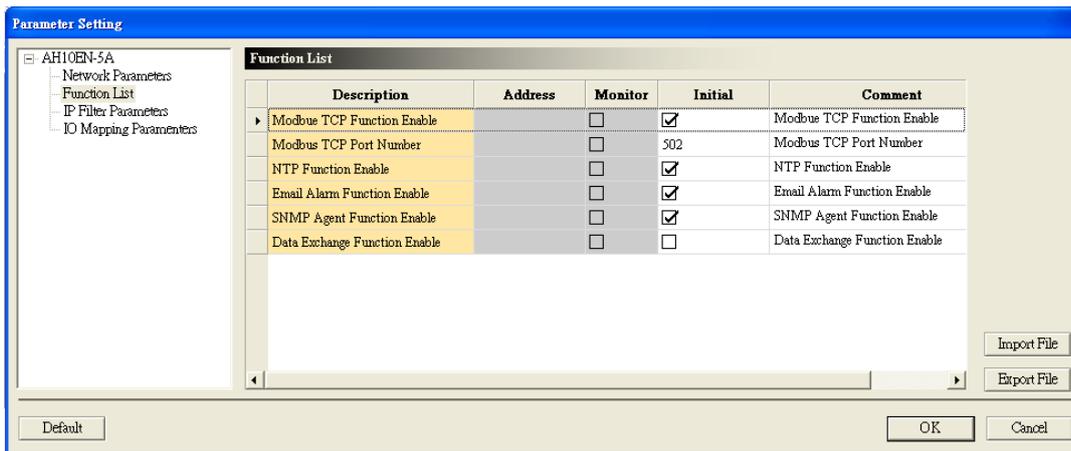
- **Enabling the MODBUS TCP function**
  Enabling or disabling the Modbus TCP protocol.
- **Modbus TCP port number**
  Users can set a Modbus TCP port number. The default value is 502.
- **Enabling the time correction function**
  AH10/15EN-5A synchronizes the real-time clock in an AH500 series PLC CPU to a slave on a network through the Network Time Protocol (NTP). To ensure that time is correct, the time is corrected every specific period of time
- **Enabling the email alarm function**
  After the email alarm function is enabled, users can trigger the sending of an email through a program.
- **Enabling the SNMP agent function**
  After the SNMP agent function is enabled, users can access a device in a CPU module
- **Enabling the data exchange function**
  After the data exchange function is enabled, users can set a data exchange.

9.4.3 HWCONFIG─IP Filter Parameters

To prevent errors from occurring, an IP filter is used to limit network connections. Only devices whose IP addresses are within the range set by users can connect to AH10/15EN-5A, and other devices whose IP addresses are not within the range can not connect to AH10/15EN-5A.
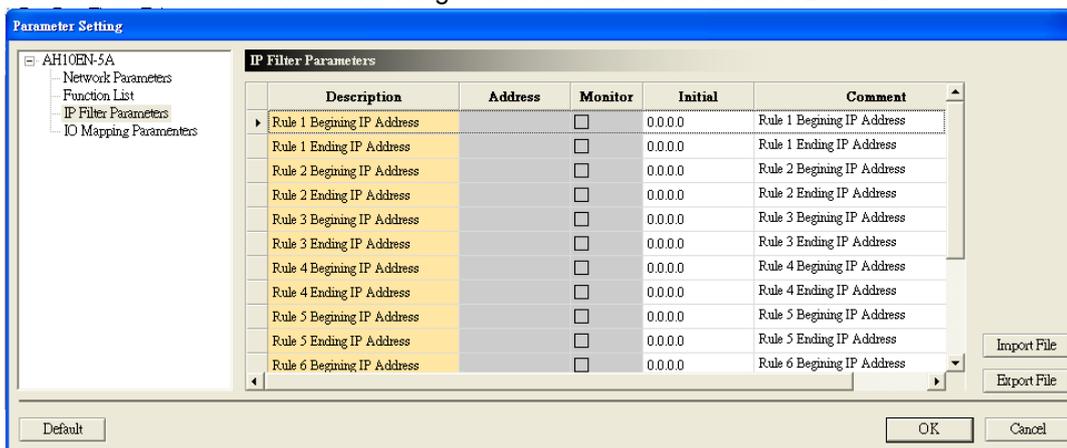
- **Setting an IP filter**
  User can set eight starting IP addresses and eight ending IP addresses.

9.4.4 HWCONFIG─I/O Mapping Parameters

I/O mapping is used to set data registers in a PLC CPU to which input data is transmitted, or from which data is transmitted.
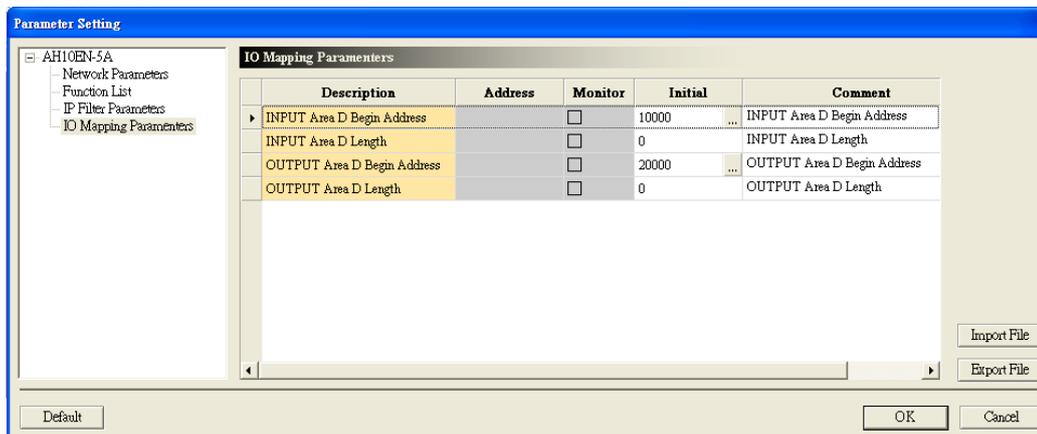
■ **Input data parameters**

Users can set an initial data register to which input data is transmitted, and the number of data registers. 12288 data registers at most can be used.

■ **Output data parameters**

Users can set an initial data register from which data is transmitted, and the number of data registers. 12288 data registers at most can be used.

9.4.5 Hardware Configuration − IEC60870-5 Parameters

This setting is used for configuring the parameters used in IEC60870-5 for AH15EN-5A; the setting range is 1s~255s.
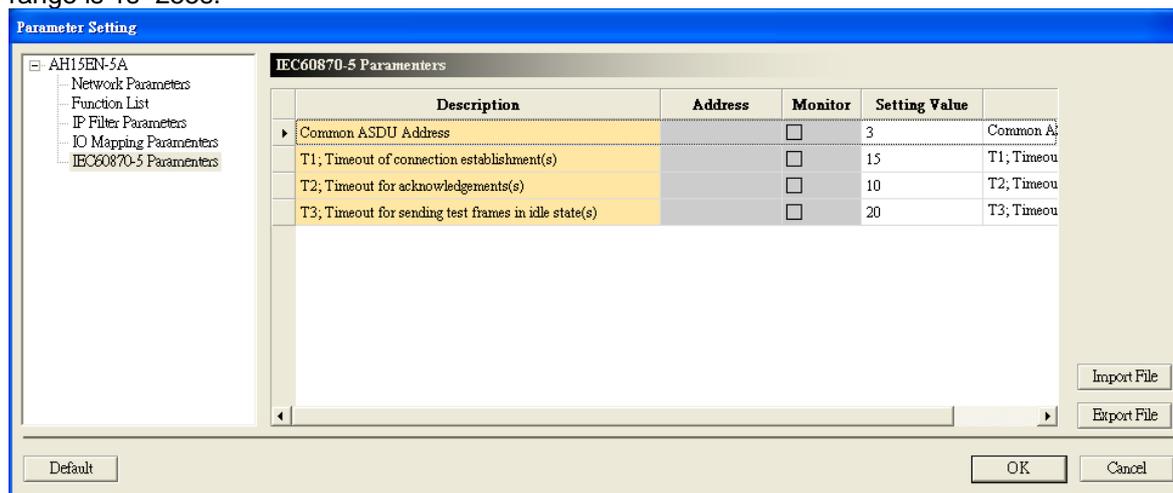
■ **Common ASDU Address**

The ASDU public address; default is 3.

■ **T1**

Timeout of connection establishment; default is 15s.

■ **T2**

Timeout for acknowledgements, if no data telegrams are transferred $t_2 < t_1$; default is 10s.

■ **T3**

Timeout for sent test telegrams in the event of long idle states; default is 20s.

9.4.6 Intelligent Module Configuration − NTP

Users can set the parameters related to time correction.
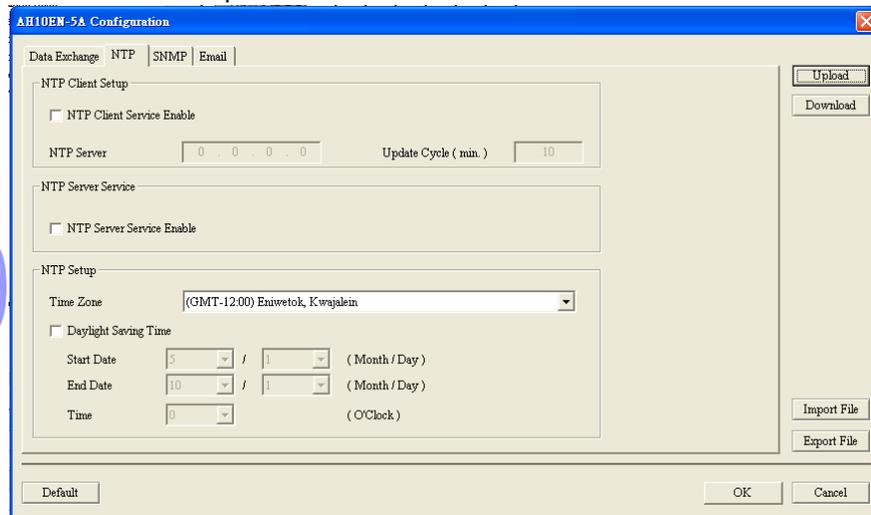
■ **Correction cycle**

AH10/15EN-5A synchronizes the real-time clock in an AH500 series PLC CPU to a slave on a network through the Network Time Protocol (NTP). To ensure that time is correct, the time is corrected every specific period of time. The default value is 10 minutes. The setting range is from 1 minute to 1440 minutes.

■ **Using Daylight saving time**

Daylight saving time—also summer time—is the practice of adjusting clocks forward one hour near the start of spring and adjusted backward in autumn. The total number of hours in a day in spring is 23. Whether a country uses daylight saving time depends on its policy. Since Taiwan does not use DST, the daylight saving time function is not enabled.

■ **Start date, end date, and time when a one-hour shift occurs**

After the **Daylight Saving Time** checkbox is selected, users can set a start date, an end data, and time when a one-hour shift occurs.

■ **NTP slave**

Users can set the IP address of an NTP slave. The real-time clock in a PLC CPU can be synchronized to the NTP slave.

■ **Time zone**

The earth is divided into 24 time zones. Each time zone calculates local time in relation to Greenwich Mean Time (GMT). Users can select the city in which their device is located, or specify the time difference between a local time zone and Coordinated Universal Time (UTC).

■ **Enabling the NTP slave service**

AH10/15EN-5A can function as an NTP slave. Modules on a network can be synchronized to AH10/15EN-5A.

9.4.7 Intelligent Module Configuration—Email

Electronic mail, also known as email, operates across the Internet or other computer networks. AH10/15EN-5A is equipped with the function of sending emails. Users can enter a text message related to a description of a status or an error in the **SMTP Subject** box. If a condition of triggering the sending of an email is met, the email will be sent to the users. There are three subtabs in the **Email** tab.

■ **Mail slave**

■ **SMTP slave**

An email is sent to an SMTP slave, and then the SMTP slave sends the email to an address which is specified.

■ **Local email address**

It is the address of an actual sender. A local email address is composed of 64 English characters at most.

■ **Subject of an email**

Users can enter a text message in the **SMTP Subject** box. The text message will be the subject of an email, and will be sent to a receiver. The subject of an email is composed of 64 English characters at most.

■ **Username and password**

Users can enter a username and a password for authentication.
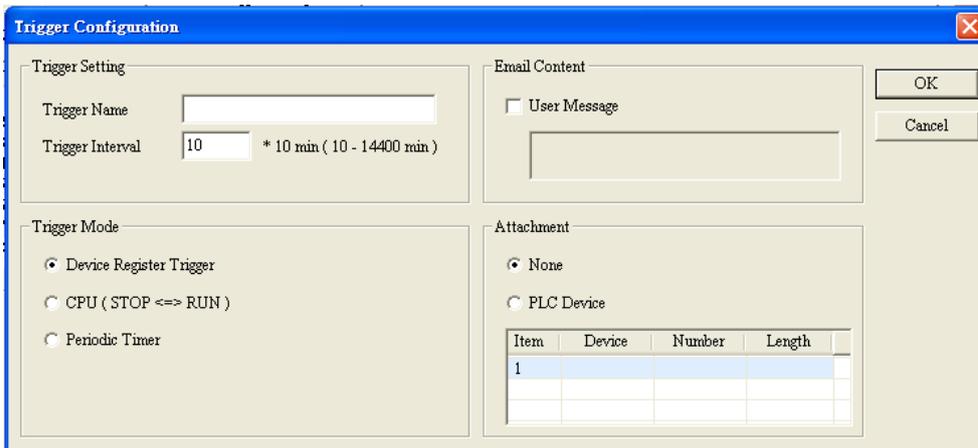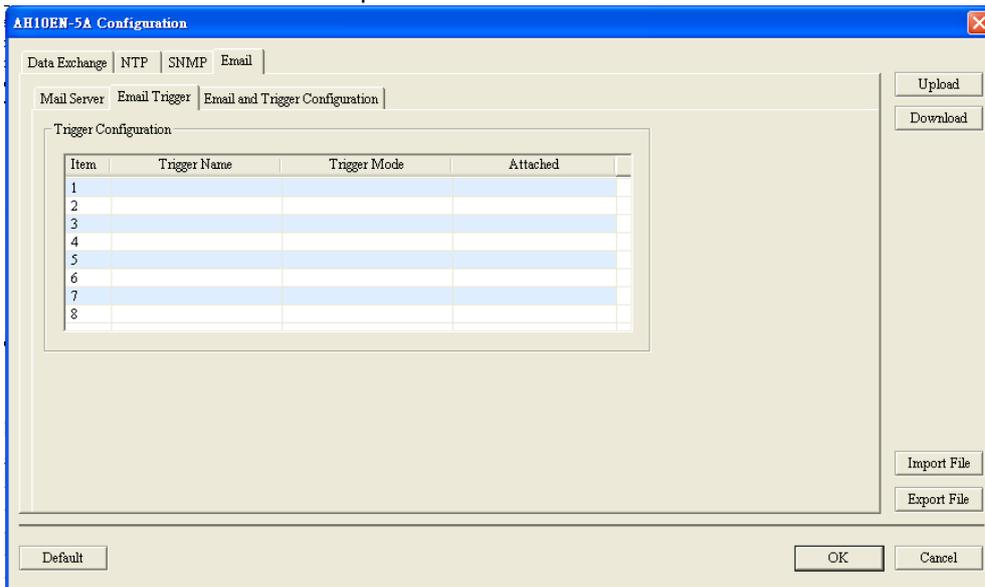
■ **Trigger name**

If a condition of triggering the sending of an email is met, AH10/15EN-5A will send the email, and the trigger name will be the subject of the email.

■ **Time Interval**

After a condition of triggering the sending of an email is met, a second email will not be sent within the time interval.

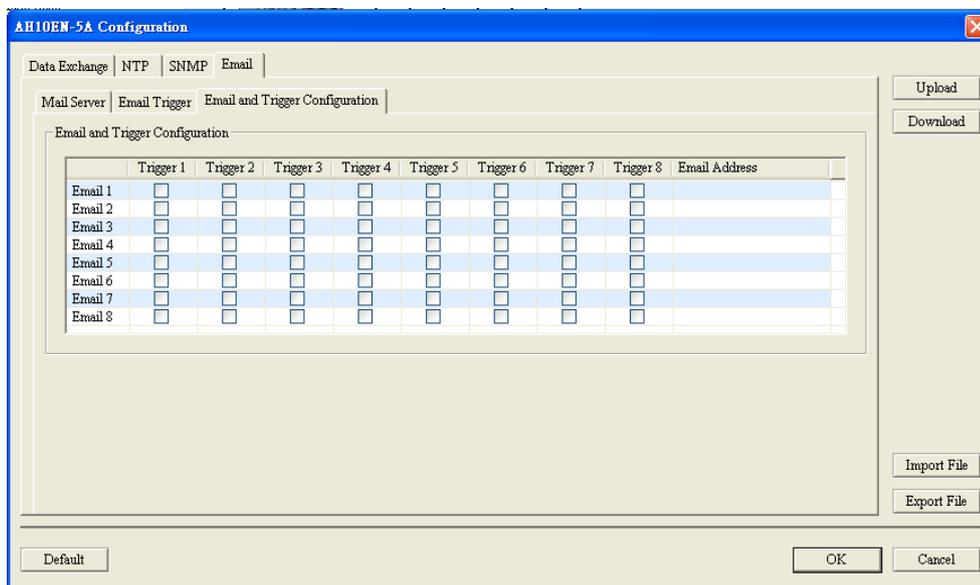■ **Mode of triggering the sending of an email**

The sending of an email can be triggered by the value in a register, triggered when a PLC CPU runs, or triggered periodically.

■ **User message**

Users can enter a user message. The message will be the contents of an email.

■ **Attachment**

The present value in a device in a PLC CPU can be an attachment to an email.

■ **Email address and trigger**

After the setting of email parameters is complete, users have to set email addresses to which emails are sent, and select triggers for the sending of the emails.

■ **Email address of a sender**

The email address of a sender is an address to which an email is sent.　(An email address is composed of 63 English characters at most.)

Note: Only if there is a mail slave on a network can an email be sent correctly. An email is sent to a mail slave, and then the mail slave sends the email to an address which is specified.

9.4.8 Intelligent Module Configuration─Data Exchange

CPU modules can exchange the data in devices which are specified through the data exchange function of AH10/15EN-5A.

■ **Data exchange setup**
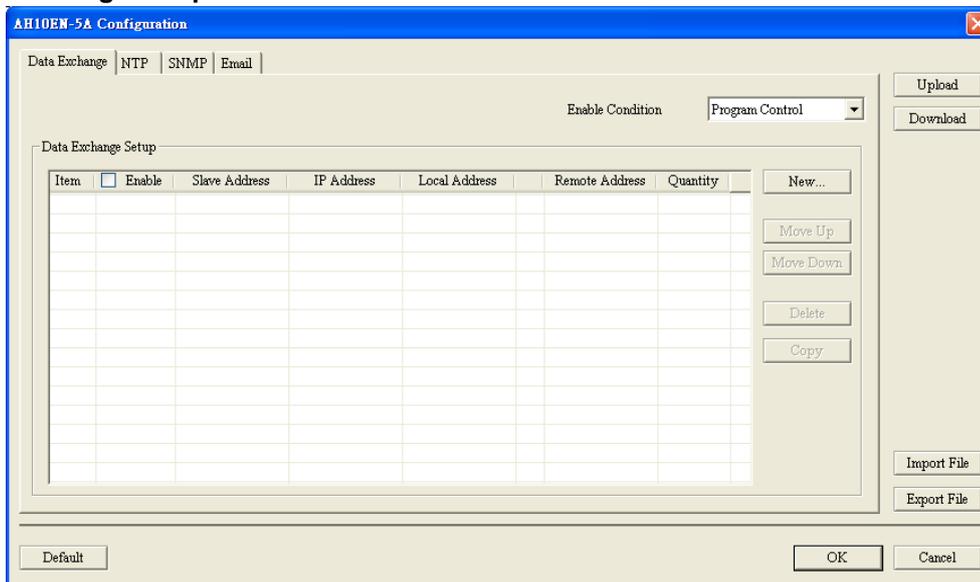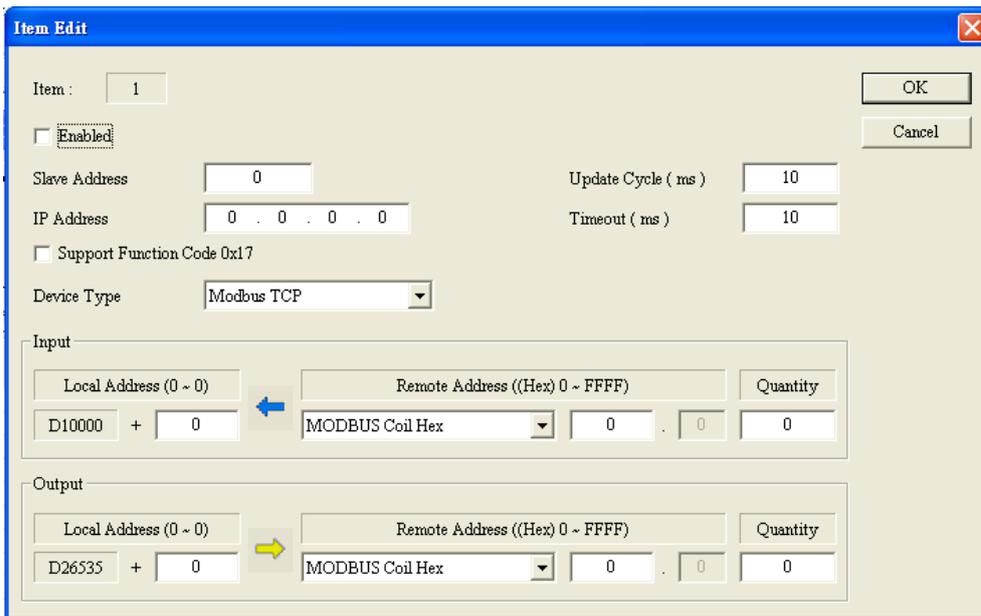
- **Operation mode**

  The data exchange function can be always enabled, controlled by a program, or enabled when a PLC runs. If the data exchange function is always enabled, AH10/15EN-5A will execute the function continually. when a PLC runs, the status of the PLC will be detected. When the PLC runs, the function is enabled. If the data exchange function is controlled by a program, the function will be controlled by the setting value in an output register. If the data exchange function is enabled

- **Station address and IP address**

  Users need to enter the IP address and the station address of a slave station.

- **Initial register in a master station, initial register in a slave station, and number of data**

  Input: Initial reception register in a master station←Initial transmission register in a slave station

  Output: Initial transmission register in a master station→Initial reception register in a slave station

  Number of data: A slave station can send 100 pieces of data at most and receive 100 pieces of data at most simultaneously.

9.4.9 Intelligent Module Configuration—SNMP

SNMP is used in a network environment to read and control CPU parameters.

■ **SNMP**

■ **Community string**

The communities which can be connected to AH10/15EN-5A

■ **Access type**

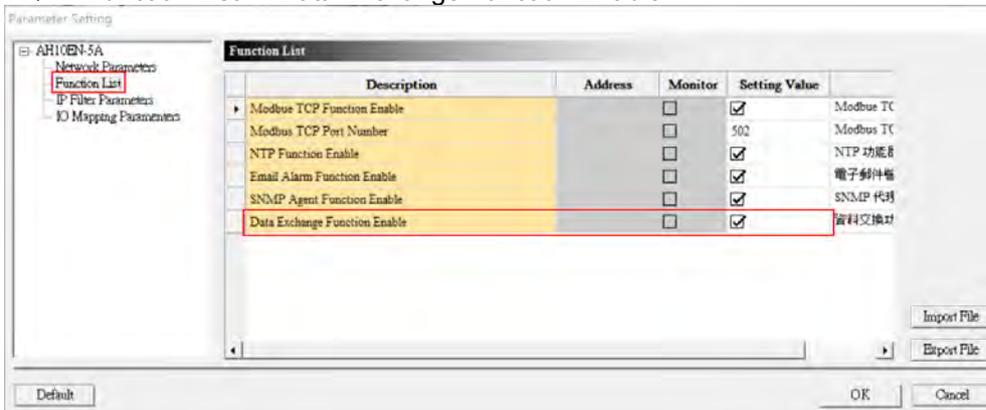Users can select **GET** (reading), or **GET/SET** (reading/writing).

9.5 Application Example

9.5.1 Data Exchange through MODBUS TCP

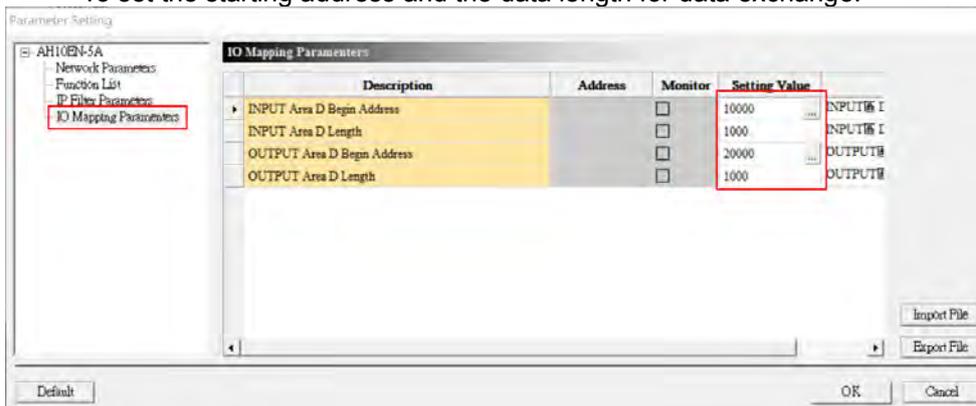AH10EN-5A is used in the following example. AH15EN-5A shares the same setting procedures.

1. **HWCONFIG Settings**
   - ◆ Function List -> Data Exchange Function Enable

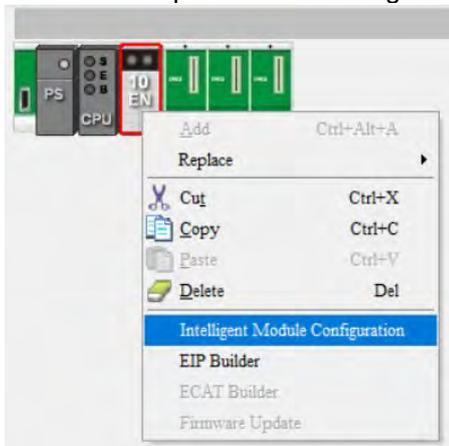   - ◆ IO Mapping Parameters -> Setting Value
     To set the starting address and the data length for data exchange.

   - ◆ Download the HWCONFIG parameters.

2. **Set up the data exchange table.**
   - ◆ Right-click AH10EN-5A to see the context menu and then double-click Intelligent Module. Configuration to set up the data exchange table.

◆ Set up the data exchange table and the Enable Conditions and then download.

◆ If downloading fails, close COMMGR on PC and use the PC administrator as the user to open COMMGR again.

3. **Enable conditions for data exchange**
   ◆ **Always Enable** means that the data exchange will be performed constantly when PLC is powered on.
   ◆ **PLC Run** means that the set data exchange will be performed automatically when PLC is in RUN state.
   ◆ **Program Control** means PLC decides whether the set data exchange is performed. When this condition is selected, you need to select the data exchange table otherwise this cannot work. You can use output registers to control the data exchange.
      ● Make sure you have assigned the output registers to their corresponding data registers.
      ● Write commands in the mapped data registers of the output registers to start data exchange. One bit represents one remote device. The setting value "0" indicates disabled and "1" indicates enabled. If you need to enable data exchange 1~3, write 2#0000 0000 0000 0111 in #12. To start performing data exchange, you need to control registers. See the next step for more details.
      ● Write commands in data exchange mode #11. The setting value "0" indicates no data exchange, "1" indicates all the data-exchange-enabled registers will perform data exchange once and then stop, "2" all the data-exchange-enabled registers will perform data exchange continuously. If you need to perform data exchange once and then again, you need to set the setting value to "1" to exchange data once and then set the setting value to "0" to stop and then set the setting value to "1" again.

Number		Attribute	Device Name
HW	LW		
-	#11	W	Data exchange mode
-	#12	W	Trigger 1~16 registers for data exchange
-	#13	W	Trigger 17~32 registers for data exchange
-	#14	W	Trigger 33~48 registers for data exchange
-	#15	W	Trigger 49~64 registers for data exchange

◆ Connection status check: use the input registers #11~15 to check the number of connections and status flags. If an error occurs, the corresponding byte will be set to 1.

## 9.5.2 Setting AH10EN-5A as EtherNet/IP Scanner

This example shows how to set up AH10EN-5A as an EtherNet/IP scanner. Make sure you use EtherNet to connect to AH Series PLC CPU in ISPSoft and AH10EN-5A is connected as an adapter.

1. **HWCONFIG Settings**
   The setting procedures are the same as setting MODBUS TCP, refer to section 9.5.1. for more information.

2. **EIP Builder Settings**
   ◆ Right-click AH10EN-5A to see the context menu and then double-click EIP Builder.
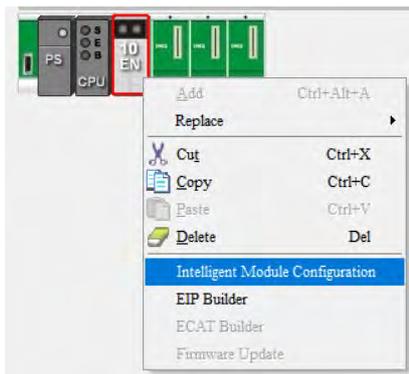
   ◆ Use **Scan** button on the tool bar to find adapters and select the one you'd like to add. If the device you want to add is not from Delta Electronics, you need to install the EDS file by selecting Tool and then select Install EDS files.
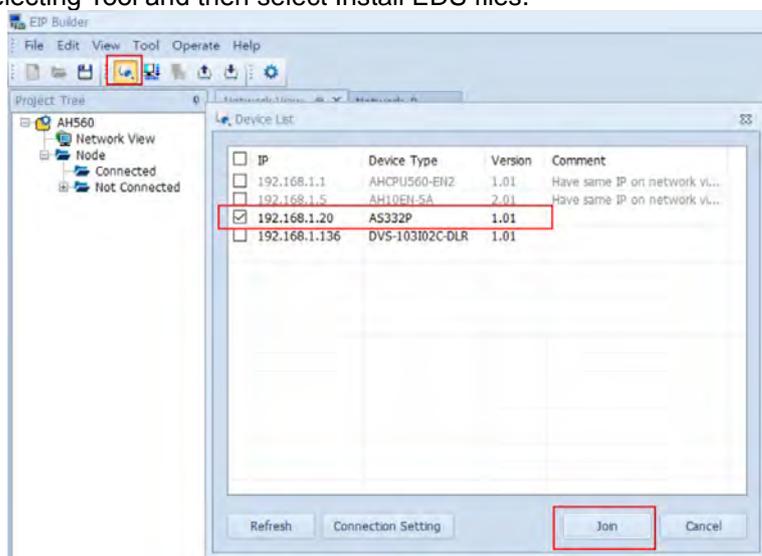
◆ Establishing a network connection: Click to select the red spot on the device and drag it to the dotted line below. By doing so, the network connection is created. Be sure to place AH10EN-5A and the adapter to the same network. AH10EN-5A has two red spots, select the one with the number that is the same as the last number of the IP address to create the network connection.
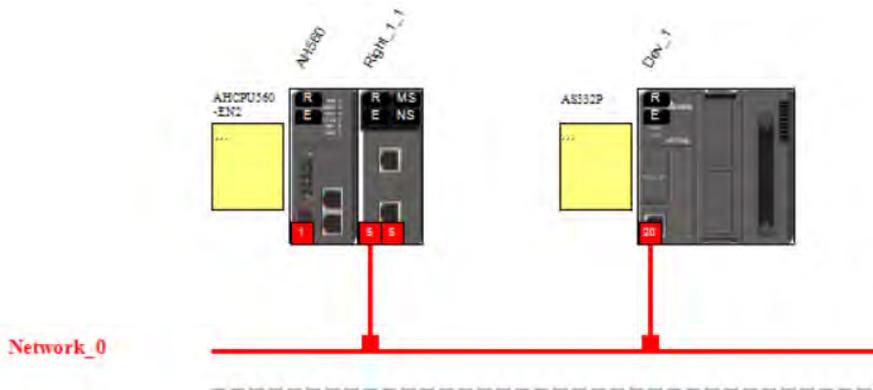

◆ Setting up the data exchange table: Right-click the red spot of AH10EN-5A to open Data Mapping setting page. Add the IP address of the adapter net in the list and edit the data mapping area on the right as requested. Only the mentioned data mapping area in HWCONFIG can be used.

◆ Setting up the EIP connection parameters: Double-click the … on the column of Property to open the Property Setting page and edit the parameters for data mapping. The value in Timeout varies with values in RPI. For example, if RPI = 20ms, TimeOut = 4 times of RPI = 500ms. Set the RPI value according to accuracy of the device time to ensure safety on the site.
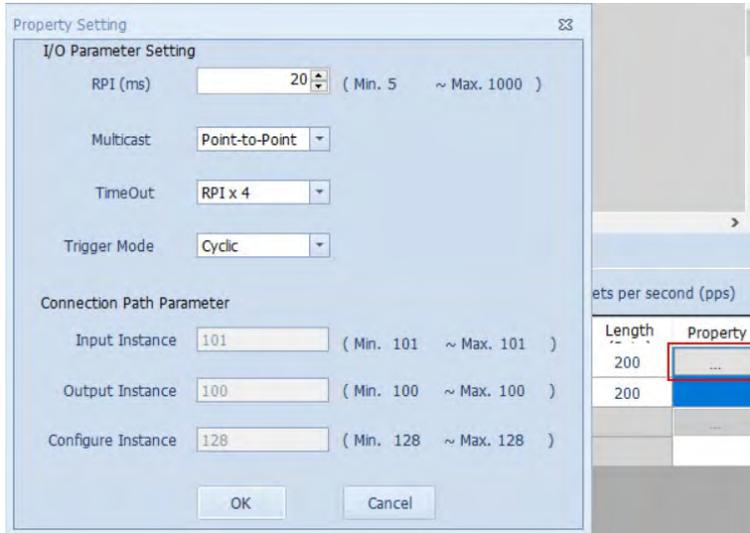
◆ Once the setting is done, you can download the EtherNet/IP parameters.
◆ Connection status check: During the execution of EIP connection, you can check the status of each data mapping in EIP Builder. If any error occurs, the error message appears on the right side of the data exchange table stating the cause of the error. Currently status flags are not available for AH10EN-5A.
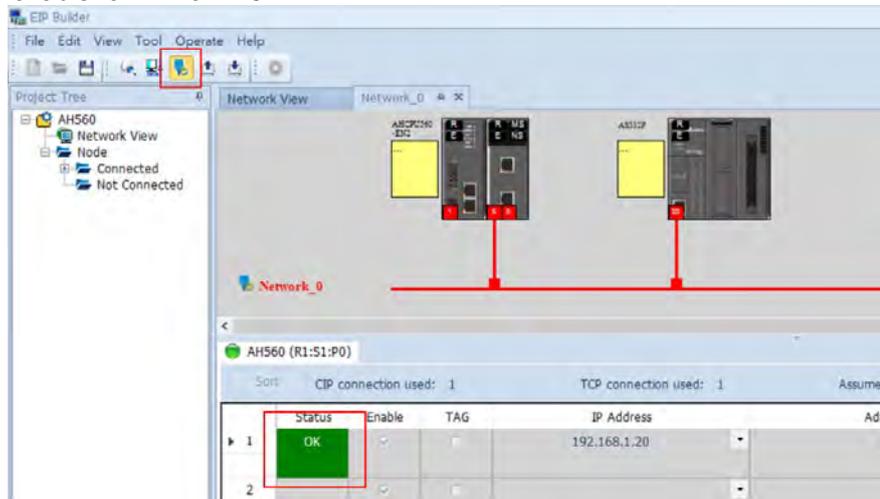
3.   Things to note

◆ AH10EN-5A can NOT connect to AHRTU-ETHN-5A or AS00SCM-RTU (AS-FEN02). AHRTU-ETHN-5A and AS00SCM-RTU (AS-FEN02) are RTU devices and they can only be adapters of the PLC CPU.
◆ PLC CPU and AH10EN-5A can NOT connect to the same network.
◆ If timeout occurs too frequently. It is suggested to increase the value in timeout to 32 times or even bigger. After the system is more stable, you can decrease the value in timeout. If increasing the value in timeout does not improve the timeout occurring too frequently problem, it is suggested to edit the RPI value to a bigger value, bigger than the maximum scan time of the input registers for data mapping. (#16 and #17).

9.6 Error Codes and Troubleshooting

Error code	Description	Resolution
80	The communication with an AH500 series PLC CPU failed.	1. Check whether the module is connected to the backplane properly. 2. Supply power to thePLC CPU and the module again. If the error still occurs, please contact the factory.
E2	1. The subnet mask set is illegal. 2. Two IP addresses are assigned. The IP address of host 1 conflicts with the IP address of host 2.	Check whether the network parameters in HWCONFIG are set correctly.
F1	An error occurs in an internal component.	1. Supply power to the module again. 2. If the error still occurs, please contact the factory.
F2	An error occurs in an internal component.	1. Supply power to the module again. 2. If the error still occurs, please contact the factory.
F3	MAC error	1. Supply power to the module again. 2. If the error still occurs, please contact the factory.
F4	IP conflicts	1. Make sure the Ethernet parameters of the module is set correctly. 2. Check if there are more than one device shares the same IP address on the network.
F5	DHCP/BOOTP failed	1. Make sure the Ethernet connection is correct. 2. Make sure the server status of DHCP/BOOTP is normal.

MEMO

9

MEMO

Chapter 10 DeviceNet Communication Module AH10DNET

Table of Contents

10.1 Introduction

AH10DNET-5A is installed at the right side of an AH500 series CPU module. AH10DNET-5A and an AH500 series CPU module constitute the DeviceNet master or slave.

10.1.1 Feature

- Constitutes the DeviceNet master by connecting an AH500 series CPU module and supports DeviceNet protocol.
- The network configuration software DeviceNet Builder provides the handy graphical configuration interface and automatically scans and recognizes all slaves on the bus.
- Supports DeviceNet master and slave mode.
- An AH500 series CPU module could be expanded by connecting 8 AH10DNET-5A scanner modules.
- Supporting 8 transmission speeds: 10 kbps, 20 kbps, 50 kbps, 125 kbps, 250 kbps, 500 kbps, 800 kbps and 1 Mbps.

10.1.2 Functions

AH10DNET-5A can be used as DeviceNet master as well as slave.

As a master, AH10DNET-5A can provide the following function.

- Automatically performing the data exchange with an AH500 series CPU module; users can directly operate the specified register in an AH500 series CPU module to achieve the real-time monitor of the slave.
- The configuration software can configure the network via the module as AH10DNET-5A serves as the connection medium between DeviceNet Builder configuration software and DeviceNet network.
- Supports to send the explicit message to monitor the slave through PLC program.
- The maximum input and output data length are both 980 bytes.

As a slave, AH10DNET-5A can provide the following function.

- Automatically performing the data exchange with an AH500 series CPU module; users can directly operate the specified register in an AH500 series CPU module to gain the control data of the master and return the corresponding data to the master.
- The maximum input and output data length are both 1000 bytes.

10.1.3 Specifications

- **AH500 series CPU modules which are supported**

Item	Specifications
Model name	AH500 series PLCs

- **DeviceNet interface**

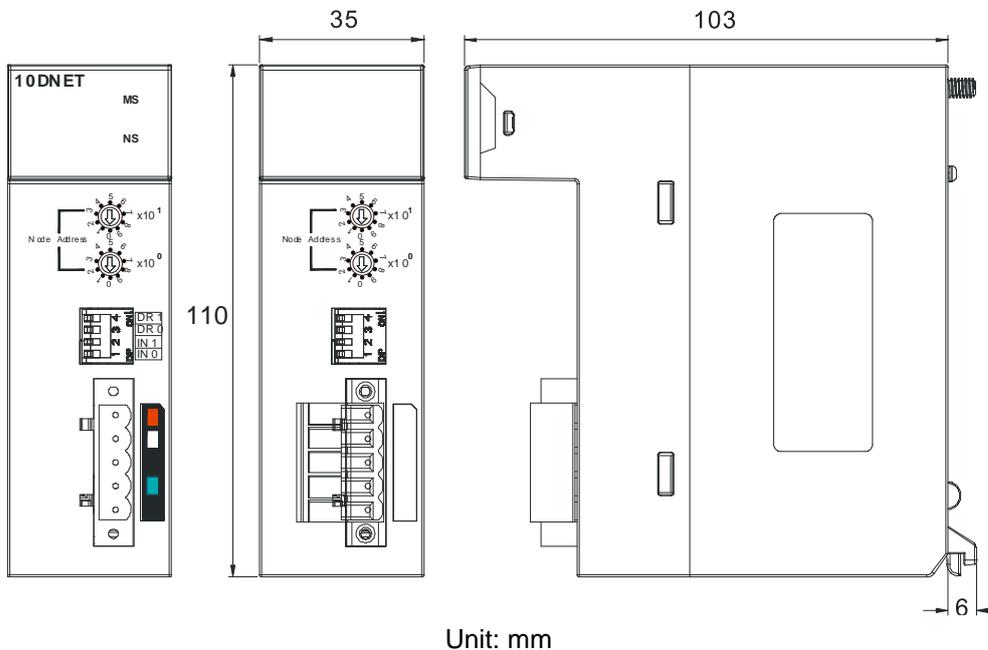| Item	Specifications
Transmission method	CAN
Electrical isolation	500 V DC
Connector	Removable connector (5.08 mm)
Communication cable	Recommend to use Delta standard cables; TAP-CB01 and TAP-CB02. The communication cable should be away from the power cable and the shielded cable should be connected to the ground.
Voltage	DeviceNet network provides 11~25 V direct current. e.g. 28 mA (Typical value), 125 mA impulse current (24 V DC).

● **DeviceNet Communication**

| Item	Specifications
Message type	Master mode: Support explicit message, all kinds of I/O connection with the slave such as I/O polled, bit-strobe, state changing, cyclic Slave mode: Support explicit message and Group 2 only server
Transmission speed	Standard: 125 kbps, 250 kbps and 500 kbps Extension: 10 kbps, 20 kbps, 50 kbps, 125 kbps, 250 kbps, 500 kbps, 800 kbps and 1 Mbps

● **Environment**

Item	Specifications
Noise immunity	ESD (IEC 61131-2, IEC 61000-4-2): 8 kV air discharge EFT (IEC 61131-2, IEC 61000-4-4): Power line:2 kV, Digital I/O: 1 kV Analog & Communication I/O: 1 kV Damped-oscillatory wave: Power line:1 kV, Digital I/O: 1 kV RS (IEC 61131-2, IEC 61000-4-3): 26 MHz~1 GHz, 10 V/m
Operation temperature	0ºC~55ºC (Temperature), 50~95% (Humidity), pollution level 2
Storage temperature	-25ºC~70ºC (Temperature), 5~95% (Humidity)
Vibration/Shock resistance	International standard IEC 61131-2, IEC 68-2-6 (TEST Fc)/IEC 61131-2 & IEC 68-2-27 (TEST Ea)
Certifications	IEC 61131-2, UL508

# 10.2 Profile and Outline

10.2.1 Profile and Dimensions
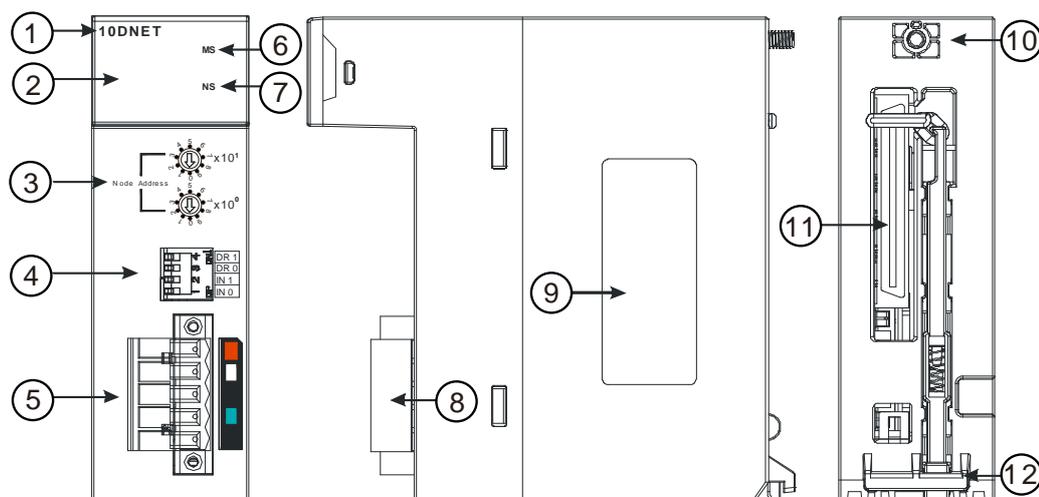
Unit: mm

10.2.2 Parts

Number	Name	Description
1	Model name	The name of the module
2	Seven-segment display	A display
3	Address switch	For setting the address
4	Function switch	For setting the function
5	DeviceNet connection port	For DeviceNet connection
6	MS indicator	An indicator
7	NS indicator	An indicator
8	Removable terminal	The terminals for wiring
9	Label	Nameplate
10	Set screw	Fixing the module
11	Backplane interface	The connector is used to connect the module and the backplane.
12	Projection	Fixing the module

10.2.3 DeviceNet Communication Connector

The connector is used on the connection to DeviceNet. Wire by using the connector enclosed with AH10DNET-5A.

| Pin	Signal	Color	Description
5	V+	Red	24 V DC
4	CAN_H	White	Signal+
3	-	-	Shielded wire
2	CAN_L	Blue	Signal-
1	V-	Black	0 V DC
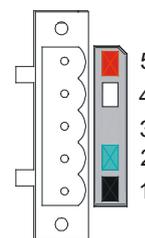
Note:
1. Connect the 24 V DC network power supply between V+ and V-.
2. One 121 ohm terminal resistor may be needed to connect between white and blue signal wires. For more details, please refer to section 10.3.4.

10.2.4 Address Switch

The switch is used on setting up the node address of AH10DNET-5A on DeviceNet. Range: 00~63 (64~99 are forbidden.)

Switch setting	Description
0-63	Valid DeviceNet node address
64-99	Invalid DeviceNet node address
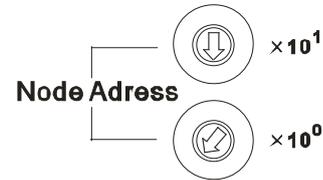
Example: If you need to set the node address of AH10DNET-5A to 26, simply switch the corresponding switch of $x10^1$ to 2 and the corresponding switch of $x10^0$ to 6.
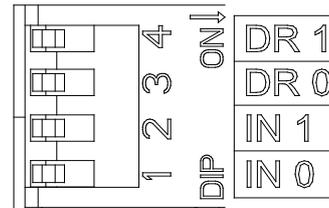
Note:
1. After the setup is completed, repower AH10DNET-5A. While AH10DNET-5A is working, changing the setting of node address will be invalid.
2. Use the slotted screwdriver to rotate the switch carefully in case you scratch the switch.

10.2.5 Function Switch

The function switches are used for:
● Setting up the work mode (IN0)
● Setting up the baud rate of DeviceNet (DR0~DR1)

DR1	DR0	Baud rate	Max. transmission distance
OFF	OFF	125 kbps	500 m
OFF	ON	250 kbps	250 m
ON	OFF	500 kbps	100 m
ON	ON	Entering the mode of extended baud rate (See section 10.7.3.)	

|	ON	When the corresponding equipment is off-line, the I/O data in the buffer area will be held.
IN0	OFF	When the corresponding equipment is off-line, the I/O data in the buffer area will be cleared.
IN1	Reserved	

Note:
1. After the setup of the function switch including DR1, DR0 and IN0 is completed, repower AH10DNET-5A.
2. Use slotted screwdriver to adjust the DIP switch carefully in case you scratch the switch.

10.2.6 Seven-segment Display

The digital display provides the following function:

● Showing the node station number of AH10DNET-5A

● Showing the error message of the slave
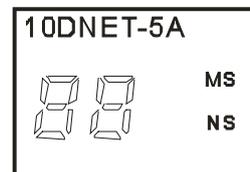
Note:
1. While AH10DNET-5A is working normally, the digital display shows its own node address.
2. If "E1" and "03" are shown continuously, it indicates that the error of E1 exists in the slave of node address 03.
3. If the error codes such as "E7" and "E1" are shown, please refer to section 10.10.2 for treatment.
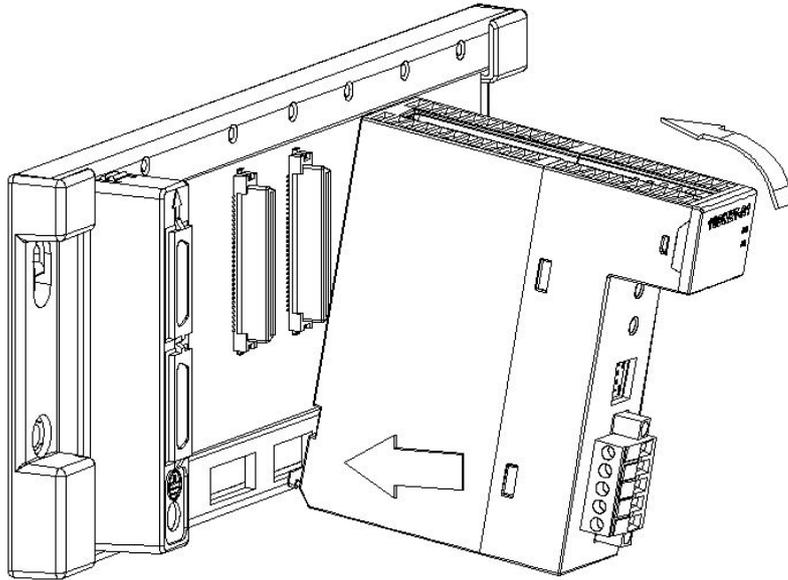
10.2.7 Backplane Interface

The interface is used for connection between AH10DNET-5A and a backplane.

10.3 Installation

10.3.1 Installing the Module

1. Insert the projection under the module into the hole in the backplane.
2. Push the module in the direction indicated by the following arrow to meet the I/O slot of the backplane.
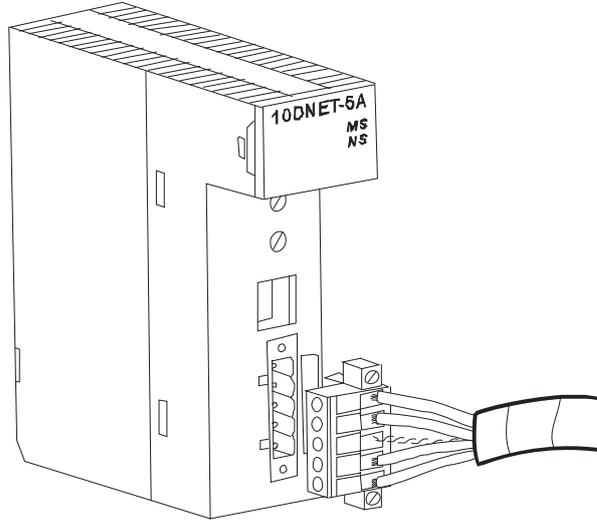

3. After properly installing, tighten the screw on the upper of the module.
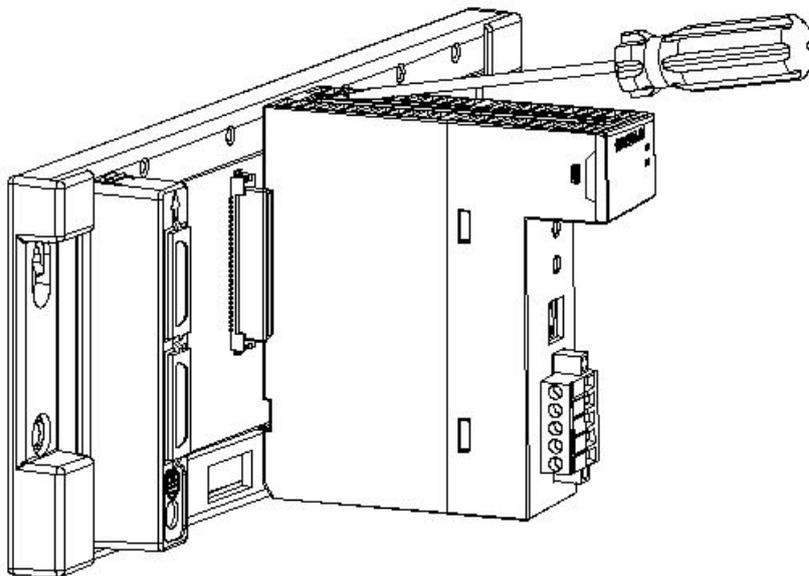
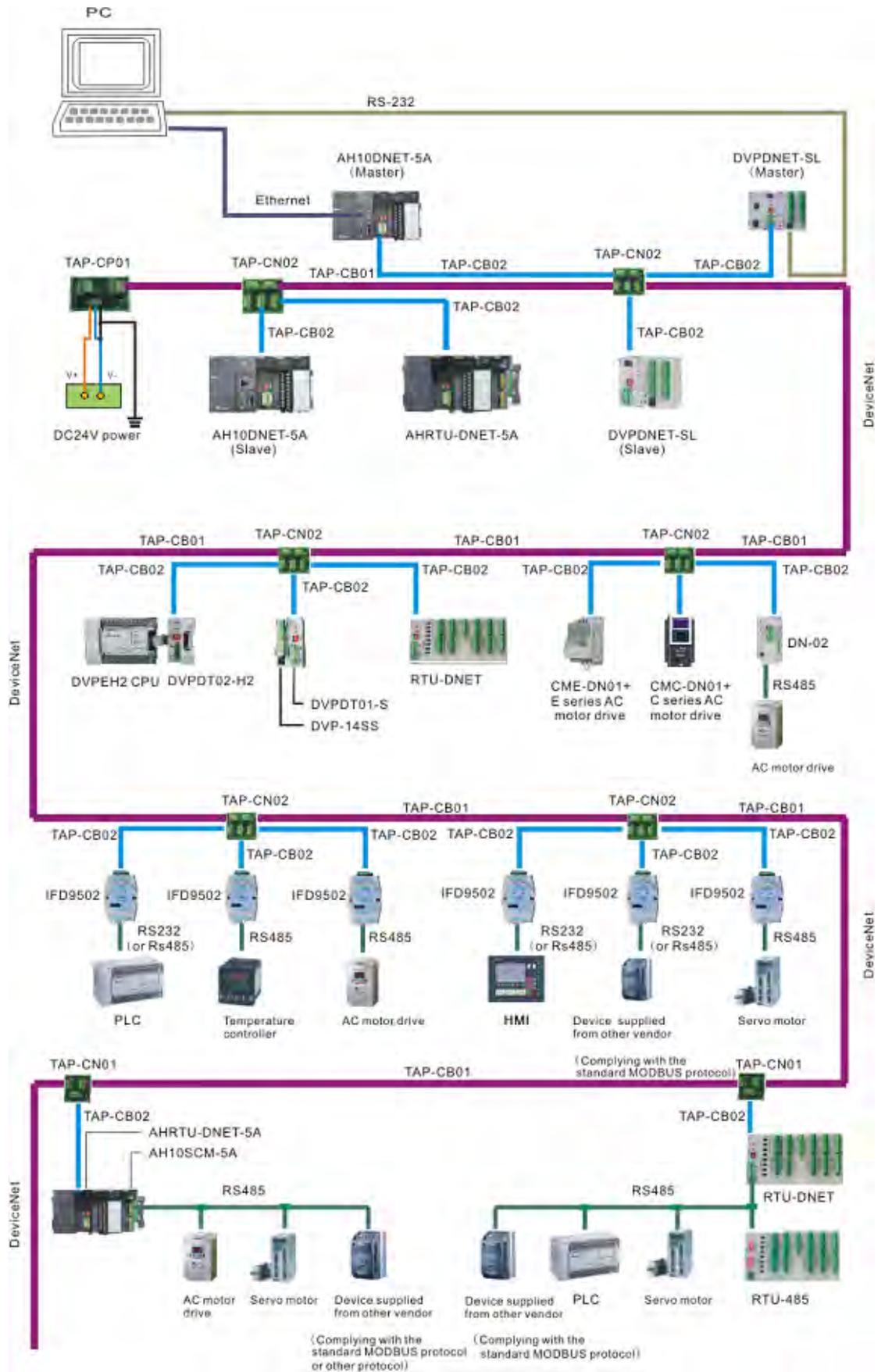## 10.3.2 Connecting to the DeviceNet Communication Connector

1. After wiring is completed, insert the DeviceNet connector to the port.
2. Tighten the screws on two sides of the DeviceNet terminal.


10.3.3 DeviceNet Bus Network Topology Structure

The transmission distance on the DeivceNet bus network is determined by the transmission rate. The following table shows the corresponding maximum communication distance at different baud rates.

Baud rate (Bit/s)	10K	20K	50K	125K	250K	500K	800K	1M
Max. transmission distance (M)	5000	2500	1000	500	250	100	50	25

Delta network products related with DeviceNet bus:

Product picture	Type	Function
	AH10DNET-5A	AH10DNET-5A, a DeviceNet module, running on the I/O slot of an AH500 series main backplane can work as the DeviceNet master or slave.
	AHRTU-DNET-5A	AHRTU-DNET-5A, a remote I/O module, is used for connecting an AH500 series DI/DO module, AI/AO module and 10SCM module to the DeviceNet network.
	DVPDNET-SL	DVPDNET-SL, a DeviceNet module, running on the left of an S series PLC can work as the DeviceNet master or slave.
	RTU-DNET	RTU-DNET, a remote I/O module, is used for connecting S-series DI/DO module, AI/AO module and other device to the DeviceNet network.
	IFD9502	Used for connection between the DeviceNet network and electromechanical equipment such as AC motor drive, PLC, temperature controller, servo drive, HMI, user-defined device.
	IFD6503	The bus data analysis tool, with one end of CAN interface and the other end of USB interface can be used for getting the CAN bus data or sending the data to the CAN bus node. It is used with the Netview Builder software together.
	E series AC motor drive	Used for connecting the AC motor drive to the DeviceNet network via CME-DN01 card

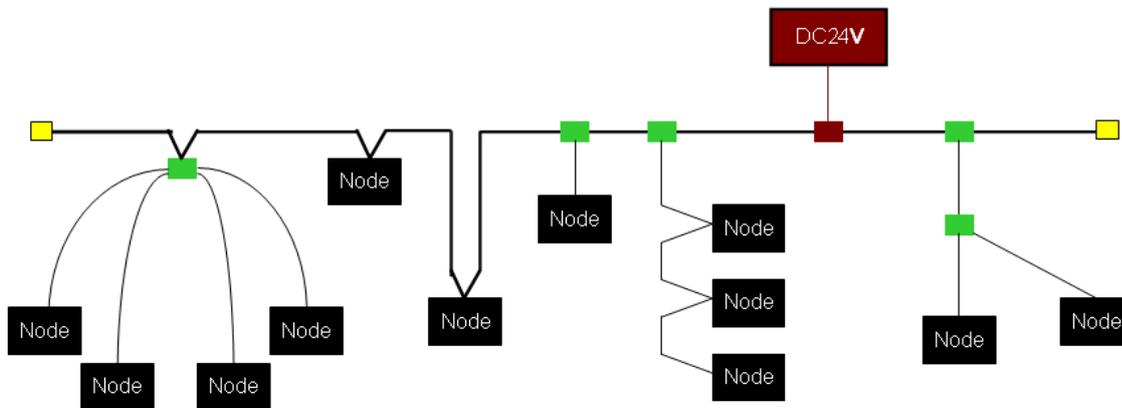| Product picture	Type	Function
	CMC-DN01	Used for connecting the C2000 series AC motor drive to the DeviceNet network
	DN-02	Used for the connection between the DeviceNet network and AC motor drive.
	DVPDT01-S	Used for the connection between the DeviceNet network and S series PLC.
	DVPDT02-H2	Used for the connection between the DeviceNet network and DVP-EH2 series PLC.
	TAPCP01	The CAN bus topology tapping box with the 120 ohm resistor enclosed which is effective or not via its switch.
	TAP-CN01	The CAN bus topology tapping box with the 120 ohm resistor enclosed which is effective or not via its switch.
	TAP-CN02	The CAN bus topology tapping box with the 120 ohm resistor enclosed which is effective or not via its switch.
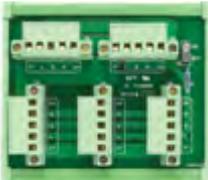
Product picture	Type	Function
	TAP-CB01	TAP-CB01: DeviceNet trunk cable
	TAP-CB02	TAP-CB02: DeviceNet drop cable

10.3.4 Choice and Purpose of a DeviceNet Terminal Resistor

● **Choice of a DeviceNet Terminal Resistor**

A DeviceNet network needs to connect a terminal resistor of 121 ohm at both ends of the trunk cable respectively.

The thick cable represents the main cable and the thin cable represents the sub-cable.

● **Purpose of a DeviceNet Terminal Resistor**

The terminal resistor is used for eliminating the signal reflection in the communication cable.

All signal transmission cables have the characteristic impedance. The characteristic impedance of Delta DeviceNet communication cable is about 121 ohm.

When being transmitted to the end of the communication cable, because the impedance of the end is different from the characteristic impedance, the signal will be reflected, which will interfere with the new signal and the signal wave form distortion will happen.

The phenomenon of the signal wave form distortion is not obvious in the short-distance transmission. But the wave form distortion will become severe with the increasing communication cable. Therefore, the two ends of the trunk cable must be installed with the terminal resistors respectively.

● **Installation Position of a Terminal Resistor**

The DeviceNet communication cable consists of five wires such as red wire, blue wire, white wire, black wire and shielded wire as below.
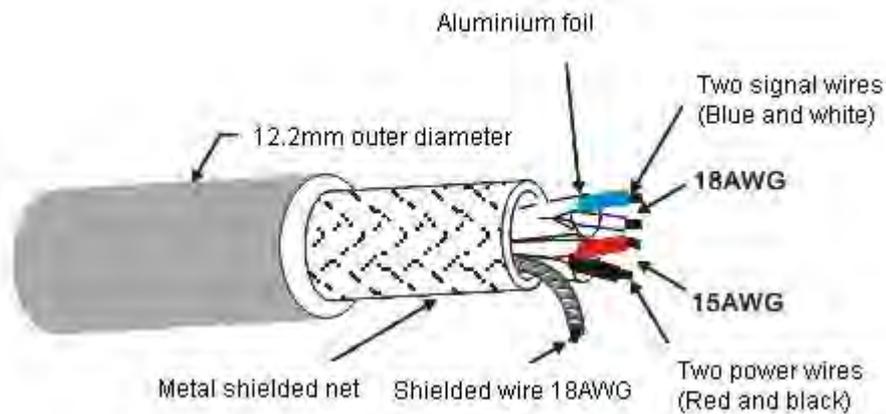
The terminal resistors must be installed to the two ends of the trunk cable only. Since the blue wire and white wire are for signal transmission, the terminal resistor must be installed between blue wire and white wire.

10.3.5 DeviceNet Network Supply Power

The network just needs one or multiple supply powers which supply the power to each piece of network equipment via the bus cable.
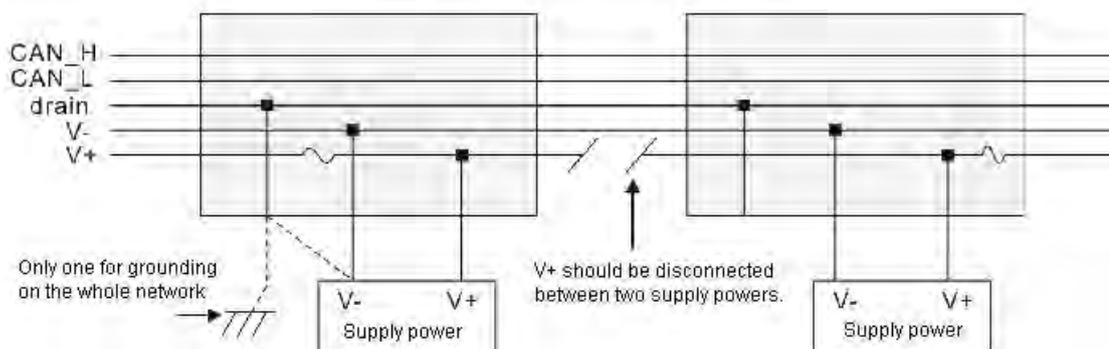
Delta DeviceNet bus cable consists of five wires, among which the power wire and signal wire occupy two wires respectively and the left one is the shielded wire as the above figure shows.

The supply power for the bus is optional and could be a single supply power or multiple supply powers according to the actual demand.

● **Single Supply Power**
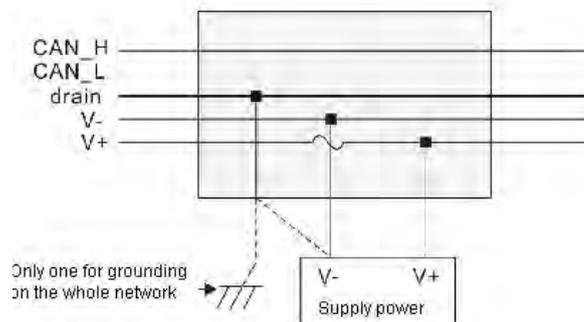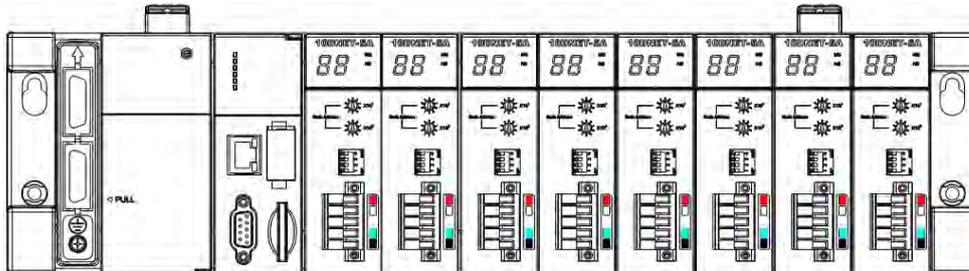

● **Multiple Supply Powers**

10.4 Configuration of AH10DNET-5A

10.4.1 Data Mapping Areas

This section is going to introduce the mapping relations between an AH500 series CPU module and AH10DNET-5A.

An AH500 series CPU module can be extended by connecting maximum 8 AH10DNET-5A scanner modules which could only be installed to the main backplane. After AH10DNET-5A and an AH500 series CPU module is connected, users could specify the starting register addresses for the input mapping and output mapping.

When only one backplane exists and there are several AH10DNET-5As on the right side of an AH500 series CPU module, the software distinguishes different AH10DNET-5As according to their unit numbers. The farther the scanner module is away from an AH500 series CPU module, the larger its unit number is. The unit number of the first AH10DNET-5A of the right side of an AH500 series CPU module is 1. The next one nearest to the first scanner module is 2. And the following ones will be 3, 4 and so on.

10.4.2 Assignment of Mapping Area (in Master Mode)

While AH10DNET-5A works in master mode and the starting addresses for output and input are specified as D500 and D1000 respectively, the mapping area will be assigned as the following table is.

Input area: Slave->Master			Output area: Master->Slave		
AH500 series CPU module Register No.	Purpose	Data Length	AH500 series CPU module Register No.	Purpose	Data Length
D1000~D1003	Scan list node status display area (See section 10.6.1.)	4 words	D500~D503	Bit-strobe command area (See section 10.5.)	4 words
D1004	Scanner module status display area (See section 10.6.2.)	1 word	D504	Reserved	1 word
D1005~D1494	DeviceNet input data area: these registers are used for receiving the status data feedback from the slave.	Max. length: 490 words	D505~D994	DeviceNet output data area: the values in these registers are sent to the slave as the control data.	Max. length: 490 words

Note: D1000 and D500 in the above table are the starting addresses in the mapping area. If the addresses are set to other registers, the corresponding function will be assigned to other registers.

If the length of DeviceNet input data area is 3 words, AH10DNET-5A will occupy D1000~D1004 and D1005~D1007 in an AH500 series CPU module automatically. Meanwhile, if the length of DeviceNet output data area is 2 words, AH10DNET-5A will occupy D500~D504 and D505~D506 in an AH500 series CPU module automatically.

10.4.3 Assignment of Mapping Area (in Slave Mode)

While AH10DNET-5A works in slave mode and the starting addresses for output and input are specified as D1000 and D500 respectively, the mapping area will be assigned as the following table is.

Output area: Master->Slave			Input area: Slave->Master		
Initial register	Purpose	Max. length	Initial register	Purpose	Max. length
D1000	The register is used for receiving the control data that the master sends out.	490 words	D500	The values in the register will be feedback to the master.	490 words

The data length of AH10DNET-5A can be set freely when it works as a slave.

10.4.4 Data Flow Direction of Master and Slave

There are two AH10DNET-5As on the network working as the master and slave respectively.
One AH10DNET-5A works as the master and the starting address of its mapping area is shown as the following window. The starting addresses for output and input are D500 and D1000 respectively.
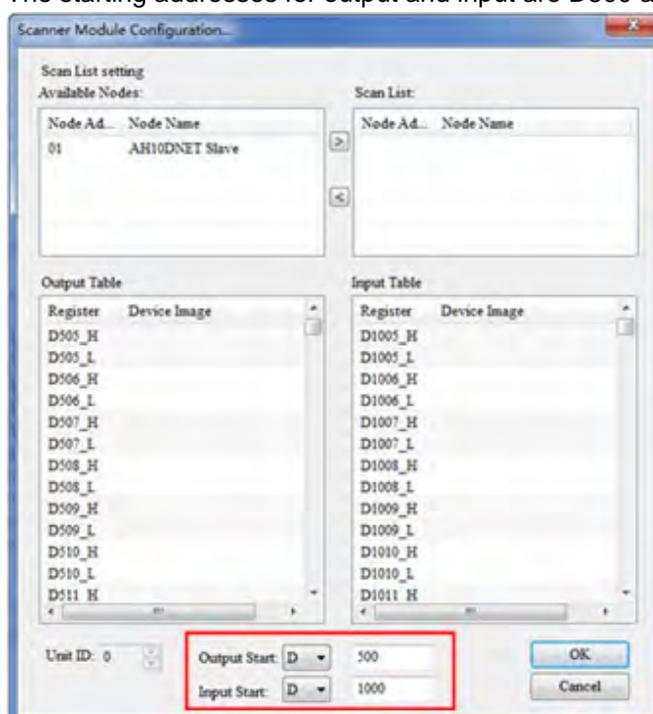

Note: D500 and D1000 in the above window are the registers in an AH500 series CPU module on the left of AH10DNET-5A functioning as a master.

The other AH10DNET-5A serves as a slave and the starting address of its mapping area is shown as below window. The data that master sends to the slave will be updated in the registers starting from D1000 and meanwhile, the values in the registers starting from D500 will be sent to the master by the slave.
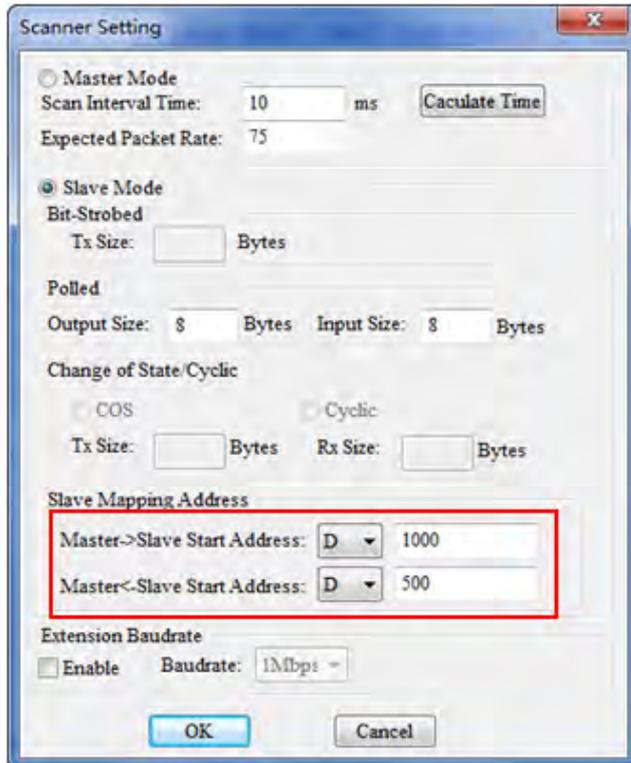
Note: D1000 and D500 in the above window are the registers in an AH500 series CPU module on the left of AH10DNET-5A functioning as a slave.

The following figure illustrates the corresponding relations in the mapping areas of the master and slave. The master and slave both consist of AH10DNET-5A and an AH500 series CPU module.
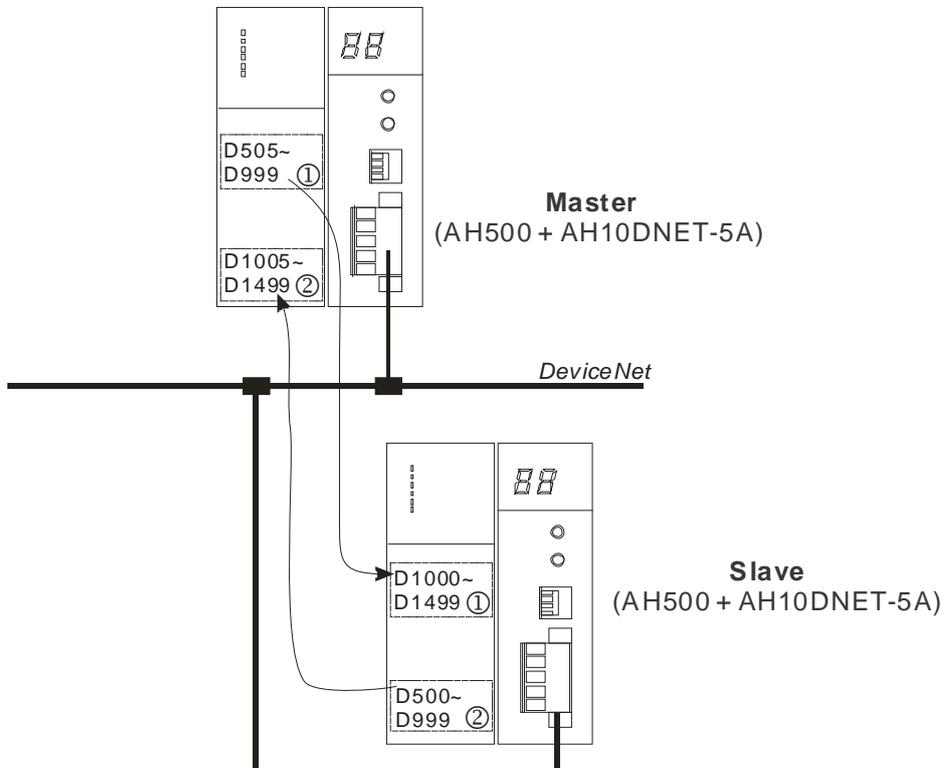
Note: In the above figure, the maximum data length is introduced. But the actually configured data length may be different from it.

① represents the control data that DeviceNet master sends and these data will be updated in the registers starting from D1000 in real time. Meanwhile, ② represents the values in the registers starting from D500 and these values will be transmitted back to DeviceNet master automatically. The two groups of data will be both updated in every scan period so as to achieve the real-time control.

## 10.5 Bit-strobe Command

10.5.1 Bit-strobe Work Principle

Bit-strobe is one of the DeviceNet standard I/O transmission methods. The command length is fixed to 8 bytes, i.e. 64 bits. (Maximum 64 stations exist on the DeviceNet network.) And one bit corresponds to one node. In the bit-strobe transmission method, the master does not send the control data to the slave. But when the corresponding bit is set to OFF, the slave needs to reply the I/O data to the master; when the corresponding bit is set to ON, the slave does not need to reply the I/O data to the master.

If the starting address for the output is D500, the corresponding relations between bit-strobe registers and the nodes are shown as the following table.

Bit-strobe register	Corresponding network node					
	b15	**b14**	**b13**	**… …**	**b1**	**b0**
D500	Node 15	Node 14	Node 13	… …	Node 1	Node 0
D501	Node 31	Node 30	Node 29	… …	Node 17	Node 16
D502	Node 47	Node 46	Node 45	… …	Node 33	Node 32
D503	Node 63	Node 62	Node 61	… …	Node 49	Node 48

Note:
1. If the starting address for the output is set to D123 (which you can refer to section 10.6.2), the bit-strobe registers are D123~D126 instead of D500~D503.
2. If the slave does not support the bit-strobe function, the slave will still reply the I/O message to the master after the corresponding bit is set to ON.
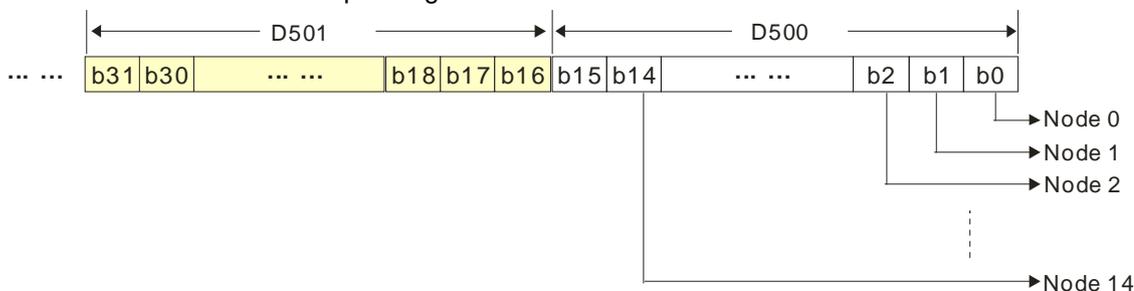
Suppose the starting address for the output is D500 and the slaves support the bit-strobe function. When bit 0 in D500 is OFF, the node 0 is selected and it needs to return its data to the master. When bit 0 and bit 1 are both OFF in D500, the node 0 and node 1 are both selected and they need to send their own data to the master.

10.6 Network Node Status Display

10.6.1 Scan List Node Status Display

The function is used for monitoring whether the DeviceNet slave is offline or not. The scanner module conducts the real-time monitor and control of the nodes in the scan list and maps the status of each node in the scan list to one bit so that users could acquire the status information of the network node through monitoring the value in the corresponding register.

If the starting address for the input is D1000, the corresponding relations between the node status registers and the slave are as follows.

Node status register	Corresponding network node					
	b15	b14	b13	… …	b1	b0
D1000	Node 15	Node 14	Node 13	… …	Node 1	Node 0
D1001	Node 31	Node 30	Node 29	… …	Node 17	Node 16
D1002	Node 47	Node 46	Node 45	… …	Node 33	Node 32
D1003	Node 63	Node 62	Node 61	… …	Node 49	Node 48

Note: If the starting address for the input is set to D567 (See section 10.6.2), the node status registers are D567~D570 instead of D1000~D1003.

When the nodes in the scan list are normal, the corresponding bit is OFF; when the nodes are abnormal, the corresponding bit is ON.

10.6.2 Scanner Module Status Display

If the starting address for the input is D1000, users could acquire the status message of the scanner module AH10DNET-5A through monitoring D1004 in real time.

When the scanner module works normally, the content of D1004 is 0; when the scanner module is initializing, the content of the high byte and low byte in D1004 are 1 and 0 respectively; when an error occurs in the scanner module, the high byte content in D1004 is 2 and the low byte content is the error code.

Regarding the details on the error code, please refer to the seven-segment display in section 10.10.2.

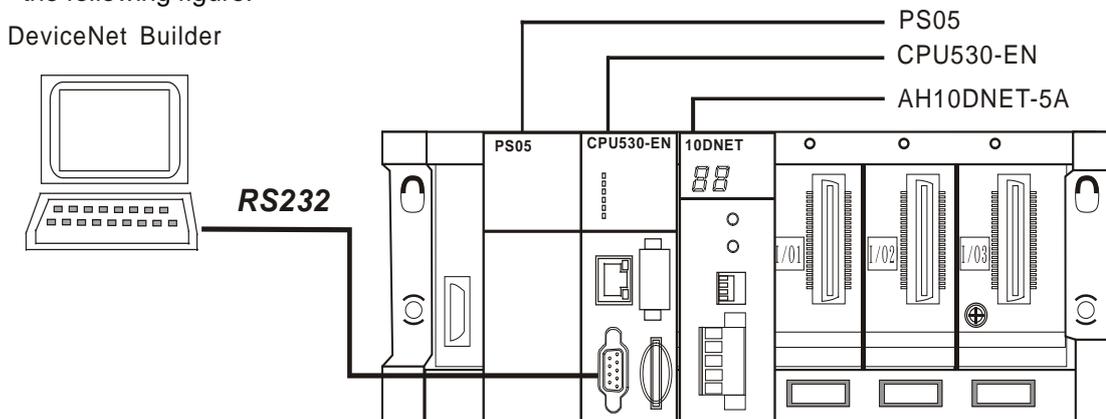| PLC register	Description															
	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
D1004	Scanner module status (0: Normal, 1: Initializing, 2: Error)								Error codes in the scanner module (See section 7.11.2.)							

Note: If the starting address for the input is set to D600 (Refer to section 10.6.2), the register in the above table is D604 instead of D1004.

10.7 Special Operation in Master Mode

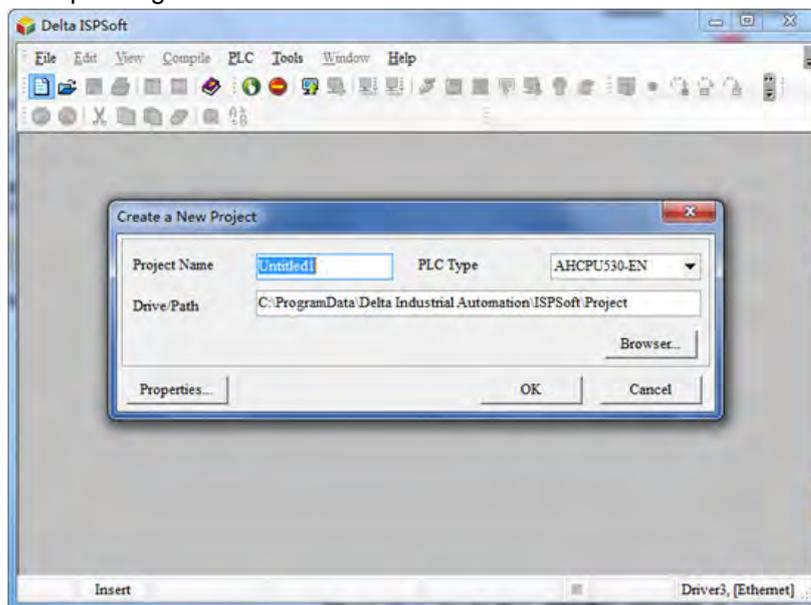### 10.7.1 Master Mode Setting

If AH10DNET-5A is in slave mode, it can be set to the master mode via the DeviceNet Builder software.

1. PC accesses an AH500 series CPU module via USB after connecting the device according to the following figure.
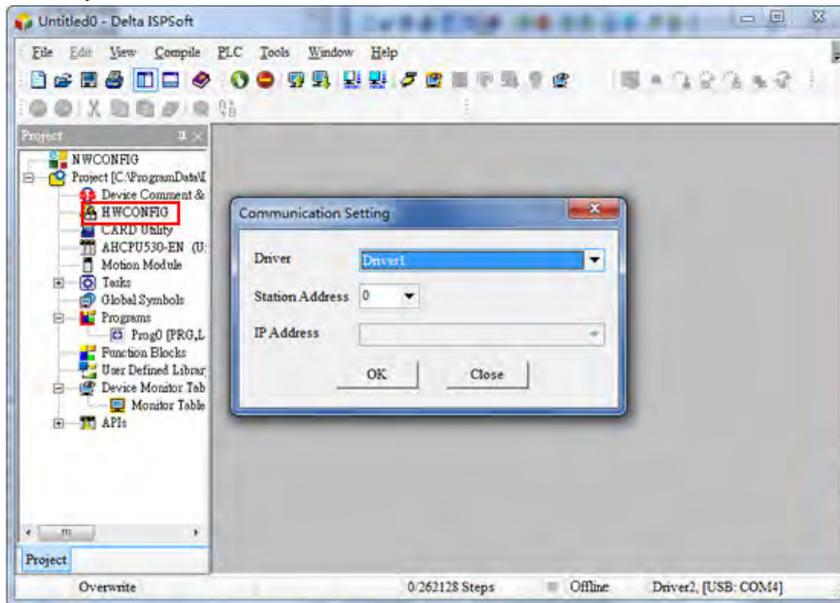

Note: The introduction in this section is made in the USB communication method.

2. Open ISPSoft, select "File" >> "New" >> "New" and then the following dialog box appears where select the corresponding PLC.

Note: The PLC used in this section is AHCPU530-EN.

3. Select "Tool" >> "Communication Setting" and then the following dialog box appears where select the already built driver.

   Note: The driver is built via COMMGR software. See section 8.1.4 in the help file of the DeviceNet Builder software for more.

4. Double click "HWCONFIG" symbol in the above window and then a new interface pops up, where select "Option" >> "I/O Scan" and then the icon of AH10DNET-5A will emerge as below.


   Note: AH10DNET-5A could be installed to other slot.

5. Select "Option" >> "Download" in the HWCONFIG software interface and then the following dialog box appears, where select "OK" to download the data.
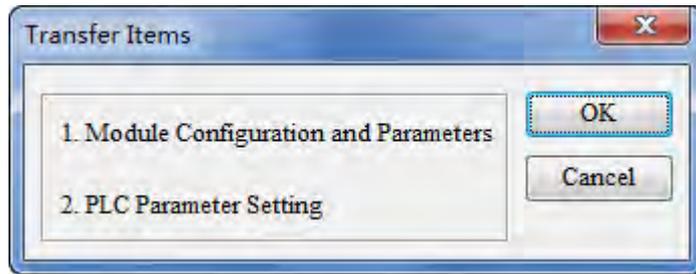
6. Right click 10DNET icon in the HWCONFIG software interface and then select "Intelligent Module Setting".
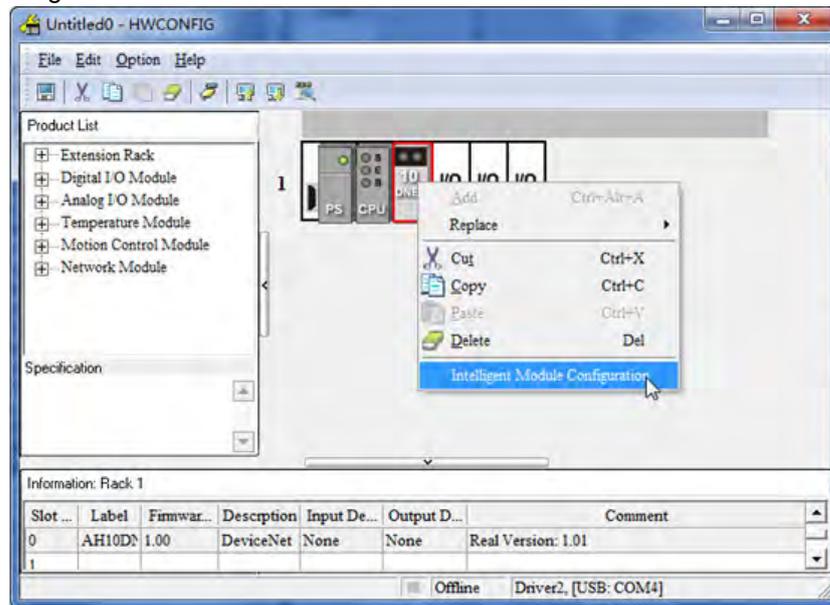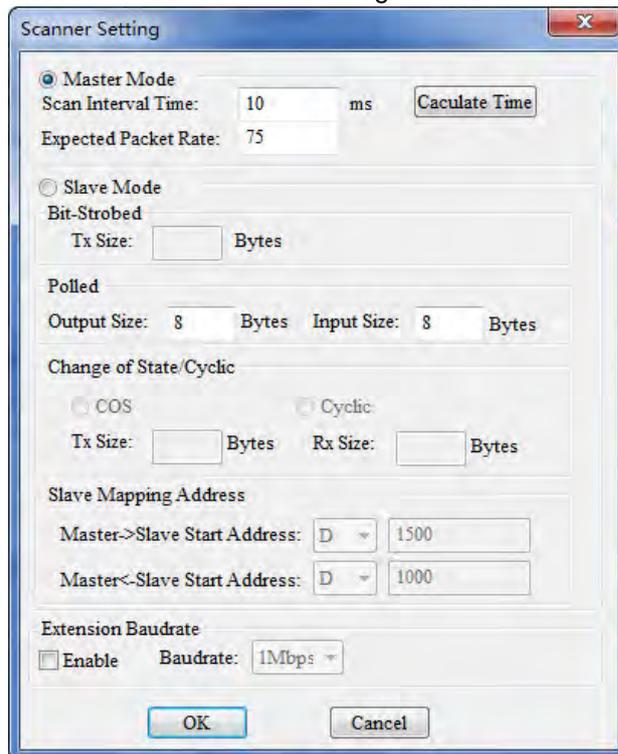

7. The DeviceNet Builder software is called out, where select "Network" >> "Online".
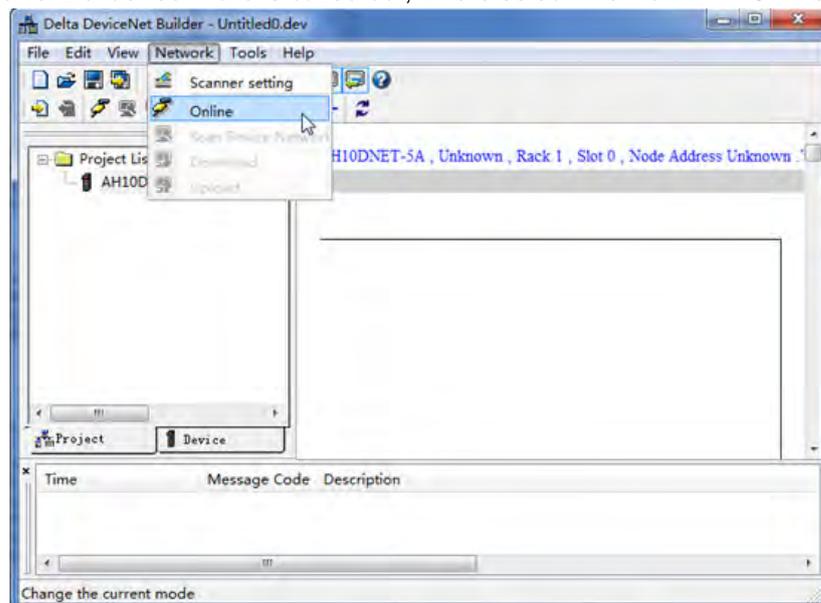
8. Select "Network" >> "Online" and the software interface will be shown as below.
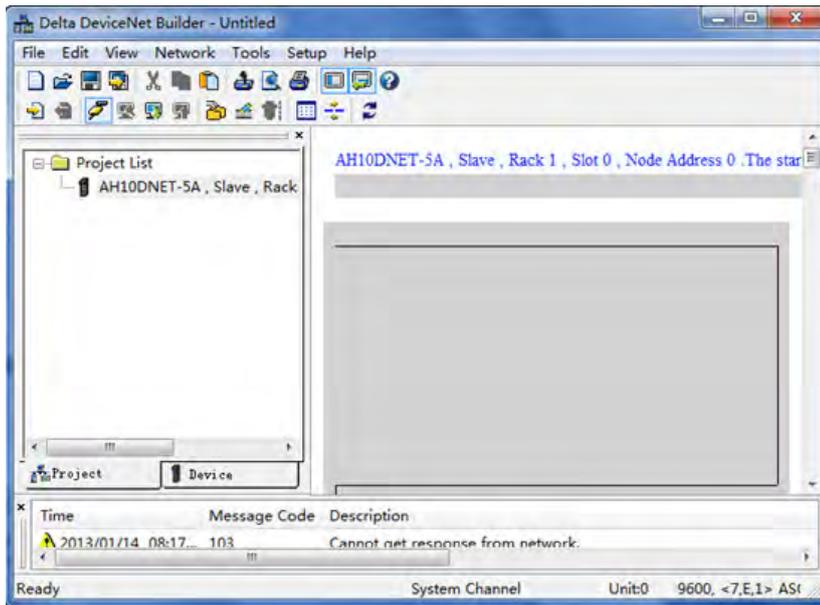
9. Select "Network" >> "Scanner Setting" and then "Scanner Setting" dialog box appears, where pick "Master Mode" and then click "OK" after setting is over.

10. Select "Network" >> "Download" and then the following dialog box appears, where click "OK" to download the configuration data to AH10DNET-5A automatically.
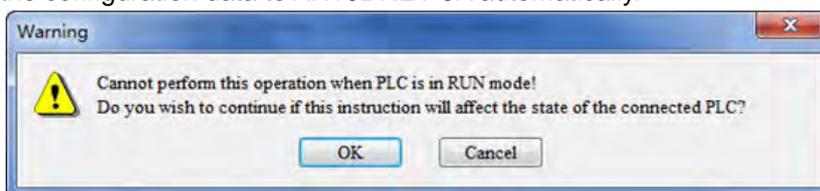
Note: If "E7" is displayed on AH10DNET-5A, please remove its DeviceNet terminals before downloading. Otherwise, failure to download will occur.

11. Power off the AH500 series CPU module and then power it on again after downloading is finished. And at the time, AH10DNET-5A is set to the master mode.
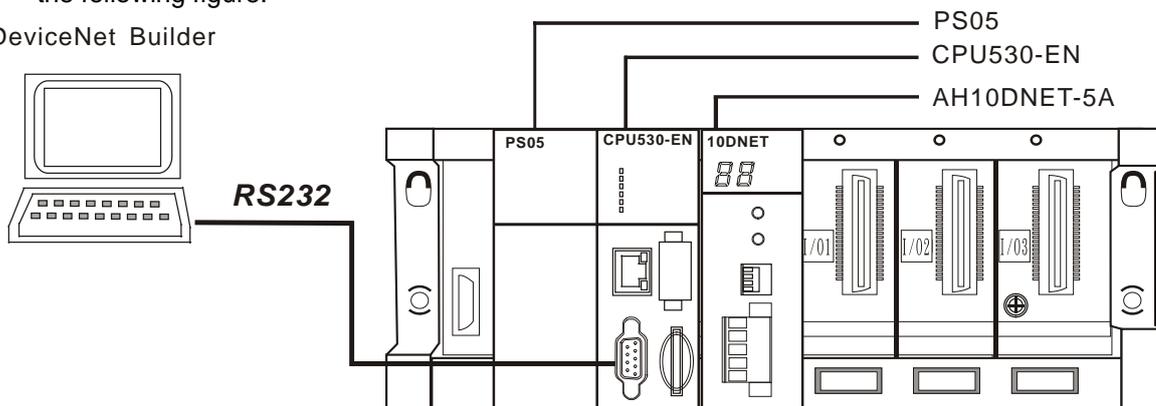
10.7.2 Mapping Areas Setting

When AH10DNET-5A serves as a master, there are two methods of modifying the starting address of its mapping areas.

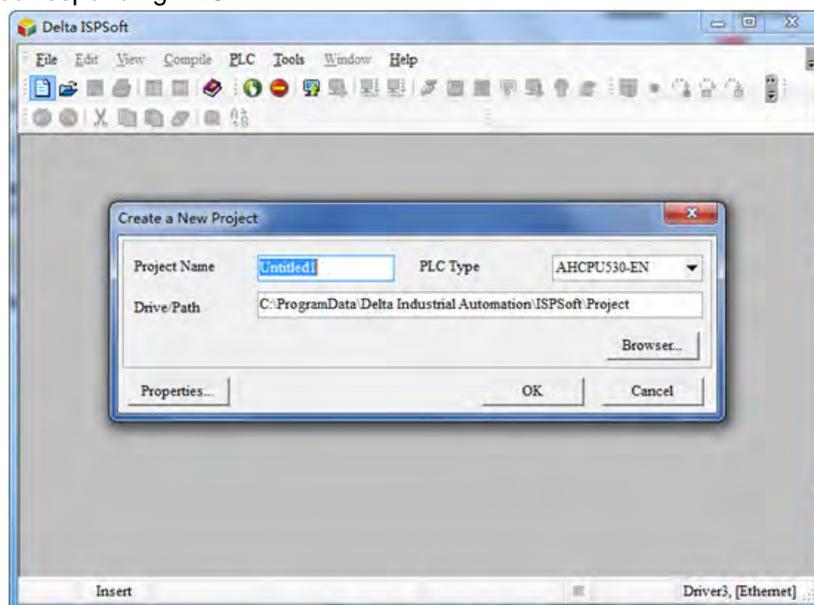**Method 1: Modifying the starting address of the mapping areas through ISPSoft and DeviceNet Builder**

1. PC accesses an AH500 series CPU module via USB after connecting the device according to the following figure.
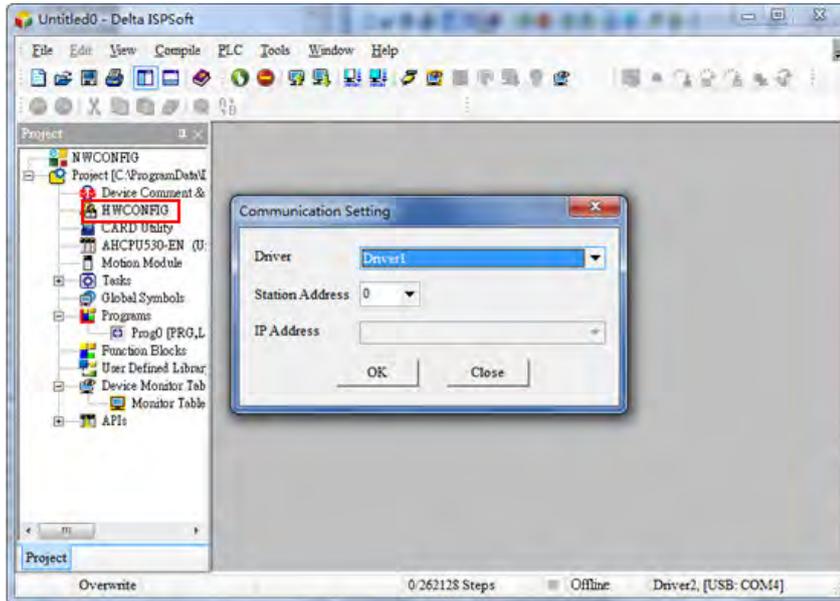

Note: The introduction in this section is made in the USB communication method.

2. Open ISPSoft, select "File" >> "New" >> "New" and then the following dialog box appears where select the corresponding PLC.
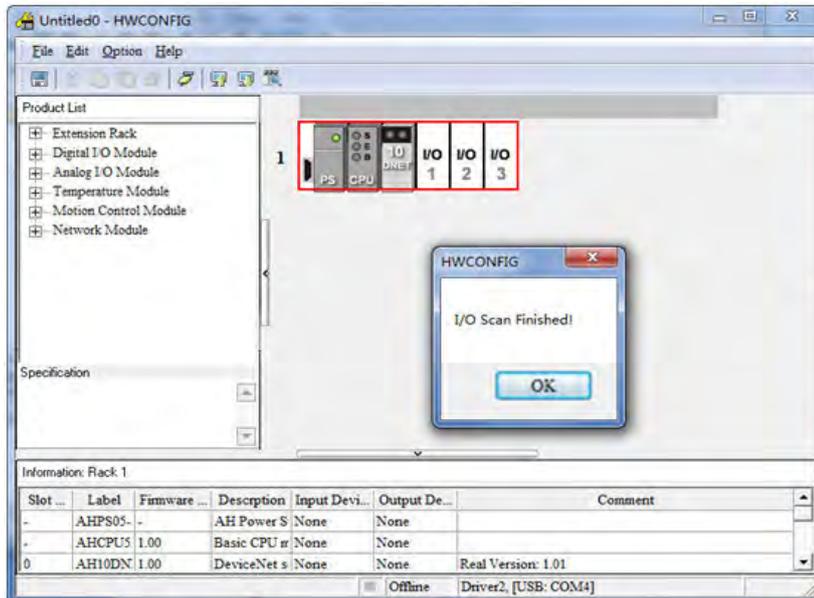

Note: The PLC used in this section is AHCPU530-EN.

3. Select "Tool" >> "Communication Setting" and then the following dialog box appears where select the already built driver.


> Note: The driver is built via COMMGR software. See section 8.1.4 in the help file of the DeviceNet Builder software for more.

4. Double click "HWCONFIG" symbol in the above window and then a new interface pops up, where select "Option" >> "I/O Scan" and then the icon of AH10DNET-5A will emerge as below.


> Note: AH10DNET-5A could be installed to other slot.

5. Double click 10DNET icon in the above window and the parameter configuration interface of AH10DNET-5A will pop up as follows.
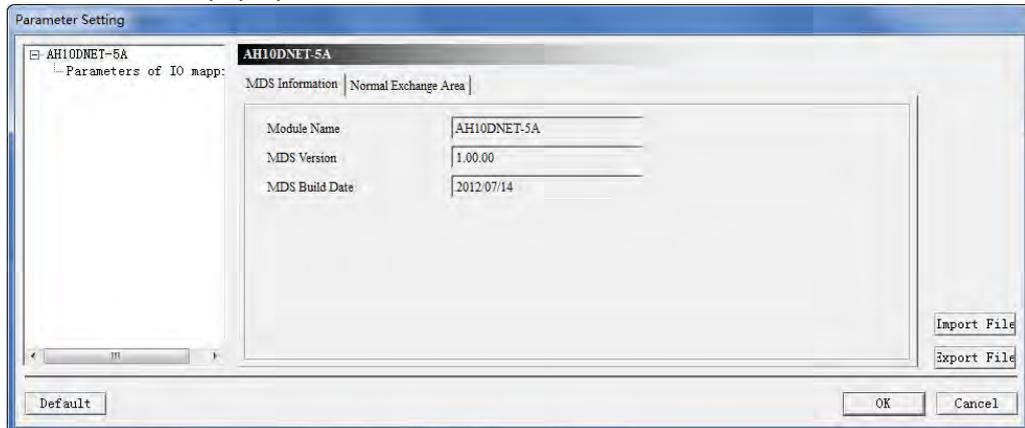

Double click "Parameter of IO Mapping" on the above window; set the value in "Parameters of IO mapping" and the set value is the starting address of the mapping area. Click "OK" after setting is over.
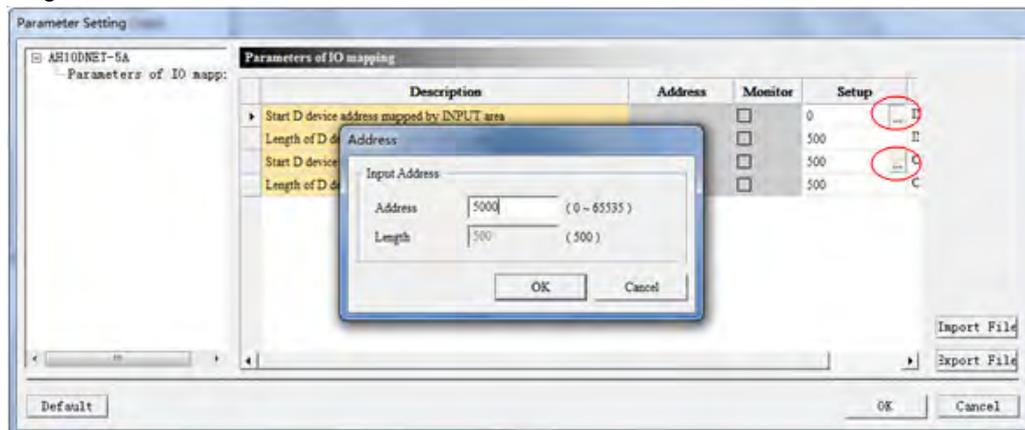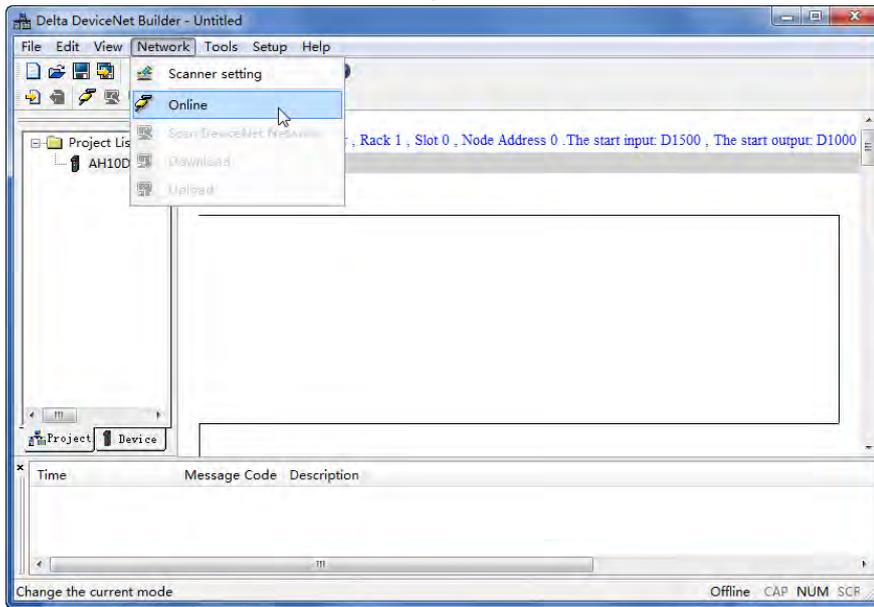

Note: The set value is the starting address of the mapping area. Both of the length of the input and output mapping areas is 500 words.

6. Right click 10DNET icon in the HWCONFIG software interface and then select "Intelligent Module Setting".
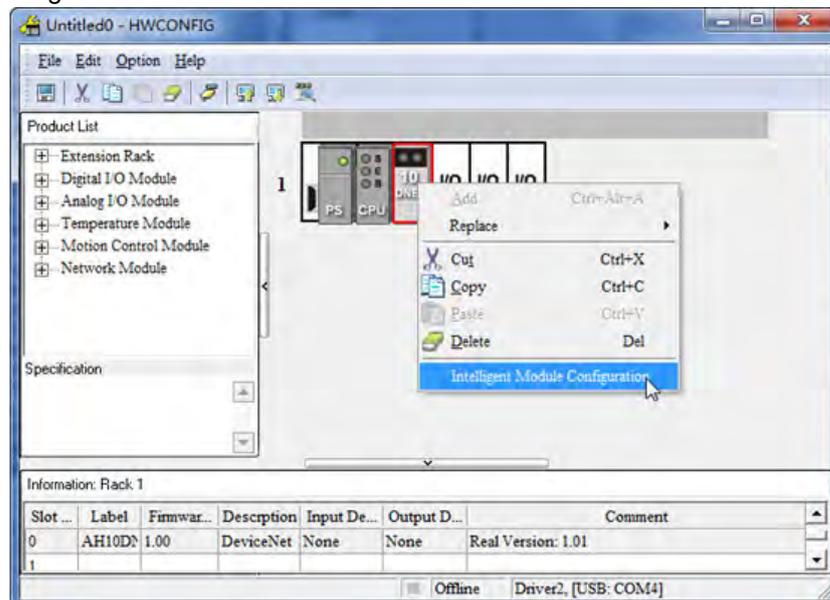
7. The DeviceNet Builder software is called out, where select "Network" >> "Online".

8. Select "Network" >> "Download" to download the starting address of the mapping area and the configuration data to AH10DNET-5A after the network enters the online mode and the configuration is completed.
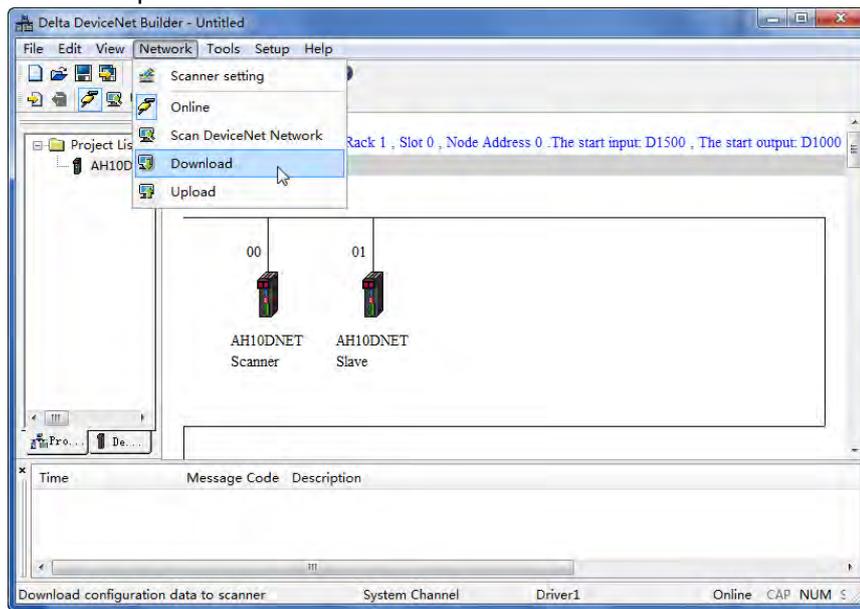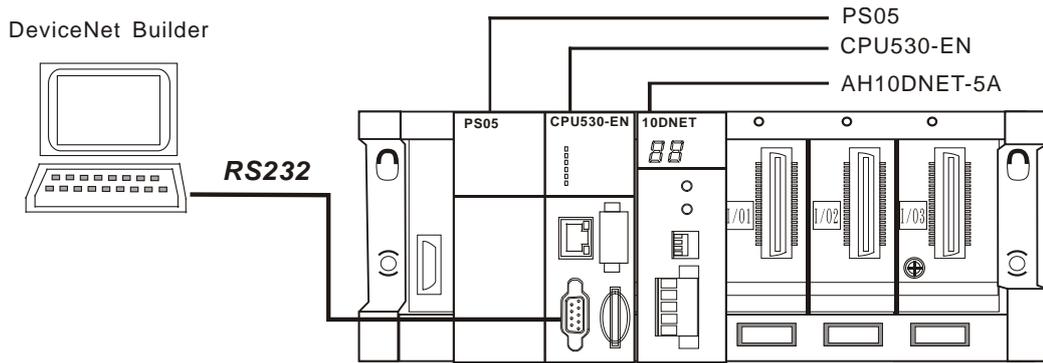

9. Power off the AH500 series CPU module and then power it on again after downloading is finished. And at the time, the starting address of the mapping area is modified successfully.

Method 2: Modifying the starting address of the mapping areas through DeviceNet Builder

Note: Compared to the first method, the second one is a bit simpler but D device is probably used by multiple modules at the same time because of no uniform configuration through HWCONFIG. Please think carefully before adopting this method.

1. PC accesses an AH500 series CPU module via USB after connecting the device according to the following figure.

DeviceNet Builder
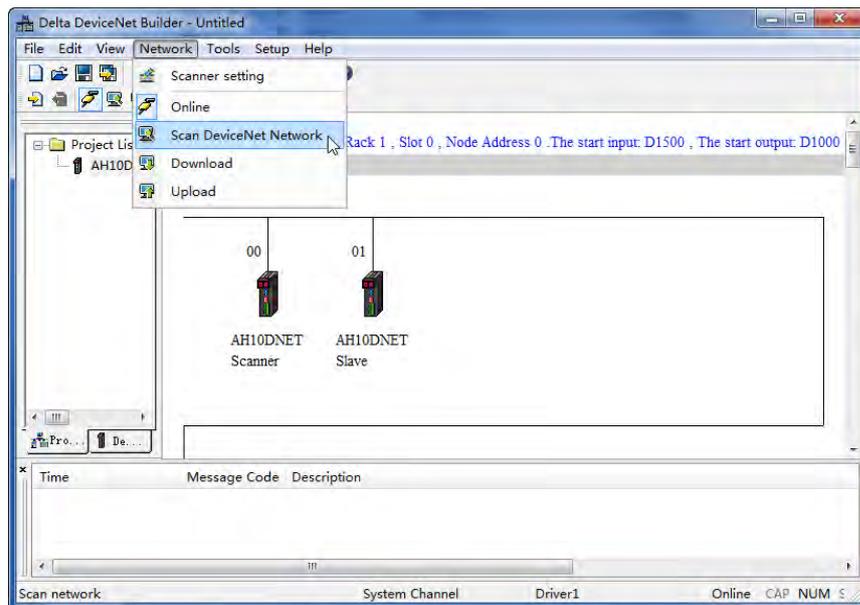
PS05
CPU530-EN
AH10DNET-5A

RS232

Note: The introduction in this section is made in the USB communication method.

2. Open DeviceNet Builder, select "Network" >> "Online" and then the following dialog box appears
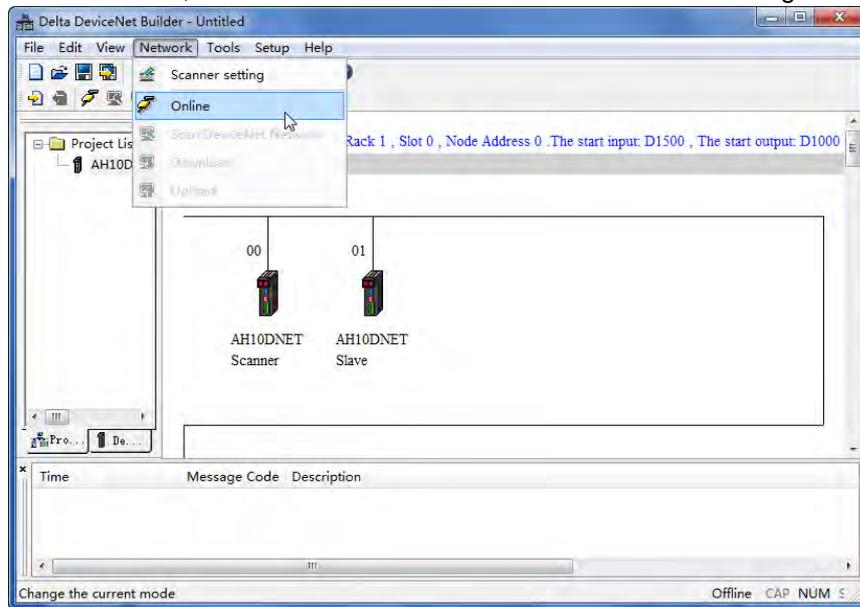
3. Select "Network" >> "Scan DeviceNet Network" and the whole network will be scanned.

4. Double click AH10DNET Scanner icon on the above software interface and then the following dialog box appears where "Output Start" and "Input Start" are for setting the starting addresses of the mapping areas.
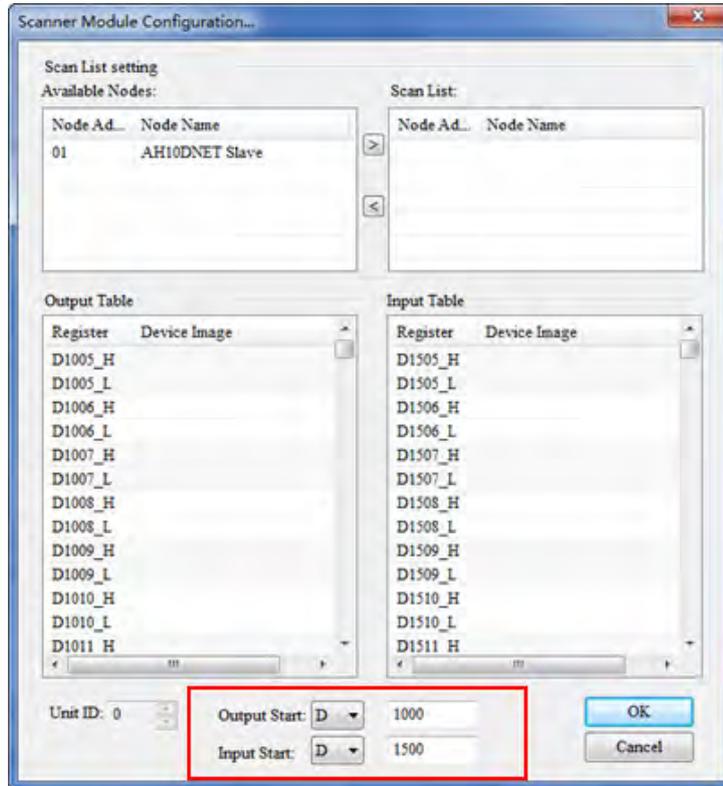
5. Select "Network" >> "Download" to download the starting addresses of the mapping areas and the configuration data to AH10DNET-5A after the network configuration is completed.
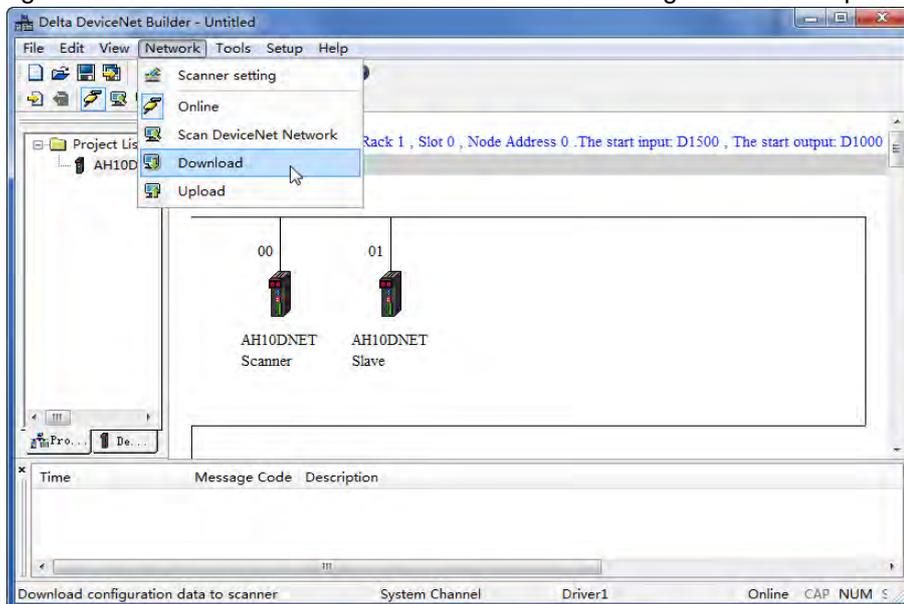
6. Power off the AH500 series CPU module and then power it on again after downloading is finished. And at the time, the starting addresses of the mapping areas are modified successfully.

10.7.3 Extension Baud Rate Setting

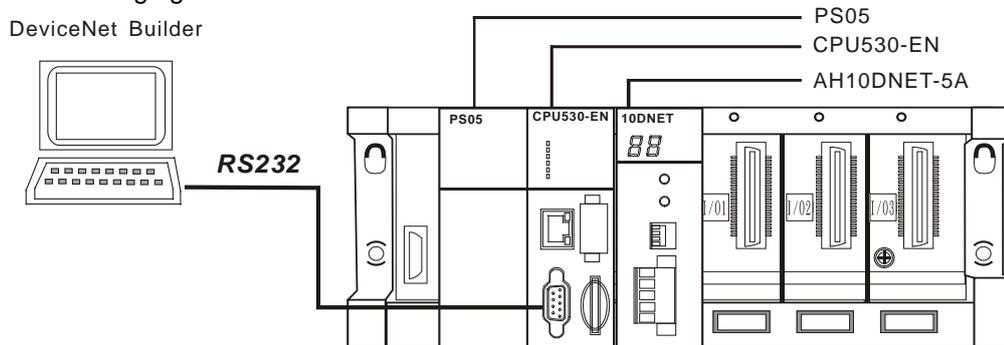1. PC accesses the AH500 series CPU module via RS232 after connecting the device according to the following figure.

2. Open DeviceNet Builder; then select "Setup" >> "Communication Setting" and then the following dialog box appears, where select the already built driver.
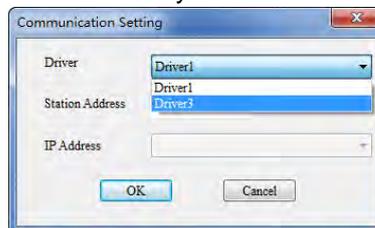
Note: The driver is built through COMMGR. Please refer to section 8.1.3 in DeviceNet Builder help file.

3. Select "Network" >> "Online" as below.

4. Select "Network" >> "Scanner Setting" and then the "Scanner Setting" dialog box pops up. By picking "Master Mode" and "Enable", the extension baud rate function is started up. Afterwards, select an appropriate baud rate according to the actual demand. Click "OK" after selection is over.
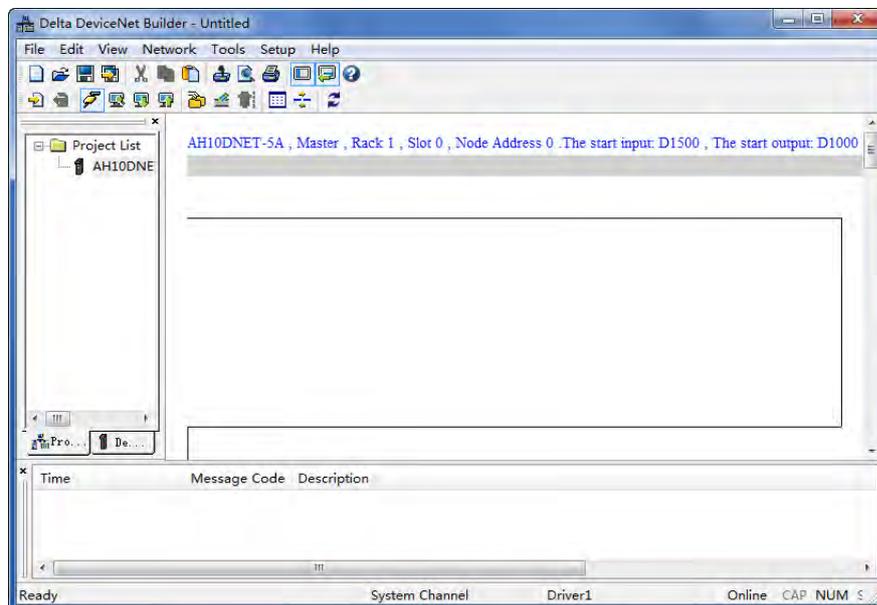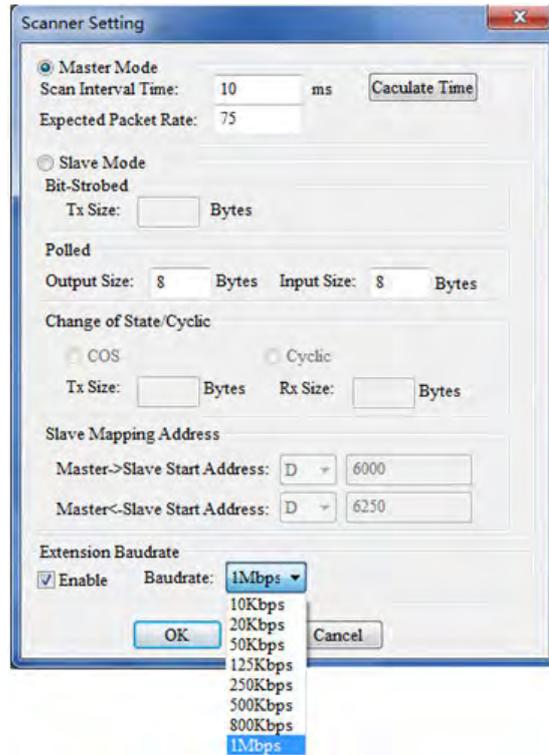

Note: If "Slave Mode" is selected, AH10DNET-5A will be set to a slave eventually.

5. Select "Network" >> "Download" and then the following dialog box appears, where click "OK" to download the configuration data to AH10DNET-5A automatically.
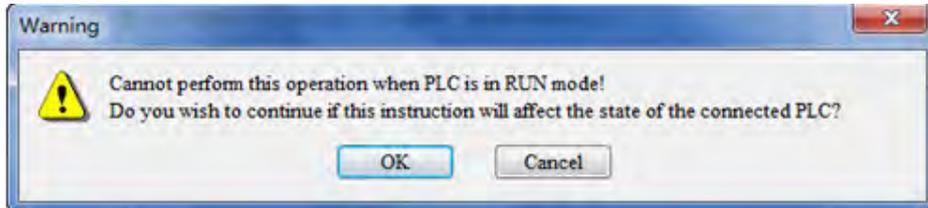
Note: If "E7" is displayed on AH10DNET-5A, please remove its DeviceNet terminals before downloading. Otherwise, failure to download will occur.

6. After downloading is completed, turn both of the function switch DR0 and DR1 of AH10DNET-5A to ON and then repower the AH500 series CPU module. At the time, the extension baud rate setting is finished.

10.8 Special Operation in Slave Mode

10.8.1 Slave Mode and Mapping Areas Setting

AH10DNET-5A can be set to the DeviceNet slave through the software. When AH10DNET-5A works as a slave, the default input/ output length is 8 bytes and maximum input/output data length is 1000 bytes.

There are two methods of setting AH10DNET-5A to the slave. While the slave mode is being set, the starting addresses of the mapping areas of AH10DNET-5A can be set simultaneously.

Method 1: Setting slave mode and the starting addresses of the mapping areas through ISPSoft and DeviceNet Builder

1. PC accesses an AH500 series CPU module via USB after connecting the device according to the following figure.

Note: The introduction in this section is made in the USB communication method.

2. Open ISPSoft, select "File" >> "New" >> "New" and then the following dialog box appears where select the corresponding PLC.

Note: The PLC used in this section is AHCPU530-EN.

3. Select "Tool" >> "Communication Setting" and then the following dialog box appears where select the already built driver.

Note: The driver is built via COMMGR software. See section 8.1.4 in the help file of the DeviceNet Builder software for more.

4. Double click "HWCONFIG" symbol in the above window and then a new interface pops up, where select "Option" >> "I/O Scan" and then the icon of AH10DNET-5A will emerge as below.


Note: AH10DNET-5A could be installed to other slot.

5. Double click 10DNET icon in the above window and then the following dialog box appears, where modify the starting addresses of the mapping areas of AH10DNET-5A.
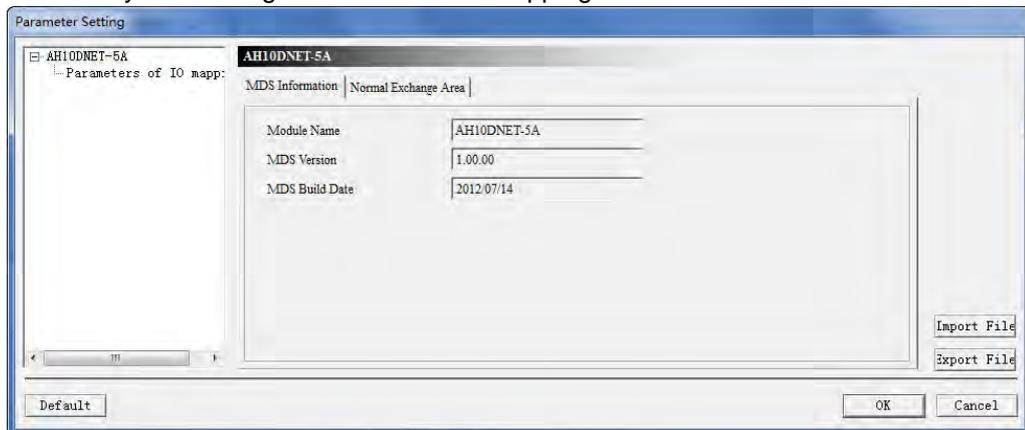
Double click "Parameter of IO Mapping" on the above window; set the value in "Parameters of IO mapping" and the set value is the starting address of the mapping area. Click "OK" after setting is over.
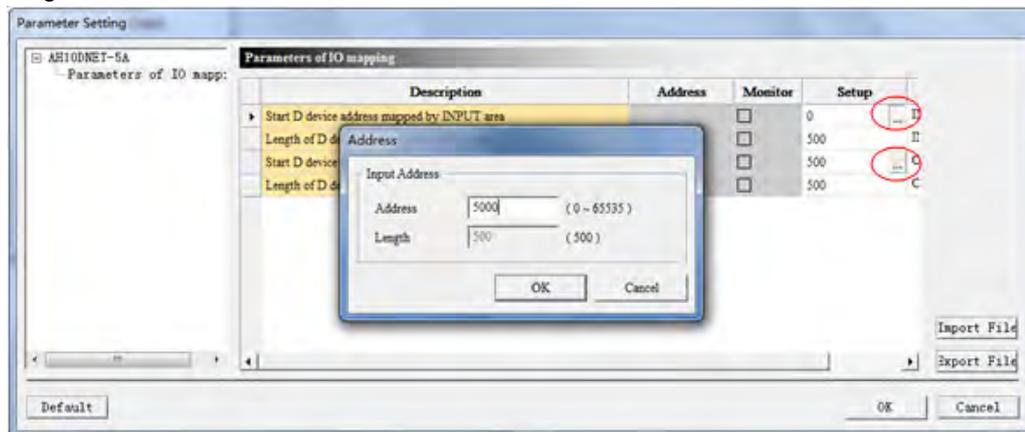
Note: The set value is the starting address of the mapping area. Both of the length of the input and output mapping areas is 500 words.

6. Select "Option" >> "Download" in the HWCONFIG interface and then the following dialog box appears, where click "OK" to download the data.
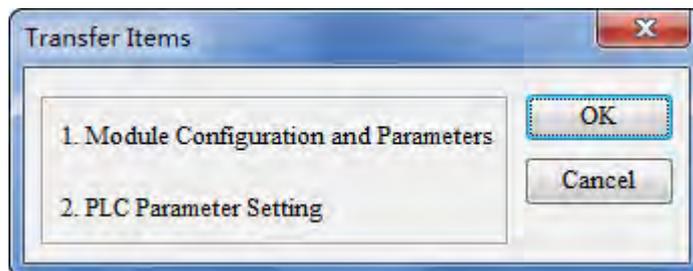
7. Right click 10DNET icon in the HWCONFIG software interface and then select "Intelligent Module Setting".
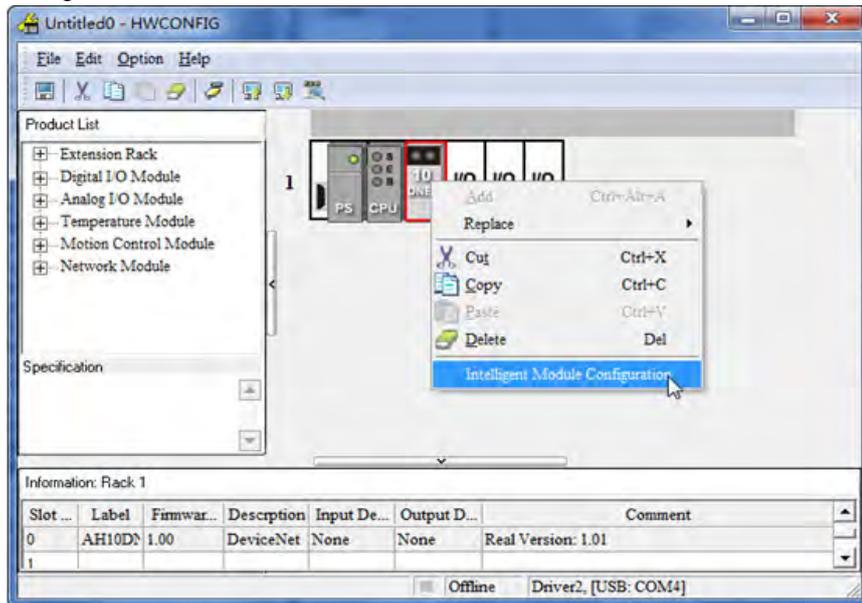
8. Select "Network" >> "Online" and the software interface is shown as below.

9. Select "Network" >> "Scanner Setting" and "Scanner Setting" dialog box pops up. After picking "Slave Mode", fill the appropriate data length and mapping address of the slave. Click "OK" after setting is over.

Note: "Output Size" and "Input Size" under "Polled" in the above window are used for setting the data length of AH10DNET-5A as the slave.
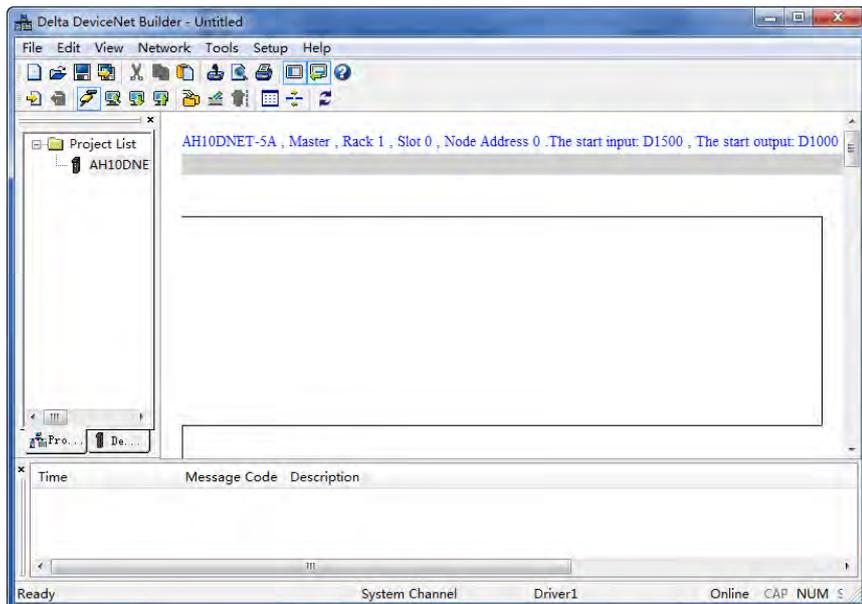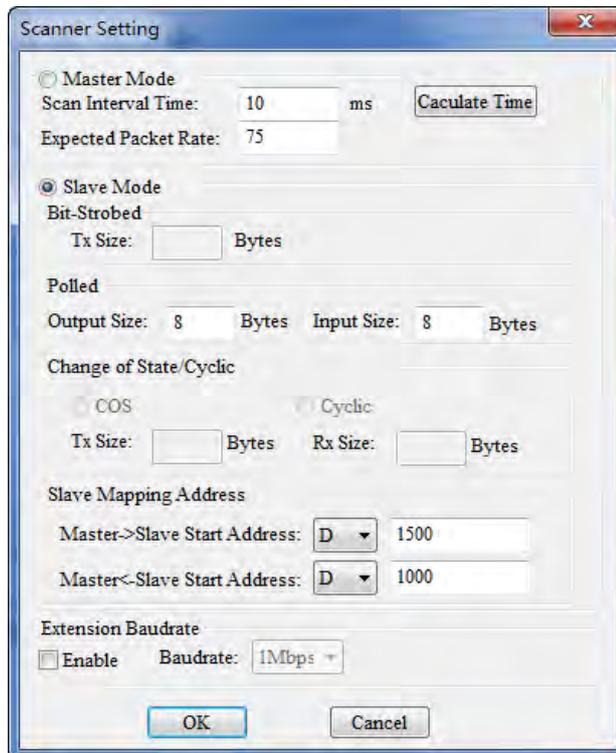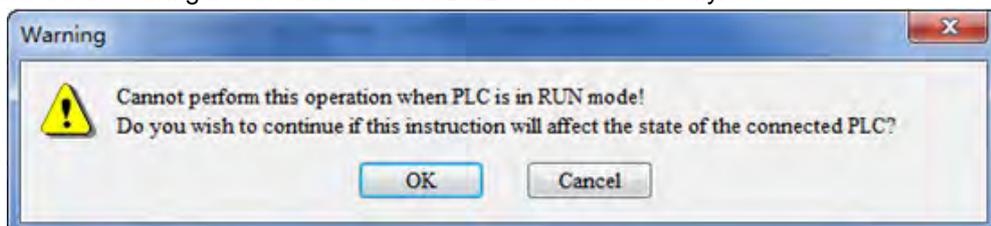
10. Select "Network" >> "Download" and then the following dialog box appears, where click "OK" to download the configuration data to AH10DNET-5A automatically.

Note: If "E7" is displayed on AH10DNET-5A, please remove its DeviceNet terminals before downloading. Otherwise, failure to download will occur.

11. Power off the AH500 series CPU module and then power it on again after downloading is finished. And at the time, AH10DNET-5A is set to the slave mode.

Method 2: Setting slave mode and the starting addresses of the mapping areas through DeviceNet Builder

Note: Compared to the first method, the second one is a bit simpler but D device is probably used by multiple modules at the same time because of no uniform configuration through HWCONFIG. Please think carefully before adopting this method.

1. PC accesses an AH500 series CPU module via USB after connecting the device according to the following figure.

Note: The introduction in this section is made in the USB communication method.

2. Open DeviceNet Builder, select "Setup" >> "Communication Setting" and then the following dialog box appears, where select the driver.
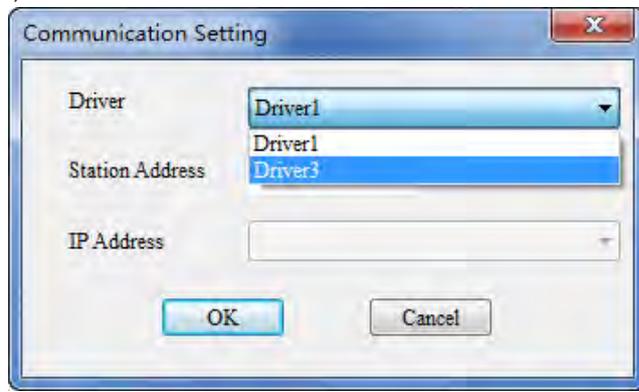
Note: The driver is built via COMMGR software. See section 8.1.4 in the help file of the DeviceNet Builder software for more.

3. Select "Network" >> "Online" and then the following dialog box appears.

4. Select "Network" >> "Scanner Setting" and then "Scanner Setting" dialog box appears, where "Slave Mapping Address" is for setting the starting address of the mapping area. After selecting "Slave Mode", fill the set starting address of the mapping area. Click "OK" after setting is over.
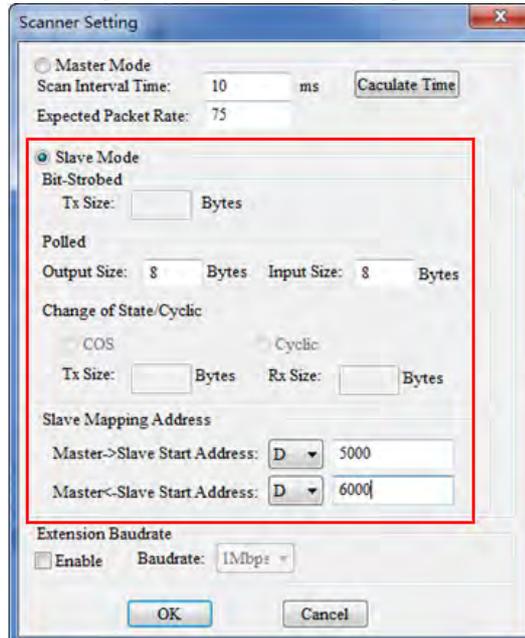
Note: "Output Size" and "Input Size" under "Polled" in the above window are used for setting the data length of AH10DNET-5A as the slave.

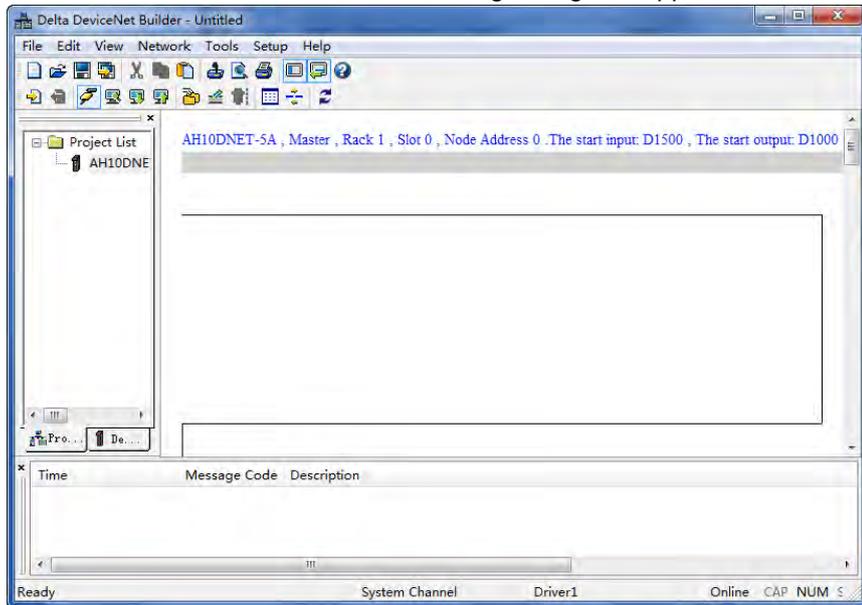5. Select "Network" >> "Download" and then the following dialog box appears, where click "OK" to download the configuration data to AH10DNET-5A automatically.
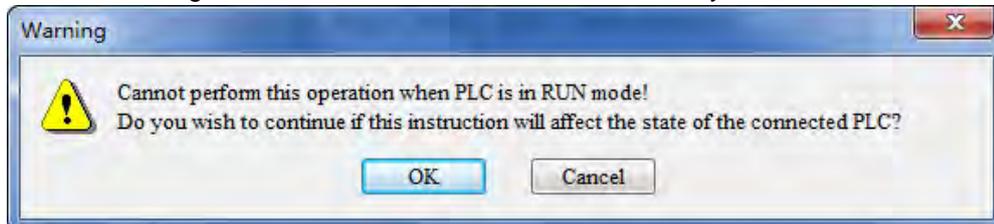
Note: If "E7" is displayed on AH10DNET-5A, please remove its DeviceNet terminals before downloading. Otherwise, failure to download will occur.

6. Power off the AH500 series CPU module and then power it on again after downloading is finished. And at the time, AH10DNET-5A is set to the slave mode.

10.8.2 Modifying the Data Length of the Slave

When AH10DNET-5A works in slave mode, the data length could be modified through the software according to the following steps.

1. Scan AH10DNET-5A in slave mode through the DeviceNet master.

   "AH10DNET Slave" represents for AH10DNET-5A module in slave mode and "AH10DNET Scanner" refers to AH10DNET-5A module in master mode as the following window shows.

   The data length of AH10DNET Slave is modified through AH10DNET Scanner on the software.
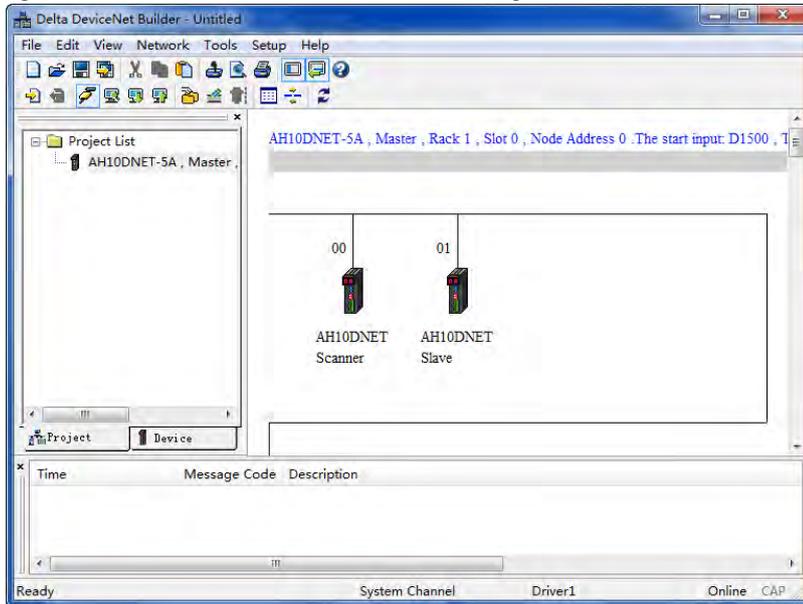
2. After scanning is successful, right click "AH10DNET-5A (Slave)"and select "Parameters Edit…".
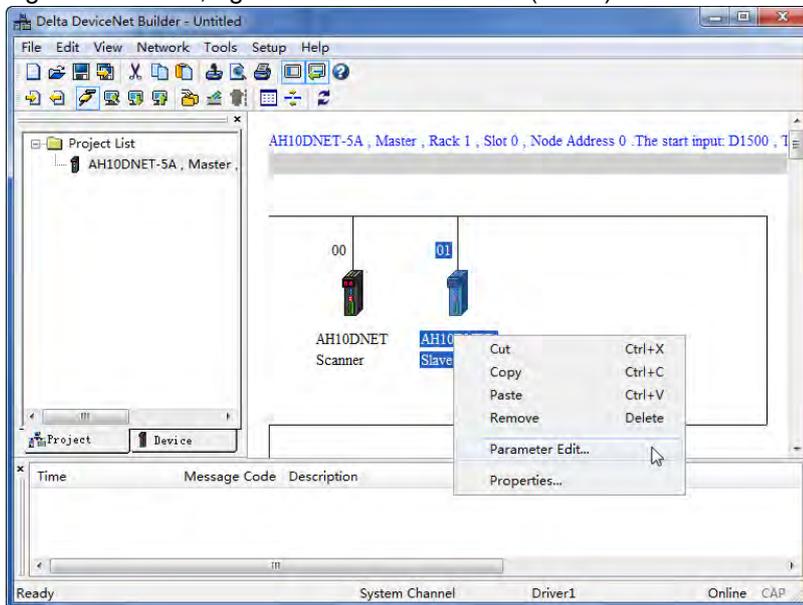
3. Modify the data length of the slave in the parameter editor.

"Length of input data" is the length of the data that the slave sends to the master and "Length of output data" is the length of the data that the master sends to the slave.

The two parameters are used for setting the polled IO data length of the slave and the polled IO data length of AH10DNET Slave can be set in the following window.

After setting is over, click "Write".
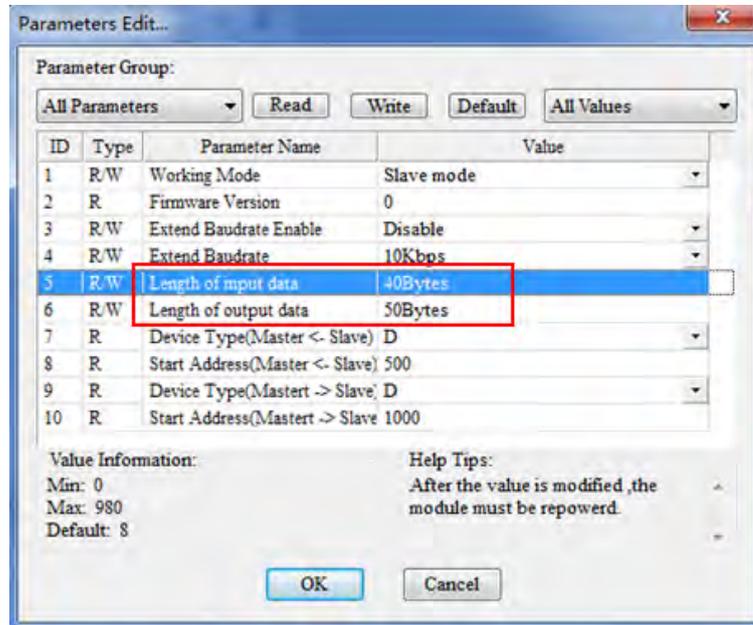
Click "OK" to return the main interface of the software after downloading is completed.

Note: These parameters in the parameter editor belong to the current slave.

4. After returning to the main interface, double click "AH10DNET Slave" icon and then "Node Configuration" dialog box pops up as below. Since the polled input length and output length have been set to 10 bytes when the slave is configured, the two parameters in the following window must be set to 10 bytes. Otherwise, the master will alarm E1 error code which indicates that the data length of the slave does not match after the slave is configured into the master.
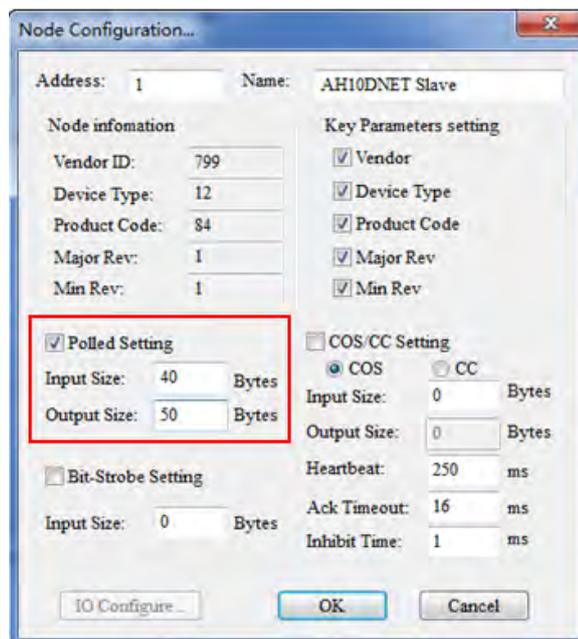

Note: The polled input and output data length in the above window are set to 40 bytes and 50 bytes respectively. After AH10DNET Slave (Node 1) is configured to the scan list, the master will automatically assign 40 bytes of registers in the input list to AH10DNET Slave.

Meanwhile, the master will automatically assign 50 bytes of registers in the output list to AH10DNET Slave.

5. Repower AH10DNET-5A after setting is over and then modifying the data length is successful.

10.8.3 Extension Baud Rate Setting

When AH10DNET-5A is in slave mode, its extension baud rate can be set as the following steps.

1. Scan AH10DNET-5A in slave mode through the DeviceNet master. "AH10DNET Slave" represents for AH10DNET-5A module in slave mode and "AH10DNET Scanner" refers to AH10DNET-5A module in master mode as the following window shows.
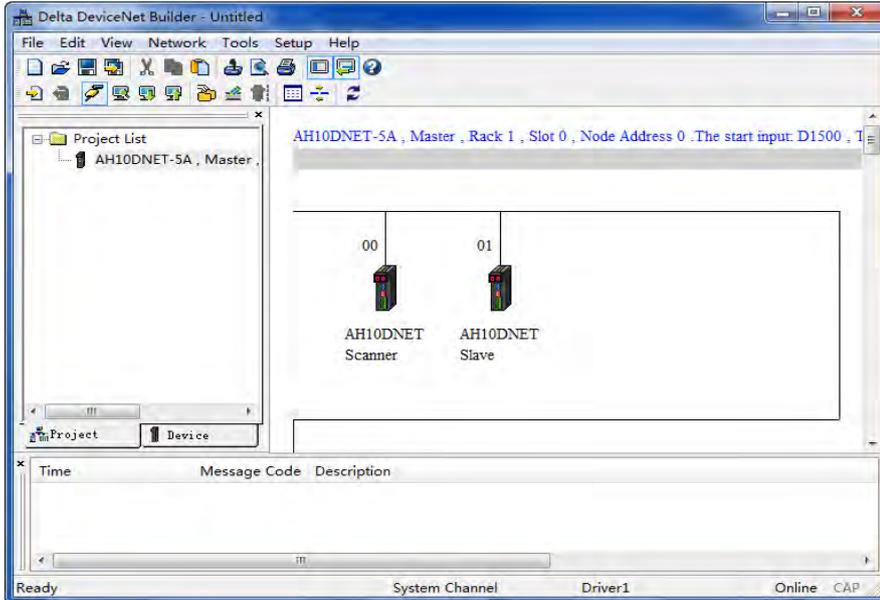
2. Right click AH10DNET-5A (Slave) and select "Parameter Edit…" after scanning is successful.
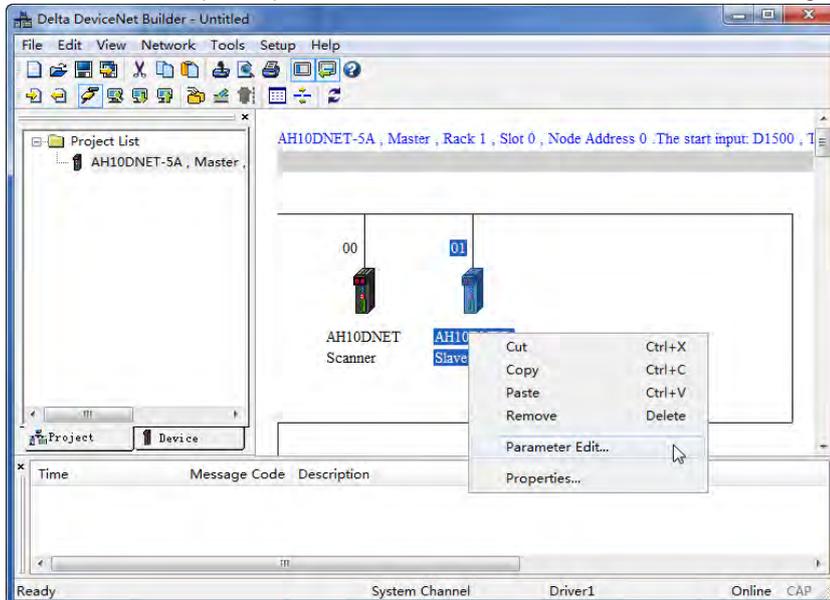
3. Select "Enable" for "Extend Baud rate Enable" in the following parameter editor.
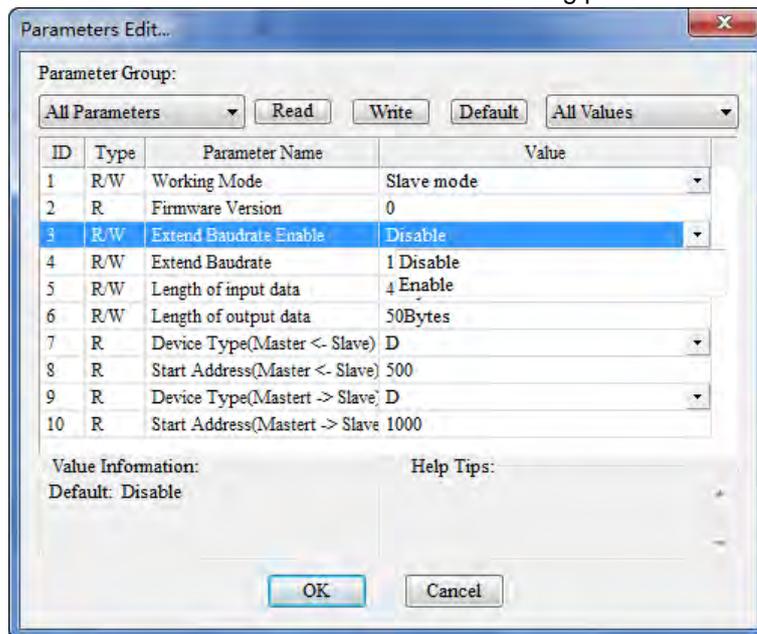
Meanwhile, select the desired baud rate for "Extend Baud rate" as follows.
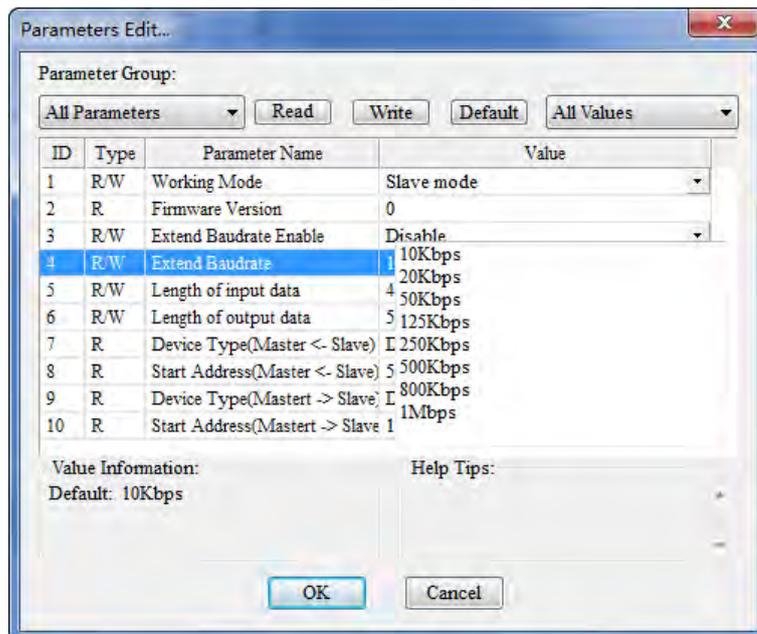
Click "OK" to return to the main interface of the software after downloading is completed.
Note: These parameters in the parameter editor belong to the current slave.

4. After downloading is completed, turn both of the function switch DR0 and DR1 of AH10DNET-5A (Slave) to ON and then repower the AH500 series CPU module. At the time, the extension baud rate setting is finished.

10.9 Application Example

This section describes how to configure the DeviceNet network in an application example.
Control purpose: AHCPU510-EN can make the remote monitor of D0, D30, D50, D150 and D230 in AHCPU530-EN via the DeviceNet bus.

10.9.1 Constructing One DeviceNet Network

1. Connection figure
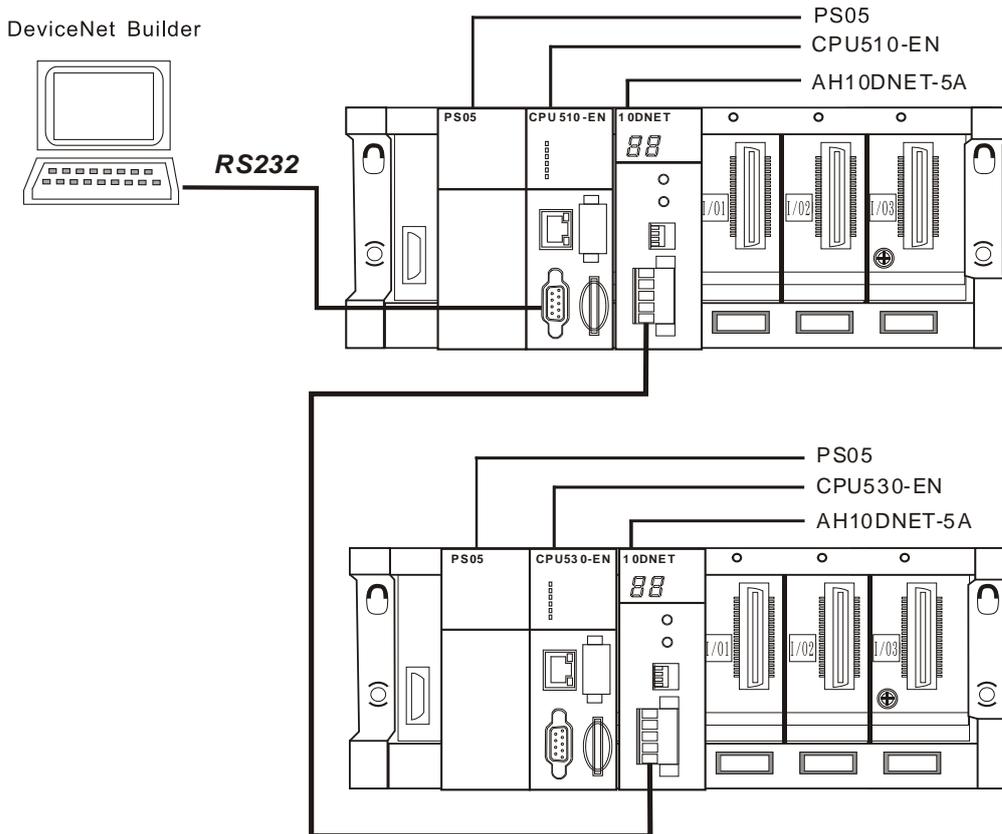
Note:
(1) AHCPU510-EN and AHCPU530-EN both are Delta AH500 series CPU modules.
    AHCPU510-EN and AH10DNET-5A constitute the DeviceNet master and AHCPU530-EN
    and AH10DNET-5A constitute the DeviceNet slave.
(2) Either end of the DeviceNet bus must be connected with one terminal resistor of about 121
    ohm. (The resistor should be connected between CAN_H and CAN_L. See section 10.3.4
    for more details.)

2. Set up the two AH10DNET-5As according to the following table.

DeviceNet device	Node address	Communication rate
AH10DNET-5A (On the right of AHCPU510-EN)	0	500 kbps
AH10DNET-5A (On the right of AHCPU530-EN)	1	500 kbps

10.9.2 Configuration of DeviceNet Slave

1. PC accesses an AH500 series CPU module via RS232 after connecting the device according to the following figure.
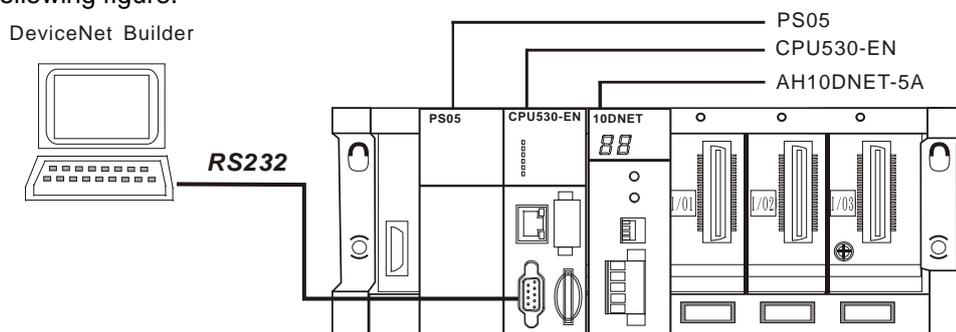
Note: AH10DENT-5A on the right of AHCPU530-EN will serve as the slave and therefore the RS232 communication cable must be connected to AHCPU530-EN.

2. Open ISPSoft; select "Tool" >> "Communication Setting" and then the following dialogue box will pop up. Select the already built driver and then click "OK".

3. Select "File" >> "New" >> "New" and the following dialogue box will appear. Click "OK" after selecting the corresponding PLC model.

4. Double click HWCONFIG under "Project" and the HWCONFIG software interface is called out.

5. Start to scan by selecting "Option" >> "I/O Scan" in the HWCONFIG software interface.

Chapter 10 DeviceNet Communication Module AH10DNET
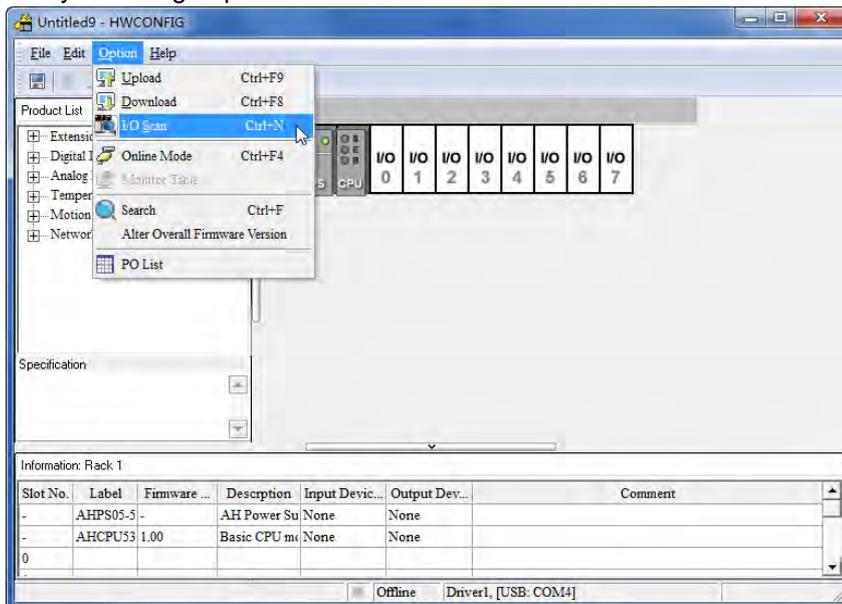
The device connected to AHCPU530-EN will be scanned.
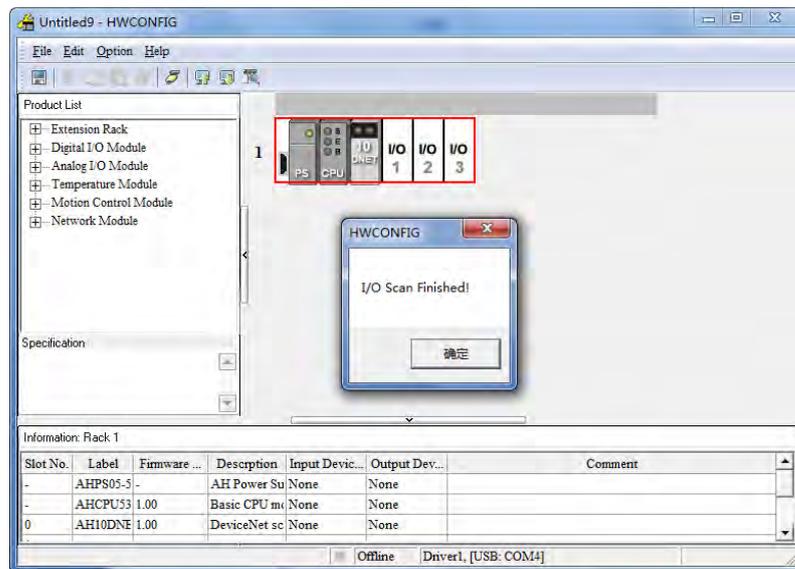
6. 10DNET in the window is the abbreviation of AH10DNET-5A. Double click the icon of 10DNET and then the parameter setting window of 10DNET will pop up.

Set the mapping starting address of D in the INPUT area (the initial input mapping address) and the OUTPUT area (The initial output mapping address). In this example, the two addresses are set to D2000 and D2500 respectively. Click "OK" after setting is over.
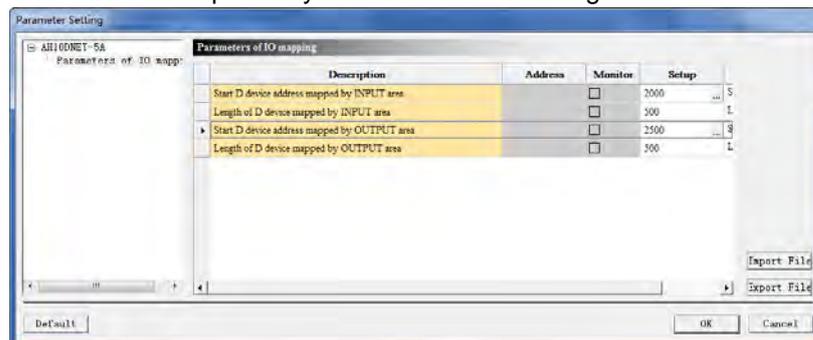
7. Select "Option" >> "Download" to download the above setting to AHCPU530-EN.
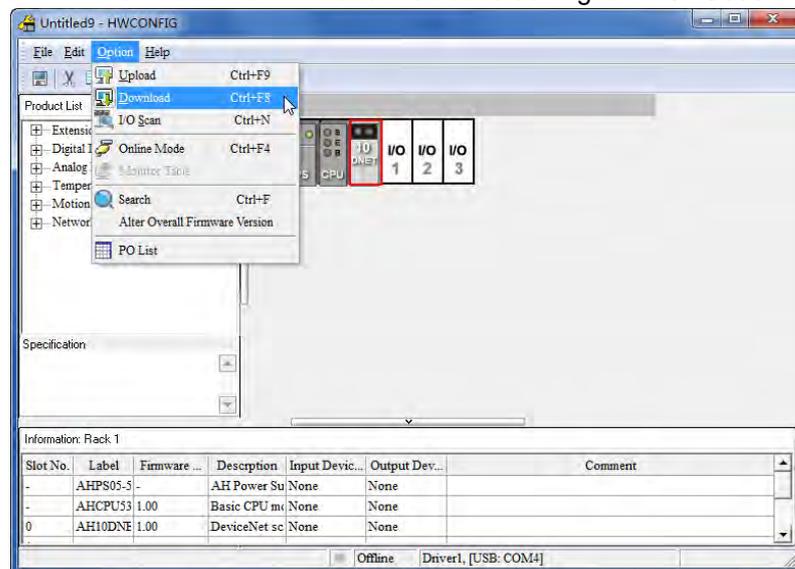
8. Right click 10DNET icon and select "Intelligent Module Configuration" to call the DeviceNet Builder software interface out.
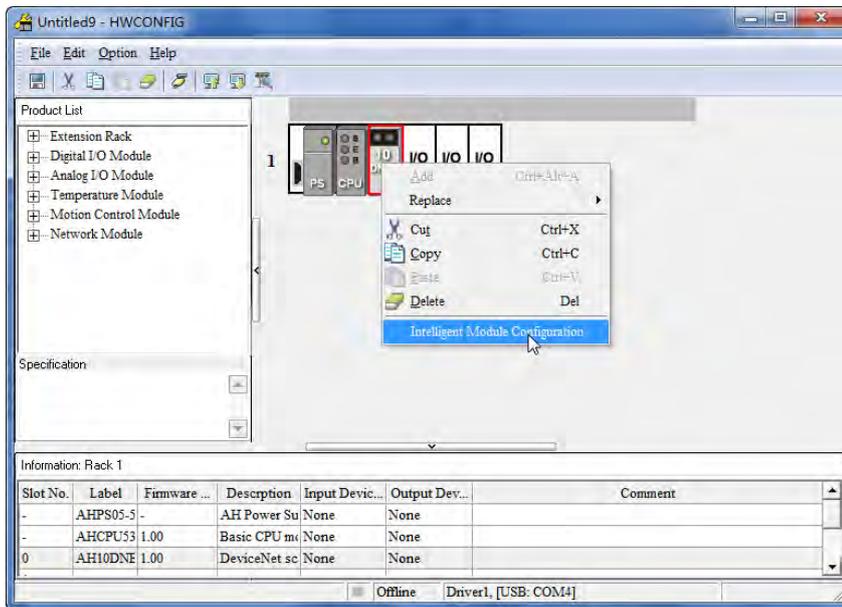
9. The DeviceNet Builder software is called out.
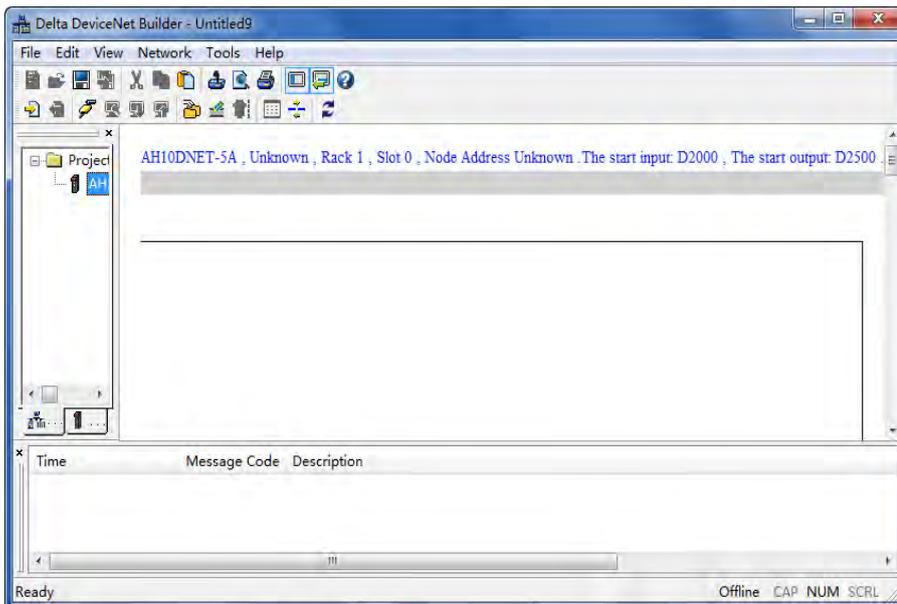
10. Select "Network" >> "Online" and AH10DNET-5A will appear under the project list.
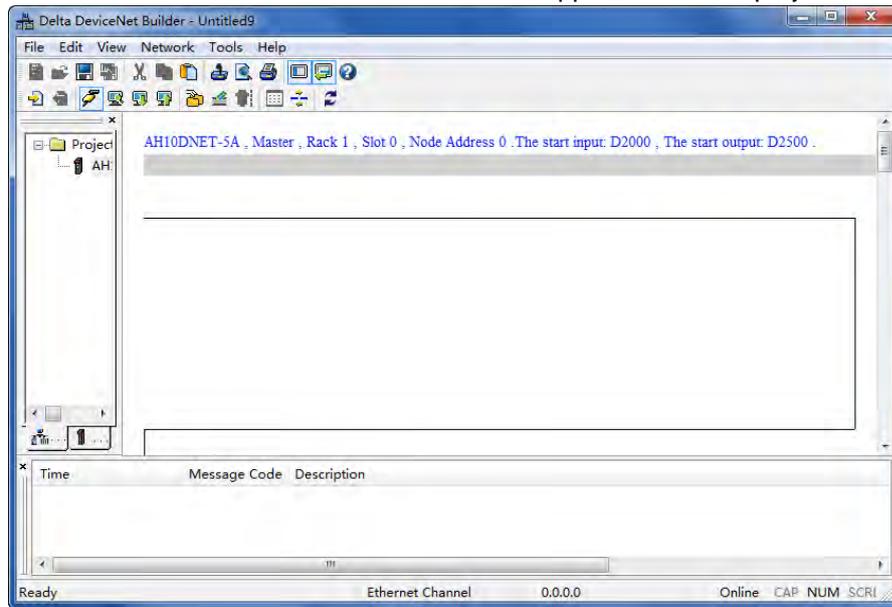
If current AH10DNET-5A has been set to the slave mode, the software interface will be as shown below.
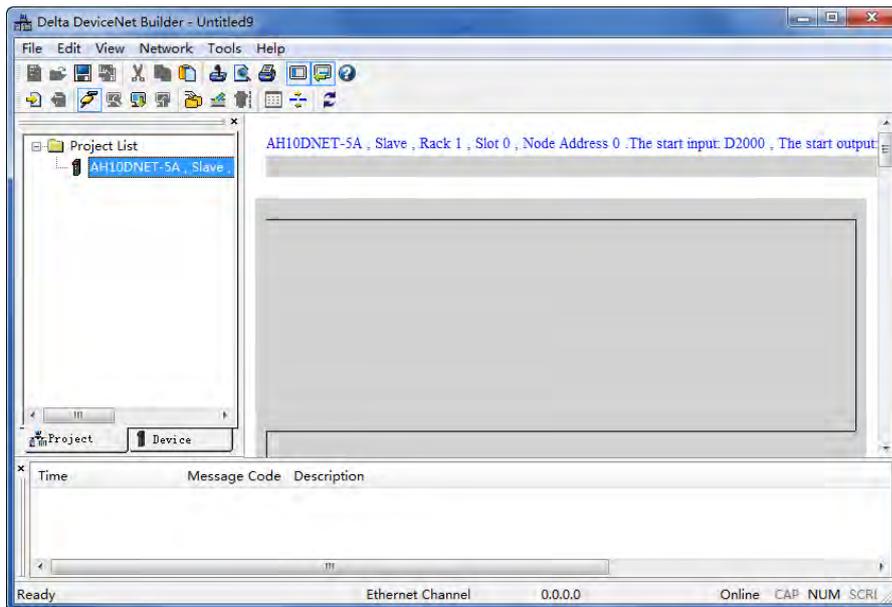
11. Select "Network" >> "Scanner Setting" and "Scanner setting" dialogue box pops up. Select "Slave Mode" and fill the data length of the slave and the mapping address of the device.

   In this example, AHCPU510-EN monitors 5 registers in AHCPU530-EN and therefore the output length and input length are both set to 10 bytes. "Master -> Slave Start Address" and "Master <- Slave Start Address" are set to D2000 and D2500 respectively. The two addresses are specified by ISPSoft in the above step. But users could modify them.

   Click "OK" after setting is over.
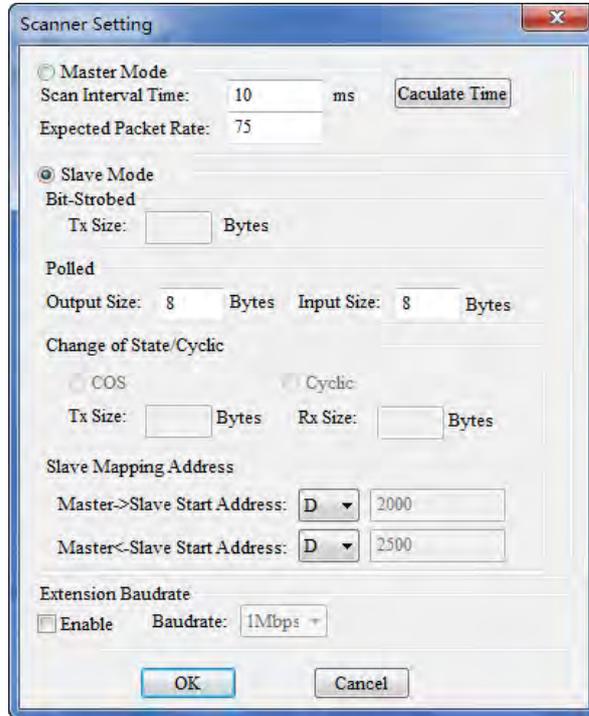
Note:
(1) "Output length" and "Input length" are for specifying the data length when AH10DNET-5A serves as the slave.
(2) "Master -> Slave Start Address" is used for setting the mapping starting address for output as AH10DNET-5A is in slave mode and the data that the master sends out will be updated in the area.

   "Master <- Slave Start Address" is used for setting the mapping starting address for input as AH10DNET-5A is in slave mode and the data in these registers will be transmitted to the master in real time. In the DeviceNet software, the starting address of AH10DNET-5A (slave) can be modified only here.
(3) In the configuration interface, AH10DNET-5A can be set to the master mode or slave mode.

12. Select "Network" >> "Download" and the following dialogue box pops up. Click "OK" to download the configuration data to AH10DNET-5A automatically.
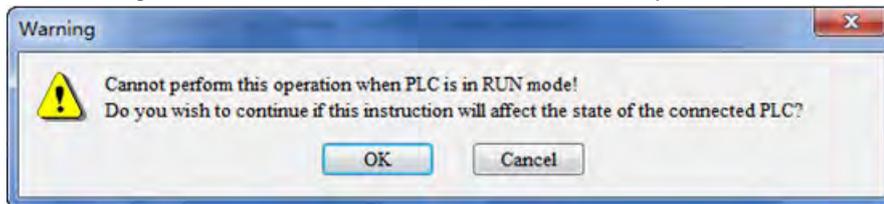
   Note: If E7 appears on AH10DNET-5A, please remove the DeviceNet terminal before downloading. Otherwise, Failure to download will occur.

13. After downloading is completed, power off the AH500 series CPU module and then repower it. At the moment, AH10DNET-5A is set to the slave mode.

   Note: Pick "Master Mode" in step 11; follow the steps and AH10DNET-5A will be set to the master mode.

10.9.3 Configuration of DeviceNet Master

1. Connect the devices following the figure below and remove the RS232 cable from AHCPU530-EN to AHCPU510-EN.
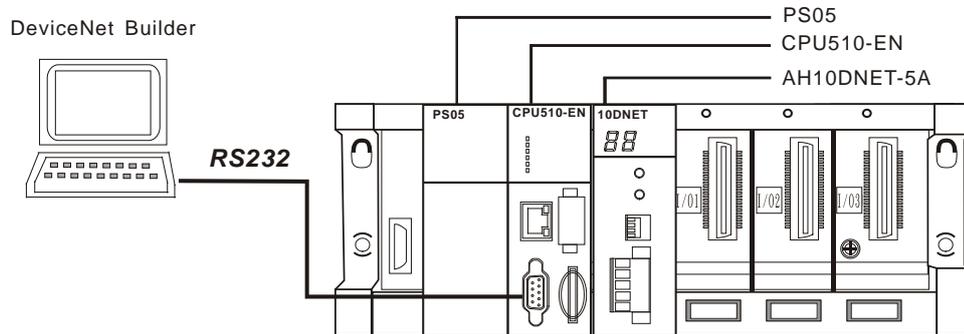
Note: AH10DENT-5A on the right of AHCPU510-EN is used as the master and therefore the RS232 cable must be connected to AHCPU510-EN.
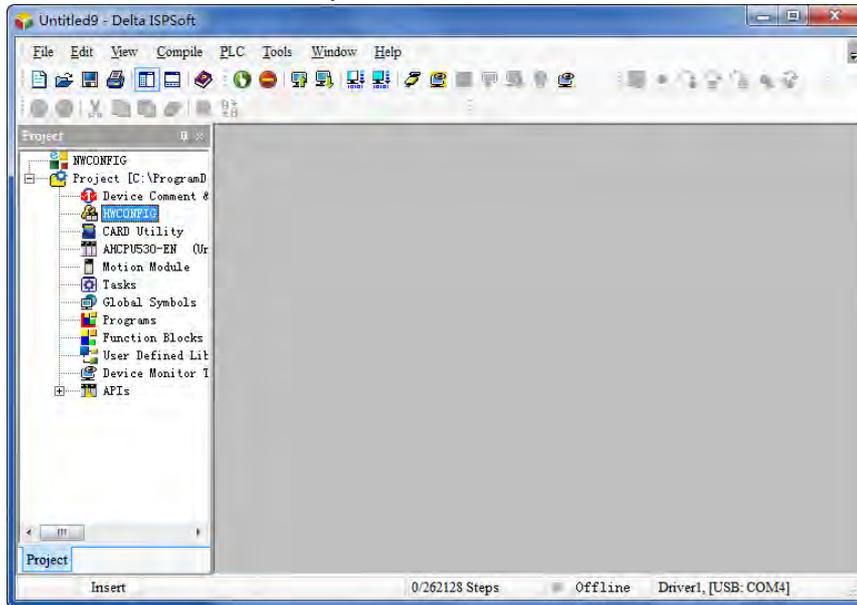
2. Open ISPSoft; select "Tool" >> "Communication Setting" and then the following dialogue box will pop up. Select the already built driver and then click "OK".


3. Select "File" >> "New" >> "New" and the following dialogue box will appear. Click "OK" after selecting the corresponding PLC model.

4. Double click HWCONFIG under "Project" and the HWCONFIG software interface is called out.
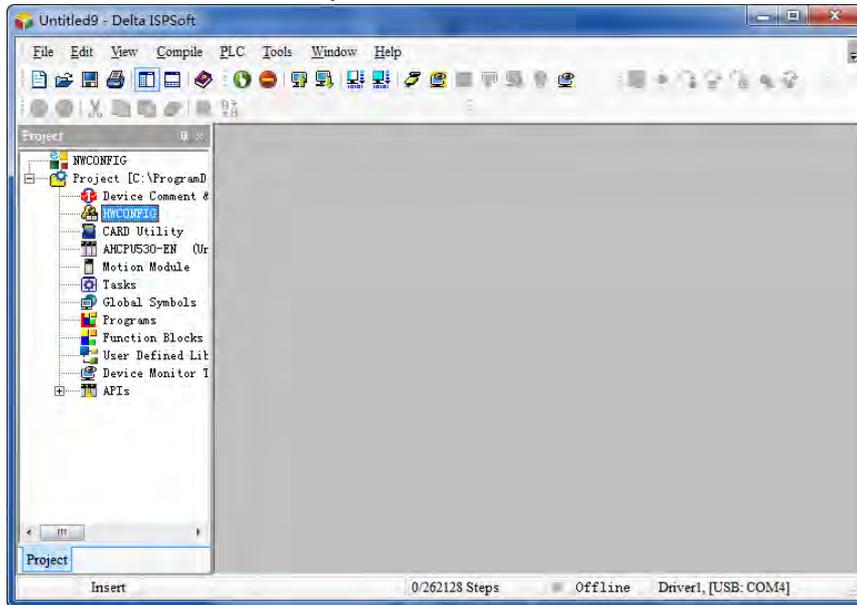
5. Start to scan by selecting "Option" >> "I/O Scan" in the HWCONFIG software interface.
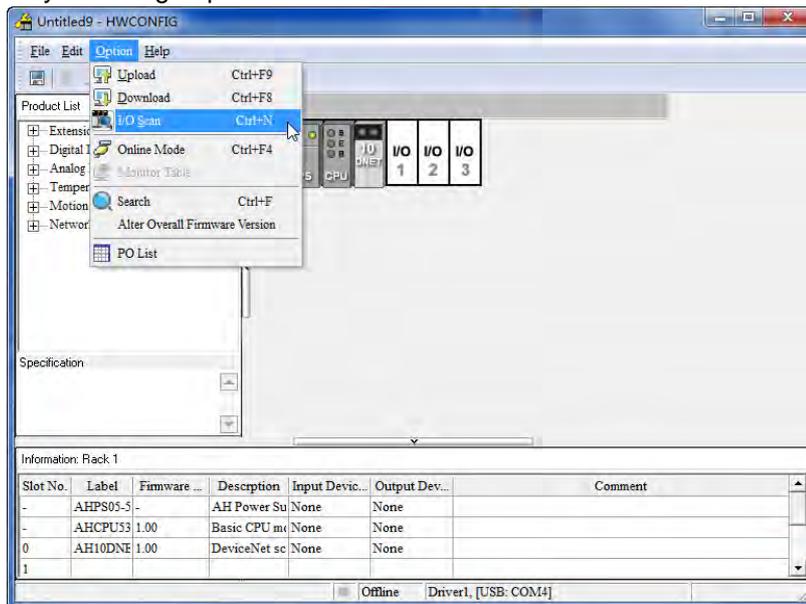
The device connected to AHCPU510-EN is scanned.
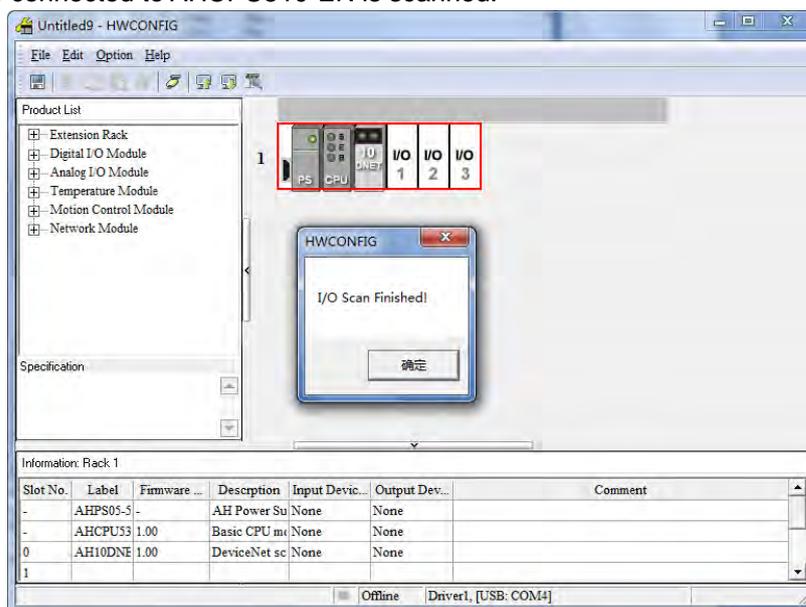
6. 10DNET in the window is the abbreviation of AH10DNET-5A. Double click the icon of 10DNET and then the parameter setting window of 10DNET will pop up.
    Set the mapping starting address of D in the INPUT area (the initial input mapping address) and the OUTPUT area (the initial output mapping address). In this example, the two addresses are set to D1000 and D1500 respectively. Click "OK" after setting is over.
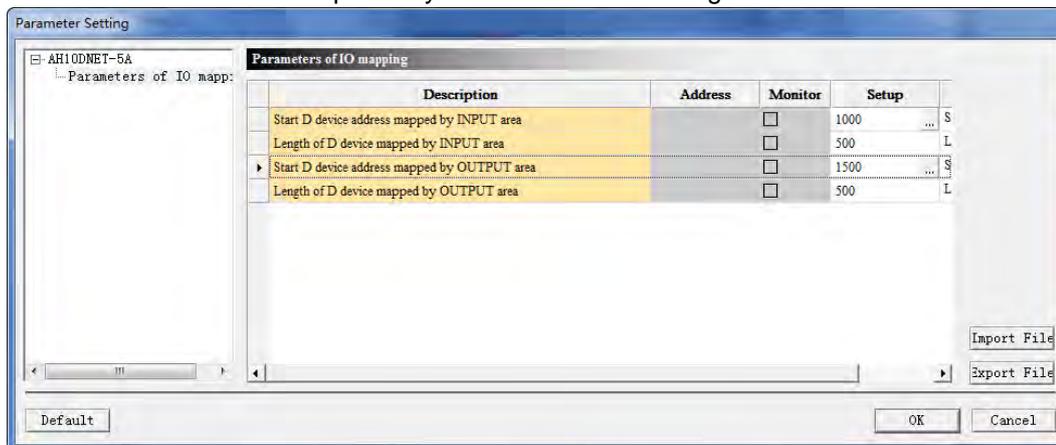
7. Select "Option" >> "Download" to download the above setting to AHCPU510-EN.
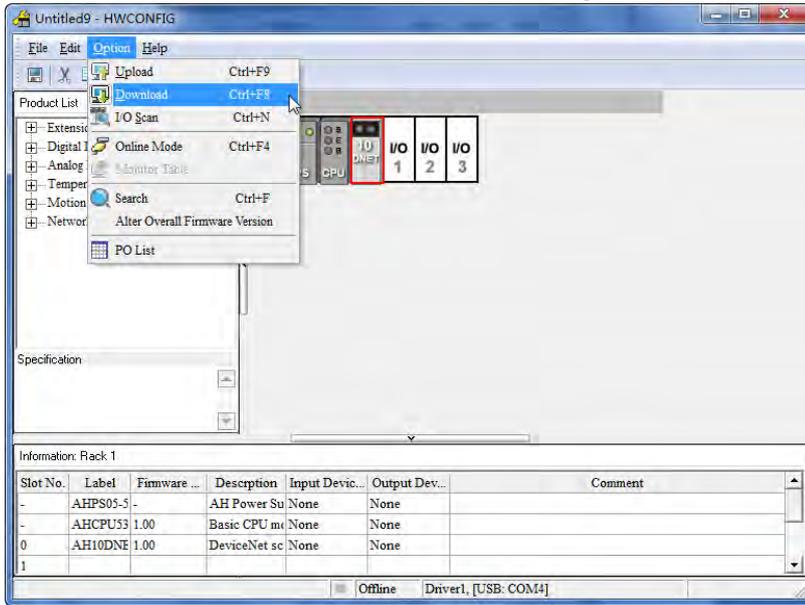
8. Right click 10DNET icon and select "Intelligent Module Configuration" to call the DeviceNet Builder software interface out.
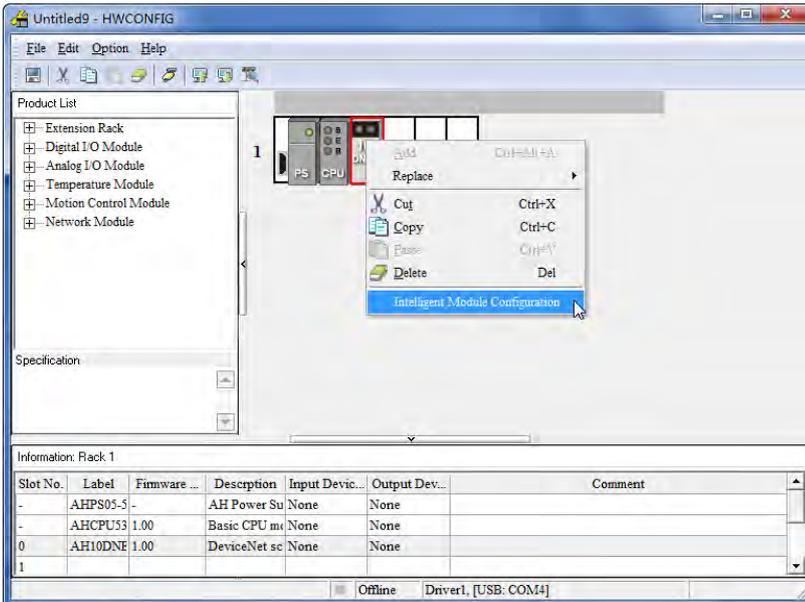
9.   The DeviceNet Builder software is called out.
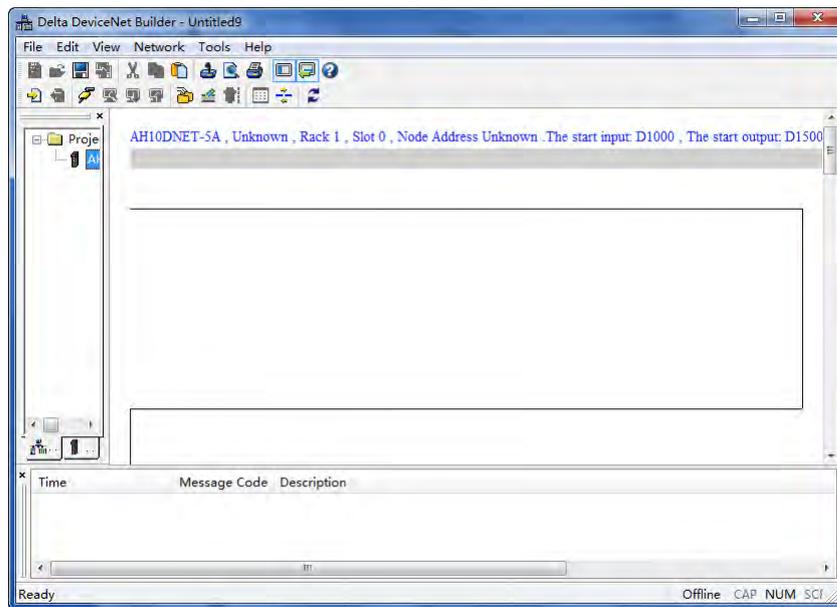
10.   Select "Network" >> "Online" and AH10DNET-5A will appear under the project list.
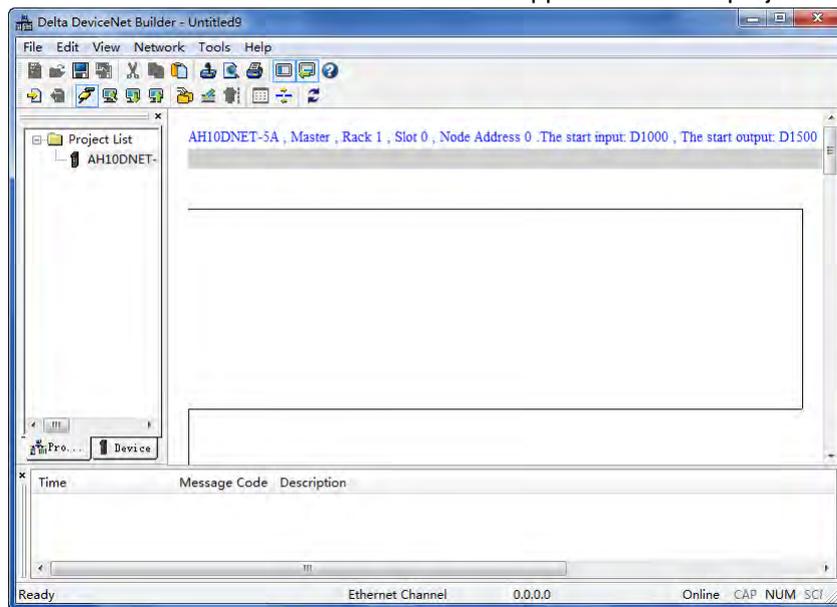
If AH10DNET-5A has been set to the slave mode, the software interface will be as shown below.
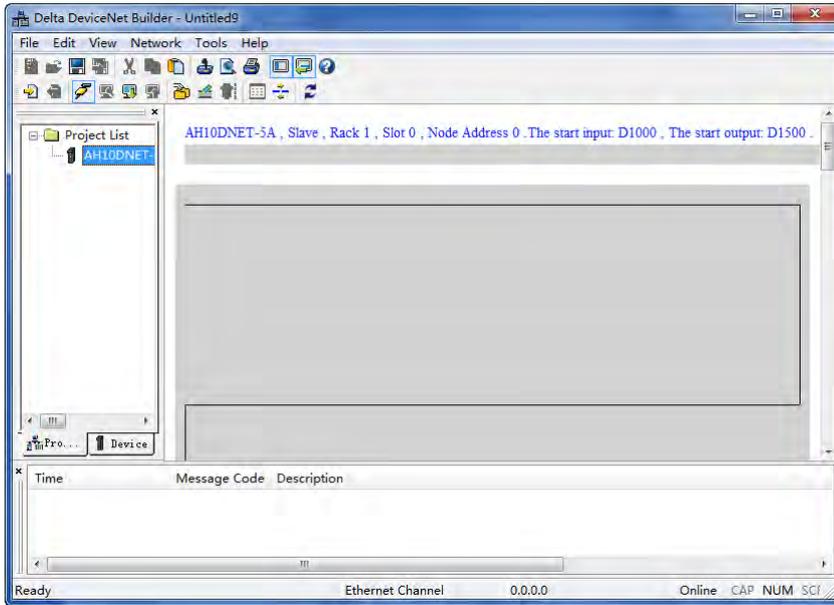
Note: If AH10DNET-5A has been set to the slave mode, set current AH10DNET-5A to the master mode first and then conduct the next operation.

11. Select "Network" >> "Scan DeviceNet Network" and AH10DNET-5A starts to scan the whole network. All the node icons and device names on the network will be displayed on the software as below.
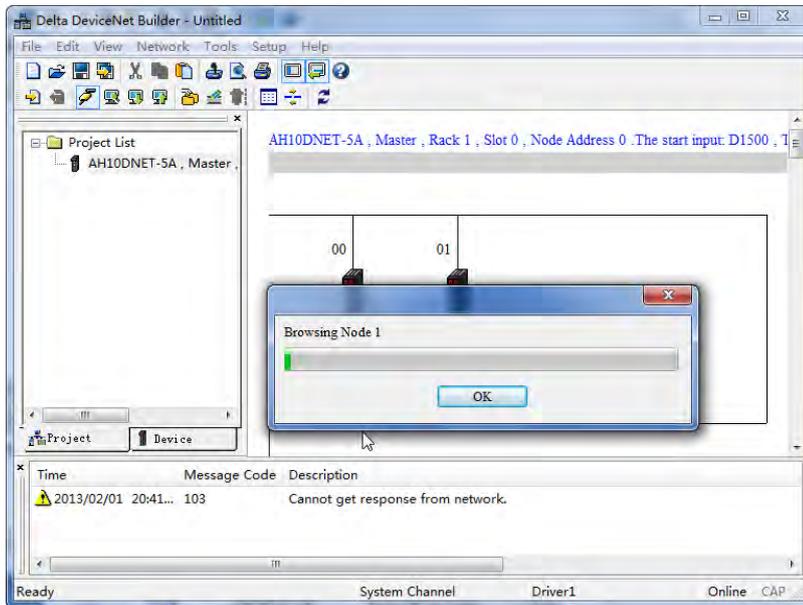
12. Right click the icon on AH10DNET Slave (node 1) and select "Parameter Edit...".
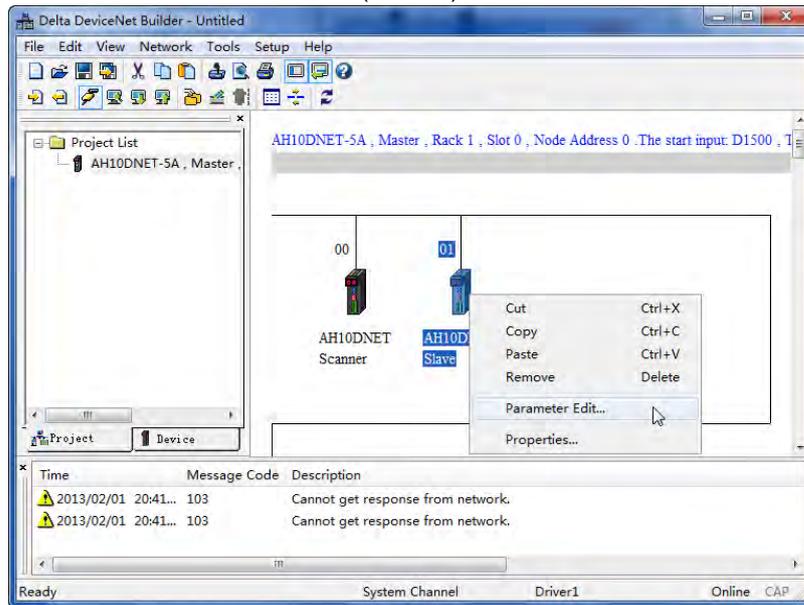
13. Read all parameters in the following dialogue box. Set both of Length of input data and Length of output data of the slave to 10 bytes. After reading is over, click "OK" to return to the main interface of the software.
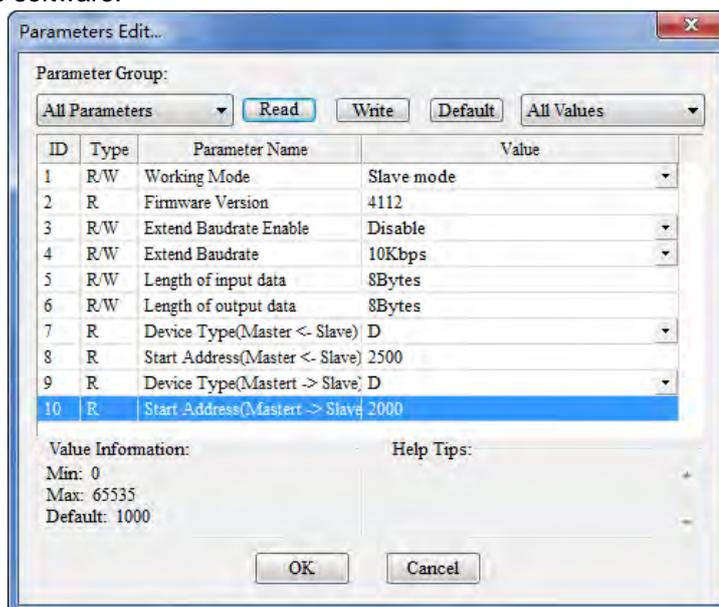
10.9.4 Configuring DeviceNet Slave into the Master

1. Double click AH10DNET Scanner (Node 1) on the main software interface and "Scanner Module Configuration" dialog box appears, where see the currently available node AH10DNET Slave in the left list.
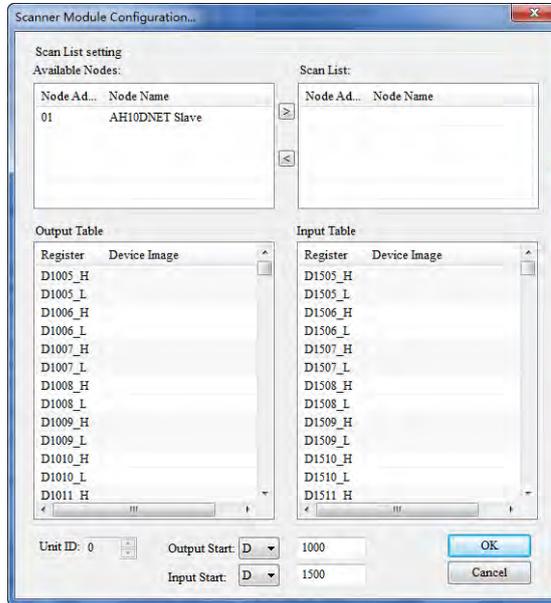
2. Add the node device in "Available Nodes" to Scan List. In the example, the starting addresses for output and input are D1500 and D1000 respectively.
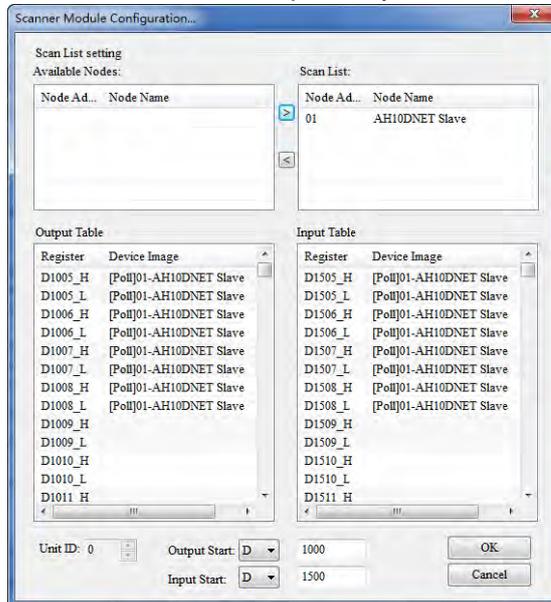
Note:

(1) After the connection between the master and slave is built successfully, fill the control data in the registers in "Output Table" and the data will be transmitted to the slave automatically.

(2) After the connection between the master and slave is built successfully, the data that slave feedback will be transmitted to the registers in "Input Table".

(3) The registers in "Output Table" are specified by "Output Start".

(4) The registers in "Input Table" are specified by "Input Start".

3. Click "OK" after confirming that no error exists to download the configuration to AH10DNET-5A. If the AH500 series CPU module is in run mode during downloading, the warning dialogue box will pop up as below.

Warning

⚠ Cannot perform this operation when PLC is in RUN mode!
Do you wish to continue if this instruction will affect the state of the connected PLC?

[OK]   [Cancel]
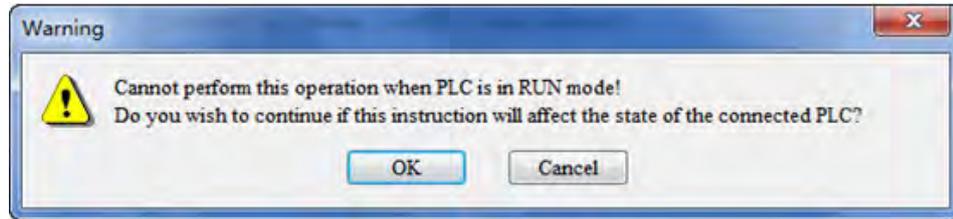
4. Click "OK" to download the configuration to the scanner module. At the moment, the configuration of the DeviceNet network is completed.

10.9.5 Data Flow Direction

Configure the DeviceNet network following the above steps and the mapping relation between AH10DNET-5A and the slave device is shown below:

AH500 series CPU module → AH10DNET-5A → Slave device

AHCPU510-EN	AH10DNET-5A (Master)	AH10DNET-5A (Slave)	AHCPU530-EN
D1505			D2000
D1506			D2001
D1507	⇒	⇒	D2002
D1508			D2003
D1509			D2004

AH500 series CPU module ← AH10DNET-5A ← Slave device

AHCPU510-EN	AH10DNET-5A (Master)	AH10DNET-5A (Slave)	AHCPU530-EN
D1005			D2500
D1006			D2501
D1007	⇐	⇐	D2502
D1008			D2503
D1009			D2504

Note: AHCPU510-EN is to monitor and control D0 in AHCPU530-EN via the DeviceNet bus; move the value in D2000 to D0 and meanwhile move the value in D0 to D2500 in AHCPU530-EN in real time.

10.9.6 Ladder Diagram Program

Control request:

AHCPU510-EN makes the remote monitor and control of D0, D30, D50, D150 and D230 in AHCPU530-EN via the DeviceNet bus.

In order to achieve the above control request, write the following PLC program in AHCPU530-EN.

PLC program:

NETWORK 1

```
SM400                          MOV
 ┤├                            En
              D2000 ─ S        D ─ D0
```

NETWORK 2

```
SM400                          MOV
 ┤├                            En
              D2001 ─ S        D ─ D30
```

NETWORK 3

```
SM400                          MOV
 ┤├                            En
              D2002 ─ S        D ─ D50
```

NETWORK 4

```
SM400                          MOV
 ┤├                            En
              D2003 ─ S        D ─ D150
```

NETWORK 5

```
SM400                          MOV
 ┤├                            En
              D2004 ─ S        D ─ D230
```

NETWORK 6

```
SM400                              MOV
 ┤ ├                           En
                    D0  ─ S        D ─ D2500
```

NETWORK 7

```
SM400                              MOV
 ┤ ├                           En
                    D30 ─ S        D ─ D2501
```

NETWORK 8

```
SM400                              MOV
 ┤ ├                           En
                    D50 ─ S        D ─ D2502
```

NETWORK 9

```
SM400                              MOV
 ┤ ├                           En
                   D150 ─ S        D ─ D2503
```

NETWORK 10

```
SM400                              MOV
 ┤ ├                           En
                   D230 ─ S        D ─ D2504
```
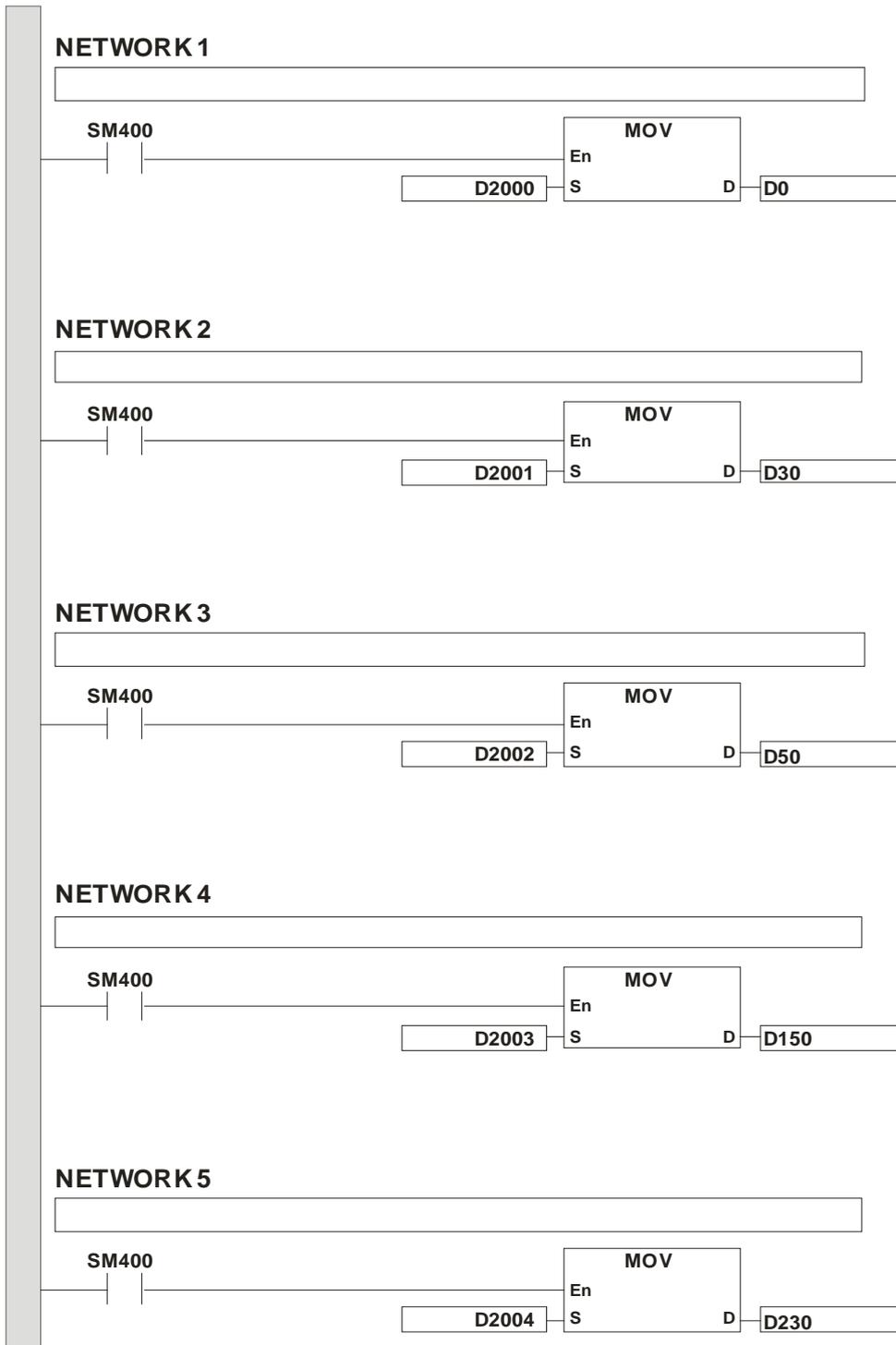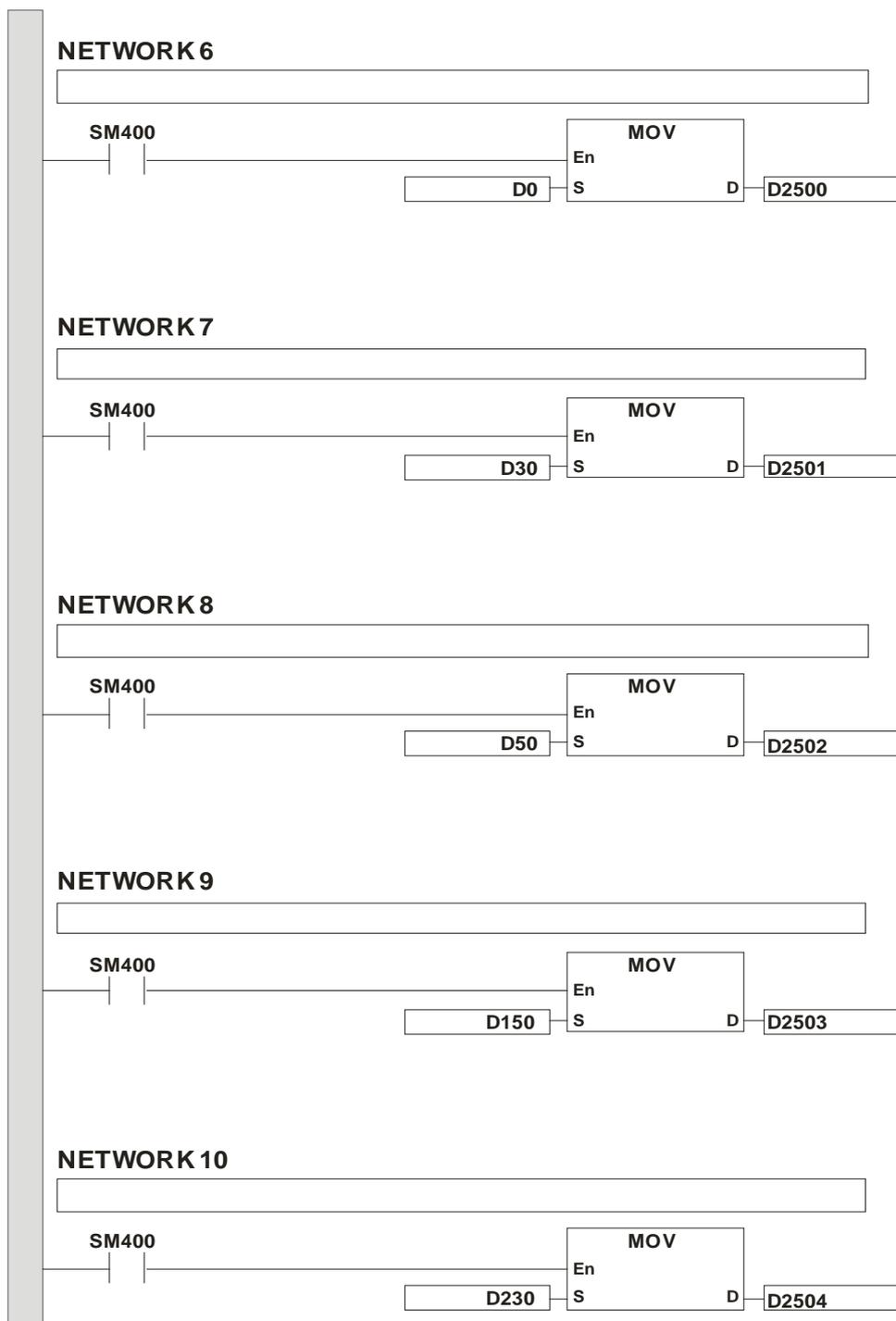
Note:
1. The above program is the ladder diagram program of AHCPU530-EN.
2. Controlling D1505~D1509 in AHCPU510-EN is equal to controlling D0, D30, D50, D150 and D230 in AHCPU530-EN.
3. Meanwhile, the current values in D0, D30, D50, D150 and D230 in AHCPU530-EN will be transmitted to D1005~D1009 in AHCPU510-EN in real time.

10.10 Error Diagnosis and Trouble Shooting

AH10DNET-5A provides three diagnosis methods such as indicator, seven-segment display and software diagnosis.
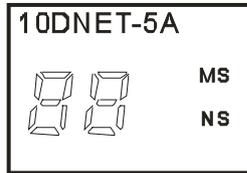
10.10.1 Indicator Diagnosis

● **NS LED**

LED status	Indication	How to deal with
OFF	No power; Duplicate ID detection has not completed.	1. Make sure that AH10DNET-5A is powered. 2. Ensure that at least one node or more are communicating on the network.
Green light blinking	No connection with the DeviceNet	No correction; Or refer to the code on the seven-segment display for the error-shooting.
Green light ON	Online and connecting with the DeviceNet normally	--
Red light blinking	Communication error.	Refer to the code on the seven-segment display for the error-shooting.
Red light ON	Network error: duplicate ID; no network power or bus-off	1. Make sure all the devices have their unique node address. 2. Check if the network installation is correct 3. Check if the node address of AH10DNET-5A is valid. 4. Check if the network power is normal.

● **MS LED**

LED status	Indication	How to deal with
OFF	No power	Make sure that AH10DNET-5A is powered and connected properly.
Green light blinking	The scanner module has not been configured	Configure the scan list and re-download the configuration to AH10DNET-5A.
Green light ON	Normally input/output data	--
Red light blinking	As the master, the slave in the scan list of AH10DNET-5A works abnormally; as the slave, it is a configuration problem	Refer to the display on the seven-segment display and ensure that the slave message is consistent with that actually connected.
Red light ON	The internal error in AH10DNET-5A	1. Check if the configuration is correct 2. Repower it first and return it to the factory for repair if the error still exists.

● **NS and MS LED**

LED status		Indication	How to deal with
NS	MS		
OFF	**OFF**	No power	Check if the power of AH10DNET-5A is normal.

LED status		Indication	How to deal with
NS	**MS**		
OFF	**Green light ON**	Duplicate ID detection has not completed.	Ensure that at least one node and AH10DNET-5A have the same baud rate and communicate normally on the network.
Red light ON	**Green light ON**	Duplicate ID detection failed or bus-off.	1. Ensure that the node address of AH10DNET-5A is unique. 2. Repower it.
Red light ON	**Red light blinking**	No network power	1. Check if the network cable connection is correct. 2. Check if the network power is normal.
Red light ON	**Red light ON**	Hardware error	Return it to the factory for repair.

10.10.2 Seven-segment Display Diagnosis

Code	Indication	How to deal with
0~63	Node address of DVPDNET-SL (in normal operation)	--
80	AH10DNET-5A in STOP status.	Turn the AH500 series CPU module to RUN and start I/O data exchange.
F0	The node address of AH10DNET-5A is identical to that of other node or exceeds the valid range.	1. Ensure that the node address of AH10DNET-5A is unique. 2. Repower it after changing its node address.
F1	No slave device is configured in the scan list of AH10DNET-5A	Configure the slave in the scan list and download the scan list to AH10DNET-5A.
F2	Excessively low voltage for AH10DNET-5A	Check if the power supply for AH10DNET-5A and the AH500 series CPU module is normal.
F3	Entering test mode	Switch IN1 from ON to OFF and repower AH10DNET-5A.
F4	Bus-off	1. Check if the network cable is normal and the shielded wire has been grounded. 2. Check if the baud rates of all node equipment on the network are consistent. 3. Check if both of the two ends of the network have a 121 Ω resistor. 4. Repower AH10DNET-5A.
F5	No network power	Make sure the cable is correctly connected and check if the network power is normal.
F6	Internal errors; internal memory unit errors	If the error still exists after power on again, send your AH10DNET-5A back to the factory for repair.
F7	Data exchange unit errors	If the error still exists after power on again, send your AH10DNET-5A back to the factory for repair.
F8	Sequence number detection errors	If the error still exists after power on again, send your AH10DNET-5A back to the factory for repair.
F9	An error in reading/writing the configuration data.	If the error still exists after power on again, send your AH10DNET-5A back to the factory for repair.
FA	The node address of AH10DNET-5A is the same as that of the slave configured in the scan list.	Method 1: Reset the node address of AH10DNET-5A, which must be different from that of the slave configured in the scan list and then repower it.

Code	Indication	How to deal with
		Method 2: No slave is configured in the scan list. Download the empty configuration to AH10DNET-5A by using the "Simulate online" function. Finally, repower it.
FB	The data exchange between AH10DNET-5A and AHCPU fails.	If the error still exists after AH CPU and AH10DNET-5A are repowered, send your AH10DNET-5A back to the factory for repair.
E0	AH10DNET-5A has detected that the node equipment on the bus is different from that in the scan list.	1. Check if the node address of the slave has been changed. 2. Check if the node equipment on the bus has been changed. 3. Configure the network again.
E1	The actual polled data length in the slave is not consistent with that set in the scan list.	1. Check the actual IO data length of the slave. (Please see section 10.9.2.) 2. Configure relevant slaves to the scanner module again.
E2	The slave in the scan list is offline or does not exist when in master mode. 10DNET slave module is disconnected to the IO of master when in slave mode.	1. Check if the node address of the slave has been changed. 2. Check if the network cable is connected normally in case it is loose or cut. 3. Check if the bus communication cable length exceeds the maximum transmission distance. If it does, the system will no longer keep stable. (See section 10.3.3.)
E3	AH10DNET-5A fails to transmit a message.	1. Check if the connection between the scanner module and network is normal 2. Ensure that the baud rates of the scanner module and other node are same.
E4	An error detected in sequence of fragmented I/O messages from the slave device	Check if the slave is operating normally.
E5	The slave device returns error messages when AH10DNET-5A attempts to communicate with it.	Check if the slave is operating normally.
E6	The size of IO data returned from the slave is greater than that configured in the scan list.	Ensure that the IO data length of the slave is the same as that configured in the scan list.
E7	AH10DNET-5A is checking if its node address is repeated in that of other node equipment on the network	Please follow the methods below to shoot the troubles if the error code appears for long. 1. Ensure that at least two nodes work normally on the network. 2. Check if both ends of the network are connected with 121 Ω terminal resistors respectively. 3. Ensure that the baud rates of all node equipment are same. 4. Check if the network cable is connected normally in case it is loose or cut. 5. Check if the bus communication cable length exceeds the maximum transmission distance. The system may no longer keep stable if the maximum distance is exceeded. 6. Check if the shielded wire in the network communication cable is grounded. 7. Repower AH10DNET-5A.

Code	Indication	How to deal with
E8	AH10DNET-5A is initializing.	If initializing lasts too long, please repower AH10DNET-5A.
E9	An error in the modules on the rack connected to AHRTU-DNET or the extension rack error	1. Check if the modules on the rack connected to AHRTU-DNET are normal. 2. Check if the extension rack connected to AHRTU-DNET is connected normally.

10.10.3 Software Diagnosis

When ISPSoft is used to read PLC system record, the following error codes may appear.

Error code	Description	How to deal with
16#A0F1	No slave is configured in the scan list	Configure the slave in the scan list and then download the scan list to AH10DNET-5A.
16#A0F0	The node address of AH10DNET-5A is repeated in that of other node or exceeds the valid range.	Ensure that the node address of AH10DNET-5A is unique and repower it after changing its node address.
16#A0F2	Excessively low voltage for AH10DNET-5A.	Check if the work power for AH10DNET-5A and the AH500 series CPU module is normal.
16#A0F3	AH10DNET-5A enters the test mode.	Switch IN1 from ON to OFF and repower AH10DNET-5A.
16#A0F4	AH10DNET-5A enters the bus-off state.	1. Check if the network cable is normal and the shielded wire has been grounded. 2. Check if the baud rates of all node equipment on the network are the same. 3. Check if both ends of the network have been connected with a 121 Ω resistor respectively. 4. Repower AH10DNET-5A.
16#A0F5	No power for the DeviceNet network is detected.	Make sure that the cable is correctly connected and check if the network power supply is normal.
16#A0F6	Internal storage unit errors in AH10DNET-5A	If the error still exists after power on again, send your AH10DNET-5A back to the factory for repair.
16#A0F7	Data exchange unit errors in AH10DNET-5A	If the error still exists after power on again, send your AH10DNET-5A back to the factory for repair.
16#A0F8	Sequence number detection errors in AH10DNET-5A	If the error still exists after power on again, send your AH10DNET-5A back to the factory for repair.
16#A0F9	Errors in reading/writing the configuration data	If the error still exists after power on again, send your AH10DNET-5A back to the factory for repair.
16#A0FA	The node address of AH10DNET-5A is repeated in that of the slave configured in the scan list.	Method 1: Reset the node address of AH10DNET-5A, which must be different from that of the slave configured in the scan list and then repower it. Method 2: Do not configure any slave in the scan list. Download the empty configuration to AH10DNET-5A by using the "Simulate online" function. Finally, repower it.
16#A0FB	The data exchange between AH10DNET-5A and AHCPU fails.	If the error still exists after AH CPU and AH10DNET-5A are repowered, send your AH10DNET-5A back to the factory for repair.
16#A0FC	Some error occurs in the slave or in the modules on the rack connected to AHRTU-DNET or the	1. Check if the node address of the slave has been changed. 2. Check if the network cable is connected normally in case it is loose or cut.

Error code	Description	How to deal with
	extension rack connection fails.	3. Check if the bus communication cable length exceeds the maximum transmission distance. (Refer to section 10.3.3. The system may no longer keep stable if the maximum distance is exceeded.) 4. Check if all modules on the rack are normal. 5. Check if the extension rack connected to AHRTU-DNET is connected normally.

Chapter 11 DeviceNet Remote I/O Module AHRTU-DNET

Table of Contents

11.1 Introduction of AHRTU-DNET-5A

1. Thank you for choosing Delta AHRTU-DNET-5A. To ensure correct installation and operation of the device, please read the instruction carefully before use.
2. This manual only provides introductory information on AH10PFBS-5A. Detailed information about DeviceNet protocol is not included in this manual. Please refer to relevant literatures for more information on DeviceNet protocol.
3. Defined as a remote I/O module for data exchange, AHRTU-DNET-5A is used for connecting AH500 series I/O module, analog I/O module, temperature module and AH10SCM-5A module to the DeviceNet network.

11.1.1 Feature

- It supports the standard DeviceNet communication protocol as the DeviceNet slave.
- It supports explicit connection via predefined Master/Slave connection set.
- It supports polling.
- The network configuration software DeviceNet Builder provides the graphic configuration interface, automatically scans and identifies I/O modules, randomly maps the parameters of special modules as I/O exchange data, sets the methods to deal with the errors and diagnoses the error status of each module.
- According to the actual need, users select whether to retain the buffer register information when the network is offline.
- It is can be connected to one main rack, 7 extension racks and 68 AH500 series I/O modules. The maximum input and output data it supports: 980 bytes respectively
- It supports a hot swap. (When power ON, the device can be plugged directly for use after being removed.)

11.1.2 Function and Specifications

- DeviceNet connection

Item	Specification
Transmission method	CAN
Electric isolation	DC 500 V
Interface	Removable connector (5.08 mm)
Transmission cable	2 communication wires, 2 power wires and 1 shielded wire (The shielded wire must be connected to the ground and the communication wire must keep away from the power cable)
Voltage	11~25 V DC, supplied by DeviceNet network
Current	60 mA

- DeviceNet communication

Item	Specification
Communication protocol	Standard DeviceNet communication protocol
Message type	I/O polling, explicit, Group 2 only servers
Baud rate	Standard: 125 kbps; 250 kbps; 500 kbps
	Extension: 10 kbps; 20 kbps; 50 kbps; 125 kbps; 250 kbps; 500 kbps; 800 kbps; 1Mbps

● Environment

Item	Specification
Noise immunity	ESD (IEC 61131-2, IEC 61000-4-2): 8 kV Air Discharge
	EFT (IEC 61131-2, IEC 61000-4-4): Power Line: 2 kV, Digital I/O: 1 kV
	Analog & Communication I/O: 1 kV
	Damped-Oscillatory Wave: Power Line: 1 kV, Digital I/O: 1 kV
	RS (IEC 61131-2, IEC 61000-4-3): 26 MHz~1 GHz, 10 V/m
Operation	0ºC~55ºC (temperature); 5~95% (humidity); pollution level 2
Storage	-25ºC~70ºC (temperature); 5~95% (humidity)
Vibration/Shock resistance	Standard: IEC 61131-2, IEC 68-2-6 (TEST Fc)/IEC 61131-2 & IEC 68-2-27 (TEST Ea)
Certificates	IEC 61131-2, UL508

11.2 Profile and Outline

11.2.1 Dimensions
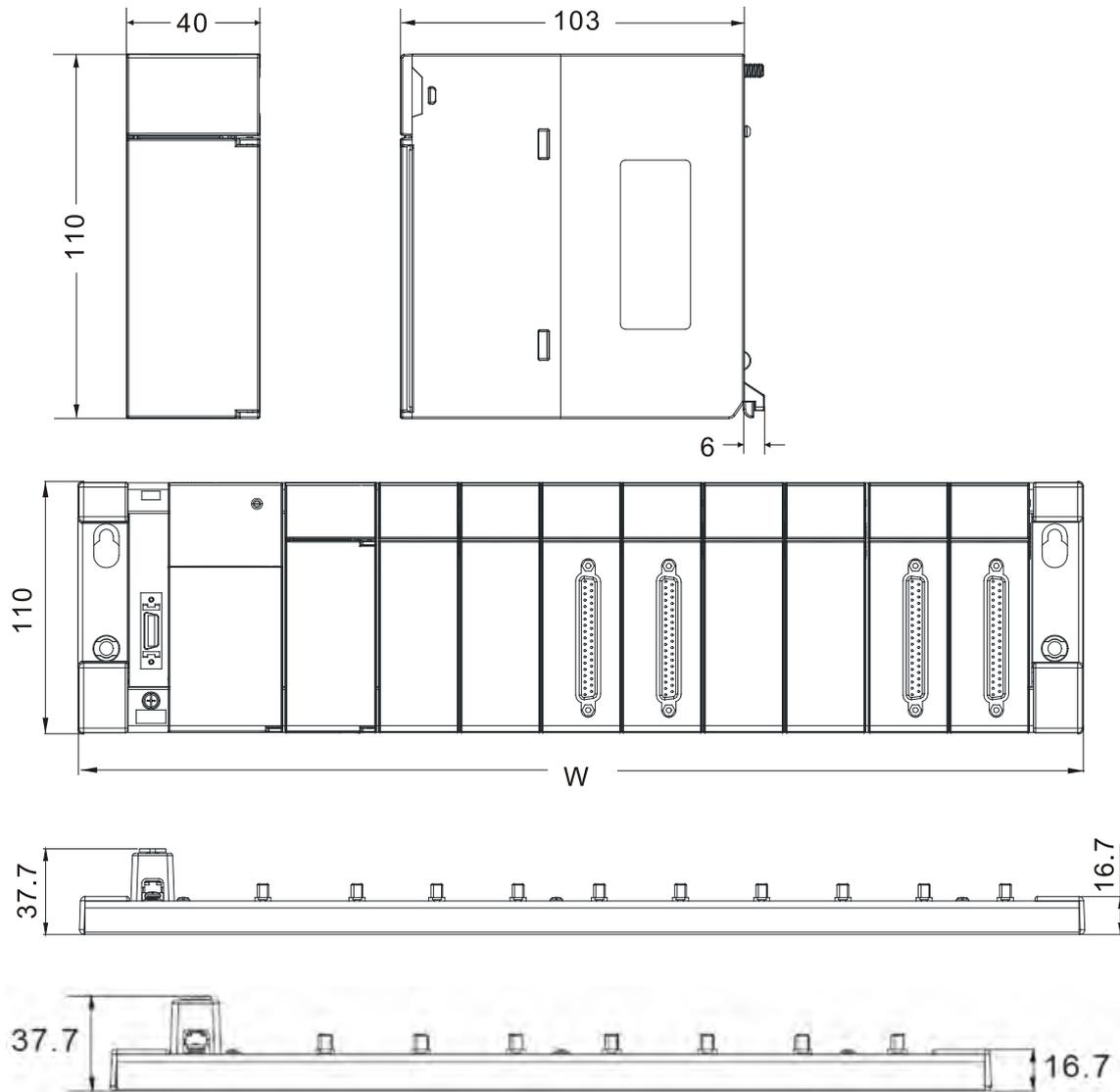
Unit: mm

Note: W indicates the length of the main rack where AHRTU-DNET-5A is mounted.

Length and height of each rack:

Model	Length W	Rack's height	Total height of rack plus module
AHBP04M1-5A (Main rack)	298	16.7	119.7 (16.7+103)
AHBP06M1-5A (Main rack)	369	16.7	119.7 (16.7+103)
AHBP08M1-5A (Main rack)	440	16.7	119.7 (16.7+103)
AHBP12M1-5A (Main rack)	582	16.7	119.7 (16.7+103)
AHBP06E1-5A (Extension rack)	328	16.7	119.7 (16.7+103)
AHBP08E1-5A (Extension rack)	399	16.7	119.7 (16.7+103)

11.2.2 Profile
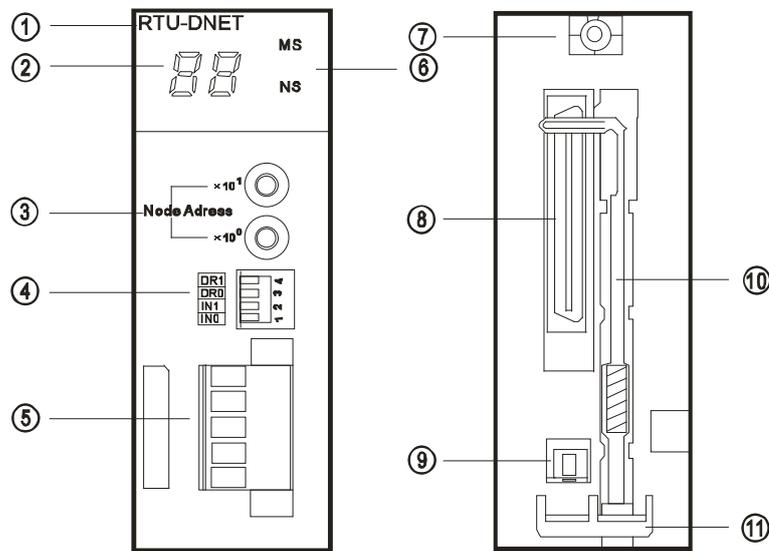
1. Model name	2. Digital displayer
3. Address switch	4. Function switch
5. DeviceNet communication port	6. MS indicator & NS indicator
7. Set Screw hole	8. CPU interface
9. Static metal dome	10. Spring and pushrod
11. Projection for fixing the module	

11.2.3 DeviceNet Communication Connector

The connector is used on the connection to DeviceNet. Wire it by using the connector enclosed with AHRTU-DNET-5A.

Pin definition of DeviceNet connector:

Pin	Signal	Color	Description
1	V+	Red	24 V DC
2	CAN_H	White	Signal (positive pole)
3	SHIELD	-	It is connected to a shielded cable.
4	CAN_L	Blue	Signal (negative pole)
5	V-	Black	0 V DC
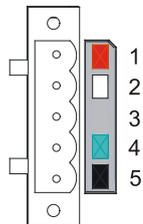
Note:
- Connect externally one 24 V DC network power between V+ and V-.
- One 121 ohm terminal resistor may be needed to connect between white (CAN_H) and blue (CAN_L) signal cable. For more details, please refer to the information in section 11.3.5.

11.2.4 Address Switch

The switch is used on setting up the node address of AHRTU-DNET-5A on DeviceNet. Range: 00~63 (64~99 are forbidden.)

Switch setting	Description
0 … 63	Valid DeviceNet node address
64…99	Invalid DeviceNet node address
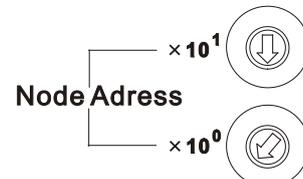
Node Adress
$\times 10^1$
$\times 10^0$

Example: If you need to set the node address of AHRTU-DNET-5A to 26, simply switch the corresponding switch of $x10^1$ to 2 and the corresponding switch of $x10^0$ to 6.

Note:
1. Please set up the node address when the power is switched OFF. After the setup is completed, repower AHRTU-DNET-5A. While AHRTU-DNET-5A is working, changing the setting of node address will be invalid.
2. Use slotted screwdriver to rotate the switch carefully in case you scratch the switch. Please see section 3.5 for more details.

11.2.5 Function Switch

The function switches are used for:
- Setting the data retaining function (IN0)
- Setting DeviceNet baud rate (DR0~DR1)

DR1	DR0	Baud rate
OFF	OFF	125 Kbps
OFF	ON	250 Kbps
ON	OFF	500 Kbps
ON	ON	Extended baud rate
IN1		Reserved
IN0	ON	Clear the data in the internal storage in AHRTU-DNET-5A.
	OFF	No action

Note:
- ✓ After modifying the setting of the function switch including DR1, DR0 and IN0, the new setting will be effective after AHRTU-DNET-5A is repowered.
- ✓ Supports the extended baud rate such as 10 kbps, 20 kbps, 50 kbps, 125 kbps, 250 kbps, 500 kbps, 800 kbps and 1 Mbps. Set the specific one in the DeviceNet Builder software.
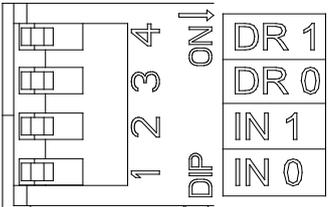- ✓ When IN0 is ON, the I/O output data in AHRTU-DNET-5A will be cleared every time the connection is disrupted.
- ✓ Use slotted screwdriver to rotate the switch carefully in case you scratch the switch.

11.2.6 CPU Interface

The interface is used to connect AHRTU-DNET-5A to the CPU slot of AH500 series rack.

Please note that AHRTU-DNET-5A must be inserted to the CPU slot on the rack in order to prevent from damaging the module or the rack.

11.3 Basic Installation of AHRTU-DNET-5A

11.3.1 Installing AHRTU-DNET-5A on the Rack

- Insert the projection under the module into the hole in the rack.
- Push the module in the direction indicated by the following arrow to meet the CPU slot of the rack.
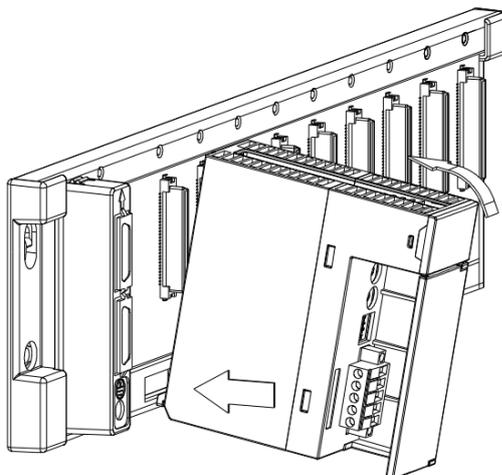
Note: AHRTU-DNET-5A is installed to the CPU slot of the main rack only.

● After installing properly, tighten the screw on the top of the module.
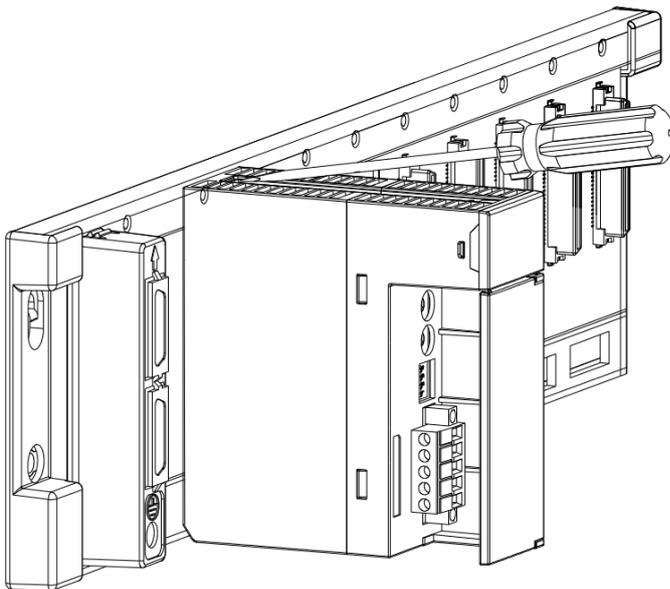
● By the same way, install the following power and I/O module. The power module must be installed to the POWER slot; the I/O module must be installed to the I/O slot; AH10SCM-5A must be installed to the I/O slot on the main rack.
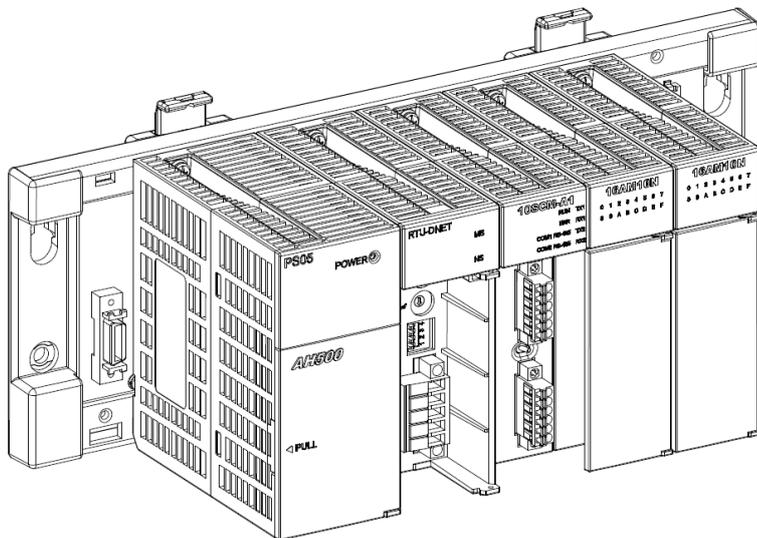
● AHRTU-DNET-5A supports maximum 1 main rack, 7 extension racks and 68 I/O modules. See the figure of connection of the racks as below.
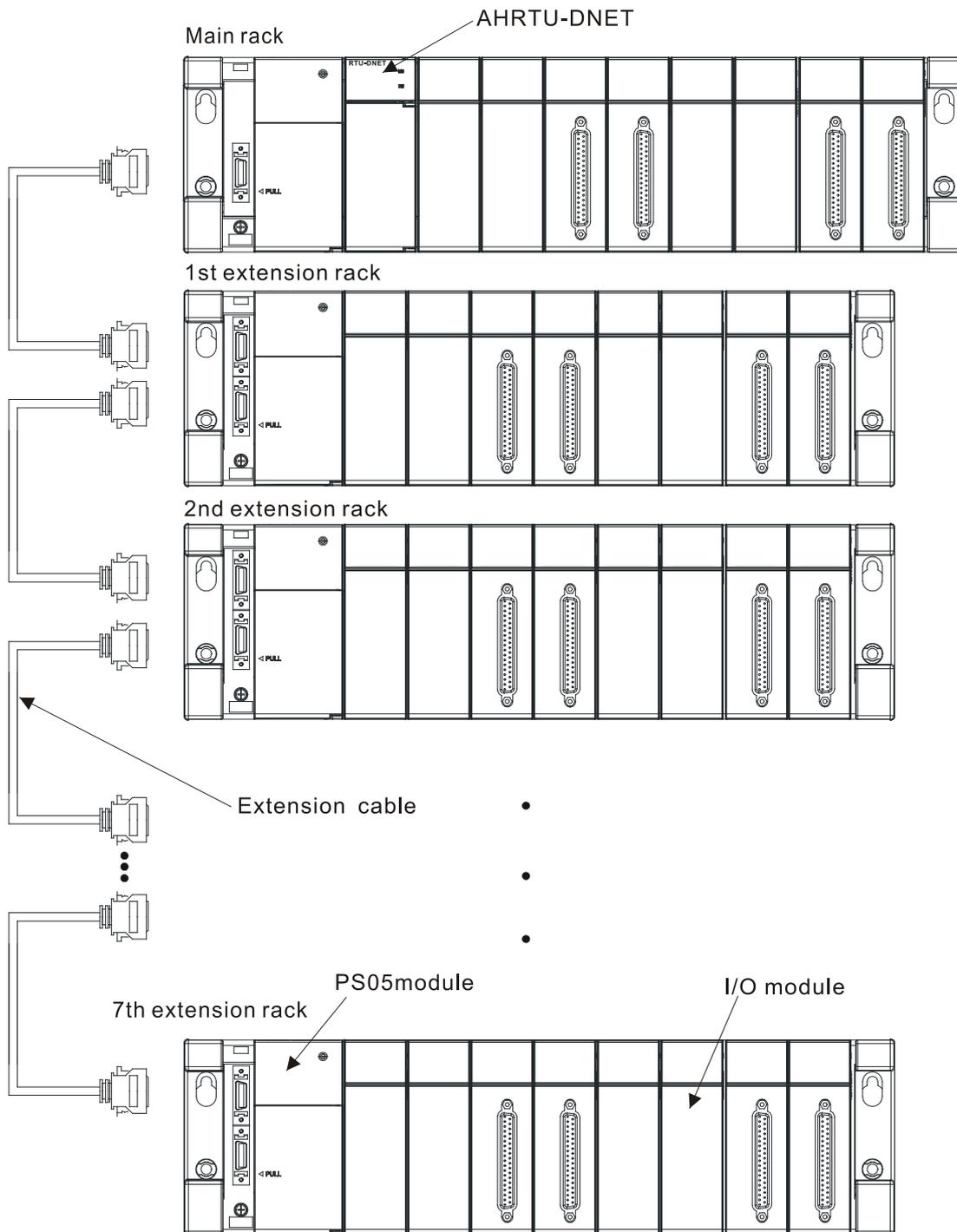
Note:
✓ AHRTU-DNET-5A must be installed to the CPU interface and AHPS05-5A power supply module can only be mounted to the POWER slot and I/O modules are mounted to the I/O slots only. Or else, the device may be damaged.
✓ AH10SCM-5A can only be installed to I/O slot of the main rack. Otherwise, it can not work normally.
✓ As for the extension rack connection, please follow the order that the first port on the extension rack is to connect last rack and the second port is to connect the next rack.
✓ AHRTU-DNET-5A supports maximum 1 main rack, 7 extension racks and 68 I/O modules.

11.3.2　Applicable Modules during Installation

● The power module, main rack, extension rack and the model and specification of the rack communication cable, which could be connected to AHRTU-DNET-5A are listed in the following table.

Module	Description
AHPS05-5A	Power module of 100-240 V AC and 50/60 HZ
AHBP04M1-5A	CPU/RTU exclusively uses the 4 –slot main rack.
AHBP06M1-5A	CPU/RTU exclusively uses the 6-slot main rack.
AHBP08M1-5A	CPU/RTU exclusively uses the 8-slot main rack.
AHBP12M1-5A	CPU/RTU exclusively uses the 12-slot main rack.
AHBP06E1-5A	CPU/RTU exclusively uses the 6-slot extension rack.
AHBP08E1-5A	CPU/RTU exclusively uses the 8-slot extension rack.
AHACAB06-5A	Extension rack exclusively uses the 0.6 m extension communication cable.
AHACAB10-5A	Extension rack exclusively uses the 1.0 m extension communication cable.
AHACAB15-5A	Extension rack exclusively uses the 1.5 m extension communication cable.
AHACAB30-5A	Extension rack exclusively uses the 3.0 m extension communication cable.

● The model and specification of digital I/O modules connected to AHRTU-DNET-5A

Digital I/O module	Default I/O mapping data length (Unit: Word)	
	DeviceNet→AHRTU-DNET-5A	AHRTU-DNET-5A→DeviceNet
AH16AM10N-5A	N/A	1
AH32AM10N-5A	N/A	2
AH32AM10N-5B	N/A	2
AH32AM10N-5C	N/A	2
AH64AM10N-5C	N/A	4
AH16AM30N-5A	N/A	1
AH16AN01R-5A	1	N/A
AH16AN01T-5A	1	N/A
AH16AN01P-5A	1	N/A
AH32AN02T-5A	2	N/A
AH32AN02T-5B	2	N/A
AH32AN02T-5C	2	N/A
AH32AN02P-5A	2	N/A
AH32AN02P-5C	2	N/A
AH64AN02T-5C	4	N/A
AH32AN02P-5B	2	N/A
AH64AN02P-5C	4	N/A
AH16AN01S-5A	1	N/A
AH16AP11R-5A	1	1
AH16AP11T-5A	1	1
AH16AP11P-5A	1	1

● The model and specification of special modules connected to AHRTU-DNET-5A

Special module	Default I/O mapping data length (Unit: Word)	
	DeviceNet→AHRTU-DNET-5A	AHRTU-DNET-5A→DeviceNet
AH04AD-5A	N/A	8
AH08AD-5B	N/A	16
AH08AD-5C	N/A	16

Special module	Default I/O mapping data length (Unit: Word)	
	DeviceNet→AHRTU-DNET-5A	AHRTU-DNET-5A→DeviceNet
AH04DA-5A	8	N/A
AH08DA-5B	16	N/A
AH08DA-5C	16	N/A
AH06XA-5A	4	8
AH04PT-5A	N/A	8
AH04TC-5A	N/A	8
AH08TC-5A	N/A	16
AH10SCM-5A	20	38

Note:

✓ AH10SCM-5A can only be mounted to the main rack.

✓ The data mapping length of the digital I/O module connected to AHRTU-DNET-5A is fixed. Those of the analog I/O module and AH10SCM-5A are the data length of the mapped parameters for I/O data exchange and can not be modified.

✓ When AHRTU-DNET-5A connects the analog I/O module and AH10SCM-5A, the mapped data that AHRTU-DNET-5A uploads and downloads could be default or optional according to the users' need. The input and output mapped address length of the selectable parameters of each analog I/O module could not exceed 20 words. Besides the input and output mapped address length of the selectable parameters could not exceed 20 words, AH10SCM-5A can provide maximum 100 words of input and 100 words of output mapped addresses for serial port data exchange.

11.3.3 Connecting the Cable to the DeviceNet Connector

Please use the special tool to strip off the skin of the communication cable for 30 mm. Note not to damage the shielded wire.	
After removing the outer metal shielded net and aluminum foil, you will see 2 power wires (red and black), 2 signal wires (blue and white) and one shielded wire.	
Strip off the plastic skin of the power wire and signal wire for an appropriate length after removing the outer metal shielded net and aluminum foil of the cable.	
Insert the stripped communication cable wires to the holes of the communication connector in order as the right figure shows.	
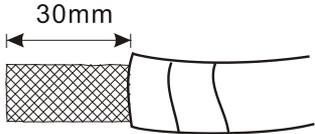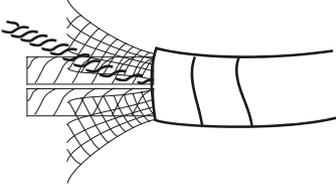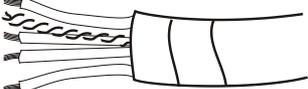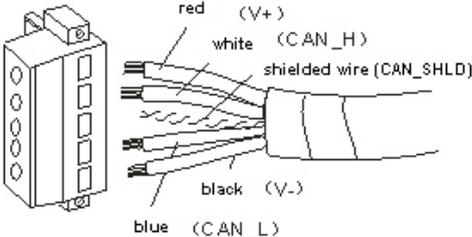
Tighten the screw of the communication connector to fix the cable to the holes of the connector with a standard slotted screwdriver.	
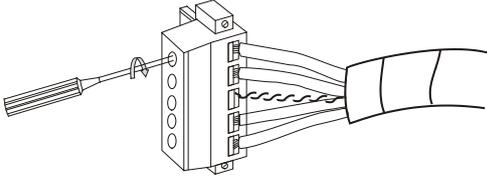
11.3.4 Installing the DeviceNet Connector

● After wiring is over, insert the DeviceNet connector to the interface.
● Tighten the screws of the two sides of the DeviceNet terminals.
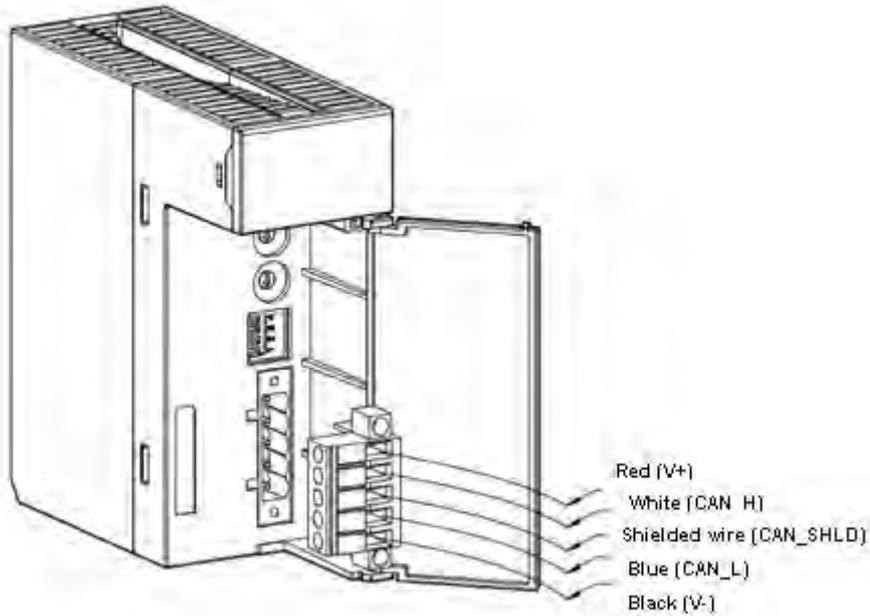
Note:
✓ The cable should be away from the power wire to decrease the electromagnetic interference.
✓ The two ends of the shielded wire should be grounded.
✓ The 121 ohm resistor should be connected between the white and blue signal wires.

11.3.5 DeviceNet Bus Transmission Distance and Network Topology Structure

DeviceNet bus transmission distance is determined by the DeviceNet bus transmission speed. See the following table on different transmission speed and the corresponding maximum communication distance.

| Transmission speed (bit/second)	10K	20K	50K	125K	250K	500K	800K	1M
Maximum communication distance	5000	2500	1000	500	250	100	50	25

- Choice of terminal resistor

  DeviceNet is required to install one terminal resistor of 121 ohm to either end of the trunk cable respectively.

  In the following figure, the thick line represents the main cable and the thin line represents the sub-cable. And the yellow objects at the ends of the main cable stand for the terminal resistors. The red object is the power distribution box and the blue one is the topology distribution box.
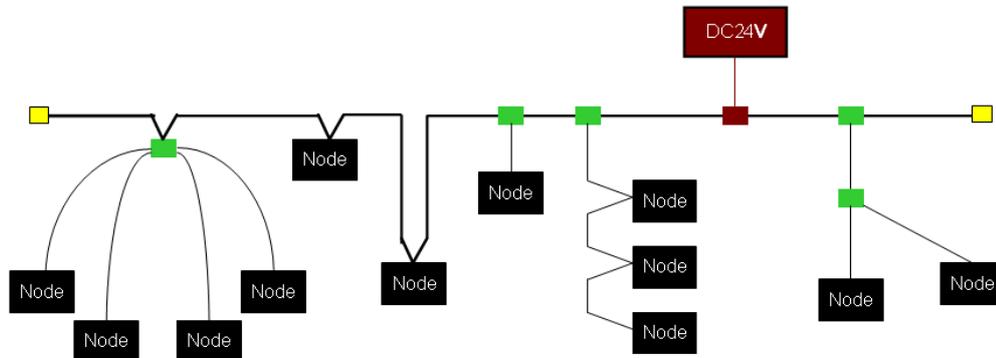
- Purpose of terminal resistor

  The terminal resistor is used for eliminating the signal reflection in the communication cable.

  All signal transmission cables have the characteristic impedance. The characteristic impedance of Delta DeviceNet communication cable is about 121 ohm.

  When being transmitted to the end of the communication cable, because the impedance of the end is different from the characteristic impedance, the signal will be reflected, which will interfere with the new signal and the signal wave form distortion will happen.

  The phenomenon of the signal wave form distortion is not obvious in the short-distance transmission. But the wave form distortion will become severe with the increasing communication cable. Therefore, the two ends of the trunk cable must be installed with the terminal resistors respectively.

- Installation of terminal resistor

  The DeviceNet cable consists of five wires: red wire, blue wire, white wire, black wire and shielded wire.
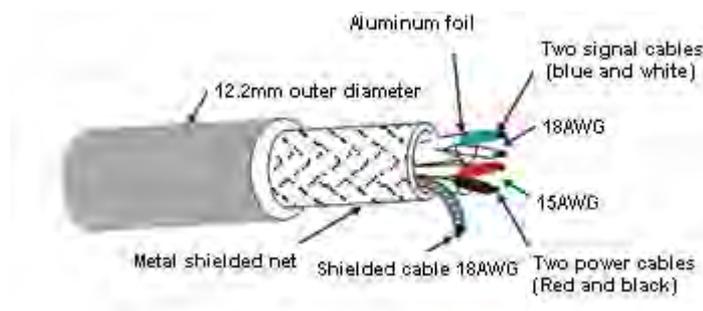
  The terminal resistors must be installed to the two ends of the trunk cable only. Since the blue wire and white wire are for signal transmission, the terminal resistor must be installed between blue wire and white wire.

The DeviceNet network topology structure is illustrated as below.

Delta network products related with DeviceNet bus:

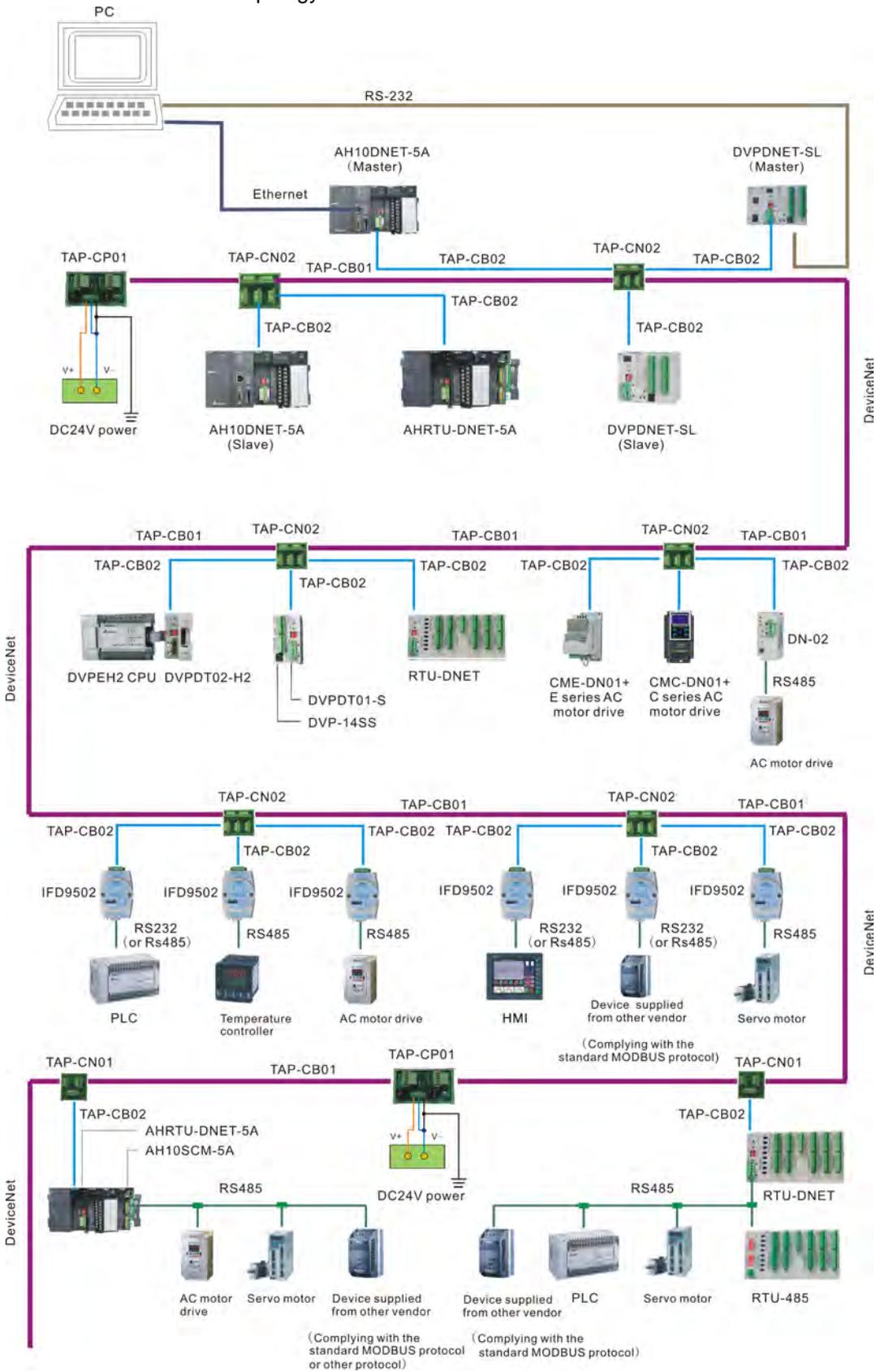| Product picture	Type	Function
	AH10DNET-5A	AH10DNET-5A, a DeviceNet module, running on the I/O slot of AH500 series main rack can work as the DeviceNet master or slave.
	AHRTU-DNET-5A	AHRTU-DNET-5A, an AH500 series remote I/O data exchange module, is used for connecting AH500 series DI/DO module, AI/AO module and AH10SCM-5A module to the DeviceNet network.
	DVPDNET-SL	DVPDNET-SL, a DeviceNet module, running on the left of S series PLC CPU can work as the DeviceNet master or slave.
	RTU-DNET	RTU-DNET, an S series remote I/O module, is used for connecting S-series DI/DO module, AI/AO module and other device to the DeviceNet network.
	IFD9502	It converts DeviceNet to Modbus gateway, which can connect the equipment with the RS-232 port or RS485 port complying with the Modbus protocol to the DeviceNet network.
	IFD6503	The bus data analysis tool, with one end of CAN interface and the other end of USB interface can be used for getting the CAN bus data or sending the data to the CAN bus node. It is used with the Netview Builder software together.

Product picture	Type	Function
	CME-DN01	Used for connecting the E series AC motor drive to the DeviceNet network.
	CMC-DN01	Used for connecting the C2000, CH2000, CP2000 series AC motor drive to the DeviceNet network.
	DN-02	It converts DeviceNet to Modbus gateway with the DeviceNet interface at one end and the RS485 port at the other end. It is used for connecting the AC motor drive to the DeviceNet network.
	DVPDT01-S	Used for connecting the S series PLC CPU to the DeviceNet network. The module can be connected to the extension port in the right side of the S series PLC CPU.
	DVPDT02-H2	Used for connecting the DVP-EH2/EH3 series PLC CPU to the DeviceNet network. The module can be connected to the extension port in the right side of DVP-EH2/EH3 series PLC CPU.
	TAPCP01	The CAN bus topology tapping box with the 120 ohm resistor enclosed which is controlled to be effective or not via its switch.

Product picture	Type	Function
	TAP-CN01	The CAN bus topology tapping box with the 120 ohm resistor enclosed which is controlled to be effective or not via its switch.
	TAP-CN02	The CAN bus topology tapping box with the 120 ohm resistor enclosed which can be controlled to be effective or not via its switch.
	TAP-CB01	TAP-CB01: DeviceNet trunk cable
	TAP-CB02	TAP-CB02: DeviceNet drop cable

11.4 Configuration of AHRTU-DNET-5A

As the DeviceNet slave, AHRTU-DNET-5A is used to achieve the remote data exchange between the DeviceNet master and the AH500 series I/O modules connected to itself.
● Transmits the output data of the DeviceNet master to I/O modules.
● Transmits the input data of I/O module to the DeviceNet master.

11.4.1 Terms

No.	Name	Unit	Explanation
1	AHRTU-DNET-5A input data range	Word	The input data mapping range of all modules connected to AHRTU-DNET-5A. The range depends on the input starting address and offset which the master assigned to AHRTU-DNET-5A. The max. offset is 126 as DVPDNET-SL works as the master; the max. offset is 489 as AH10DNET-5A is the master.
2	AHRTU-DNET-5A output data range	Word	The output data mapping range of all modules connected to AHRTU-DNET-5A. The range depends on the output starting address and offset which the master assigned to AHRTU-DNET-5A. The max. offset is 126 as DVPDNET-SL works as the master; the max. offset is 489 as AH10DNET-5A is the master.
3	Control word	Word	The first word of the output data which the master assigned to AHRTU-DNET-5A is the control word of AHRTU-DNET-5A. It is used for setting the work mode of AHRTU-DNET-5A. When the control word content is set to 2, AHRTU-DNET-5A is in STOP mode; when the control word content is set to 1, AHRTU-DNET-5A is in RUN mode.

| No.	Name	Unit	Explanation
4	Status word	Word	The first word of the input data which the master assigned to AHRTU-DNET-5A is the status word of AHRTU-DNET-5A. It is used for displaying the operational state of AHRTU-DNET-5A. Refer to section 4.3.3 for more details on status word.
5	Module input data range	Word	The range value is determined by the input starting address and input mapping parameter length of each module. The input mapping parameter length of each module is composed by both of the default mapping parameter length of the module and user-added mapping parameter length (max. 20 words). The digital I/O module length is fixed and so user could not add the parameter.
6	Module output data range	Word	The range value is determined by the output starting address and output mapping parameter length of each module. The output mapping parameter length of each module is composed by both of the default mapping parameter length of the module and user-added mapping parameter length (max. 20 words). The digital I/O module length is fixed and so user could not add the parameter.
7	Input data length	Word	The sum of status word length of AHRTU-DNET-5A and the input data length of the connected modules. The status word length is 1 word, it is 1 word per 16 points for the digital input module and the input data lengths of analog I/O module, temperature module and AH10SCM-5A are determined by the default mapping parameter length and user-added parameter length.
8	Output data length	Word	The sum of control word length of AHRTU-DNET-5A and the output data length of the connected modules. The control word length is 1 word, it is 1 word per 16 points for the digital output module and the output data lengths of analog I/O module, temperature module and AH10SCM-5A are determined by the default mapping parameter length and user-added parameter length.
9	When loses DeviceNet connection	--	When AHRTU-DNET-5A is disconnected from the DeviceNet network, how AHRTU-DNET-5A will deal with the trouble. User can choose "RTU keep running" or "RTU stop running".
10	When I/O module error occurs	--	When AHRTU-DNET-5A detects that any one of the connected I/O module alerts the errors such as alarming, power-off, how AHRTU-DNET-5A will deal with the trouble. User can choose "RTU keep running" or "RTU stop running".
11	Auto-Addr	--	Auto-assign the mapping address and the offset of the mapping parameters of all modules according to the module sequence. For the analog module, only the default parameters are assigned if user does not choose the mapping parameters.
12	Clear address	--	Clear the assigned mapping address of all modules.

11.4.2 Introduction of Software

Please make sure to have installed the communication manager COMMGR when using DeviceNet Builder of new version to connect with PLC CPU. (Please refer to appendix C for more details on COMMGR usage)

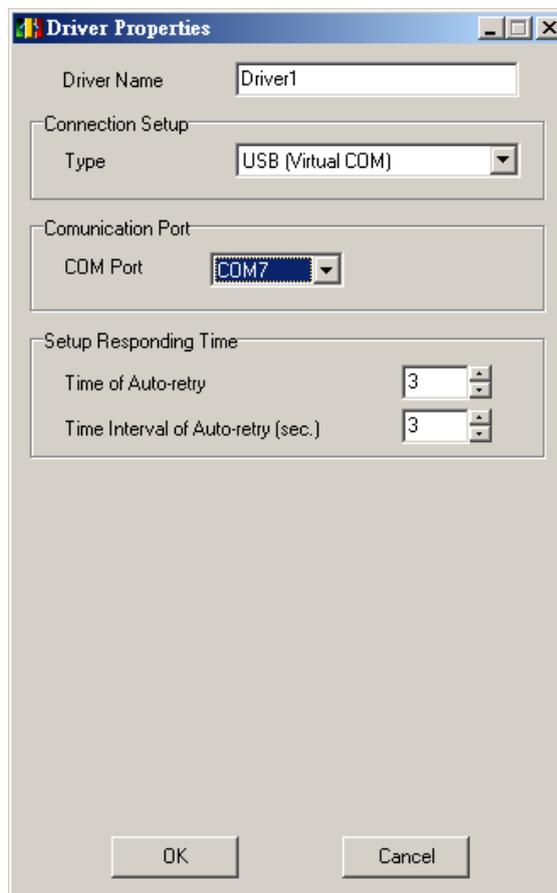### 11.4.2.1 Establishing the Connection between DeviceNet Builder and a PLC

To make the normal communication between DeviceNet Builder and PLC CPU, the communication management software COMMGR should be set up first.
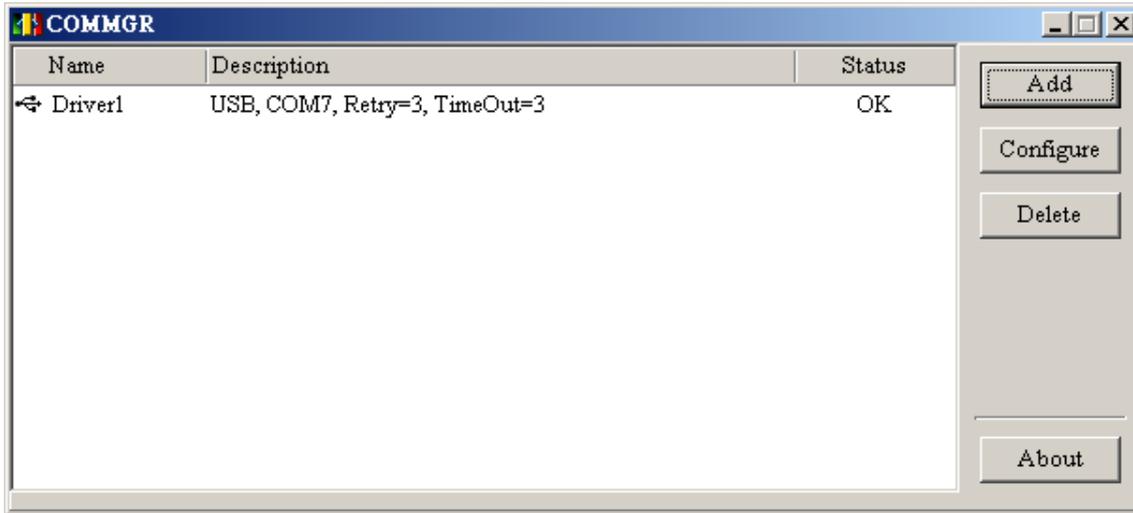
Set up COMMGR as below:

1. Open COMMGR.
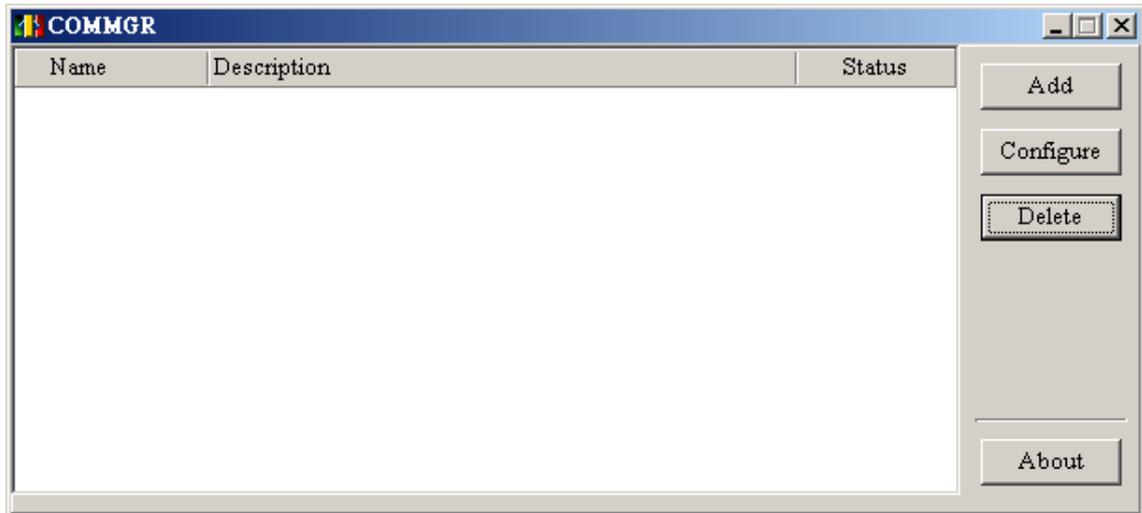
2. Click "Add" button to add a communication channel Driver 1 and set up the channel as follows.

3. Click "OK" after setting Driver 1 is completed. OK will show up on the status column if Driver1 is started up successfully.


4. Open DeviceNet Builder and select menu "Setup">"Communication Setting" after the communication channel Driver 1 is started up successfully.
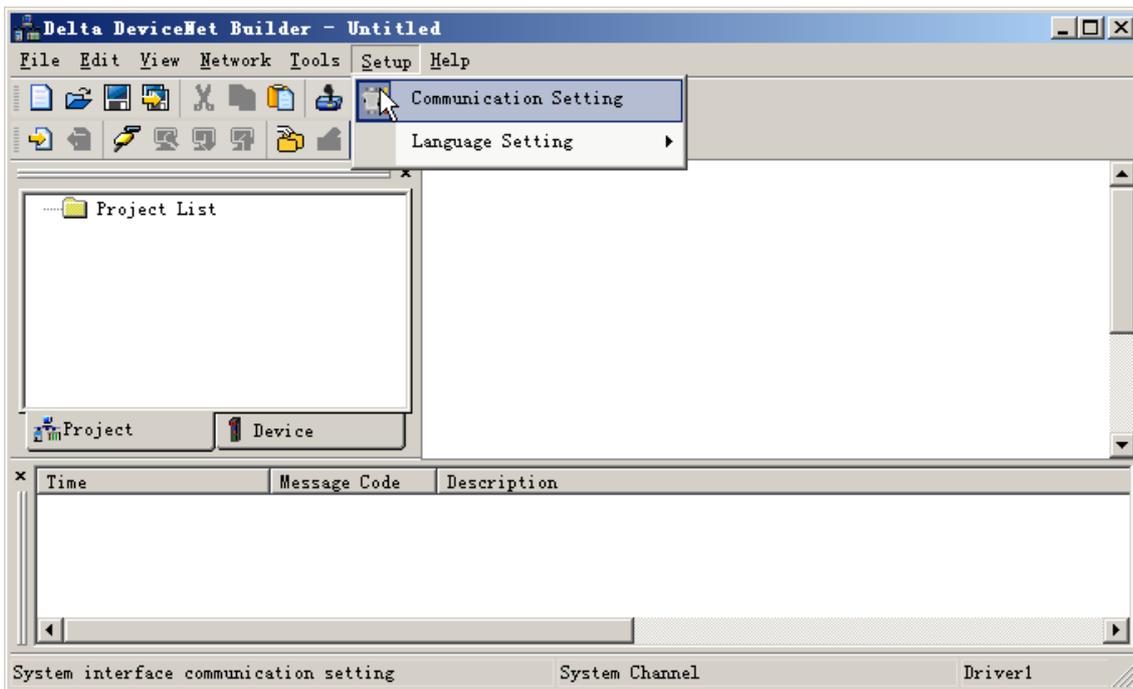
5. On the "Communication Setting" interface, select Driver 1 for "Driver". "Station address" represents the address of PLC CPU and the station address 0 indicates to broadcast. Finally, click "OK".
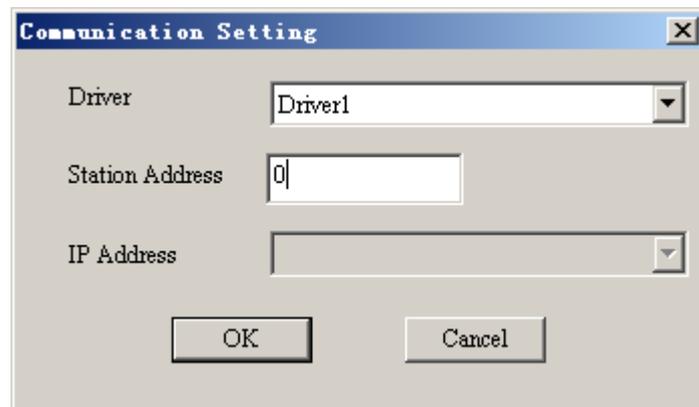

6. Click "Online" button, all DeviceNet scanner modules AH10DNET-5A connected to the main rack will show up with relevant properties in Project List. It indicates that the communication between DeviceNet Builder and PLC has been built successfully.
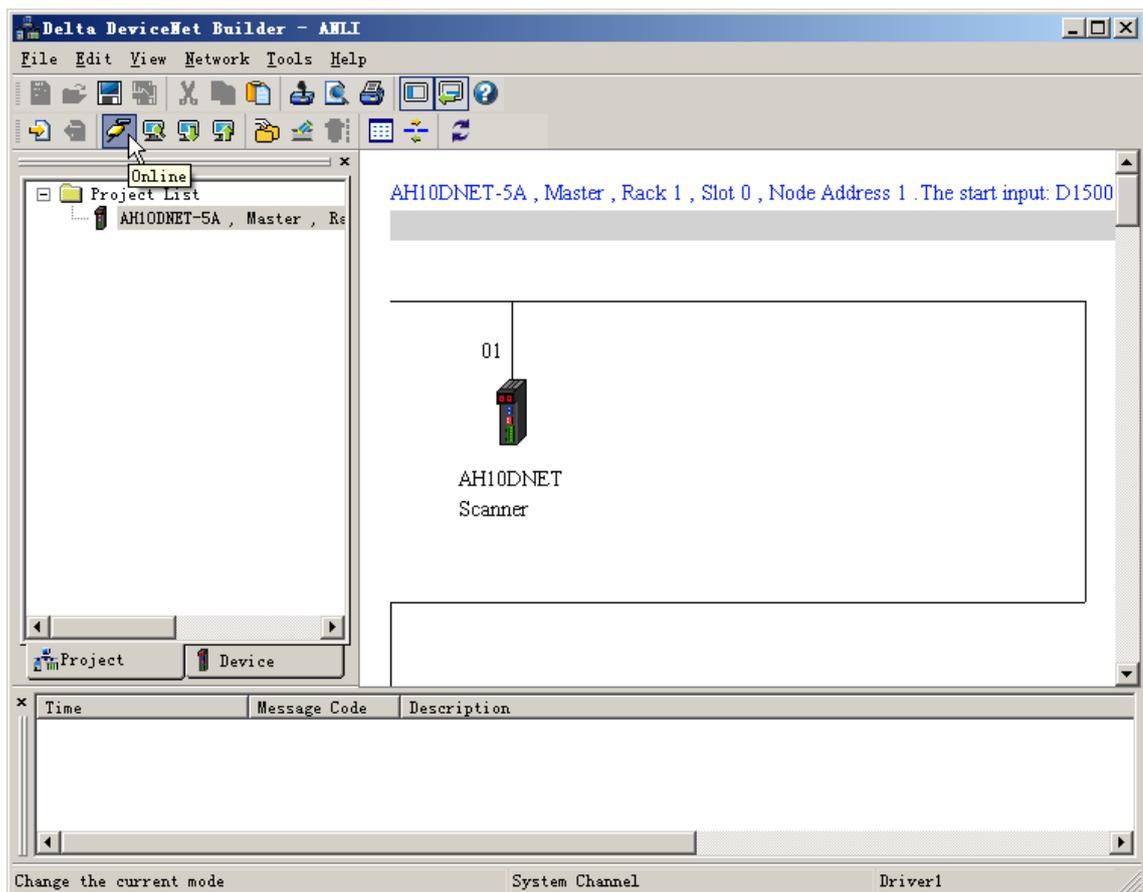
7. After the modules succeed in being online, select the module AH10DNET-5A to be operated in Project List and then click "Scan DeviceNet Network" button to start scanning the nodes on the network. Before clicking the "Scan DeviceNet Network" button, make sure that the selected AH10DNET-5A in Project List is the master.
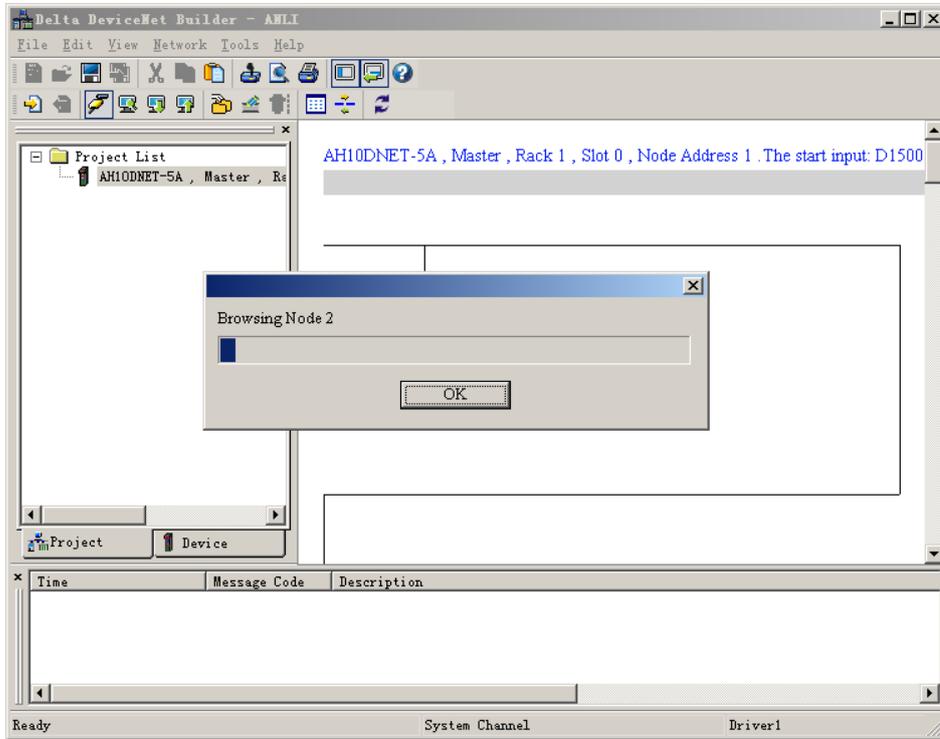
11.4.2.2 AHRTU-DNET-5A Configuration Interface

1. After scanning network nodes is finished, the following interface will show up.
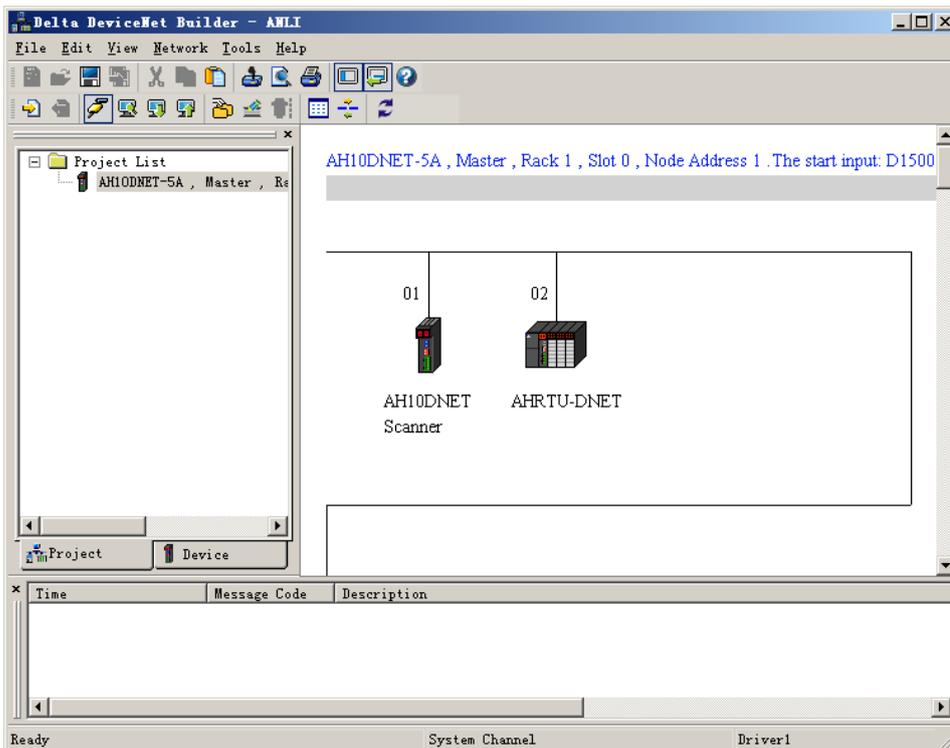
2. Double click AHRTU-DNET-5A icon of the network nodes and the "Node Configuration…" dialog box will pop up.

3. Click "I/O Configure…" button on the "Node Configuration" dialog box and then the following main interface of AHRTU-DNET-5A configuration will appear.

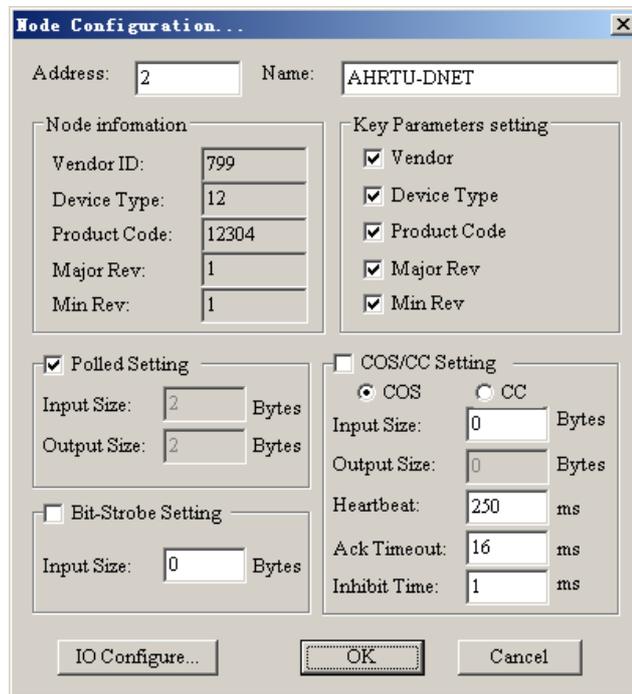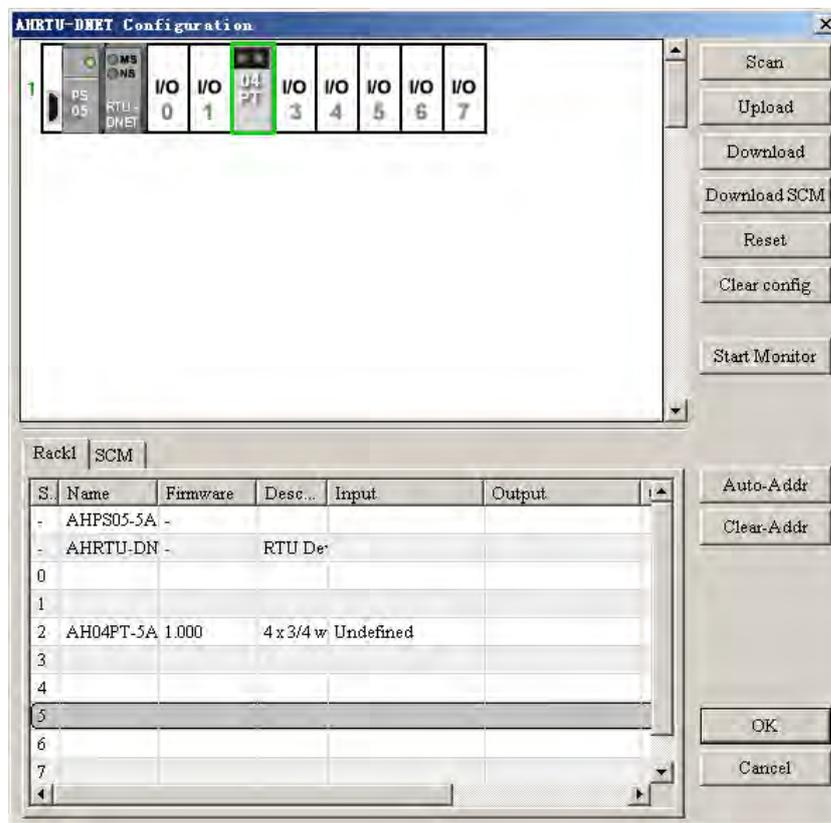Explanation of AHRTU-DNET-5A configuration interface:

Item	Description
Scan	To detect all modules currently inserted to the I/O slots of the rack. The modules saved on the software will be compared with the modules actually inserted to the I/O slots of the rack and the inconsistency will be displayed with the abnormal icons. When the I/O slot of the rack on the software is empty, the module actually connected to the I/O slot of the rack will be displayed. If the rack information is not consistent with the actual rack information, the previously saved module information on the software will be deleted and the actual rack information and the modules actually inserted to the I/O slots of the rack will be displayed.
Upload	It is an opposite action to the download. To upload and display current AHRTU-DNET-5A configuration to the software interface, which includes the I/O list, I/O configuration information, parameter mapping and the basic control information of AHRTU-DNET-5A.
Download	To download and save the AHRTU-DNET-5A configuration to AHRTU-DNET-5A, which includes the I/O list, I/O configuration information, parameter mapping and the basic control information of AHRTU-DNET-5A. The configuration is retained when power OFF.
Download SCM	To download and save the configuration of the serial port data exchange of AH10SCM-5A to AH10SCM-5A, which contains all Modbus configuration or UD Link configuration of COM1 and COM2. The configuration is retained when power OFF.
Reset	To make the connected AHRTU-DNET-5A restart up once.
Clear config	Clear the configuration stored in the latched area, reset automatically and F1 appears on the indicator after resetting.
Start Monitor	To find and set current exchange data already configured in system in real time, change the output data, find the input data in real time and use the control word to control the running state of AHRTU-DNET-5A.
Auto-Addr	Automatically allocate the mapping address and allocate the offset of mapping parameters in order. When no selection of mapping parameter is set for user in AIAO module data, system only recognizes the allocated offset of the mapping parameters.
Clear-Addr	To clear the address allocation of all modules. After clicking this button the mapping addresses of all modules can be reallocated.
Rack 1	Select and set the mapping range of each module on the rack. The start offset of mapping range can be set and the length depends on the quantity of the register mapped by the module parameter.
SCM	To set the mapping range of serial port data exchange of AH10SCM-5A, the start offset and length. Input and output mapping length are both 20 words.
Slot	The serial number of the slot of the module on the rack
Name	The name of the module
Firmware	The firmware version of the module. Through selecting the corresponding firmware version, download the module parameter information which matches the firmware version of the module.
Description	Describe the basic information of each module
Input	The input data mapping range of each module which depends on the start address offset and length of input mapping data

Item	Description
Output	The output data mapping range of each module which depends on the start address offset and length of output mapping data
Comment	Remark for the I/O modules on the rack
OK	Click "OK" to exit from AHRTU-DNET-5A configuration interface and then the current configuration will be stored.
Cancel	Click "Cancel" to exit from AHRTU-DNET-5A configuration interface but the current configuration will not be stored.

4. Click the right-side "Scan" button on the following "AHRTU-DNET-5A Configuration" interface.
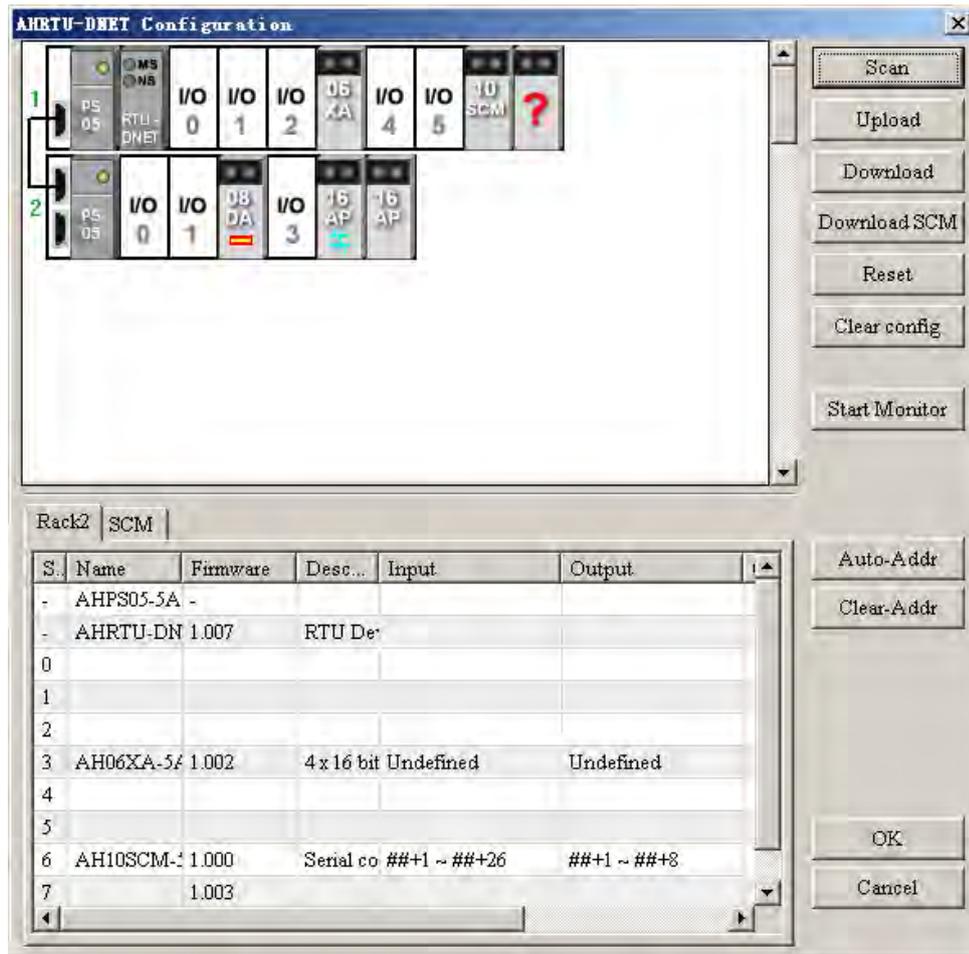
The abnormal icons may appear after scanning the I/O modules connected to AHRTU-DNET-5A is completed. The explanation of the abnormal icons is listed in the following table.
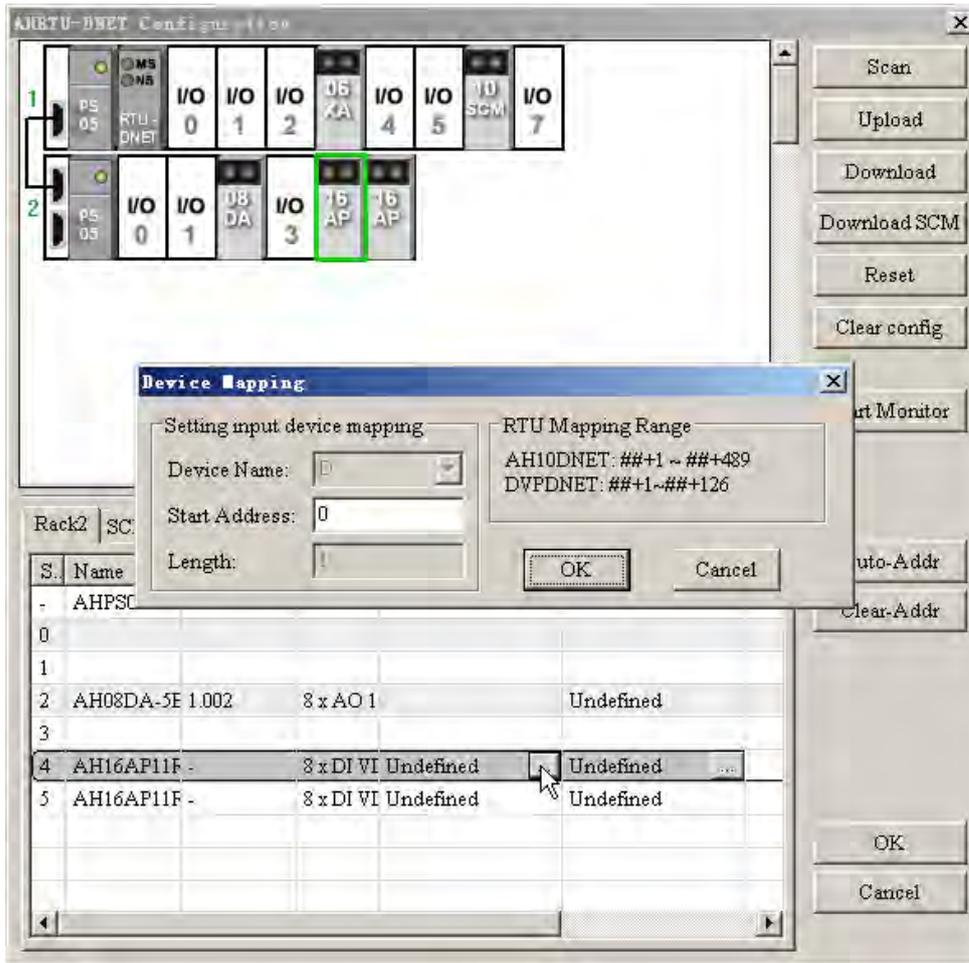
	The I/O module configured in the software does not match that actually connected. For example, the I/O module inserted to slot 4 in the rack 1 in the software is 32AM. But actually, it is 16AP connected. After scanning, the icon as left one is shown. Double click the icon and change it into the current configuration icon.
	The I/O module configured in the software does not match that actually connected by scanning. For example, the I/O module inserted to slot 4 in the rack 1 in the software is AH04AD-5A. But actually, no such a module is connected. After scanning, the icon as left one is shown. Double click the icon and change it into the current configuration icon.

One module which can not be identified is scanned by AHTRUT-DNET. Right click the current icon and select "Change" to change the icon into one identifiable icon for configuration.

5. Select the icon of the rack where the I/O module is placed or the I/O module symbol. Click of the input and output items in the lower box for setting the starting address of D device mapped of each module as follows
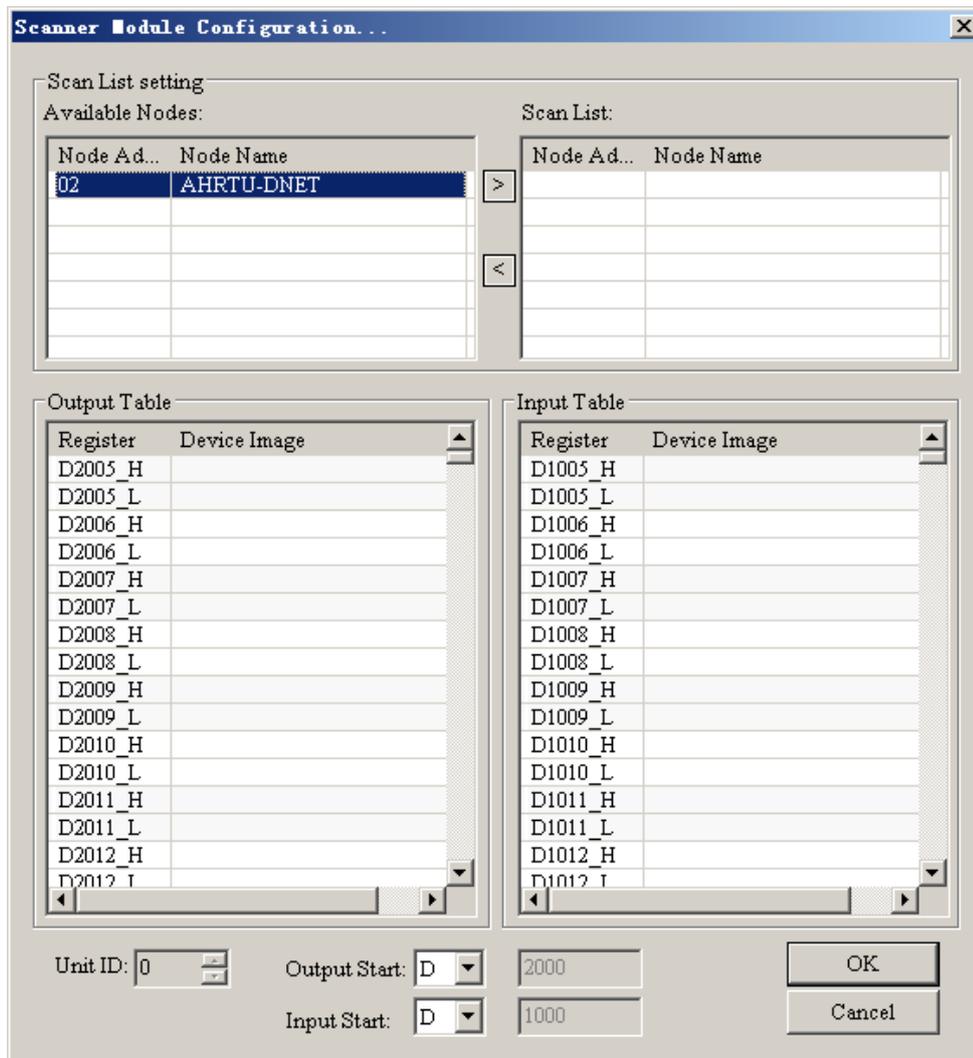
The mapping starting addresses of each module can be classified into the following two cases.

The first case: The window is as below before the DeviceNet master has assigned the starting address to AHRTU-DNET-5A (that is, AHRTU-DNET-5A has not been pulled into the scan list).

The offset for the starting address of each module can be set here. If the value in Start Address is set to 1, it means that the offset for the mapping starting address of the module is ##+1.
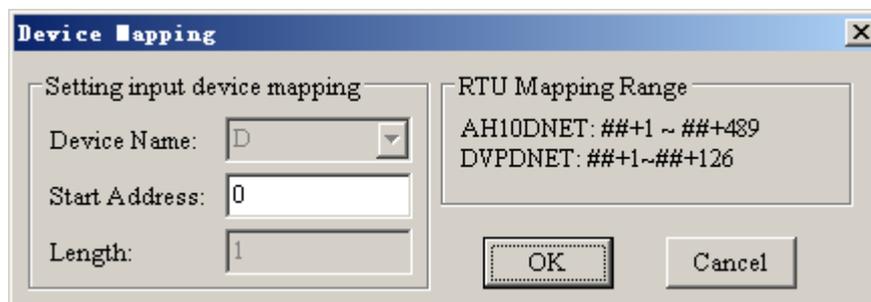
The second case: The window is as below after the DeviceNet master has assigned the starting address to AHRTU-DNET-5A (that is, AHRTU-DNET-5A has been pulled into the scan list).
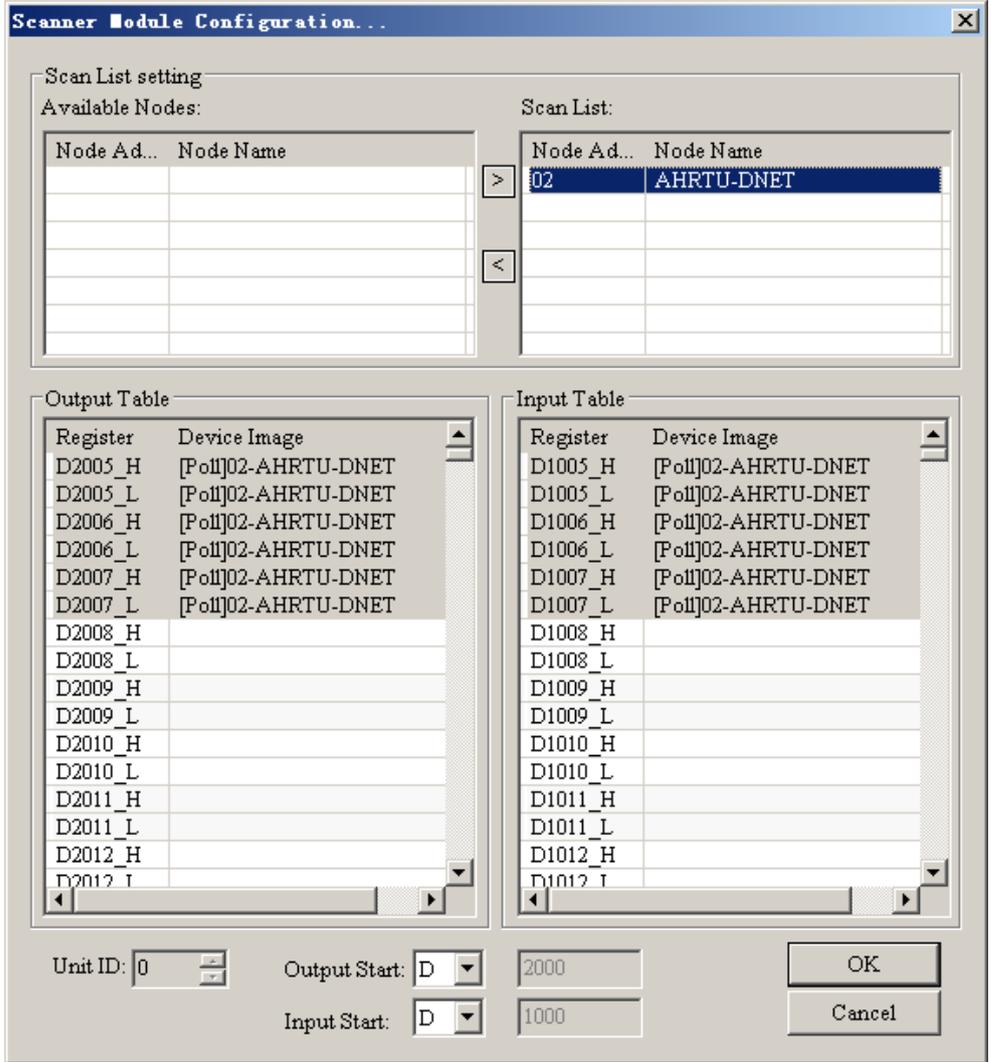
The starting address of each module can be set here. If the value in Start Address is set to 1006, it means that the mapping starting address of the module is D1006.
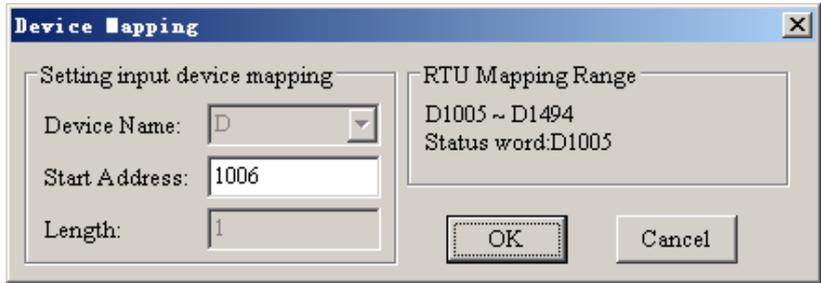
If the starting address assigned to AHRTU-DNET-5A is D1005, the offset of the starting address of the module is ##+1, that is equal to, D1006. If AHRTU-DNET-5A is removed from the scan list, it means the DeviceNet master does not assign the starting address to AHRTU-DNET-5A and the starting address D1006 of the module will show the offset ##+1.

11.4.2.3 AHRTU-DNET-5A Status Setting Interface

After setting the mapping addresses of the I/O module devices is finished, the AHRTU-DNET-5A configuration interface will be shown as follows.
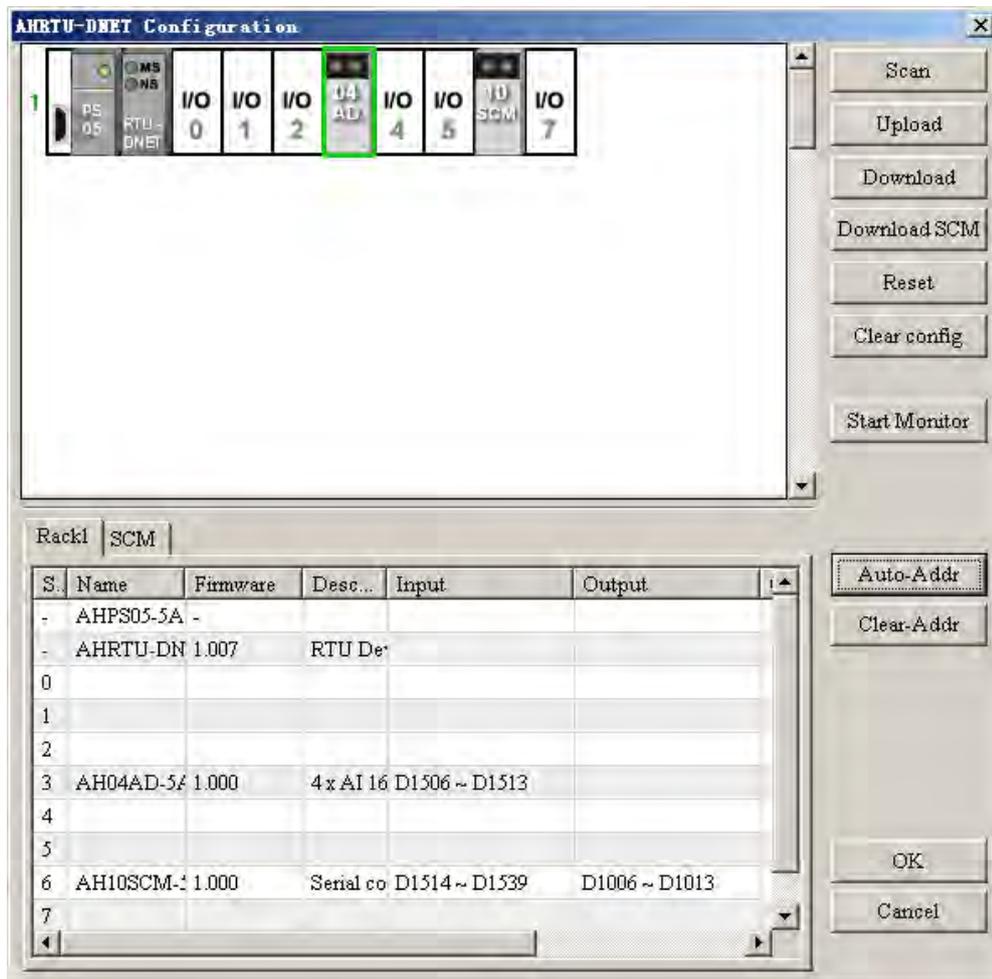
On the AHRTU-DNET-5A configuration interface, double click left-side AHRTU-DNET-5A icon and its status setting interface will pop up, which is used for setting the error treatment of AHRTU-DNET-5A as below.
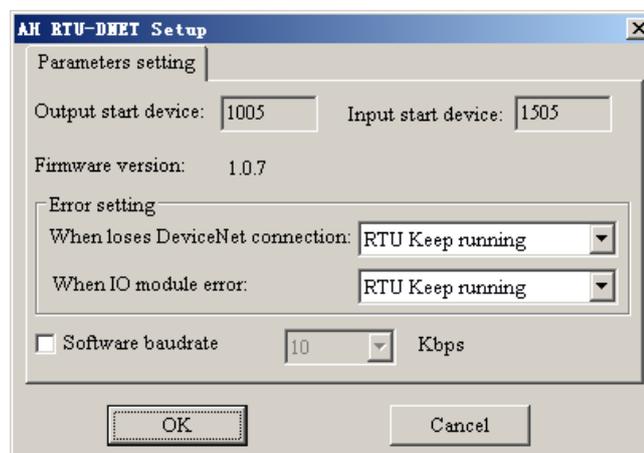
Explanation of "AHRTU-DNET Setup" interface:

Item	Explanation	Default
Output start device	It is the initial output address of AHRTU-DNET-5A and occupies one word.	-
Input start device	It is the initial input address of AHRTU-DNET-5A and occupies one word.	-
When loses DeviceNet connection	When being disconnected from the DeviceNet network, how AHRTU-DNET-5A will treat the error. Options "RTU keep running" and "RTU stop running" are for selection.	RTU keep running
When I/O module error	When detecting that an error occurs in any one of I/O modules, how AHRTU-DNET-5A will treat the error. Options "RTU keep running" and "RTU stop running" are for selection.	RTU keep running
Software baud rate	Setup of the extended baud rate of AHRTU-DNET-5A. Pick the item so as to set the extended baud rate of AHRTU-DNET-5A. Download and save the data to AHRTU-DNET-5A. Only when both of DR1 and DR0 switches are ON, the extended baud rate will be effective.	-
Firmware version	To show the firmware version of AHRTU-DNET-5A	-

Note: When error treatment setting of AHRTU-DNET-5A is inconsistent with exception handling of each I/O module, option "RTU stop running" is selected in priority.

11.4.2.4 I/O Module Configuration Interface

Double click I/O modules to set the parameter mapping configuration of each module on the "AHRTU-DNET Configuration" interface.
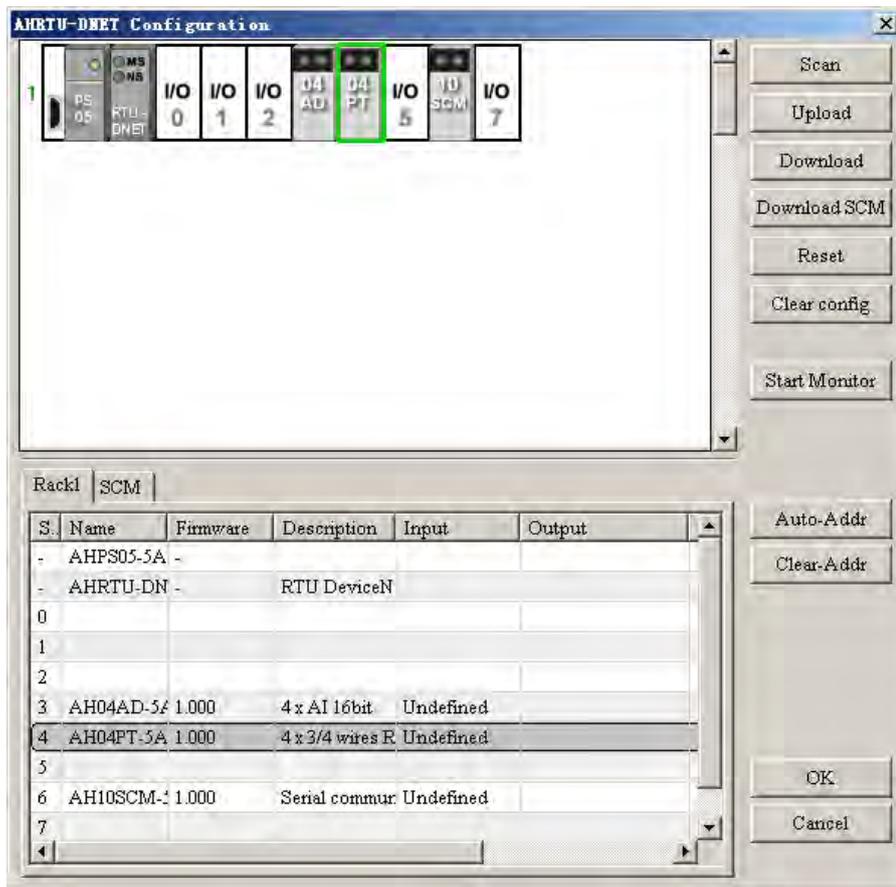
E.g. double click where "AH04AD-5A" icon is and AH04AD-5A configuration interface will pop up immediately as below, which is used for parameter mapping configuration of AH04AD-5A.
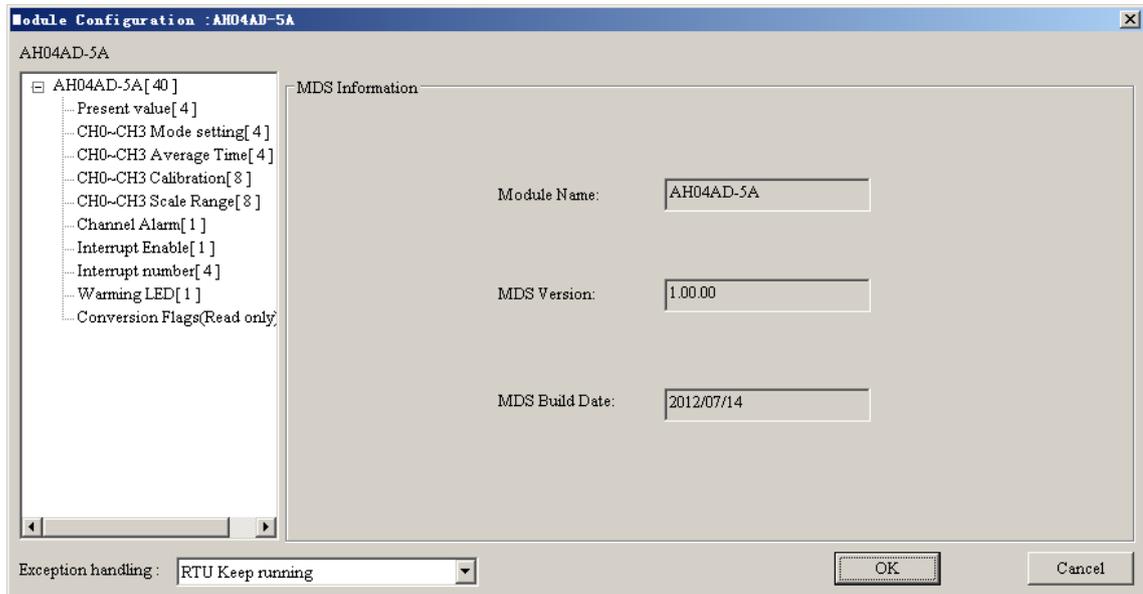
Explanation of the I/O module configuration interface:

Item	Explanation
MDS information	To show the module name, MDS version and MDS build date. The module parameters will be displayed on the left-side window according to MDS file. Regarding details on the module parameters refer to the user manual of relevant module.
Parameter list of module	All module parameters read from MDS file are listed and these parameters are set to control the module to run normally.
Exception handling	When AHRTU-DNET-5A detects an error occurs in the module, how AHRTU-DNET-5A will treat it. Options "RTU keep running" and "RTU stop running" are for selection.

Note: When the exception handling setting of the I/O module is inconsistent with error setting of AHRTU-DNET-5A module, "RTU stop running" will be selected in priority.

The mapping relations between the general I/O module parameters and devices are set in the following four kinds of cases.

1. Select the appropriate parameter value in the pull-down box of the Initial column (Channel 0 input mode: -10 V~+10 V for AH04AD-5A as shown below)
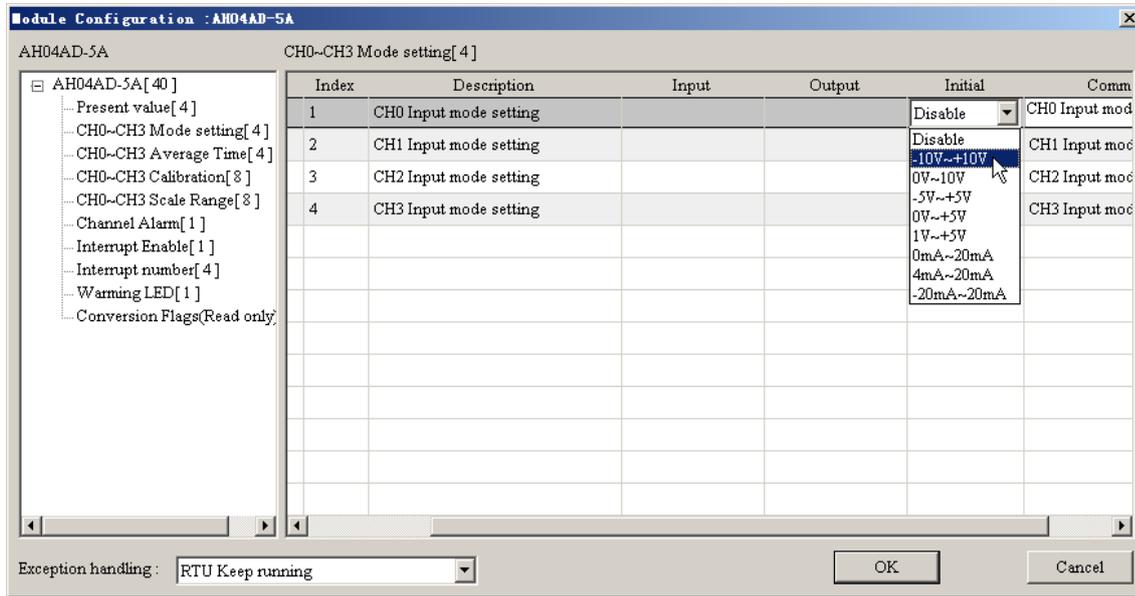
2. Enter the desired parameter value in the Initial column (Channel 1 average time: 15 for AH04AD-5A as shown below)
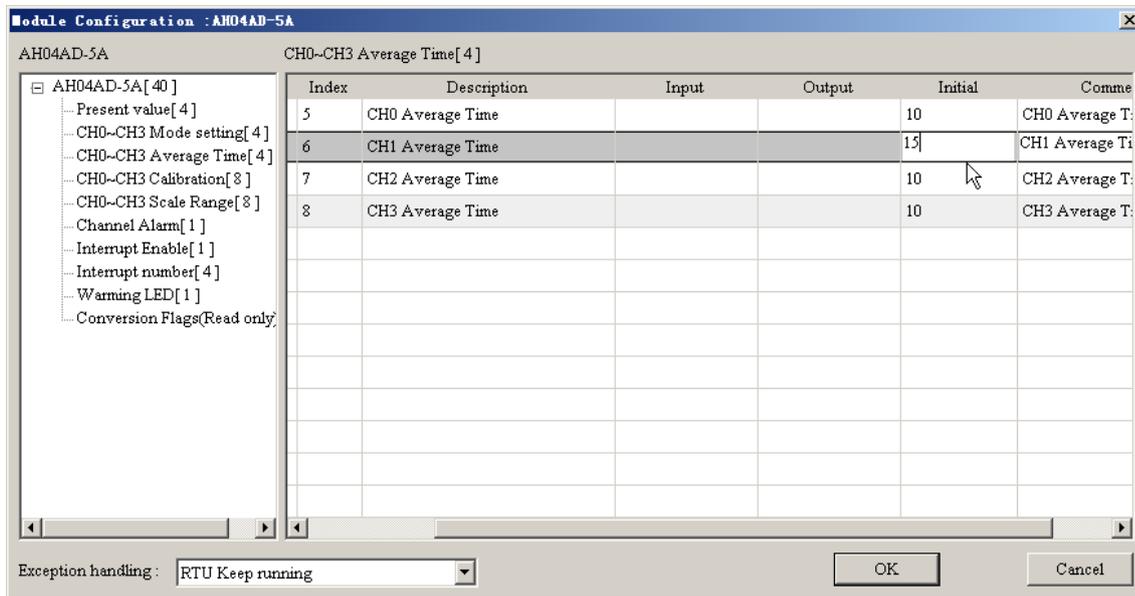
3. Tick the small box to the left of the Initial column, and then * can be seen there. (For AH04AD-5A, when channel 1 input signal exceeds the hardware range, warning LED indicator will flash as below.)
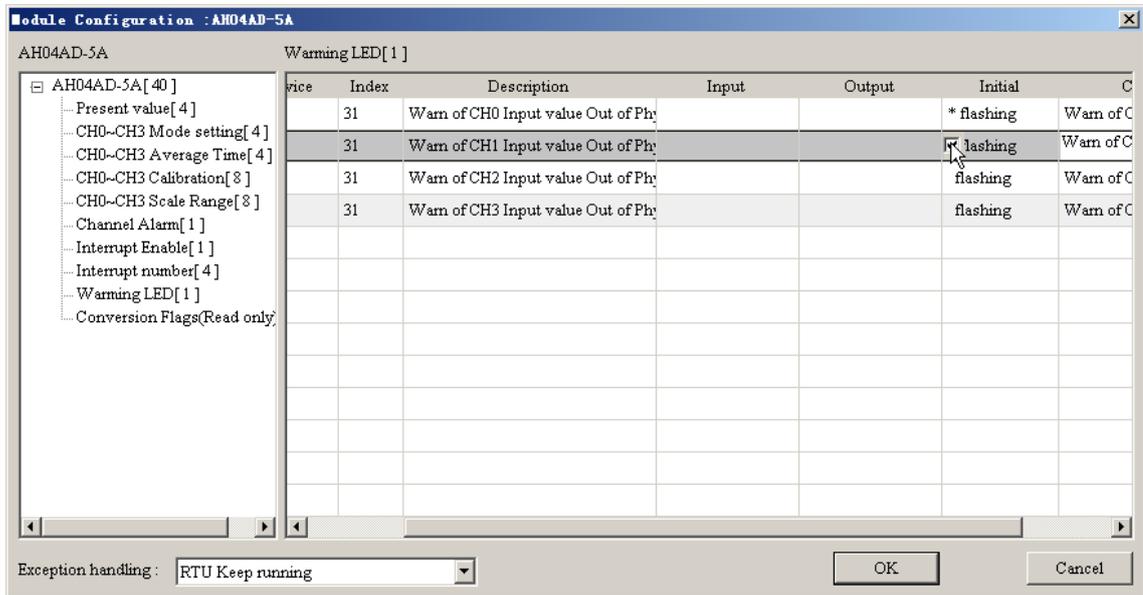
4. For those module parameters which need to be monitored or be revised in real time, tick the corresponding Map to Device column and the corresponding values will be mapped to the bus exchange data (in the D register in PLC CPU). After entering the software monitor interface, the parameter values picked in the Mapped to Device column can be used to monitor the present values of the parameters and modify them by manual.
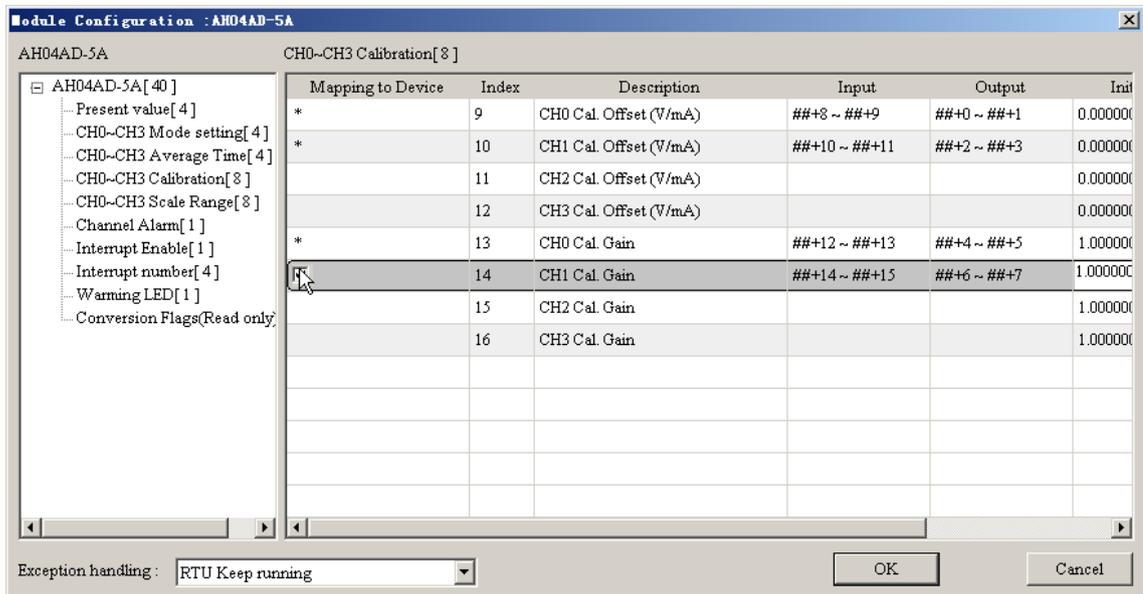
11.4.2.5   Monitoring Function of Software

When the software is online and the current configuration of AHRTU-DNET-5A is consistent with that saved in the software, click "Start Monitor" to enter the monitor interface through which the operation state of AHRTU-DNET-5A and I/O modules can be monitored in real time.
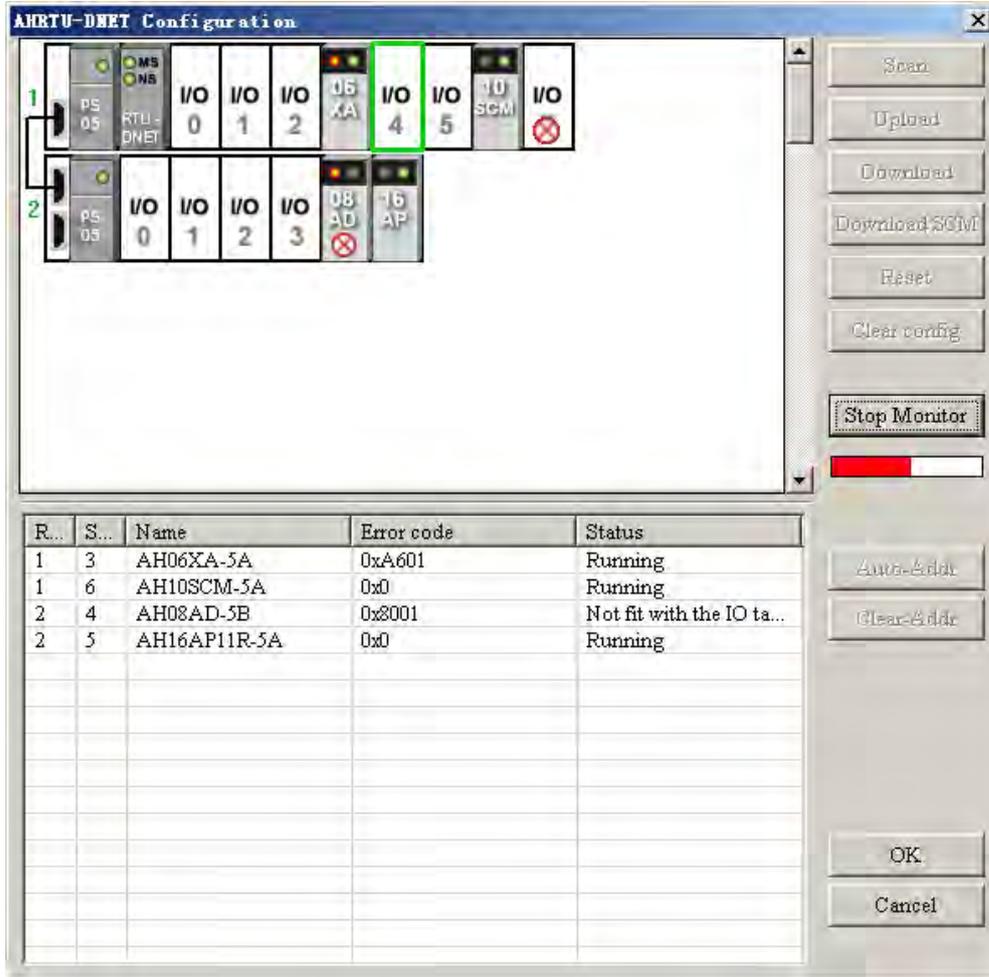
Description of operation state of each module:

	Indicates that the module is in RUN state
	Indicates that the module is in STOP state
	Indicates that the module is reporting the alarm or running with faults For detailed information on errors, see Error Codes in the user manual of the relevant module.
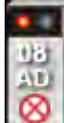
	Indicates that the module connected to the slot of the rack does not match that configured in the software or the current module has been removed from the slot though it matched that configured in the software previously
	Indicates that the slot in the software is empty but actually, it is inserted by other module on the rack

On the monitor interface, right click the module icon and select "Run" or "Stop" to change the operational state of the I/O module.
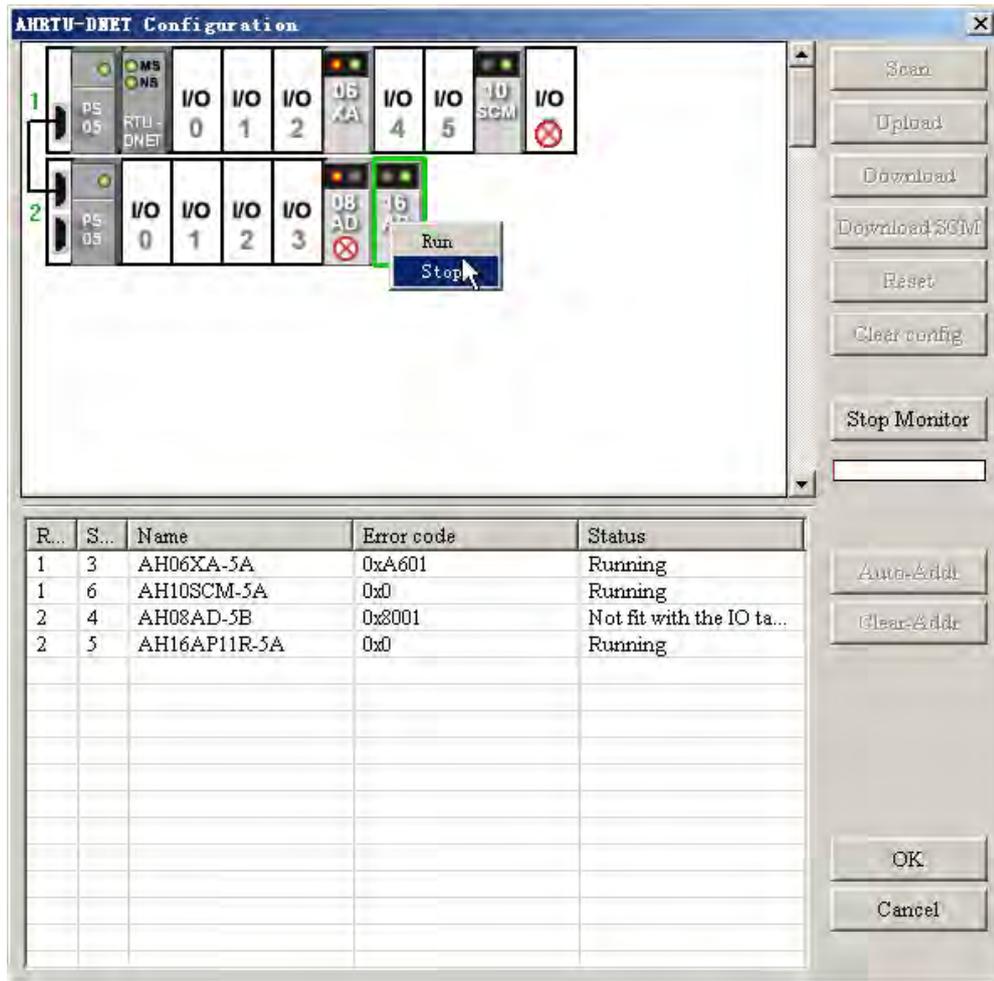
On the monitor interface, double click the selected module icon to enter the monitor interface of the module. The module can be monitored in real time through the default mapping address of the module and the mapping register of the parameter that user chooses.
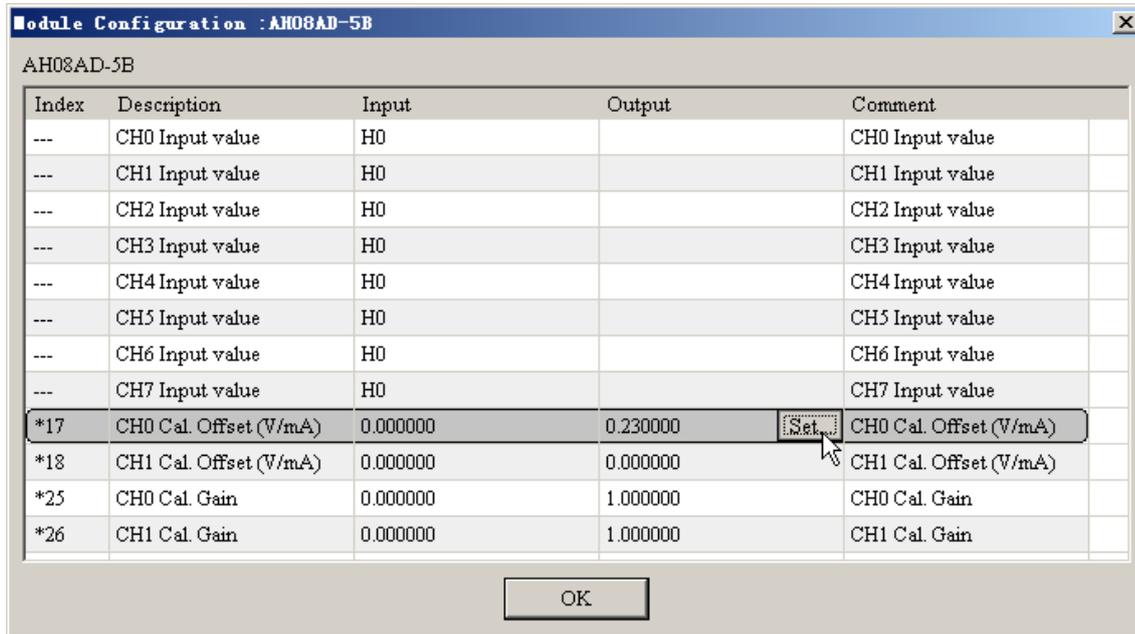
Click "Set" of the Output column to change the size of the present value which supports the floating point number. The present value is written to the corresponding device by clicking "Send" button.
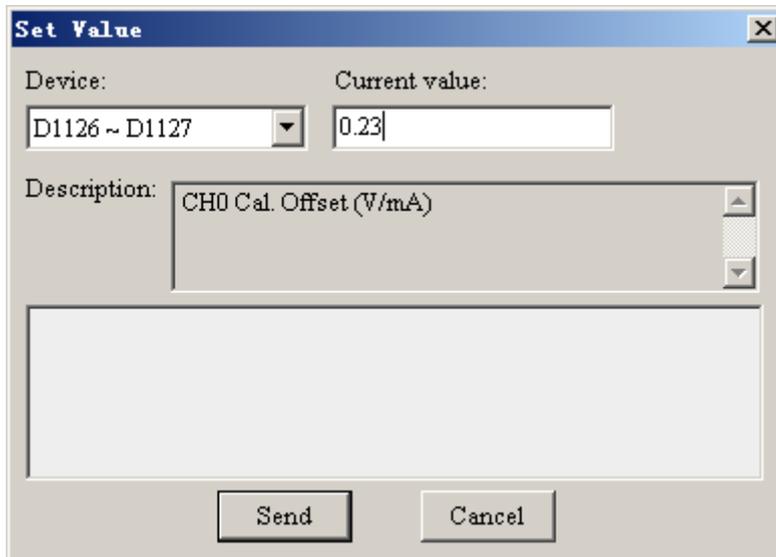
11.4.2.6 AH10SCM-5A Module Configuration Interface

● AH10SCM-5A parameter setting

When AH10SCM-5A is used as the I/O module of AHRTU-DNET-5A, please ensure that the master on the network is AH10DNET-5A and AH10SCM-5A has been inserted to the I/O slot of the main rack. If the master is DVPNET on the network, AHRTU-DNET-5A will not support to configure AH10SCM-5A.

On the main configuration interface of AHRTU-DNET-5A, double click AH10SCM-5A to set the parameter mapping.
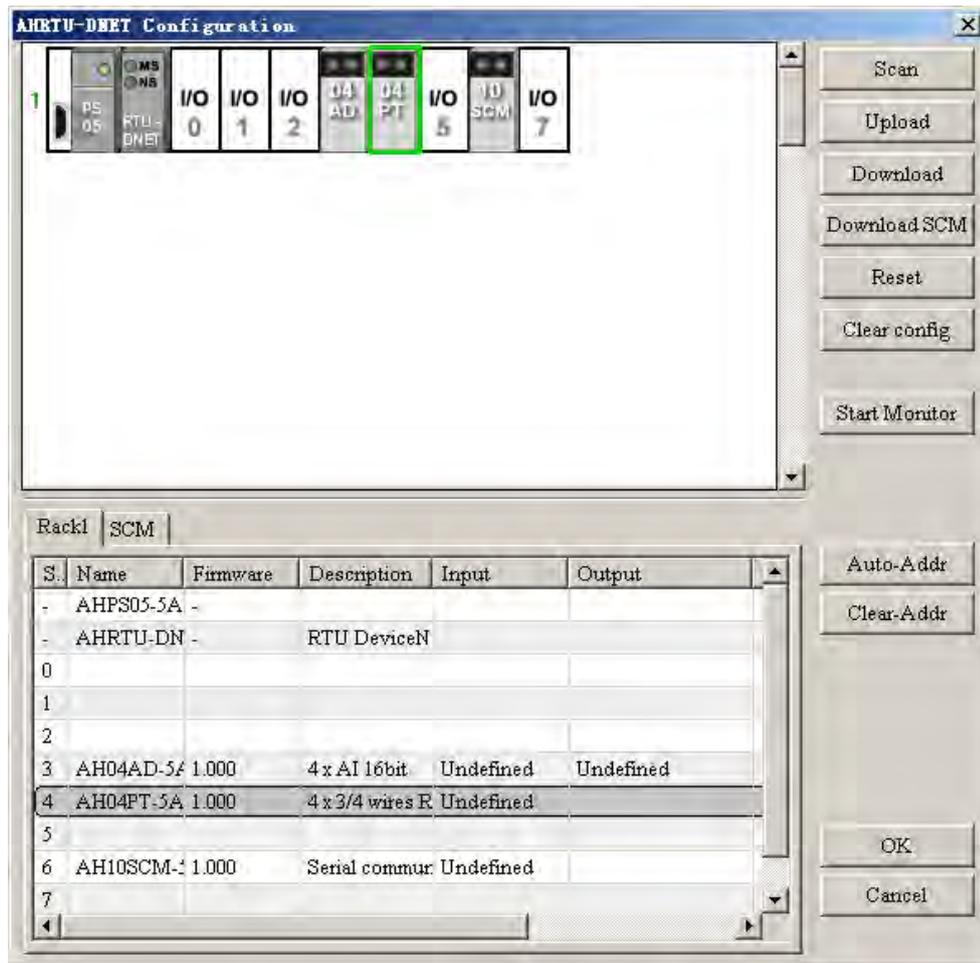
Double click AH10SCM-5A icon to enter the communication parameter configuration interface of AH10SCM-5A as follows. The left-side box contains the module parameters read from MDS file by AH10SCM-5A and the right-side contains the module name, MDS version, MDS Build date and etc.
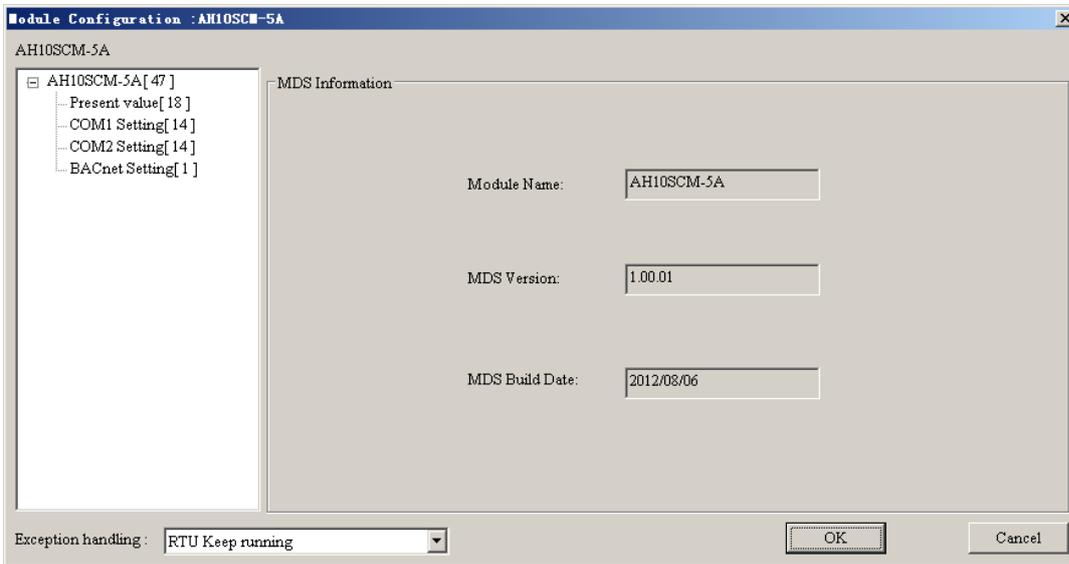
"Present value" represents the default mapping addresses of AH10SCM-5A, which is used to display the communication state of COM serial port of AH10SCM-5A.
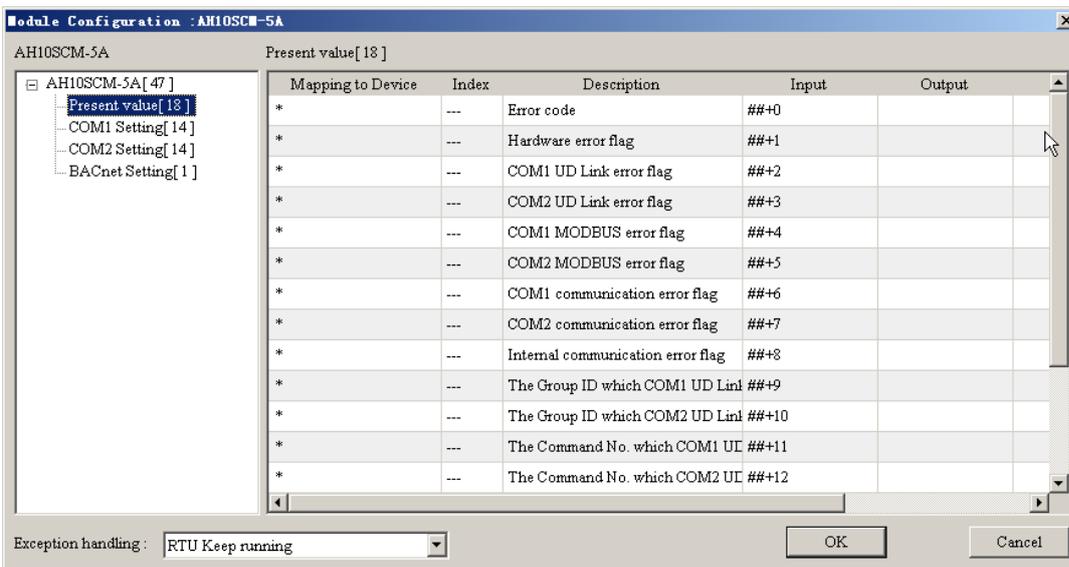
Communication parameters setting of COM1 of AH10SCM-5A (The communication format of COM1 serial port and the mapping register corresponding to the trigger condition of the serial port data exchange are set here, corresponding to the basic register BR in AH10SCM-5A.)

Module Configuration : AH10SCM-5A					
AH10SCM-5A	COM1 Setting[14]				

AH10SCM-5A[47]
 Present value[18]
 COM1 Setting[14]
 COM2 Setting[14]
 BACnet Setting[1]

Mapping to Device	Index	Description	Input	Output
	1	Slave ID / BACnet MAC Address		247
	3	Baudrate		9600
	4	Format		7_E_
	5	Communication Timeout (ms)		3000
	6	Transmitter Delay (ms)		0
	7	Physical Type		RS-4
	8	MODBUS Advance Read Trigger		0
	9	MODBUS Advance Write Trigger		0
	22	Group ID Trigger Number		0
	23	UD Link [Base + Offset] Data Sourc		0
	24	UD Link [Base + Offset] Data Destir		0
	31	UD Link Sequence Trigger Times		0
	51	Transfer Mode		ASC

Exception handling :   RTU Keep running   OK   Cancel

Communication parameters setting of COM2 of AH10SCM-5A (The communication format of COM2 serial port and the mapping register corresponding to the trigger condition of the serial port data exchange are set here, corresponding to the basic register BR in AH10SCM-5A.)

Module Configuration : AH10SCM-5A					
AH10SCM-5A	COM2 Setting[14]				

AH10SCM-5A[47]
 Present value[18]
 COM1 Setting[14]
 COM2 Setting[14]
 BACnet Setting[1]

Mapping to Device	Index	Description	Input	Output
	11	Slave ID / BACnet MAC Address		246
	13	Baudrate		9600
	14	Format		7_E_
	15	Communication Timeout (ms)		3000
	16	Transmitter Delay (ms)		0
	17	Physical Type		RS-4
	18	MODBUS Advance Read Trigger		0
	19	MODBUS Advance Write Trigger		0
	26	Group ID Trigger Number		0
	27	UD Link [Base + Offset] Data Sourc		0
	28	UD Link [Base + Offset] Data Destir		0
	32	UD Link Sequence Trigger Times		0
	71	Transfer Mode		ASC

Exception handling :   RTU Keep running   OK   Cancel

● AH10SCM-5A intelligent module setting

The setting of serial port data exchange of AH10SCM-5A is done on the configuration interface of AH10SCM-5A and the method is as below.

Right click the AH10SCM-5A icon and select "Intelligent module configuration" to go to the AH10SCM-5A configuration interface.
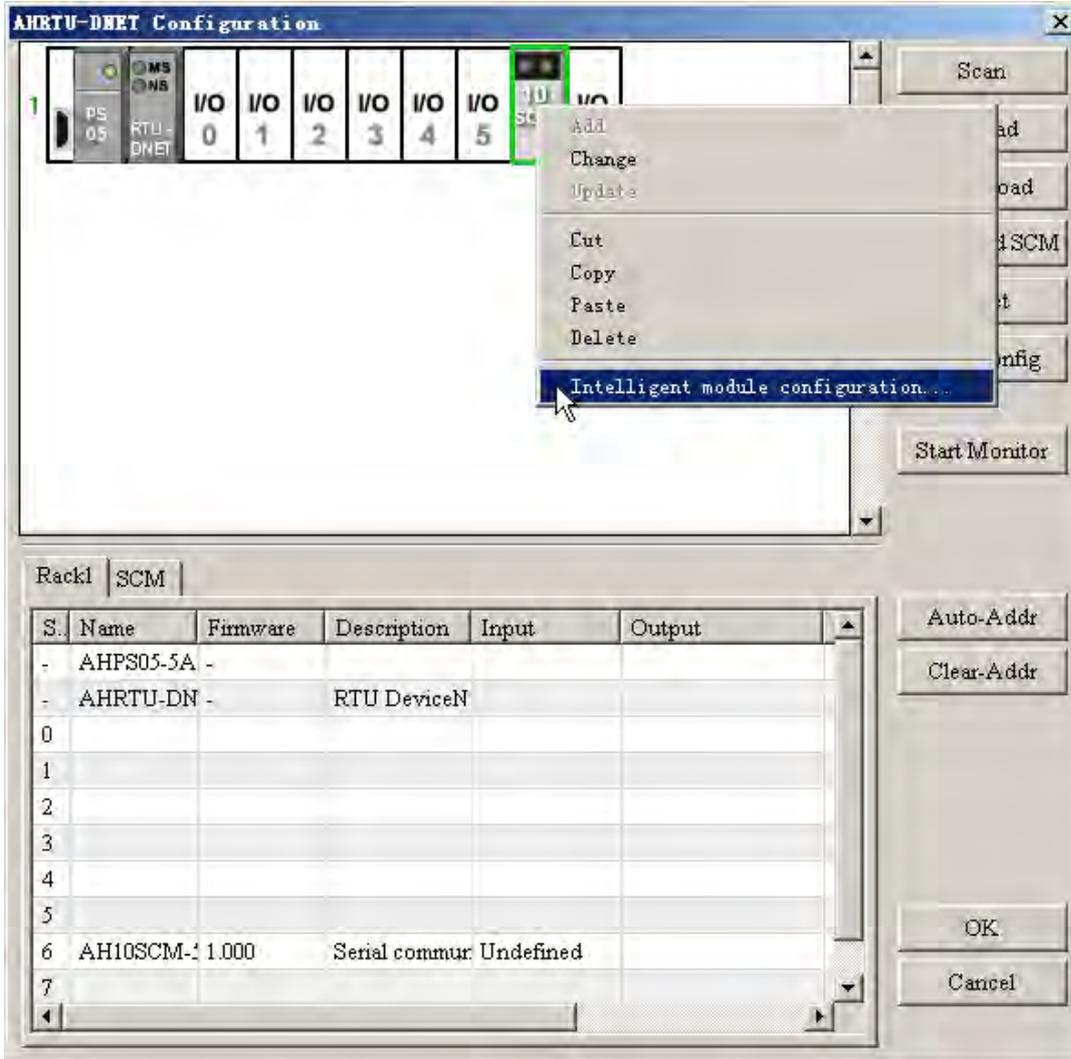
The AH10SCM-5A configuration interface contains the basic information of AH10SCM-5A, the communication mode of every COM port (UD Link or Modbus), the mapping relations between register mapping range and the internal register I and Q in AH10SCM-5A and etc.

Explanation of SCM Configuration interface:

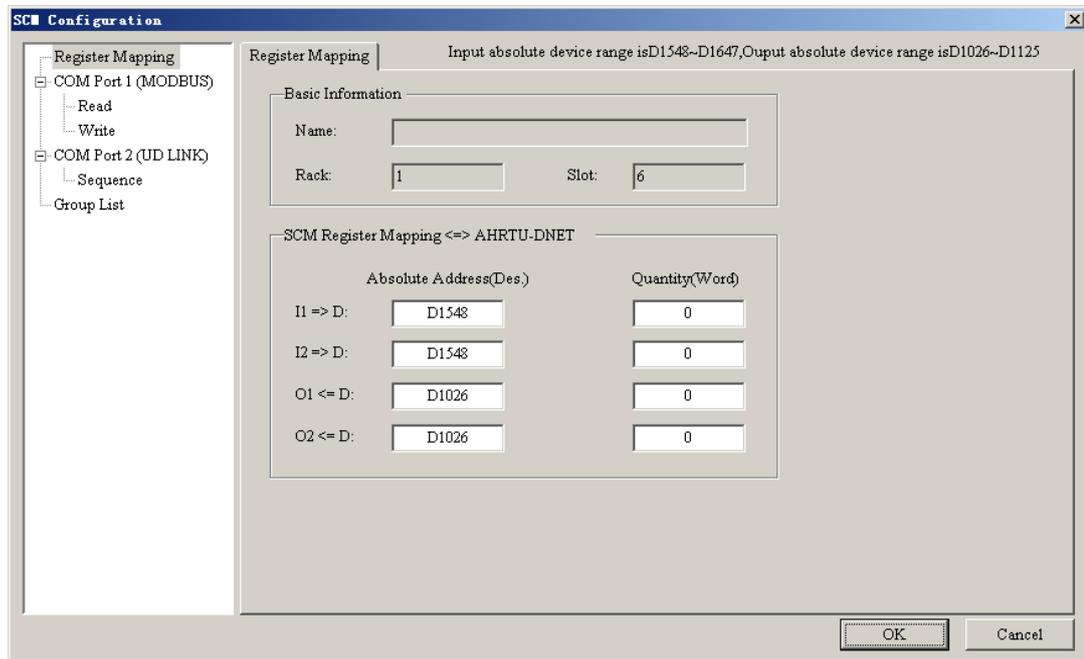| Item	Explanation
COM Port 1 (MODBUS)	To set the communication format of COM port 1; default: Modbus mode, which can be switched to UD Link mode by a right click
Read	Click Read to go to the Modbus mode—read setting interface.
Write	Click Write to go to the Modbus mode—write setting interface.
COM Port 2 (UD LINK)	To set the communication format of COM port 2; default: UD Link mode, which can be switched to Modbus mode by a right click
Sequence	To enter Sequence setting interface and to place multiple groups to Sequence and set the execution order
Group List	List of groups Right click to add a new group and the newly added group can be set in packet and command on the group setting interface.
Basic Information	To show the number of the rack and slot where AH10SCM-5A is inserted.
SCM Register Mapping	To set the mapping relations between the registers inside AH10SCM-5A and those in PLC CPU I1, I2, O1 and O2 will be used only when editing the variable information in UD Link mode.

COM port can be set to UD Link mode or Modbus mode via the right key of the mouse. (Select Modbus Mode when using the standard Modbus protocol; select UD Link mode when using RS485 user-defined format). In the two-mode switch, please note that the previous mode will be lost after being changed into the other one.
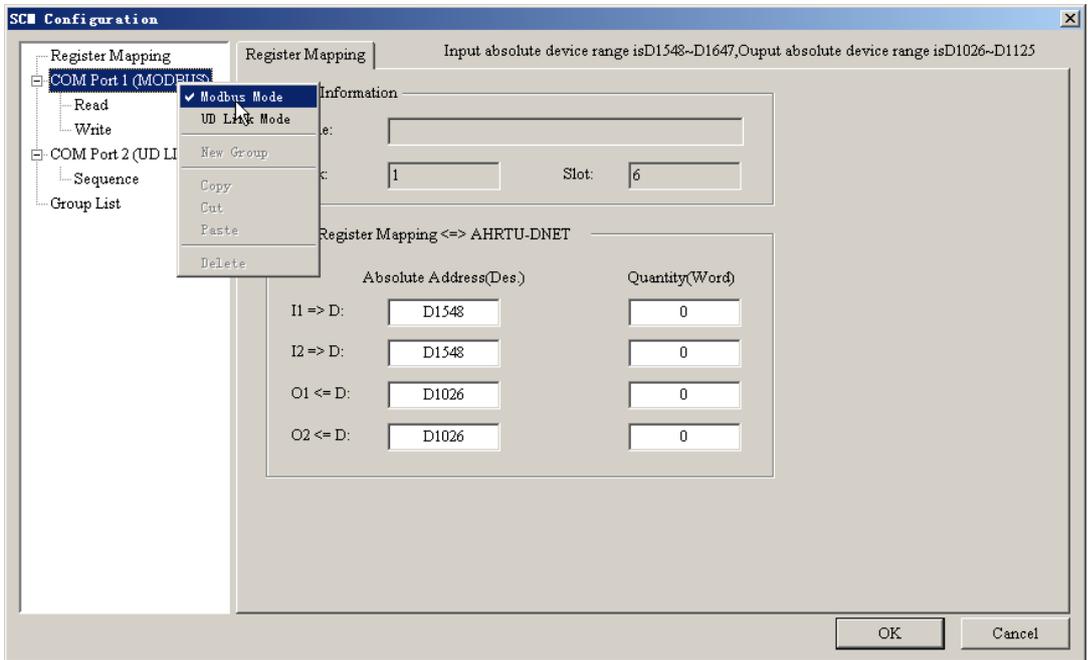
● Modbus mode setting

Click Read or Write to enter the MODBUS read or MODBUS write setting interface in the following left-side box. Right click on the following right-side box to select "Add Item" to add bit and word item of Read and Write. The upper part is bit item of Read/Write and the lower part is word item of Read/Write.
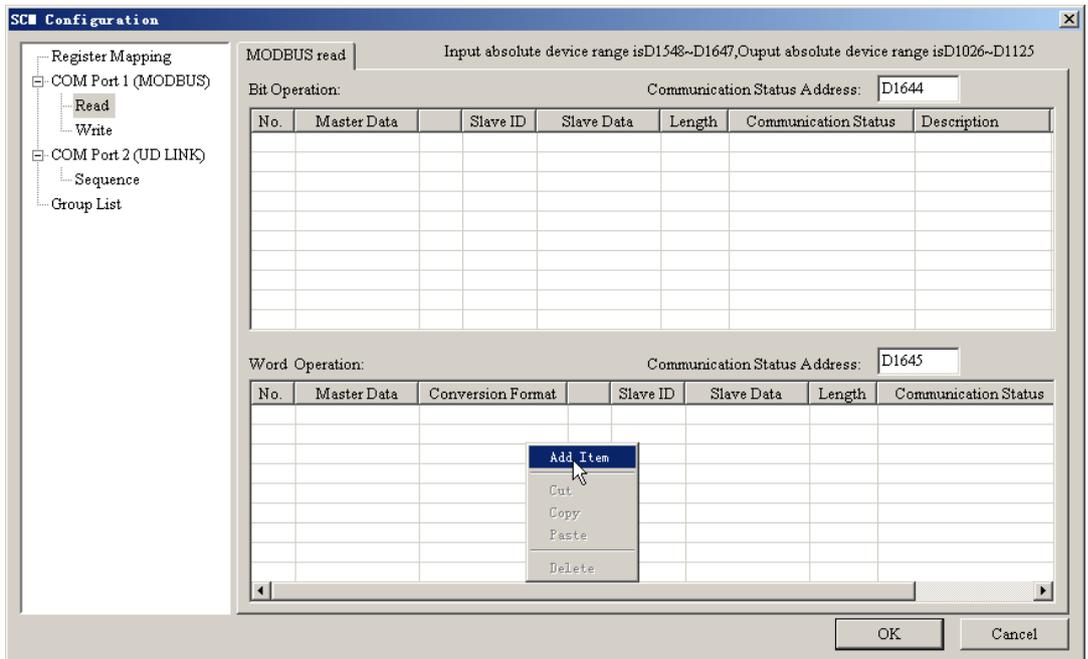
The interface is shown as below after the new item of Read/ Write is added.
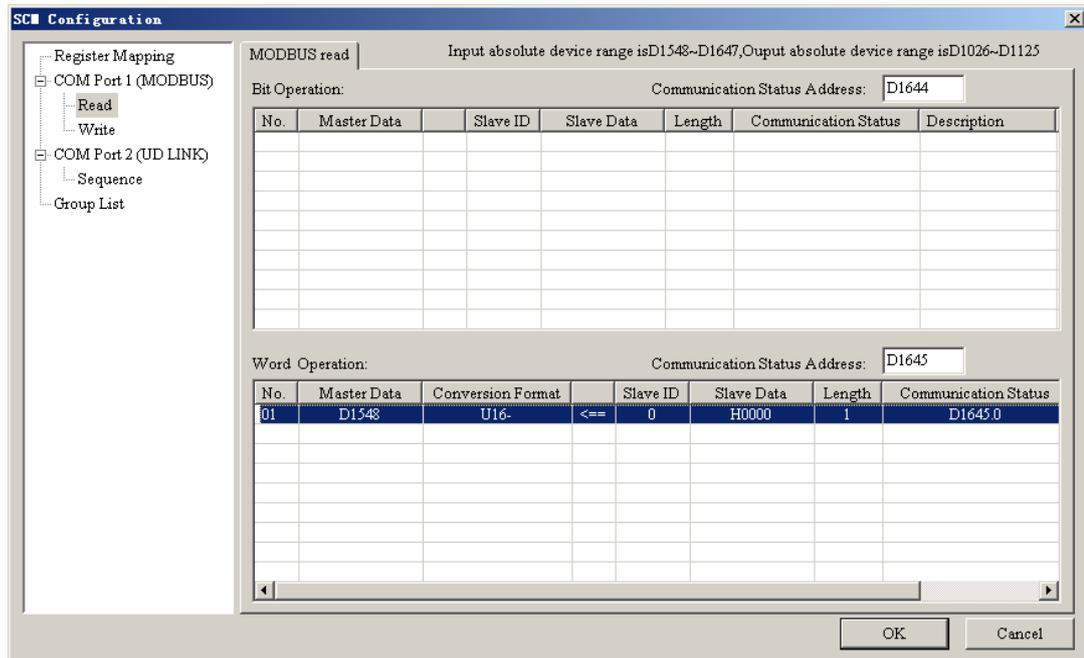
Double click the newly added item to enter the parameter editing interface of Read/Write of Modbus, where set the mapping relations of the serial port data exchange between the master and slave.
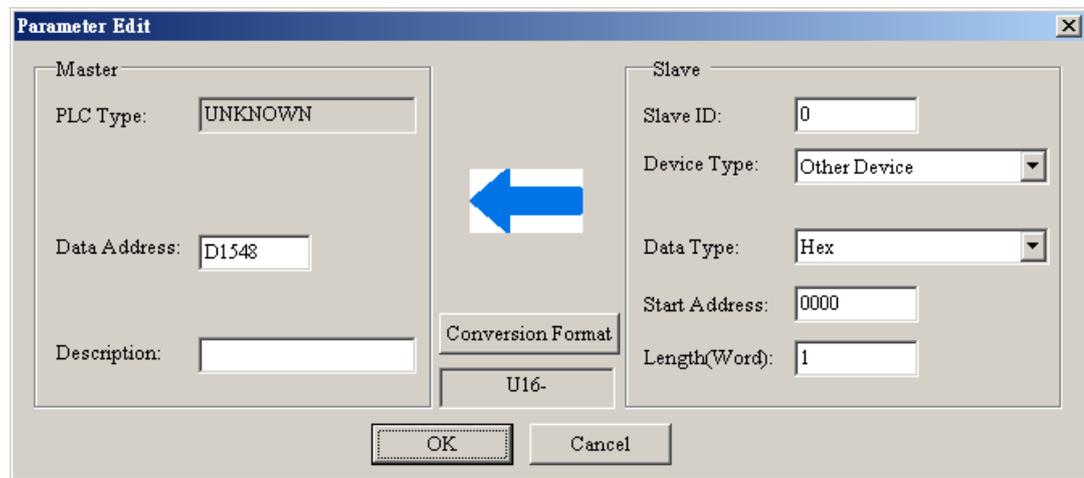
Explanation of parameter editing interface:

Item	Explanation
PLC Type	To display the preset PLC model used as the CPU where the mapping registers are
Data Address	The register in the master PLC for exchanging the data with the slave
Description	Description of the device where the data of maximum 30 bytes can be input
Slave ID	The station number of the slave to exchange the data with AH10SCM-5A
Device Type	Delta PLC model is selectable; default: other Device If the non-Delta PLC device is used, select other Device.

Item	Explanation
Data Type	Hex or MODBUS 6 digit is selectable. Hex refers to a hexadecimal 4-bit digit and MODBUS 6 digit is a decimal 6-bit digit. If the device type is the Delta PLC model, the data type will be changed into D register or M device automatically.
Start Address	If the data type is other Device, the input value is the starting address of the slave for data exchange; if Delta PLC for Data Type, the input value is the initial number of D or M device in the slave.
Length	Represents the size of the exchange data; max 100 words

● UD Link setting
UD Link provides the data exchange function of the non-standard Modbus protocol. The packet can be edited according to the communication format of the slave exchanging data with AH10SCM-5A.
The method of setting UD Link is as follows.
Select Group List>New Group to build a new group.
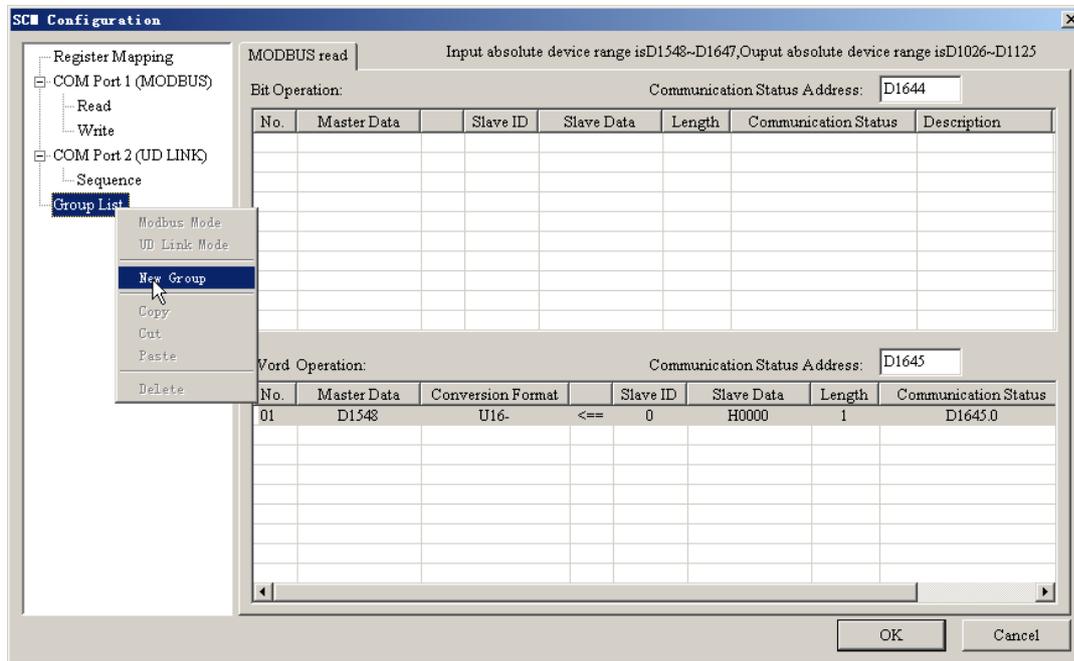
On one new Group setting interface, right click on Packet List box to add Tx/Rx packet. In one group, multiple Tx packets and Rx packets can be built.
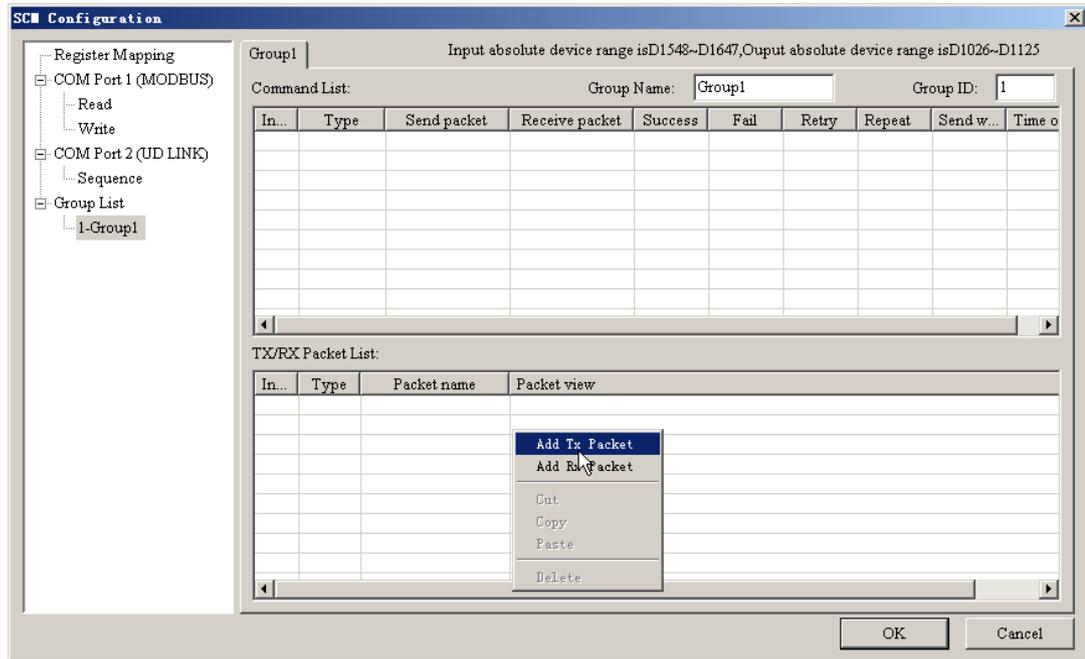
Double click the new Tx/Rx packet, the Packet Edit interface will pop up as below.

The Tx/Rx packet consists of message, address, length and checksum. Multiple messages and one address, length and checksum may exist in the packet.

Explanation of packet edit interface:

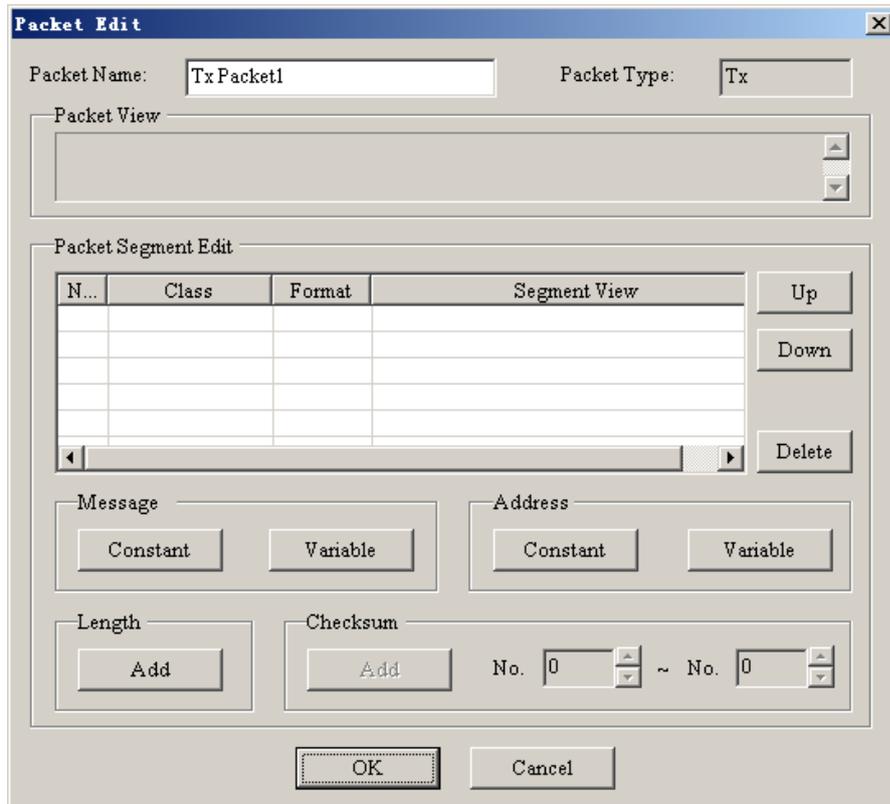| Item	Explanation
Packet Name	For editing the name of the packet
Packet View	Displays the content of the edited packet
Packet Segment Edit	Adjusts the sequence of the packet segments, adds and deletes the segment packet
	No: It displays the number of the packet segment. Maximum 64 segments can be edited in one packet.
	Class: Displays the segment class including message, address, length and checksum
	Format: Displays the data format of the segment including Hex, ASCII, Code and etc
	Segment view: Description of the segment content.
Message	Constant and Variable are selectable for editing the message which can be used in the header, start bit, end bit and data segment of the packet. One packet could contain multiple messages.
Address	Constant and Variable are selectable to edit the address. One packet contains only one address segment.
Length	For editing the length of the packet
	One packet contains only one address segment.
Checksum	For editing the check code
	One packet contains only one checksum segment.
Constant	The value is fixed.
Format	Sets the data format to Hex, ASCII or Code
	Code indicates that the data use the handle.
Variable	The input value is variable, which means the mapping register could be specified as the internal register in AH10SCM-5A or that in PLC.

The Message Variable Edit interface is as follows.
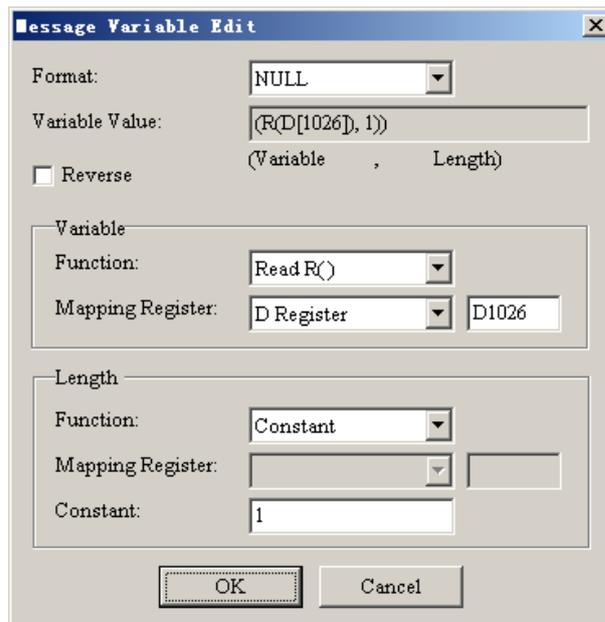
Explanation of message variable edit interface:

Item	Explanation
Format	To set the format of the data Null: No action of the data is taken. Hex: It converses data from ASCII into hex format. The character which can not be conversed will be changed to 0. ASCII: It converses the data from hex into ASCII. The character which can not be conversed will be changed to 0.
Variable value	To display the edited packet content
Variable	Function: Read R ( ) Write W ( ) and * (indicates no action) are for option. For TX packet, Read R ( ) can be selected. For RX packet, both of Read R ( ), Write W ( ) and * can be selected. Mapping Register: The internal register in AH10SCM-5A or register in PLC CPU can be selected. The internal register in AH10SCM-5A includes I1, I2, O1, and O2 for PLC CPU, the D device can be chosen directly.
Length	Function: Read R ( ), Write W ( ) or Constant are selectable. Mapping Register: The internal register in AH10SCM-5A or register in PLC CPU can be selected. The internal register in AH10SCM-5A includes I1, I2, O1, and O2. For PLC CPU, the D device can be chosen directly. Constant: Size of the length (Unit: Byte)

After multiple Tx and Rx packets are built, right click on the box of "Command List" to create a new item and double click the new item to edit the packet and plan the execution sequence of all commands.
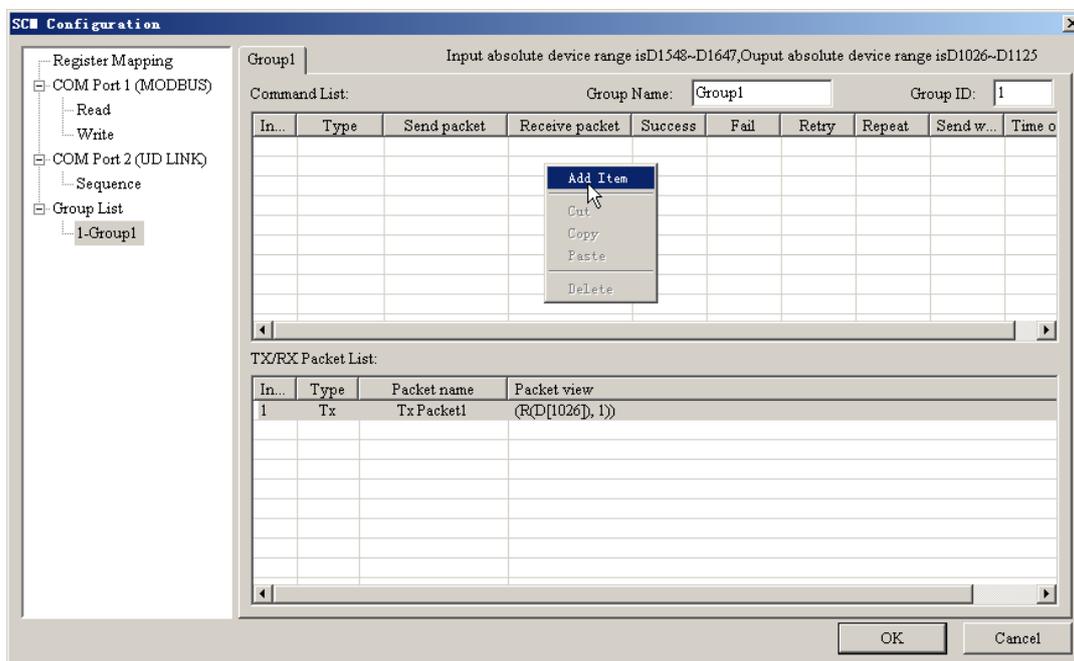
Command Edit interface:

Explanation of Command Edit interface:

| Item	Explanation
Command No.	Each group has its number and the execution order is specified through the number.
Command Type	Send, Receive and Send & Receive are for option.
Send Packet	The name of the packet already built in the group could be selected.
Receive packet	The name of the packet already built in the group could be selected.

Success	It specifies the action after the command execution is completed. Next, Goto and End are for option.
	
	Next: To execute the next command
	
	   E.g. the number of the currently executed command is 1; the next one to be executed is the command of number 2.
	
	Goto: To skip to execute the command
	
	   Directly specifies the command of a bigger number.
	
	End: Finish

Fail	To specify the action after the command execution is completed; Next, Goto and End are for option. Next: To execute the next command. E.g. the number of the currently executed command is 1; the next one to be executed is the command of number 2. Goto: To skip to execute the command; directly specify the command of a bigger number. End: Finish.
Retry	The retry times when transfer failure occurs
Repeat	The repeated execution times when the command execution succeeds
Transfer delay	The interval time for sending every message; default: 0 which means that the next command will be sent out immediately once the response is received
Timeout	After the serial port releases the command, no response is received within the set time, that is, communication timeout. Default: 50 ms

The already built group could be added to Sequence by clicking the Add button on the Sequence setting interface. Download the group with sequence as the unit to COM port and make the execution.

In addition, besides that the execution group is selected, the group number to be executed when an error occurs can be set at the same time. When the executed group has a fault, execute the group according to the setting of the execution group when the error occurs.
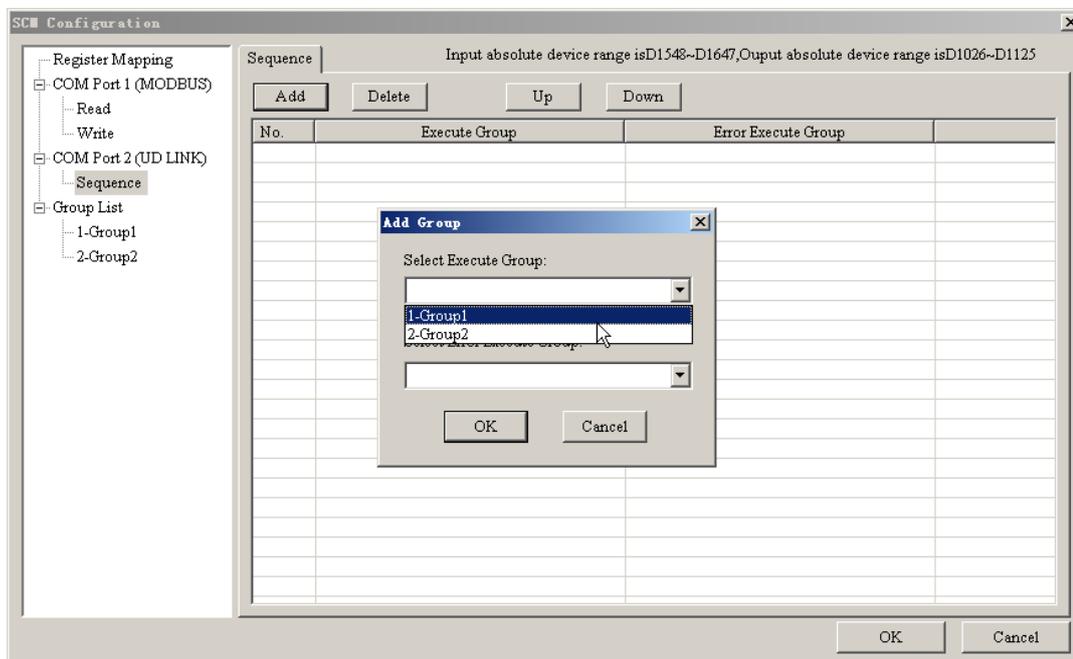
11.4.3 DeviceNet Mapping Data

The model of the entire mapping data exchange is shown as below, which is finally mapped to the registers in PLC.
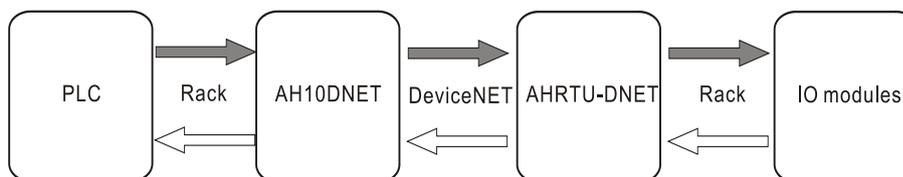
Note: The mapping addresses mentioned below are the D registers in PLC CPU.

For AH10DNET-5A master, its input and output starting addresses can be set freely. (The input and output starting addresses are set via HWCONFIG when the DeviceNet Builder software is called through HWCONFIG in ISPSoft; otherwise, the input and output starting addresses are set via the DeviceNet Builder software when the software is used separately.) The lengths of the mapping addresses of the input and output are determined by the configuration of all slaves connected to AH10DNET-5A master. Their maximum lengths are both 495 words.

For AHRTU-DNET-5A, its input and output starting mapping addresses are automatically allocated by the master when AHRTU-DNET-5A is added to the master. And the lengths of the input and output mapping addresses are determined by the configuration of the modules connected to AHRTU-DNET-5A.

For the I/O modules, their input and output mapping starting addresses can be allocated automatically or set by users. The lengths of the input and output mapping addresses depend on the configuration of the modules.

The ranges of the input and output mapping addresses of the modules are limited by those of the input and output mapping addresses of AHRTU-DNET-5A.

11.4.3.1 Allocation of the Mapping Addresses for Master AH10DNET-5A
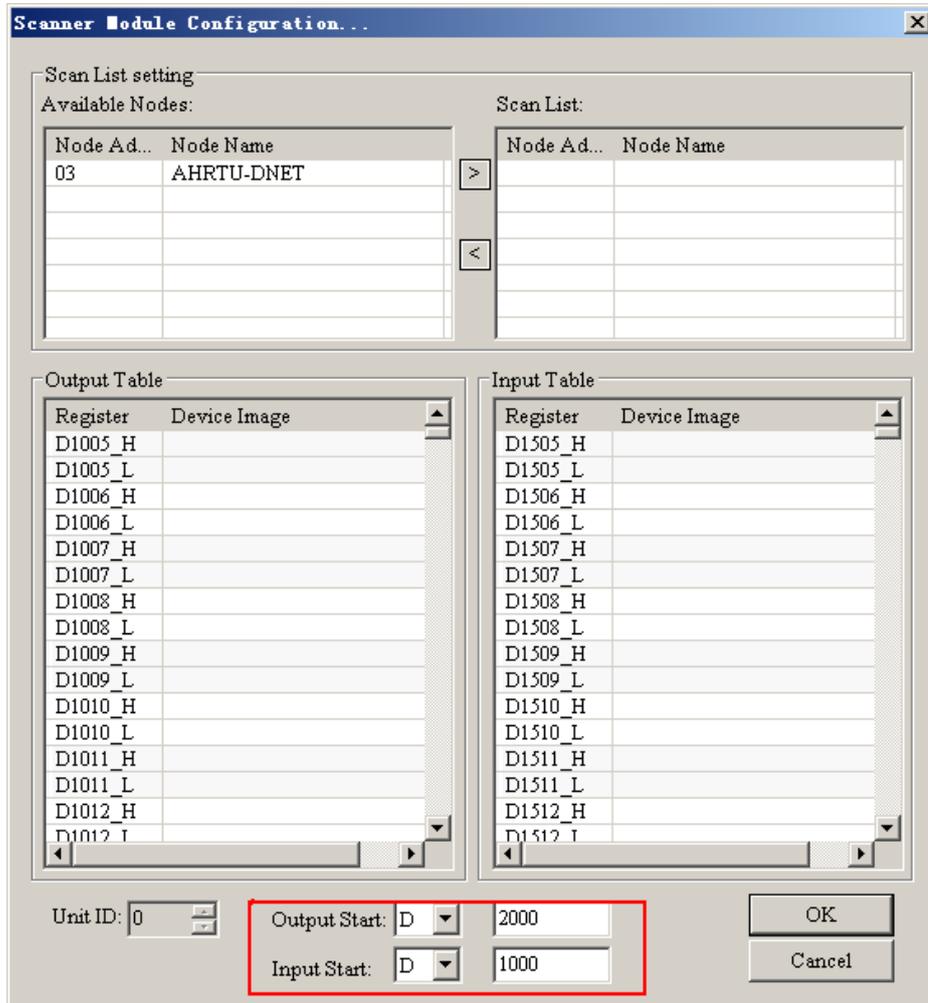
When AH10DNET-5A serves as the master, the output and input starting addresses can be specified by users. The maximum lengths of the input and output mapping addresses are both 495 words. If the output and input starting addresses of AH10DNET-5A are specified as D2000 and D1000 respectively in the above window, the data mapping areas will be allocated according to the following table.

Input area: Slave ⇨ Master			Output area: Master ⇨ Slave		
AH500 series CPU register number	**Purpose**	**Data Length**	**AH500 series CPU register number**	**Purpose**	**Data Length**
D1000~D1003	The status display area of the node in the scan list	4 words	D2000~D2003	Bit-strobe command area	4 words
D1004	The status display area of the scanner module	1 word	D2004	Reserved area	1 word

Input area: Slave ⇨ Master			Output area: Master ⇨ Slave		
AH500 series CPU register number	**Purpose**	**Data Length**	**AH500 series CPU register number**	**Purpose**	**Data Length**
D1005~D1494	DeviceNet input data area: these registers are used for receiving the status data feedback from the slave.	490 words	D2005~D2494	DeviceNet output area: the values in the registers will be sent to the slave as the control data	490 words

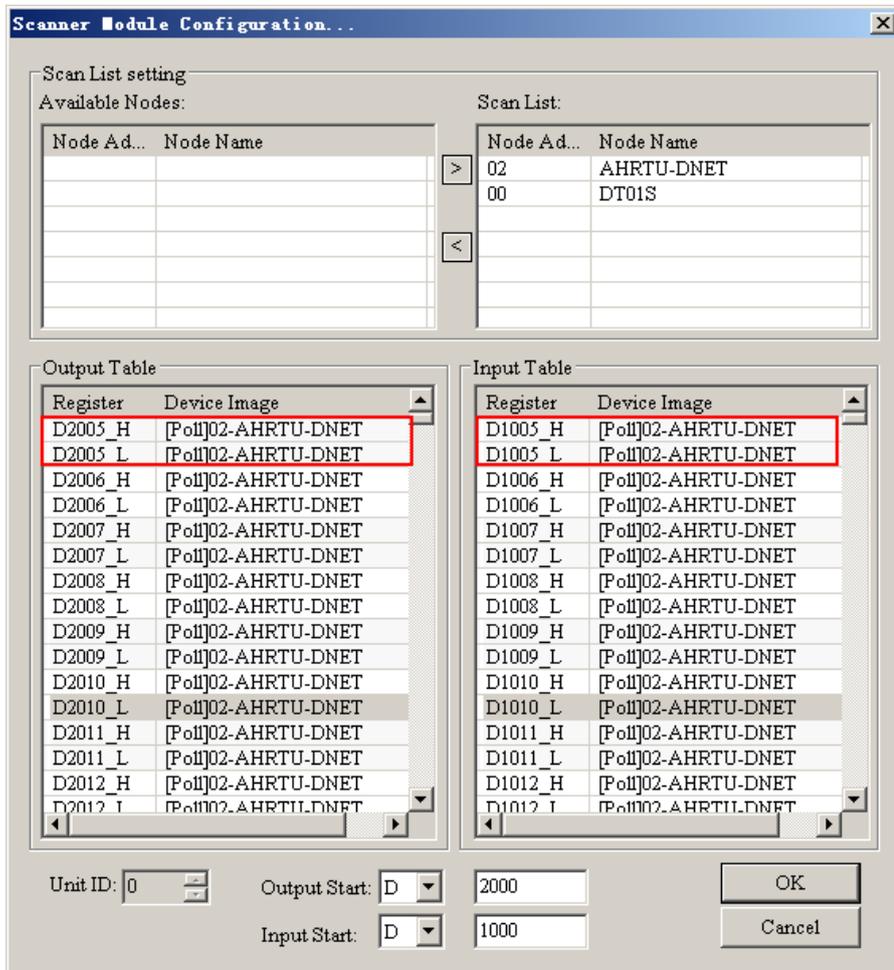## 11.4.3.2 Allocation of the Mapping Addresses for AHRTU-DNET-5A

The input and output mapping starting addresses of AHRTU-DNET-5A are allocated automatically by the master when it is added to the master. And the AH10DNET-5A master will allocate the mapping address to AHRTU-DNET-5A according to the lengths of the input and output mapping addresses of AHRTU-DNET-5A. The lengths of the input and output mapping addresses are determined by the configuration parameters of the modules connected to AHRTU-DNET-5A. The mapping starting addresses will be allocated to AHRTU-DNET-5A only when it is added to the master and meanwhile they are related with the sequence in which the slave is added to the master.

When the two slaves DT01S and AHRTU-DNET-5A exist simultaneously, the lengths of input and output mapping addresses of AHRTU-DNET-5A are both 80 bytes; those of DT01S are both 4 bytes; the input and output mapping starting addresses of AH10DNET-5A are specified as D1000 and D2000 as below. If DTO1S is added to the master prior to AHRTU-DNET-5A, the input and output mapping addresses of AHRTU-DNET-5A are D1007~D1046 and D2007~D2046 respectively and D1007 and D2007 are its input and output mapping starting addresses respectively.
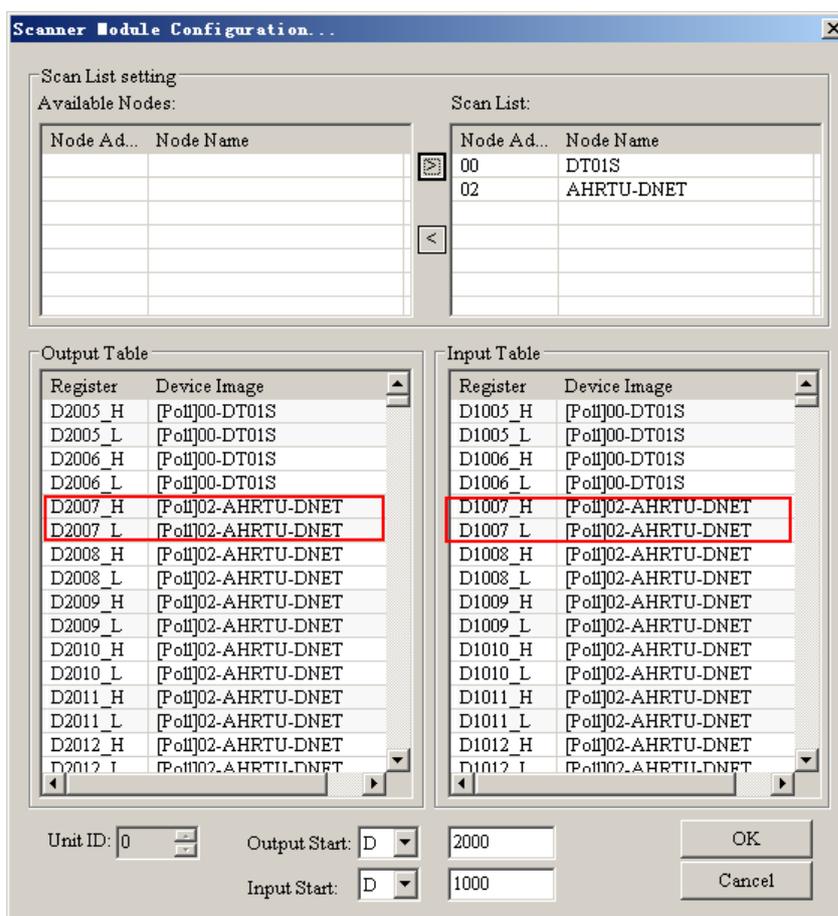
If AHRTU-DNET-5A is added to the master prior to DT01S, the input and output mapping addresses of AHRTU-DNET-5A are D1005~D1044 and D2005~D2044 respectively and D1005 and D2005 are its input and output mapping starting addresses respectively.

When AHRTU-DNET-5A is added to the master, its input and output mapping starting addresses are fixed and defined as the status word and control word of AHRTU-DNET-5A respectively as below. The registers after the input and output mapping starting addresses are used for mapping the configuration parameters of the I/O module.

11.4.3.3 Allocation of the Mapping Addresses for the Modules
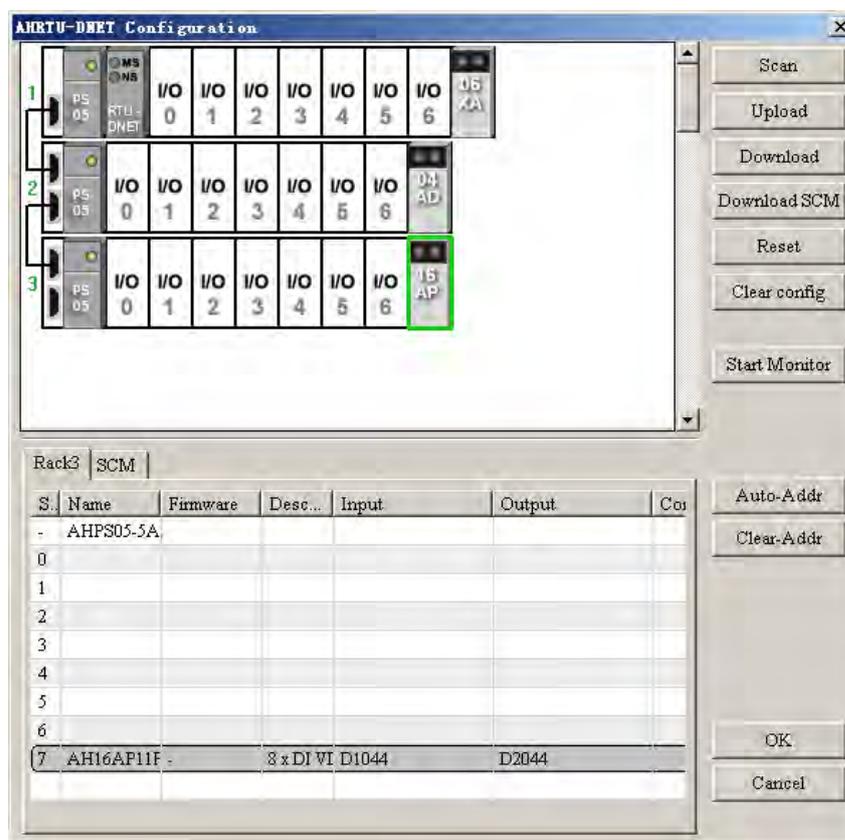
There are two forms of data mapping for each module.

When the DeviceNet master has not allocated the input and output mapping starting addresses to AHRTU-DNET-5A, the value in "Start Address" as below represents the offset based on the input or output mapping starting address that the DeviceNet master allocates to AHRTU-DNET-5A.

When the DeviceNet master has allocated the input and output mapping starting addresses to AHRTU-DNET-5A, the value in "Start Address" as below represents the mapping starting address of the module.

When AHRTU-DNET-5A is pulled to "Scan List" on the Scanner Module Configuration interface, the DeviceNet master will allocate the input and output mapping starting addresses to AHRTU-DNET-5A.

If AHRTU-DNET-5A is removed from "Scan List" on the Scanner Module Configuration interface, the input and output mapping starting addresses will be unknown.

When the DeviceNet master has not allocated the input and output mapping starting addresses to AHRTU-DNET-5A, the value in "Start Address" is set to 1, which means that the starting address of the module is the offset ##+1 based on the input or output mapping starting addresses which the DeviceNet master has allocated to AHRTU-DNET-5A.

When the input starting address that the DeviceNet master allocates to AHRTU-DNET-5A is D1005 and the value in "Start Address" is set to 1006, it means that the input starting address of the module is D1006.

If AHRTU-DNET-5A is pulled out of the DeviceNet master configuration, that is, the DeviceNet master does not allocate the mapping starting address to AHRTU-DNET-5A, the starting address of the module will become the offset ##+1 based the input or output mapping starting address that the DeviceNet master allocates to AHRTU-DNET-5A.

When the mapping address is not allocated to AHRTU-DNET-5A, the Device Mapping interface is shown as below.
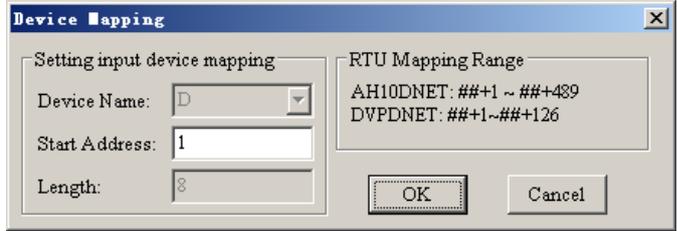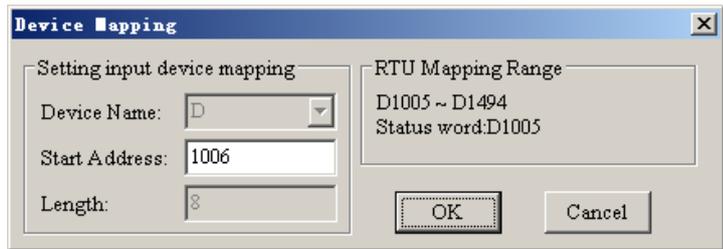

AHRTU-DNET-5A is pulled into Scan List for allocation of its mapping addresses.
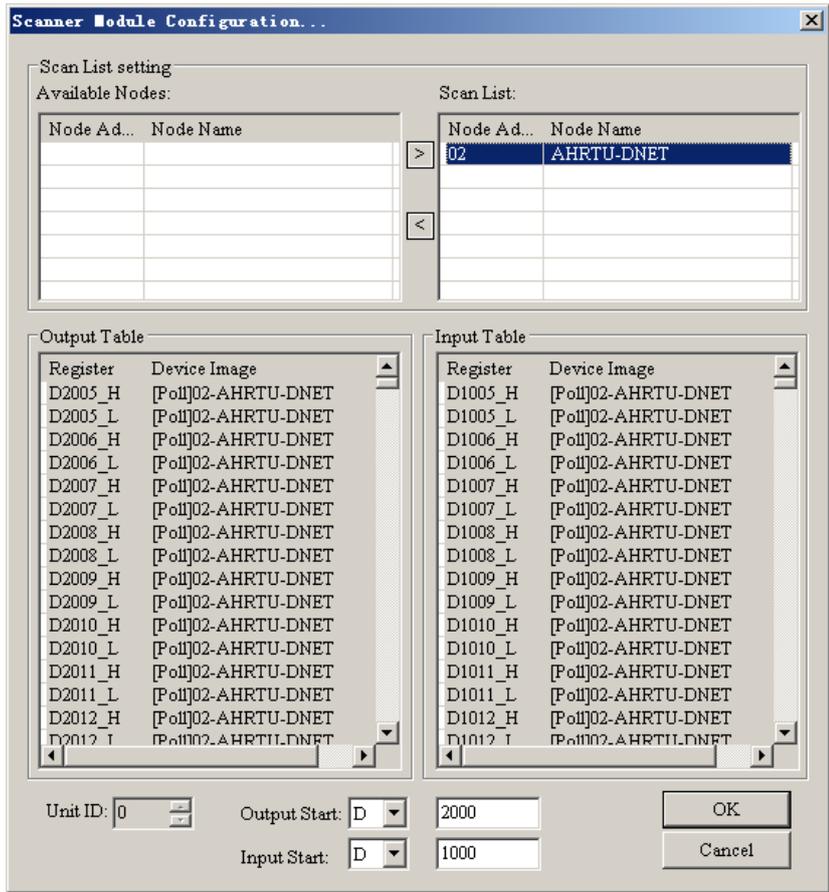
After the mapping address is allocated to AHRTU-DNET-5A, the Device Mapping interface is as follows.

The mapping address allocation for each module is independent and adding or deleting one module will not affect the mapping addresses of other module. By doing so, the work load of modifying the program can be reduced. Since the control over each module is comparatively independent in one program, even if one or more modules are added or deleted, other module can still run normally and no change is needed to make in the main program as long as the mapping range of the original module is not changed

The range of mapping address of each module can be allocated automatically by the software or allocated manually by users. Automatic allocation is easy and quick; the lengths of the input and output mapping addresses are the shortest and the rate of data exchange on the bus is the highest. While, manual allocation can reserve the mapping addresses of each module, adding or deleting the mapping parameters of the module will not influence the mapping addresses of other module. The lengths of the input and output mapping addresses of AHRTU-DNET-5A will be a bit longer and the data exchange rate on the bus will be a bit lower due to the reserved mapping addresses.

● Automatic allocation of the addresses

Click the "Auto-Addr" button on the interface, the software will automatically allocate the parameter mapping addresses of the module according to the numbers from small to large of the rack and the slot where the modules are. As above, AH06XA-5A is set to the present value of 4 channels and 8 words input and the present value of 2 channels and 4 words output; AH04DA-5A is of 4 channels and 8 words output by default and is configured with 2 parameters "Mapping to the device" (2 words input and 2 words output); 16AP occupies 1 word of input present value and 1 word of output present value and every word corresponds to one D in the mapping area of the master (That is to map to PLC).

Suppose that the input and output mapping starting addresses which the master allocates to AHRTU-DNET-5A are D1005 and D2005 respectively. The mapping addresses that the software automatically allocates to each module are like this. For example, D2005 and D1005 are the control word and status word of AHRTU-DNET-5A respectively; then the corresponding input and output mapping addresses for AH06XA-5A are D1006~D1013 and D2006~D2009 respectively; the corresponding input and output mapping addresses for AH04DA-5A are D1014~D1015 and D2010~D2019 respectively; the corresponding input and output mapping addresses for 16AP are D1016 and D2020 respectively.

Auto-allocation	Input	Output
AHRTU-DNET-5A	D1005 status word	D2005 control word
AH06XA-5A	D1006~D1013	D2006~D2009
AH04DA-5A	D1014~D1015	D2010~D2019
16AP	D1016	D2020

The input and output mapping addresses of AHRTU-DNET-5A are D1005~D1016 and D2005~D2020 respectively.

● Manual allocation of the addresses

Manual allocation of the addresses means to set the input and output mapping starting addresses of each module by manual. Suppose one module currently needs to use 4 words of input data and 4 words of output data, but it may use 8 words of input data and 8 words of output data in the future. Set that the input and output mapping starting addresses of the module and the last input and output mapping addresses of the previous neighboring module are inconsecutive so that the mapping relations between the original module parameters and the D registers will keep unchanged. While, by means of automatic allocation of addresses, the mapping relations between the original module parameters and D registers will be changed if the module needs to add some parameters. The input and output mapping starting addresses or the offsets of the starting addresses of each module can be set and the input and output mapping starting addresses of different modules can not be repeated, which the software can count automatically. The mapping addresses of a single module are consecutive.

Add AHRTU-DNET-5A to Scan List on the Scanner Module Configuration interface before the I/O module parameters of AHRTU-DNET-5A has not been configured. Suppose that the input and output mapping starting addresses that the master allocates to AHRTU-DNET-5A are D1005 and D2005 respectively.

Configuration of the module parameters:

AH06XA-5A is set to the present values of 4 channels and 8 words of input and 2 channels and 4 words of output.

AH04DA-5A is of 4 channels and 8 words for output by default and is configured with 2 parameters "Mapping to Device" (2 words of input and output respectively). 16AP occupies 1 word of input and output respectively. Every word corresponds to one D in the mapping area of the master (That is to map to PLC)

Setting of the input and output mapping starting addresses of the module:

Set the input an output mapping starting addresses to D1010 and D2010 respectively for AH06XA-5A, D1030 and D2030 respectively for AH04DA-5A; D1060 and D2060 respectively for 16AP.

By means of manual allocation of addresses, D2005 and D1005 are used as the control word and status word of AHRTU-DNET-5A respectively. Hence the corresponding input mapping addresses and the output mapping addresses for AH06XA-5A are D1010~D1017 and D2010~D2013 respectively; for AH04DA-5A are D1030~D1031 and D2030~D2039 respectively; for 16AP are D1060 and D2060 respectively.

Allocated manually	Input	Output
AHRTU-DNET-5A	D1005 status word	D2005 control word
AH06XA-5A	D1010~D1017	D2010~D2013
AH04DA-5A	D1030~D1031	D2030~D2039
16AP	D1060	D2060

The input and output mapping addresses of AHRTU-DNET-5A are D1005~D1060 and D2005~D2060 respectively.

11.4.3.4 Control Word and Status Word of AHRTU-DNET-5A

The input and output starting addresses in the mapping areas of AHRTU-DNET-5A are defined as the status word and control word respectively with the detailed explanation as below.

● Control word of AHRTU-DNET-5A

Bit	Status value	Definition
Bit 0~bit 2	000	Set no control of operation of AHRTU-DNET-5A
	001	Set AHRTU-DNET-5A to RUN mode
	010	Set AHRTU-DNET-5A to STOP mode
	Other	Reserved
Bit 3	0	Reserved
	1	Restart AHRTU-DNET-5A
Bit 4	0/1	Reserved
Bit 5	0/1	Reserved
Bit 6	0/1	Reserved
Bit 7	0/1	Reserved
Bit 8	0/1	Reserved
Bit 9	0/1	Reserved
Bit 10	0/1	Reserved
Bit 11	0/1	Reserved
Bit 12	0/1	Reserved
Bit 13	0/1	Reserved
Bit 14	0/1	Reserved
Bit 15	0/1	Reserved

● Status word of AHRTU-DNET-5A

Bit	Status value	Definition
Bit 0	0	AHRTU-DNET-5A is in operational state.
	1	AHRTU-DNET-5A is in STOP state.
Bit 1	0/1	Reserved
Bit 2	0	No abnormality occurs for I/O module.
	1	The abnormality occurs for I/O module.
Bit 3	0/1	Reserved
Bit 4	0	The current connection is consistent with the configuration.
	1	The current connection is inconsistent with the configuration.
Bit 5	0	AHRTU-DNET-5A works normally.
	1	The work voltage of AHRTU-DNET-5A is too low.
Bit 6	0/1	Reserved
Bit 7	0	AHRTU-DNET-5A works normally.
	1	Point number/Quantity of the modules exceeds maximum.
Bit 8	0/1	1: extension rack 1 is abnormal; 0: normal
Bit 9	0/1	1: extension rack 2 is abnormal; 0: normal
Bit 10	0/1	1: extension rack 3 is abnormal; 0: normal
Bit 11	0/1	1: extension rack 4 is abnormal; 0: normal
Bit 12	0/1	1: extension rack 5 is abnormal; 0: normal
Bit 13	0/1	1: extension rack 6 is abnormal; 0: normal
Bit 14	0/1	1: extension rack 7 is abnormal; 0: normal
Bit 15	0/1	Reserved

11.4.4 Connecting AHRTU-DNET-5A to the DeviceNet Network

In general, AHRTU-DNET-5A is set through the following steps from successful configuration to normal operation on the network.
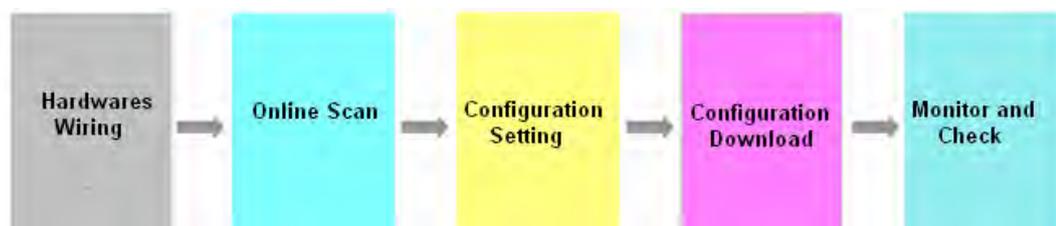
● Hardware Wiring

In the hardware wiring, make sure to use the standard cable and connect the terminal resistors of 121 ohm to the two ends of the mains of the DeviceNet network. All node addresses on the network must not be identical and their baud rates should keep the same.

● Online Scan

The scan consists of two parts such as network nodes scanning and I/O modules scanning in AHRTU-DNET-5A configuration. Before scanning is carried out, ensure that the communication channel is chosen properly and the communication setting in COMMGR is done correctly.

● Configuration Setting

Configuration Setting includes the master and AHRTU-DNET-5A configuration settings. The master configuration contains master scanner module setting (master configuration) and scan list configuration. AHRTU-DNET-5A configuration contains AHRTU-DNET-5A and other I/O module settings.

● Configuration Download

Configuration Download refers to master and AHRTU-DNET-5A configuration download. When AH10SCM-5A exists, AH10SCM-5A serial port data configuration download will be added. While

the master is downloading the configuration, 80 and its node address are shown on the seven-segment display of AHRTU-DNET-5A alternately; While AHRTU-DNET-5A configuration is being downloaded, 83 and its node address are shown alternately; while AH10SCM-5A serial port data configuration is being downloaded, 84 and its node address are shown alternately.

● Monitor and Check

After configuration and download are completed, check if AHRTU-DNET-5A works normally. If AHRTU-DNET-5A is in normal operation, the digital displays of the master and AHRTU-DNET-5A show their own node addresses; MS and NS indicators are green constantly.

11.5 Application Example

This section is going to describe how to configure the I/O module parameters in AHRTU-DNET-5A and the I/O mapping relations between AHRTU-DNET-5A and AH10DNET-5A with one application example.

Control requirement

1. Capable of setting the input voltage of channel 1 of AH06XA-5A through the CPU automatically
2. When the input voltage of channel 1 of AH06XA-5A>5 V, the input indicator Y0.0 of AH16AP11T-5A is on and the output indicator Y0.1 is OFF.
3. When the input voltage of channel 1 of AH06XA-5A<&=5 V, the input indicator Y0.0 of AH16AP11T-5A is off and the output indicator Y0.1 is ON.

11.5.1 Network Structure
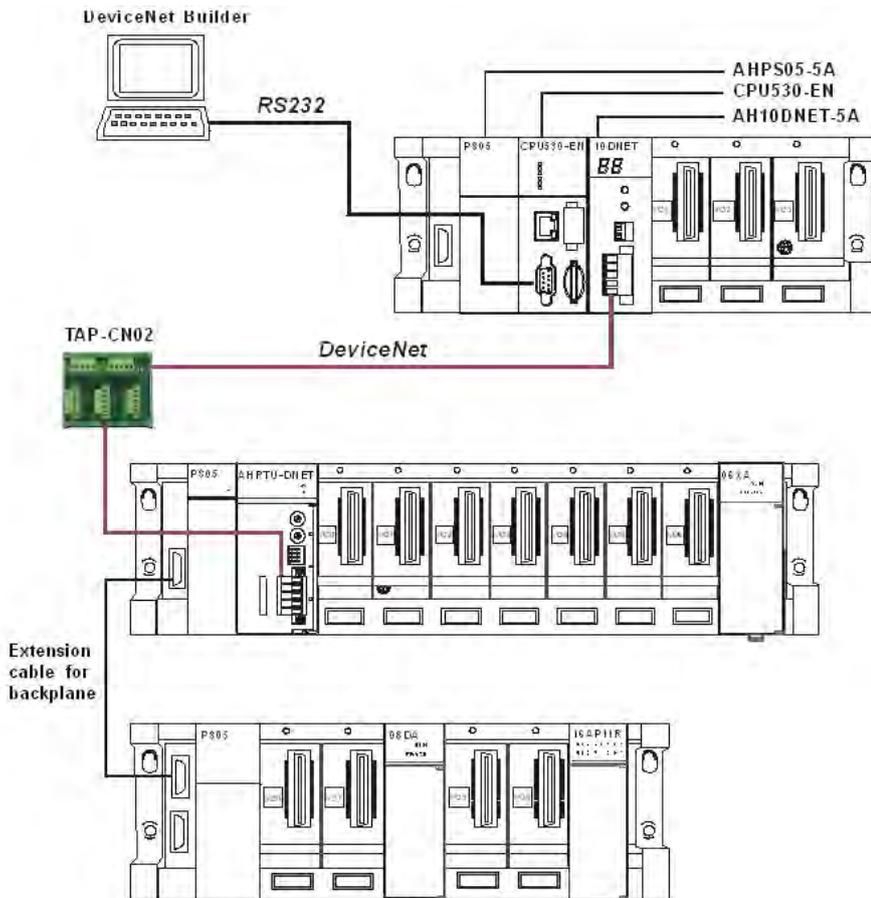
Note:

1. Before configuring AHRTU-DNET-5A, use HWCONFIG configuration interface via the ISPSoft software to configure AH10DNET-5A module to AHCPU530-EN and download it.
2. Connect the output of channel 1 of 08DA to the input of channel 1 of AH06XA-5A by using the hardware; add 24 V power to AH04DA-5A and AH06XA-5A respectively.

3. Ensure that the baud rates of AH10DNET-5A and AHRTU-DNET-5A are same.

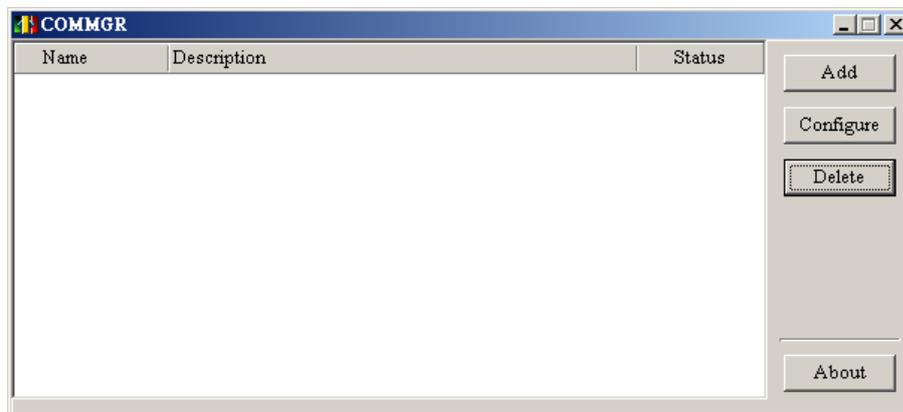| Module	Station address	Baud rate
AH10DNET-5A	3	500 kbps
AHRTU-DNET-5A	1	500 kbps

4. Add 24 V network power between V+ and V- and the 120 ohm terminal resistor between CAN_H and CAN_L.
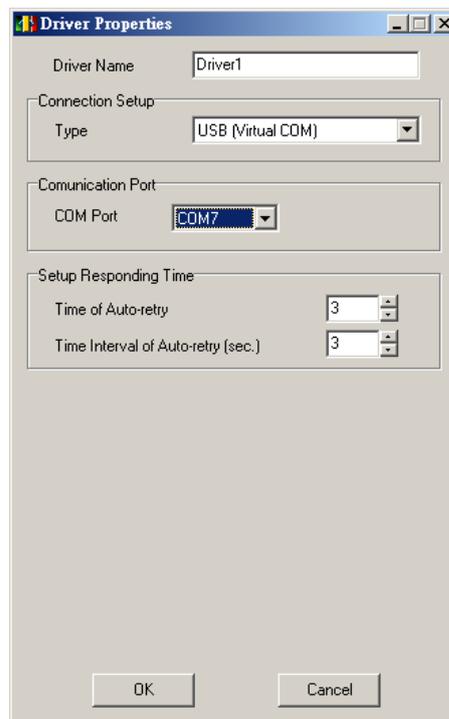
11.5.2 Using DeviceNet Builder to Configure the Network

11.5.2.1 Building and Starting the Communication Channel Driver 1 in COMMGR
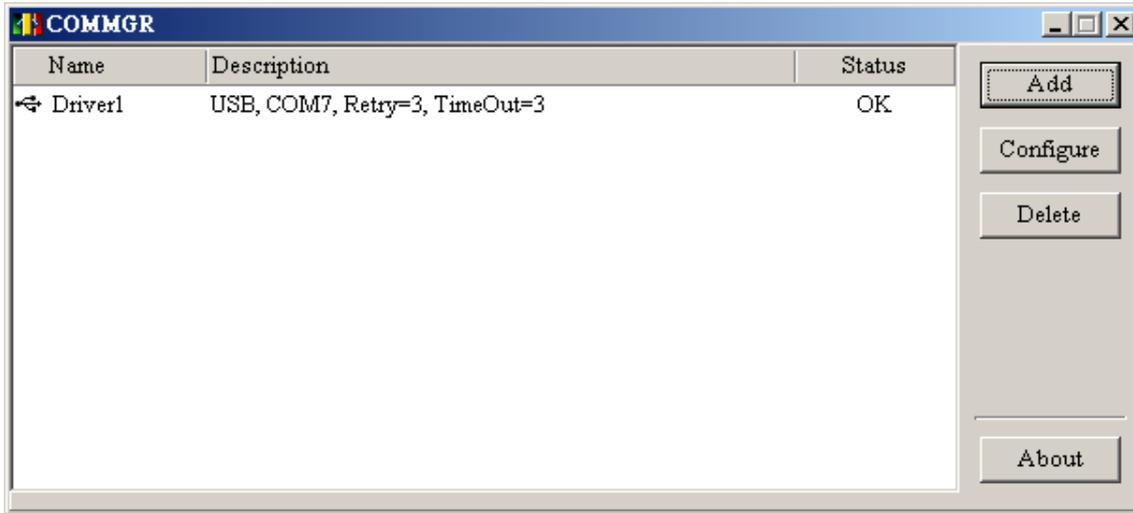
Open COMMGR and the following interface will appear.

Click "Add" button to add a communication channel Driver 1 and set up the channel as follows.

Click "OK" after setting Driver 1 is completed. OK will show up on the status column if Driver 1 is started up successfully.

11.5.2.2 Calling DeviceNet Builder via ISPSoft

Open ISPSoft and select "Tools">>"Communication Settings"; the following dialogue box will appear, where select the built driver and then click OK.
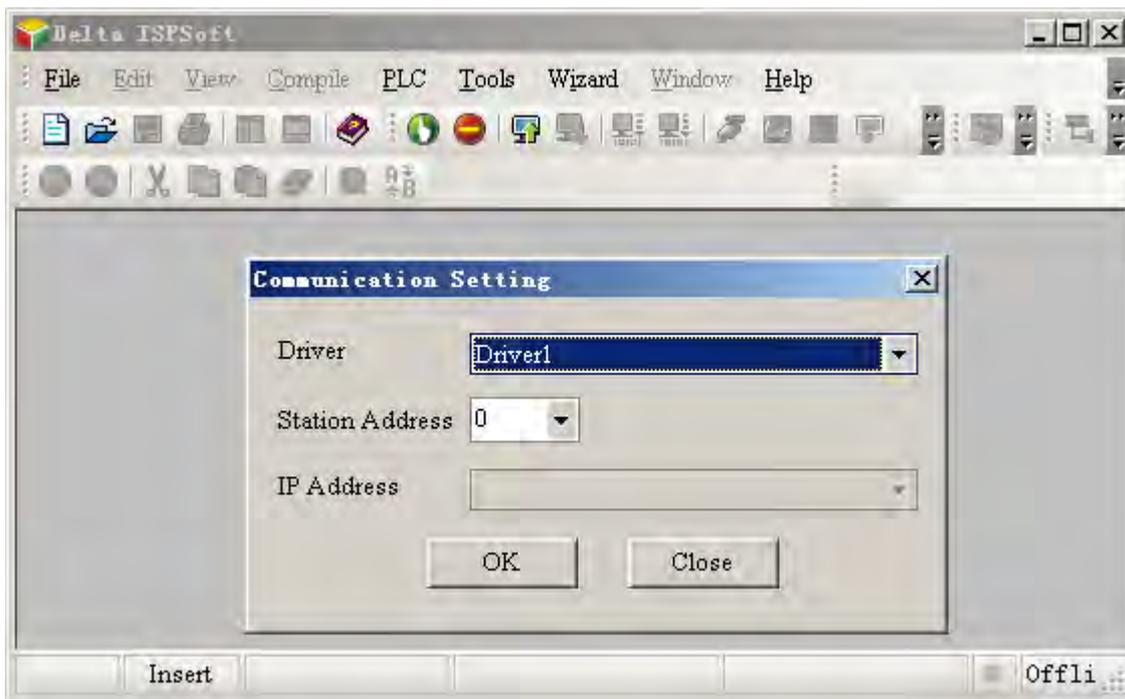
1. Select "File">>"New">>"New" and the following dialogue box will appear, where select the corresponding PLC type and then click OK.
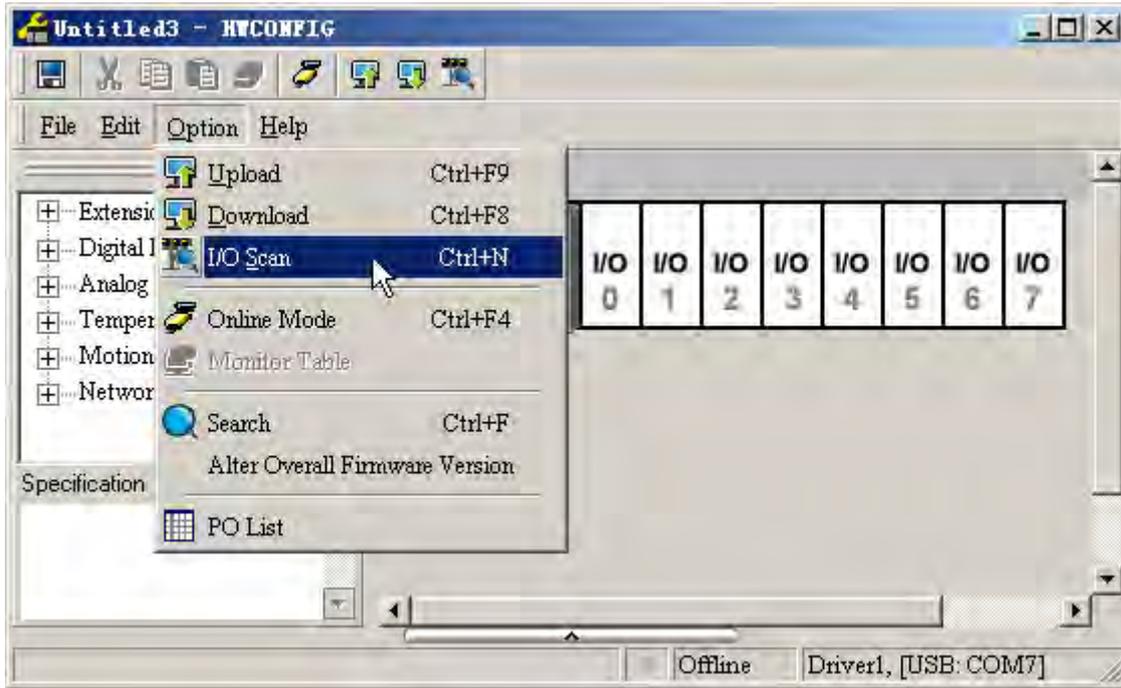

2. Double click "HWCONFIG" on the Project area to call the HWCONFIG software.
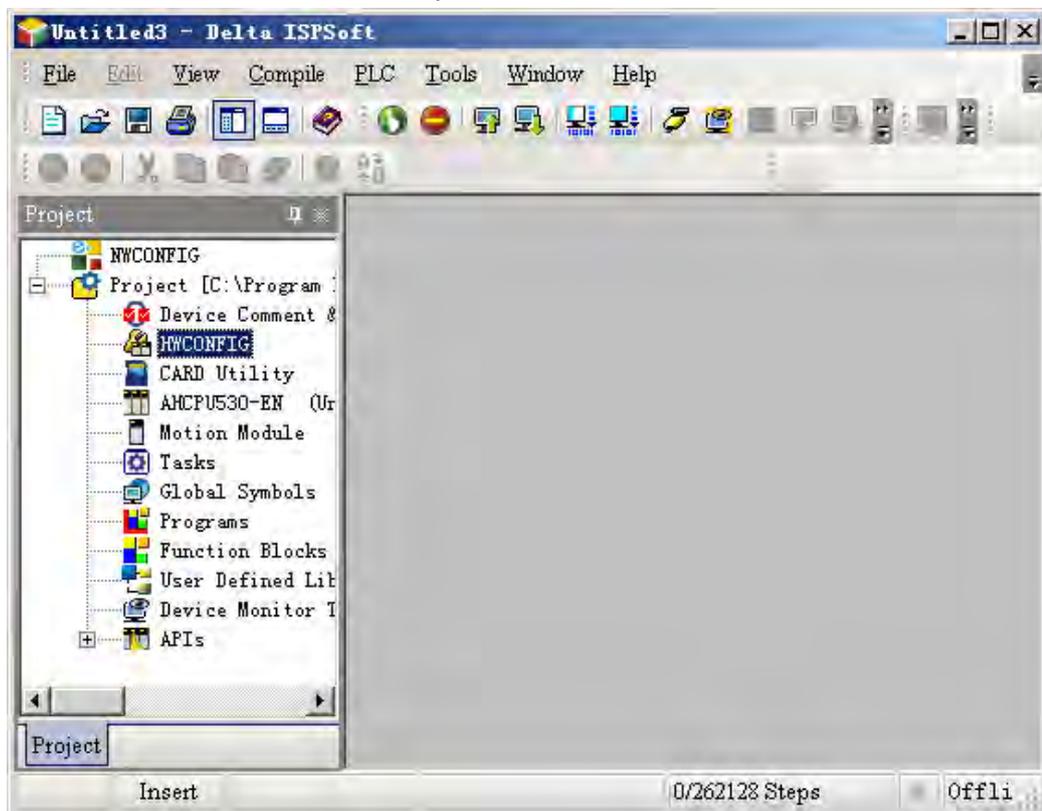
3. Select "Option">>"I/O Scan" in HWCONFIG to start scanning.

The device connected to AHCPU530-EN will have been scanned.
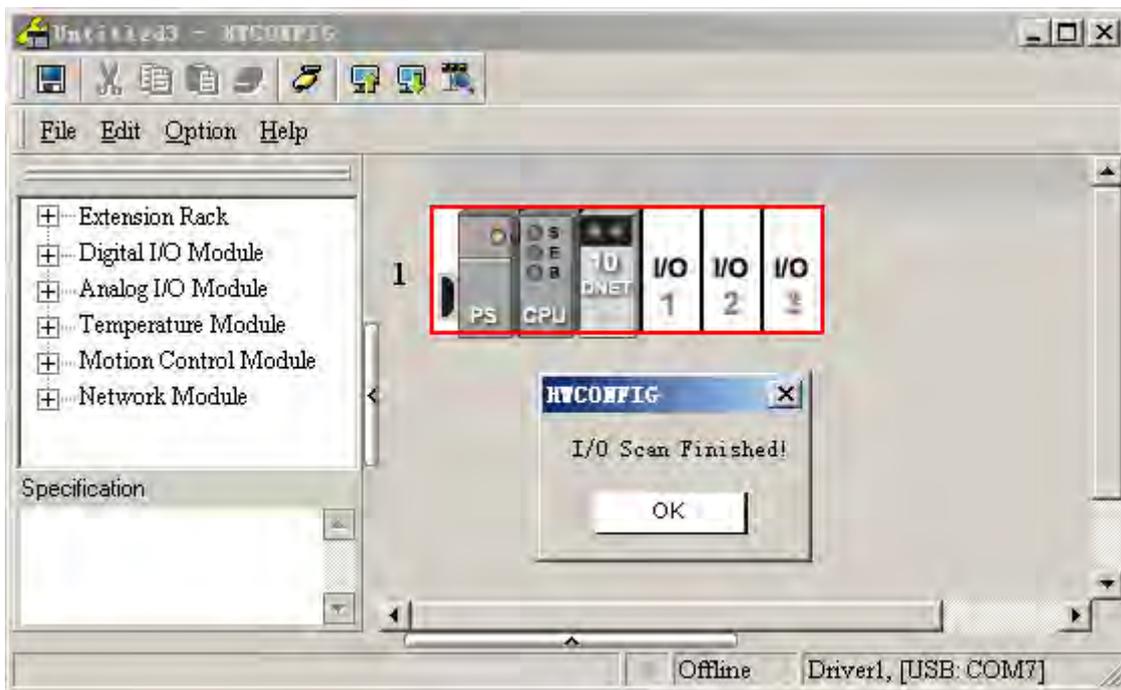
4. "10DNET" on the above window is the abbreviation of AH10DNET-5A.

Double click the AH10DNET-5A icon and then the parameter configuration dialog box of AH10DNET-5A will pop up.

Set Start D device address mapped by INPUT area (input mapping starting address) and Start D device address mapped by OUTPUT area (output mapping starting address) on the Parameters of I/O Mapping interface as follows.
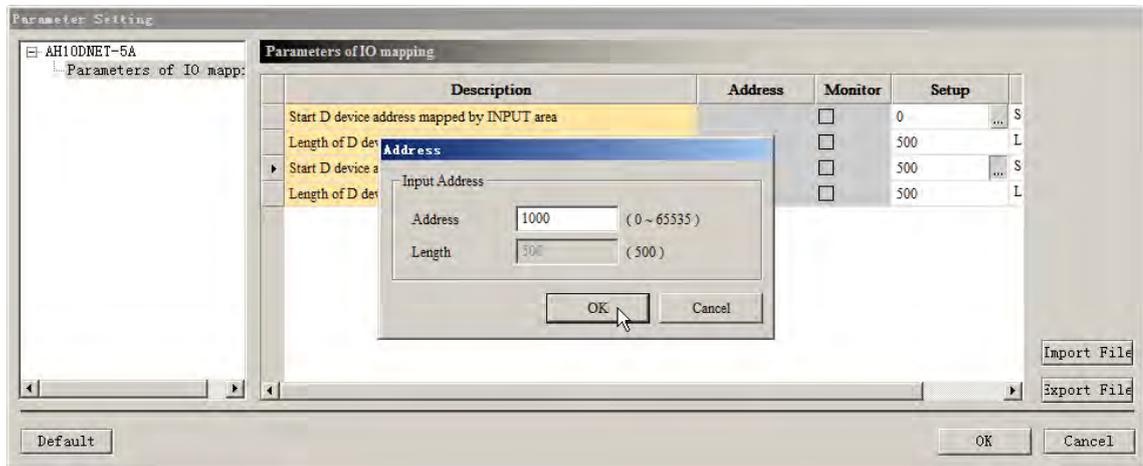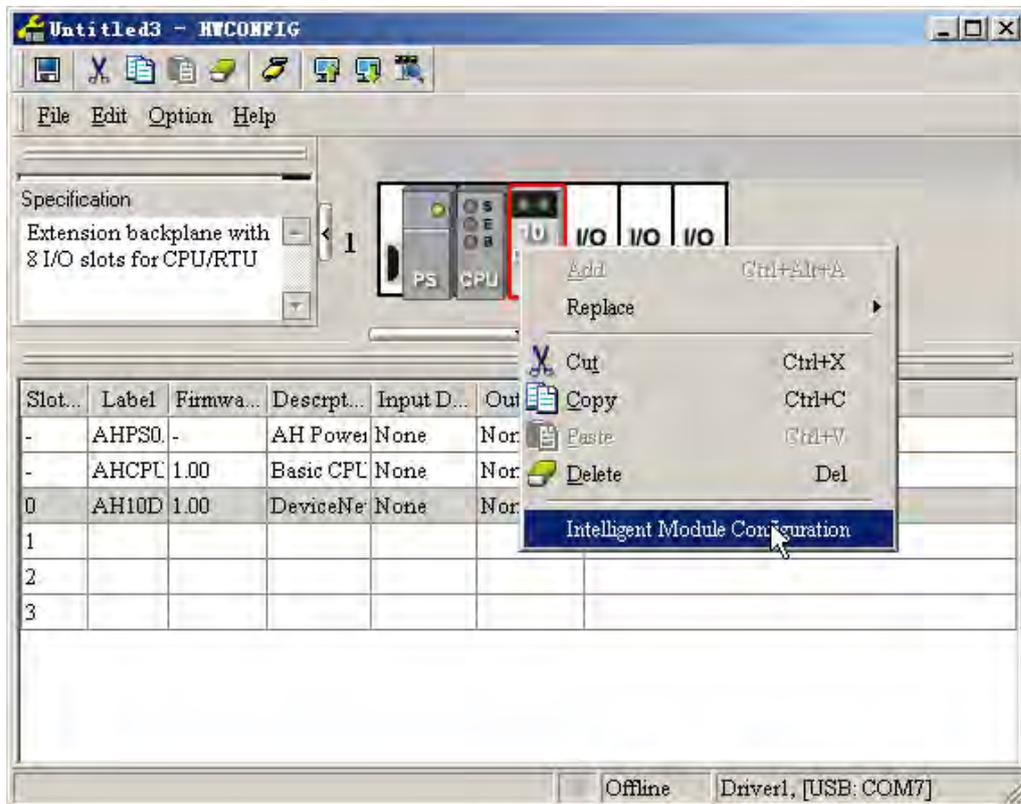

The two addresses are set to D500 and D1000 respectively in the example. Click "OK" after the setting is completed.
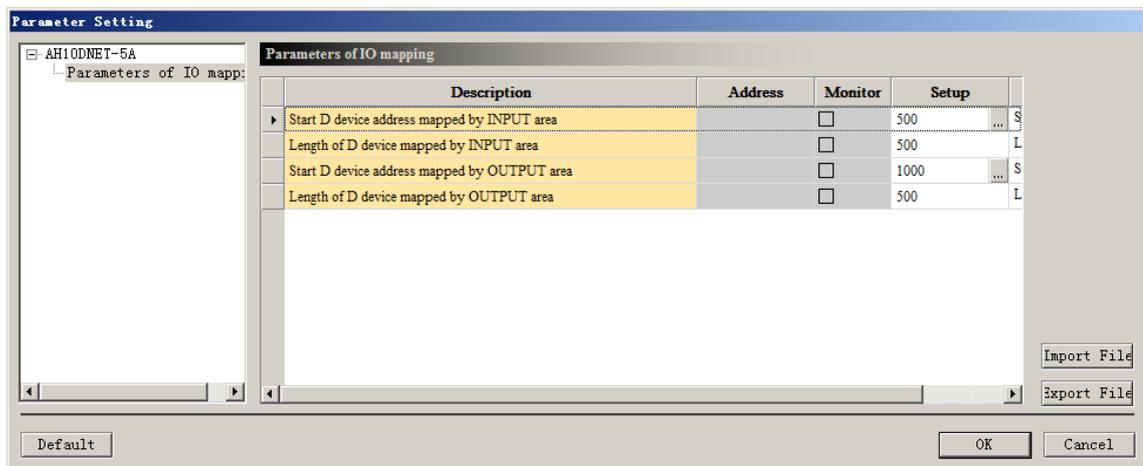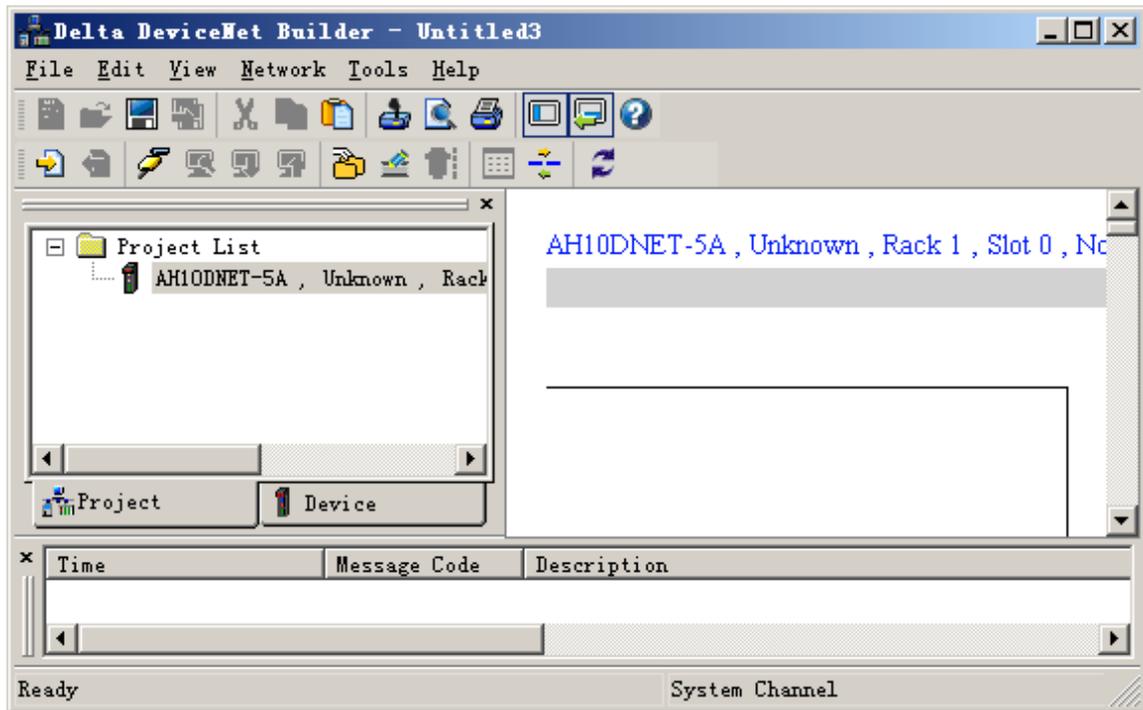
5. Select "Option">>"Download" to download the above setting to AHCPU530-EN.
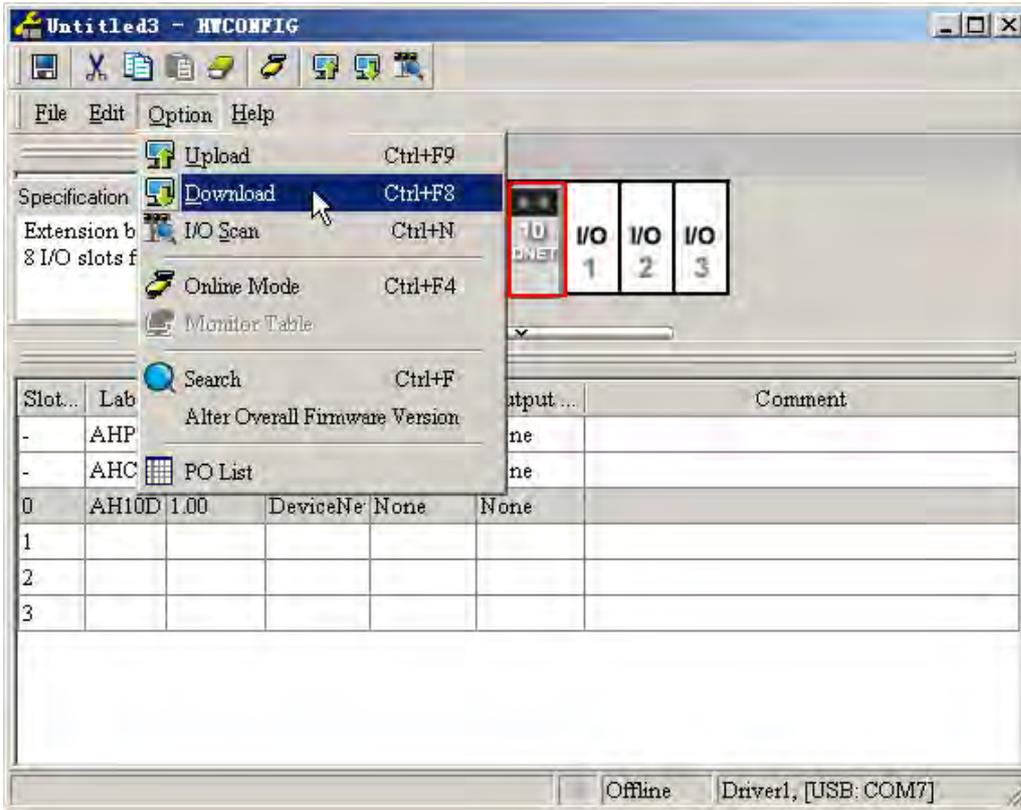
6. Right click the AH10DNET-5A icon and select "Intelligent Module Configuration" to call the DeviceNet Builder software.

7. The initialized interface of the called DeviceNet Builder is shown as below.

8. Click "Online" button, all DeviceNet modules AH10DNET-5A connected to AHCPU530-EN will show up with the relevant properties in Project List.
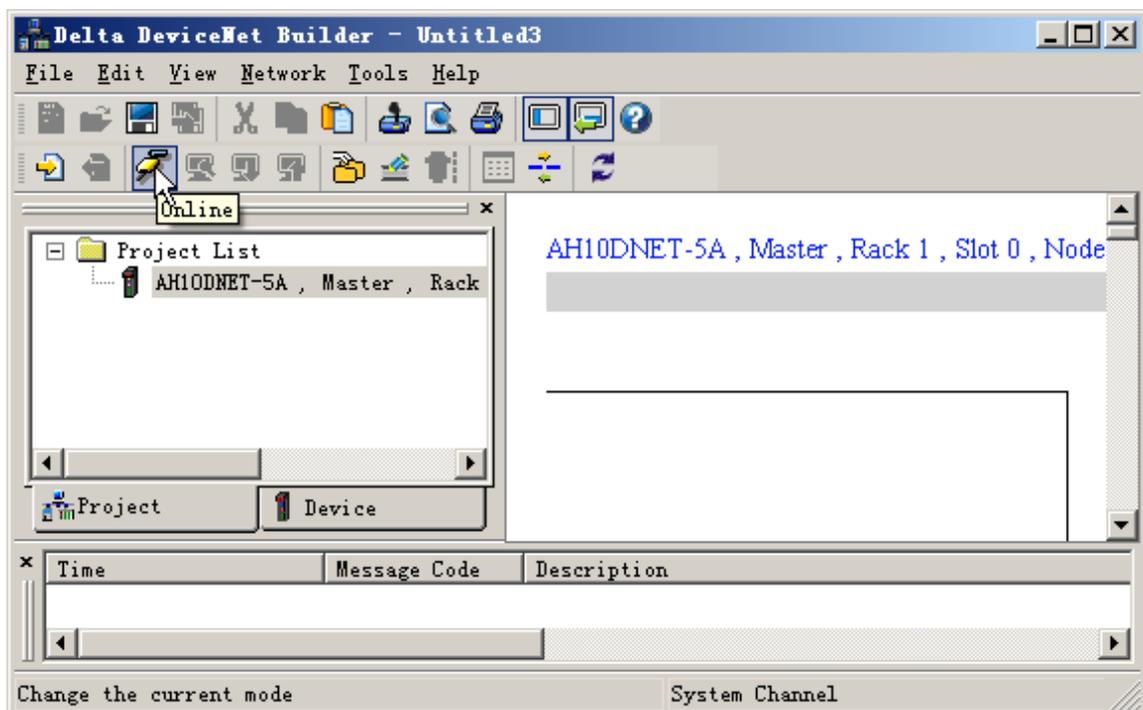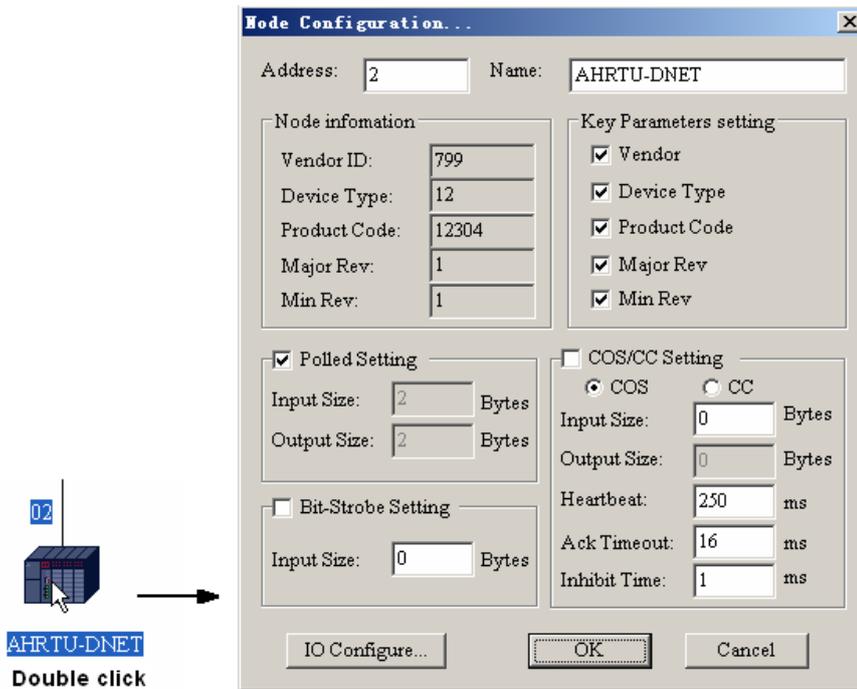
11.5.2.3 Configuration of AHRTU-DNET-5A

Select the network to be scanned in Project List, click the button "Scan DeviceNet network" to start scanning the nodes on the network. If scanning fails, please check if the selected AH10DNET-5A in Project List is the master.
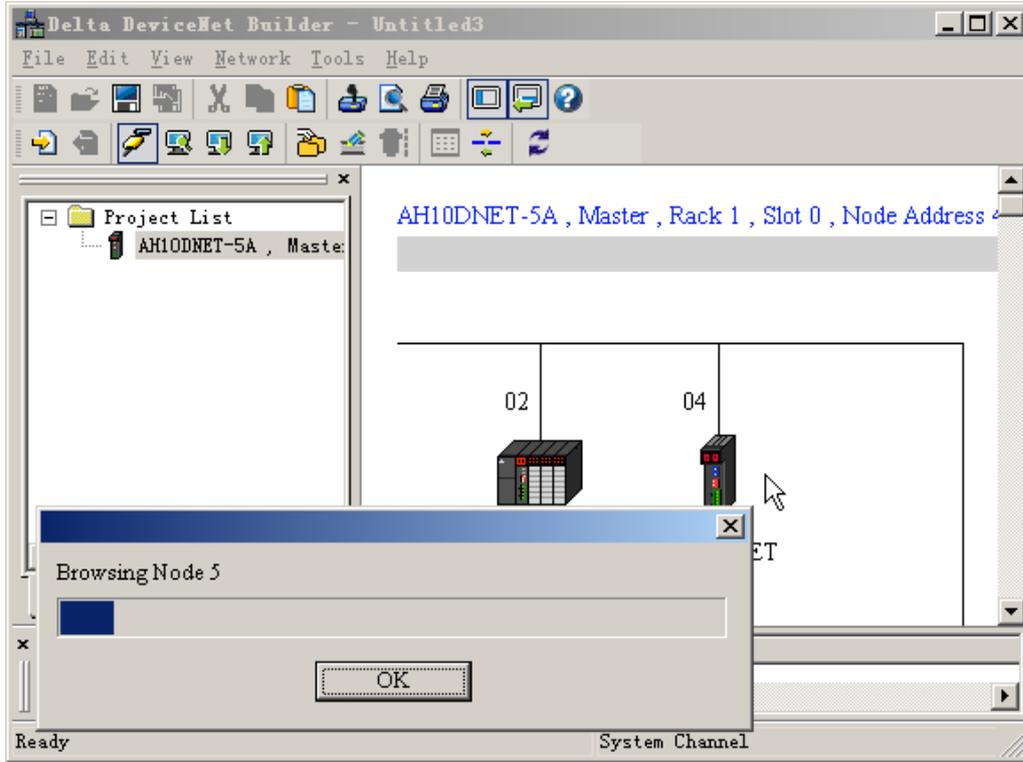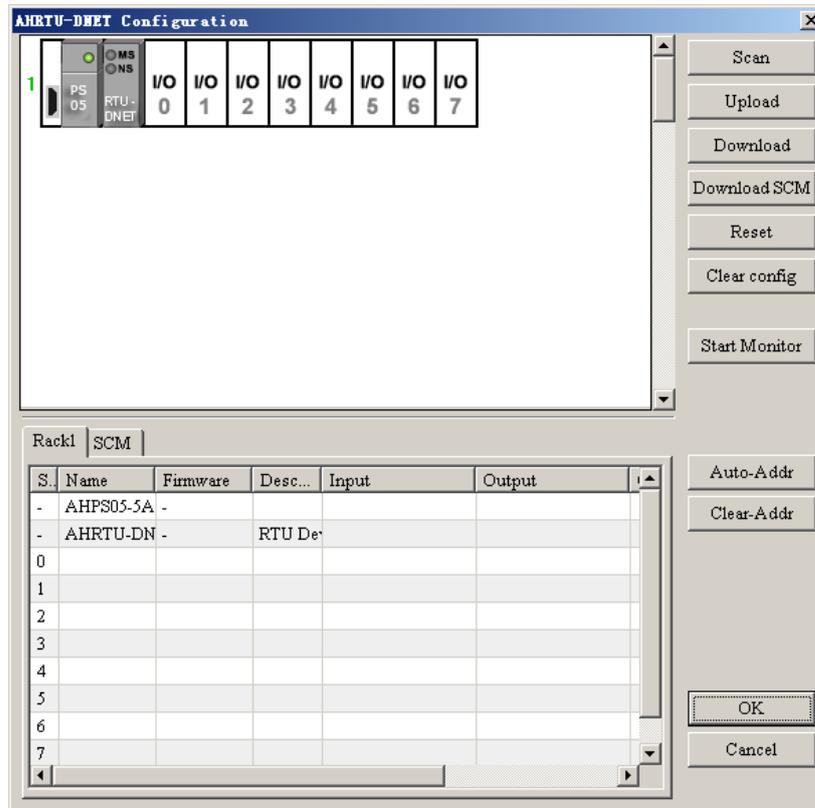

Double click the AHRTU-DNET-5A icon to enter the Node Configuration interface after scanning is finished.
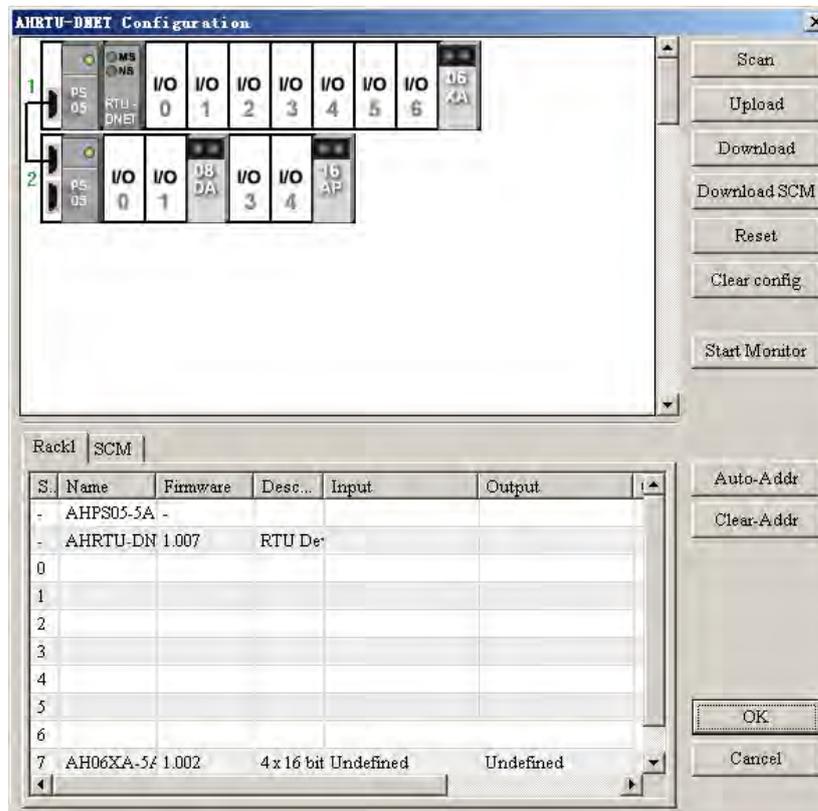
Click "IO Configure" on the Node Configuration interface to go to the AHRTU-DNET-5A Configuration interface.

Click the "Scan" button and all the I/O modules currently inserted to the rack will be scanned.

Double click the selected module icons respectively to enter the configuration interface of each module and select the module parameters which need to be configured. The corresponding module parameters can be monitored in real time by ticking "Mapping to Device". Channel 0 input mode of AH06XA-5A is set to -10 V~+10 V. Tick "Mapping to Device" for Channel 0 input cali. offset and Channel 0 input cali. Gain respectively.
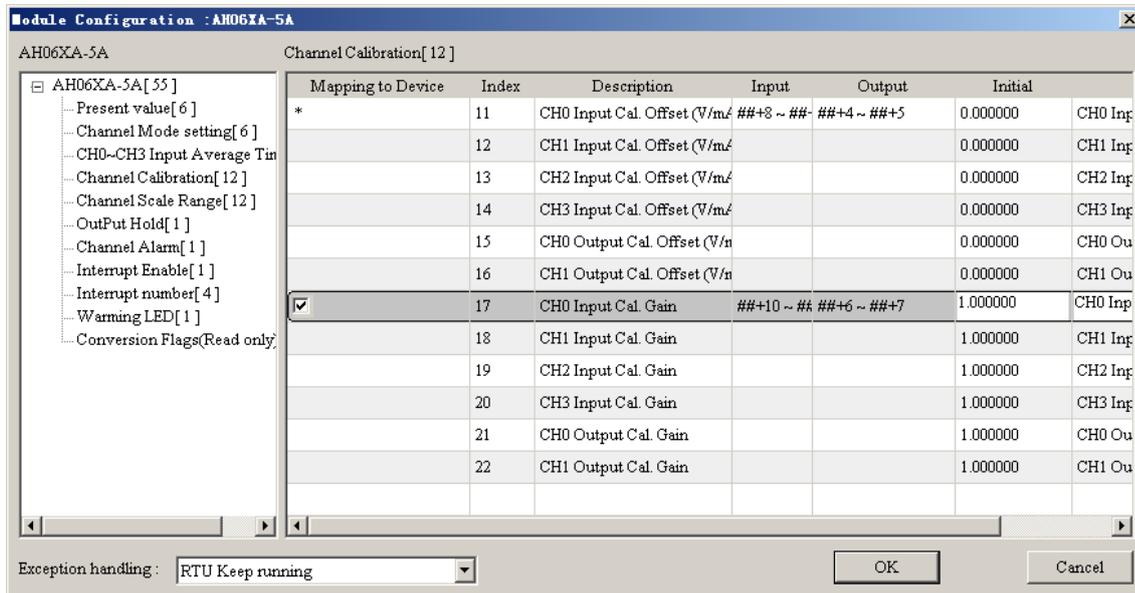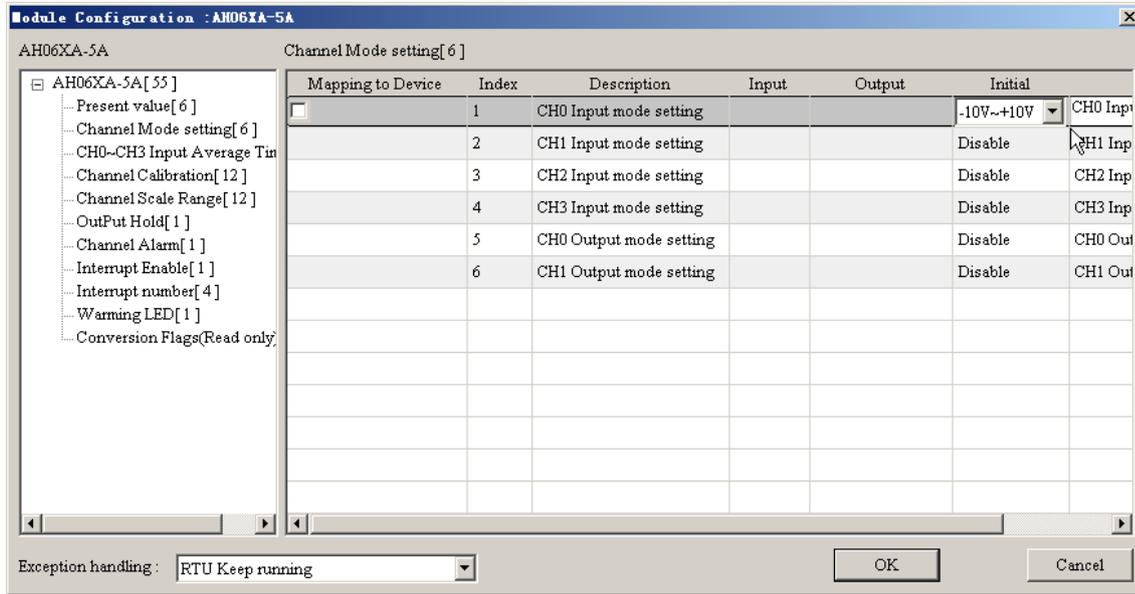
Set Channel 0 output mode of AH08DA-5B to -10 V~+10 V in the same way. Tick "Mapping to Device" for Channel 0 cali. offset and Channel 0 cali. Gain respectively.

After configuration of the module is completed, select "Auto Addr" and then all modules will automatically allocate the parameter addresses according to the arrangement of the modules inserted on the rack.

User can also configure the starting mapping address of each module by manual through the Setup button for input and output on the rack.
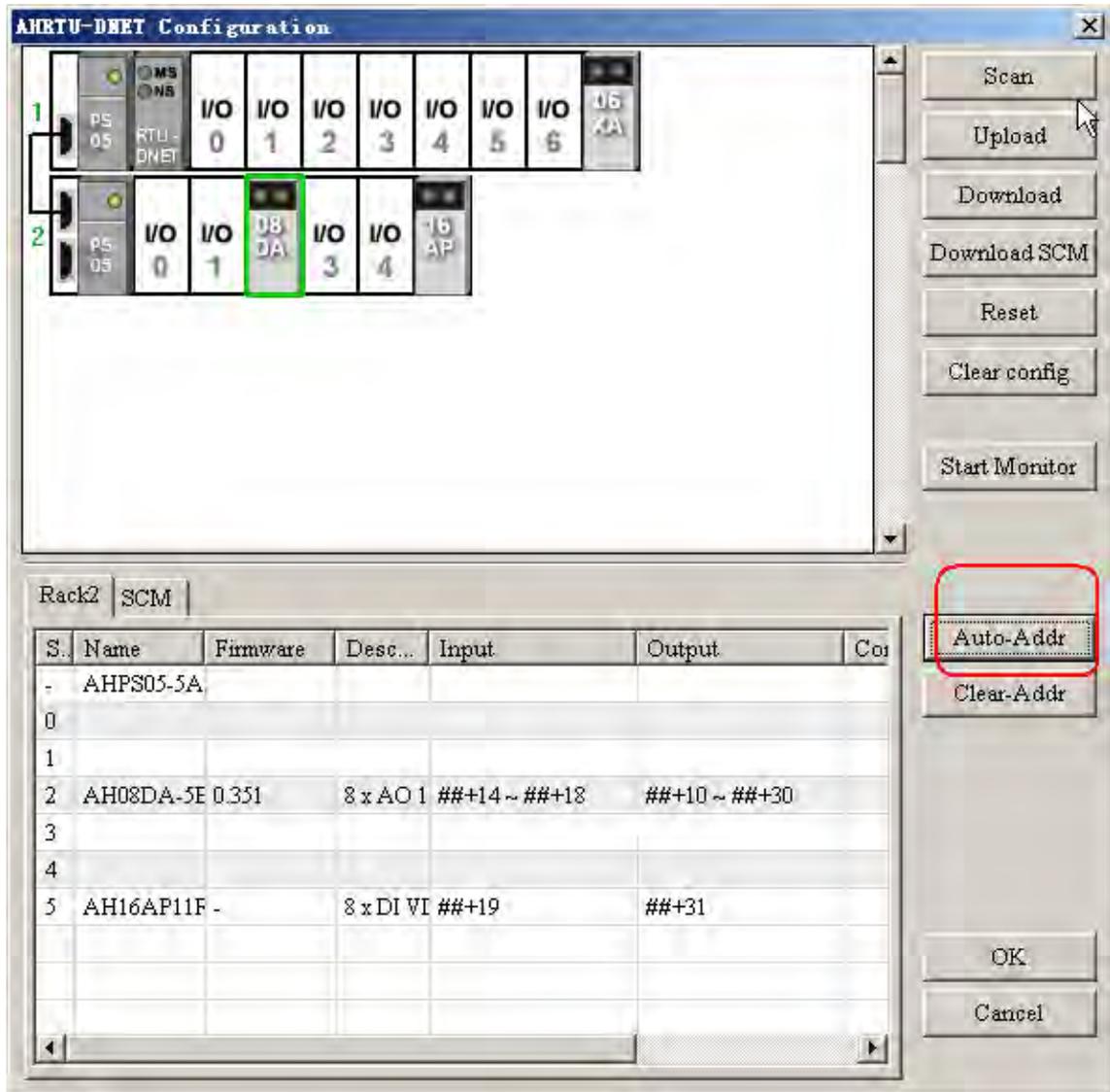
Double click the AHRTU-DNET-5A icon, select its work mode. Set the operational mode of
AHRTU-DNET-5A through error setting.
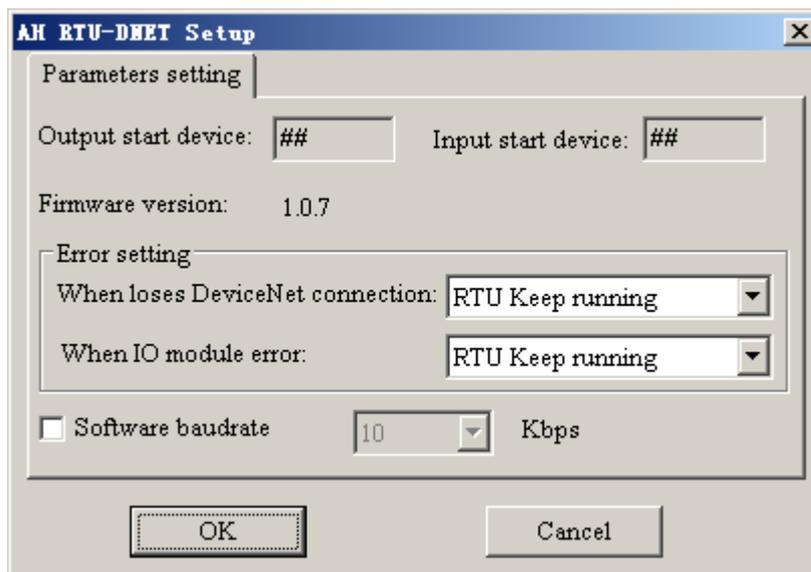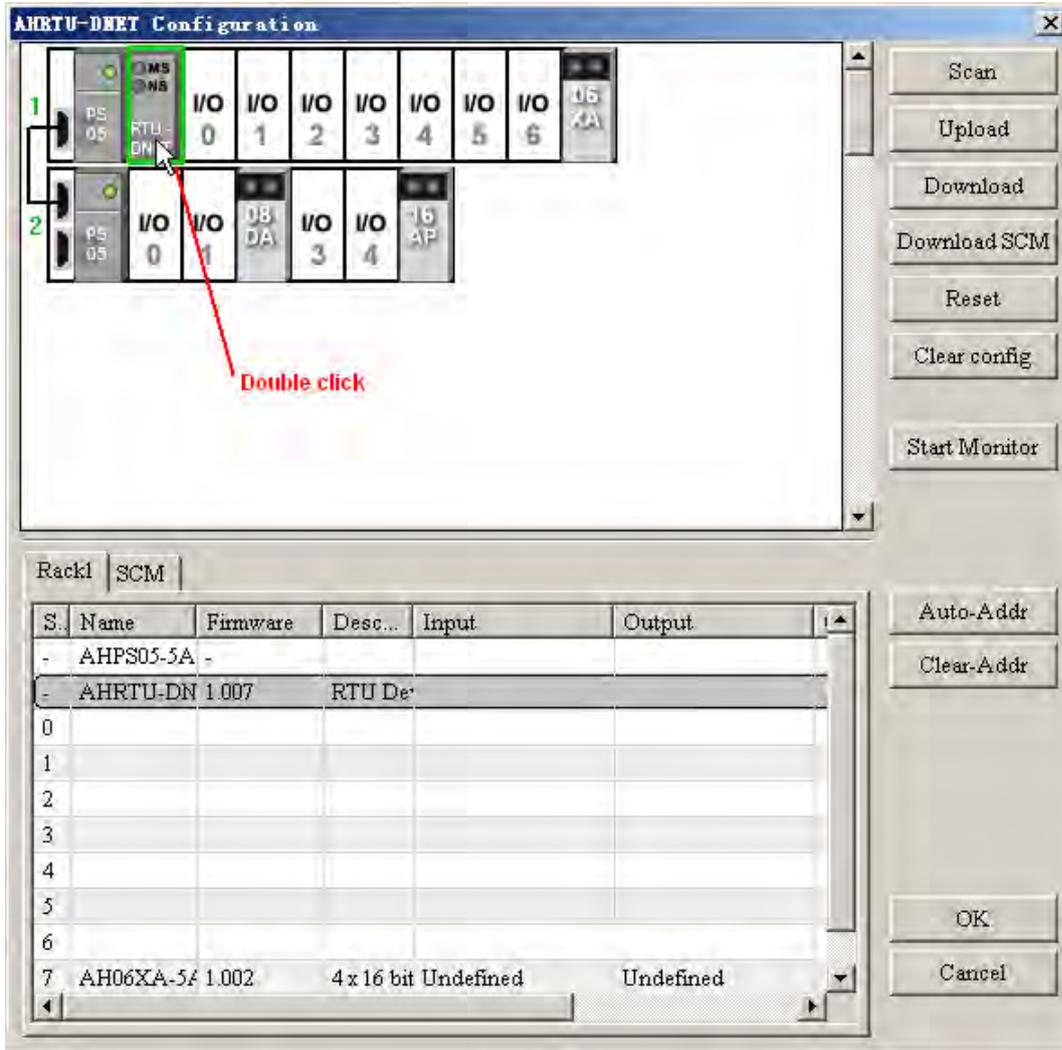
11.5.2.4 Downloading and Monitoring

Click "Download" to download and save the current configuration of AHRTU-DNET-5A to AHRTU-DNET-5A after all module mapping allocation has been completed.
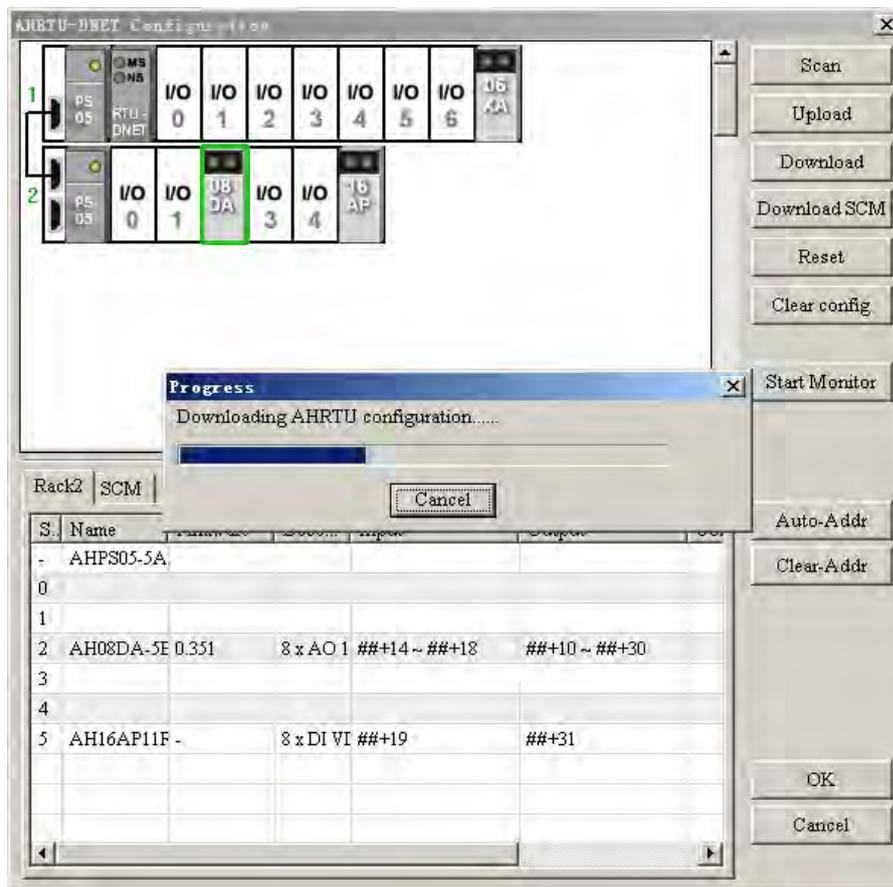
After downloading is finished, click "OK" to return to the node configuration interface where ensure that "Input Size" and "Output Size" are identical to that actually configured in AHRTU-DNET-5A.

After returning to the main interface of the software, double click AH10DNET-5A Scanner icon, the "Scanner Module Configuration" dialogue box will pop up immediately, where the currently available node AHRTU-DNET-5A can be seen in the left-side list. Remove AHRTU-DNET-5A in Available Nodes to the right-side Scan List and specify Output Start and Input Start of AH10DNET-5A to D1000 and D500 respectively.

After AHRTU-DNET-5A has been added to the AH10DNET-5A master, the mapping starting address of output and input which the master allocates to AHRTU-DNET-5A are D1005 and D505 respectively and their respective mapping address lengths are 60 bytes and 36 bytes. Therefore, the input mapping addresses that the master allocates to AHRTU-DNET-5A are D505~D522 and the allocated output mapping addresses are D1005~D1034.

Finally, click "OK" to download the configuration to AH10DNET-5A.
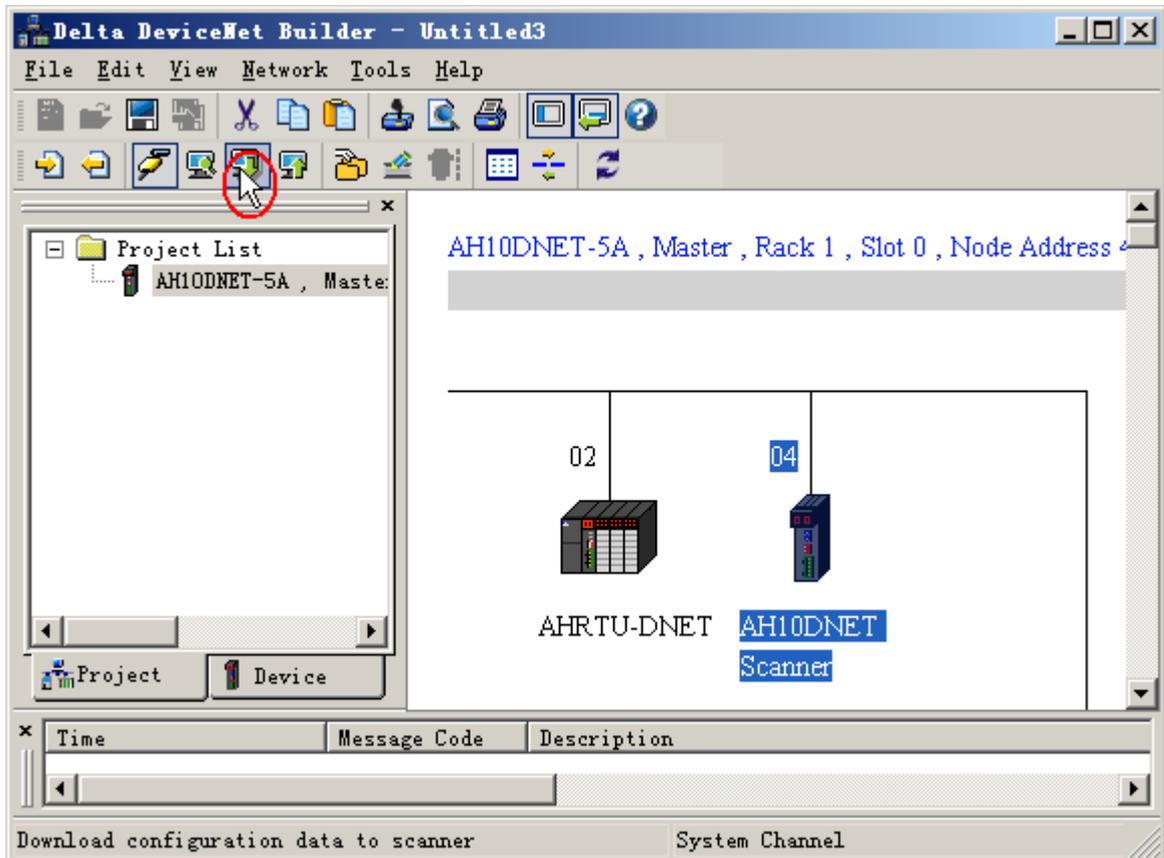
After downloading is over, double click the AHRTU-DNET-5A icon to enter the Node Configuration interface, where click "IO Configure…" to enter the "AHRTU-DNET-5A Configuration" interface. There click "Start Monitor" to enter the software monitor state.
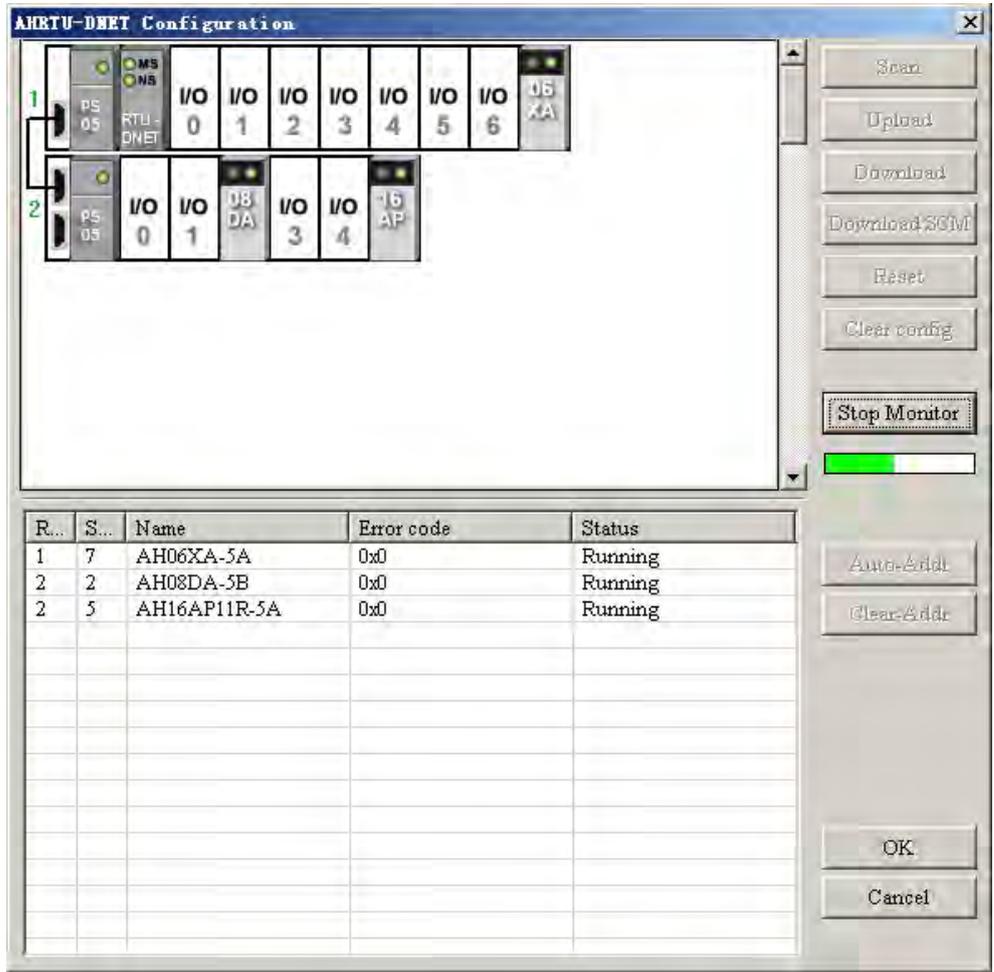
Double click the selected module icon to go to the monitor interface of each module where the default output mapping parameter and the input mapping parameter to be monitored when user sets the configuration of the module can be modified in real time.
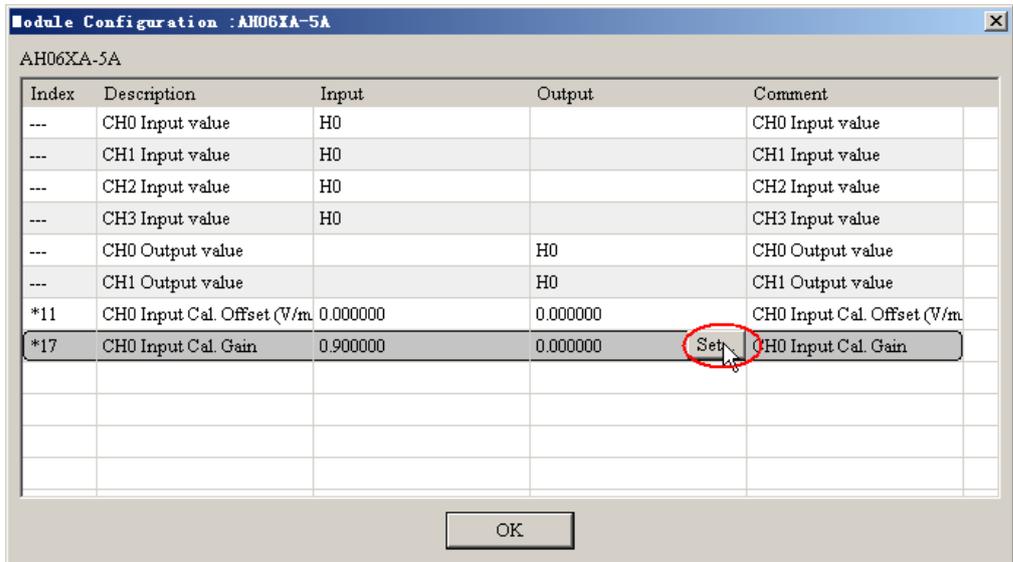
The input mapping addresses of AHRTU-DNET-5A are D505~D522 and the output mapping addresses are D1005~D1034. The initial mapping addresses for output and input are D1005 and D505 as the control word and status word of AHRTU-DNET-5A respectively.

The mapping addresses for each module connected to AHRTU-DNET-5A are listed in the following table.

Module		INPUT	OUTPUT
AH06XA-5A	Channel 0 input value	D506~D507	-
	Channel 1 input value	D508~D509	-
	Channel 2 input value	D510~D511	-
	Channel 3 input value	D512~D513	-
	Channel 0 output value	-	D1006~D1007
	Channel 1 output value	-	D1008~D1009
	Channel 0 input cali. Offset (V/mA)	D514~D515	D1010~D1011
	Channel 0 input cali. Gain	D516~D517	D1012~D1013
AH08DA-5B	Channel 0 output value	-	D1014~D1015
	Channel 1 output value	-	D1016~D1017
	Channel 2 output value	-	D1018~D1019
	Channel 3 output value	-	D1020~D1021
	Channel 4 output value	-	D1022~D1023
	Channel 5 output value	-	D1024~D1025
	Channel 6 output value	-	D1026~D1027
	Channel 7 output value	-	D1028~D1029
	Channel 0 input cali. Offset (V/mA)	D518~D519	D1030~D1031
	Channel 0 input cali. Gain	D520~D521	D1032~D1033
AH16AP11R-5A	Channel 0~7 input status	D522	-
	Channel 0~7 input status	-	D1034

11.5.3 Using the Ladder Diagram to Control the Entire Network
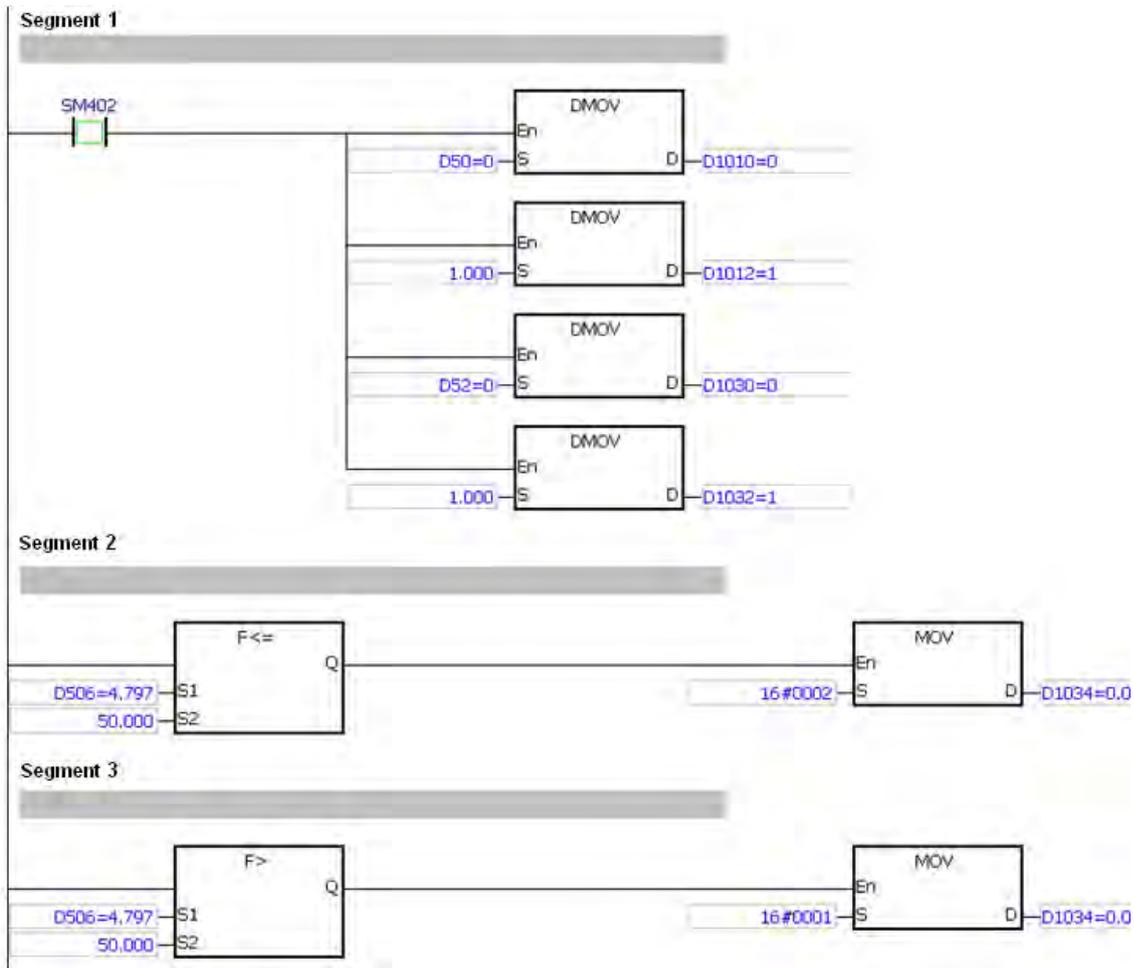
Program Explanation: :

● In segment 1, the curve gain is set to 1 for Channel 1 of AH06XA-5A and AH08DA-5B.
● In segment 2, by comparing the input voltage of channel 1 of AH06XA-5A, the Y0.0 indicator is ON when the voltage is larger than 5 V.
● In segment 2, by comparing the input voltage of channel 1 of AH06XA-5A, the Y0.1 indicator is ON when the voltage is less than 5 V.

11.6   AH10SCM-5A Application Example

AHRTU-DNET-5A supports to configure the serial communication module AH10SCM-5A in the DeviceNet Builder software. Before configuring AH10SCM-5A, please ensure that the selected master is AH10DNET-5A. Otherwise, AHRTU-DNET-5A does not support to configure AH10SCM-5A.

The section mainly introduces how AH10SCM-5A uses the standard Modbus function and UD Link (user-defined) function to exchange the serial port data with other slave when connected to AHRTU-DNET-5A.

11.6.1   Hardware Configuration
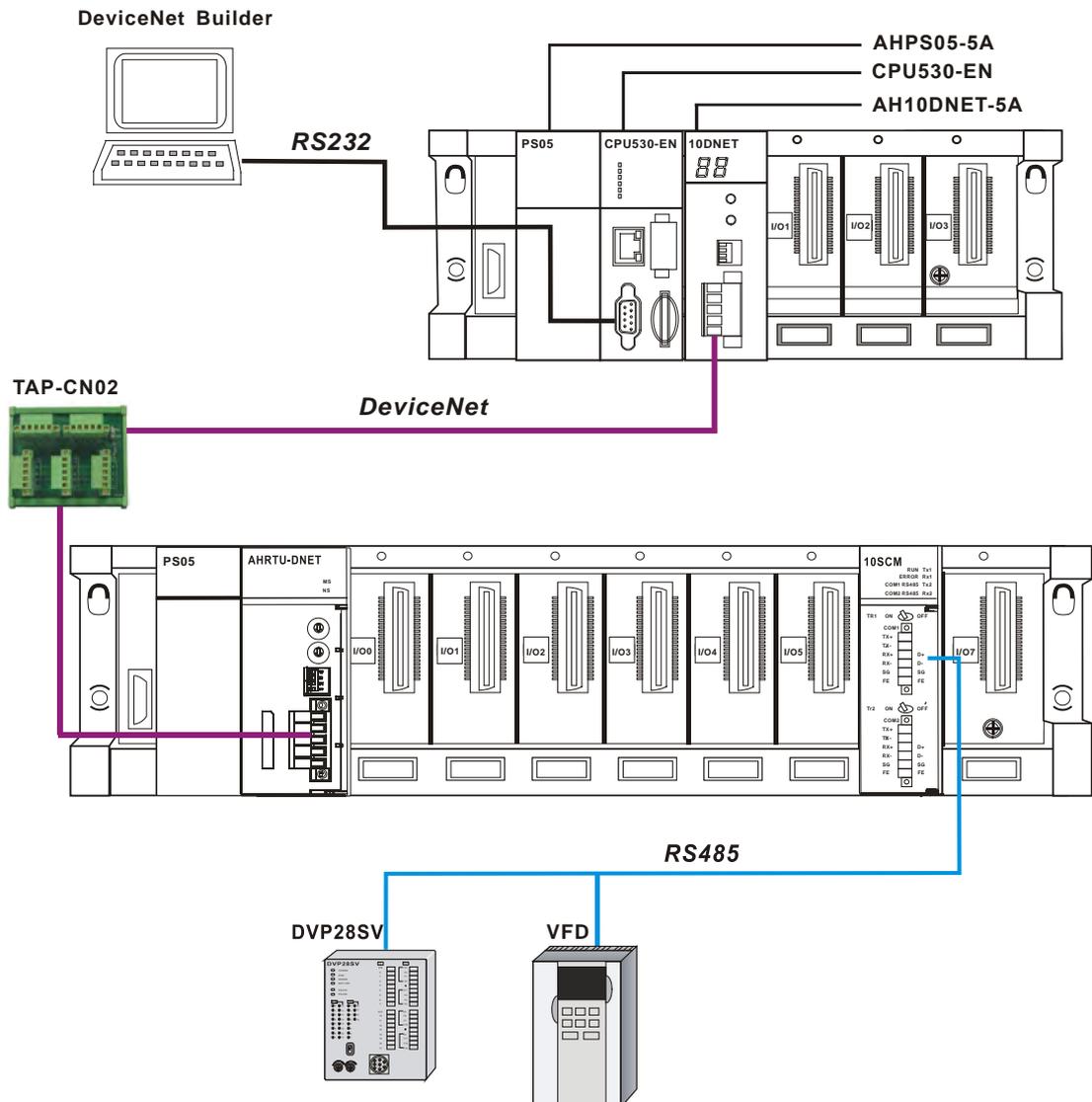
The communication format and the mapping relations between the AC motor drive and the DVP-SV series PLC are shown below.

| Product	Station address	Communication format	Read address	CPU buffer register	Write address	CPU buffer register
VFD	10	38400, ASCII 7, E, 1	16#2103	D1540	16#2000 16#2001	D1020~D1021
PLC	5	38400, ASCII 7, E, 1	D100~D109 M100~M109	D1550~D1559 Bit 0 in D1560~ bit 1 in D1561	D200~D204 M200~M204	D1030~D1034 Bit 0 in D 1040 ~bit 1 in D1040

11.6.2 AH10SCM-5A Configuration

11.6.2.1 Configuration of AH10SCM-5A Parameters

Make the communication and call the DeviceNet Builder software by following the steps introduced in section 5.2.1 and 5.2.2. And the start addresses of AH10DNET-5A for the input and output are D1500 and D1000 respectively.

Select the network to be scanned in Project List and then click "Scan DeviceNet Network" button to begin to scan the nodes on the network. If scanning fails, please ensure that the selected master must be AH10DNET-5A in Project List.
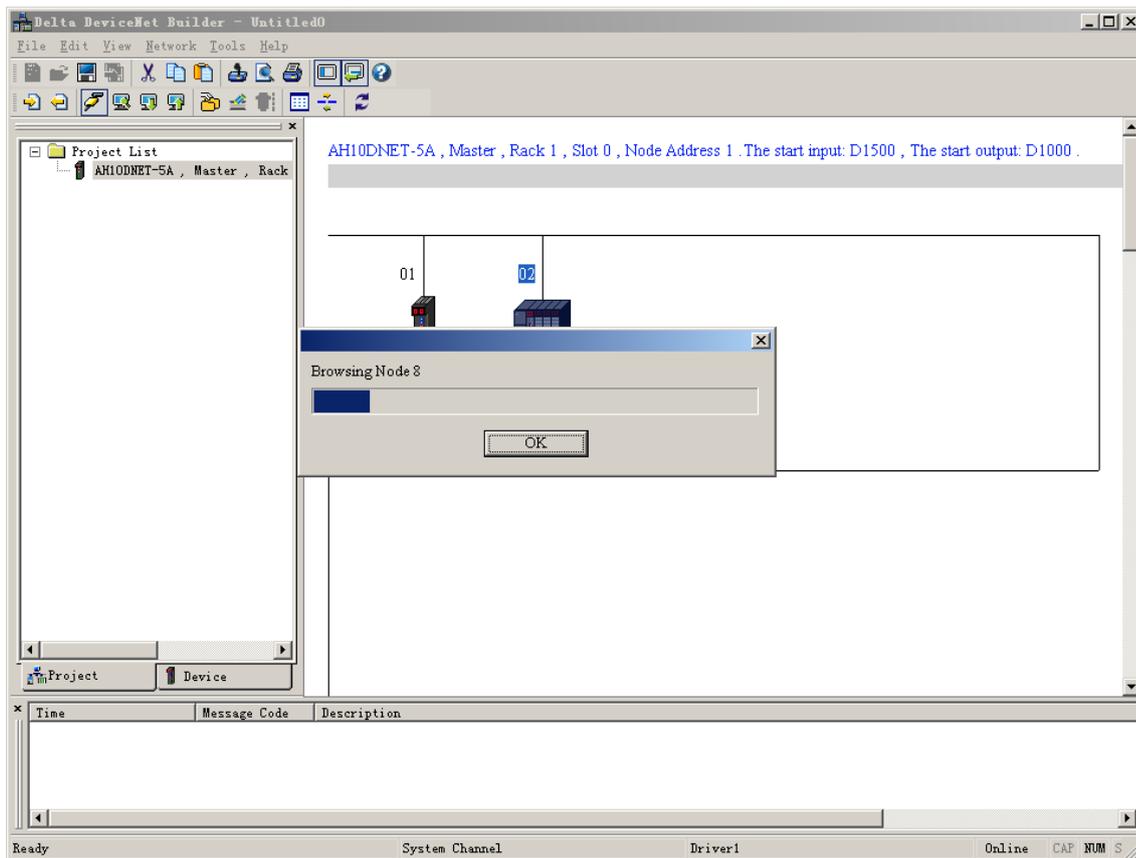
Double click AHRTU-DNET-5A icon to enter the Node Configuration interface after scanning is over.
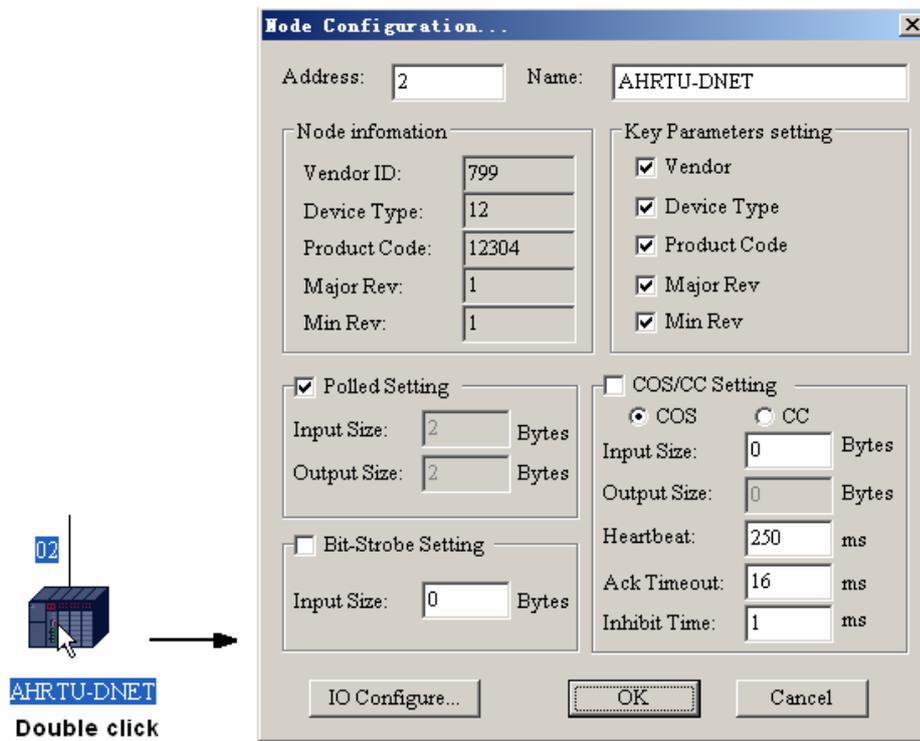
Click "IO Configure" on the Node Configuration interface to enter the AHRTU-DNET-5A configuration interface as follows.
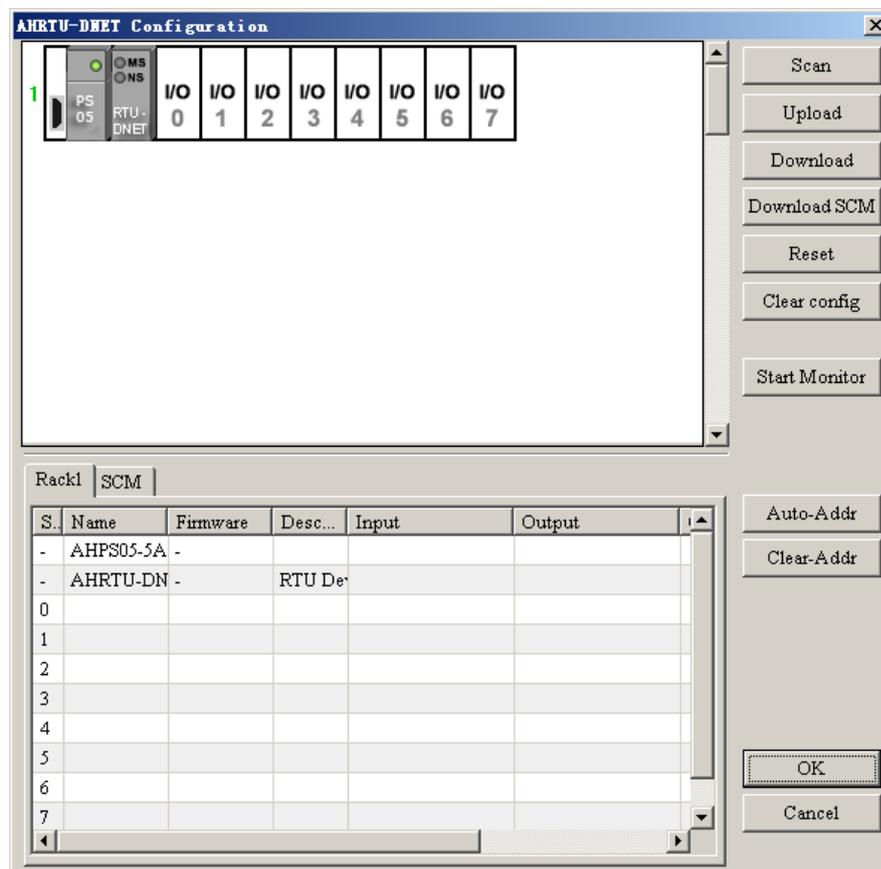
Click "Scan" button and then all AH10SCM-5A modules currently inserted to the I/O slots on the rack can be scanned as below.
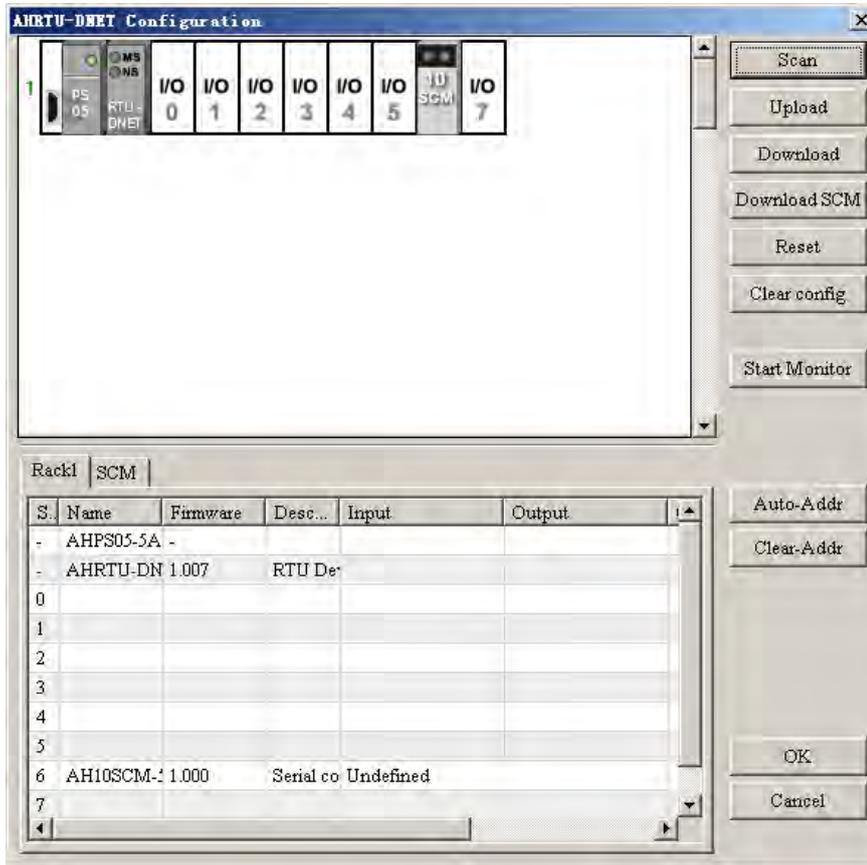
Double click the selected AH10SCM-5A icon and then the "Module Configuration: AH10SCM-5A" interface pops up, where MDS version, MDS build date of AH10SCM-5A can be seen and the communication parameters of the COM port can be set.

Click "COM1 Setting" on the left side to enter the interface where set the communication parameters of COM1 and select the special register parameters to be mapped to the device (COM1 is set to Modbus mode and its communication format should be consistent with those of slave 28SV and VFD connected to COM1 and thus the baud rate is set to 38400 bps).

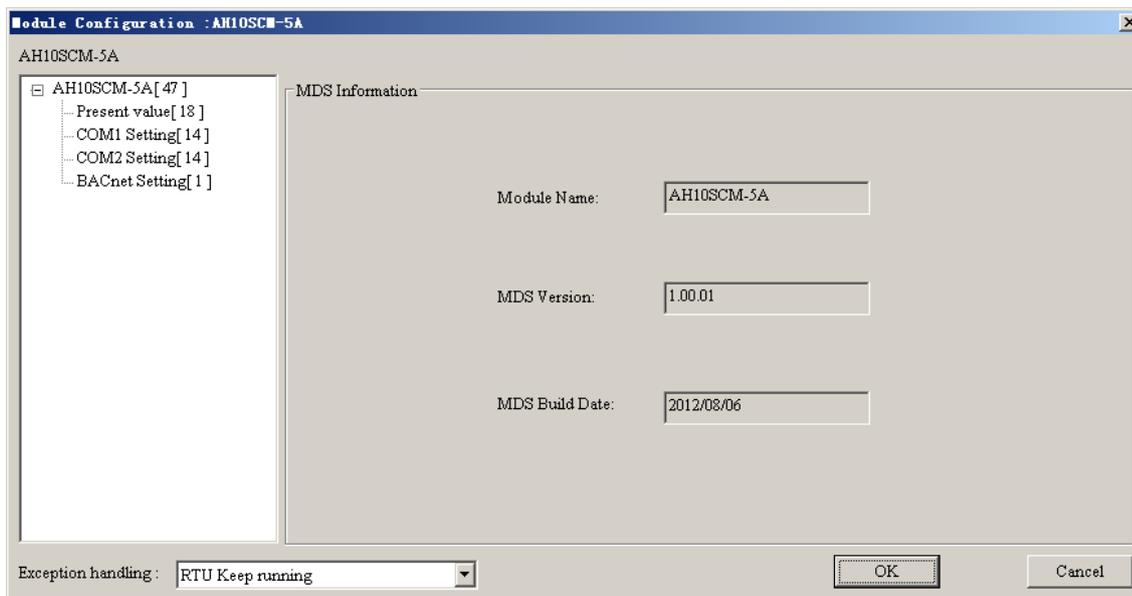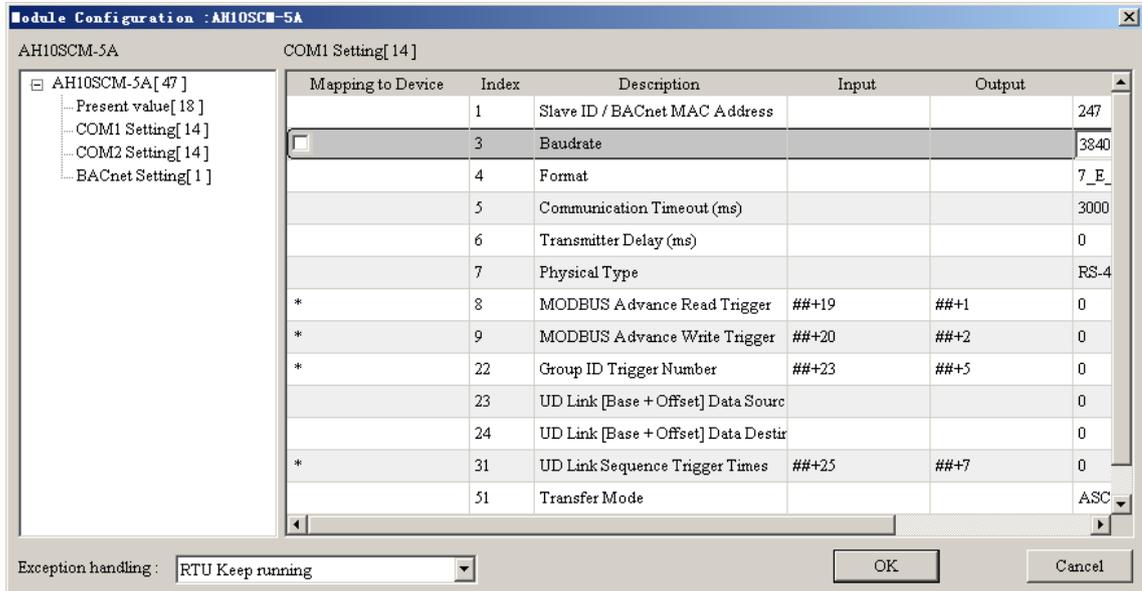Click "COM2 Setting" on the left side to enter the interface where set the communication parameters of COM2 and select the special register parameters to be mapped to the device. (COM2 is set to UD Link mode and its communication format should be consistent with that of slave connected to COM2.)
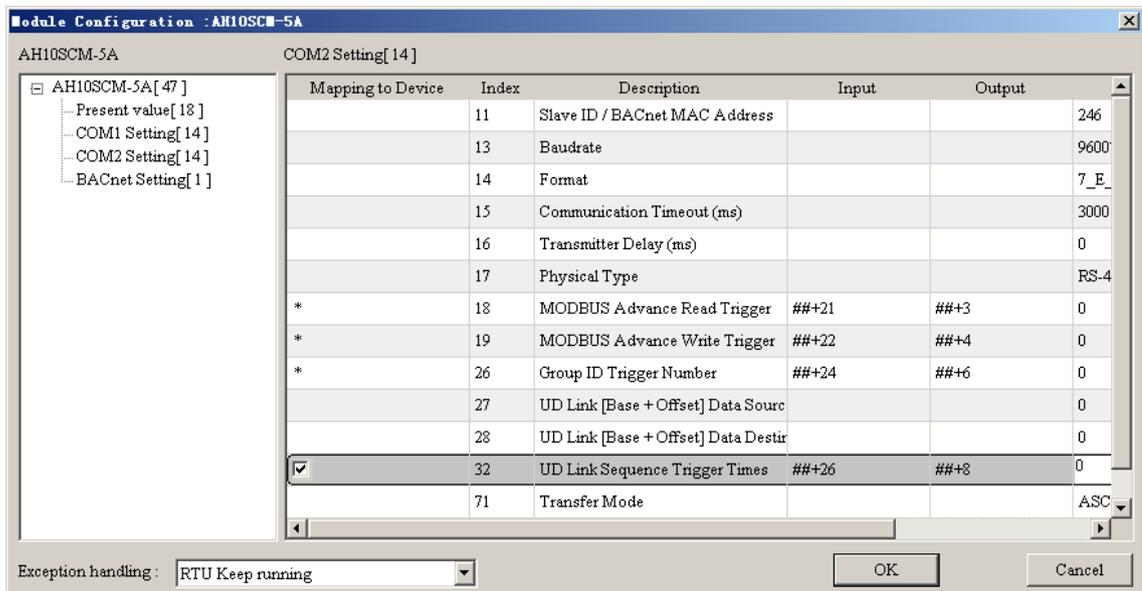
11.6.2.2 Configuration of AH10SCM-5A Serial Port Data

Click "SCM" on the lower side and then click the button of Input or Output column to enter the Device Mapping interface of AH10SCM-5A where set the start address and length of input and output mapping of the serial port data in AH10SCM-5A and the maximum length is 100 words.
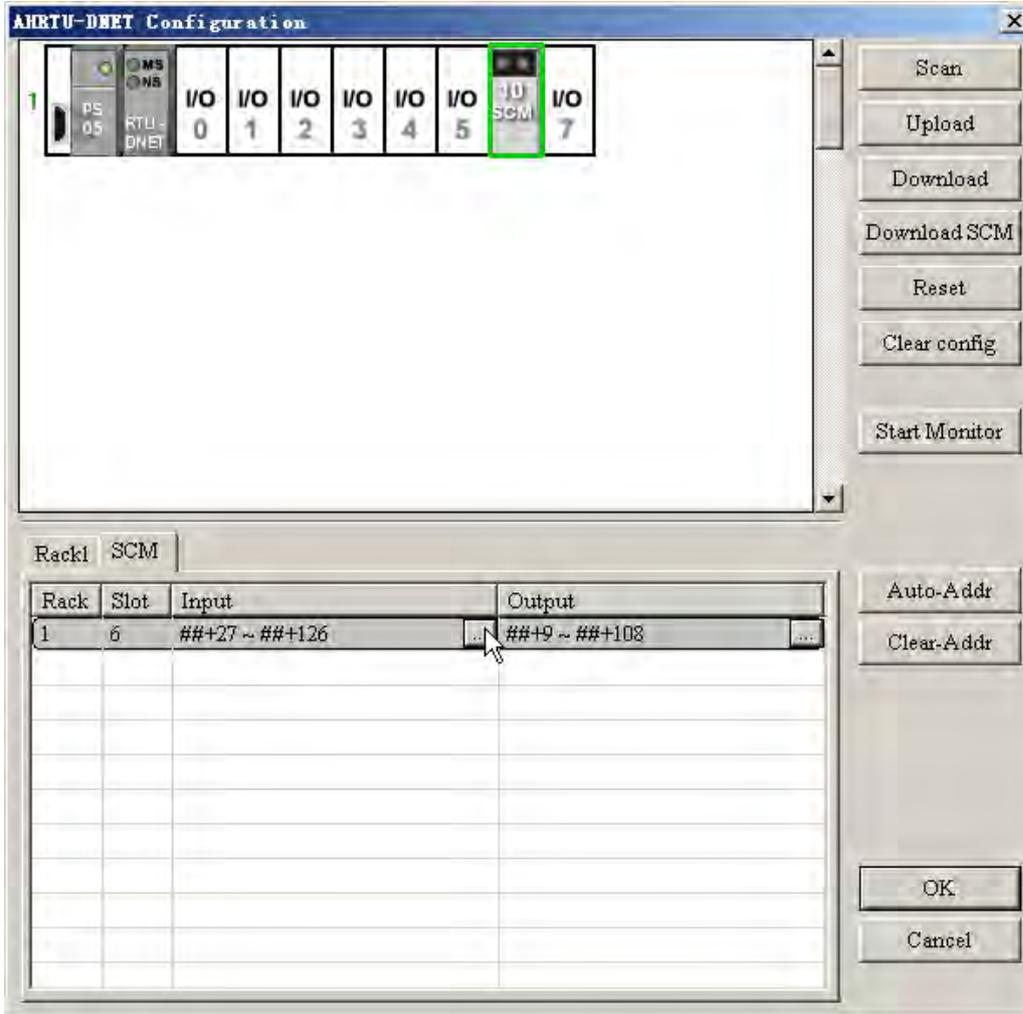
To display the mapping relations of the serial port data in the following configuration, please remove the slave AHRTU-DNET-5A to Scan List of the master AH10DNET-5A and then the mapping addresses of the serial port data in AH10SCM-5A will be fixed.
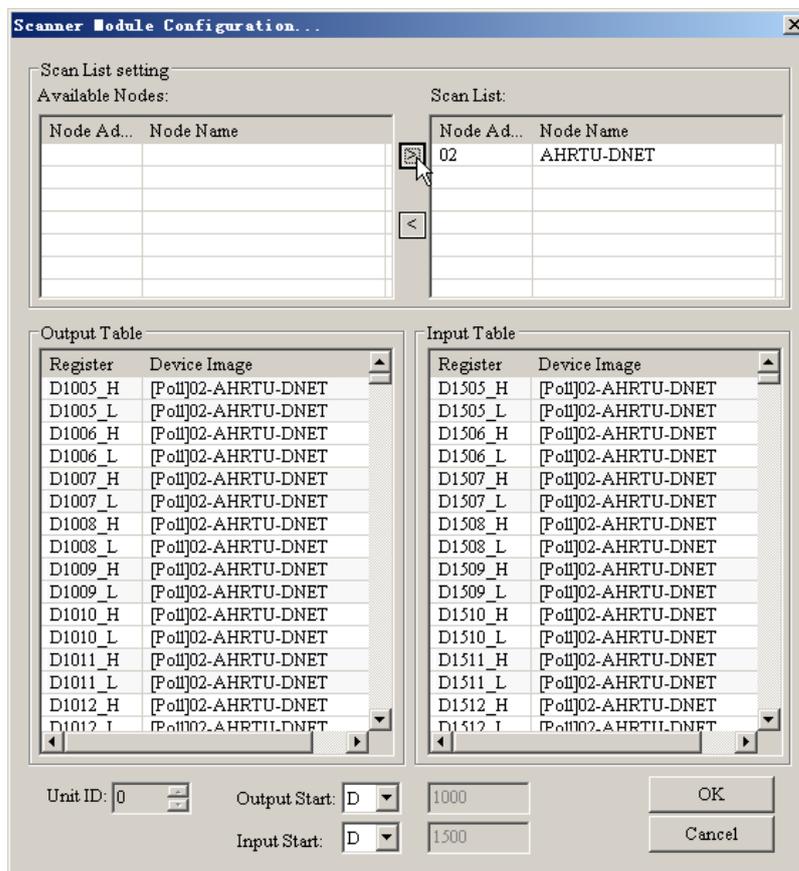
After adding AHRTU-DNET-5A to AH10DNET-5A master, set the Input Start and Output Start to D1005 and D1505 respectively which are the master allocates to AHRTU-DNET-5A and then download the configuration data to AH10DNET-5A.
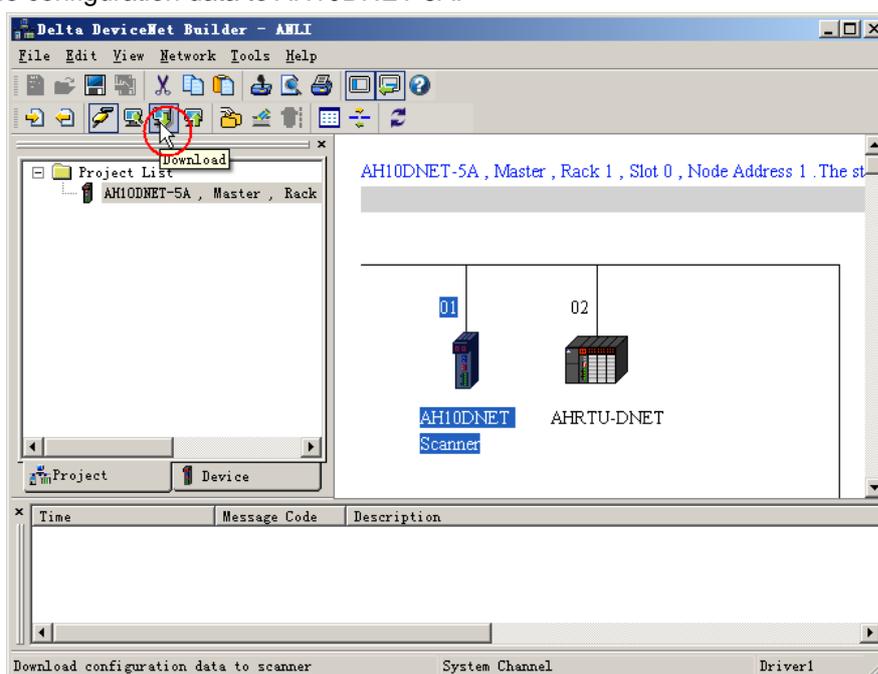
Return to the interface of AHRTU-DNET-5A configuration, right click AH10SCM-5A icon and select "Intelligent module configuration" to enter the interface of SCM configuration.
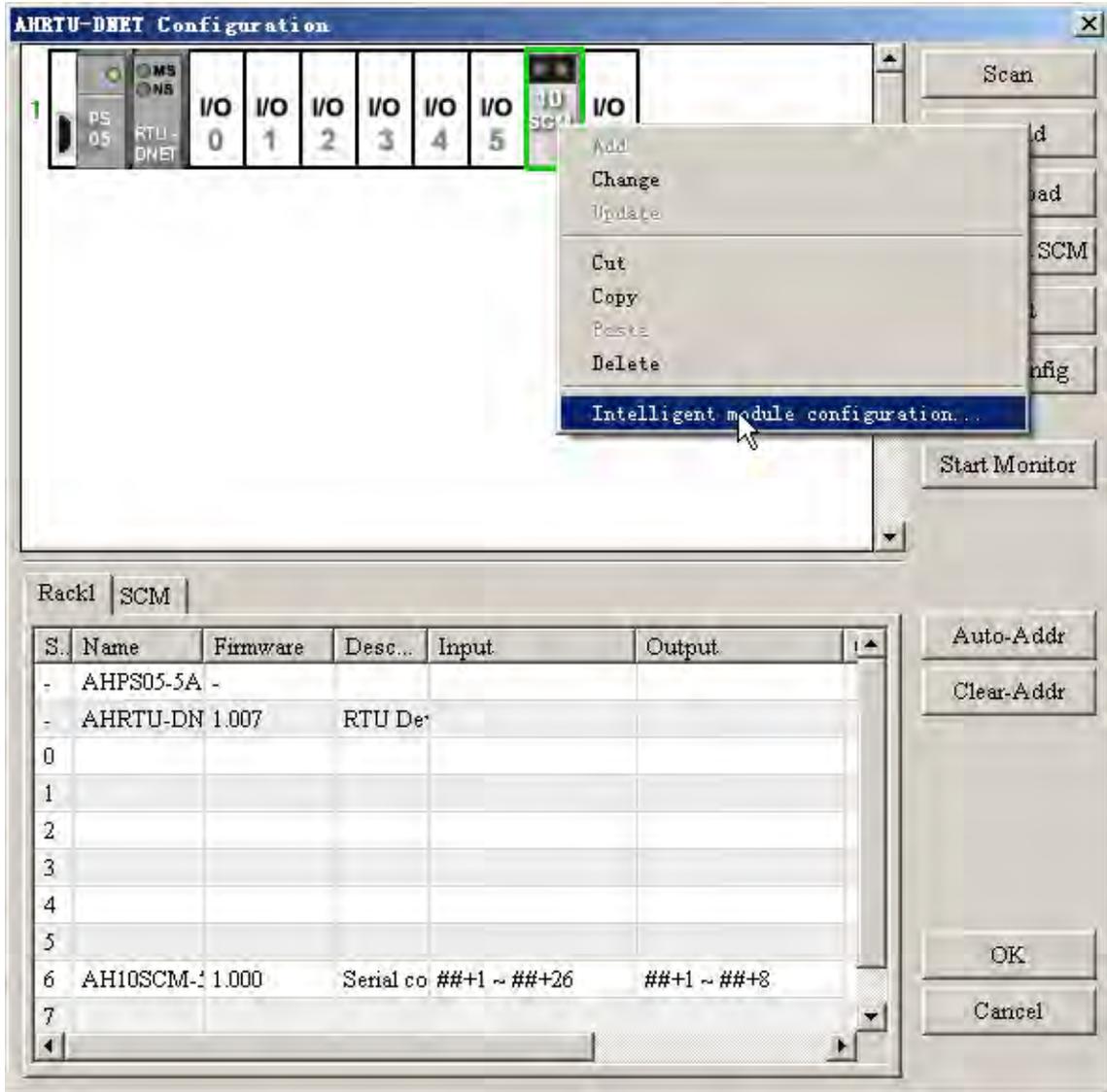
AH10SCM-5A intelligent module configuration interface shows basic information of AH10SCM-5A, communication mode of COM port, mapping range of registers and the mapping relation of the internal register I and Q in AH10SCM-5A. Right click "COM Port" on the left side and then select Modbus mode or UD Link mode as the communication mode of COM port.
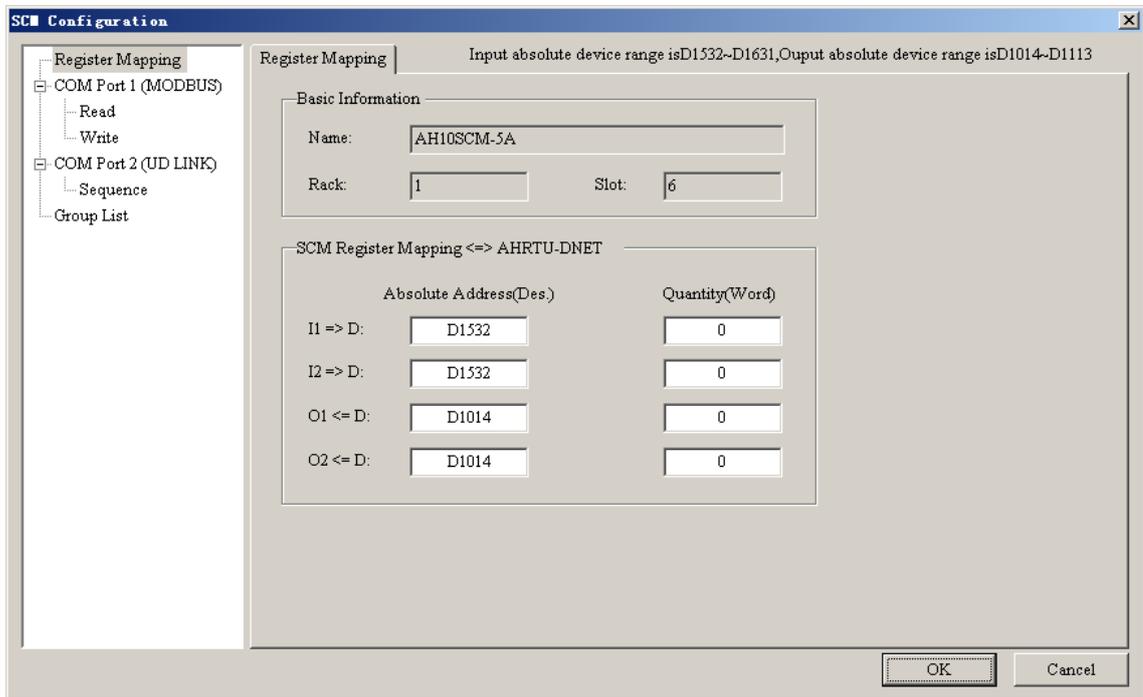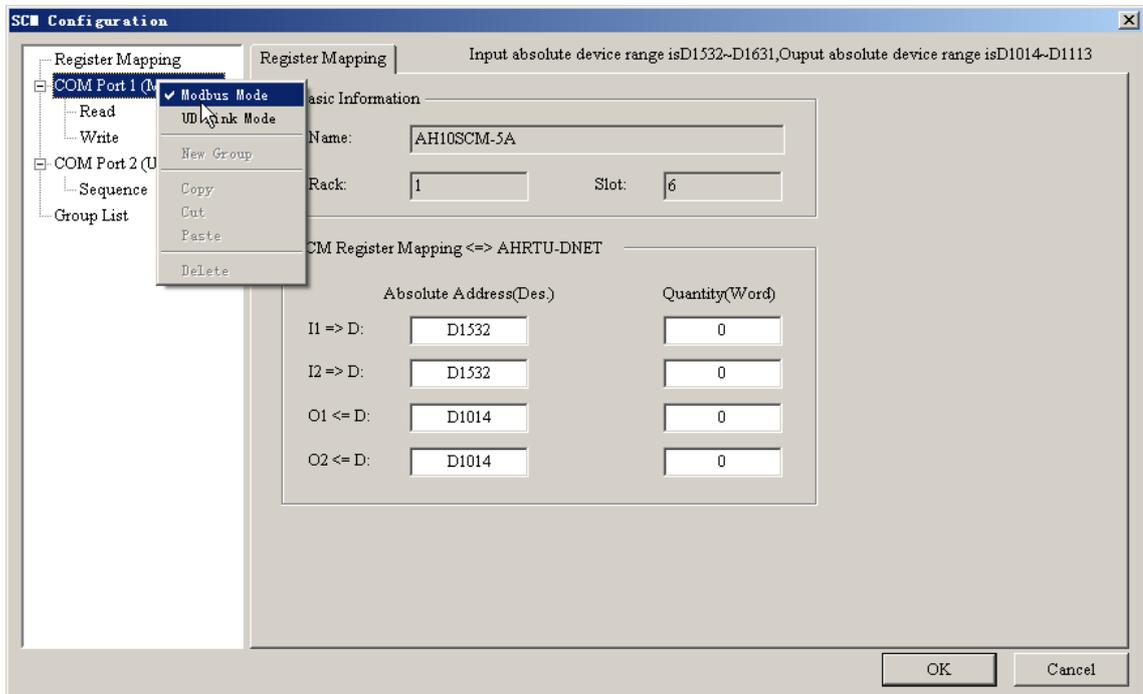
- Modbus mode

When COM port 1 is in Modbus mode, click "Read" or "Write". Right click the right box and click "Add Item" to add bit and word item of Read and Write. The upper part is bit item of Read/Write and the lower part is word item of Read/Write.
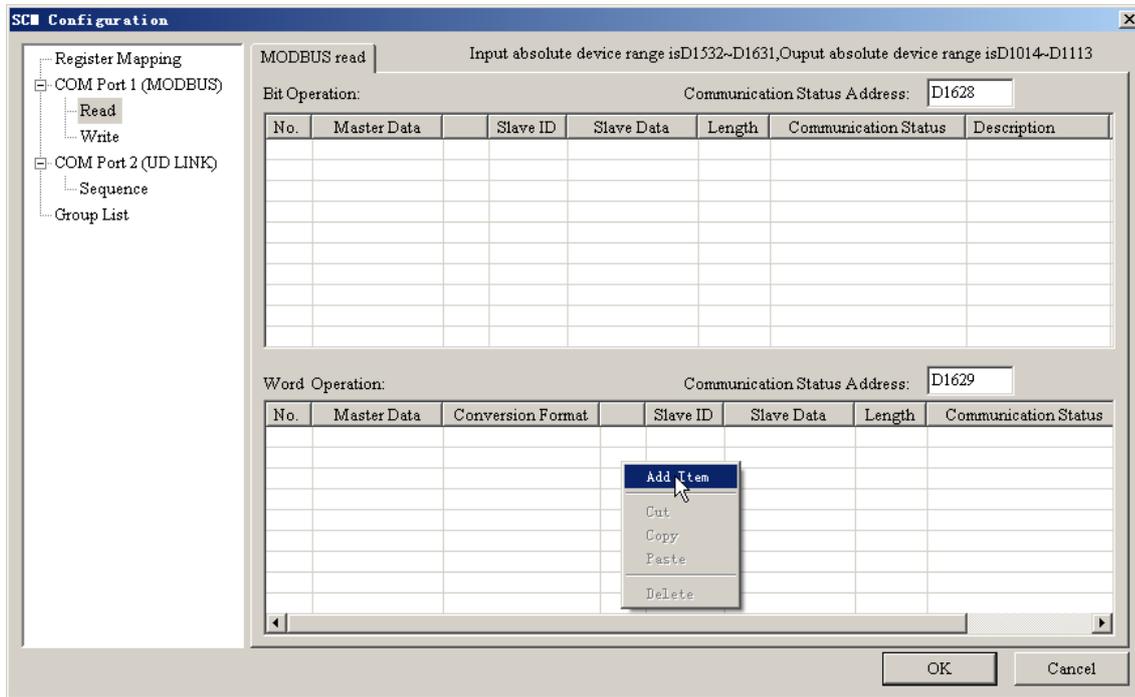
Double click the new item to enter the parameter editing interface of Read/Write of Modbus.

Parameter editing of write and read of Modbus is shown as below.

AH10SCM-5A reads the value of the address 2103 (hex) of the AC motor drive via the serial port; the read value will be transmitted to AHRTU-DNET-5A via the rack; AHRTU-DNET-5A will transmit the data to AH10DNET-5A along the DeviceNet bus and AH10DNET-5A will transmit the data to D1540 of AH500 series PLC via the rack.

The values in D1020 and D1021 of AH500 series PLC are transmitted to AH10DNET-5A via the rack; AH10DNET-5A will transmit the data to AHRTU-DNET-5A along the bus; AHRTU-DNET-5A will transmit the data to AH10SCM-5A via the rack and AH10SCM-5A will write the data to the addresses 2000 (hex) and 2001 (hex) of the AC motor drive via the serial port.

Parameter Edit

Master
PLC Type: UNKNOWN
Data Address: D1540
Description:

Conversion Format
U16-

Slave
Slave ID: 10
Device Type: Other Device
Data Type: Hex
Start Address: 2103
Length(Word): 1

OK   Cancel

Parameter Edit

Master
PLC Type: UNKNOWN
Data Address: D1020
Description:

Slave
Slave ID: 10
Device Type: Other Device
Data Type: Hex
Start Address: 2000
Length(Word): 2

OK   Cancel

D1550~D1559 (AH500 series PLC)←D100~D109 (DVP-SV series PLC), D1030~D1034 (AH500 series PLC)→D200~D204 (DVP-SV series PLC)

The data transmission method is the same as that between AH500 series PLC and the AC motor drive.

Bit 0 in D1560~bit 1 in D1561 (AH500 series PLC)←M100~M109 (DVP-SV series PLC), bit 0 in D1040~ bit 1 in D1041 (AH500 series PLC) →M200~M209 (DVP-SV series PLC). The data transmission method is the same as that between AH500 series PLC and the AC motor drive.

● UD Link mode

When COM port 2 is in UD Link mode, right click Group List and select "New Group" so as to add a new group.
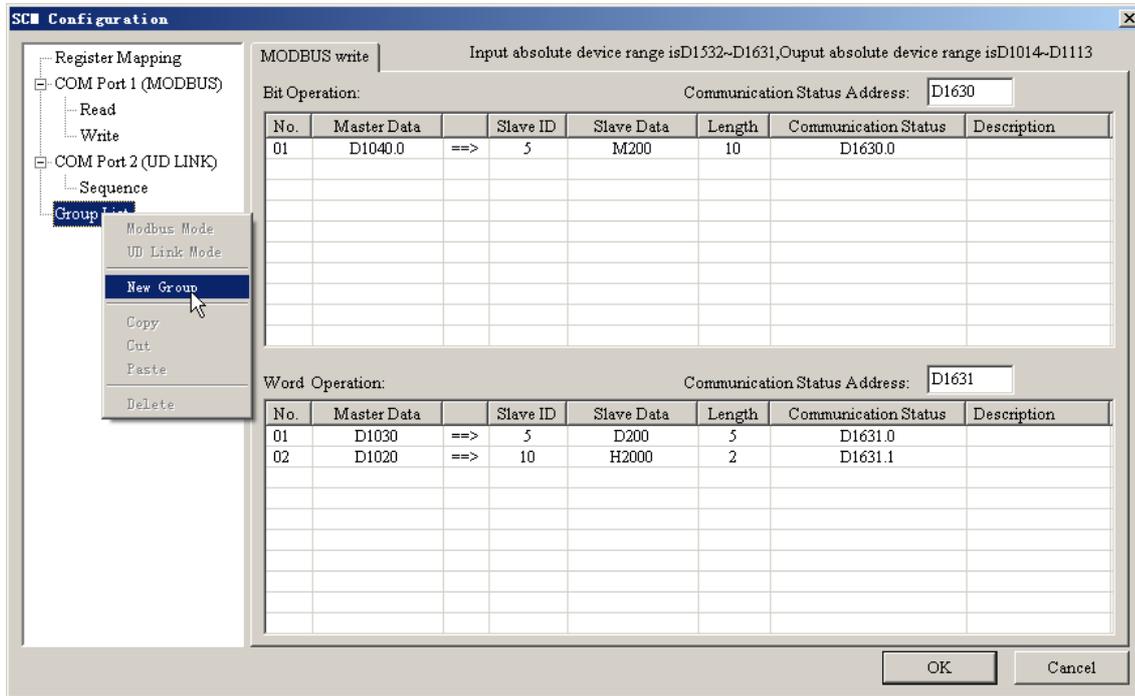
In newly built Group List, right click the box of TX/RX Packet List to add TX/RX packet.
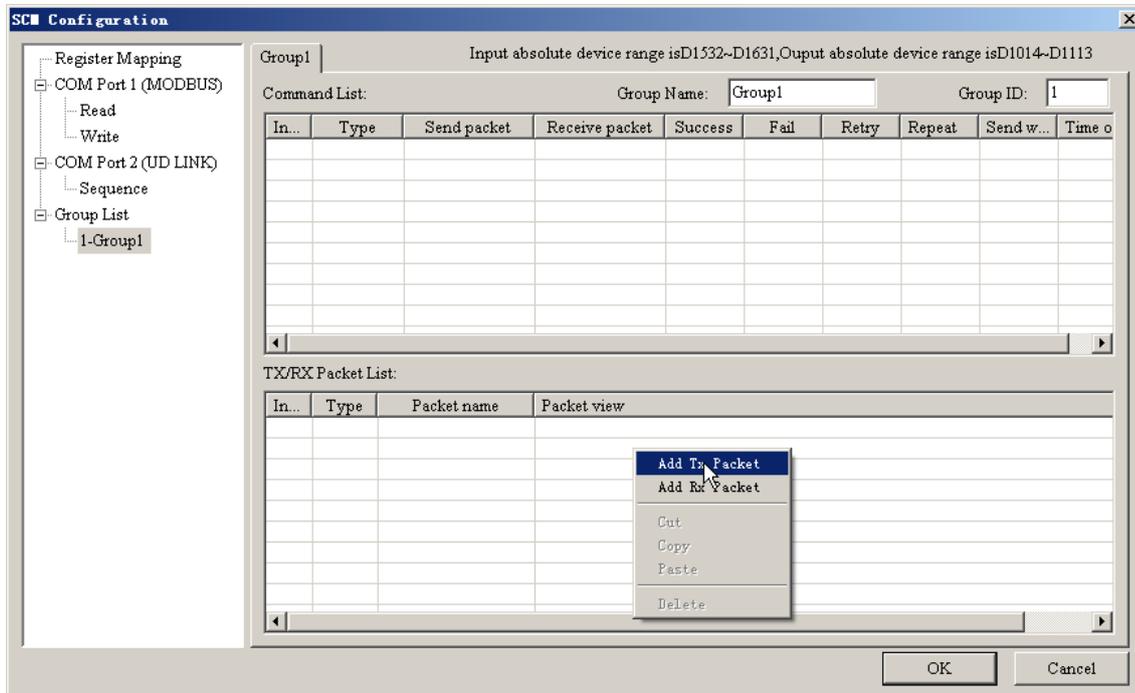
Double click the new TxPacket1 to edit the content of the data packet.
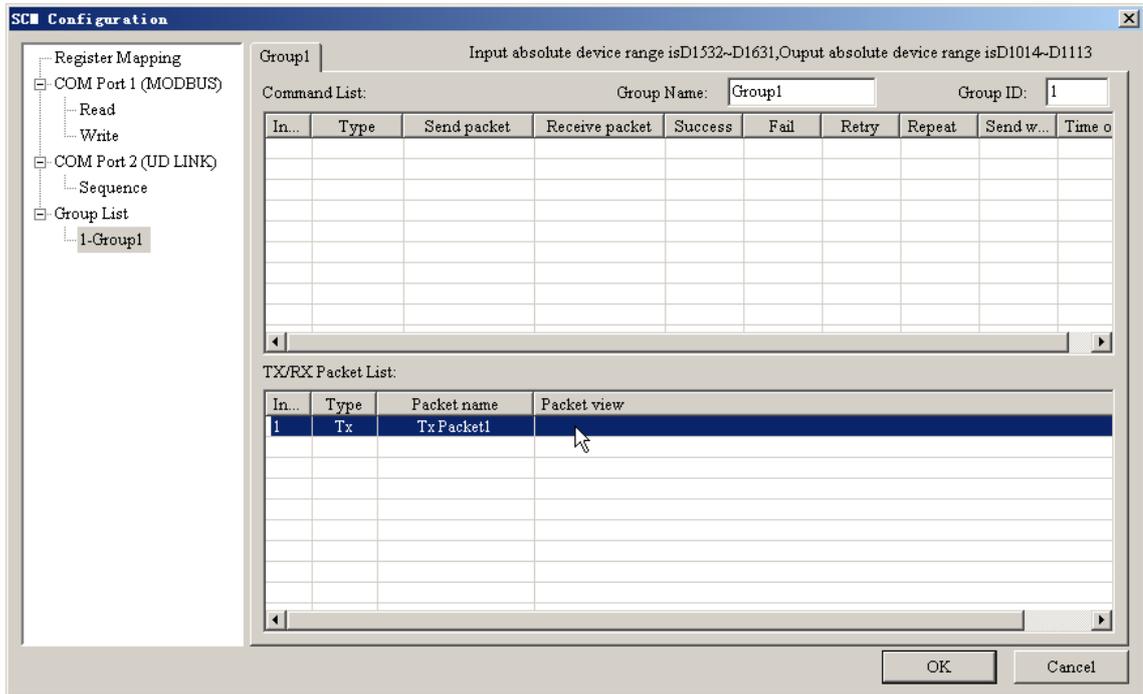
The data packet consists of message, address, length and checksum. Multiple messages and one address, length and checksum may exist in the packet.
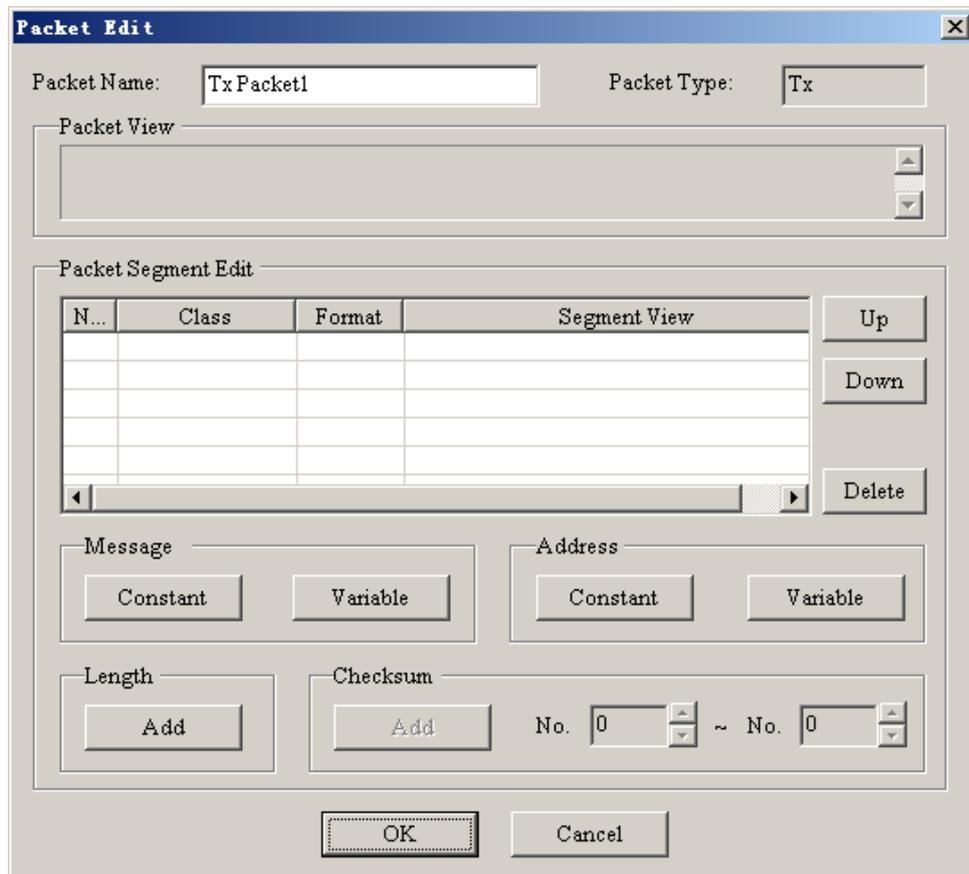
Content of the packet is as follows.
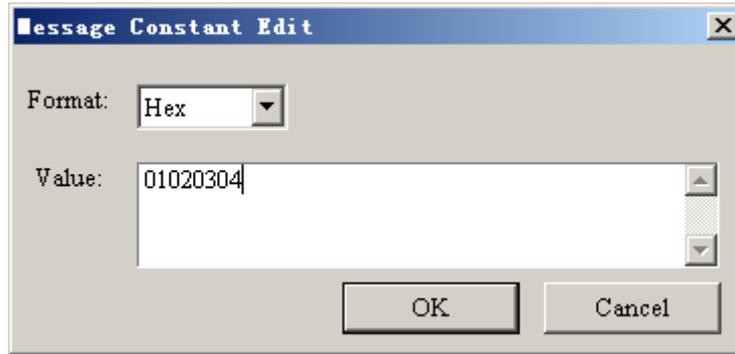
After setting is over, click "OK" to finish editing Tx Packet1.
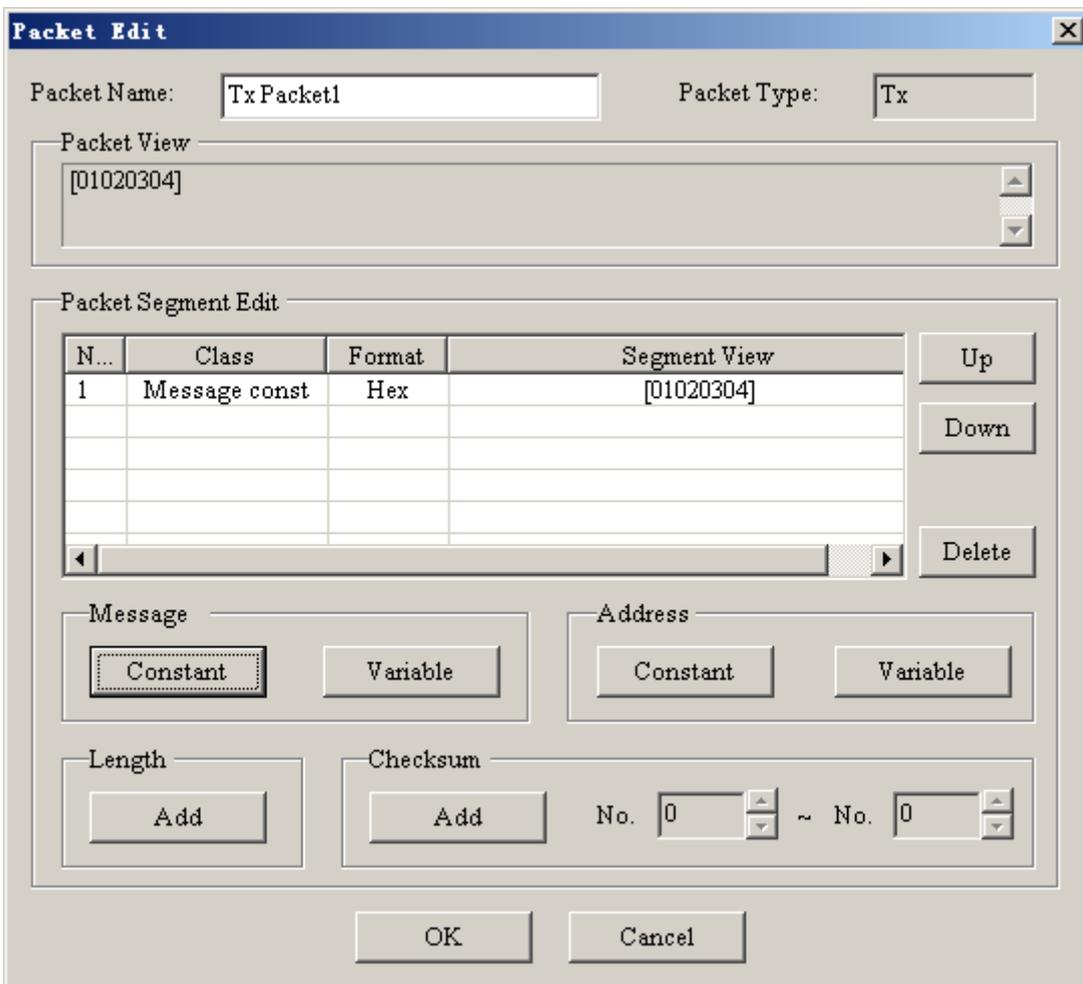
After building multiple TX and RX packets, create a new item by a right click on the "Command List" box to edit the TX/RX packet and plan the sequence of implementing commands.
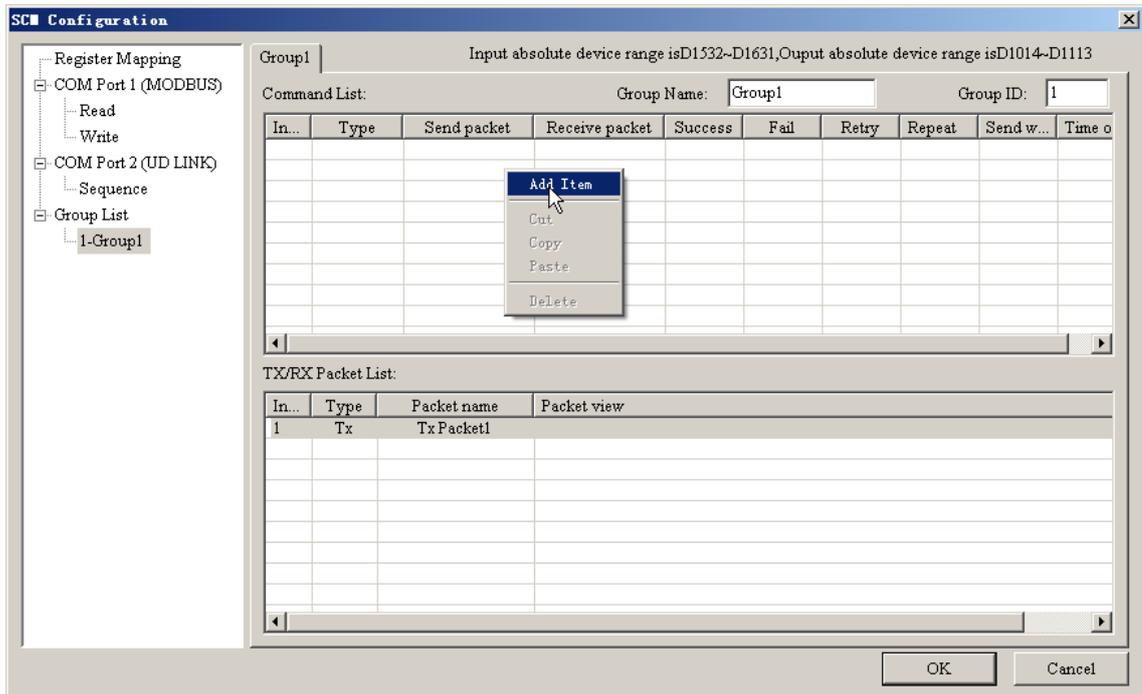
Double click the new command so as to do the editing.

Command editing interface is displayed as below.

After command editing is completed, the interface will be as follows.

By the same way, create a Group2 under Group List.

Create a new RX packet under Group list:

Edit a new command on the following interface:

The interface is shown as below after command editing is completed. :

Click "Sequence" under COM Port 2 (UD LINK) and then the sequence editing interface will appear on the right side. Clicking "Add" enables the new group to be added to Sequence. The configured data will be executed after being downloaded to AH10SCM-5A with Sequence as the unit.
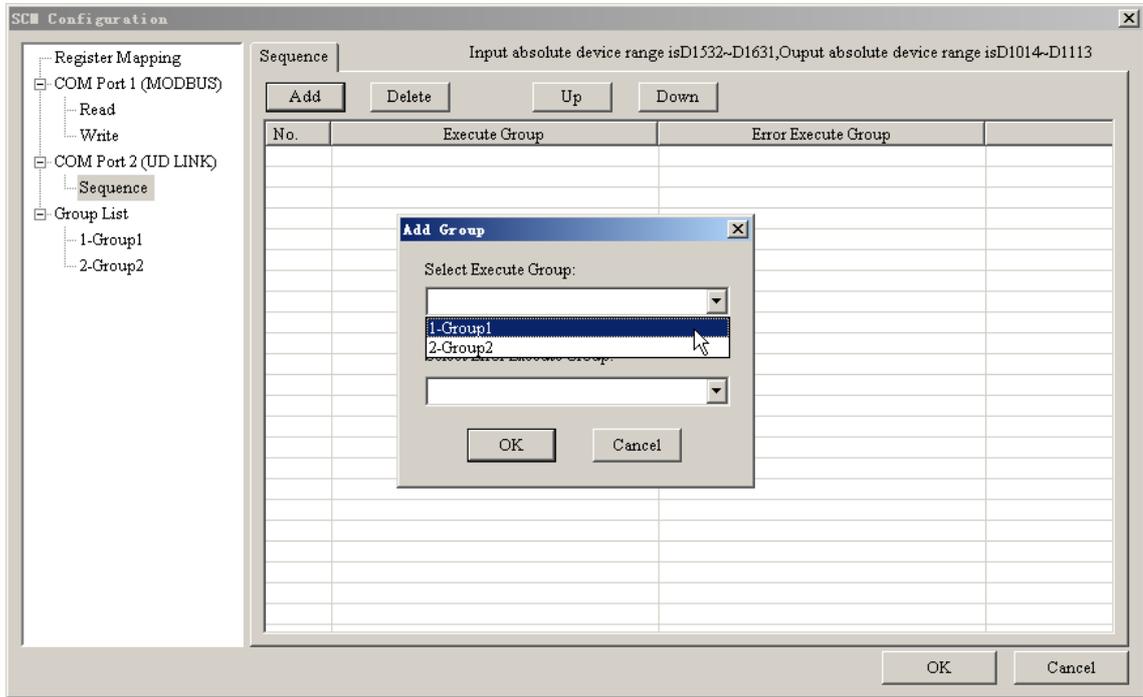
Sequence editing interface:
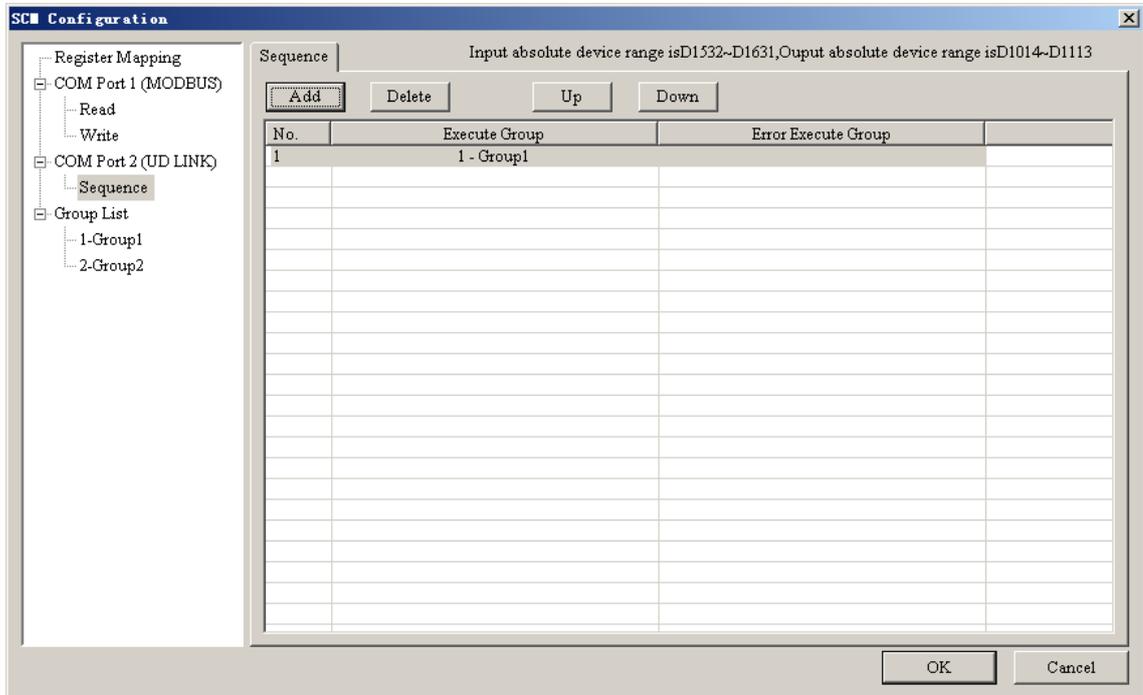
11.6.2.3 Downloading AH10SCM-5A Serial Port Configuration

Return to the main interface after configuration of the intelligent module AH10SCM-5A is completed. Please download the AHRTU-DNET-5A configuration before downloading AH10SCM-5A serial port configuration data. Click "Download" to download the configured data to AHRTU-DNET-5A.

After downloading the configuration to AHRTU-DNET-5A is over, select AH10SCM-5A module and click "Download SCM" button to download the serial port configuration data to AH10SCM-5A. When downloading the configuration to AH10SCM-5A, please note to select the AH10SCM-5A module to be downloaded first and ensure that the master AH10DNET-5A has finished allocating the mapping addresses to AHRTU-DNET-5A. Otherwise, the downloading will fail.
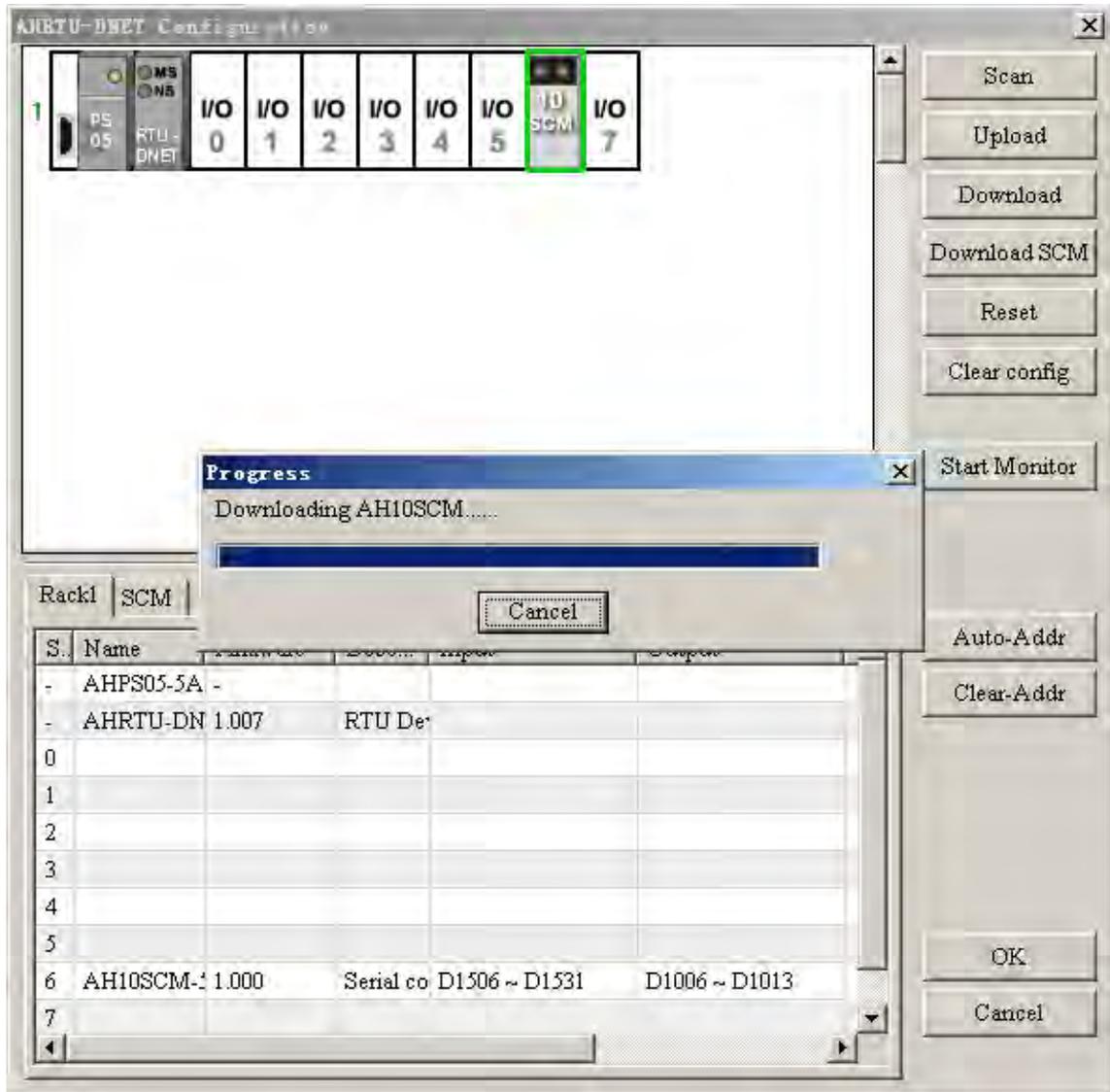
After downloading is over, below appears the dialog box showing the downloading information about AH10SCM-5A by clicking "OK".
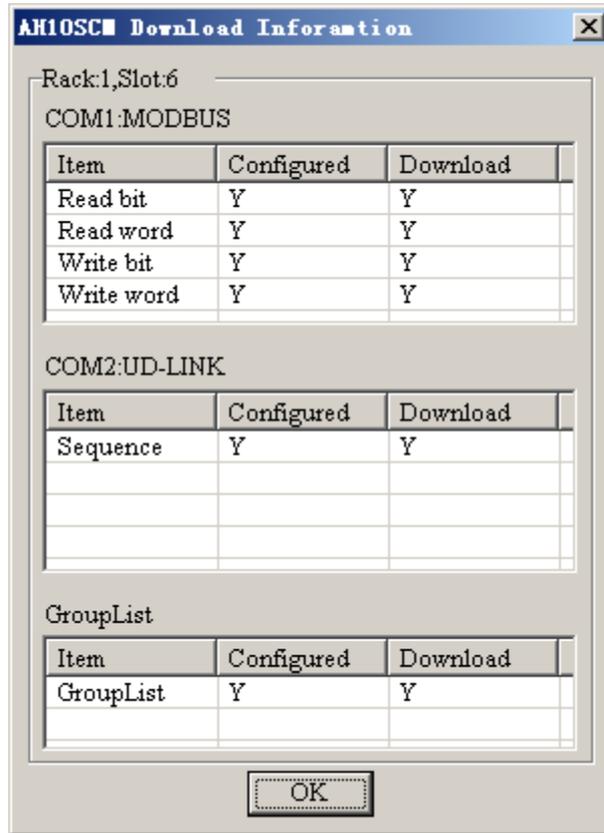
11.6.3 Execution by Trigger

11.6.3.1 Control Condition

The program edited through ISPSoft can manage Modbus data exchange (such as to read bit and word device, write bit and word device) and UD Link data transferring and receiving trigger which is classified into Group ID trigger and sequence trigger.

Input	Output	COM port communication parameter	Description
D1506	D1006	Modbus data exchange reading trigger	High byte is triggered for reading bit device; low byte is for reading word device. 0: Not triggered 1: Triggered once 2: Always triggered
D1507	D1007	Modbus data exchange writing trigger	High byte is triggered for writing bit device; low byte is for writing word device. 0: Not triggered 1: Triggered once 2: Always triggered
D1511	D1011	UD Link Group ID trigger	Group ID of UD Link trigger
D1513	D1013	UD Link sequence trigger	0: Not triggered 1~254: The times for triggering 255: Always triggered

Notes:

1. Write 16#0002 to D1006 for always reading the word device; write 16#0001 to D1006 for only reading once. Write 16#0002 to D1007 for always writing to word device and write 16#001 to D1007 for only writing once.
2. Write 16#0200 to D1006 for always reading bit device and write 16#0100 to D1006 for only reading once. Write 16#0200 to D1007 for always writing to bit device and write 16#0100 to D1007 for only writing once.
3. Writing 1 to D1011 indicates to trigger and execute the content of Group ID 1. After the execution is over, D1011 is cleared as 0. If the default value in D1011 is 0, no group will be triggered.
4. Write the number of times to D1013. If the number 0 is written, no execution or the stopping state occurs; 1~254 can be the execution times; 255 (16#FF) indicates the action is always executed.

11.6.3.2 Monitoring via the Software

On the AHRTU-DNET-5A configuration interface, click "Start Monitor" button to monitor the operational state of AH10SCM-5A.

Double click AH10SCM-5A module to enter the monitor interface of AH10SCM-5A during monitoring. By setting the values of the mapping parameter registers, the serial port data exchange is triggered.
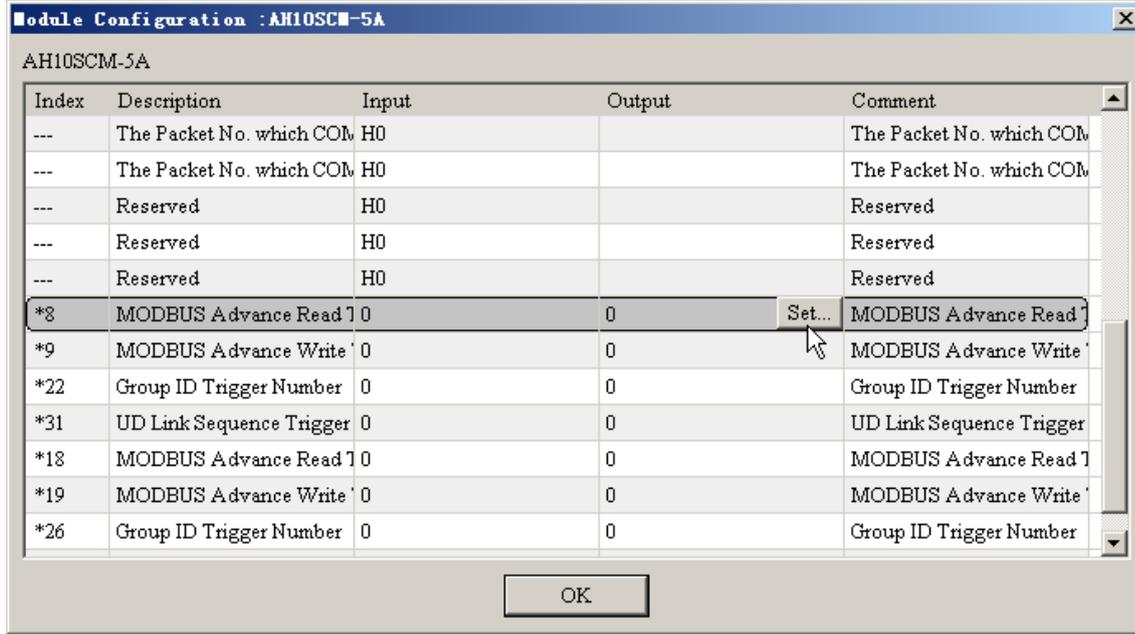
Click "Set" key on the above interface to enter the interface of setting value, where write the present value H0202 and click "Send" button. It indicates that H0202 is written to D1006. And Modbus Advance reading will be always triggered.
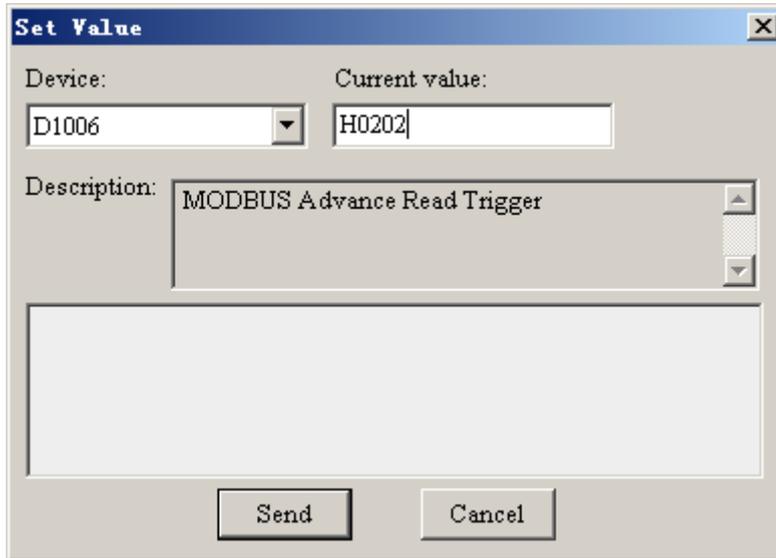
11.6.3.3 Program Control
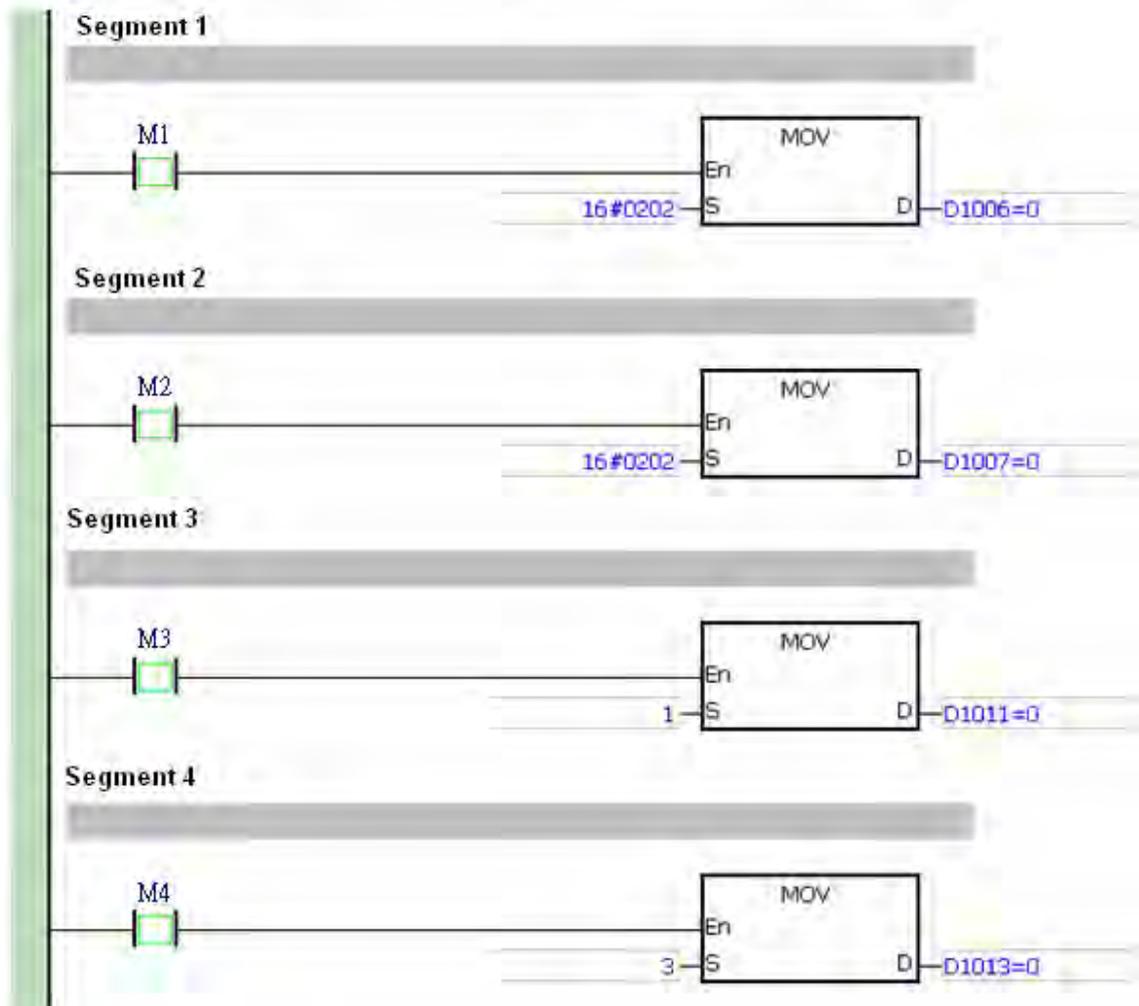
> ➢ In segment 1, by triggering M1, COM1 of AH10SCM-5A will always read the preset slave address including Word device and Bit device.
> ➢ In segment 2, by triggering M2, COM1 of AH10SCM-5A will always write to the preset slave address including Word device and Bit device
> ➢ In segment 3, by triggering M3, COM2 of AH10SCM-5A will trigger the packet command of Group 1.
> ➢ In segment 4, by triggering M4, COM2 of AH10SCM-5A will trigger and execute the group packets arranged under Sequence three times.

11.7 Error Diagnosis and Troubleshooting

AHRTU-DNET-5A provides four means of treating the errors such as indicator diagnosis, digital display diagnosis, status word diagnosis and software diagnosis.

11.7.1 Indicator Diagnosis

● NS indicator

LED status	Indication	How to deal with
Off	No power or bus OFF	1. Make sure that AHRTU-DNET-5A is powered and is connected normally. 2. Check if the communication is normal and the baud rate of AHRTU-DNET-5A is the same as that of the master.
Green light blinking	No connection between AHRTU-DNET-5A and the DeviceNet master	Configure AHRTU-DNET-5A in the DeviceNet software properly and download the configuration
Green light ON	I/O data transmission between AHRTU-DNET-5A and the DeviceNet master is normal.	--
Red light blinking	A timeout occurs when there is an I/O connection between AHRTU-DNET-5A and the DeviceNet master.	Refer to the error codes on the digital displayer to shoot the trouble.
Red light ON	Network error, ID duplication, no network power, or bus-off	1. Make sure all the devices have their unique node address. 2. Check if the network installation is correct 3. Check the baud rate of AHRTU-DNET-5A is the same as that of the bus. 4. Check if the node address of AHRTU-DNET-5A is valid. 5. Check if the network power is normal.

● MS indicator

LED status	Indication	How to deal with
Off	No power	Make sure that AHRTU-DNET-5A is powered and is connected normally.
Green light blinking	1. AHRTU-DNET-5A is waiting for the I/O data of the DeviceNet master 2. No I/O data between AHRTU-DNET-5A and the DeviceNet master 3. PLC connected to the master is in STOP state	1. Configure AHRTU-DNET-5A in the DeviceNet software properly and download the configuration. 2. Switch PLC to RUN state.
Green light ON	I/O data transmission is normal	--
Red light blinking	No network power, configuration problem or module warning	1. Check if the network power is normal. 2. Reset the internal parameters in AHRTU-DNET-5A. 3. Check if there is any error or warning in some module.

LED status	Indication	How to deal with
Red light ON	Hardware error	Send it back to the factory for repair if the error still exists after repowering AHRTU-DNET-5A.

11.7.2 Digital Display Diagnosis

LED status	Indication	How to deal with
0~63	The node address of AHRTU-DNET-5A when it works normally	--
F0	Its station number is duplicated with that of other node or exceeds the valid range.	Ensure that the node address is unique and repower it after modifying the node address.
F1	No module setting has been configured to AHRTU-DNET-5A.	Configure the module and then download it to AHRTU-DNET-5A.
F2	The work voltage of AHRTU-DNET-5A is too low.	Check if the work power of AHRTU-DNET-5A is normal.
F3	AHRTU-DNET-5A enters the test mode.	Repower AHRTU-DNET-5A.
F4	AHRTU-DNET-5A enters the Bus-Off state.	1. Check if the network cable is normal and the shielded wire has been grounded. 2. Check if the baud rate of the node equipment on the network is the same. 3. Check if the two ends of the network have been connected with one 121 Ω resistor respectively. 4. Repower AHRTU-DNET-5A.
F5	No network power	Make sure the cable is correctly connected and check if the network power is normal.
F6	Internal error; internal storage detection error	If the error still exists after repower, send your AHRTU-DNET-5A back to the factory for repair.
F7	Internal error; data exchange unit error	If the error still exists after repower, send your AHRTU-DNET-5A back to the factory for repair.
F8	Error produced in factory manufacturing	If the error still exists after repower, send your AHRTU-DNET-5A back to the factory for repair.
F9	Internal error; FLASH access error	If the error still exists after repower, send your AHRTU-DNET-5A back to the factory for repair.
FA	Main rack error	1. Check the connection of the main rack and replace it with a new one. 2. Replace the main rack with a new one.
FB	Invalid configuration data	Ensure that the network is normal and re-download the configuration; ensure the node address of AHRTU-DNET-5A is different from that of other node.
E4	Module error	The corresponding module connected to the rack slot is in error state; check if the corresponding module alarms or is bus-off or does not fit the configured module or has been added to the scan list.

LED status	Indication	How to deal with
E5	The extension rack error or the extension rack does not exist.	1. Check if the extension rack is connected correctly. 2. Check if the extension rack is consistent with the configuration.
E6	The data configuration length exceeds the allowed maximum 500 words	Check if the configured modules on the rack are so many that the configured data length exceeds the maximum 500 words.
E7	AHRTU-DNET-5A is detecting if the node address is duplicate with that of other device on the network.	If the code is shown for long, please treat the error by the following means. 1. Ensure that at least two nodes work on the network. 2. Check if the two ends of the network have been connected with a 121 Ω resistor respectively. 3. Check if the baud rate of the node equipment on the network is the same. 4. Check if the communication cable is abnormal, e.g. loose or cut. 5. Check if the communication cable exceeds the maximum transmission distance. If it does, the system can not be kept stable. 6. Check if the shielded wire has been grounded. 7. Repower AHRTU-DNET-5A.
E8	A timeout occurs when AHRTU-DNET-5A exchanges data with the I/O module.	Check if AHRTU-DNET-5A and the I/O module are running normally.
E9	The number of AH10SCM-5A module exceeds the maximum.	Reduce the quantity of the AH10SCM-5A module, which should be no more than 8.
80	AHRTU-DNET-5A is in STOP state.	1. Turn the switch RUN/STOP to RUN. 2. Check if the control word of AHRTU-DNET-5A is 1. See section 4.1 for details.
83	Downloading the I/O data configuration in the software	Wait until downloading the configuration data of AHRTU-DNET-5A is completed.
84	Downloading the data configuration of AH10SCM-5A serial port in the software	Wait until downloading the serial port configuration data of AH10SCM-5A is completed.

When multiple errors exist simultaneously, the digital displayer of AHRTU-DNET-5A will show the error codes cyclically. For example, E4 12 E5 02 E4 12 E5 02 is shown in cycle, the error indication is as follows.
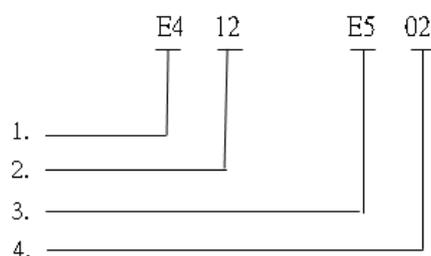
➢ E4 indicates that the module error occurs or the module is offline. See the error code for details.
➢ 12 indicates that the position of the module where the error exists. The first number 1 indicates the module is positioned on the first rack, the second number 2 indicates that the module is connected to the slot 2 on the rack. (Rack number:1~8; 1 refers to the main rack; 2~8 are the extension rack; the slot number: 0~11)
➢ E5 indicates that the extension rack error or the offline problem occurs. See error code for details.
➢ 02 indicates that the rack which has a fault or is offline is the second rack (Rack number is 1~8; 1 refers to the main rack; 2~8 are the extension rack).

11.7.3 Status Word Diagnosis

The status word in AHRTU-DNET-5A is used to display the running state of the special module, DI/DO module and the Modbus equipment. See the following table on the diagnosis of the status word.

Bit	Status value	Indication	How to deal with
Bit 0	0	AHRTU-DNET-5A is in RUN state.	--
	1	AHRTU-DNET-5A is in stop state.	Restart AHRTU-DNET-5A.
Bit 1	0	The configuration data in AHRTU-DNET-5A are valid.	--
	1	The configuration data in AHRTU-DNET-5A are invalid.	Use the DeviceNet Builder software to re-download the configuration to AHRTU-DNET-5A.
Bit 2	0	The module on the rack runs normally.	--
	1	The module on the rack is abnormal.	Ensure that the module on the rack runs normally, and there is no alarm.
Bit 3	Reserved	--	--
Bit 4	0	The module currently connected fits the configuration.	--
	1	The module currently connected does not fit the configuration.	1. Check if the module fits the configuration. 2. If not, keep the connected module fit the configuration in the software by changing the connected module or the configuration in the software.

_11_

Bit	Status value	Indication	How to deal with
Bit 5	0	AHRTU-DNET-5A runs normally.	--
	1	AHRTU-DNET-5A is in low voltage	Check if the connection between AHRTU-DNET-5A and the rack is normal and the power module works.
Bit 6	Reserved	--	--
Bit 7	0	AHRTU-DNET-5A runs normally.	--
	1	The configuration data of the hung module exceed 980 bytes.	Reduce and appropriately configure the configuration data.
Bit 8	0	The first extension rack runs normally.	--
	1	The first extension rack is abnormal.	Check the connection of the extension rack or replace it with another one.
Bit 9	0	The second extension rack runs normally.	--
	1	The second extension rack is abnormal.	Check the connection of the extension rack or replace it with another one.
Bit 10	0	The third extension rack runs normally.	--
	1	The third extension rack is abnormal.	Check the connection of the extension rack or replace it with another one.
Bit 11	0	The fourth extension rack runs normally.	--
	1	The fourth extension rack is abnormal.	Check the connection of the extension rack or replace it with another one.
Bit 12	0	The fifth extension rack runs normally.	--
	1	The fifth extension rack is abnormal.	Check the connection of the extension rack or replace it with another one.
Bit 13	0	The sixth extension rack runs normally.	--
	1	The sixth extension rack is abnormal.	Check the connection of the extension rack or replace it with another one.
Bit 14	0	The seventh extension rack runs normally.	--
	1	The seventh extension rack is abnormal.	Check the connection of the extension rack or replace it with another one.
Bit 15	Reserved	--	--

11.7.4 Diagnosis by Software

On the main interface of AHRTU-DNET-5A configuration, click "Diagnose" and then the related information will be shown on the diagnosis data area.
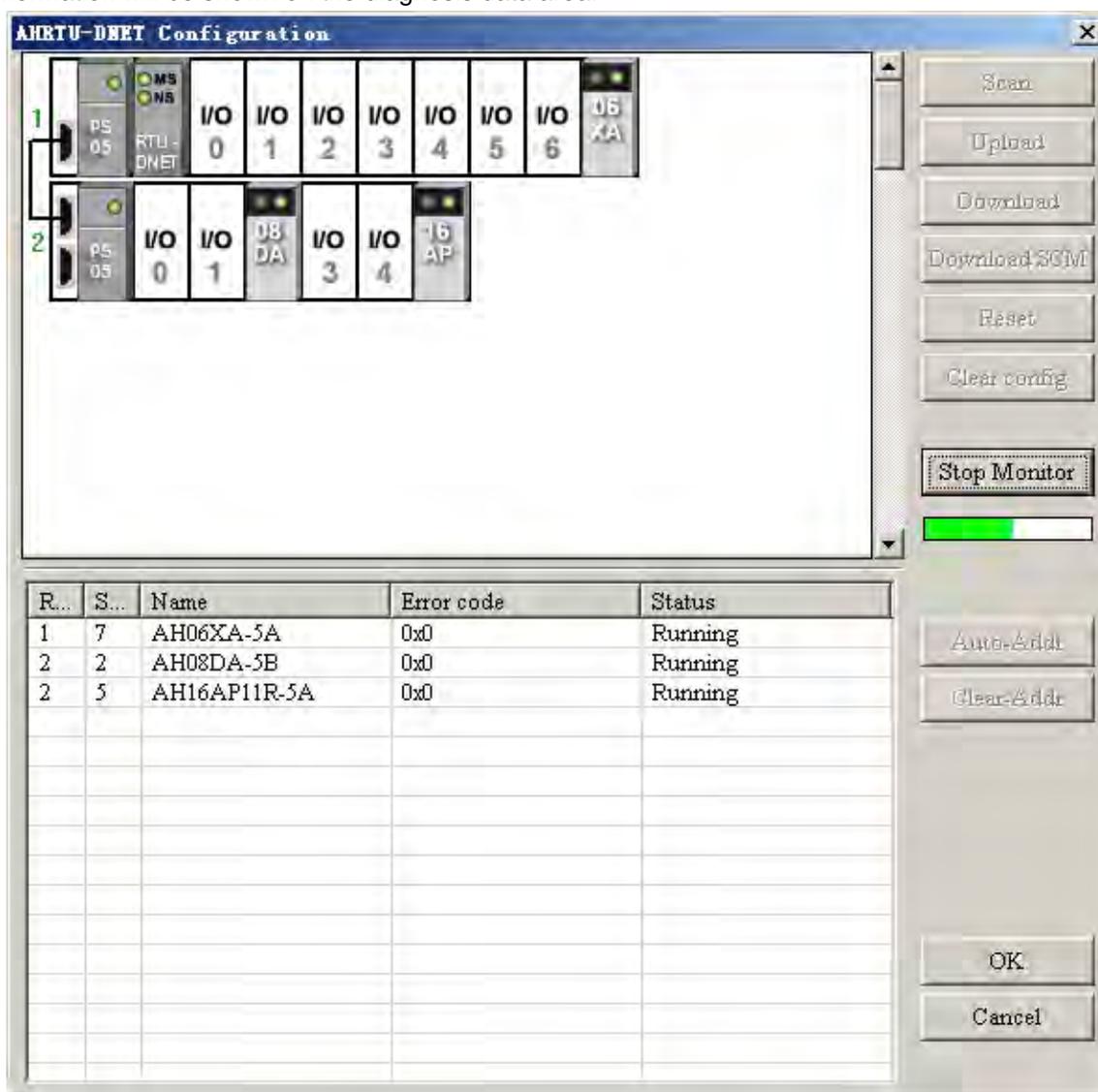
Error code	Indication	How to deal with
0x8001	AHRTU-DNET-5A was unable to detect the configured module.	1. Check if the connection between the module and the rack is loose so that the connection is broken. 2. Check is the module is damaged.
0x8002	The current module does not fit the configured module.	Ensure that the actually connected module and the module configured in the software are identical.

Notes:

For other error codes, please refer to the user manual of the related module.

The software diagnosis function can be started up only when the DeviceNet Builder software is online.

MEMO

Chapter 12 Network Module AH10PFBM

Table of Contents

12.1　Introduction to AH10PFBM-5A

AH10PFBM-5A runs on the right side of AH500 series PLC and constitutes the PROFIBUS DP master with AH500 series PLC together.

12.1.1　Features

- While using AH10PFBM-5A, the power module PS05 and the main rack and etc are necessary for AH10PFBM-5A to be used together.
- No external power is needed since the rack can provide the power to AH10 PFBM-5A.
- AH10PFBM-5A can not be inserted to the I/O slot of the extension rack except the AH main rack.
- Maximum 8 AH10 PFBM-5A modules can be connected to the main rack.
- Supports the hot plug function (The module can be inserted to the I/O slot or be removed from the I/O slot when the main rack is powered on)
- Please read the manual carefully before use. The manual merely provides the information on specification, functions and trouble-shooting of the product excluding the details on the PROFIBUS DP protocol. For more details on the PROFIBUS DP protocol, please refer to relevant professional articles or literatures.

12.1.2　Introduction

AH10PFBM-5A can be used as the class-1 DP master only with the following functions.

- Supports DPV0. That is, the master and slave make the exchange periodically. It supports maximum 2880 words of input data and 2880 words of output data.
- Supports DPV1 (The slave supporting DPV1 is needed). The master can read/write the data in the slave periodically via the read/write function of DPV1 provided by ISPSoft.
- The module automatically exchanges the data with AH500 series PLC. User can directly operate the specified registers in AH500 series PLC so as to achieve to control and monitor the slave.
- Supports multiple kinds of diagnosis such as the digital displays, indicators, specified registers and software to detect the troubles of the module and slave.
- Supports the communication rate ranging 9.6Kbps~12Mbps.
- Able to connect maximum 125 slaves and its node address can be set to 0~125 through SYCON.net and the node address of the slave can be set to 1~125. If the hardware actually connected to the network is over 32, or out of the distance that the corresponding baud rate allows, the RS-485 repeater is necessary to be added to expand the physical network.
- The network configuration software（SYCON.net）provides the easy and handy graphic configuration interface to automatically scan and recognize all slaves on the network.

12.1.3　Specifications

- **AH500 CPU supported**

Item	Specification
Model name	AH500 series PLC

- **PROFIBUS DP interface**

Item	Specification
Interface	DB9 connector
Transmission method	High-speed RS-485
Transmission cable	Two-wire twisted shielded cable
Electrical isolation	500 VDC

● **PROFIBUS DP communication**

Item	Specification
Message type	Cyclic data exchange
Module name	AH10PFBM-5A
Product ID	0B49
Serial transmission speed supported (auto-detection)	9.6kbps; 19.2kbps; 31.25kpbs;45.45kbps;93.75kbps; 187.5kbps; 500kbps; 1.5Mbps; 3Mbps; 6Mbps; 12Mbps

● **Electrical Specification**

Item	Specification
Power supply voltage	5VDC
Insulation voltage	500VDC
Power consumption	2W
Weight	190g

● **Environment**

Item	Specification
Noise immunity	ESD（IEC 61131-2, IEC 61000-4-2）: 8KV Air Discharge
	EFT（IEC 61131-2, IEC 61000-4-4）: Power Line:2KV, Digital I/O: 1KV
	Analog & Communication I/O: 1KV
	Damped-Oscillatory Wave: Power Line:1KV, Digital I/O: 1KV
	RS（IEC 61131-2, IEC 61000-4-3）: 26MHz ~ 1GHz, 10V/m
Operation	0ºC ~ 55ºC（temperature）, 5 ~ 95%（humidity）, pollution level 2
Storage	-25ºC ~ 70ºC（temperature）, 5 ~ 95%（humidity）
Shock/vibration immunity	International standards: IEC 61131-2, IEC 68-2-6（TEST Fc）/IEC 61131-2 & IEC 68-2-27（TEST Ea）
Certificate	IEC 61131-2, UL508

12.2 Profile and Components

12.2.1 Profile and Dimensions

Unit: mm
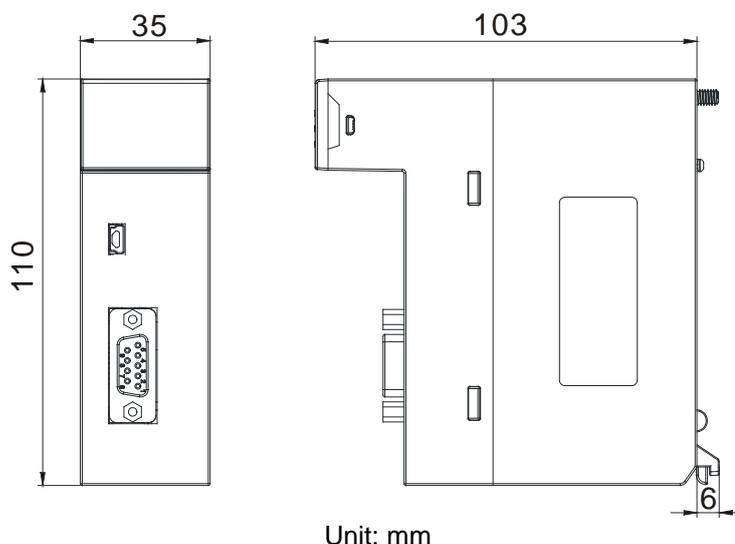
12.2.2 Components
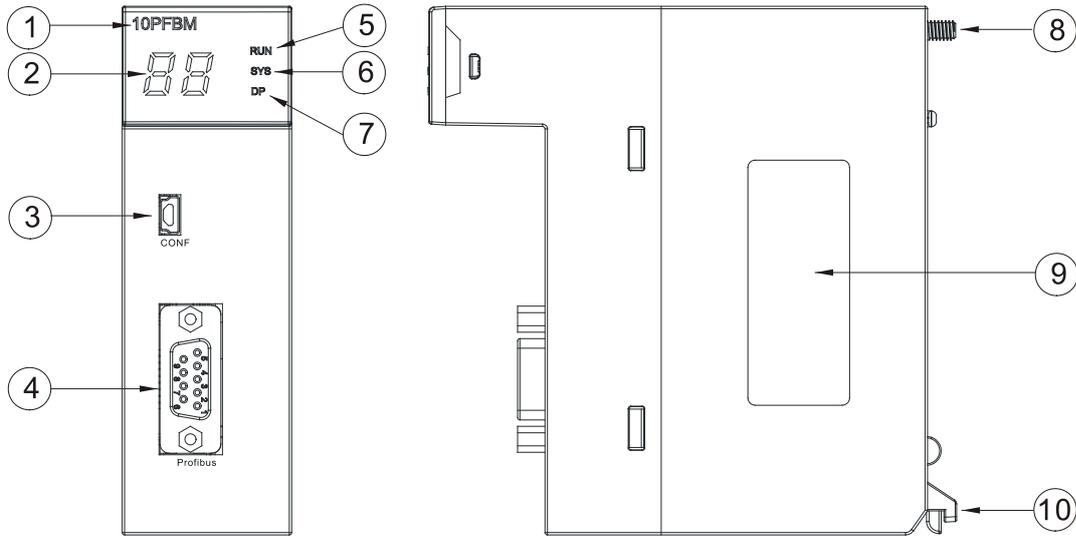
No.	Name	Description
1	Model name	The name of the module
2	7-segment display	A display
3	CONF interface	The interface where the hardware configuration is downloaded
4	PROFIBUS DP interface	PROFIBUS DP connection
5	RUN indicator	A indicator
6	SYS indicator	A indicator
7	DP indicator	A indicator
8	Set screw	To secure the module
9	Nameplate	Nameplate
10	Module fixing projection	To secure the module

12.2.3 PROFIBUS DP Port

The PROFIBUS DP port is used for connecting the module to the PROFIBUS DP network and user could make the wiring with the connector enclosed with AH10PFBM-5A.

Pin	Definition	Description
1	--	N/C
2	--	N/C
3	RxD/TxD-P	Receiving/Sending data (P (B))
4	--	N/C
5	DGND	Data reference potential (C)
6	VP	Power voltage – positive
7	--	N/C
8	RxD/TxD-N	Receiving/Sending data (N (A))
9	--	N/C
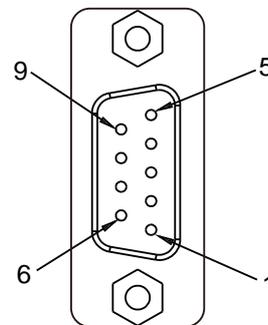
12.2.4 Seven-segment Display

The digital display could provide the following functions:
- Displaying the node address and error information of AH10PFBM-5A
- Displaying the error information of the slave

Notes:
- ✓ The digital display shows its node address when AH10PFBM-5A works normally.
- ✓ It indicates that the E2 error exists in the slave of node address 03 if E2 and 03 appear continuously.
- ✓ Please follow the instruction in section 12.7.2 if the common error such as E2, F2 and etc exists.

12.3 Installation

12.3.1 Installing AH10PFBM -5A and PLC CPU to the Main Rack

1. Insert the projection under the module into the hole in the rack;
2. Push the module in the direction indicated by the following arrow to meet the IO slot of the rack.
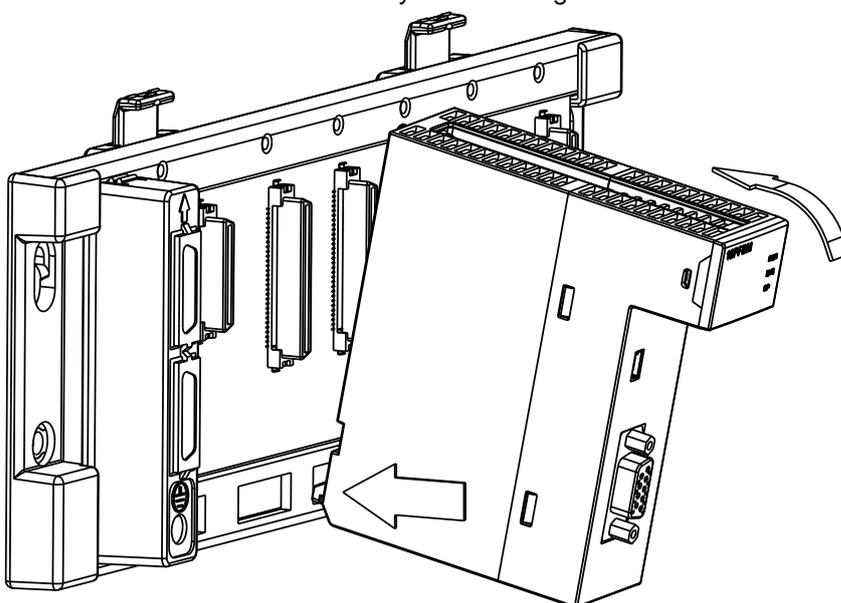
3. After properly installing, tighten the screw on the upper of the module.
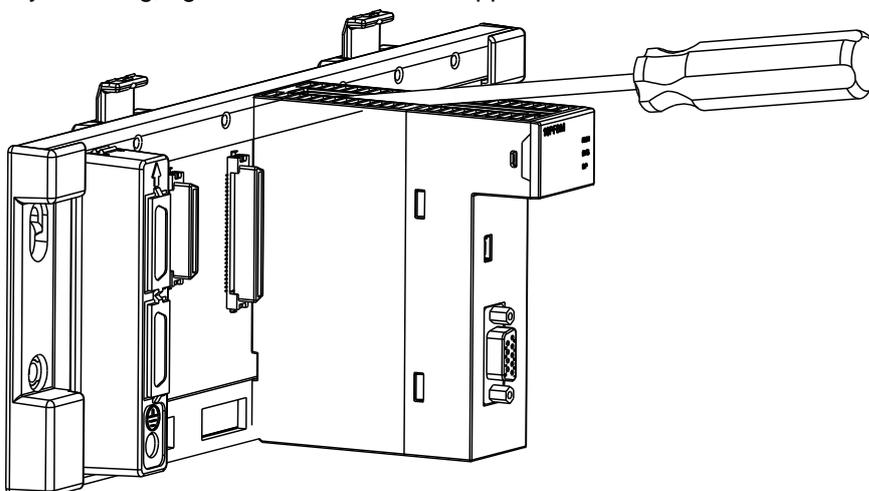
4. Install PS05 and AH CPU to the POWER interface and CPU interface on the rack respectively according to the above steps and the figure is shown as below after the installation is over.
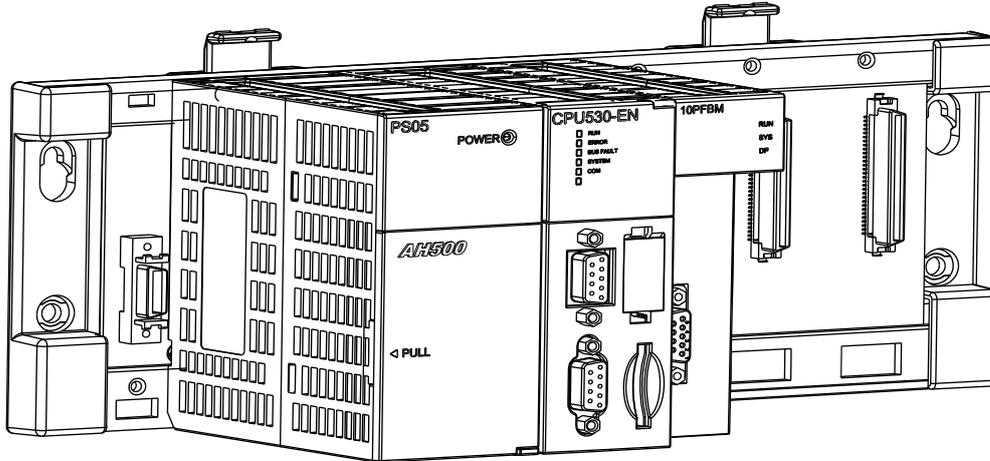
12.3.2 Connecting PROFIBUS DP Connector

1. Insert the PROFIBUS DP connector in the direction indicated by the following arrow to AH10PFBM-5A communication port.
2. Tighten the screws on the PROFIBUS DP connector.
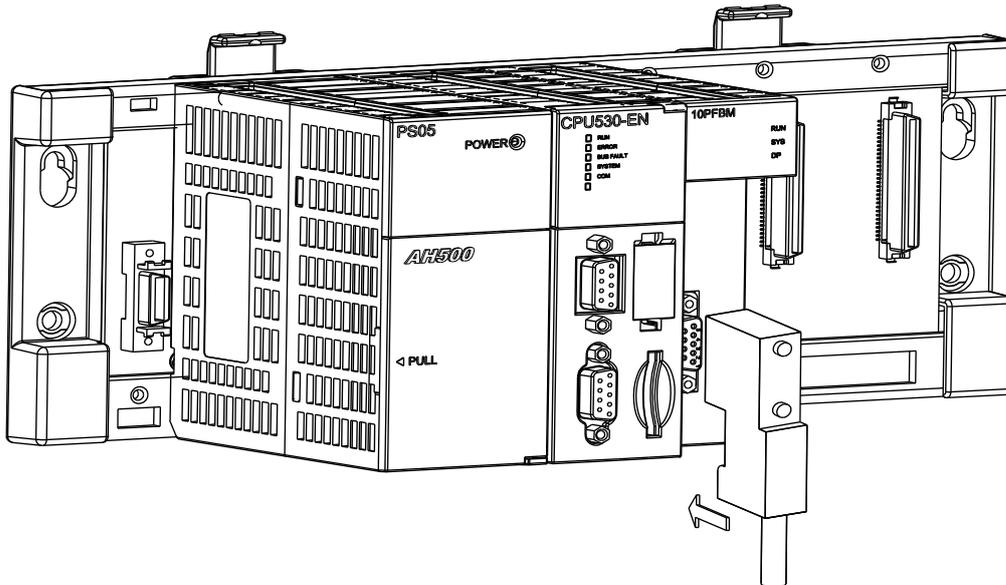
12.4 PROFIBUS DP Network Wiring and Topology

Please refer to the contents in chapter 14 in the SYCON.net help file on detailed introduction of the PROFIBUS DP network wiring and topology.

12.4.1 PROFIBUS Network Wiring

12.4.1.1 Definition of the PROFIBUS DP port pins

PIN	PIN name	Description
1	--	N/C
2	--	N/C
3	RxD/TxD-P	Receiving/sending data P(B)
4	--	N/C
5	DGND	Data reference potential (C)
6	VP	Power voltage – positive
7	--	N/C
8	RxD/TxD-N	Receiving/sending data N(A)
9	--	N/C
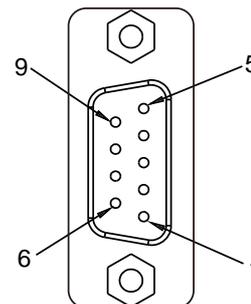
12.4.1.2 PROFIBUS Cable

The PROFIBUS network supports two kinds of communication media, RS-485 electric cable and optical fiber. Currently we mainly face the customers using the wired medium though we also have the devices which support the wireless communication.

Delta provides the standard PROFIBUS cable to the customers for purchase. The order number of the cable is 4009414800. The PROFIBUS cable is the two-wire twisted shielded cable and the two wires inside the cable, A-green and B-red are connected to the pin 3(B) and 8(A) of the DP interface respectively. The part near the cable skin is filled with the woven net and aluminum foil as the shielded layer. The skin of the cable is purple as below.

1. Data wire A(Green) And data wire B (Red)

2. "Tube" ensures the shape and strength of the cable

3. Aluminum foil layer

4. Woven net
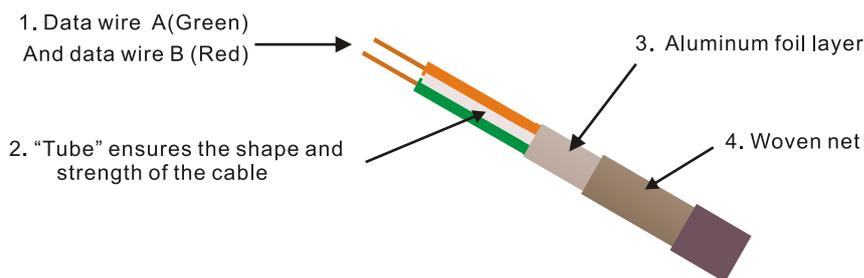
The characteristic impedance of the PROFIBUS cable should be from 100Ω to 220Ω, the cable capacitance between the conductors should be less than 60pF/m and the cross section of the cable should exceed 0.22mm2 (24 AWG).

The specification of the electric cable:

Cable parameter	Value
Conductor dimension* number of pairs	22AWG(0.65mm)* one pair
Outer diameter of cable	About 8mm
Shielded layer material* color	Oil and heat resistant PVC* purple
characteristic impedances	150Ω±10%(3~20MHZ)
Resistance of conductor	< 55Ω/Km
Cable capacitance (between conductors)	< 30pF/m
Decrement (reference value)	22db/km(4MHZ)，42db/km(4MHZ)，
Estimated quality	70kg/km

The cross section figure of the cable:
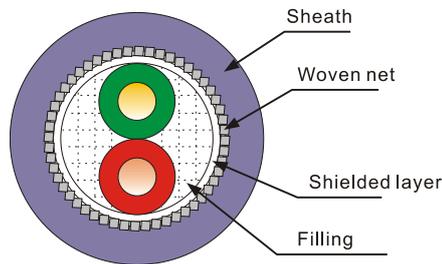
12.4.1.3 Communication Rate and Distance

The communication rate range of the PROFIBUS DP is between 9.6K bps and 12M bps. The transmission distance depends on the transmission rate and ranges from 100m to 1,200m. The communication rate that Delta PROFIBUS product supports and the corresponding distance are listed below.

Baud rate (bps)	9.6K	19.2K	93.75K	187.5K	500K	1.5M	3M	6M	12M
Distance(m)	1200			1000	400	200	100		

12.4.1.4 PROFIBUS Connector

The PROFIBUS connector used for connecting the PROFIBUS cable and stations is usually classified into two types as below. No Delta PROFIBUS connector is available for user to purchase currently. Users themselves need to choose the D-sub 9-pin PROFIBUS connector conforming to the specification.
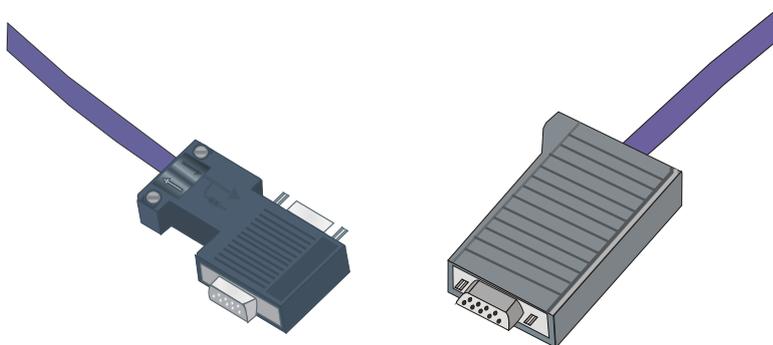
The internal structure of the PROFIBUS connector is shown as below. It contains one In hole for input, one Out hole for output, one terminal resistor switch and 3 resistors. The In hole and Out hole are connected to the previous station and next station respectively.

The In hole has 2 pins, A1 and B1 and the Out hole has two pins, A2 and B2. A1 and A2 are connected to the green wires in the cable and B1 and B2 are connected to the red wires in the cable.

The terminal resistor switch is used to select whether to connect the terminal resistor to the station or not. If the switch is set to "Off", A1 and A2 are connected; B1 and B2 are connected and the In hole is not connected to the terminal resistor.

If the terminal resistor switch is set to "On", A1 and A2 are disconnected; B1 and B2 are disconnected and the In hole is connected to the terminal resistor.

When the PROFIBUS connector is inserted to the PROFIBUS interface of the station, A1 and B1 are connected to pin 8 and pin 3 of the PROFIBUS interface of the station respectively.

The terminal resistors inside the PROFIBUS connector are illustrated in the right side figure as below.
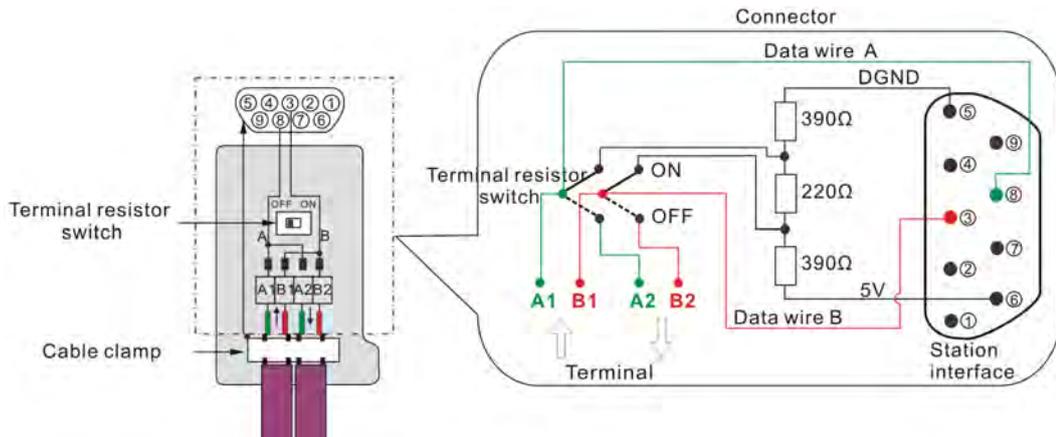
When each station is connected to the network via the connector and cable, every physical network supports 32 physical devices according to the RS-485 serial port communication protocol and the stations at the ends of every physical network should be connected with terminal resistors in order to prevent the current/voltage surf and ensure the communication quality.

Every PROFIBUS connector contains the built-in resistors. User could select whether to connect the station to the terminal resistor via the terminal resistor switch. The switch On indicates that the resistor is connected to the station and the switch Off indicates that the resistor is disconnected to the station.

When the terminal resistor switch is set to On, it means one physical network ends and the signal of the next network connected to the Out hole is aborted. Therefore, in the connectors of the two stations at the two ends of every physical network, the cables should be connected to the In holes and meanwhile the terminal resistor switches are set to On. The stations in the middle of one network, the cables should be connected to the In hole and Out hole successively and meanwhile the terminal resistor switches are set to Off as below.
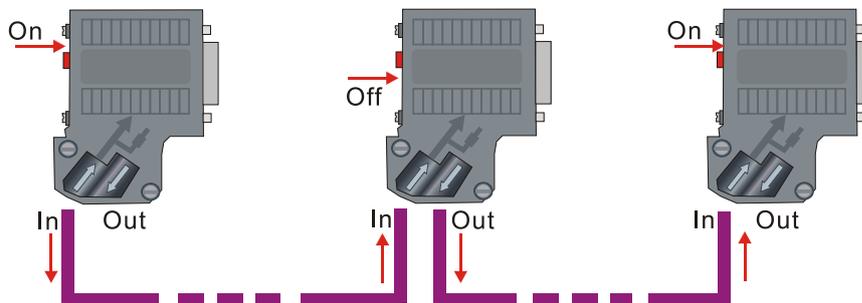
12.4.1.5 Terminal Resistor

The PROFIBUS cable must connect the terminal resistors including the following 3 resistors, Rt, Ru and Rd at its two ends. The standard PROFIBUS connector contains the built-in terminal resistor which user could select whether to be connected to the station or not via the switch. User could purchase the standard PROFIBUS connector to add the terminal resistor.

The terminal resistor is used to eliminate the signal reflection in the communication cable. There are two reasons leading to the signal reflection: Impedance discontinuity and Impedance mismatch.

Impedance discontinuity: The signal at the end of the transmission cable suddenly encounters too low impedance or even 0 impedance (E.g.: short circuit) or too high impedance (E.g.: broken circuit) and then it will cause the signal reflection. To eliminate such kind of reflection, the terminal resistor with the same characteristic impedances as that of the cable must be connected at the end of the cable and make the impedance of the cable in continuity. Since it is a two-way transmission of the signal on the cable, the other end of the communication cable must also connect a same-size terminal resistor. The following Rt is the terminal resistor.

Impedance mismatch: Another reason causing the signal reflection is the impedance mismatch between data transceiver and transmission cable. The reflection causes the entire network in a mess while the communication circuit is in idle. To prevent the kind of case happening, the upper resistor Rd (connecting the DGND) and the lower resistor Ru (connecting the positive voltage) need be complemented as below. When no data transmission from the station (I.e. in idle state), the complement forces the voltage in different state (I.e. the voltage between conductors) to approach a fixed value.

Connect one station to the PROFIBUS network via the PROFIBUS connector and cable as shown in the following figure.
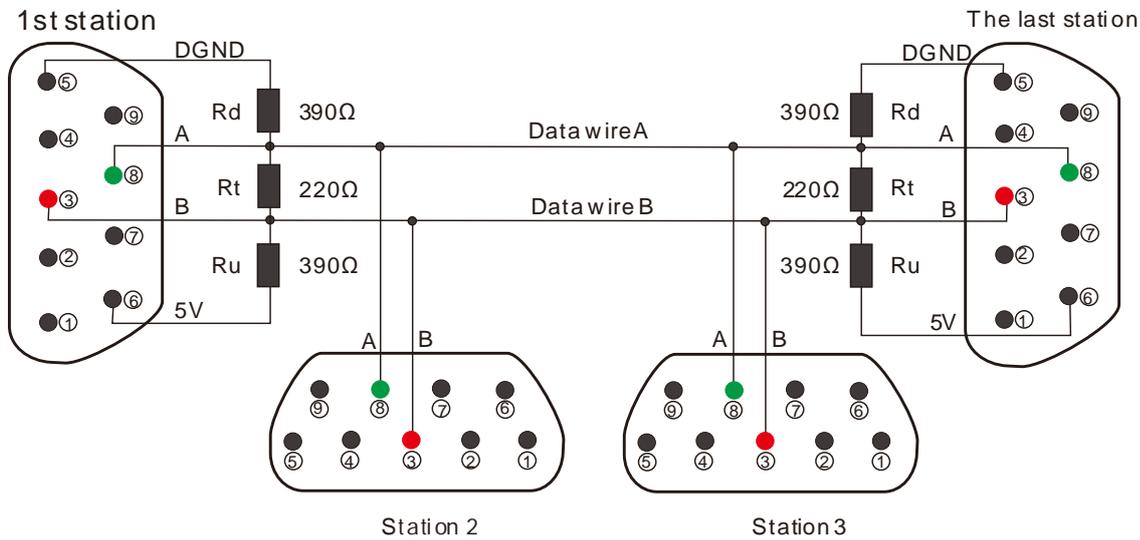
12.4.2 Network Topology

12.4.2.1 Connecting RS-485 repeater to the PROFIBUS DP network

The master module could connect 125 slaves at most and its node address could be set to 0~125 through SYCON.net software. The node address of the slave could be set to 1~125. If the actually connected devices exceeds 32 on the network or the corresponding baud rate is out of the allowed distance, the RS-485 repeaters need to be added to expand the physical network. The PROFIBUS DP network is divided into several networks using the RS-485 repeaters. Please note that the two ends of every network should be connected with the terminal resistors respectively. For use of the RS-485 repeater, please refer to the user manual of the used repeater.

12.4.2.2 Using AH10PFBM-5A to Create the ROFIBUS DP Network
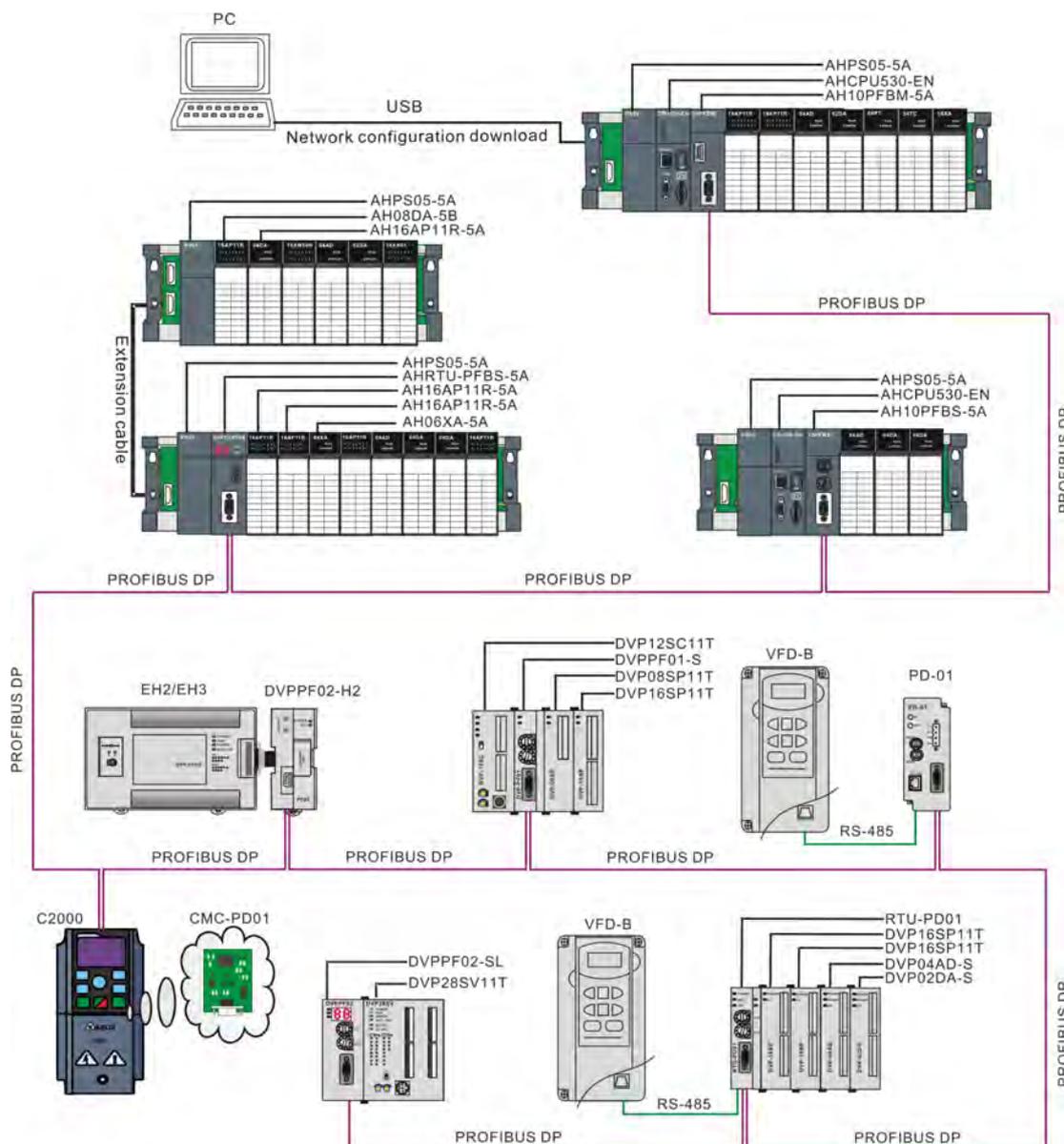
Model of Delta PROFIBUS DP slaves and function description

Product Model	Description
AH10PFBS-5A	AH10PFBS-5A is a PROFIBUS DP slave module running on the I/O slot of AH main rack and used to connect the AH series PLC CPU to the PROFIBUS DP network.
AHRTU-PFBS-5A	AHRTU-PFBS-5A is a PROFIBUS DP remote I/O communication module and used to connect Delta AH series I/O module to the PROFIBUS DP network.
DVPPF02-SL	DVPPF02-SL is a PROFIBUS DP slave module running on the left side of the S series and EH2 series PLC CPU and used to connect the PLC CPU to the PROFIBUS DP network. The PLC CPU the left side of which could connect DVPPF02-SL can be DVP-28SV, DVP-28SV2, DVP-SX2, DVP-SA2 and DVP-EH2-L.
DVPPF02-H2	DVPPF02-H2 a PROFIBUS DP slave module running on the right side of the EH2 series PLC CPU and used to connect the PLC CPU to the PROFIBUS DP network.
RTU-PD01	RTU-PD01, a PROFIBUS DP remote I/O module is used to connect the S series digital, analog and standard MODBUS (with the RS-485 interface) device to the PROFIBUS DP network. The RS-485 interface can connect 16 MODBUS devices at most.
DVPPF01-S	DVPPF01-S, a PROFIBUS DP slave module, is used to connect Delta SS2/SV/SV2/SX2/SA2 series PLC CPU to the PROFIBUS DP network.
CMC-PD01	CMC-PD01, a PROFIBUS DP slave card, is used to connect the C2000 series AC motor drive to the PROFIBUS DP network.
PD-01	PD-01 is a gateway transforming the PROFIBUS to MODBUS and is used to connect the device with the RS-485 interface (Conforming to the MODBUS protocol) to the PROFIBUS DP network.

12.4.3 Notes on Network Wiring

Please see the following notes on the PROFIBUS DP network wiring.
● Select the standard PROFIBUS communication cable
● The two ends of the PROFIBUS cable must connect the terminal resistors respectively
● For connecting the PROFIBUS cable into the connector, remove the shielded layer and squeeze the metal part inside the connector
● The power wire of high voltage and strong current uses the wire casing different from that of low voltage and weak current for wiring.
● DO NOT install the network cable too near to the power wire and DO NOT wrap them together and keep the PROFIBUS DP network cable away from I/O module cable
● The bus cable and power cable should avoid long-distance parallel wiring
● Put the bus cable as near as possible to the metal plate.
● Reduce the impact on the devices from the interference source such as the AC motor drive. For example, ground the shielded wire in the power cable of the AC motor drive or adopt the filtering method via the ferrite bead.

12.5 Configuration of AH10PFBM-5A in AH PLC

This section is going to describe how the PC communicates with PLC by means of USB. For the usage and operation of ISPSoft, please refer to the user manual of ISPSoft.

1. Open Delta communication manager COMMGR software as below.
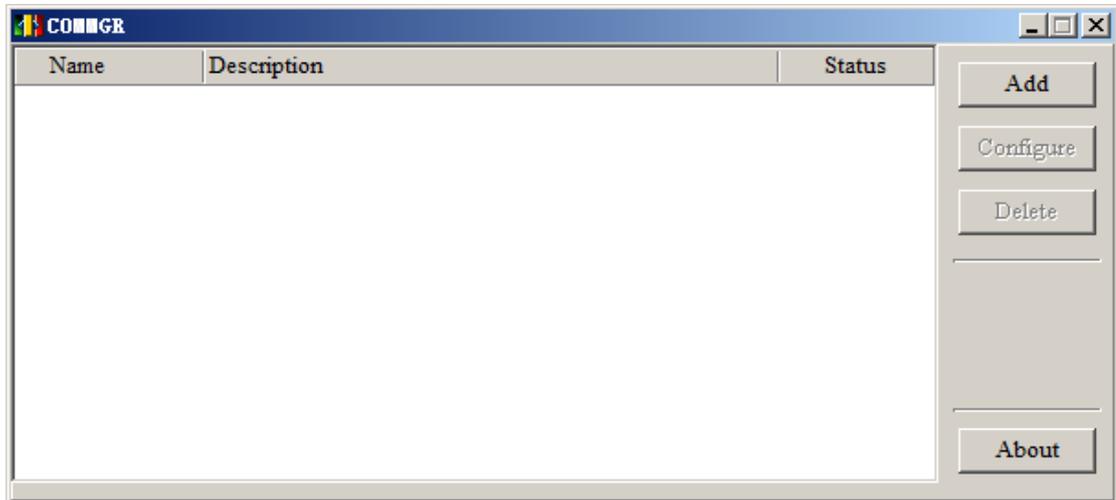
2. Click "Add" and the following window pops up then.
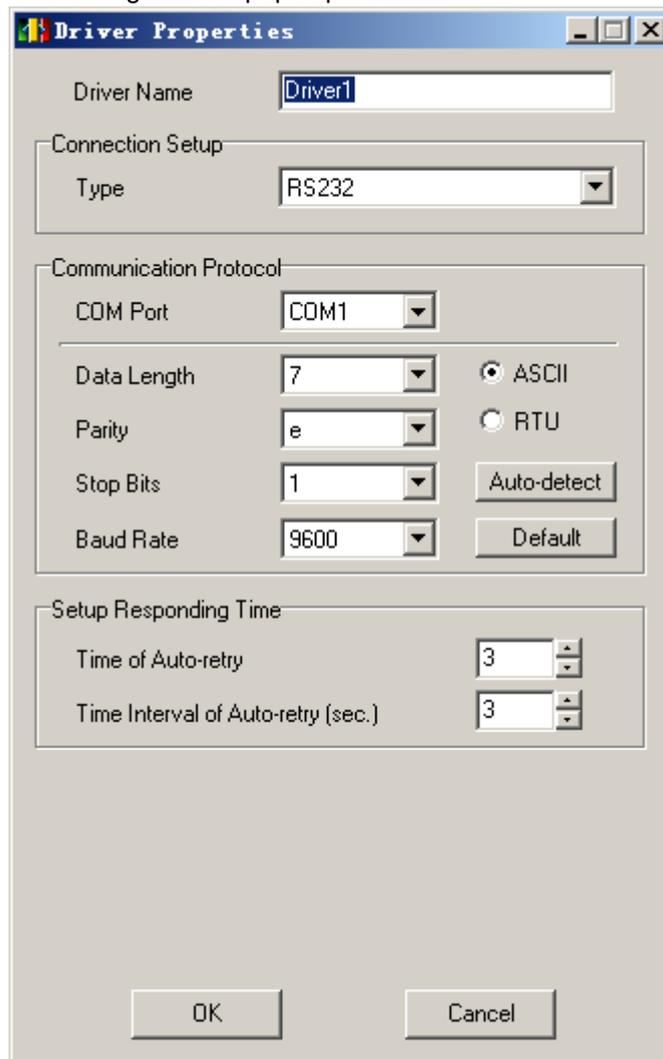
3. Select "USB（Virtual COM）" in the following window.
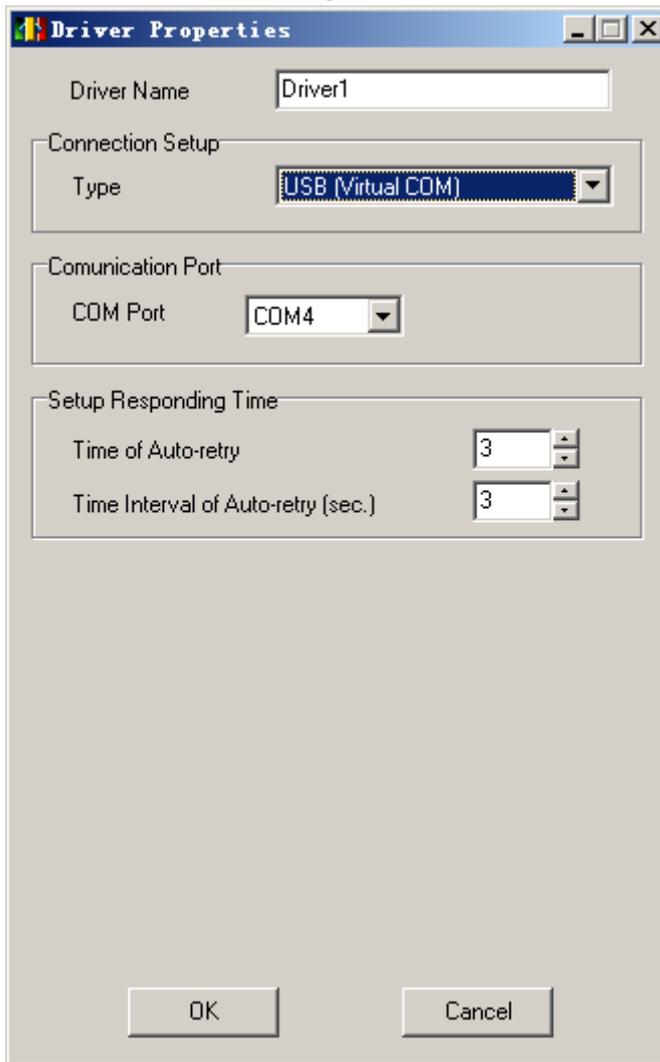
4. Clicking "OK" the USB communication drive setting succeeds.
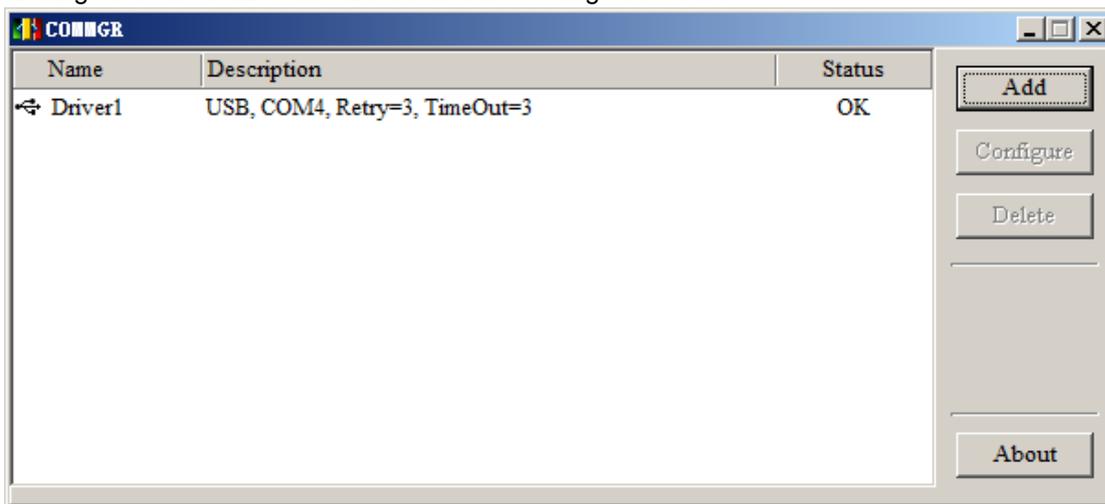
5. Open ISPSoft as below.
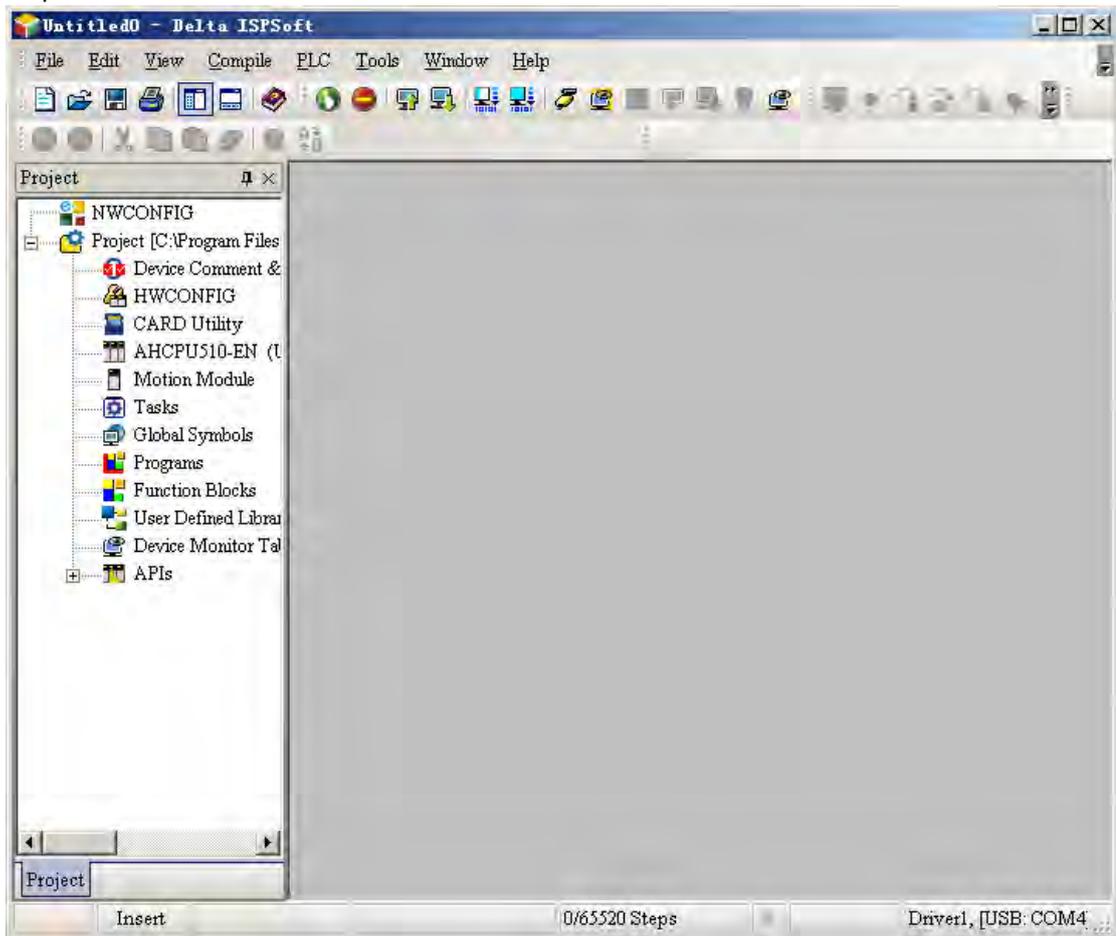
6. Click "Tool"> "Communication Settings…" and the communication setting dialog box appears as below.
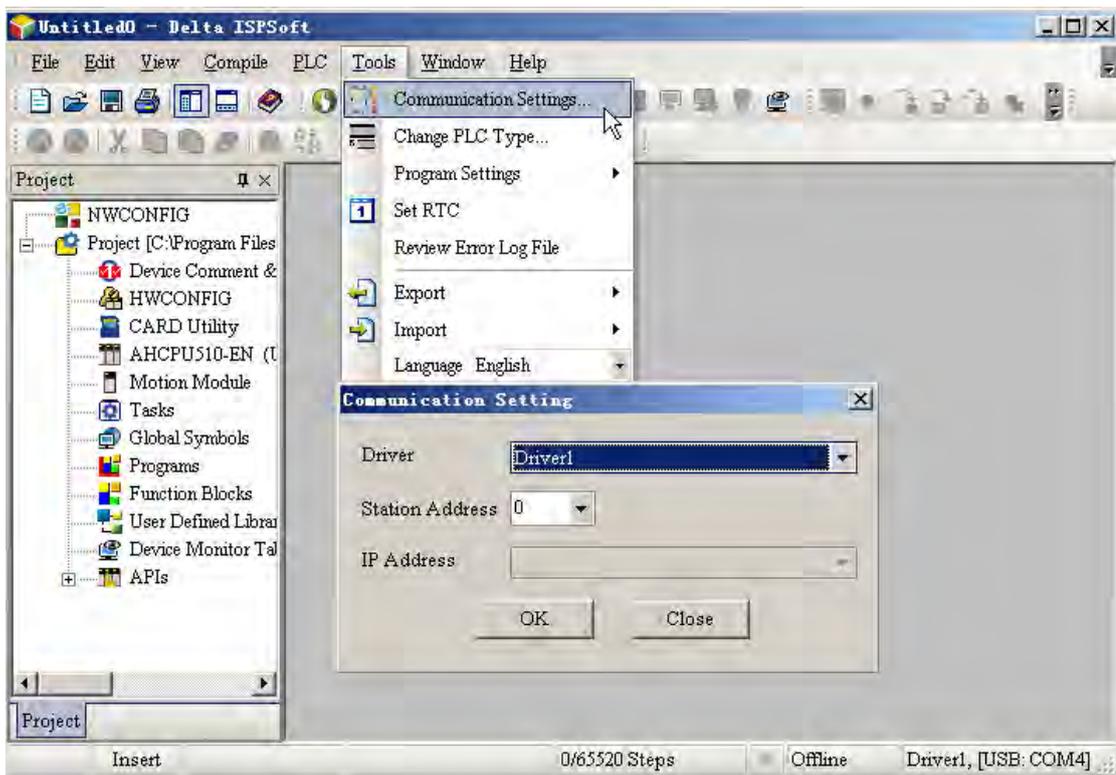
7. Select the same driver name from the drop-down menu of Driver as that in COMMRG. Set the station address to 0 or to the MODBUS station address identical to that of PLC. The station address 0 indicates the broadcast search. Finally, click "OK" to return to the main interface as below.
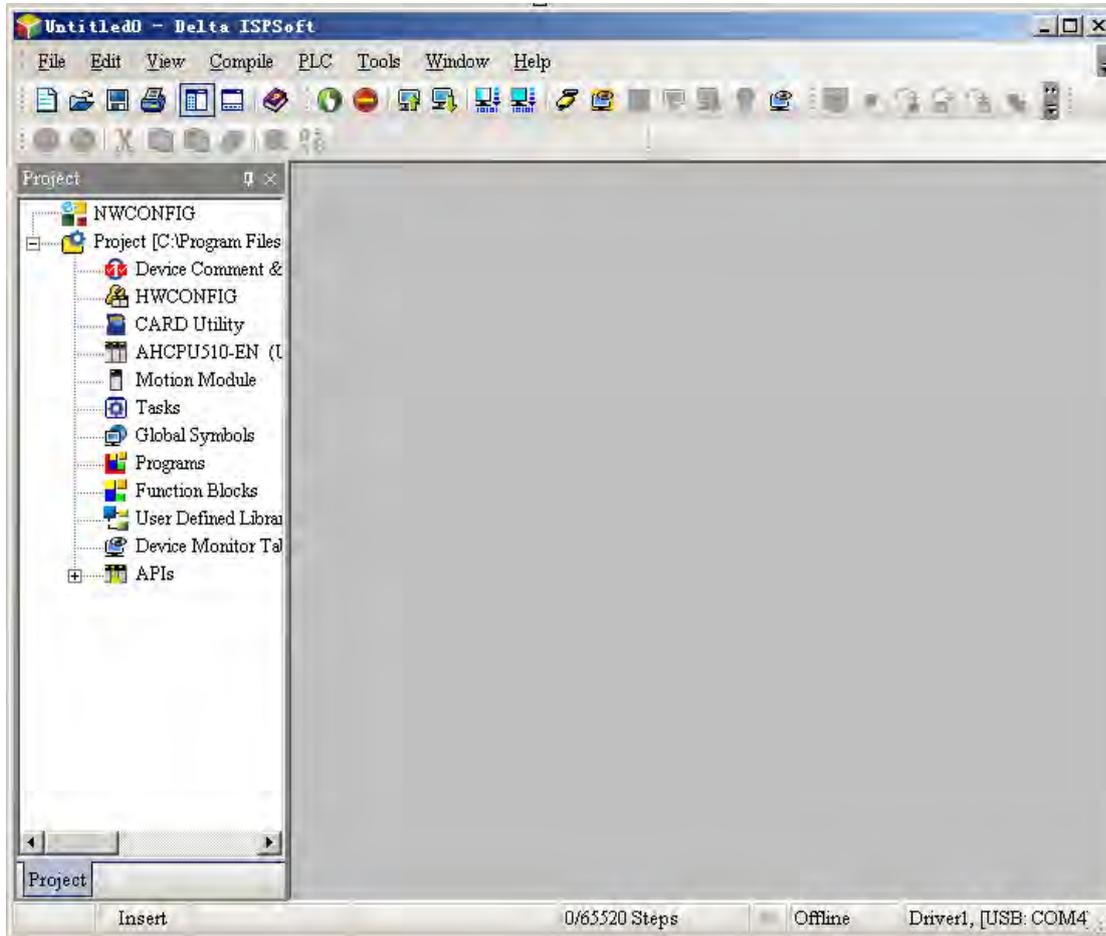
8. Double click HWCONFIG under Project and the following dialog box appears.
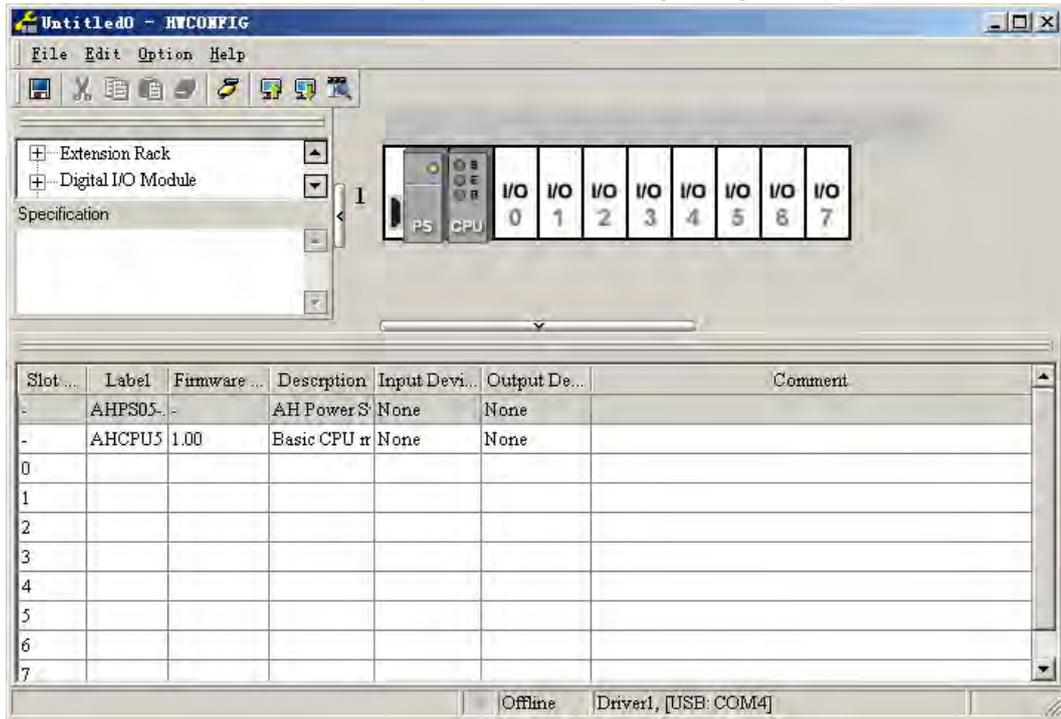
9. Click the I/O Scan button to scan the rack module.
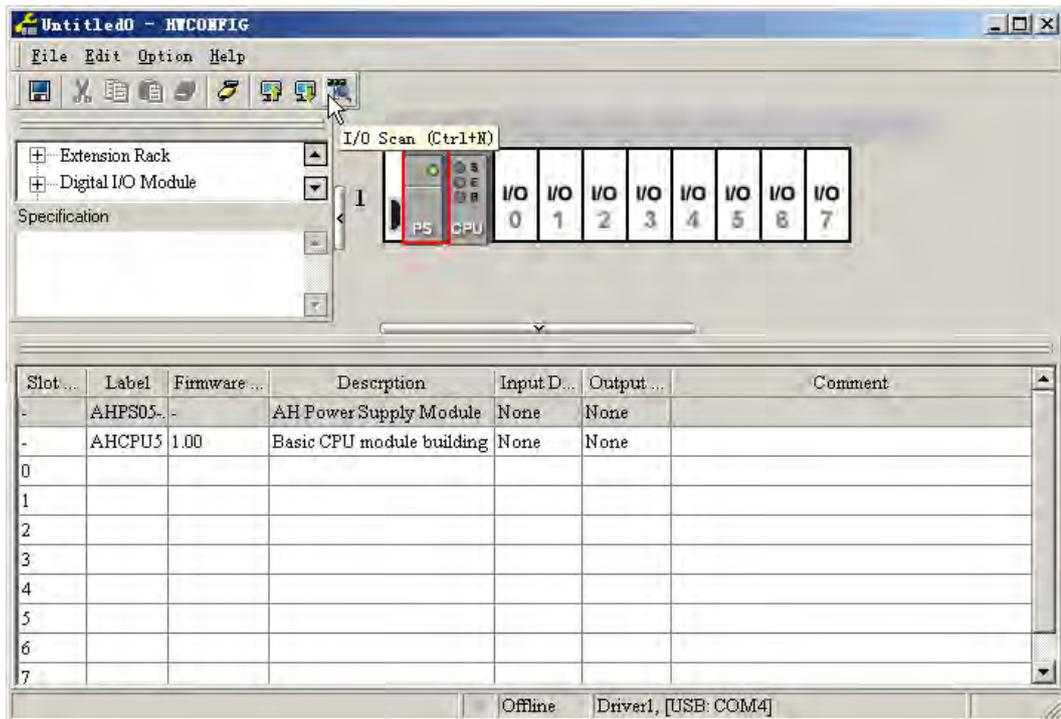
10. After scanning is over, 10PFBM module will show up beside the PLC CPU module on the rack.
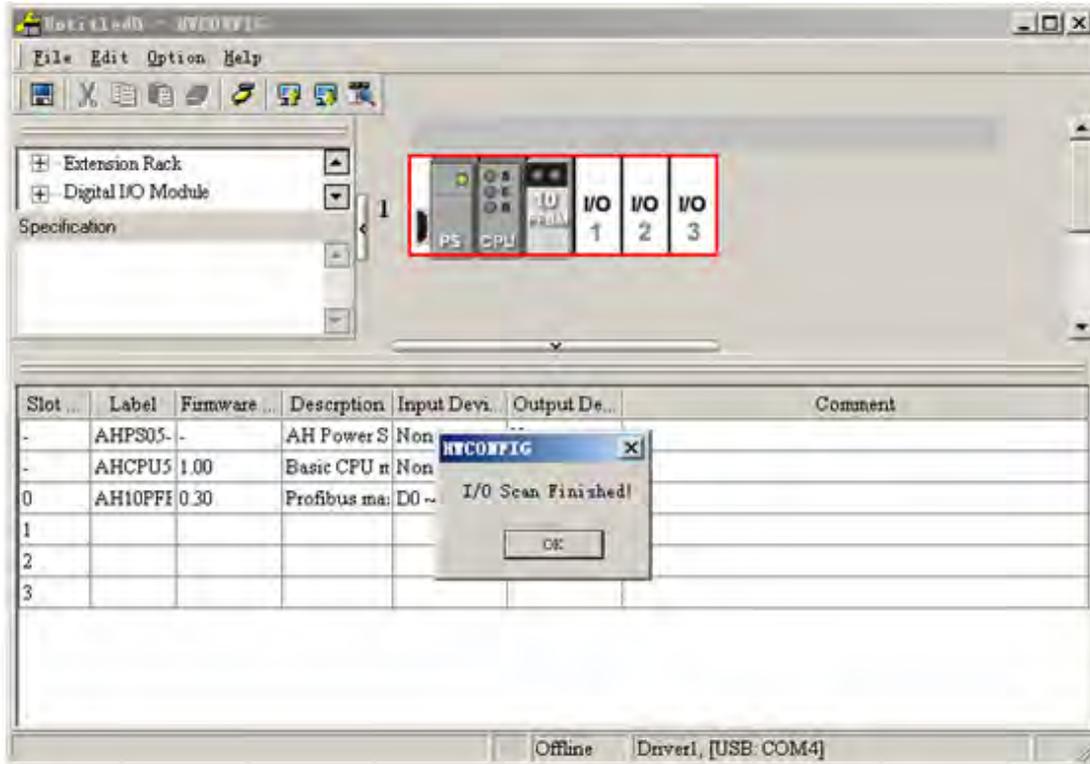
11. The registers in the normal exchange area in AH10PFBM-5A display if the current state of the PROFIBUS DP network is normal. Click the following place marked in pink box to set the registers in the normal exchange area while configuring the hardware in the ISPSoft software.
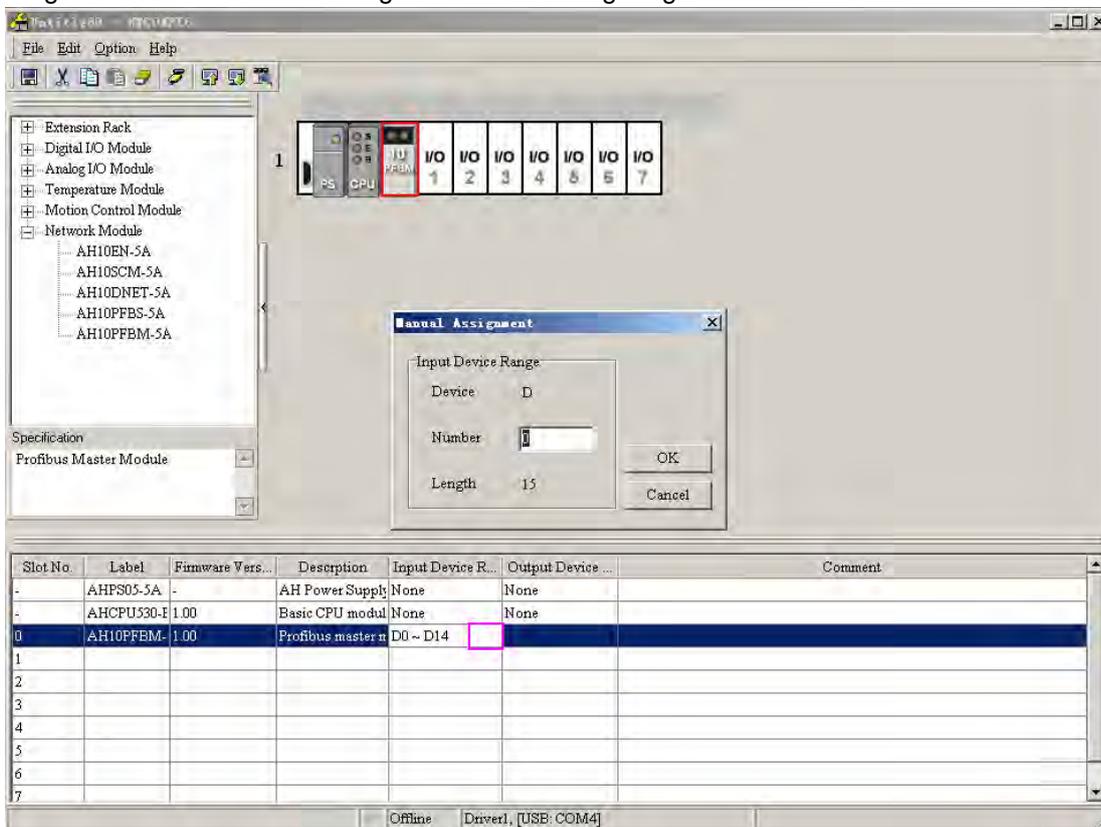
12. Double click the 10PFBM icon in the HWCONFIG window; the "Parameter Setting" dialog box pops up and then click "Normal Exchange Area" tab as below.
(Note: For details on the registers in normal exchange area, see the following table "Explanation of corresponding registers in the normal exchange area in AH10PFBM-5A".)
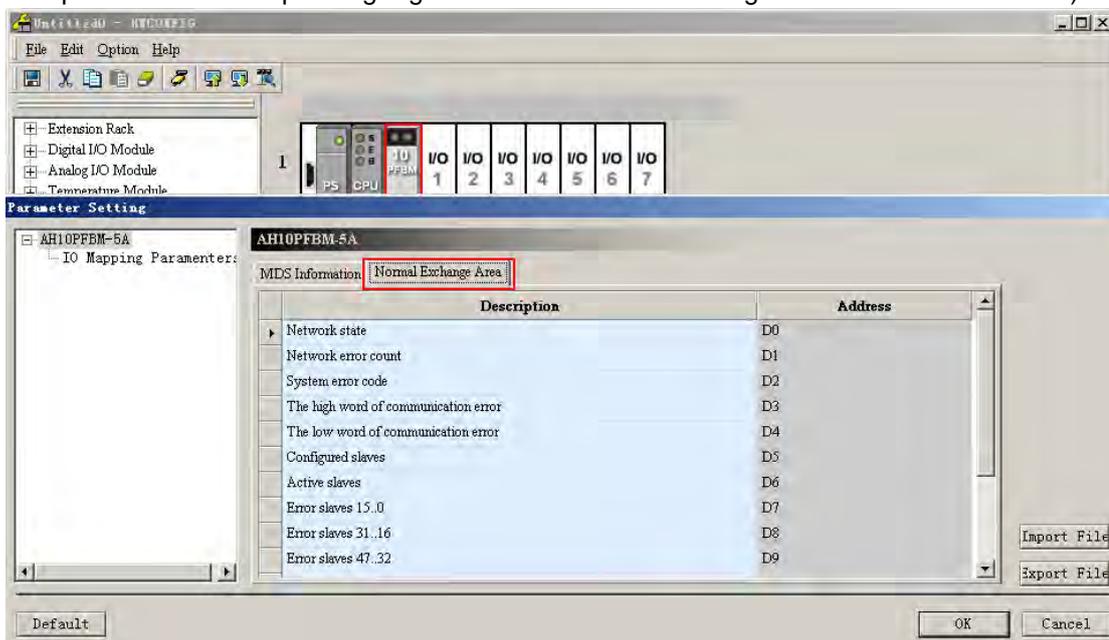
13. Double click the 10PFBM icon and then the Parameter Setting dialog box pops up.
Set Input Area D Begin Address, Input Area D Length, Output Area D Begin Address and Output Area D Length by clicking the place marked in red box below. .
(If the selected D device range is occupied, the system will remind that the device range setting conflicts and user should reset it). The data in OUTPUT area are transmitted to the slave and the INPUT area receives the data from the slave. Click "OK" to complete the parameter configuration。
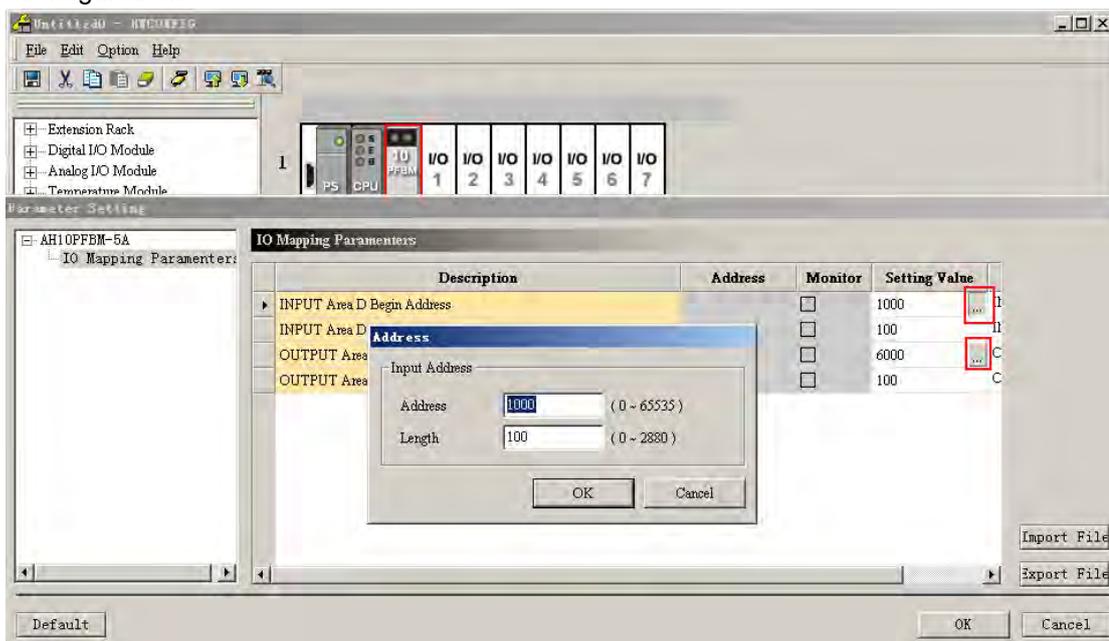
14. Click "Download" and the current configuration is downloaded to PLC then.
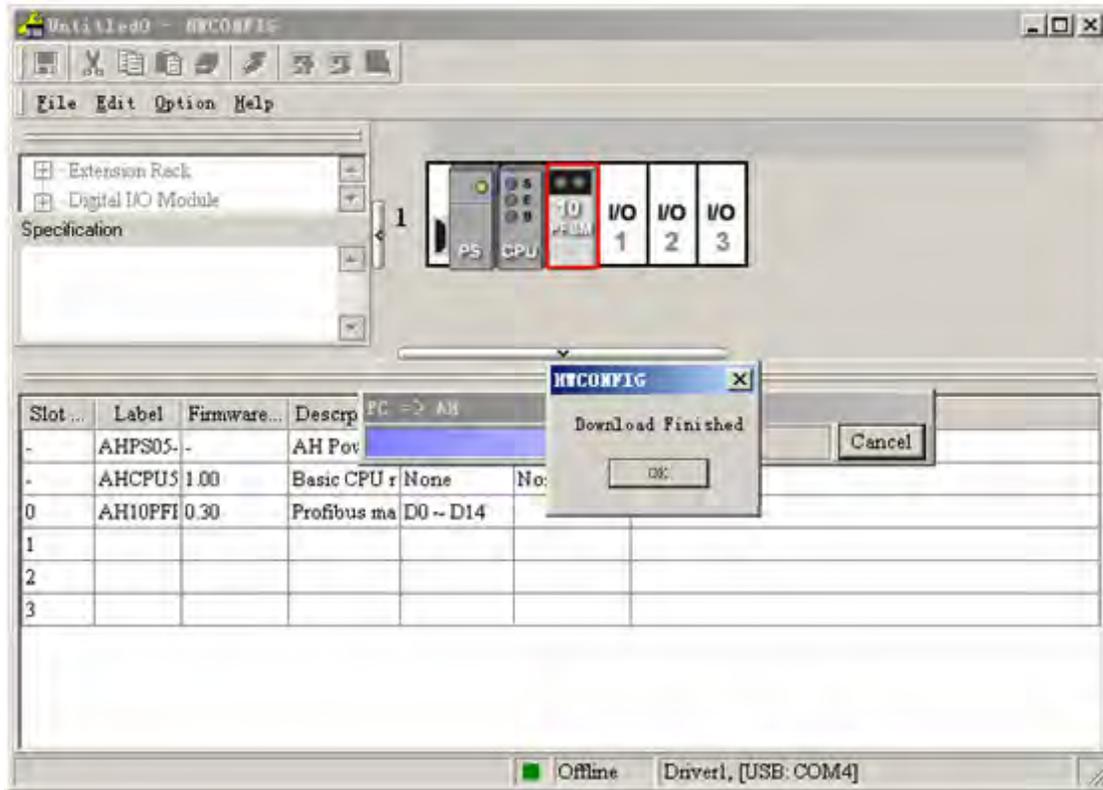
12.6 AH10PFBM-5A Application Example

12.6.1 Control Requirement

To achieve the data exchange between two PLC CPUs, the master PLC transmits 6 words of data to the slave PLC and the slave PLC transmits 6 words of data to the master PLC.

12.6.2 Connection Figure

Remove the USB cable from AH PLC and then insert it to AH10PFBM-5A in order to download the configuration to AH10PFBM-5A module as below.
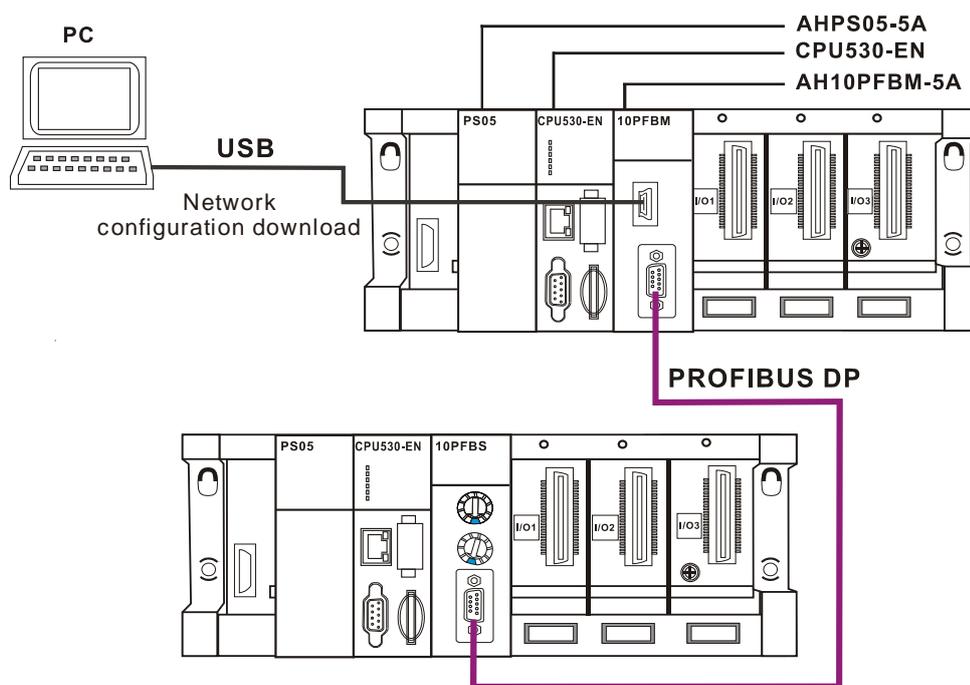
12.6.3 Slave Module Setting

Set the node address of AHRTU-PFBS-5A to 2 with the rotary switches.

● **Setup of INPUT and OUTPUT areas that AH PLC CPU assigns to master module**

The INPUT and OUTPUT areas that AH PLC CPU assigns to the master module AH10PFBM-5A are shown below. (Please refer to section 15.1 for the detailed setting).
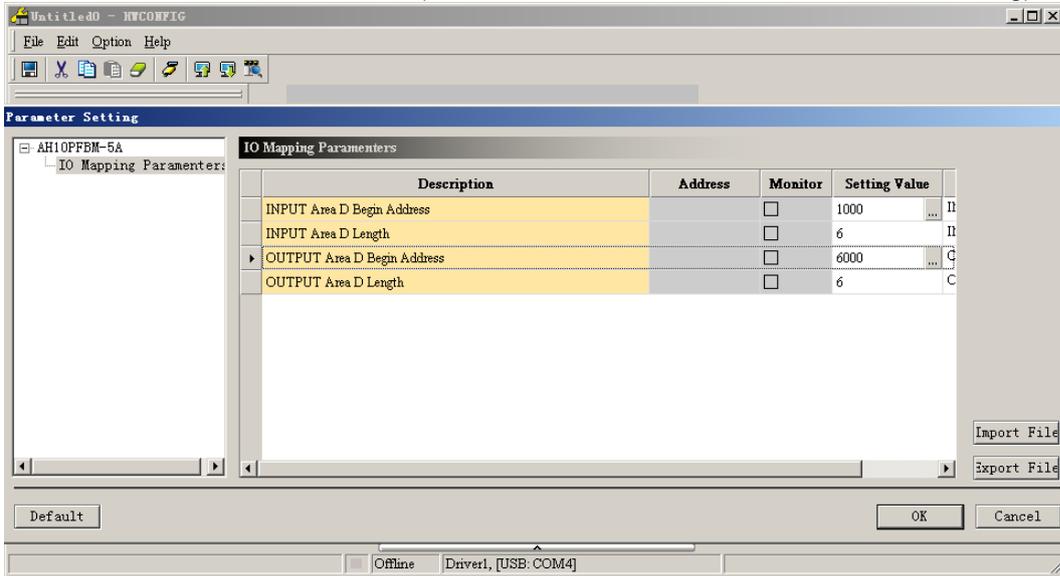
12.6.4 Configuration of master

1. Open the SYCON.net software for configuration of the master and the User Login dialog appears as follows. Please select "Administrator" for User Name and do not input anything for Password since the default password is blank.

   For the details on the setting and purpose, please refer to section 7.1 in the SYCON.net help.

2. Click "OK" and then enter the initial interface of the SYCON.net as below.

3. Select the master module AH10PFBM-5A on the right-side interface of the software and meanwhile drag it to the position as shown.

4. Release the mouse when the mark [+] appears with the arrow and then the master module is added as follows.

5. Double click the master icon to enter the master configuration interface.
   (Note: The PC and the CONF communication port of the master have correctly finished connection in hardware before the communication parameters are set.)

6. Click Driver on the left-side window and then tick the box marked in red on the right-side window to select the USB driver for the communication between the master and PC.

7. Click "Scan" button on the right-side window after clicking "Device Assignment" item on the left-side window and then select "All" from the Device Selection box on the right-side window.

8. After the master is scanned, pick the box marked in red below for the scanned master.

9. Click "OK" to exit from the slave configuration interface and return to the main interface of the software after the master communication parameters settings are over.
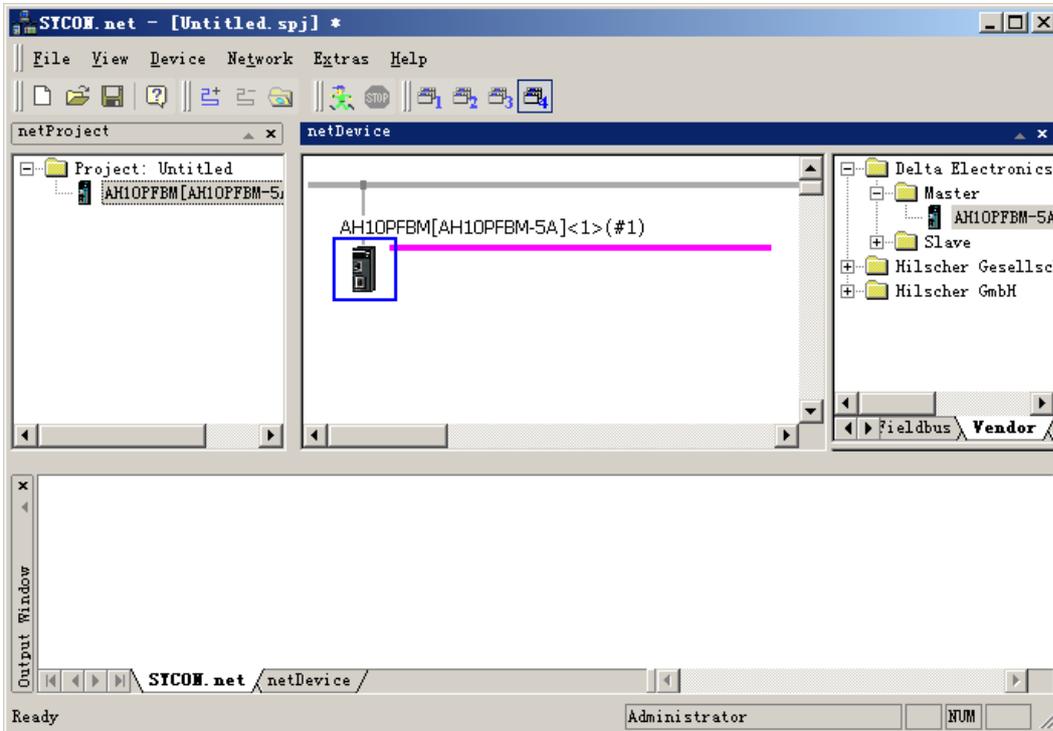
10. Right click the master and select "Network Scan…" from the menu which pops up to scan the network.
(Note: If it is the first time to use the product after it left the factory, please download the master configuration before use. For details, please refer to question 1 in section 15.11.)
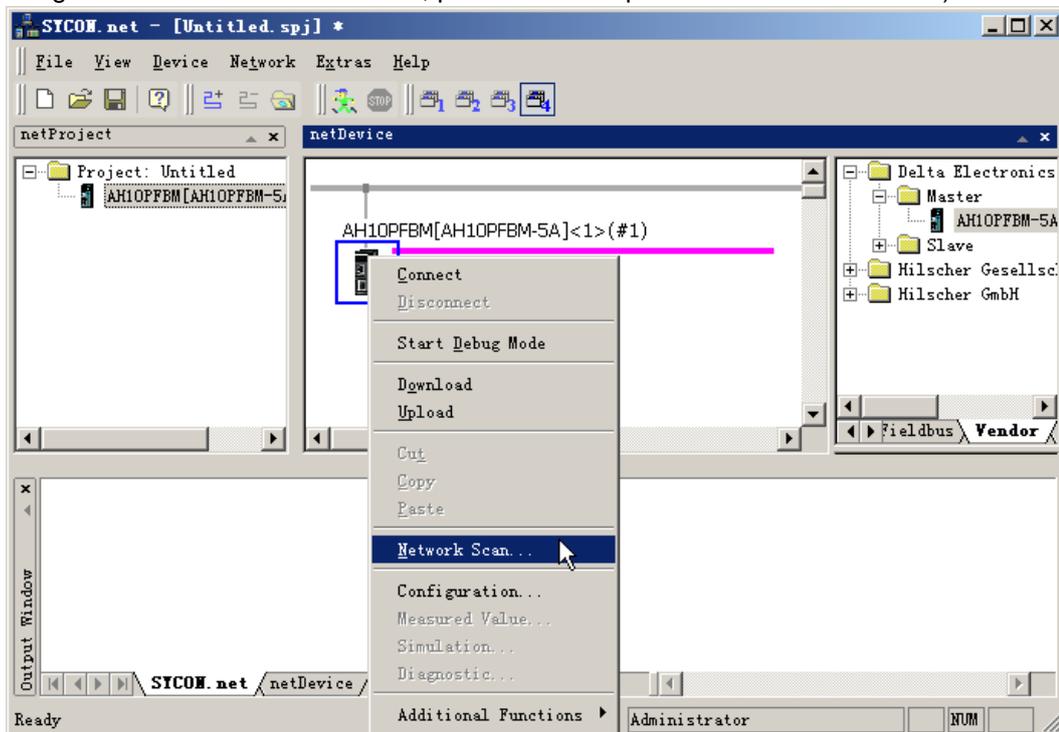
11. The slave connected to the master has been scanned as below.
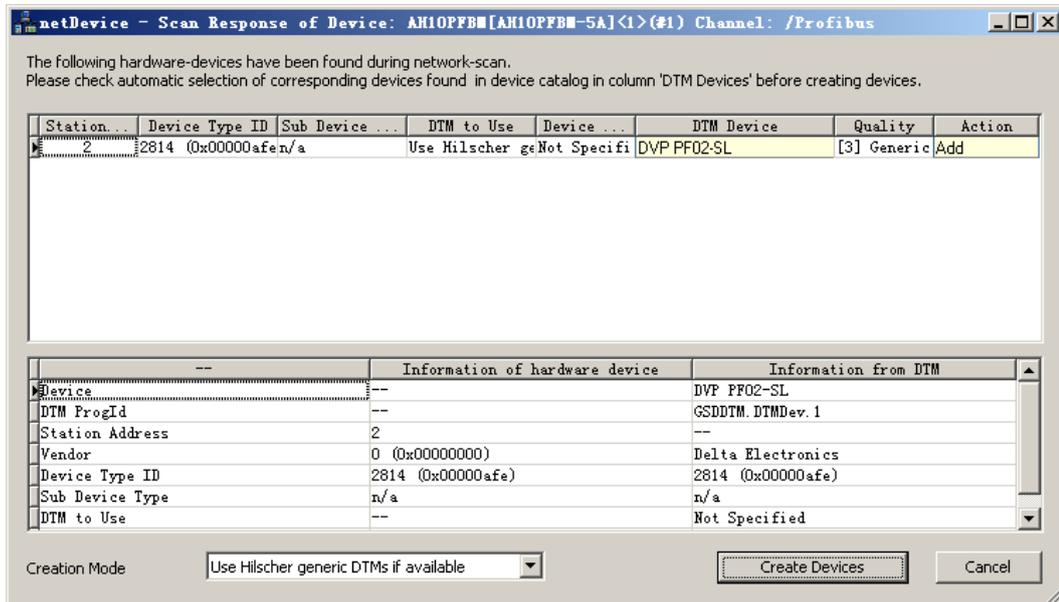
12. Select the DTM device which is consistent with the actual slave.
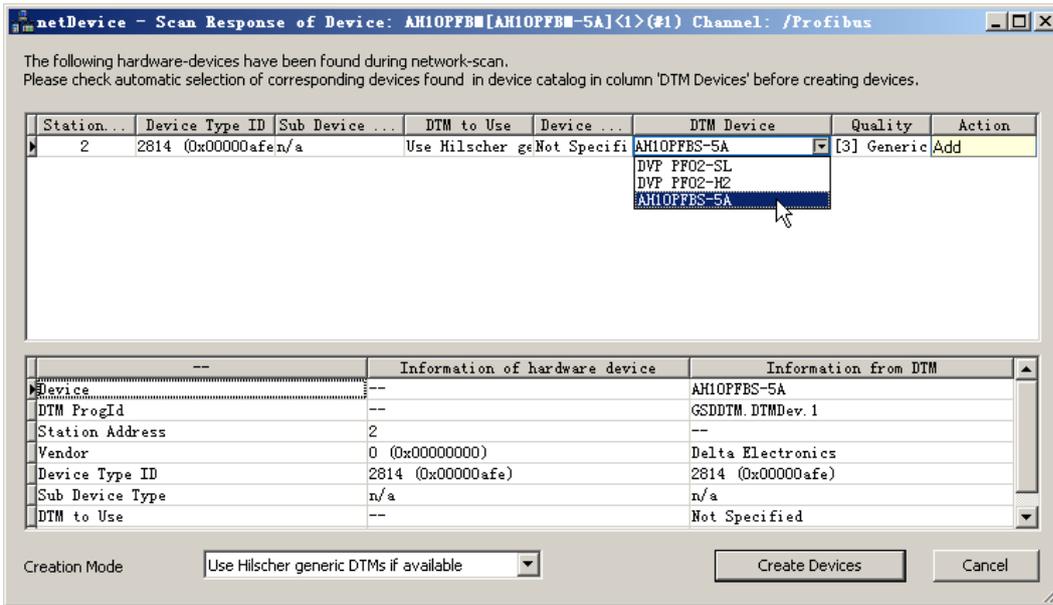
13. Click "Create Devices" button to add the slave device as below.
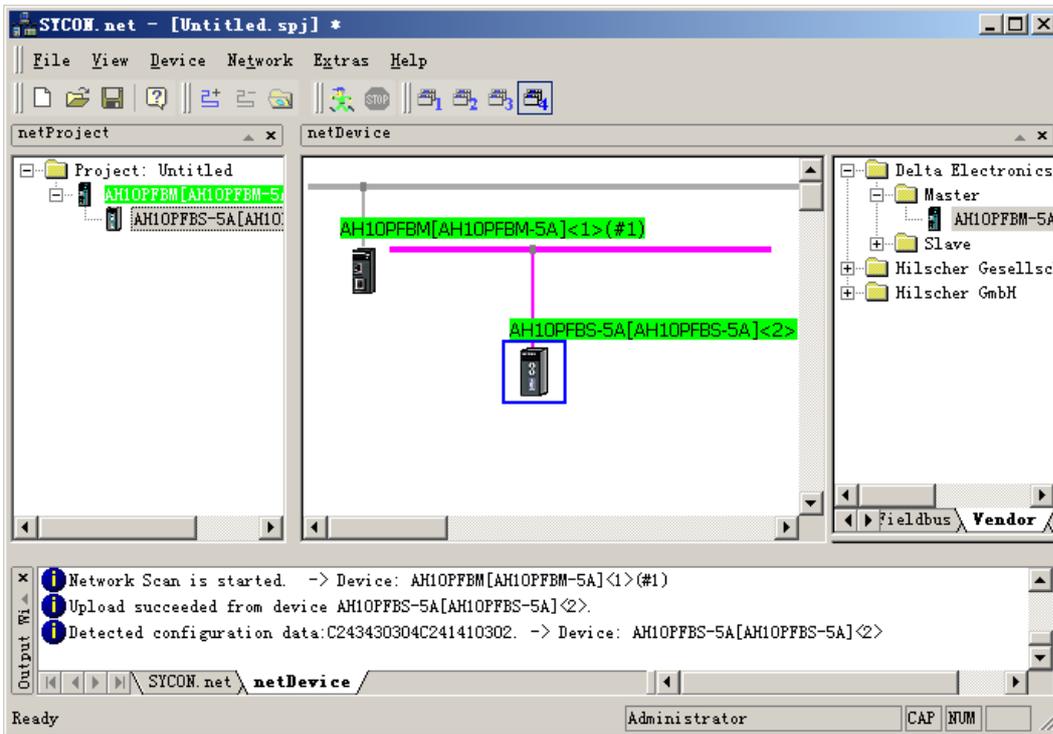
14. Right click the master and select "Disconnect" from the menu which pops up.
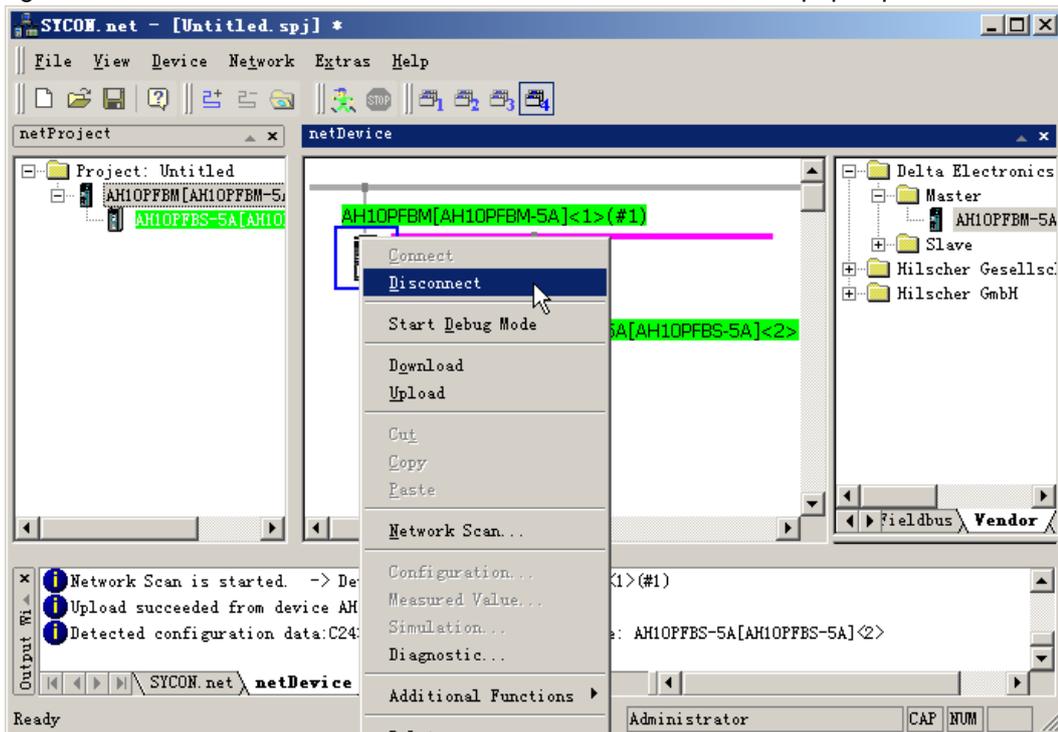
15. And then return to the main interface of the software.
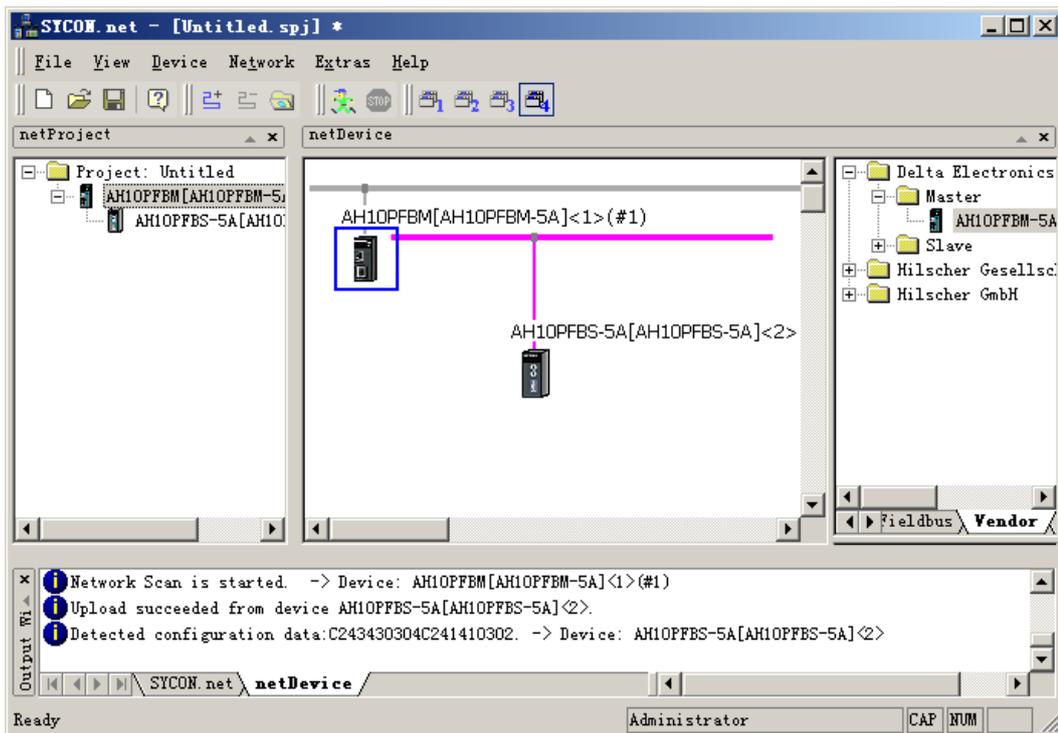
16. Double click the slave icon and then the slave configuration interface is opened as follows. (Note: In process of creating the slave device, one default "1 Word Out, 1 Word In" module is configured and user could keep or delete it according to need)

Insert: When there is no module in "Configured Modules", select the desired module in "Available Module"; click "Insert" and then the selected module is added to "Configured Module". When there are modules existing in "Configured Modules", select the desired module in "Available Module"; click "Insert" and then the selected module is inserted above the selected module in "Configured Module".

Append: Select the desired module from "Available Modules" and add it to the last row in "Configured Modules" clicking "Append" button. Or double click the desired module in "Available Modules" and then the module is directly added to the last row in "Configured Modules".

Remove: Select the module to be deleted in "Configured Modules" and delete it clicking "Remove".

Note: The same module in "Available Modules" can be added to "Configured Modules" multiple times. Click multiple modules in "Available Modules" or "Configured Modules" while pressing Ctrl key and then the multiple modules are selected.

17. Delete the module "1 Word Out, 1 Word In" and add "4 Word Out, 4 Word In" and "2 Word Out, 2 Word In" modules. "Available Modules" contains all configuration options AH10PFBS-5A supports. "Configured Modules" includes the actual configuration option. The lengths of input and output data for AH10PFBS-5A are the sum of lengths of input and output data of all configuration options respectively. The following Inputs, Outputs and In/Out are the data with the unit: byte. In/Out refers to the respective length of the input data and output data.

In the following AH10PFBS-5A configuration, the total length of input data is 12 bytes (6 words); the total length of output data is 12 bytes (6 words).

The corresponding input and output lengths in the configuration are shown below

Module	Input length (Unit: byte)	Output length (Unit: byte)
4 Word out, 4 Word In	8	8
2 Word out, 4 Word In	4	4
Sum of lengths	12	12

18. Click "Parameters" item on the left-side window and then set the slave parameters as shown on the following three interfaces.
Pick "Common" in the following box marked in red and then double click "Hold I/O data" in order to set the handling of receiving the master data after AH10PFBS-5A is offline.
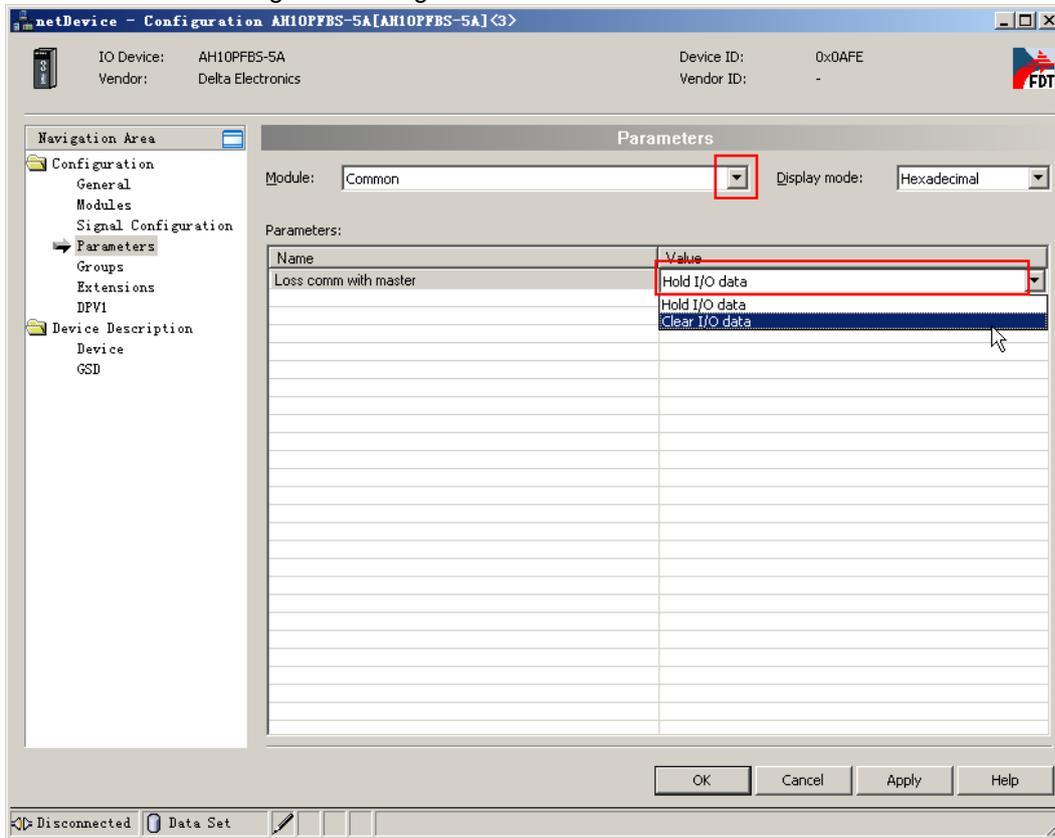
Name	Setting	Explanation
Loss comm with master	Hold I/O data	After AH10PFBS-5A is disconnected from the master, the data that the slave receives from the master will remain the same as they were before disconnection.
	Clear I/O data	After AH10PFBS-5A is disconnected from the master, the data that the slave receives from the master will be cleared to 0.

Select "<Slot 1> 4 Word Out 4 Word In" in the box marked in red and then double click the place marked in blue as below so as to set the starting addresses for input and output of the configured module.
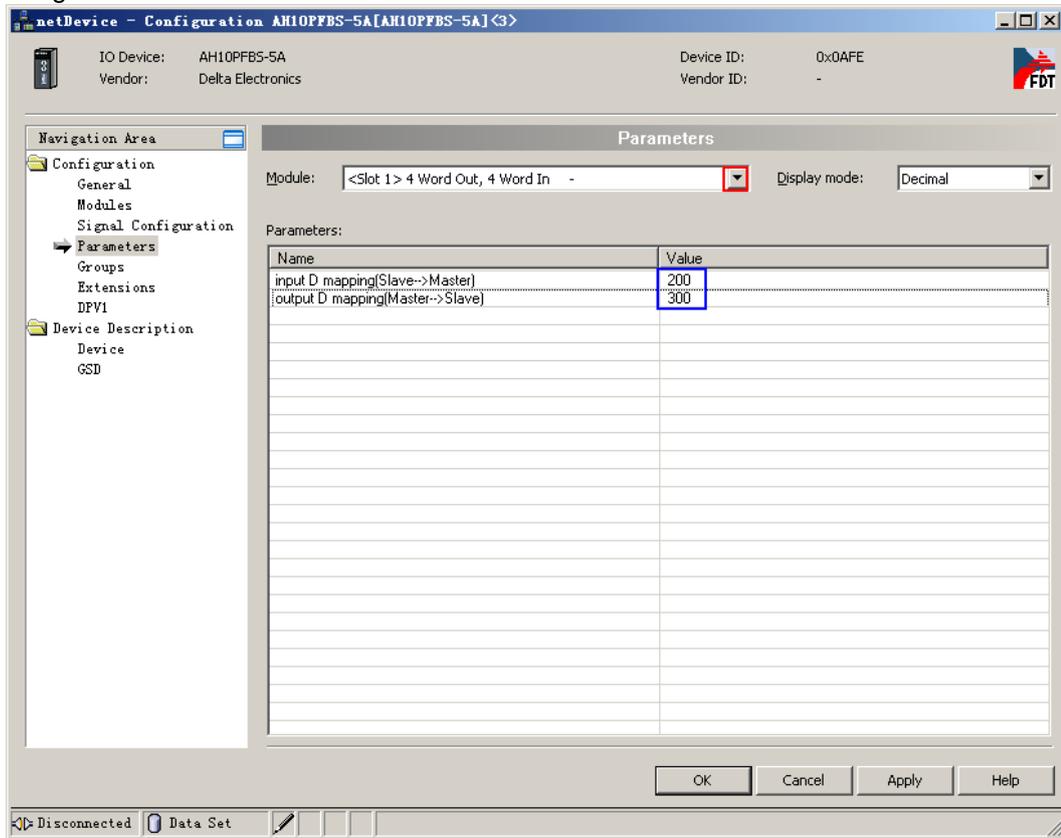
Name	Setting	Value
Input mapping (slave->master)	The initial number of the D registers in the slave PLC (The register is for sending data to the master)	D200
Output mapping (master->slave)	The initial number for the D registers in the slave PLC (The register is for receiving data that the master transmits).	D300

（Note: the initial D register No. of each configured module must be set up separately.）

Select "<Slot 2> 2 Word Out 2 Word In" in the box marked in red and then double click the place marked in blue as below so as to set the starting addresses for input and output of the configured module.
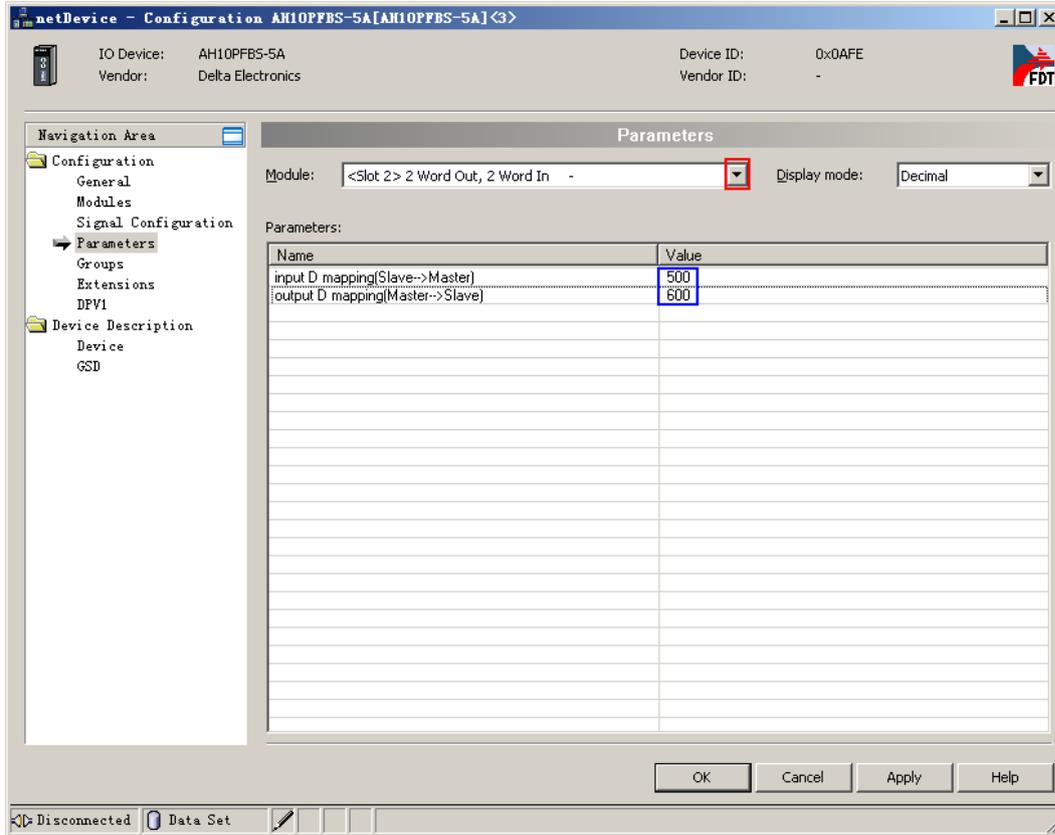
Name	Setting	Value
Input mapping (slave->master)	The initial number of the D registers in the slave PLC (The register is for sending data to the master)	D500
Output mapping (master->slave)	The initial number for the D registers in the slave PLC (The register is for receiving data that the master transmits).	D600

Note: the initial D register No. of each configured module must be set up separately.

Click "Signal Configuration" on the left-side window and then the detailed information about the configured module appears on the right-side window. The input and output data lengths of configured module on the above window can be seen from the following window.

The configured module of the slave corresponds to the mapping parameter of the slave as follows.

Configured module of slave		Mapping parameter of slave
4 Word Out, 4 Word In	Output_1	D300
	Output_2	D301
	Output_3	D302
	Output_4	D303
	Input_1	D200
	Input_2	D201
	Input_3	D202
	Input_4	D203

Configured module of slave		Mapping parameter of slave
2 Word Out, 2 Word In	Output_5	D600
	Output_6	D601
	Input_5	D500
	Input_5	D501
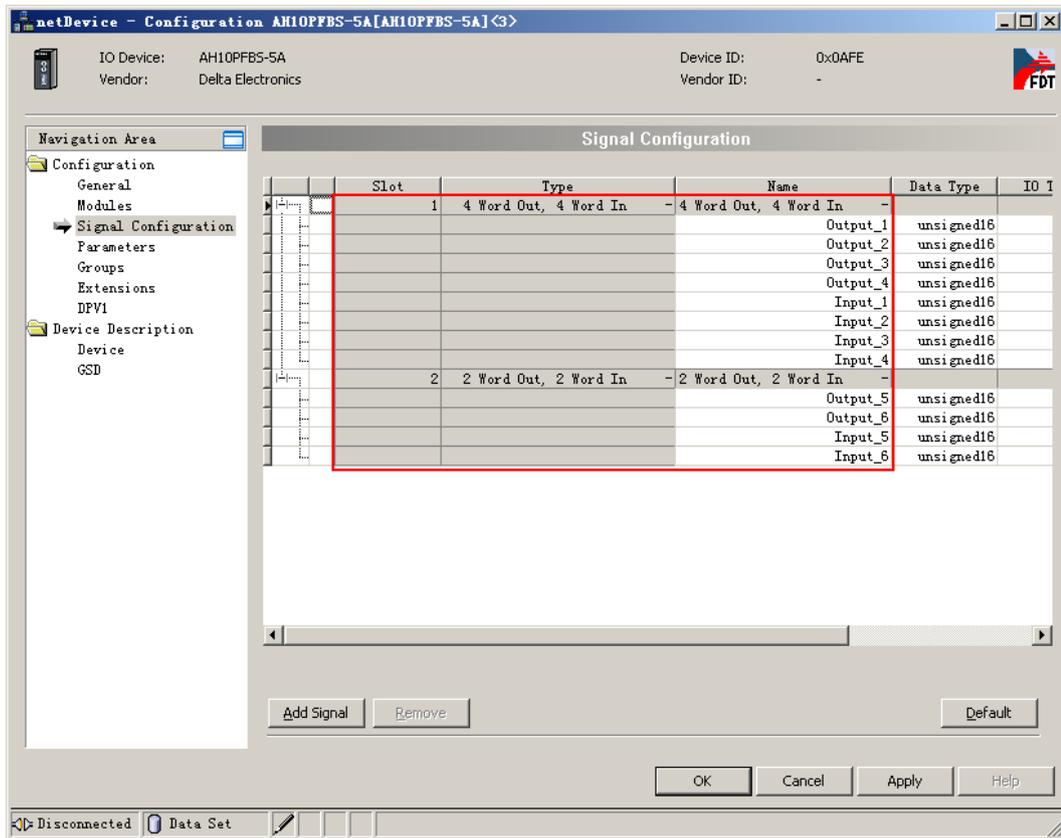
19. Click "Extensions" on the left-side window and then the following settings are done.
    (Note: The settings here are default. For the meaning of each option, please refer to section 10.2 in the SYCON.net help.)

20. After configuration of the slave module is completed, click "OK" to exit from the configuration interface and return to the main interface of the software.

21. Double click the master icon to enter the master configuration interface and start to set the master parameters.
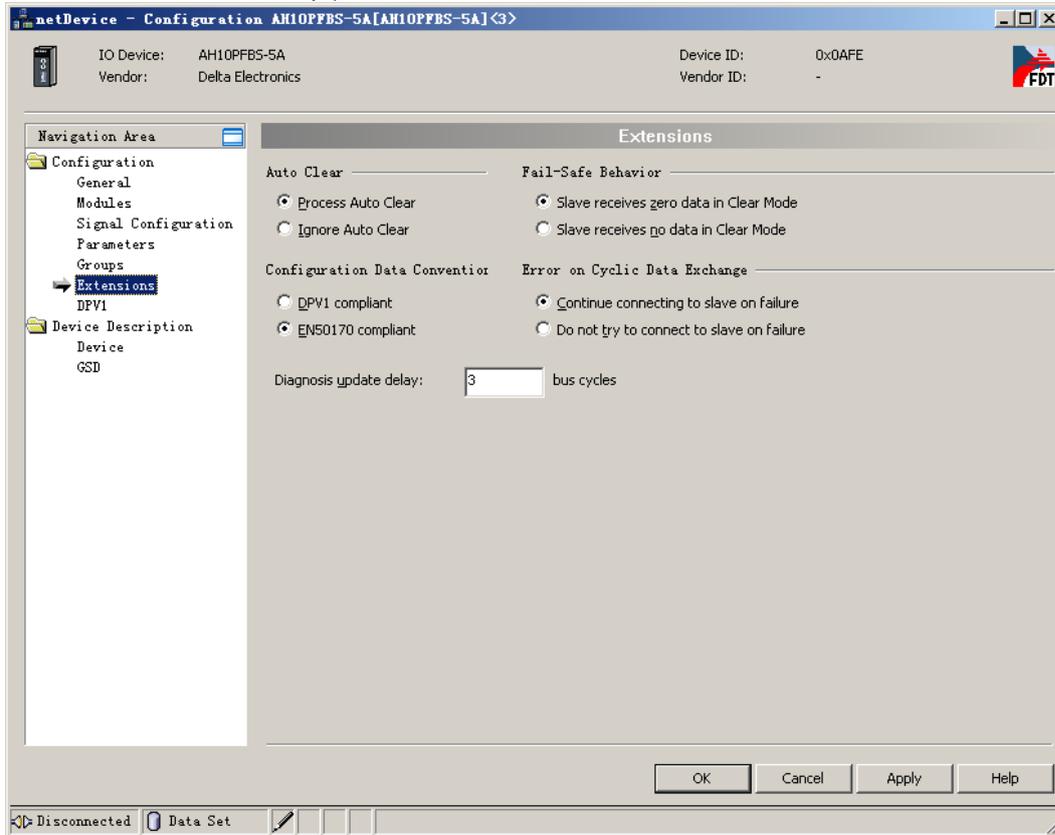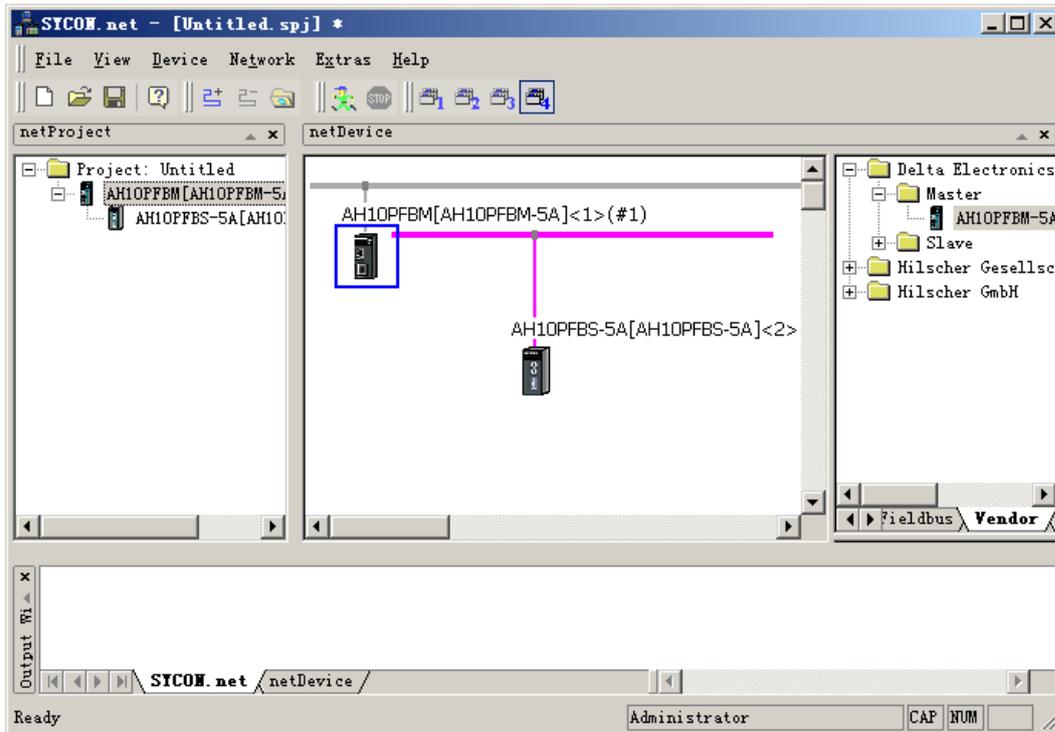
22. Click "Bus Parameters" on the left-side window to do the setting of the parameters.
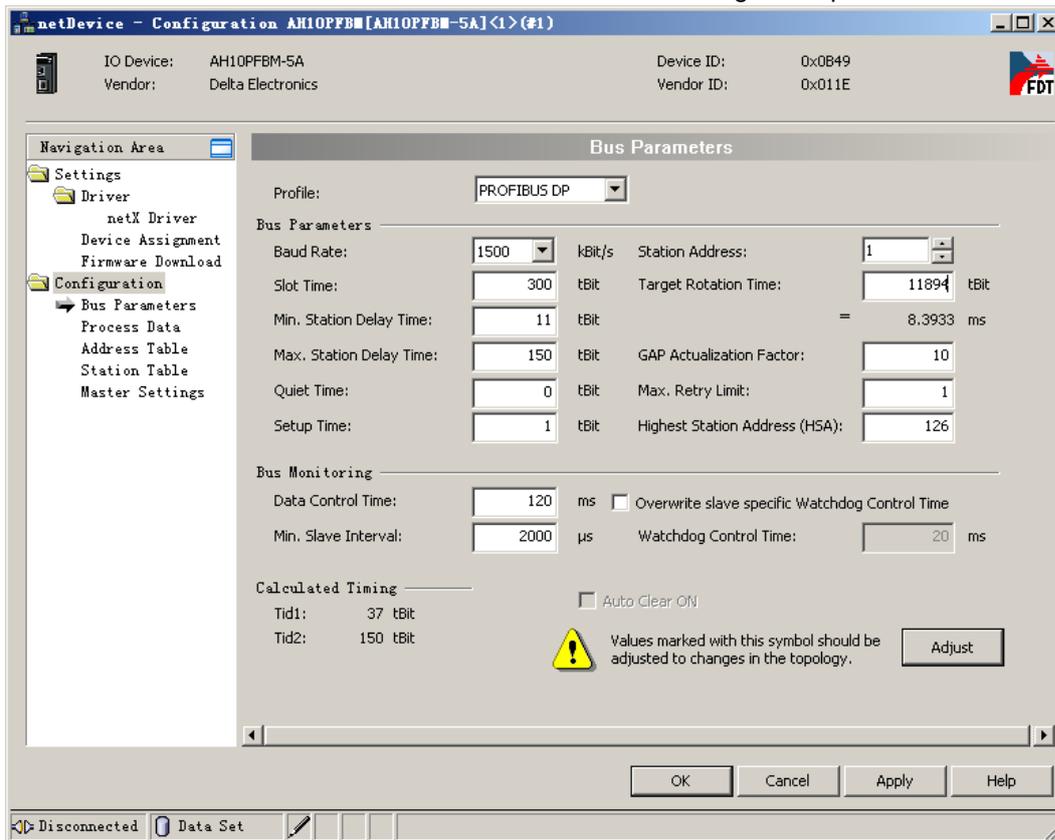
23. Pick "Overwrite slave specific Watchdog Control Time" and then click "Adjust" button to make an automatic adjustment of the bus parameters.
    (For the meaning of each item, please refer to section 10.3.2 in the SYCON.net help.)
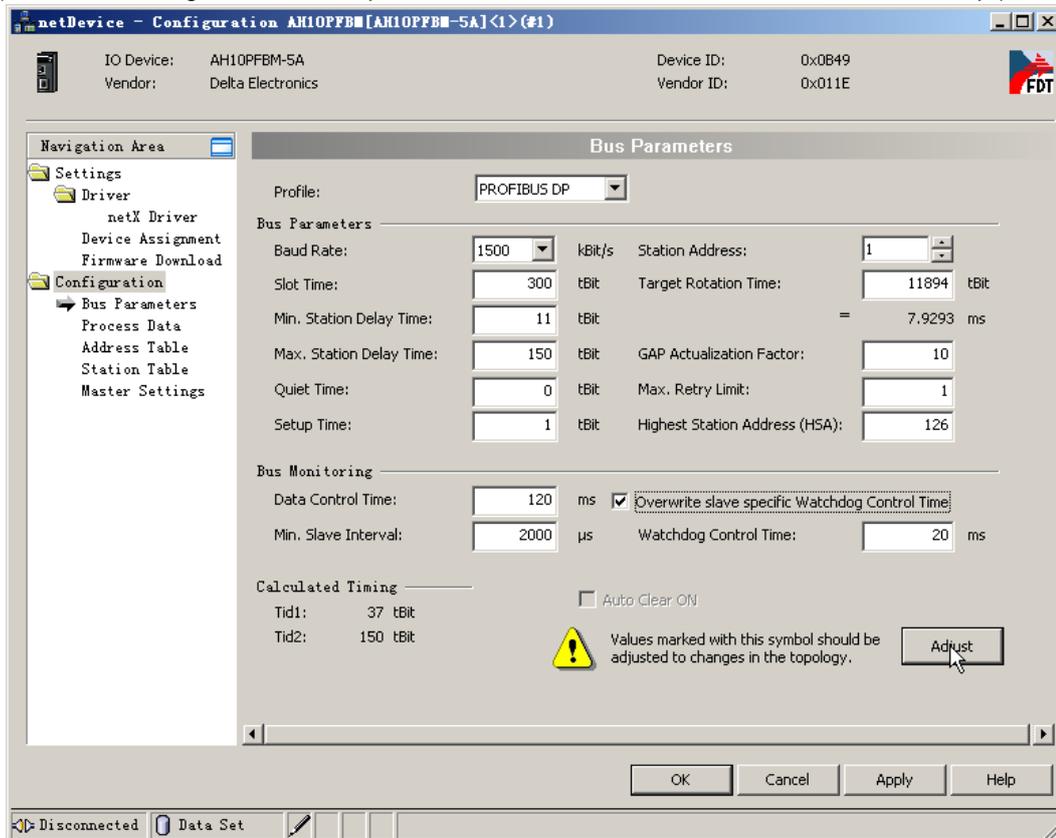
24. Click "Address Table" on the left-side window to set the offset addresses of master. For details, please refer to "I/O Mapping relations between master PLC and slave PLC" in the following section.
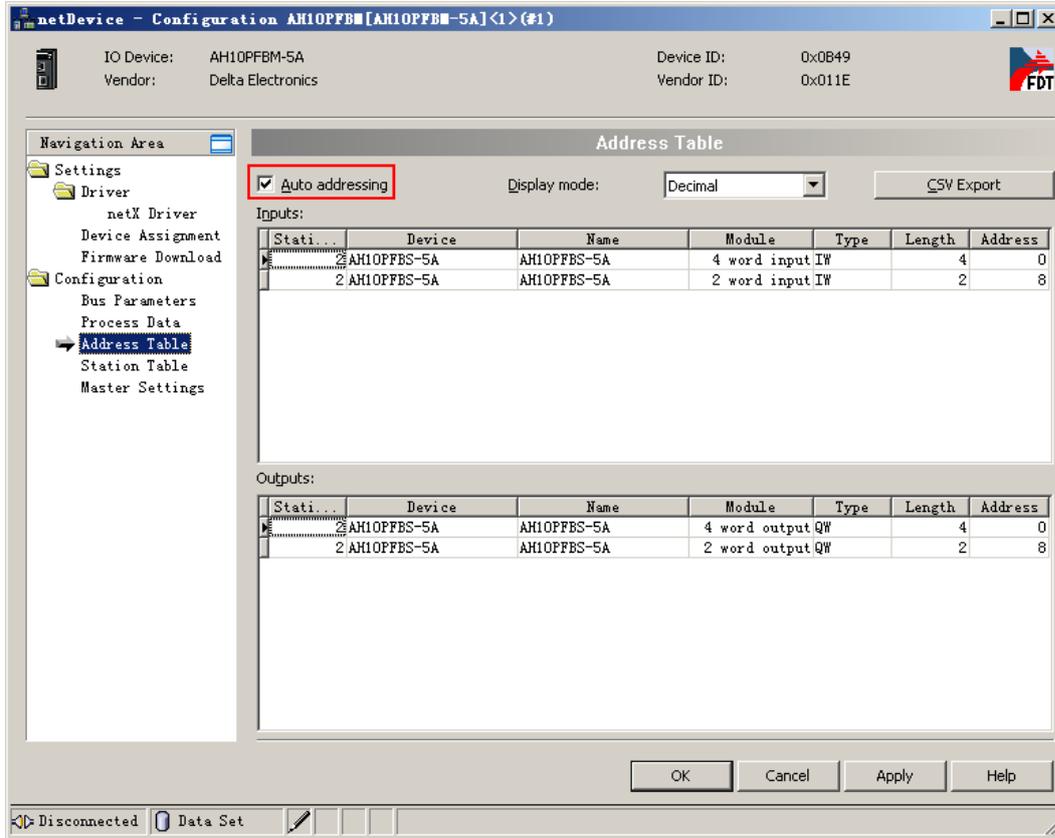
Click "Process Data" on the left-side window and the details about the slave configuration pop out on the right-side window. The corresponding relations among the slave configuration modules, the Input list and the Output list of master and the mapping parameters of the slave are listed in the following table.

Module in the Input list of master	Configured module of slave	Mapping parameter of slave	
4word input	4 Word Out, 4 Word In	Input_1	D200
		Input_2	D201
		Input_3	D202
		Input_4	D203
2 word input	2 Word Out, 2 Word In	Input_5	D500
		Input_6	D501

Module in the Output list of master	Configured module of slave	Mapping parameter of slave	
4 word output	4 Word Out, 4 Word In	Output_1	D300
		Output_2	D301
		Output_3	D302
		Output_4	D303
2 word output	2 Word Out, 2 Word In	Output _5	D600
		Output_6	D601
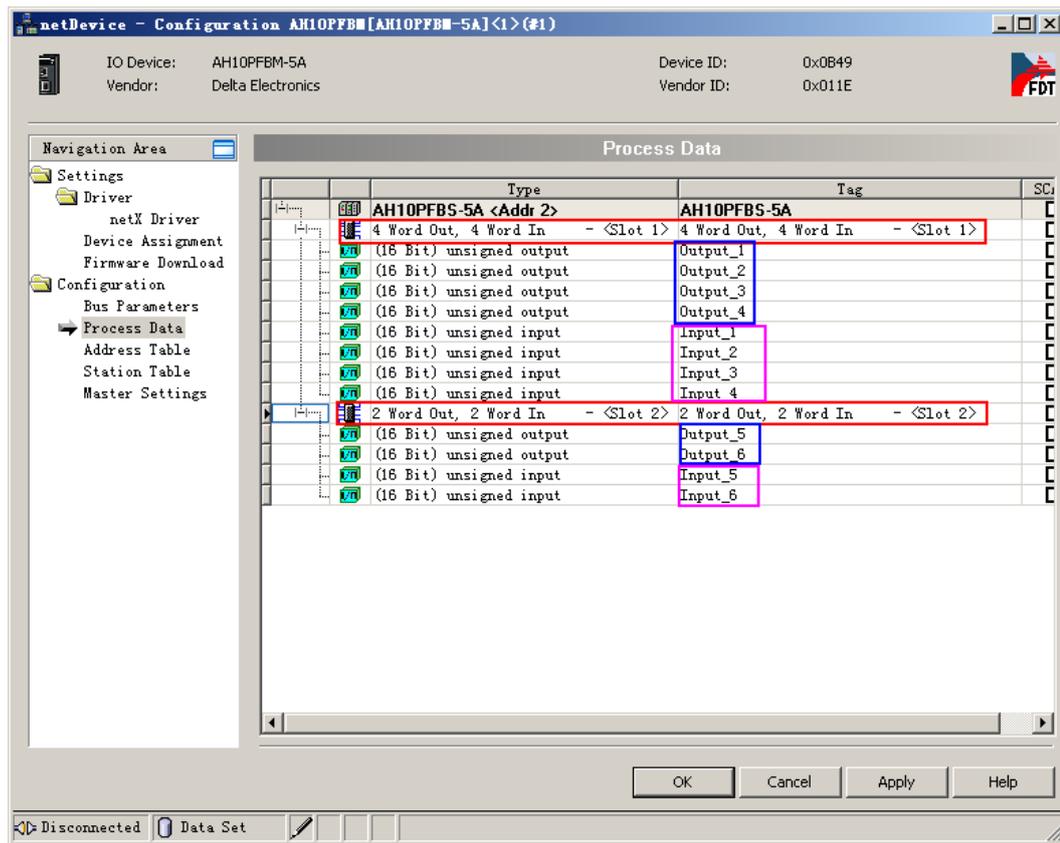
25. Click "Station Table" on the left-side window and then click the red box on the right-side window to modify the node address of the slave on the software.
(Note: Pick the place of "Activate" column as below. Otherwise, the configuration data of the slave will be invalid).
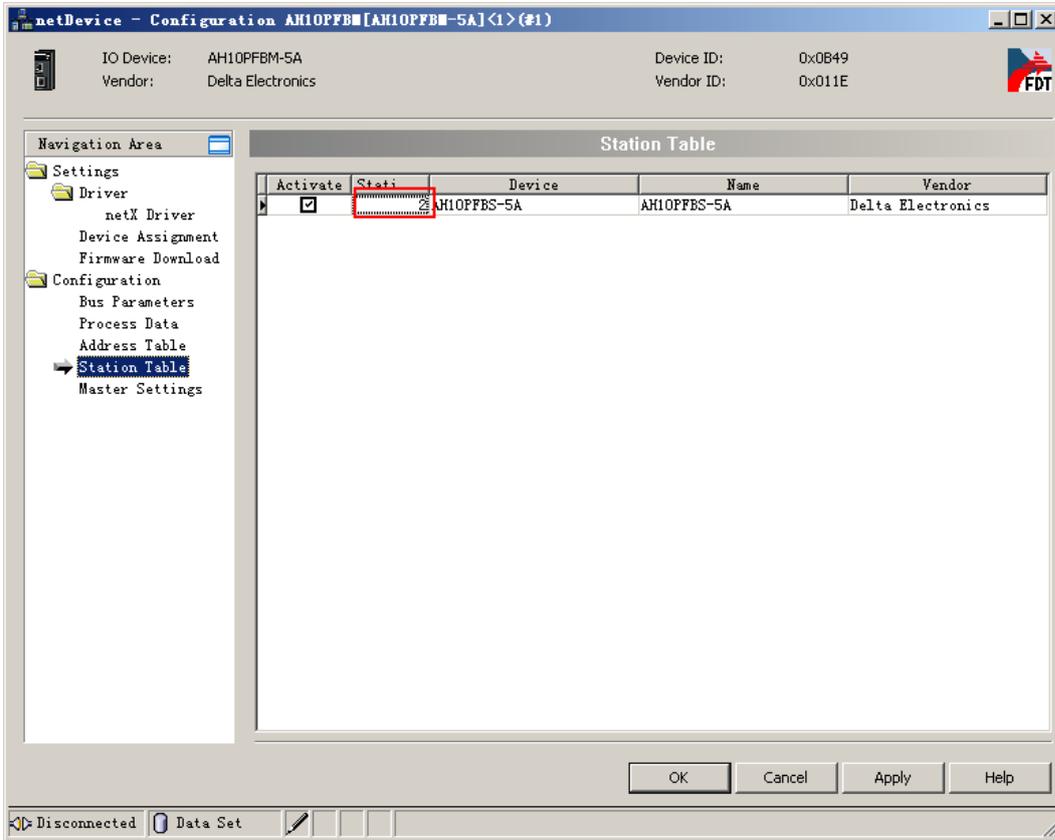
26. Click "Master Settings" on the left-side window to set the master parameters.
    (The settings here are default. For the meaning of each item, please refer to section 10.3.2 in the SYCON.net help.)
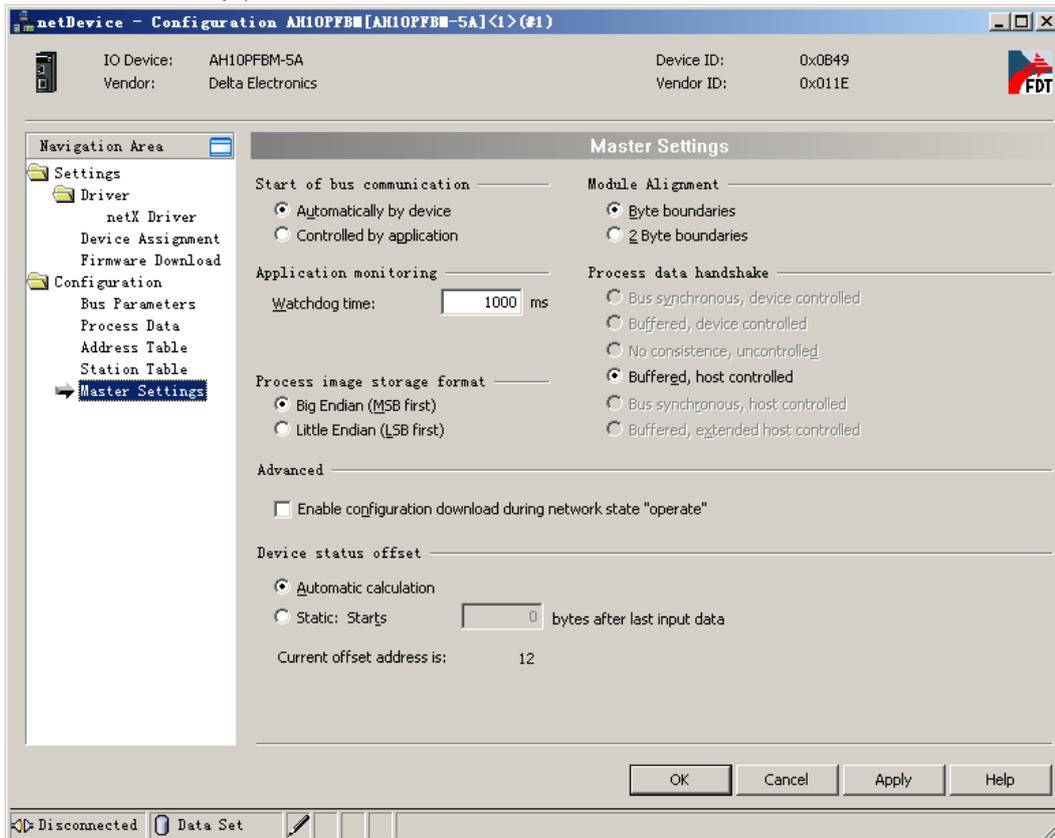
27. After setting the master parameters is over, click "OK" to exit from the master parameters setting interface and return to the main interface of the software.
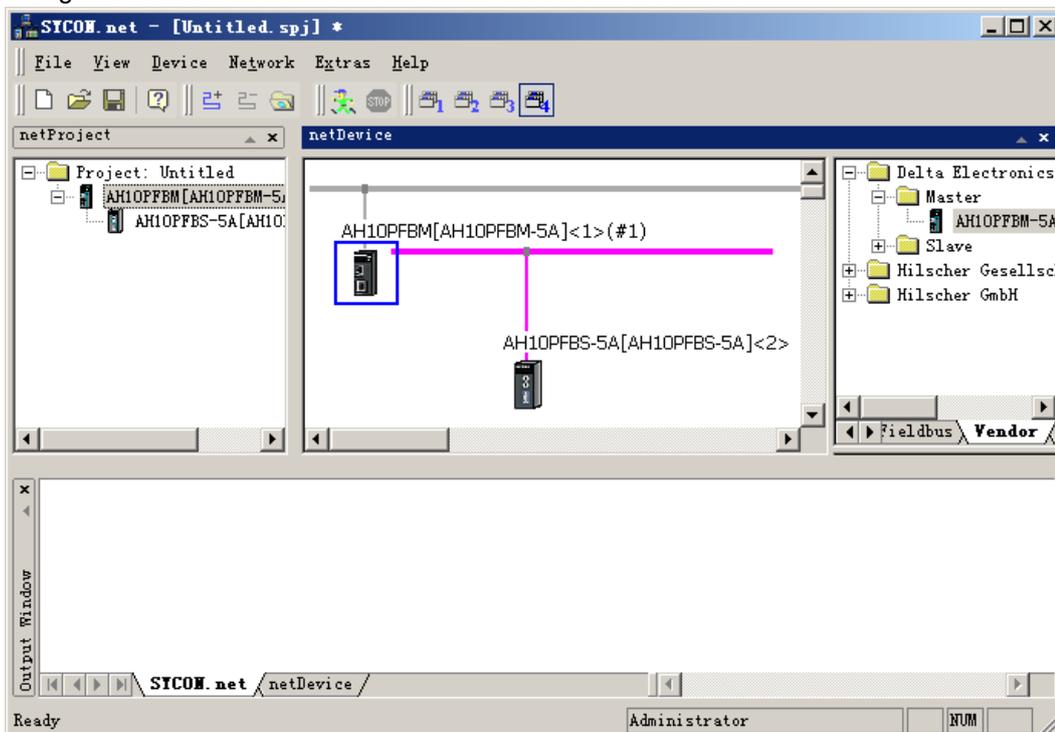
28. Right click the master module and select "Download" from the menu which pops up to download the configuration data to the master.
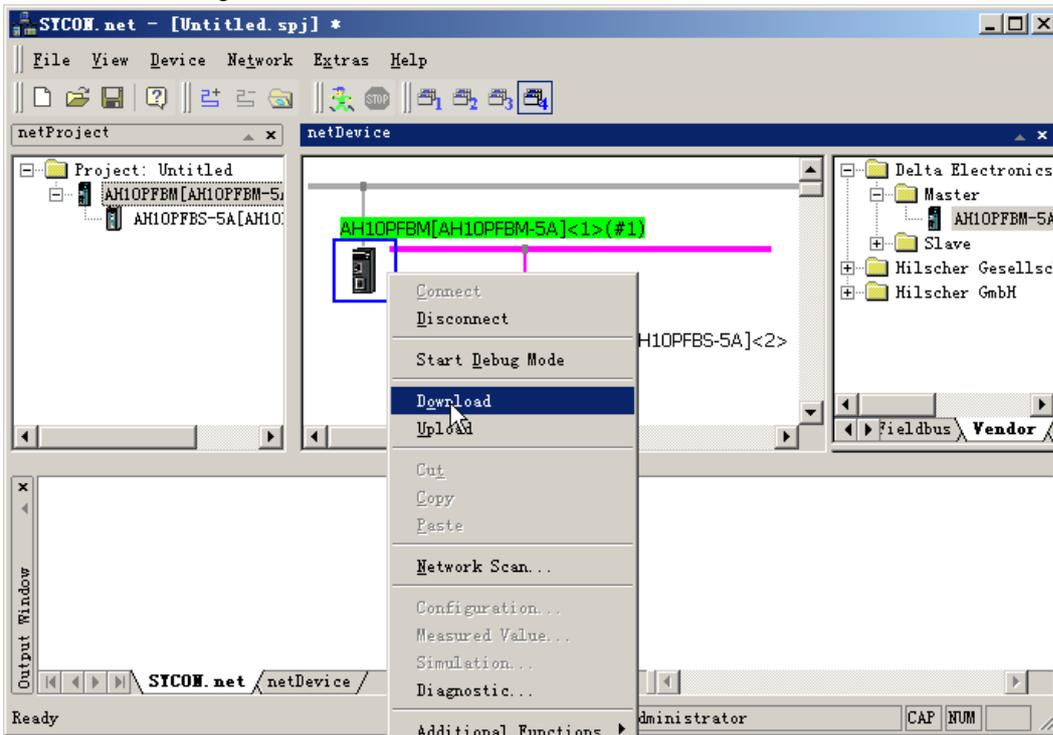
29. The following window appears; click "Yes" to continue to download then.
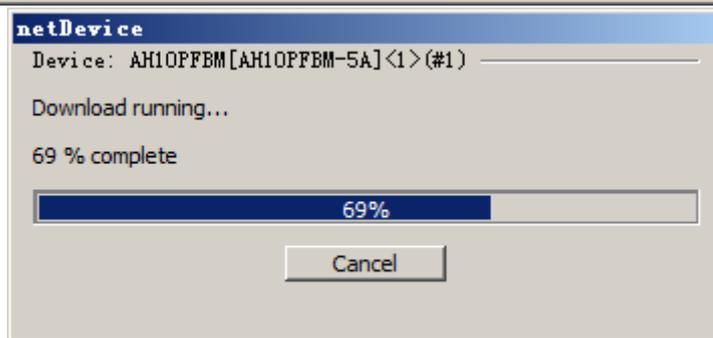
30. Return to the main interface of the software after downloading is completed.

(Note: After downloading is completed, the three indicators of the master are all green and the digital display shows the node address of the master, which indicates that the network communication is normal.)
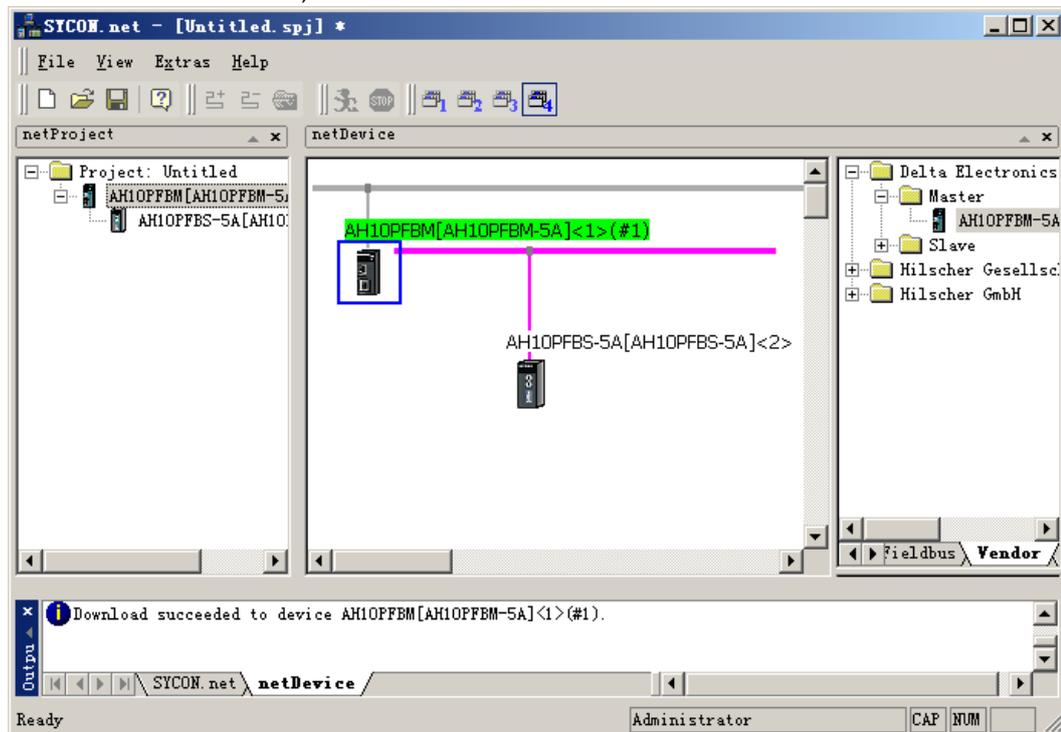
12.6.5 I/O Mapping Relations between Master PLC CPU and Slave PLC CPU

The following interface shows the starting addresses and lengths of the OUTPUT area and INPUT area that PLC CPU assigns to the master module. The data in OUTPUT area are sent to the slave and the INPUT area receives the data from the slave.
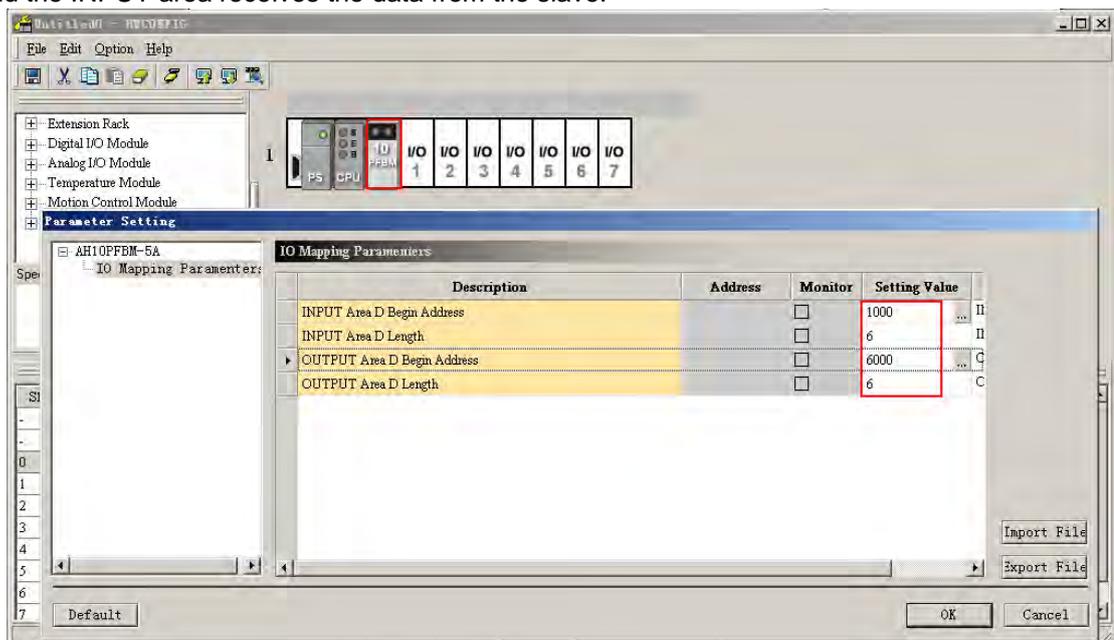
It is the mapping addresses the master assigns to the configured module parameters of the slave on the following interface. It can be seen that the configured modules of the slave corrspond to the starting number of D registers in OUTPUT and INPUT areas of the master PLC through the interfaces above and below.

Address: it is the offset of the starting addresses in INPUT and OUT areas that the AH PLC CPU assigns to the master module with the Unit: byte. If "Auto Addressing" is picked on the following interface, Address will be counted automatically; if not picked, the offset address can be input by manual, user could reserve the space for the mapping address of the master and the original mapping relation between master and slave keeps unchanged when the length of the slave parameter is modified.

The counting of the starting D register in the master PLC corresponding to the configured module of the slave:

The starting number of the D registers in OUTPUT area of the master PLC corresponding to the slave configured module = the starting address in OUTPUT area + (Address/2).

The starting number of the D registers in INPUT area of the master PLC corresponding to the slave configured module = the starting address in INPUT area + (Address/2).

The above is explained based on the connection of the master and AH10PFBS-5A slave. The mapping relations between D registers in the master PLC and the configured modules of the slave are related with the master parameters settings. For more details, please refer to section 10.3.3 in the help.
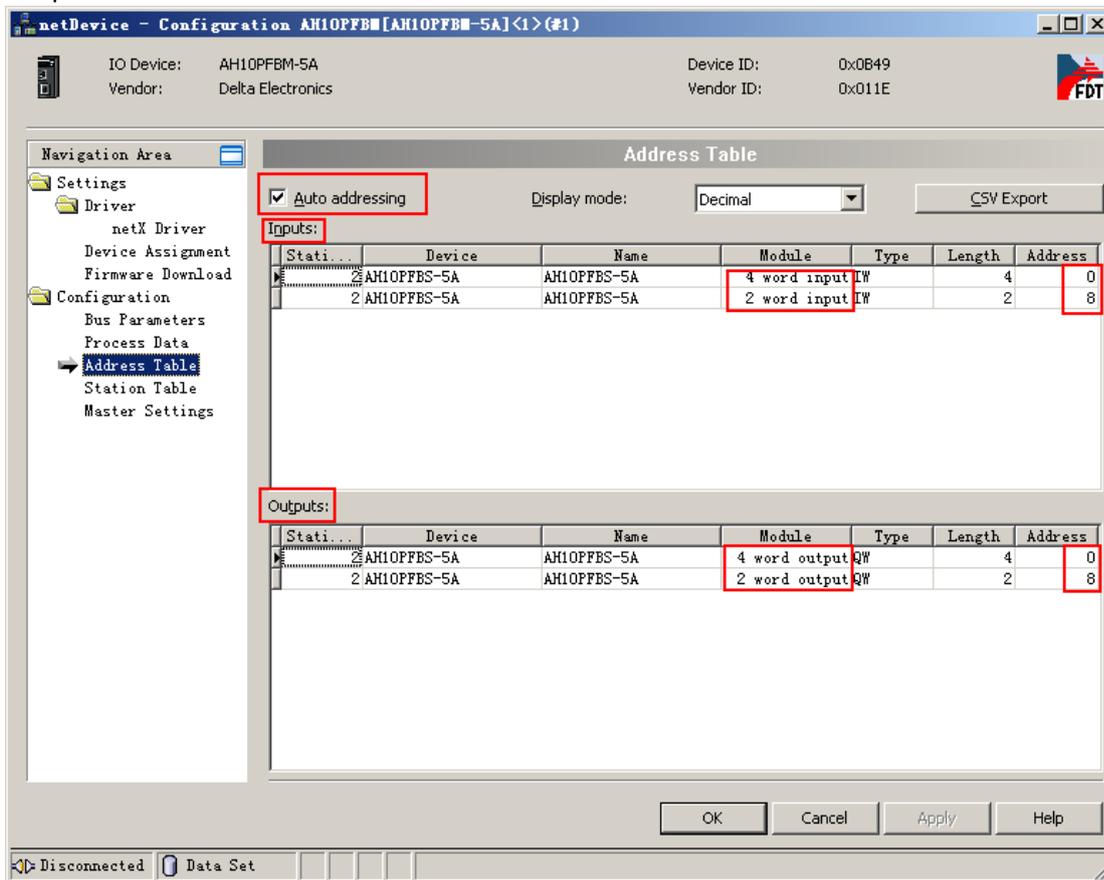
As the two interfaces above show, the starting addresses of the INPUT and OUTPUT areas that AH PLC assigns to the master module are D1000 and D6000 respectively. On the above interface, the input offset address for 4 word input is 0 and the corresponding starting number of D registers in the master PLC is 1000（1000=1000+0/2）. The input offset address for 2 word input is 8 and the corresponding starting number of D registers in the master PLC is 1004（1004=1000+8/2）. The output offset address for 4 word output is 0 and the corresponding starting number of D registers in the master PLC is 6000（6000=6000+0/2）; the output offset address for 2 word output is 8 and the corresponding starting number of D registers in the master PLC is 6004（6004=6000+8/2）.

I/O mapping relations between master PLC and slave PLC

Register in master PLC		Register in slave PLC
D6000		D300
D6001		D301
D6002	⇒	D302
D6003		D303
D6004		D600
D6005		D601

Register in master PLC		Register in slave PLC
D1000		D200
D1001		D201
D1002	⇐	D202
D1003		D203
D1004		D500
D1005		D501

Note: The PROFIBUS DP data are transmitted in cycle.

12.6.6 PLC Programs Writing

【**Control program in master PLC**】

Write the program through the ISPsoft software

After the master PLC runs and M0 is ON, write 500~505 to the corresponding D6000~D6005 in the master PLC respectively and the values in D6000~D6005 are sent to the slave through PROFIBUS.
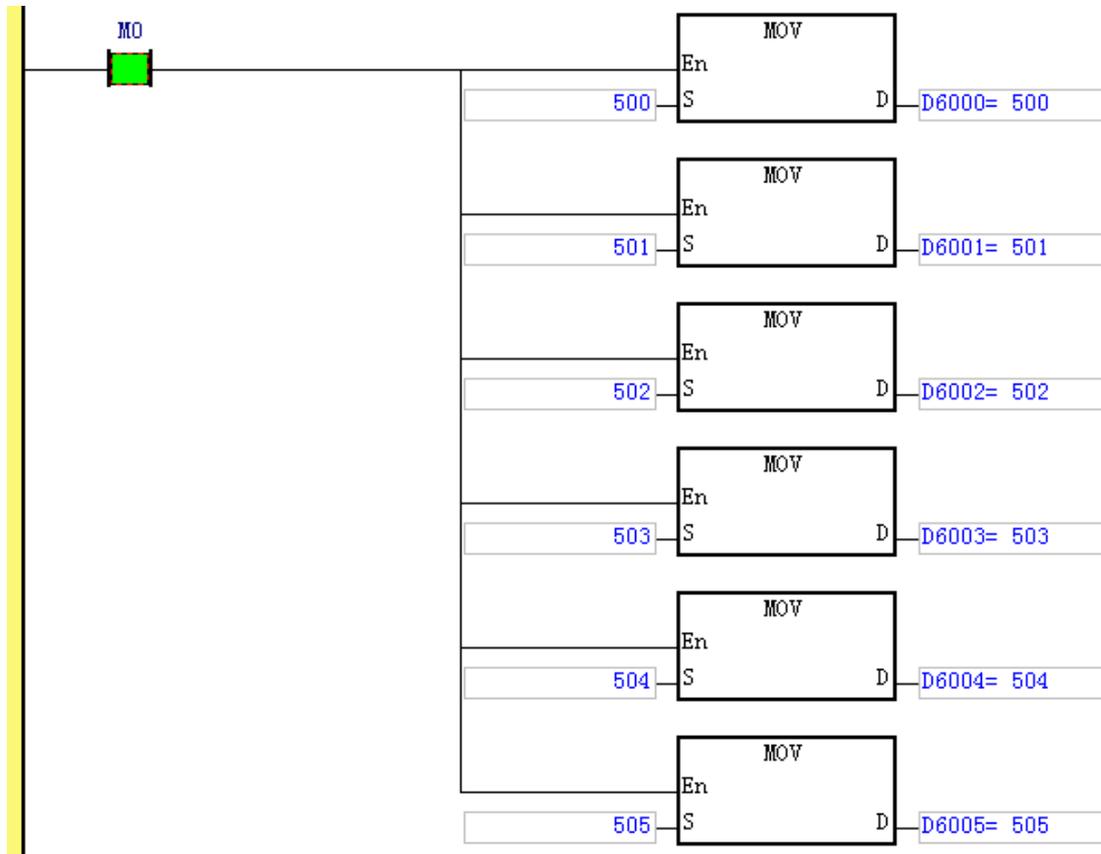
【**Control program in slave PLC**】

Write the program through the ISPsoft software

After the slave PLC runs and M1 is ON, write 100~103 to the corresponding D200~D203; 104 and 105 to D500 and D501 respectively in the slave PLC.

The values in D200~D203, D500 and D501 are sent to the master through PROFIBUS.
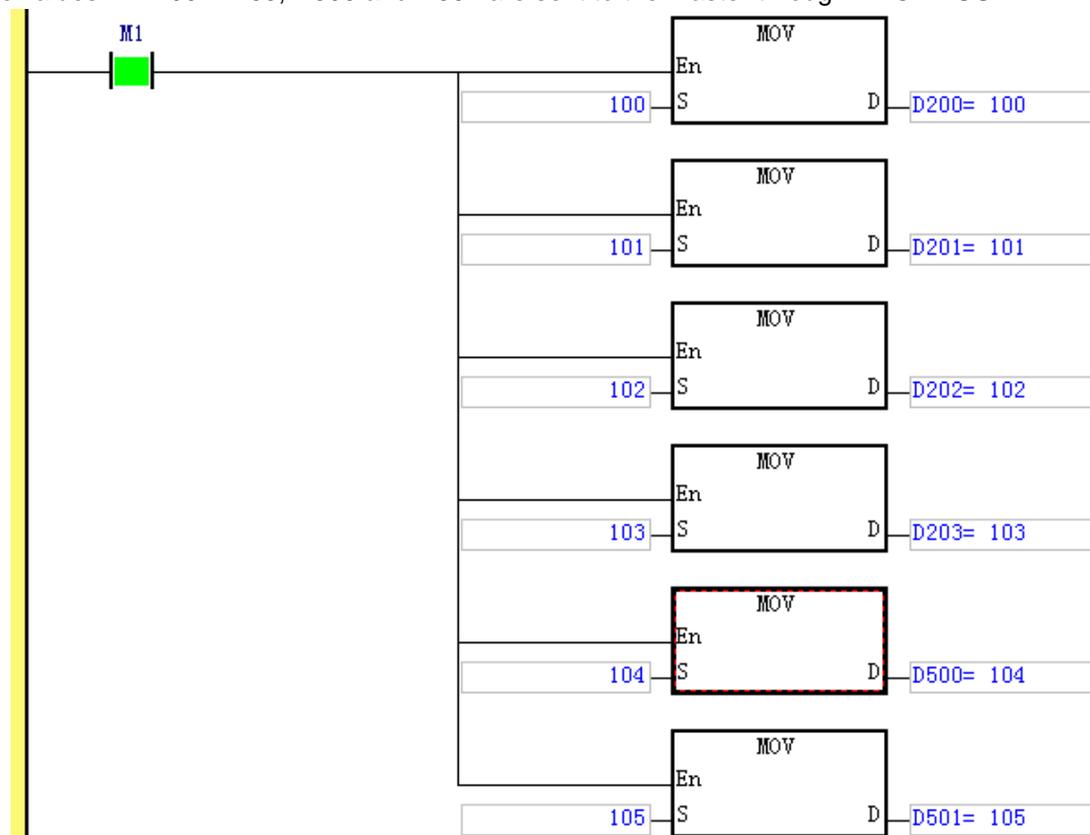
【**Program Execution**】

Before the master establishes the communication with the slave, the data in registers D of the master and slave for exchange are shown as the following table.

Register in master PLC	Value (Decimal)	No data transmitted	Register in slave PLC	Value (Decimal)
D6000	500		D300	0
D6001	501		D301	0
D6002	502		D302	0
D6003	503		D303	0
D6004	504		D600	0
D6005	505		D601	0
D1000	0		D200	100
D1001	0		D201	101
D1002	0		D202	102
D1003	0		D203	103
D1004	0		D500	104
D1005	0		D501	105

After the master establishes the communication with the slave, the data in registers D of the master and slave for exchange are shown as the following table.

Register in master PLC	Value (Decimal)	Data transmitted through PROFIBUS	Register in slave PLC	Value (Decimal)
D6000	500		D300	500
D6001	501		D301	501
D6002	502	⇒	D302	502
D6003	503		D303	503
D6004	504		D600	504
D6005	505		D601	505
D1000	100		D200	100
D1001	101		D201	101
D1002	102	⇐	D202	102
D1003	103		D203	103
D1004	104		D500	104
D1005	105		D501	105

12.7 LED Indicator and Trouble-shooting

AH10PFBM-5A provides 6 kinds of diagnosis methods such as the indicators, digital displays, registers in normal exchange area, ISPSoft software, registers in input area, SYCON.net software.

12.7.1 Indicators

● **RUN LED**
RUN LED displays the status of PLC CPU on the left of AH10PFBM-5A.

LED status	Indication	How to correct
Green light on	PLC is in RUN status.	--
Off	PLC is in STOP status.	Turn the RUN/STOP switch of AH PLC to RUN or check if the hardware configuration in AH PLC is consistent with that in the actual rack.

● **SYS LED**
SYS LED displays if the internal hardware or firmware of AH10PFBM-5A is normal.

LED status	Indication	How to correct
Green light on	After power on, the red light flickers once, which indicates the firmware is initializing and then green light is on constantly.	--
Red light flickers	The initializing of firmware in the master fails	Contact the factory if the error still exists after re-powering 10PFBM.
Red light on	The initializing of firmware in the master fails	Contact the factory if the error still exists after re-powering 10PFBM.

● **DP LED**

DP LED displays if the communication between AH10PFBM-5A and PROFIBU DP slaves is normal.

LED status	Indication	How to correct
Green light on	Master makes the connection with the slave	--
Green light flickers	The configuration in the module is empty.	Download the appropriate configuration first. Contact the factory if the error still exists.
Red light on	All slaves are offline.	1. Detect if the PROFIBUS DP bus connection is proper. 2. Detect if either end of the network is added the terminal resistor.
Red light flickers	At least one slave is offline	1. Detect if the PROFIBUS DP bus connection is proper. 2. Detect if both ends of the network have connected the terminal resistors respectively.

12.7.2 Digital Display

The digital display displays the state of AH10PFBM-5A.

Code	Indication	How to correct
0~ 7D	When AH10PFBM-5A works normally, the digital display displays its node address.	--
80	AH10PFBM-5A is in STOP status.	Turn the RUN/STOP switch of PLC to RUN or check if the hardware configuration in AH PLC is consistent with that in the actual rack.
E2	AH10PFBM-5A detects that one slave is offline.	1. Detect if the PROFIBUS DP bus connection is proper. 2. Detect if both ends of the network have connected the terminal resistors respectively.
E6	An error of some modules connected to AHRTU-PFBS-5A is detected by the master.	Check the modules connected to AHRTU-PFBS-5A.
F1	The configuration in the master module is empty.	Download the appropriate configuration.
F2	PLC does not assign the I/O mapping area to the master	Assign the appropriate I/O mapping area to the master via ISPSoft
F3	Master enters test mode	Re-power it.
F4	Master initializing error	Contact the factory if the error still exists after re-powering 10PFBM.
F5	Timeout for the communication between chips inside master	Contact the factory if the error still exists after re-downloading the appropriate configuration.
F6	Internal storage unit error	Contact the factory if the error still exists after re-powering 10PFBM.
F7	Data exchange unit error	Contact the factory if the error still exists after re-powering 10PFBM.
F8	the master serial number detection error	Contact the factory if the error still exists after re-powering 10PFBM.
FB	Timeout for the data exchange with PLC	Contact the factory if the error still exists after re-powering 10PFBM.

● The display mechanism of the digital display:
1. When AH10PFBM-5A is in normal state and PLC is in RUN state, the digital display of AH10PFBM-5A only displays the node address.
2. When AH10PFBM-5A is in normal state and PLC is in STOP state, the digital display of AH10PFBM-5A displays the node address and 80 (the STOP state code of PLC) alternately.
3. When AH10PFBM-5A is in error state, the digital display of AH10PFBM-5A displays the error code.
4. When the slave is offline and PLC is in RUN state, the display of AH10PFBM-5A displays E2 and the node address of the offline slave alternately. For example, E2, 02, E2 and 03 appear in a cycle, which means the slaves of No. 2 and No.3 are offline.
5. When the slave is offline and PLC is in STOP state, the display of AH10PFBM-5A displays 80 (the STOP state code of PLC), node address of the master, E2 and node address of the offline slave. For example, 80, 01, E2, 02, 80, 01, E2 and 03 appear in a cycle, which means PLC is in STOP state; the node address of the master is 1 and the slaves of No. 2 and No. 3 are offline.
6. When many errors occur in the master, only the high-priority error code is shown. The error codes are F7, F6, F3, F4, F8, F5, F1, E2/80, F2 and FB in order of priority from high to low. E2 and 80 have the same priority. If the two errors occur simultaneously, the display will show E2 and 80 alternately.

12.7.3 Registers in Normal Exchange Area in AH10PFBM-5A

The registers in the normal exchange area in AH10PFBM-5A display if the current state of the PROFIBUS DP network is normal.

Click the following place marked in pink box; the "Manual Assignment" dialog box appears, where set the starting number of the register in the normal exchange area while configuring the hardware in the ISPSoft software.
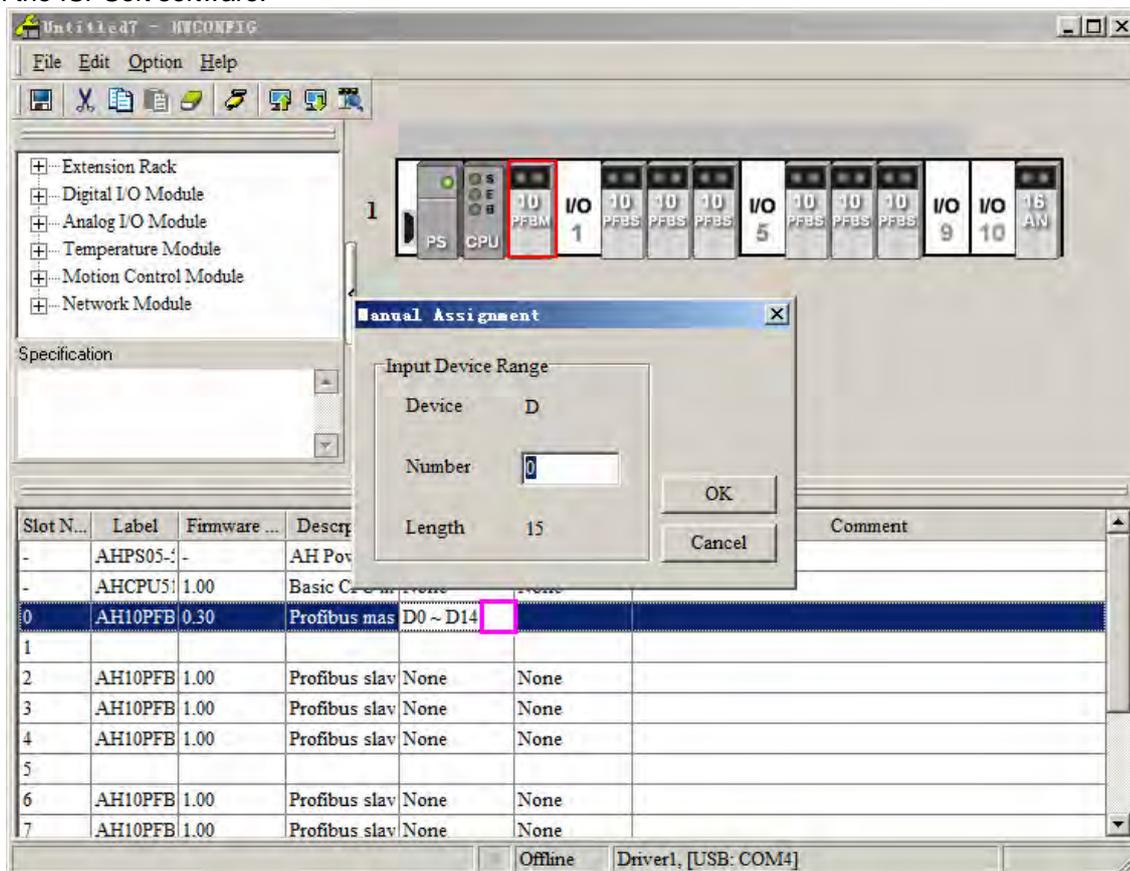
Double click the 10PFBM icon in the HWCONFIG window; the "Parameter Setting" dialog box pops up and then click "Normal Exchange Area" tab as below.
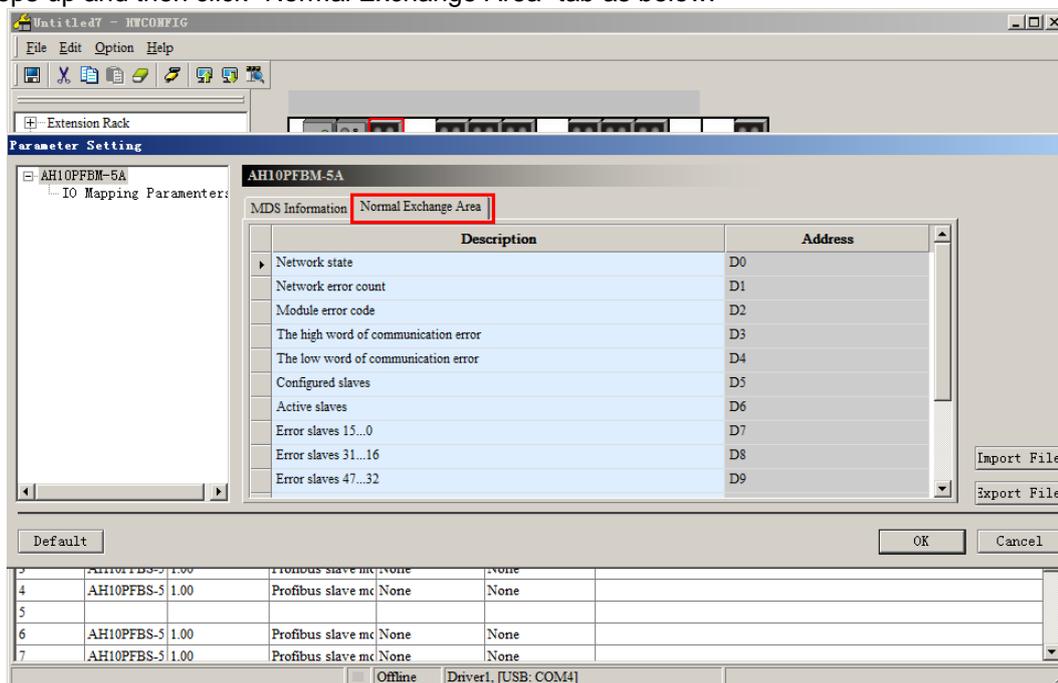
Explanation of corresponding registers in the normal exchange area in AH10PFBM-5A.

Item	Content value	Description	Treatment
Network state	0	Not found	Check if the hardware configuration for AH PLC CPU has configured the master. Refer to section 15.1 on PLC hardware configuration.
	1	Offline	The master has not configured the slave. Add the slave and then download the configuration once again.
	2	STOP	Select "Start Communication" from "Additional Functions" in the software.
	3	Idle （PLC CPU is in STOP state）	Restore PLC to RUN or check if the hardware configuration for PLC CPU is consistent with the actual configuration of the rack.
	4	RUN	No action needed.
Network error count	-	How many times for the slave which is offline on the network since the master is powered on.	1. Check if the PROFIBUS DP bus is connected correctly. 2. Check if either end of the network is added with the terminal resistor.
System error code	-	Consistent with the PROFIBUS network error codes in the PLC system log that is read via ISPSoft. For more details, refer to section 13.2.2.4.	-
The high word of communicator	-	Reserved	-

Item	Content value	Description	Treatment
error			
The low word of communicator error	-	Reserved	-
Configured slaves	-	The number of the slaves configured in the master.	-
Active slaves	-	The number of the slaves communicating with the master normally.	-
Error slaves 15…0	-	When the master detects that the error on the slaves (of number 1~125) occurs such as offline, the corresponding bit becomes 1. (Here there are totally 128 (0~127) bits assigned. Since the node addresses of the slaves can not be 0, 126 and 127, the corresponding bit has no meaning.) Otherwise, it is 0. For more details, see the following table on the error slaves.	1. Check if the PROFIBUS DP bus is connected correctly. 2. Check if either end of the network is added with the terminal resistor.
Error slaves 31…16			
……			
Error slaves 127…112			

Corresponding relation table for error slaves:

Description	Corresponding register	Node address of corresponding slave device
Error slaves 15…0	D7（bit15~bit0）	15~0
Error slaves 31…16	D8（bit15~bit0）	31~16
……	……	……
Error slaves 127…112	D14（bit15~bit0）	127~112

12.7.4 Error Codes of PROFIBUS Network on PLC System Log Read via ISPSoft

Select menu "PLC"-> "System Log" to check the system log when ISPSoft is in monitor state.
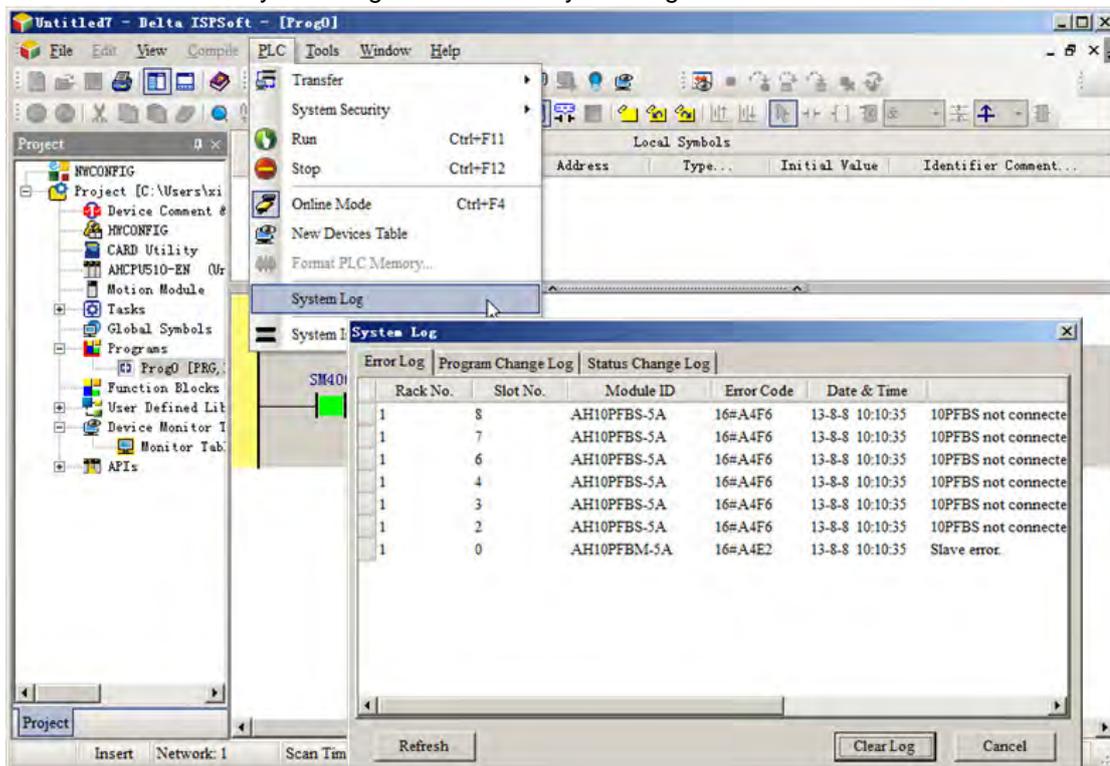
Explanation of error codes of PROFIBUS network on the PLC system log.

Error code	Explanation	Treatment
16#A4E2	AH10PFBM-5A detects that one slave is offline.	1.Detect if the PROFIBUS DP bus connection is proper. 2.Detect if both ends of the network have connected the terminal resistors respectively.
16#A4E6	An error of some modules connected to AHRTU-PFBS-5A is detected by the master.	Please check the modules connected to AHRTU-PFBS-5A.
16#A001	The configuration in the master module is empty.	Download the appropriate configuration.
16#A402	PLC does not assign the IO mapping area to the master	Assign the appropriate IO mapping area to the master via ISPSoft
16#A003	Master enters test mode	Just re-power it.
16#A404	Master initializing error	Contact the factory if the error still exists after re-powering 10PFBM.
16#A005	Timeout for the communication between chips inside master	Contact the factory if the error still exists after re-downloading the appropriate configuration.
16#A406	Internal storage unit error	Contact the factory if the error still exists after re-powering 10PFBM.
16#A407	Data exchange unit error	Contact the factory if the error still exists after re-powering 10PFBM.
16#A408	the master serial number detection error	Contact the factory if the error still exists after re-powering 10PFBM.
16#A00B	Timeout for the data exchange with PLC	Contact the factory if the error still exists after re-powering 10PFBM.

12.7.5 Explanation of Slave Status Word Registers in Input Area in AH10PFBM-5A

（Refer to Section 10.3.2 Configuration Parameters of Master in the SYCON.net help file for more details.)

12.7.6 Diagnosis of Device Status and Network Status via SYCON.net

（Refer to Chapter 12 Diagnosis of Bus Troubles via SYCON.net in the SYCON.net help file for more details.）

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Chapter 13   PROFIBUS Slave Module AH10PFBS

Table of Contents

13.1 Introduction of AH10PFBS-5A

1. Thank you for choosing Delta AH10PFBS-5A PROFIBUS-DP slave module. To ensure correct installation and operation of the product, please read this operation manual carefully before use.

2. This operation manual only provides introductory information on AH10PFBS-5A. Detailed information about PROFIBUS-DP protocol is not included in this manual. Please refer to relevant literatures for more information on PROFIBUS-DP protocol.

3. AH10PFBS-5A is a PROFIBUS-DP slave module for connecting Delta's AH500 series CPU module to PROFIBUS-DP network. It does not need to be externally connected with the power supply since its power is supplied by the rack.

4. The power module AHPS05-5A, an AH500 series PLC and the main rack are necessary for using AH10PFBS-5A.

5. AH10PFBS-5A can only be connected to the I/O slot of the main AH500 series rack instead of the extension rack.

13.1.1 Functions

- Supports PROFIBUS-DP cyclic data transmission between the master and multiple slaves
- Auto-detects baud rates; supports max. 12 Mbps
- Self-diagnosis
- Supports hot-plugging (The module could be inserted to or removed from the main rack when the main rack is powered ON.)
- The main rack can connect 8 AH10PFBS-5A modules at most.
- The I/O data of each AH10PFBS-5A supports max. 100 words of data input and 100 words of data output.

13.2 Product Profile and Outline

13.2.1 Parts
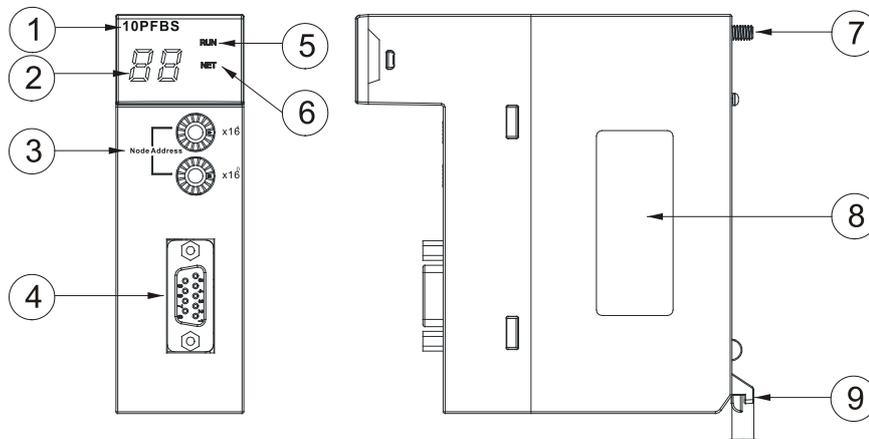
1. Model Name	2. Digital Displayer	3. Address switch
4. PROFIBUS-DP COM port	5. RUN indicator	6. NET indicator
7. Set screw	8. Nameplate	9. Module fixing projection

13.2.2 Specifications

● **PROFIBUS-DP port**

Interface	DB9 connector
Transmission method	High-speed RS-485
Transmission cable	Shielded twisted pair cable
Electrical isolation	500 V DC

● **Communication**

Message type	Cyclic data exchange
Module name	AH10PFBS-5A
GSD file	DELA0AFE.GSD
Product ID	0AFE
Serial transmission speed supported (auto-detection)	9.6 kbps; 19.2 kbps; 45.45 (31.25) kbps; 93.75 kbps; 187.5 kbps; 500 kbps; 1.5 Mbps; 3 Mbps; 6 Mbps; 12 Mbps

● **Electrical specification**

Power supply voltage	5 V DC
Insulation voltage	500 V DC
Power consumption	2 W
Weight	115 g

● **Environment**

Noise immunity	RS (IEC 61131-2, IEC 61000-4-3): 80~1,000 MHz, 1.4~2 GHz, 10 V/m
	EFT (IEC 61131-2, IEC 61000-4-4): Analog & Communication I/O: 1 kV
	ESD (IEC 61131-2, IEC 61000-4-2): 8 kV Air Discharge
Storage/Operation	Storage: -25°C~70°C (temperature), 5~95% (humidity)
	Operation: 0°C~55°C (temperature), 5~95% (humidity), pollution level 2
Shock/Vibration immunity	International standards: IEC 61131-2, IEC 68-2-6 (TEST Fc)/
	IEC 61131-2 & IEC 68-2-27 (TEST Ea)

13.3 Installation

13.3.1 Dimensions
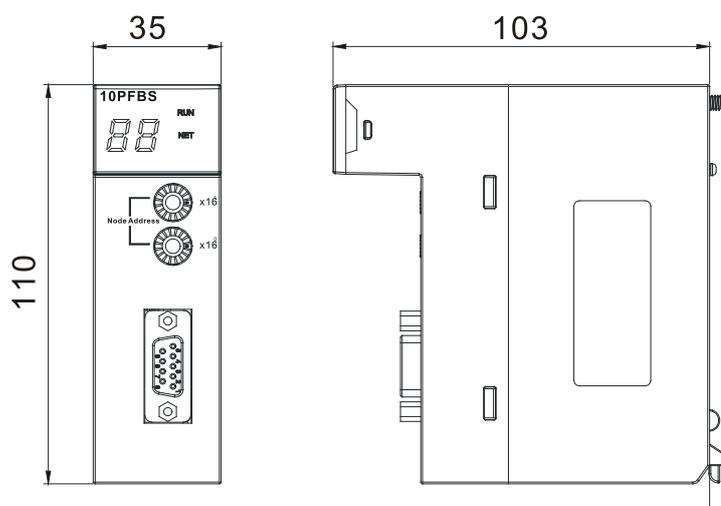
Unit: mm

13.3.2 Installing AH10PFBS-5A and a CPU Module on the Rack

● Insert the projection under the module into the hole in the rack; push the module in the direction indicated by the following arrow to meet the I/O slot of the rack.
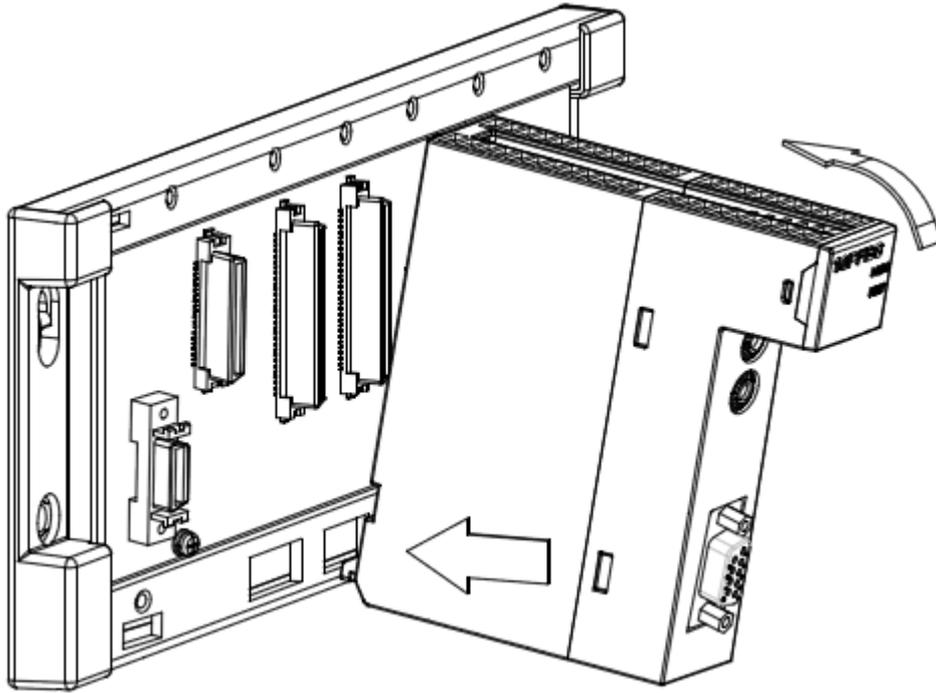
● After properly installing, tighten the screw on the upper of the module.
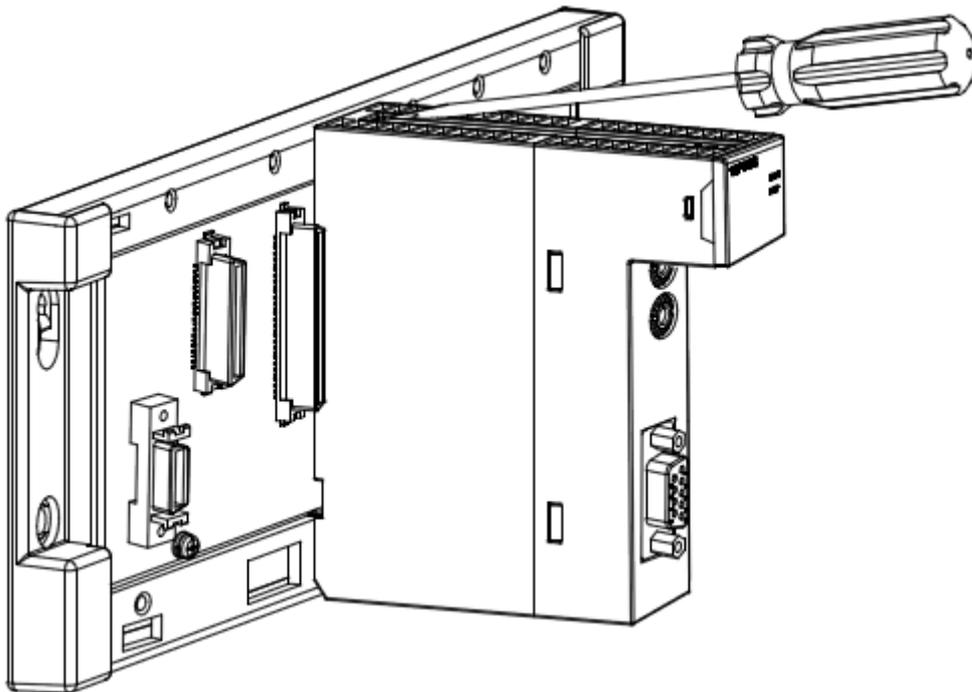
● Install AHPS05-5A and the AH500 series CPU module to the POWER interface and CPU interface on the rack respectively according to the above steps and the figure is shown as below after the installation is over.
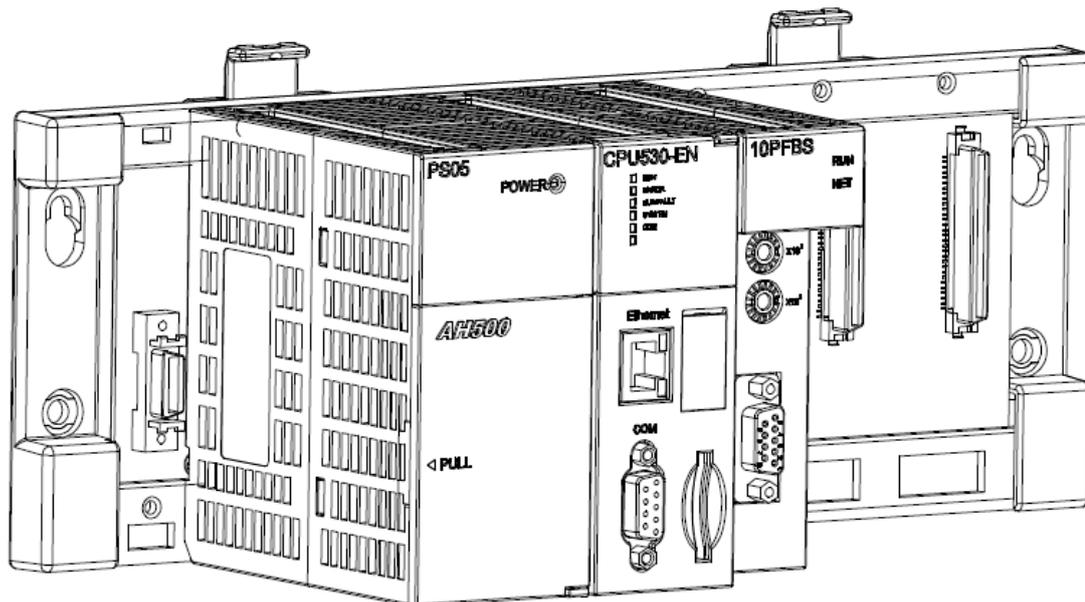
13.3.3 Connecting PROFIBUS-DP Connector

● Insert the PROFIBUS-DP bus connector in the direction indicated by the following arrow to AH10PFBS-5A communication port. Tighten the screw on the PROFIBUS-DP bus connector so as to ensure the connection between AH10PFBS-5A and PROFIBUS-DP bus is reliable.
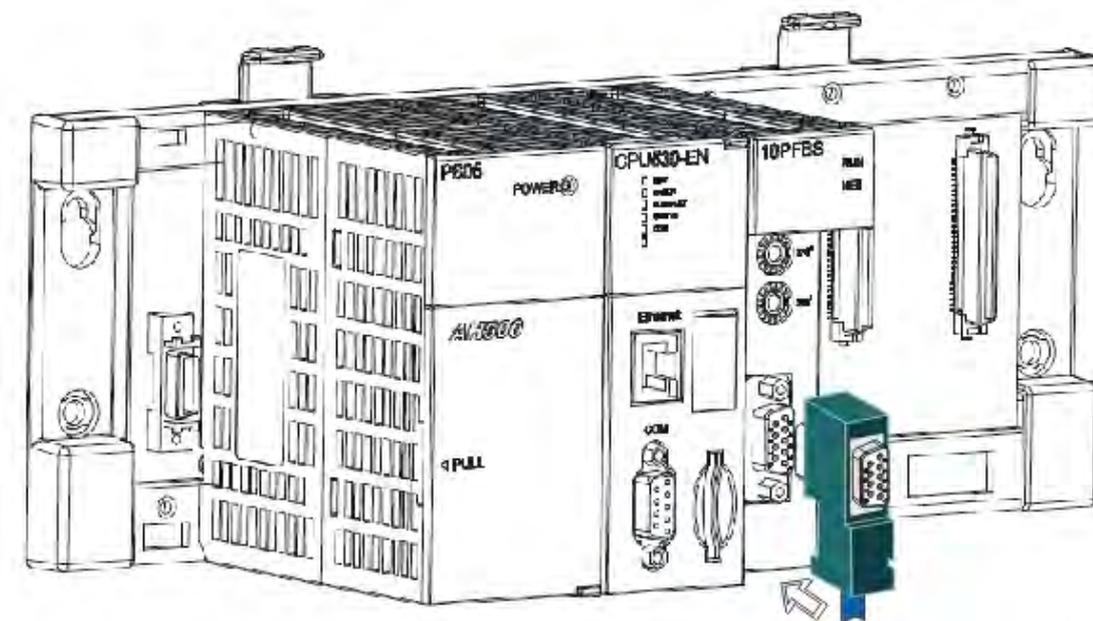
13.3.4 Definition of PROFIBUS-DP Port Pin

Pin	Definition	Description
1	--	N/C
2	--	N/C
3	RxD/TxD-P	Sending/receiving data (P (B))
4	--	N/C
5	DGND	Signal ground (C)
6	VP	Supplying positive voltage
7	--	N/C
8	RxD/TxD-N	Sending/receiving data (N (A))
9	--	N/C
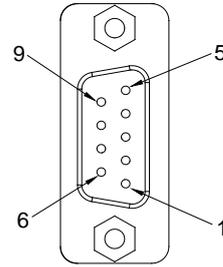
13.3.5 PROFIBUS Node Address Setting

The rotary node address switch of AH10PFBS-5A is used for setting the node address of AH10PFBS-5A on the PROFIBUS-DP network. The rotary node address switch consists of two rotary switches, $x16^0$ and $x16^1$. The range for one rotary switch is 0~F.

The range for setting the node address is as the following table is.

Address	Definition
H'1~H'7D	Valid PROFIBUS address
H'0 or H'7E~H'FF	Invalid PROFIBUS address
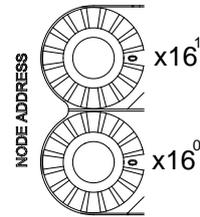
Example: If you need to set the node address of AH10PFBS-5A to 26 (decimal), simply switch the corresponding switch of $x16^1$ to "1" and the corresponding switch of $x16^0$ to "A". 26 (decimal)=1A (hex)=$1x16^1 + Ax16^0$.

Note:

➢ Switch OFF the power supply before setting up the node address of AH10PFBS-5A. Repower the module after the setup is completed.

➢ Changing the value on the switch during the operation of AH10PFBS-5A will not be valid immediately until repowering AH10PFBS-5A after powering it OFF.

➢ Use the slotted screwdriver to set up the switch. Be careful not to scratch the module.

13.4 Constructing PROFIBUS-DP Network by Using AH10PFBS-5A

13.4.1 PROFIBUS-DP Network Figure

AH10PFBS-5A is used for connecting the AH500 series CPU module to the PROFIBUS-DP network.

See the following illustration.
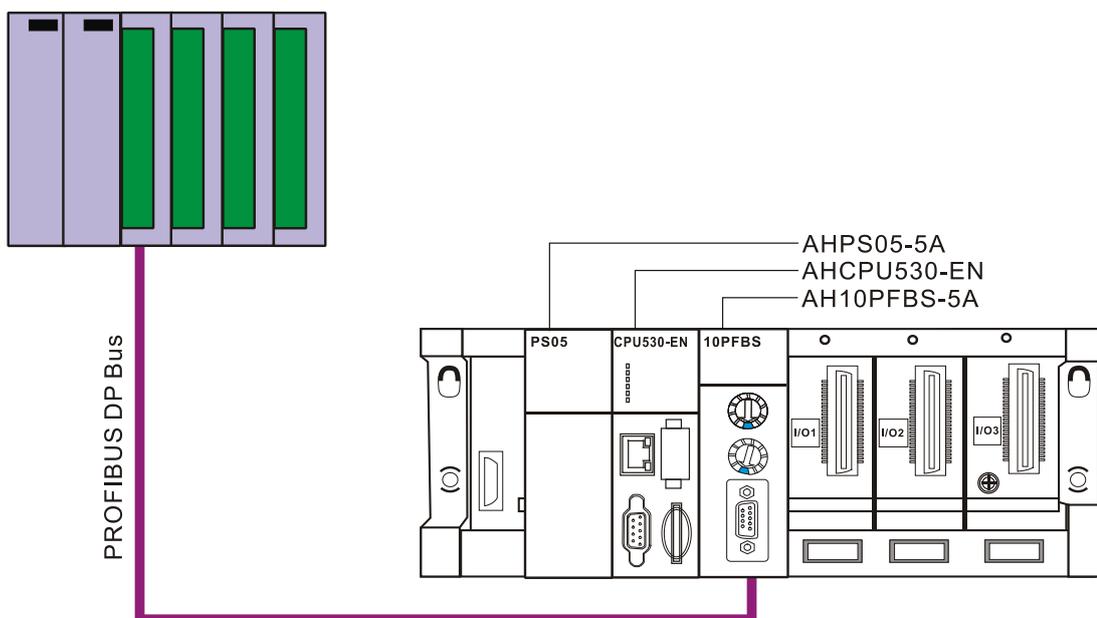
13.4.2 Terminal Resistors

When two AHRTU-PFBS-5A are installed at the two ends of the network respectively, their PROFIBUS communication ports need connect the terminal resistors (One resistor contains three small resistors, Rt, Ru and Rd as follows.) One standard PROFIBUS connector possesses a built-in terminal resistor and the resistor can be connected or not via the switch. User can purchase the PROFIBUS connector to add the terminal resistor.
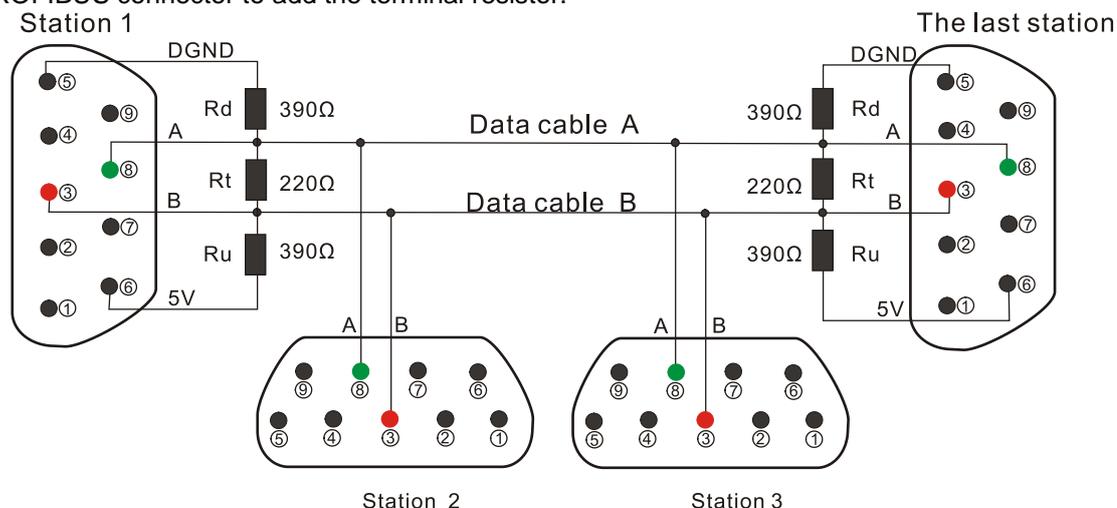
13.5 Transmission Distance and Baud Rate

The baud rate range for PROFIBUS DP is 9.6 kbps~12 Mbps, and the length of transmission cable varies upon the transmission speed. The transmission distance ranges from 100m to 1,200m. See the following table for the baud rates AH10PFBS-5A supports and their corresponding communication distance.

Baud rate (bps)	9.6k	19.2k	93.75k	187.5k	500k	1.5M	3M	6M	12M
Distance (m)	1200	1200	1200	1000	400	200	100	100	100

13.6 GSD File

The GSD file is a text file and can be used to identify PROFIBUS-DP device (master or slave). A GSD file contains the data information which is necessary for configuration of a slave in the standard PROFIBUS-DP master such as the supplier's information, baud rates supported and applicable I/O messages.

When using AH10PFBS-5A, you have to first import the GSD file to the configuration software for PROFIBUS-DP master. After the import of the file, the configuration software for master will display AH10PFBS-5A and its configuration settings. You can download the GSD file for AH10PFBS-5A at Delta's website: http://www.deltaww.com/

13.7 Mapping Area of AH10PFBS-5A

13.7.1 Configuration Options AH10PFBS-5A Supports

AH10PFBS-5A provides multiple configuration options to users for selection in order to meet users' demand of different data length when the configuration is conducted in the configuration tool of PROFIBUS-DP master. All configuration options on AH10PFBS-5A are listed in the following table.

The input (In) and output (Out) in the configuration options are based on the master. The output indicates that the master transmits the data to the slave and the input indicates that the slave transmits the data to the master.

Output configuration option	Input configuration option	Output and input configuration option
1 Word Out	1 Word Out	1 Word Out 1 Word In
2 Word Out	2 Word Out	2 Word Out 1 Word In
4 Word Out	4 Word Out	4 Word Out 1 Word In
8 Word Out	8 Word Out	8 Word Out 1 Word In
16 Word Out	16 Word Out	16 Word Out 1 Word In
32 Word Out	32 Word Out	32 Word Out 1 Word In
64 Word Out	64 Word Out	64 Word Out 1 Word In

The configuration options of AH10PFBS-5A in the master configuration software are shown in the following red box. Select the slot number and then double click one of the configuration options of AH10PFBS-5A to add to the selected slot. Please refer to the application example in chapter 10 for more details.
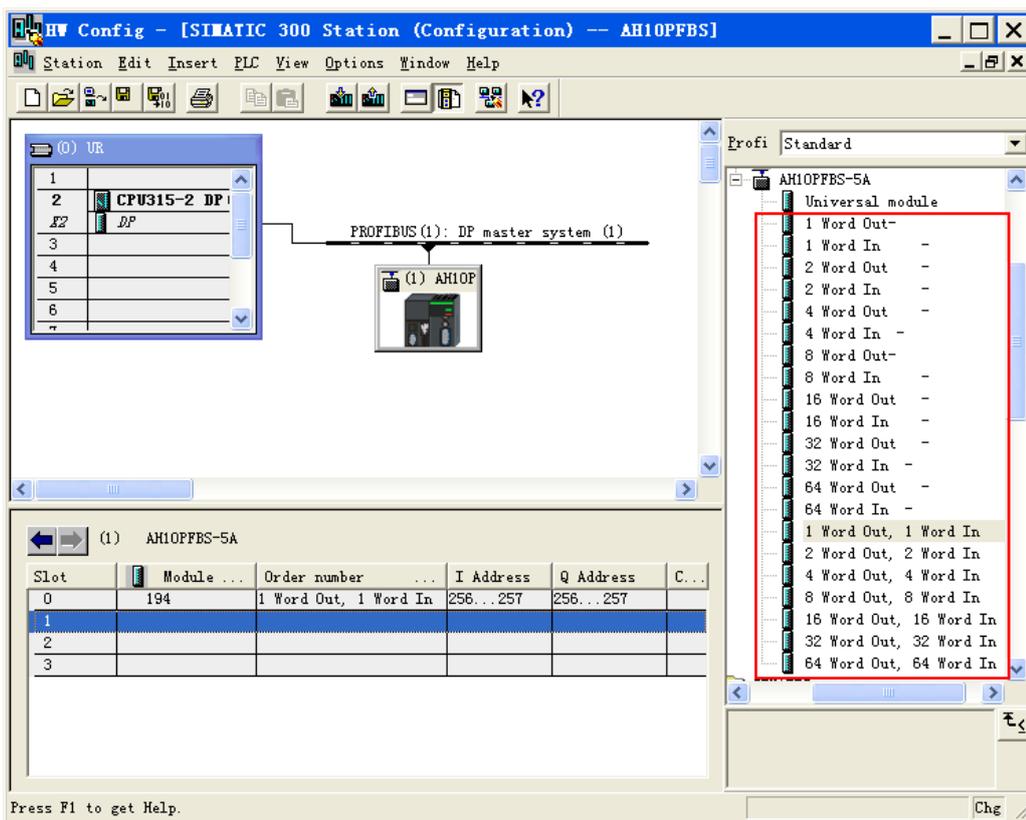
13.7.2 Mapping Relations between AH10PFBS-5A and a Master

After one slot is configured with one configuration option, double click the slot number as the mouse indicates and then the right-side "Properties—-DP slave" dialog box pops up in the following figure.
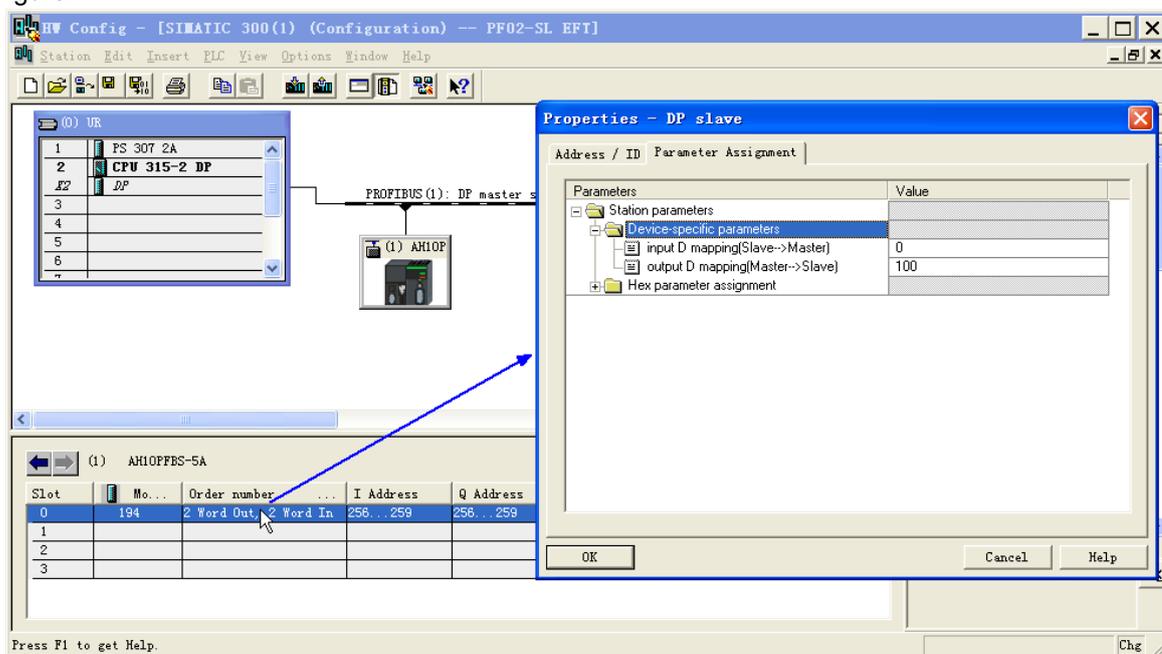
The indication of parameters in the right-side "Properties—DP slave" dialog box in the above figure is as the following table. The initial D register number of every slot must be set separately.

Item	Indication	Default value
input D mapping (Slave->Master)	The starting D register number in the input area	0 (Able to be changed through the keyboard)
output D mapping (Master->Slave)	The starting D register number in the output area	100 (Able to be changed through the keyboard)

Take Siemens S7-300 as the master and set slot 0 according to the above figure. The mapping relations between the master and AH10PFBS-5A are listed as the following table.

Register in S7-300 master	PROFIBUS-DP network data transmission direction	Corresponding registers in the AH500 series CPU module
PQW256	⟹	D100
PQW258		D101
PIW256	⟸	D0
PIW258		D1

13.7.3 Options Setting of I/O Data When AH10PFBS-5A is Offline

When users configure AH10PFBS-5A in the PROFIBUS-DP master configuration software and AH10PFBS-5A and PROFIBUS-DP master are disconnected, choose "Clear I/O data" or "Hold I/O data". Double click AH10PFBS-5A icon and "Properties—DP slave" dialog box pops up as below.
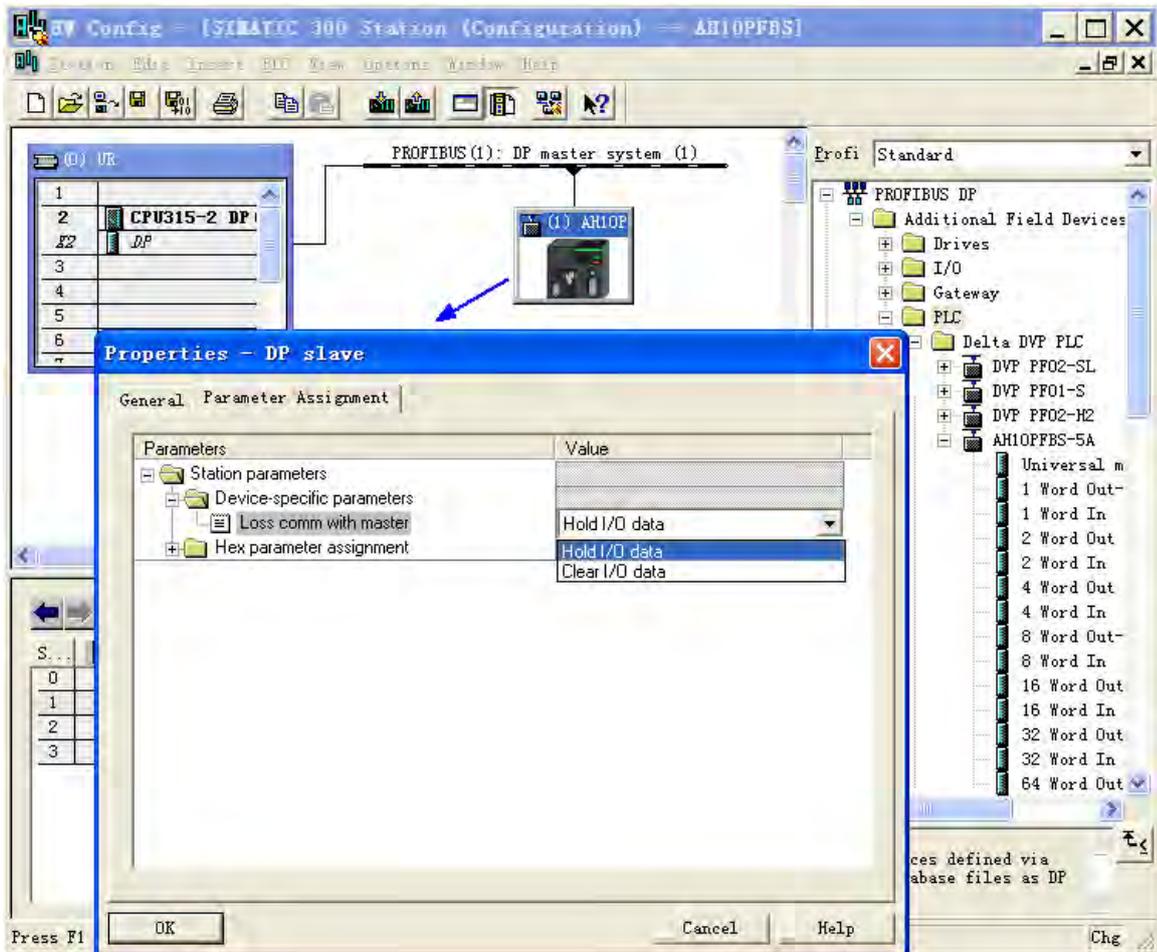
Indication of options in "Properties—DP slave" dialog box:

Option	Selection	Indication
Los comm. with master	**Hold I/O data**	After AH10PFBS-5A and PROFIBUS-DP master are disconnected, retain the input and output data before disconnection.
	Clear I/O data	After AH10PFBS-5A and PROFIBUS-DP master are disconnected, the output data is cleared to 0 and the input data is unchanged.

13.8 LED Indicator and Troubleshooting

13.8.1 RUN LED and NET LED

● RUN LED
RUN LED displays the status of the CPU module on the left of AH10PFBS-5A.

LED status	Indication	How to correct
Green light ON	PLC is in RUN status.	--
OFF	The CPU module is in STOP status.	Turn the RUN/STOP switch of the CPU module to RUN.

● NET LED
NET LED displays whether the communication between AH10PFBS-5A and PROFIBUS-DP master is working normally.

LED status	Indication	How to correct
Green light ON	Normal	--
Red light ON	AH10PFBS-5A is not connected to the master.	1. Check if AH10PFBS-5A is connected to PROFIBUS-DP bus. 2. Check if the communication cable between AH10PFBS-5A and PROFIBUS-DP master is in normal status. 3. Check if the actual address of AH10PFBS-5A is consistent with that set in the master configuration software. 4. Check if the GSD file used is correct.

13.8.2 Digital Displayer

● Digital displayer displays the status of AH10PFBS-5A.

Code	Indication	How to correct
1~7D	When AH10PFBS-5A works normally, the digital displayer displays its node address.	--
80	The CPU module connected to AH10PFBS-5A is in STOP status.	Turn the RUN/STOP switch of the CPU module to RUN.
F0	The node address of AH10PFBS-5A exceeds the valid range.	Set the node address of AH10PFBS-5A between 1~125.
F1	Internal hardware error	If the error still exists after repowering AH10PFBS-5A, replace it with a new one.
F2	Parameter error	Check if the GSD file AH10PFBS-5A is using is correct.
F3	Configuration error	Check if the GSD file AH10PFBS-5A is using is correct.

Code	Indication	How to correct
F4	GPIO detection error	If the error still exists after repowering AH10PFBS-5A, replace it with a new AH10PFBS-5A.
F5	AH10PFBS-5A enters the mode of factory test.	Repower AH10PFBS-5A after setting its node address between 1~125.
F6	1. AH10PFBS-5A has not been connected to the PROFIBUS-DP network. 2. PROFIBUS-DP master has not configured AH10PFB slave or the configured node address of AH10PFBS-5A is inconsistent with that of the actually connected one.	1. Check if the communication cable between AH10PFBS-5A and PROFIBUS-DP master is in normal status. 2. Ensure that AH10PFBS-5A slave has been configured to PROFIBUS-DP master and the configured node address of AH10PFBS-5A is consistent with that of the actually connected one. 3. Check if PROFIBUS-DP master works normally.

● The display mechanism of the digital displayer:
1. When AH10PFBS-5A is in normal state and the CPU module is in RUN state, the digital displayer of AH10PFBS-5A only displays the node address.
2. When AH10PFBS-5A is in normal state and the CPU module is in STOP state, the digital displayer of AH10PFBS-5A displays the node address and 80 (the STOP state code of the CPU module) alternately.
3. When AH10PFBS-5A is initializing or in error state and the CPU module is in RUN state, the digital displayer of AH10PFBS-5A displays the node address, initialization code and error code alternately.
4. When AH10PFBS-5A is initializing or in error state and the CPU module is in STOP state, the digital displayer of AH10PFBS-5A displays the node address, initialization code and 80 (the STOP state code of the CPU module) alternately.

13.8.3 State Register in AH10PFBS-5A

The state register in AH10PFBS-5A is used for judging whether the current status of AH10PFBS-5A is normal.

AH10PFBS-5A can specify the state register in hardware configuration via ISPSoft.

Double click AH10PFBS-5A icon in HWCONFIG and "Parameter Setting" dialog box pops up then.

Click "Conversion Flags (Read only)" in the left-side blue box as below; then click what the mouse refers to in "Parameter Setting" dialog box; and then the "Address" dialog box appears immediately, where input the number of the specified state register e.g. the input 200 indicates that D200 is the state register.

AH10PFBS-5A can only specify D device as its state register.
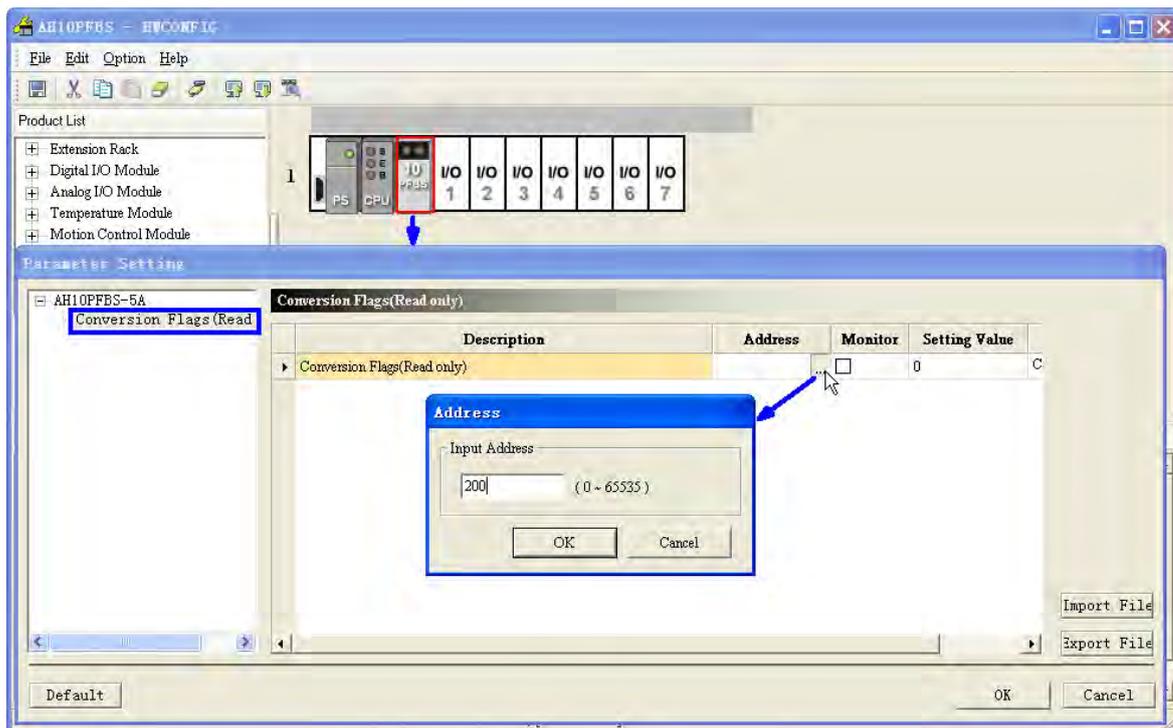
The high byte of the state register is used for monitoring whether the CPU module is in RUN or STOP state and the low byte is for monitoring whether the work state of AH10PFBS-5A is normal. See the indication of the state register values in the following table.

Byte	Content value	Indication	How to correct
High byte	0	The CPU module is in RUN state.	--
	80	The CPU module is in STOP state	Turn the RUN/STOP switch of the CPU module to RUN.
Low byte	0	AH10PFBS-5A is in normal state.	--
	F0~F6	AH10PFBS-5A can not work normally.	See digital displayer in Section 8.2 on how to deal with problems indicated by F0~F6.

13.8.4 Diagnosis via ISPSoft

While ISPSoft is being used to read the system log of PLC, the meanings of error codes occurring in the PROFIBUS network are shown below.

When ISPSoft is in state of monitoring, please select menu "PLC">"System Log" option to find the system log as below.
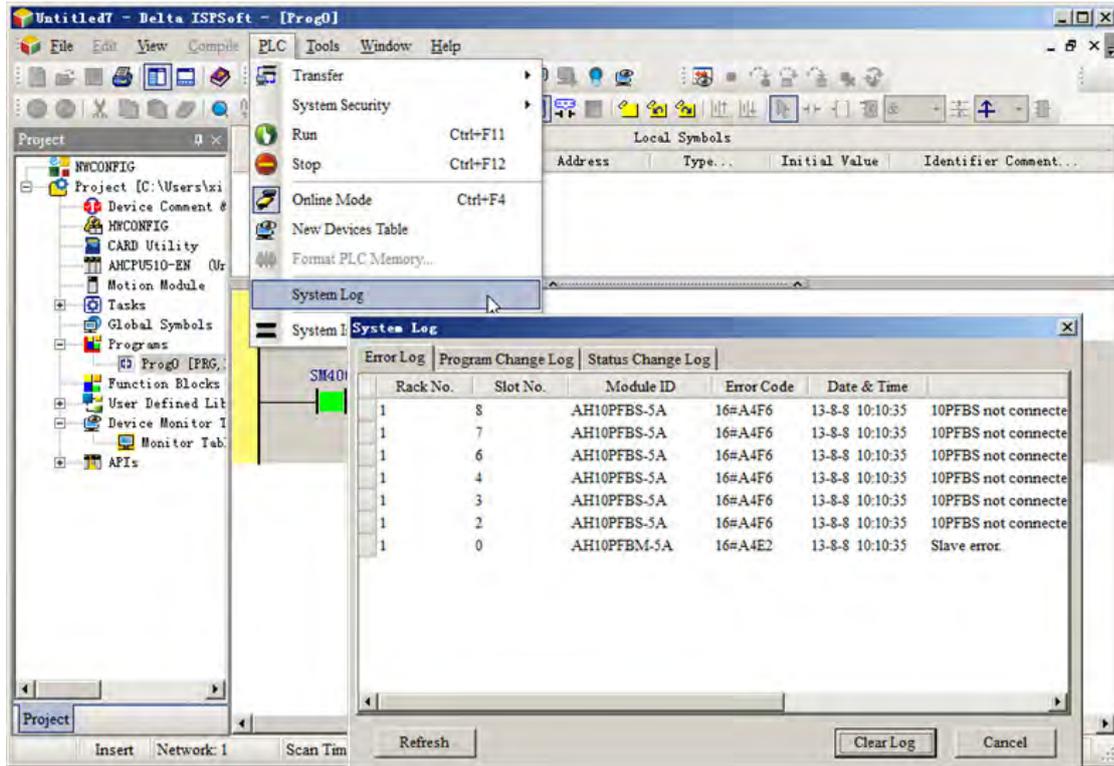
The meanings of error codes in AH10PFBS-5A shown in the system log of PLC are listed in the following table.

Error code	Indication	How to deal with it
16#A0F0	The node address of AH10PFBS-5A exceeds the valid range.	Set the node address of AH10PFBS-5A between 1~125.
16#A4F1	Internal hardware error	If the error still exists after repowering AH10PFBS-5A, replace it with a new one.
16#A4F2	Parameter error	Check if the GSD file AH10PFBS-5A is using is correct.
16#A4F3	Configuration error	Check if the GSD file AH10PFBS-5A is using is correct.
16#A4F4	GPIO detection error	If the error still exists after repowering AH10PFBS-5A, replace it with a new one.
16#A4F5	AH10PFBS-5A enters the mode of factory test.	Repower AH10PFBS-5A after setting its node address between 1~125.
16#A4F6	1. AH10PFBS-5A has not been connected to the PROFIBUS-DP network. 2. PROFIBUS-DP master has not configured AH10PFBS-5A slave or the configured node address of AH10PFBS-5A is inconsistent with that of the actually connected one.	1. Check if the communication cable between AH10PFBS-5A and PROFIBUS-DP master is in normal status. 2. Ensure that AH10PFBS-5A slave has been configured to PROFIBUS-DP master and the configured node address of AH10PFBS-5A is consistent with that of the actually connected one. 3. Check if PROFIBUS-DP master works normally.

13.9 Application Example 1

13.9.1 Control Request

Complete the data exchange between S7-300 (Siemens PLC) and AHCPU530-EN through the PROFIBUS-DP network.

13.9.2 Connecting AH10PFBS-5A to the PROFIBUS-DP Network

1. Siemens S7-300 serves as the PROFIBUS-DP master and AH10PFBS-5A+AHCPU530-EN serves as the slave in this example.
    PROFIBUS-DP network figure:
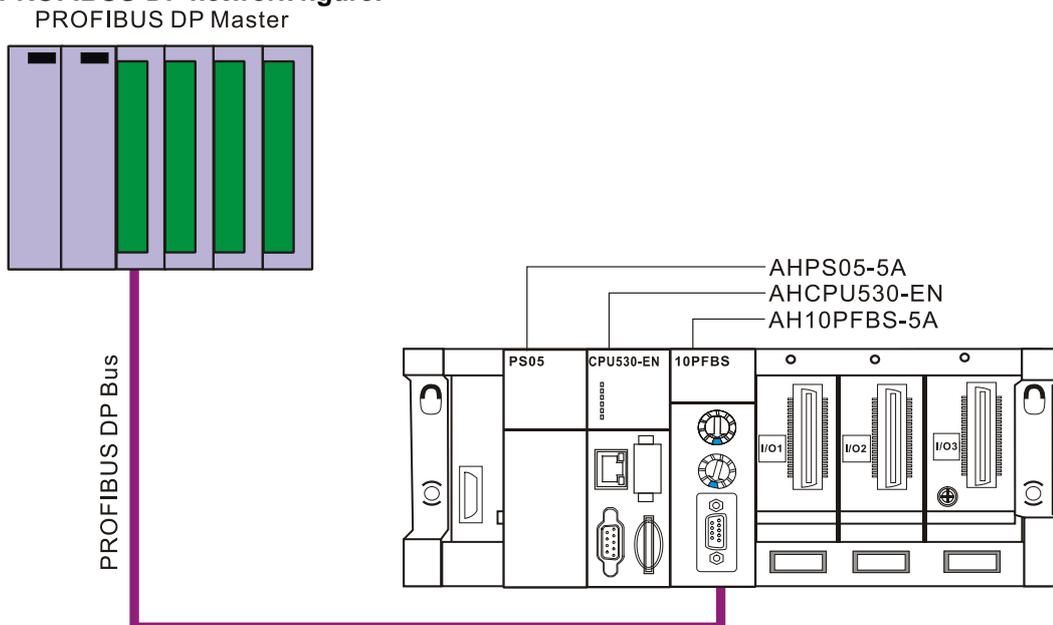
2. Set the PROFIBUS node address of AH10PFBS-5A to 1.
3. Insert AH10PFBS-5A to the I/O interface of the main AH500 series rack and ensure that the AH500 series CPU module is connected to AH10PFBS-5A normally.

13.9.3 Applied Software

*   ISPSoft is one of the PLC programming software of Delta. Users can download it at Delta website and click the following link to enter the download page. http://www.deltaww.com/
*   Siemens S7-300 is used as the PROFIBUS-DP master and Siemens PLC software Step 7 is taken as an example for an introduction.

13.9.4 Configuration of AH10PFBS-5A via ISPSoft

● Build a new project
   1. Open ISPSoft and the following interface appears then.
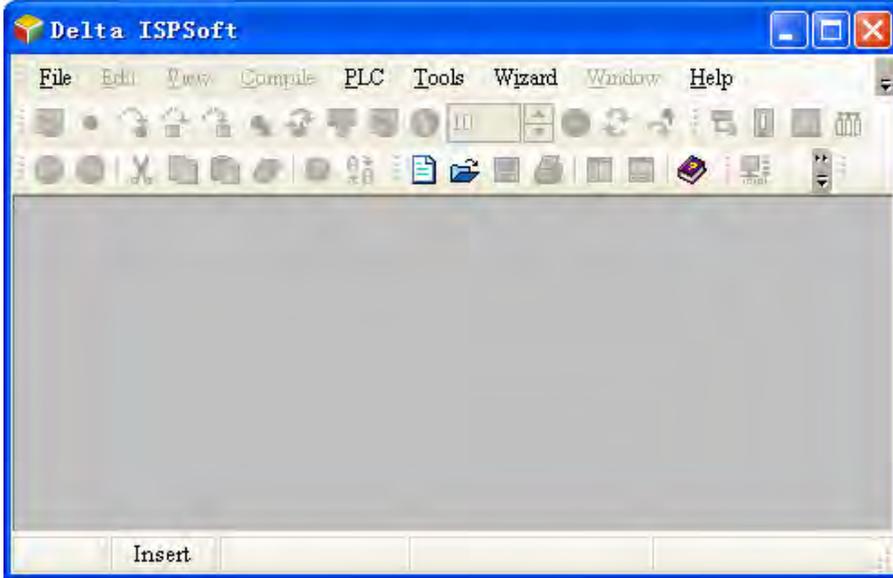
   2. Click "File">"New" and "Create a New Project" dialog box pops up then.
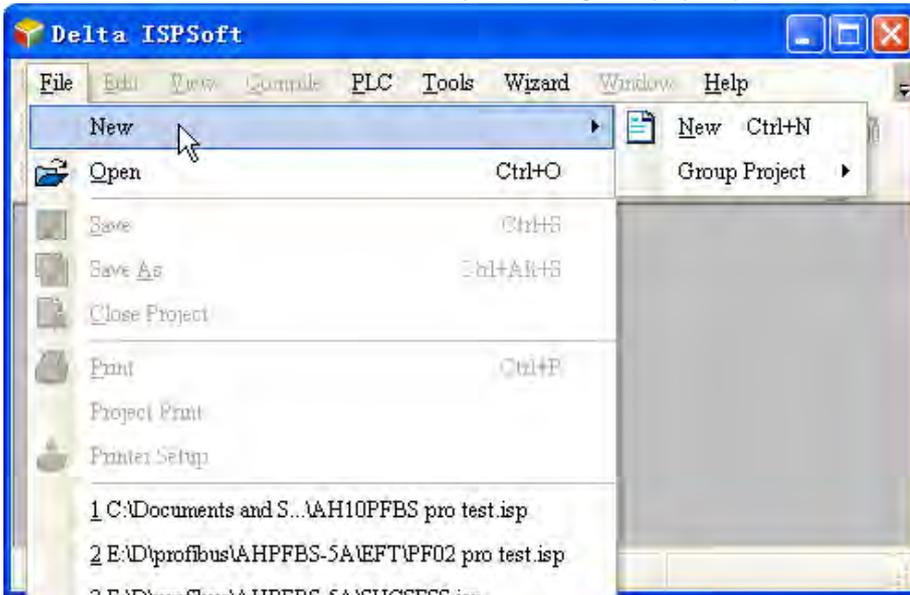
   3. Users could input the project name and select PLC type and Drive/Path and click "OK" after setting is over in the following dialog box.
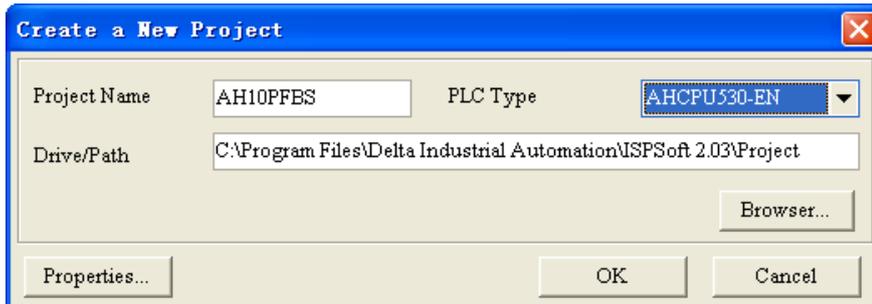
4. Build a new project interface as follows.
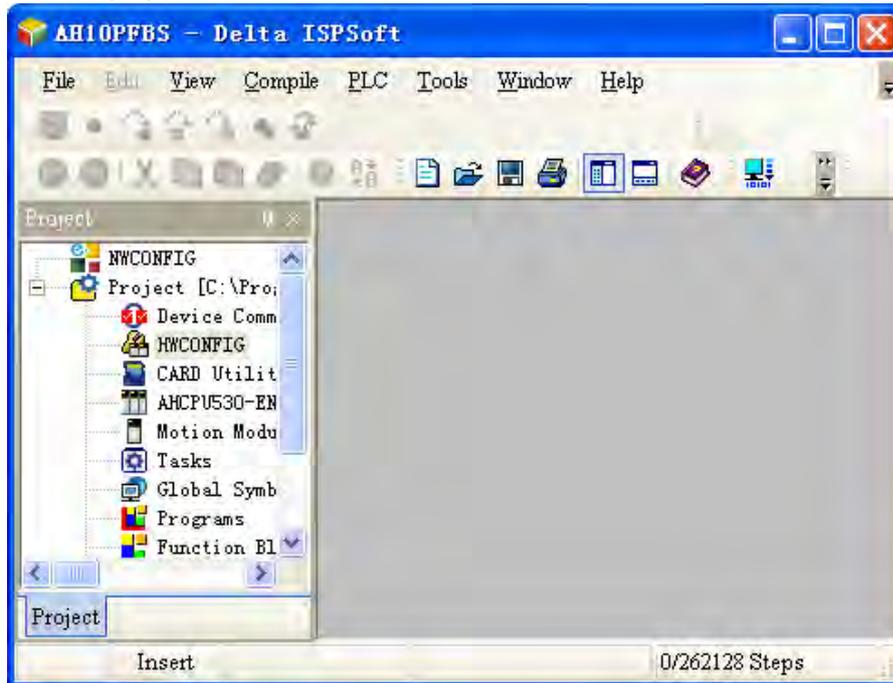
● Hardware configuration
1. Double click "HWCONFIG" icon and then "HWCONFIG" dialog box appears.
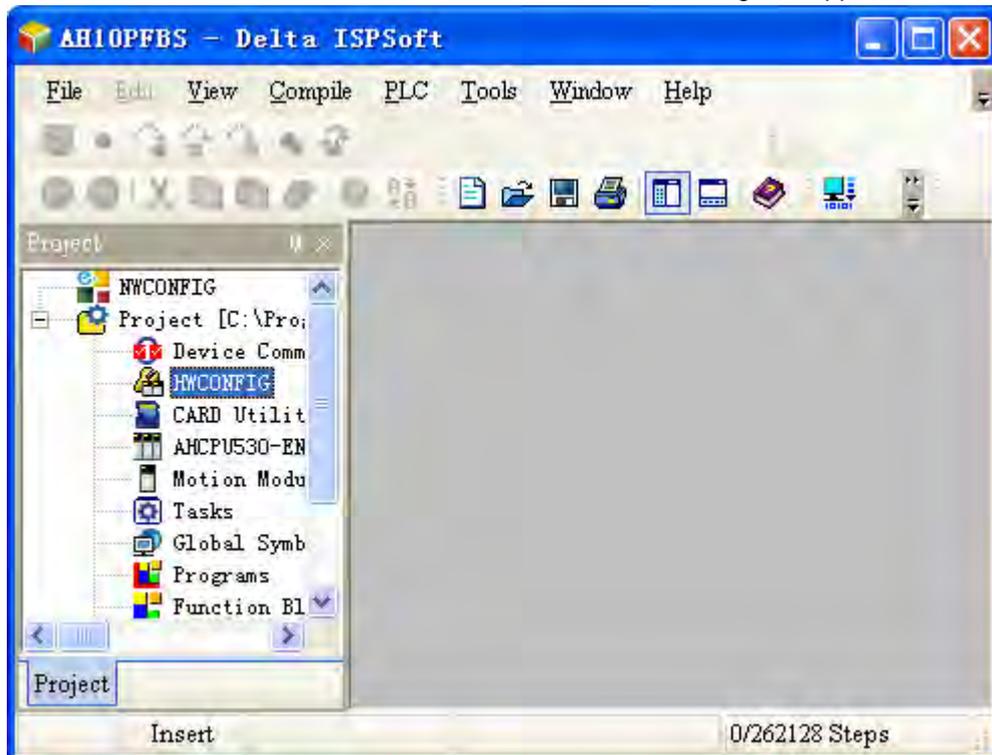
2. Click "I/O Scan" icon in the following HWCONFIG configuration interface and then the software will auto-detect all modules connected on the rack. Make sure that the communication cable connection and communication setting between the PC and the AH500 series CPU module are normal before starting the above actions.
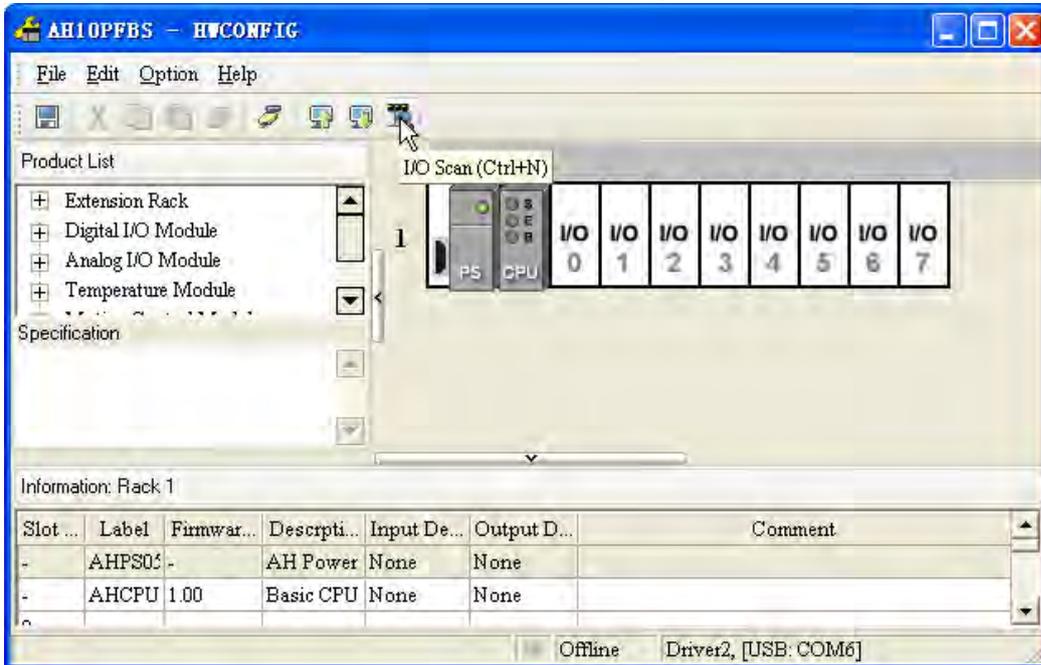
3. The already scanned AH10PFBS-5A is as the red box in the following window indicates.
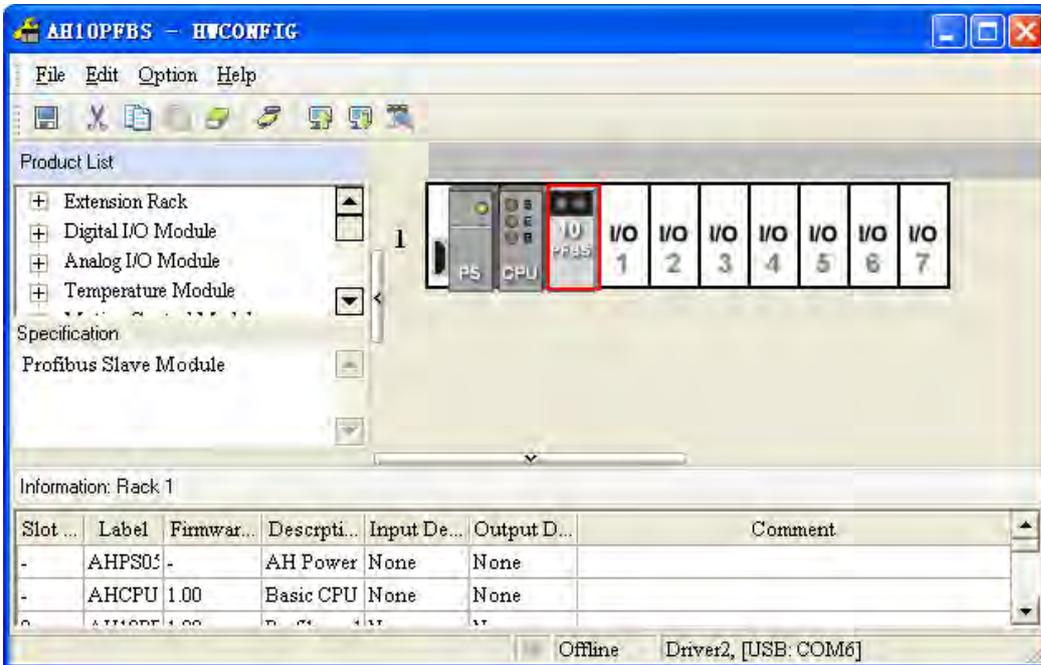
4. Double click "10PFBS" icon in the above window and then "Parameter Setting" dialog box pops up. Click the left-side "Conversion Flags (Read Only)"; then click the place indicated by the blue arrow in "Parameter Setting" dialog box and "Address" dialog box appears immediately, where input the specified state register number. E.g. the input 0 indicates to specify D0 as the state register. The state register of AH10PFBS-5A can only be D device. The state register can be used to display whether the AH500 series CPU module is in RUN or STOP state and whether the PROFIBUS communication of AH10PFBS-5A is normal. See the introduction in section 8.3 for more details.
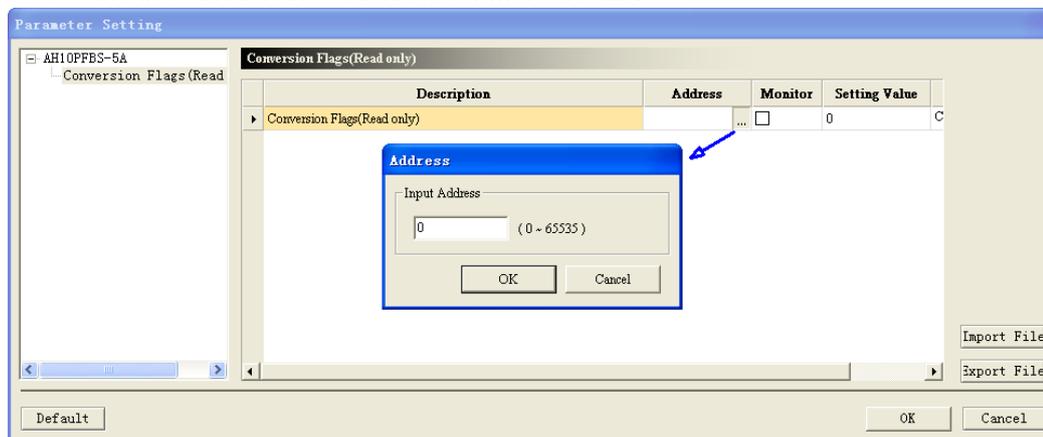
5. Click "File">"Save" to save the hardware configuration.
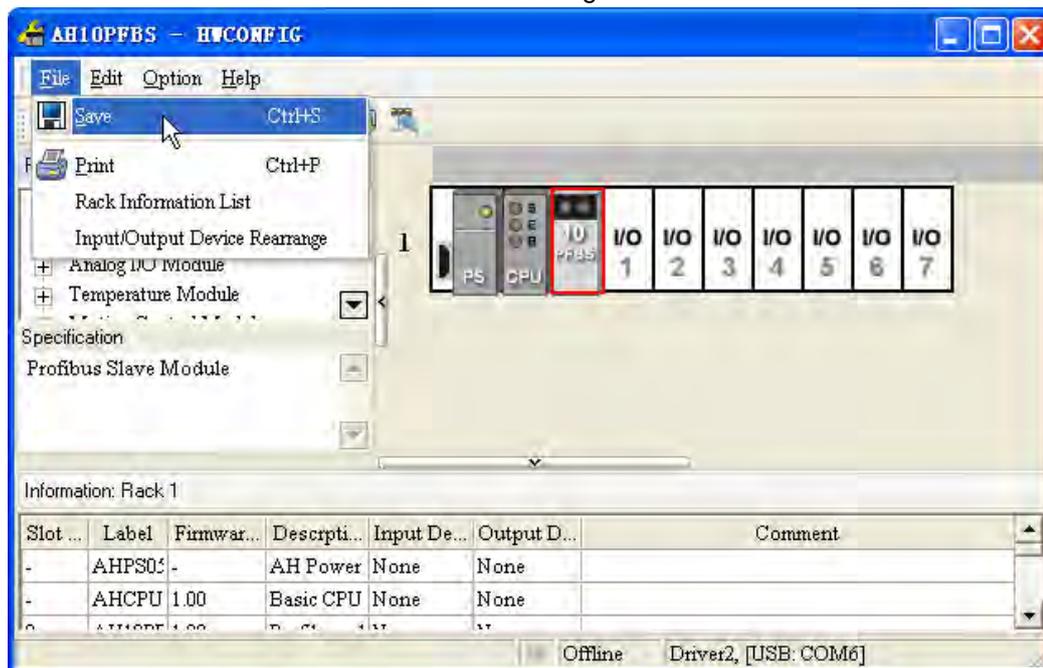
● Create a program
1. Right click "Programs" in the following window; then click "POU">"New" and finally "Create Program" dialog box appears.

2. After selecting related options, click "OK" in the following dialog box.
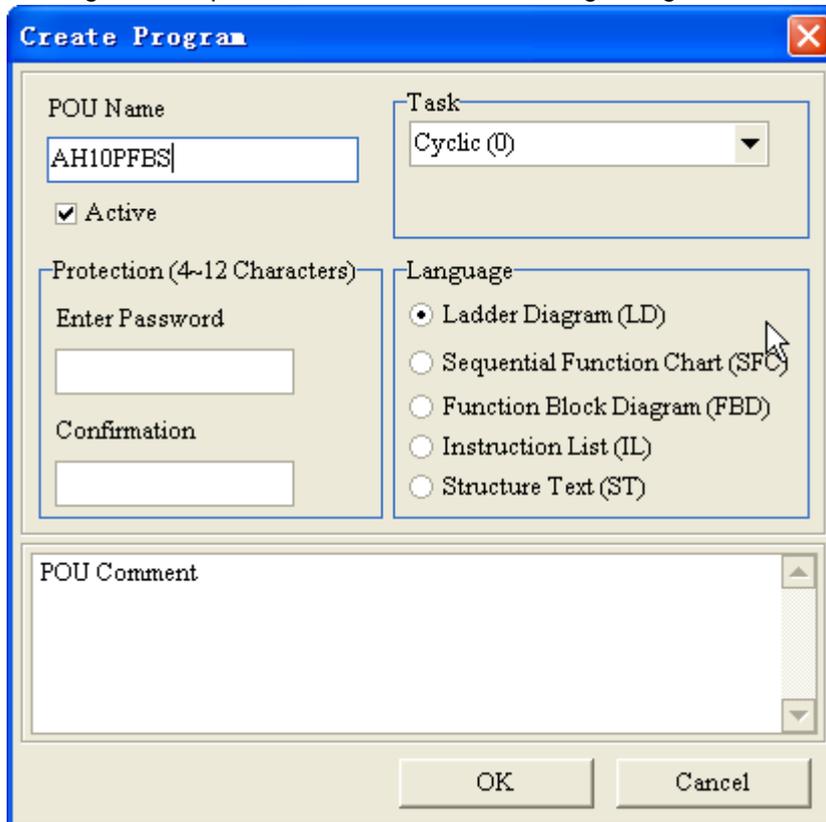
3. The interface is shown as below after one program is created.
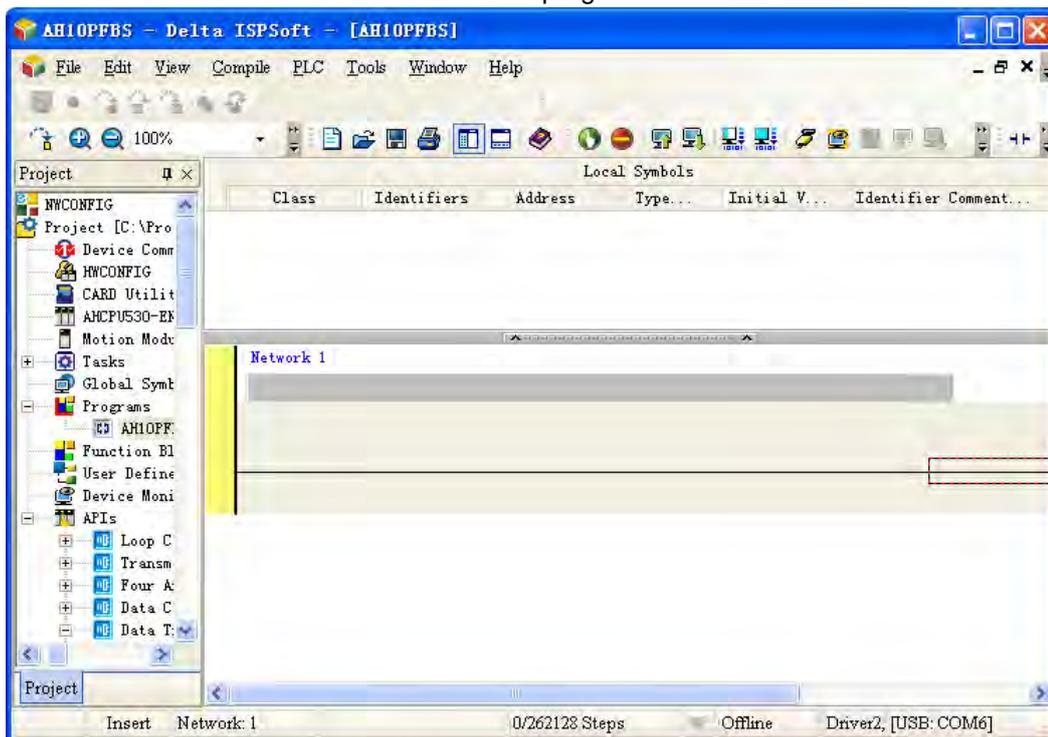
4. Users could write the program in the following program area after creating one program. See the help file of the software on the programming method.
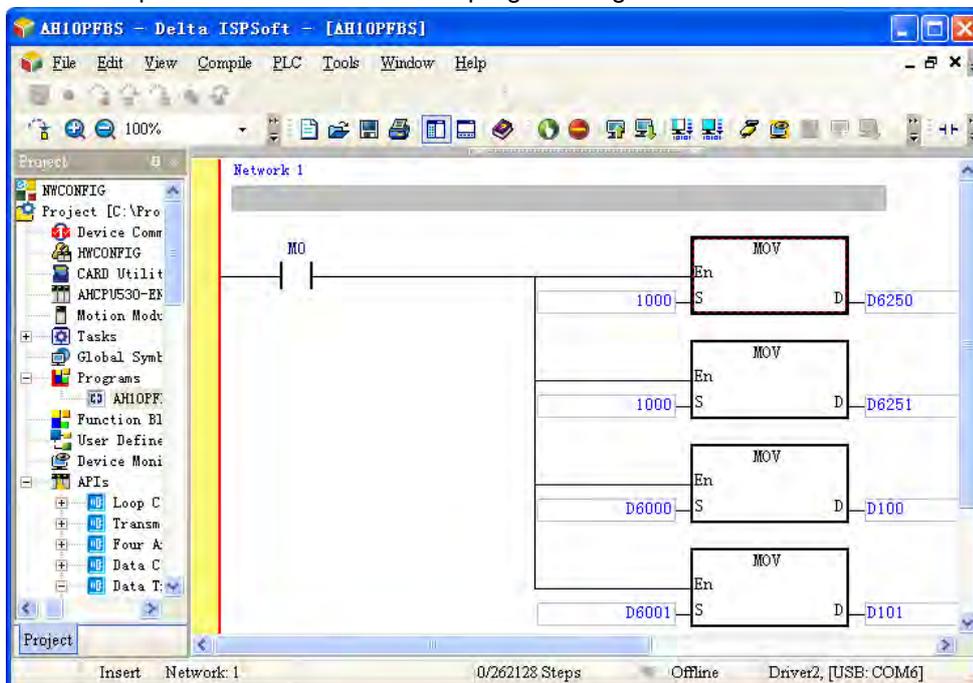
13.9.5 Configuration on the PROFIBUS-DP Network (Software Configuration)

● Create a new project by using the project wizard

    1.   Open Siemens PLC (S7-300) programming software Step7 and the software interface is shown as below.
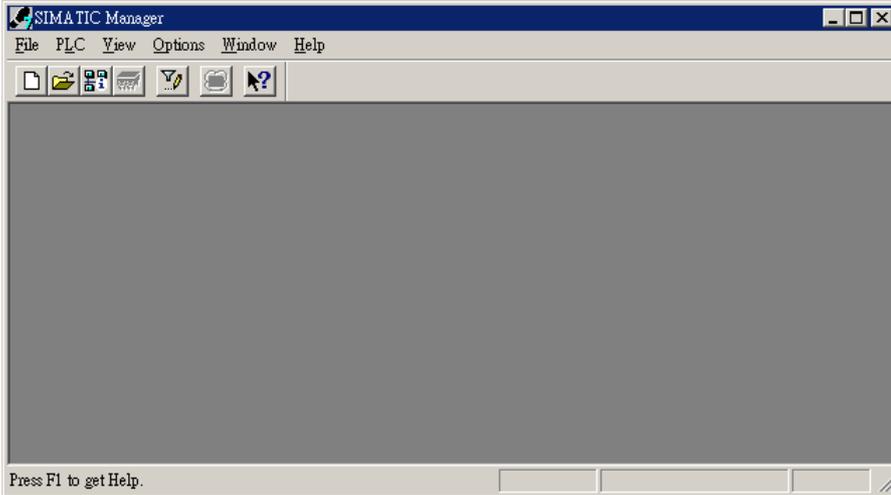
    2.   Select "File">>"New Project Wizard".
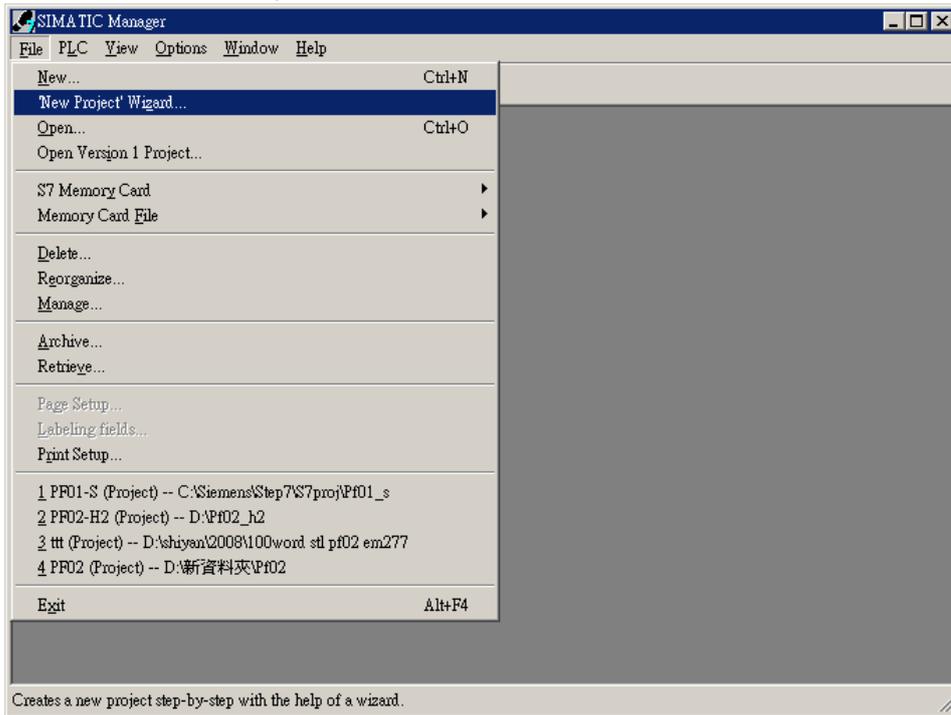
3. Click "Next" in the following "STEP 7 Wizard: New Project" dialog box.

4. Select the S7-300 CPU type according to S7-300 model and then click "Next".
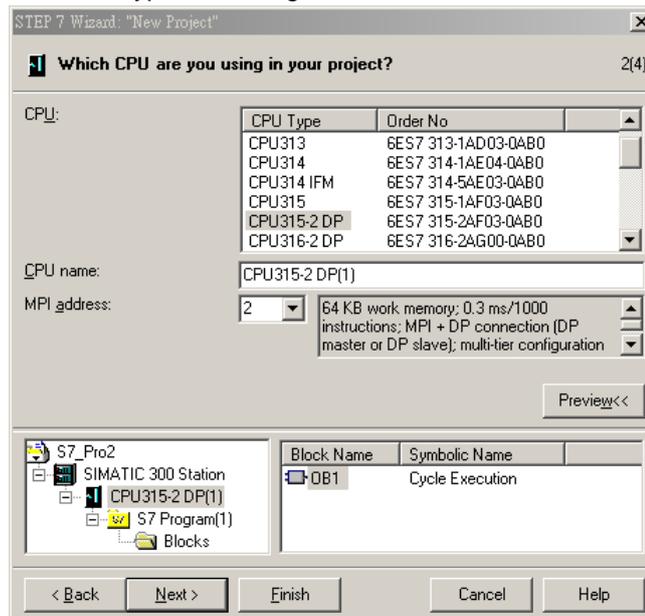
5. Select the desired program block and the language for the selected block according to the user's demand and then click "Next".
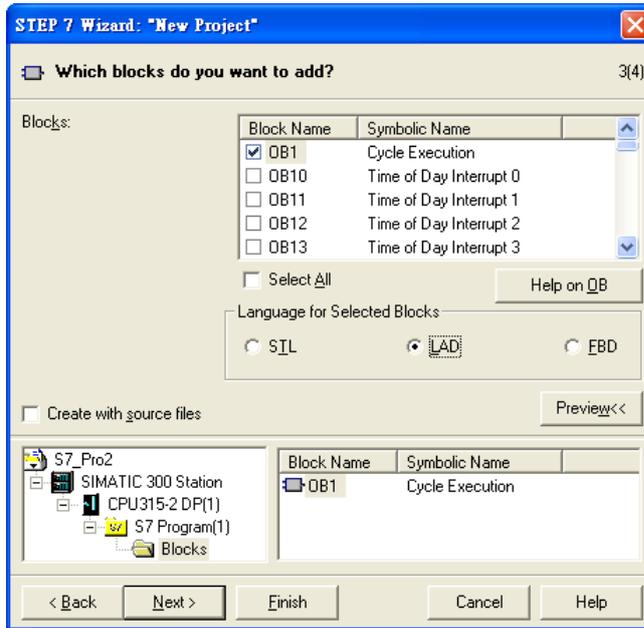
6. Input the project file name at "Project name" and then click "Finish" as the following window.
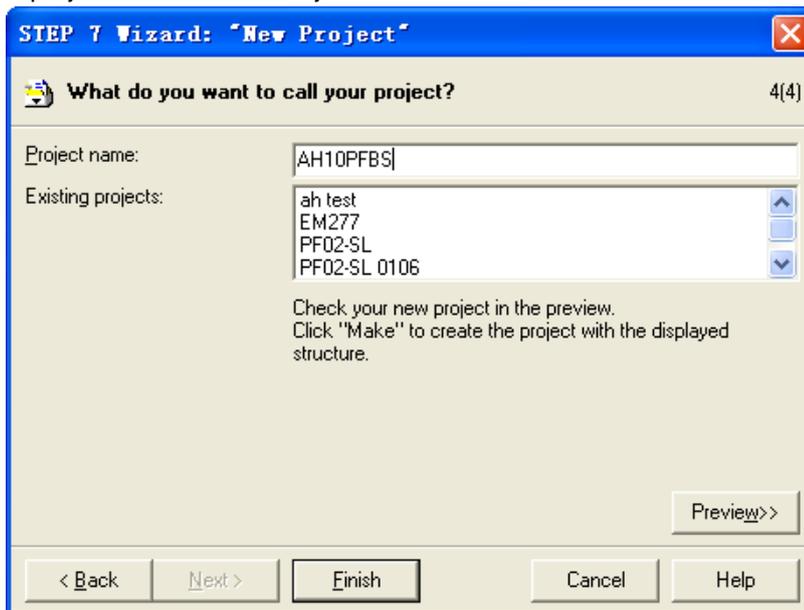
7. A new window will emerge after building the project is finished and the new project file is built.
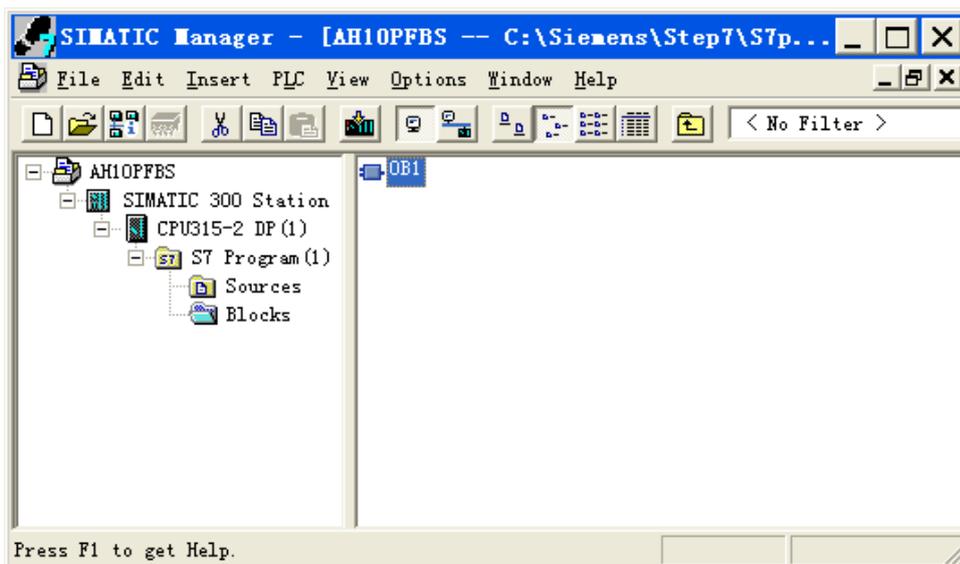
- Add one PROFIBUS-DP bus
  1. Click the following left-side "SIMATIC 300 Station"; double click "Hardware" in the right side of the window and a new window (HW-Config) will appear.
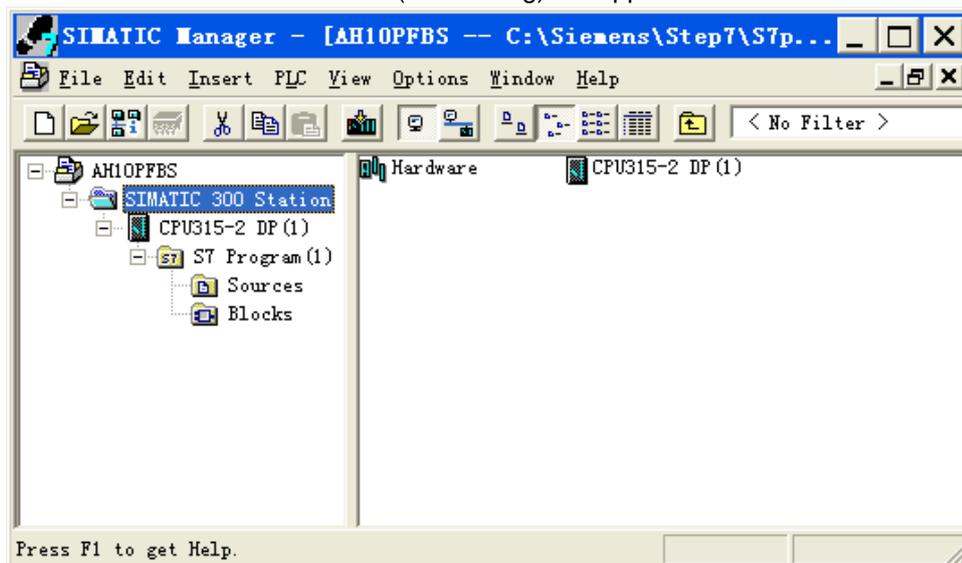
2. Double click where "DP" is in the left column of the following "HW Config" window and then a new dialog box will emerge.
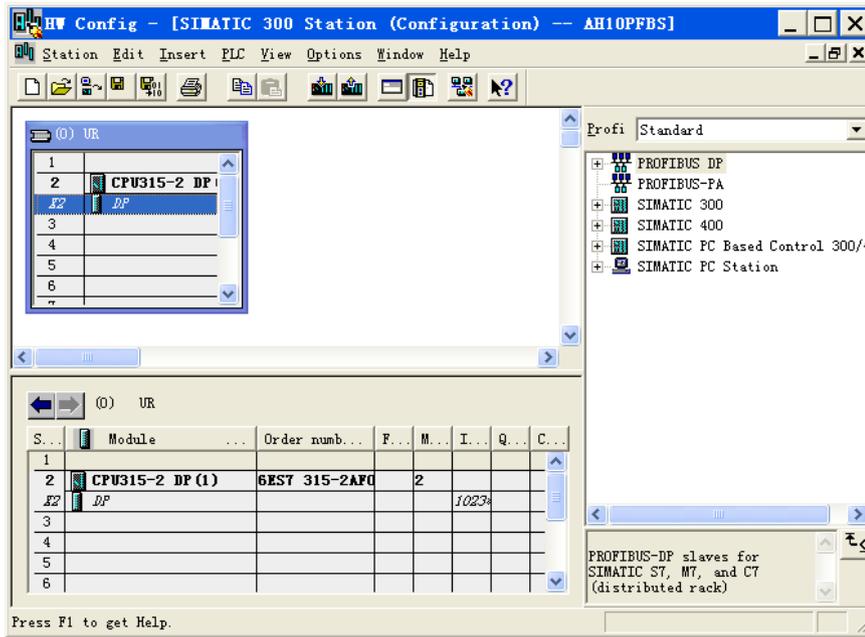
3. Click "Properties" in the following dialog box appearing newly and another new dialog box emerges then.
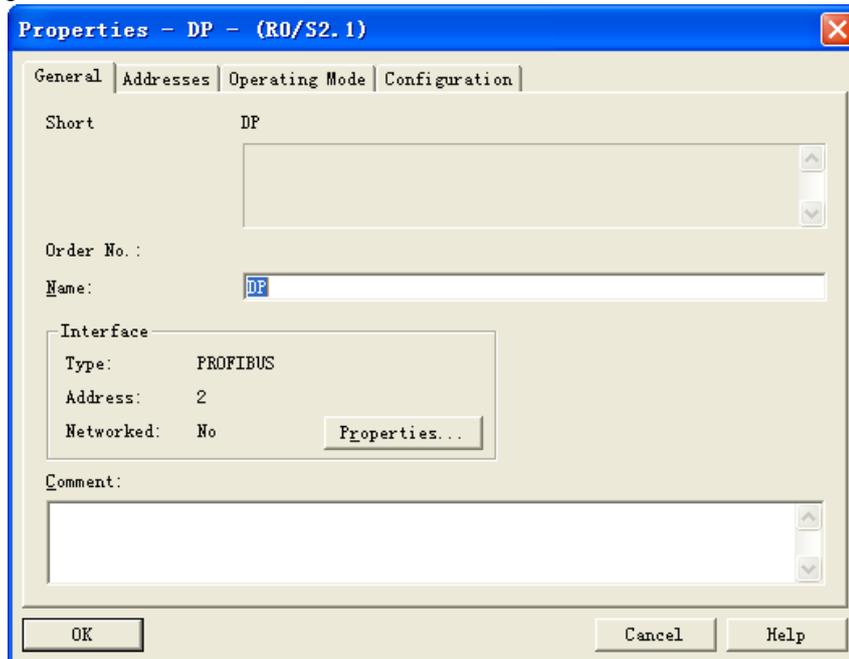
4.   Select one node address from the pull-down menu of "Address" in the following dialog box. The node address is for PROFIBUS-DP master on the PROFIBUS-DP network. Afterwards, click "New" and a new dialog box appears then.
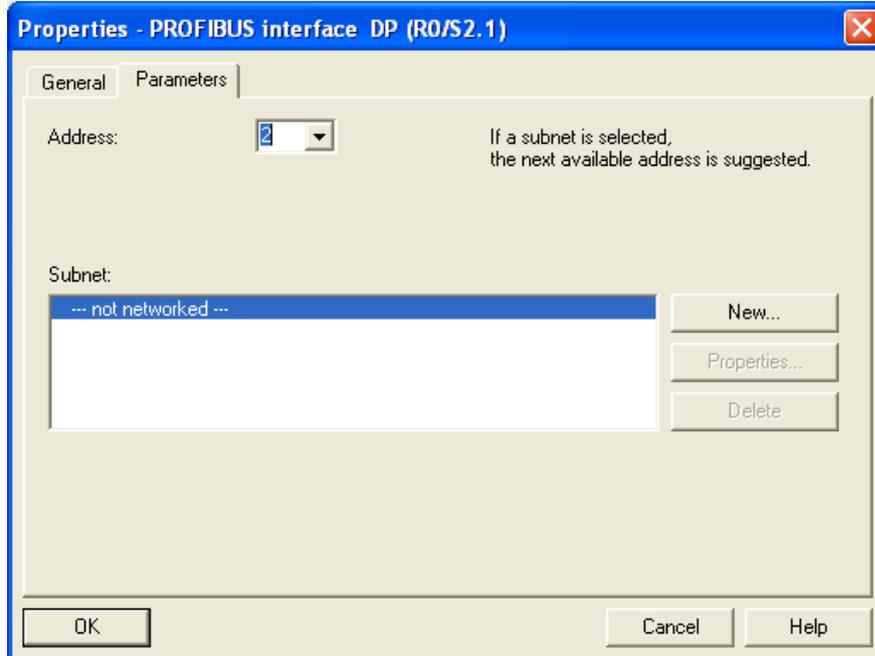
5.   Select the transmission rate value and DP for Profile of the BUS in the following dialog box and then click "OK".
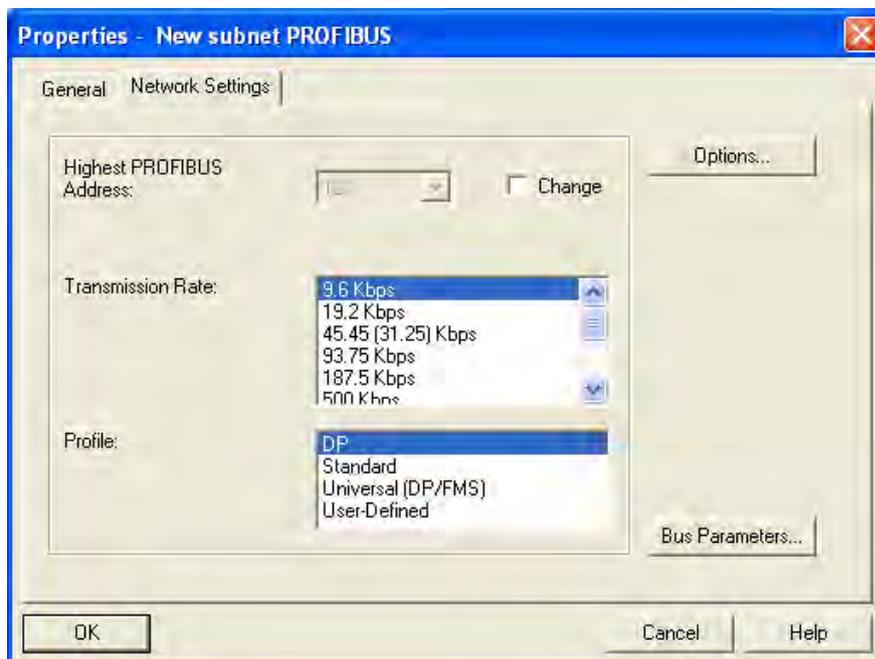
6. Click "OK" after confirming that the transmission rate and master's address of the PROFIBUS-DP bus are correct in the following dialog box.
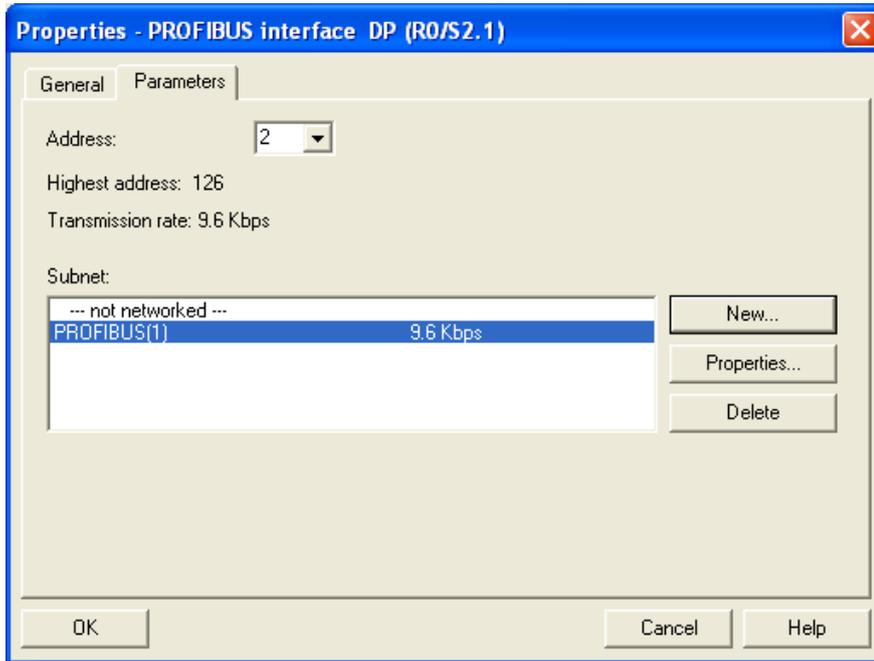
7. Click "OK" after confirming that the PROFIBUS-DP bus information is correct in the following dialog box.
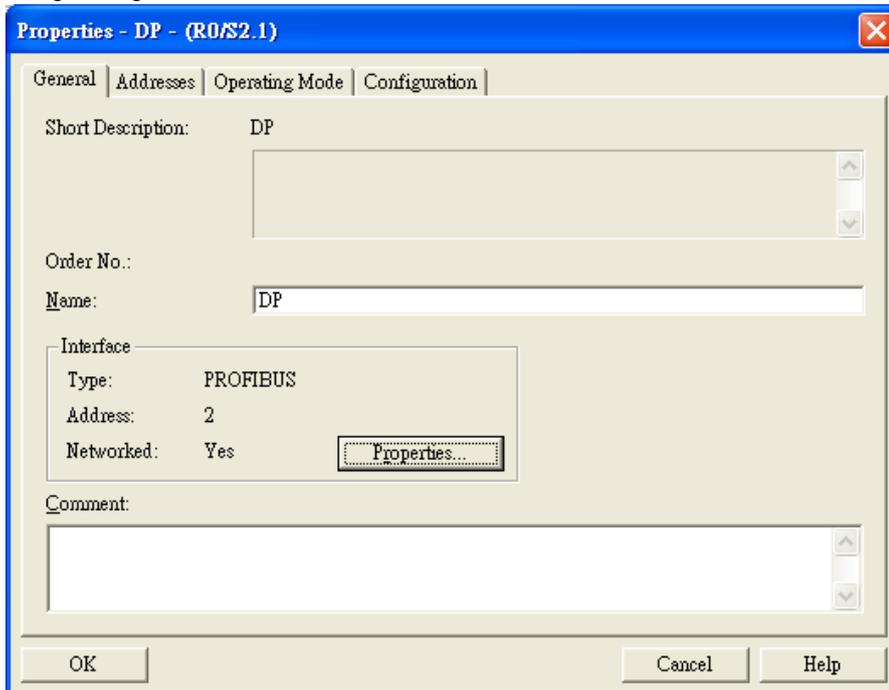
8. One PROFIBUS-DP bus will appear after UR when the above parameter setting is finished.
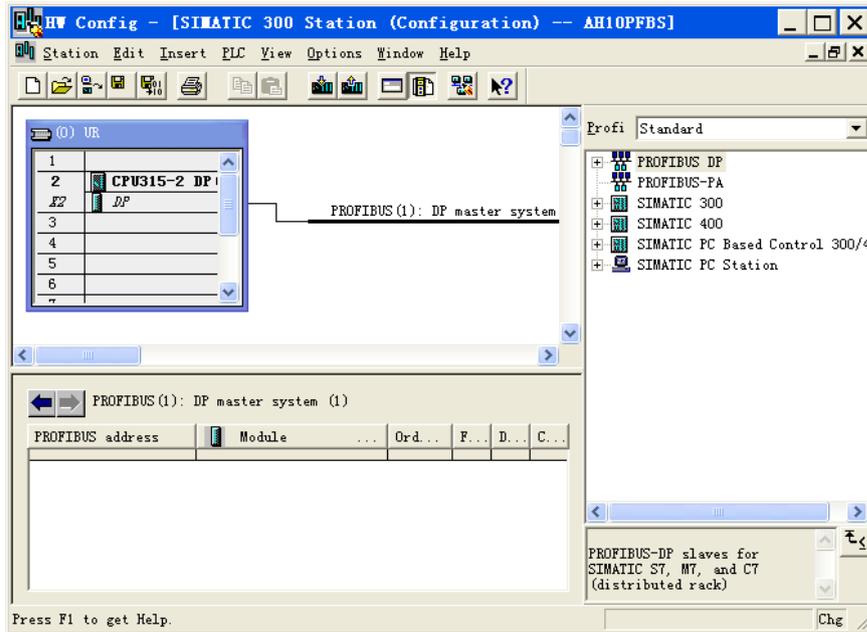
- Add AH10PFBS-5A GSD file
  1. Select "Options">>"Install New GSD…" in the following "HW Config" dialog box.
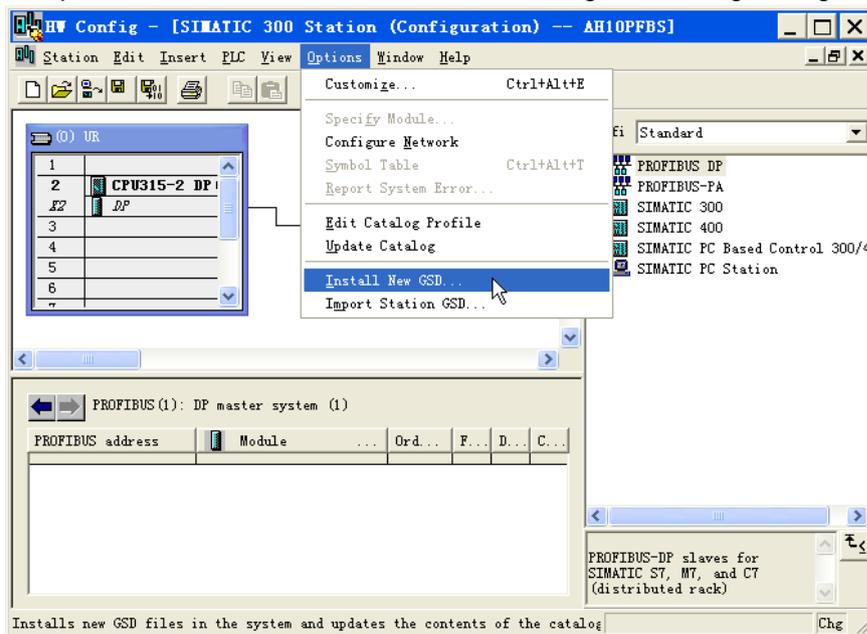
2. Click "Browse" marked in red box to find the GSD storage path and then select the GSD file indicated by the arrow and finally click "Install" marked in blue box to add the needed GSD file as below.
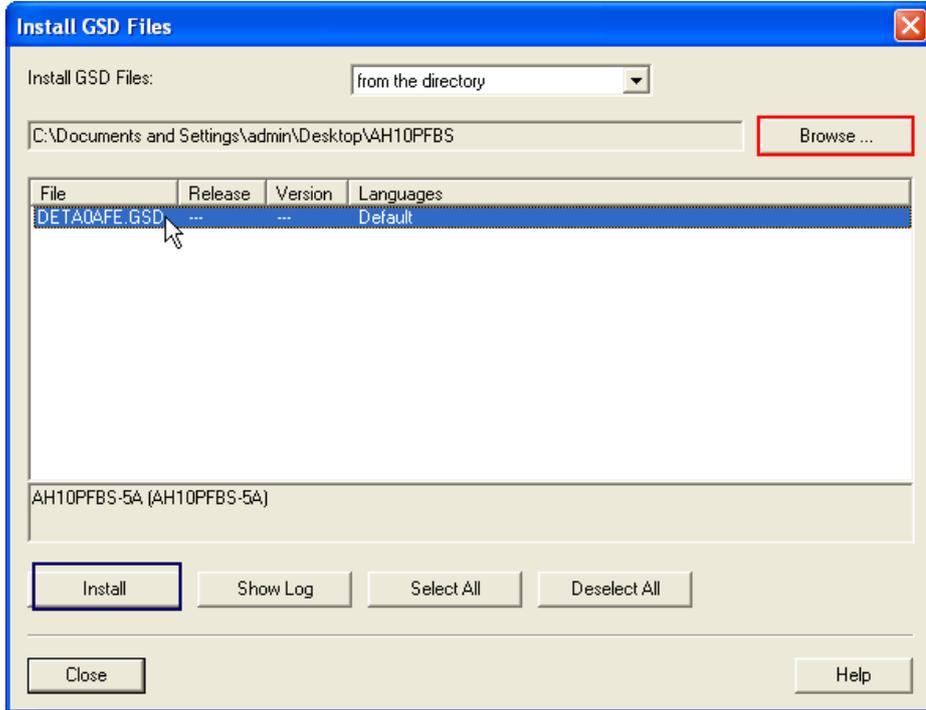
3. Find the module name of AH10PFBS-5A in the right column of the following window after adding the GDS file of AH10PFBS-5A. AH10PFBS-5A is the PROFIBUS-DP slave newly added.
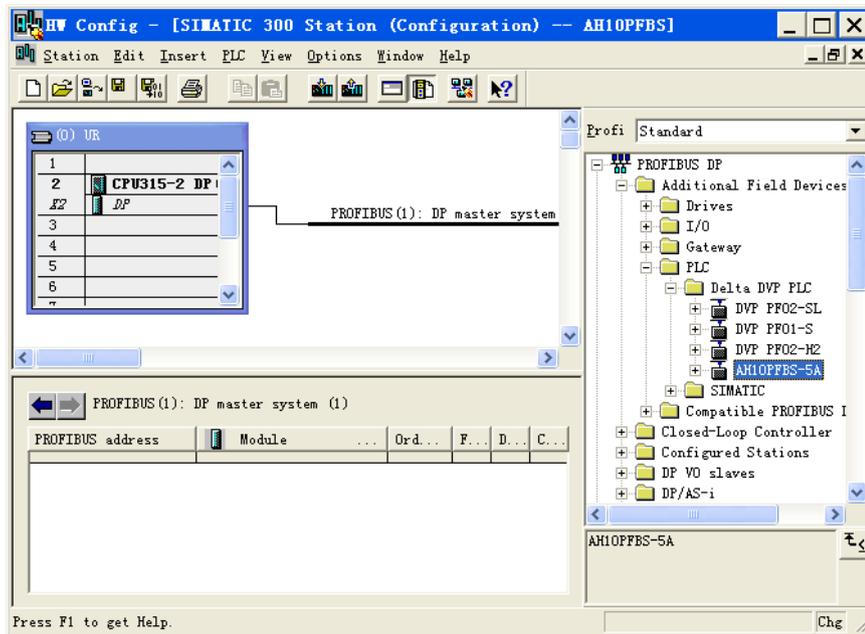
● Add AH10PFBS-5A slave and configure the parameters

1. Select the PROFIBUS-DP bus as below; double click AH10PFBS-5A icon in the right column of the following window and a new dialog box appears.
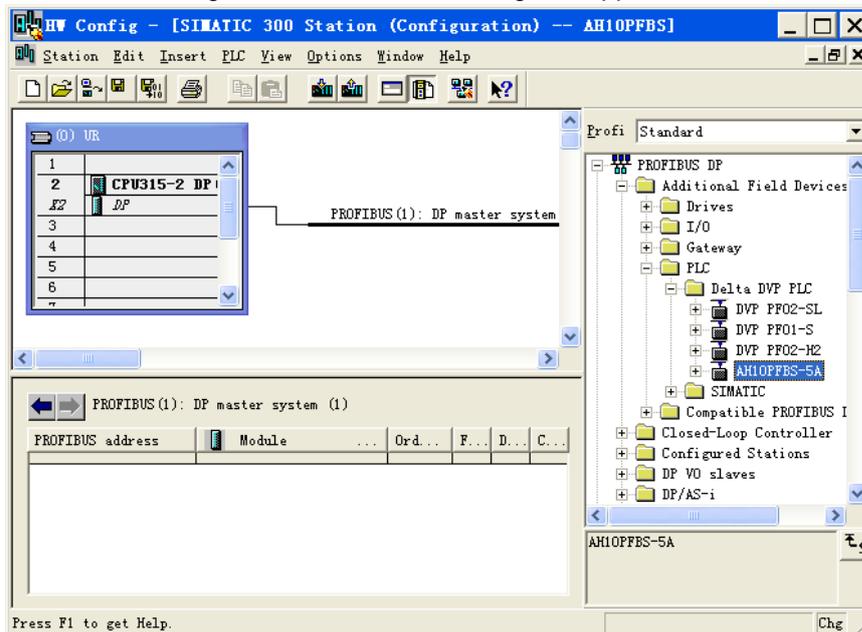
2. Select the node address of AH10PFBS-5A slave from the pull-down menu of "Address" in the following new dialog box. The node address here must be consistent with that set by the address switch of AH10PFBS-5A. Click "OK" after the node address setting is over.
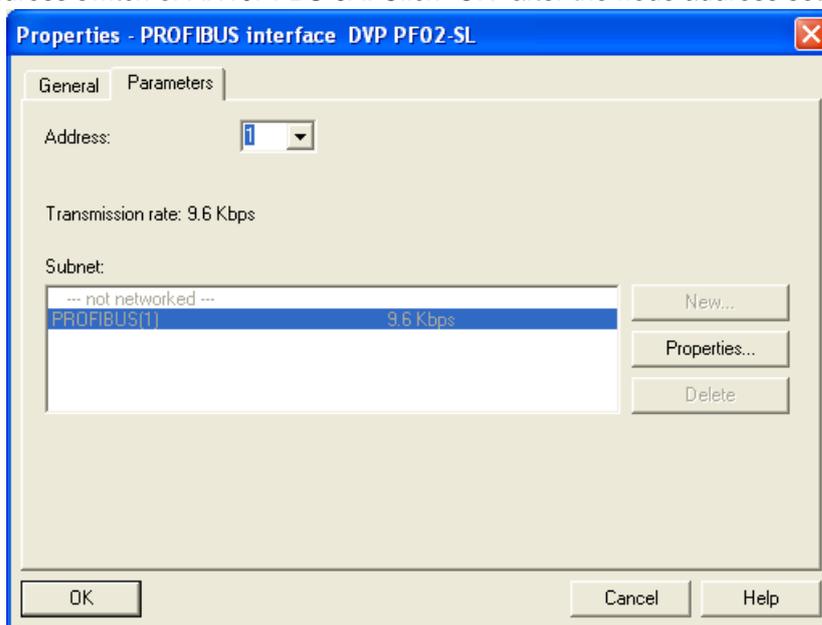
3. AH10PFBS-5A has been added to the PROFIBUS-DP bus as follows.
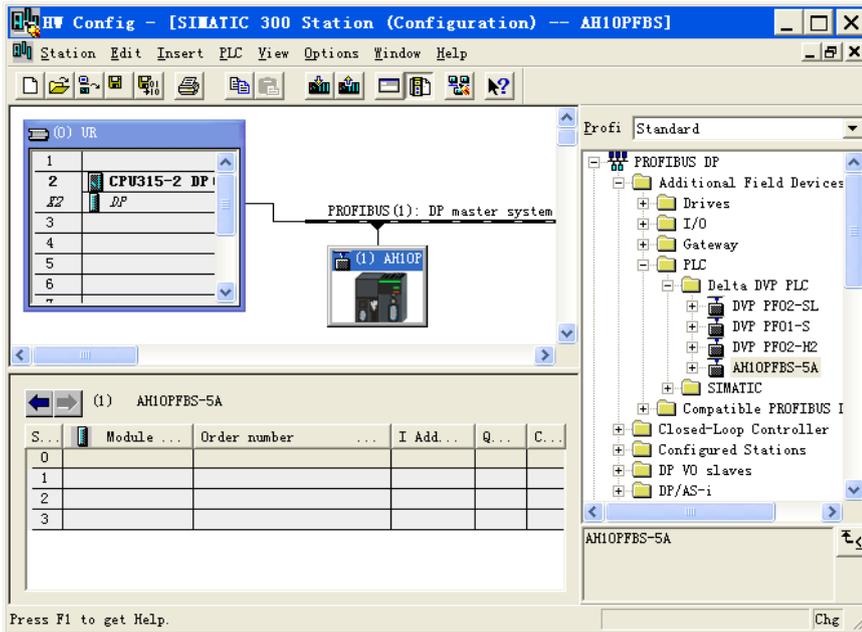
4. Select Slot 0 and then double click the "2 Word Out 2 Word In" option in the right column of the following window.
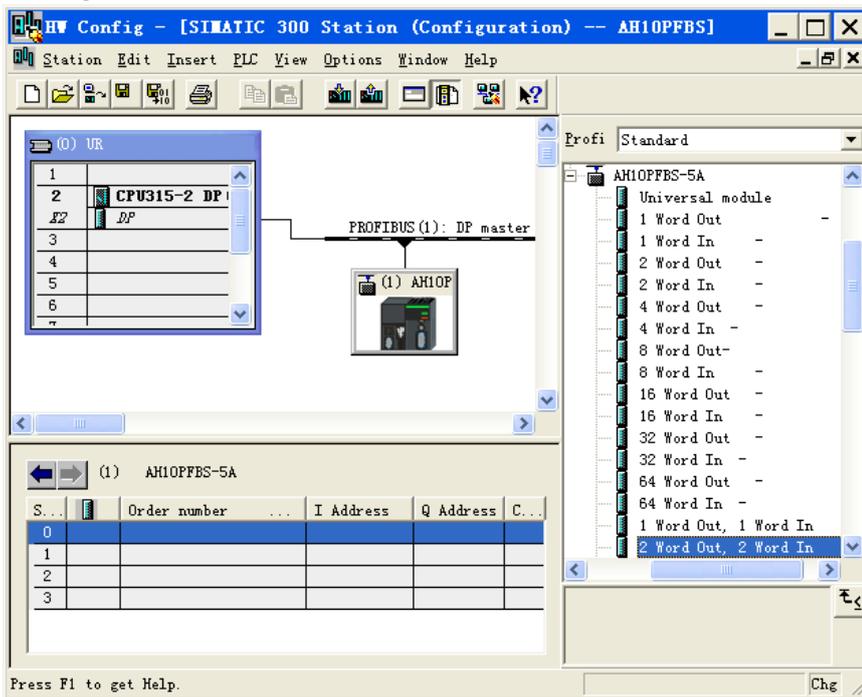
5. And "2 Word Out 2 Word In" has been configured to Slot 0 as follows.
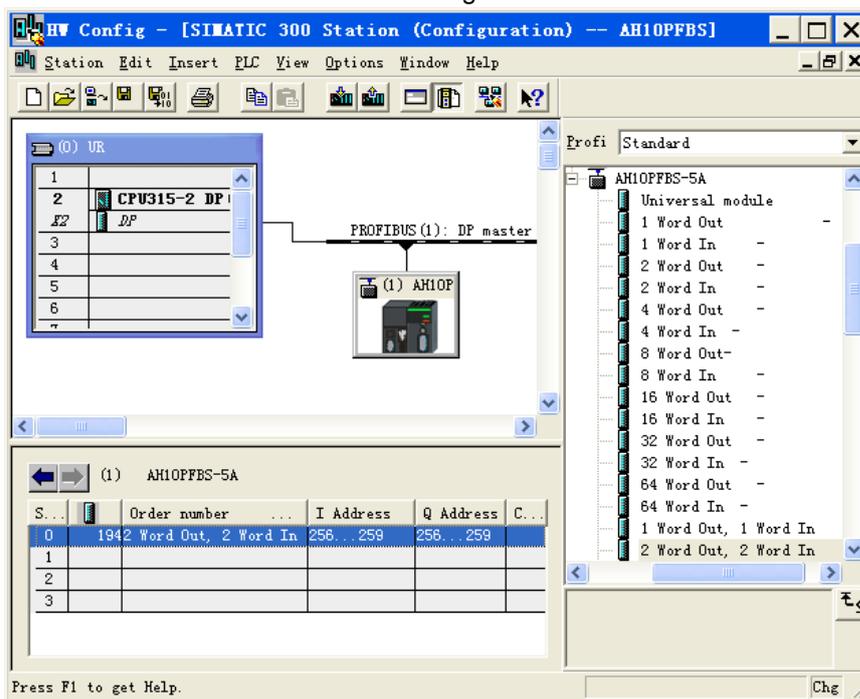
6. Double click where Slot 0 is and the following dialog box emerges.
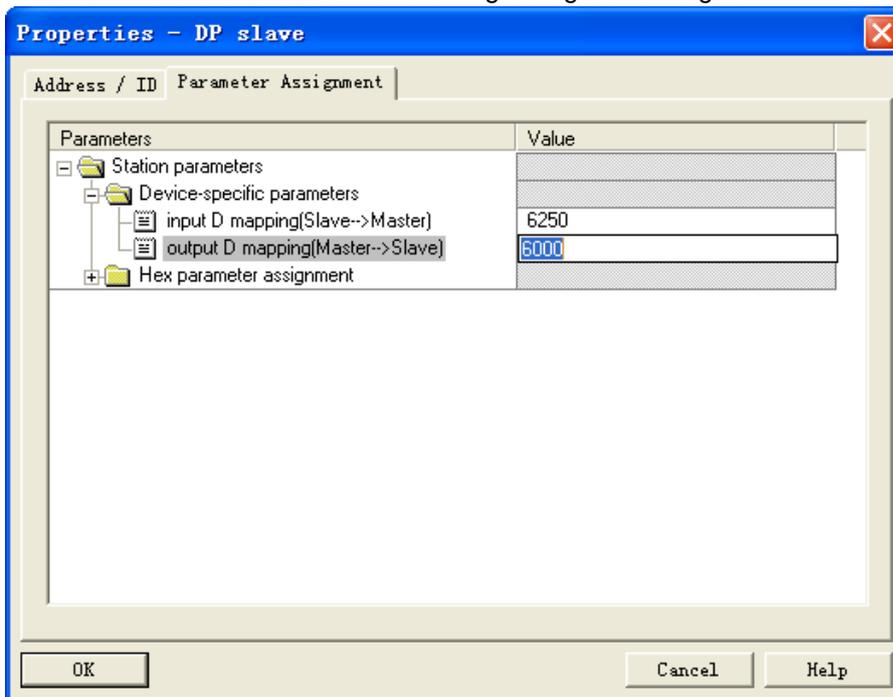
See the following table on the indications of parameters in the above window.

The number of the starting D register for input and output of the slave which every slot corresponds to must be set separately. The input D mapping and output D mapping are defined on basis of the master. E.g. Output represents that master transmits the data to the slave and input represents that the slave transmits the data to the master.

Item	Indication	Default
Input D mapping (Slave->Master)	The number of starting D register in input area	0 (Changeable by the keyboard)
output D mapping (Master->Slave)	The number of starting D register in output area	100 (Changeable by the keyboard)

7. Double click AH10PFBS-5A icon on the PROFIBUS network in "HW Config" dialog box and then the following window pops up.
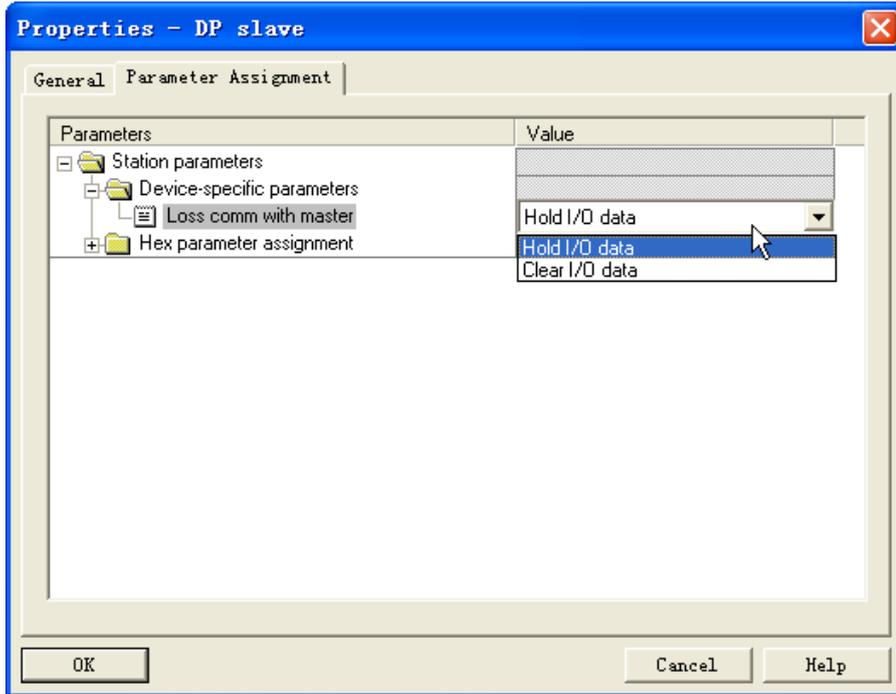
The indication of the above option is shown below.

Option	Selection	Indication
Los comm. with master	**Hold I/O data**	The input and output data before offline will keep unchanged when AH10PFBS-5A and the master are offline (E.g. the PROFIBUS-DP bus connector is removed from the slave).
	Clear I/O data	The output data received from the master will be cleared to 0 and the input data will keep unchanged when AH10PFBS-5A and the master are offline (E.g. the PROFIBUS-DP bus connector is removed from the slave).

8. Download the configuration data after configuration of the data is over.

After the connection between the master and AH10PFBS-5A is made and the NET light of AH10PFBS-5A is green, it indicates that the communication between AH10PFBS-5A and the PROFIBUS-DP master is normal. Otherwise, shoot the trouble according to the instruction in chapter 8.

13.9.6 Data Mapping
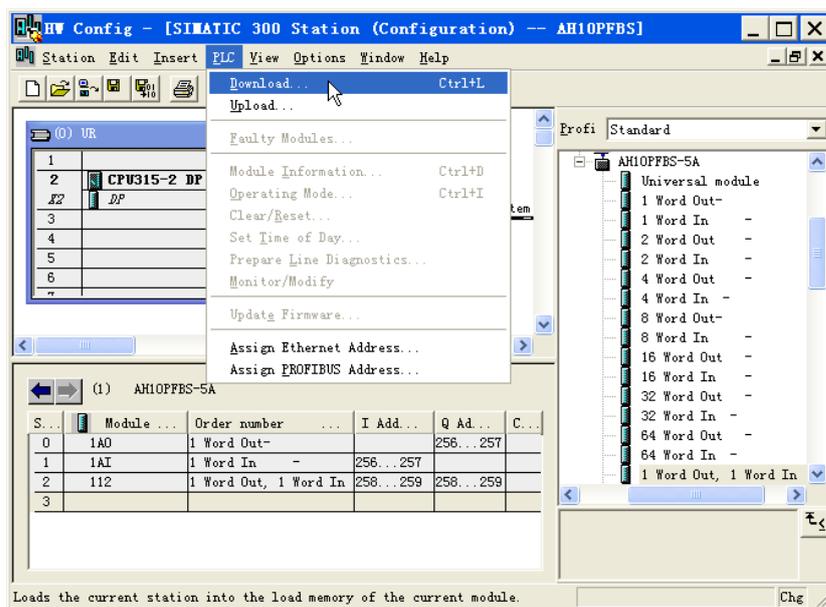
Data mapping relations in the above parameter configuration are listed as below.

Register in S7-300 master	PROFIBUS-DP network data transmission direction	Corresponding register in the AH500 series CPU module
PQW256	⟹	D6000
PQW258	⟹	D6001
PIW256	⟸	D6250
PIW258	⟸	D6251

13.9.7 Program Example

● Master program
1. Write the master program inside OB1.
2. When M0.0 is ON, write 1000 to PQW256 and 2000 to PQW258. The master will transmit the data in PQW256 and PQW258 to D6000 and D6001 in the slave respectively via the PROFIBUS-DP bus.
3. When M0.0 is ON, write the data in PIW256 to MW10 and PIW258 to MW12. The data in PIW256 and PIW258 are those in D6250 and D6251 of the slave transmitted to the master via the PROFIBUS-DP bus.
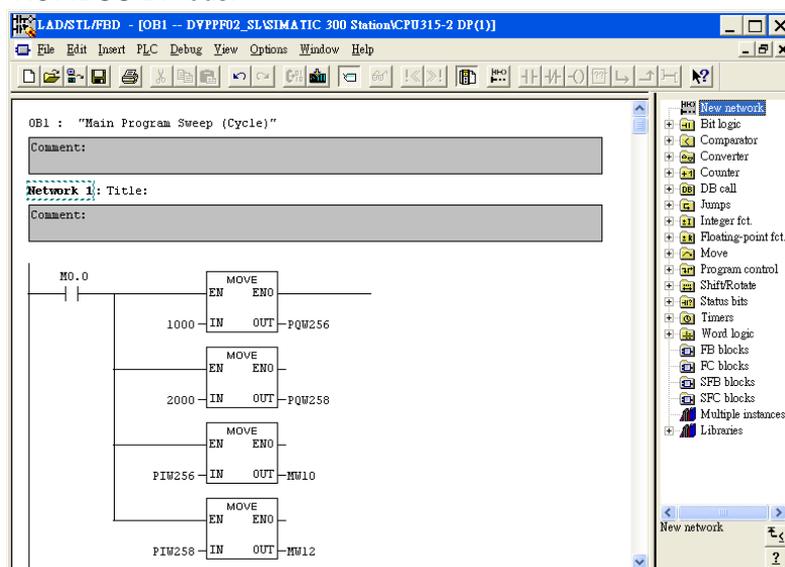
- Slave program
  1. The Delta AH500 series PLC program can be programmed via ISPSoft and see the software help file for more details on how to program.
  2. When M0 is ON, write 1000 to D6250 and D6251 and AH10PFBS-5A will transmit the data in D6250 and D6251 to PIW256 and PIW258 of the master via the PROFIBUS-DP bus. Write the values in D6000 and D6001 to D10 and D11 respectively. The data in D6000 and D6001 are what the master transmits to AH10PFBS-5A via the PROFIBUS-DP bus.
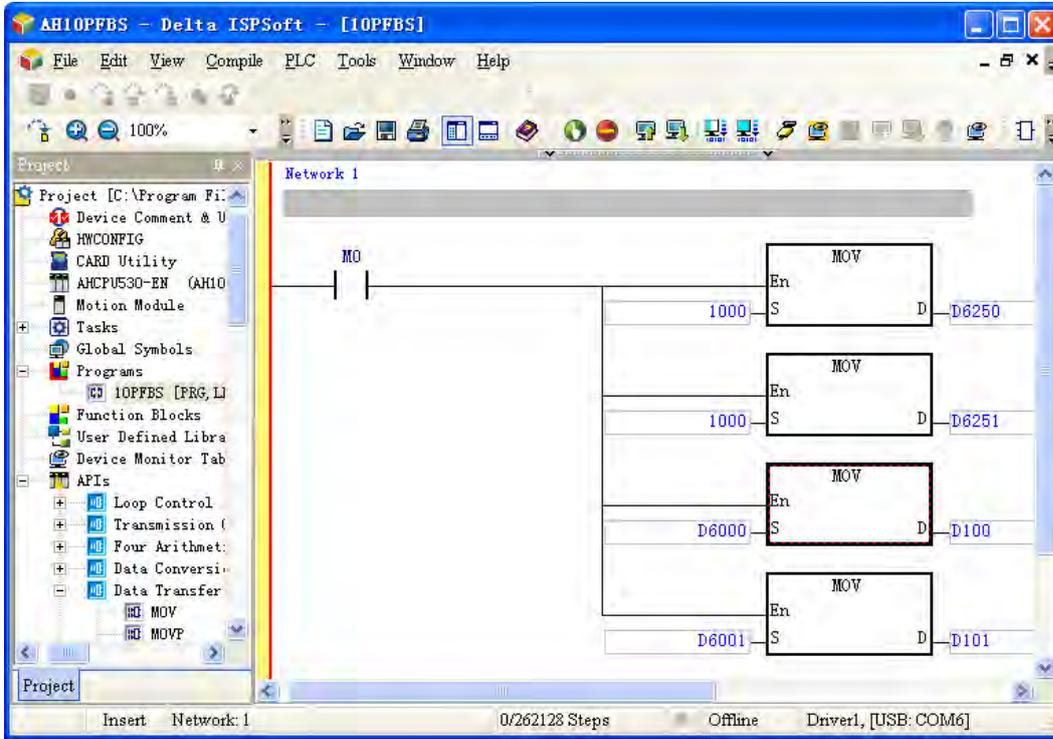
Chapter 14 Remote I/O Communication Module AHRTU-PFBS

Table of Contents

14.1 Introduction to AHRTU-PFBS-5A

1. Thank you for choosing Delta AHRTU-PFBS-5A module. Please read the product instruction carefully before use so as to install and operate the product properly.

2. The instruction is simply a guideline for operation of the product and the details on the PROFIBUS DP protocol is excluded here. Please refer to the relevant articles and literatures for more details on the PROFIBUS DP protocol.

3. AHRTU-PFBS-5A, defined as the PROFIBUS DP remote I/O communication module, is used to connect Delta AH series I/O module to the PROFIBUS DP network.

4. AHRTU-PFBS-5A need be used with the power module PS05 and I/O module, main rack and etc. together.

14.1.1 Function

- Supports DPV0 (i.e. the cyclic data exchange with the master.) Each AHRTU-PFBS-5A supports maximum 244 bytes input and 244 bytes output.
- Supports DPV1 (that is, the master can make the acyclic read/ write of the data in AHRTU-PFBS-5A.)
- Support maximum 8 racks (1 main rack and 7 extension racks) and maximum 48 I/O modules.
- Supports auto-detection of the baud rate and the maximum baud rate is 12Mbps.
- Supports self-diagnosis and diagnosis of I/O module troubles.
- Supports the hot plug. (When the main rack is powered on, the module can be inserted to the I/O slot or be removed from the I/O slot.)

14.2 Profile and Specification

14.2.1 Components
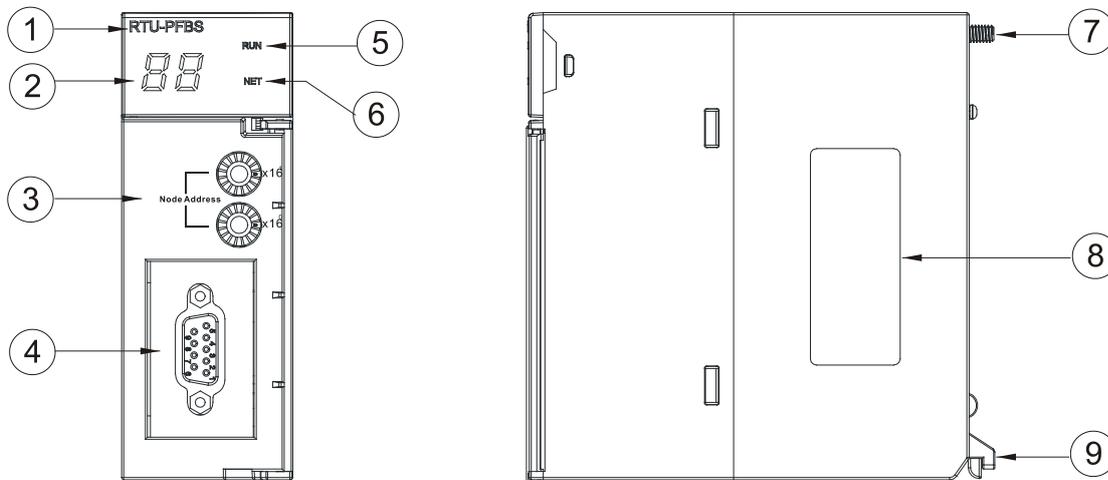
1. Model name	2. 7-segment display	3. Address switch
4. PROFIBUS DP communication port	5. RUN indicator	6. NET indicator
7. Set screw	8. Name plate	9. Module fixing projection

14.2.2 Specification

● PROFIBUS DP port

Interface	DB9 connector
Transmission method	High-speed RS-485
Transmission cable	Two-wire twisted shielded cable
Electrical isolation	500 VDC

● Communication

Message type	Cyclical data exchange
Module name	AHRTU-PFBS -5A
GSD file	DETA09B9.GSD
Product ID	09B9
Serial transmission speed supported (auto-detection)	9.6kbps; 19.2kbps; 45.45kbps;93.75kbps; 187.5kbps; 500kbps; 1.5Mbps; 3Mbps; 6Mbps; 12Mbps

● Electrical Specification

Power supply voltage	5VDC
Insulation voltage	500VDC
Power consumption	2W
Weight	200g

● Environment

Noise immunity	RS (IEC 61131-2, IEC 61000-4-3): 80~1, 000 MHz, 1.4 ~ 2 GHz, 10 V/m EFT(IEC 61131-2, IEC 61000-4-4): Analog & Communication I/O: 1 kV ESD(IEC 61131-2, IEC 61000-4-2): 8 kV Air Discharge
Storage/operation	Storage：-25 ~ 70°C(temperature), 5 ~ 95% (humidity) Operation：0 ~ 55°C(temperature), 5~ 95% (humidity), pollution level 2
Shock/vibration immunity	International standards: IEC 61131-2, IEC 68-2-6 (TEST Fc)/IEC 61131-2 & IEC 68-2-27(TEST Ea)

14.3 Installation

14.3.1 Dimension

Unit: mm
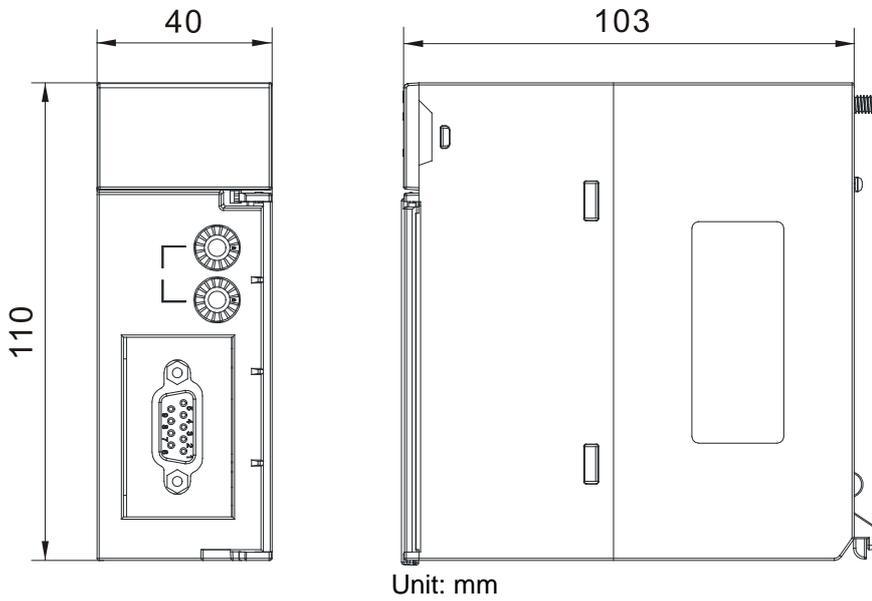
14.3.2 Installing AHRTU-PFBS-5A to the Main Rack

● Insert the projection under the module into the hole in the rack; push the module in the direction indicated by the following arrow to meet the CPU slot of the rack.
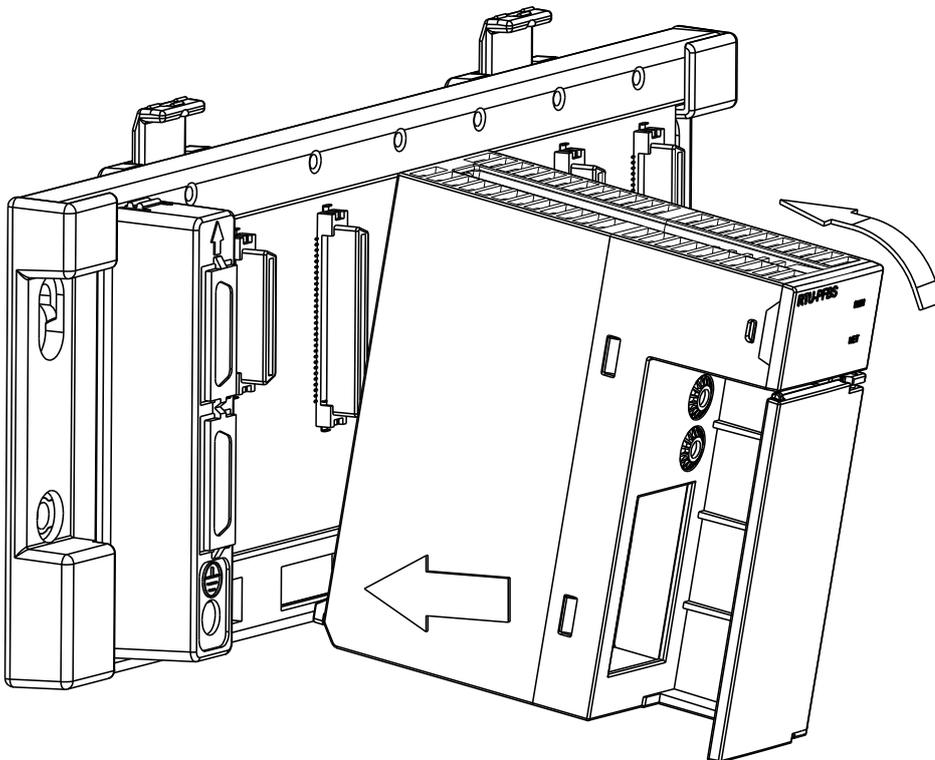
● After properly installing, tighten the screw on the upper of the module.
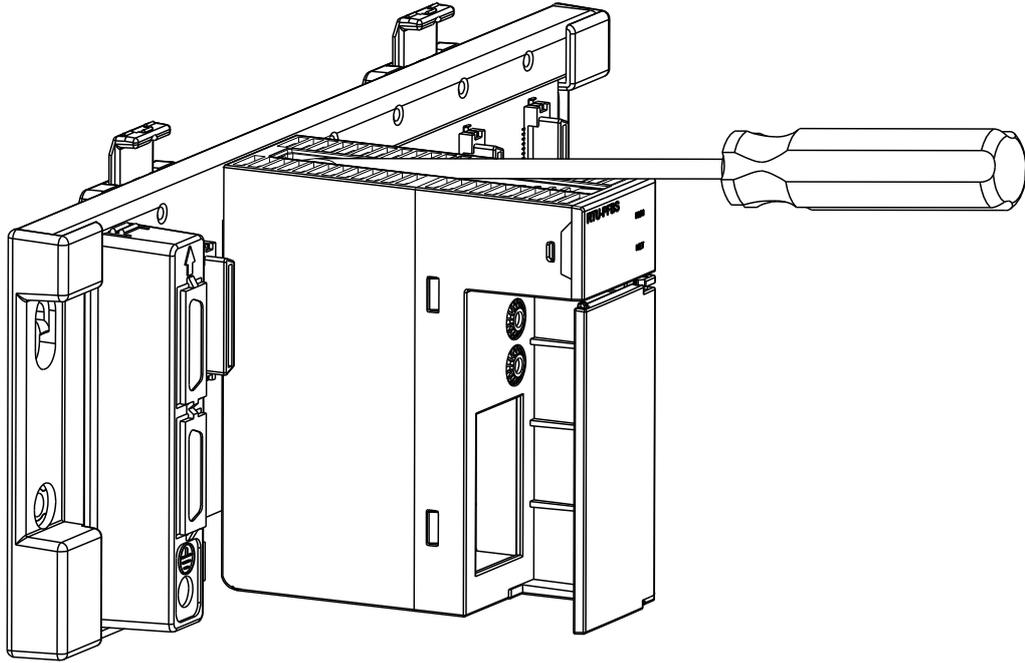
14.3.3 Connecting PROFIBUS DP Connector

● Insert the PROFIBUS DP bus connector in the direction indicated by the following arrow to AH10PFBS-5A communication port. Tighten the screw on the PROFIBUS DP bus connector so as to ensure the connection between AHRTU-PFBS-5A and PROFIBUS DP bus is reliable.
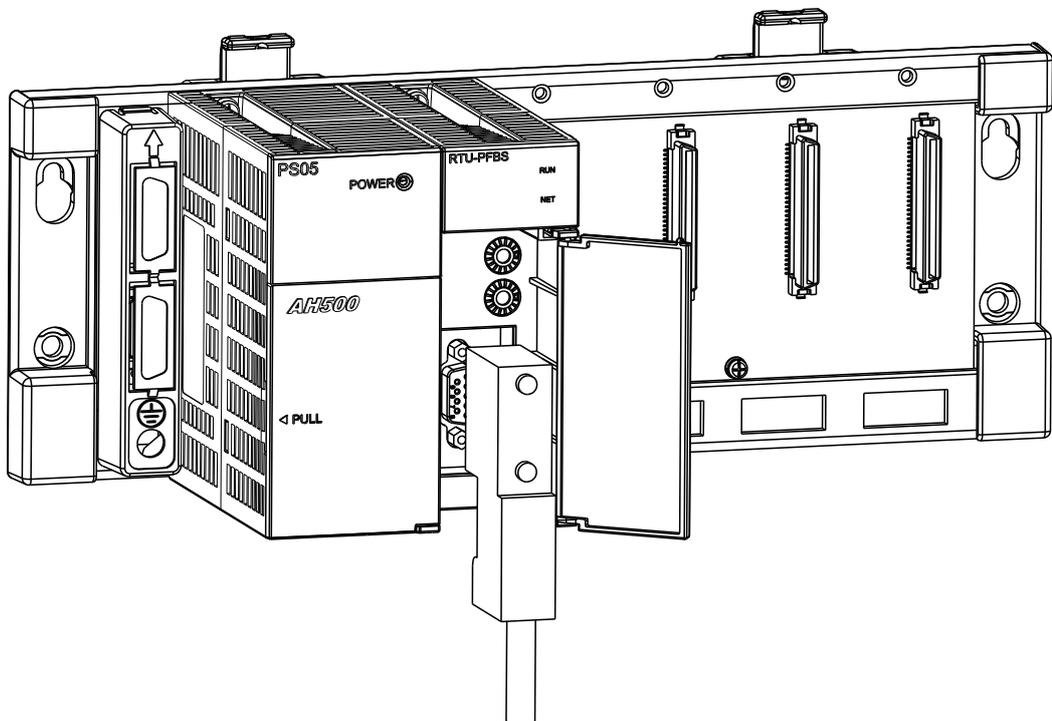
14.3.4 Definition of PROFIBUS DP Port Pin

Pin	Definition	Description
1	--	N/C
2	--	N/C
3	RxD/TxD-P	Receiving/Sending data (P (B))
4	--	N/C
5	DGND	Data reference potential (C)
6	VP	Power voltage – positive
7	--	N/C
8	RxD/TxD-N	Receiving/Sending data (N (A))
9	--	N/C
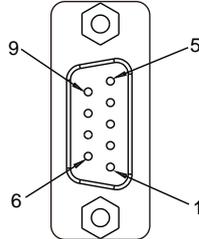
14.3.5 Setting PROFIBUS Node Address via the Rotary Switches

The rotary node address switch of AHRTU-PFBS -5A is used for setting the node address of AHRTU-PFBS-5A on the PROFIBUS DP network. The rotary node address switch consists of two rotary switches, $x16^0$ and $x16^1$. The range for either rotary switch is 0 ~ F.

The range for setting the node address is as the following table.

Address	Definition
H'1 ~ H'7D	Valid PROFIBUS address
H'0 or H'7E ~ H'FF	Invalid PROFIBUS address
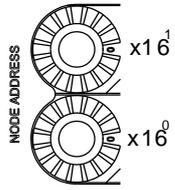
Example: If you need to set the node address of AHRTU-PFBS-5A to 26 (decimal), simply switch the corresponding switch of $x16^1$ to "1" and the corresponding switch of $x16^0$ to "A". 26 (decimal) = 1A (hex) = $1x16^1 + Ax16^0$.

Note:

➢ Switch off the power supply before setting up the node address of AHRTU-PFBS-5A. Re-power the module after the setup is completed.

➢ Changing the value on the switch during the operation of AHRTU-PFBS-5A will not be valid immediately until re-powering AHRTU-PFBS-5A after powering it off.

➢ Use the slotted screwdriver to set up the switch. Be careful not to scratch the module.

14.4 Using AHRTU-PFBS-5A to Create the PROFIBUS DP Network

14.4.1 PROFIBUS DP Network Figure

AHRTU-PFBS-5A is used to connect AH series I/O modules to the PROFIBUS DP network. The PROFIBUS DP network figure is illustrated as below with AH10PFBM as the master and AHRTU-PFBS-5A as the slave.
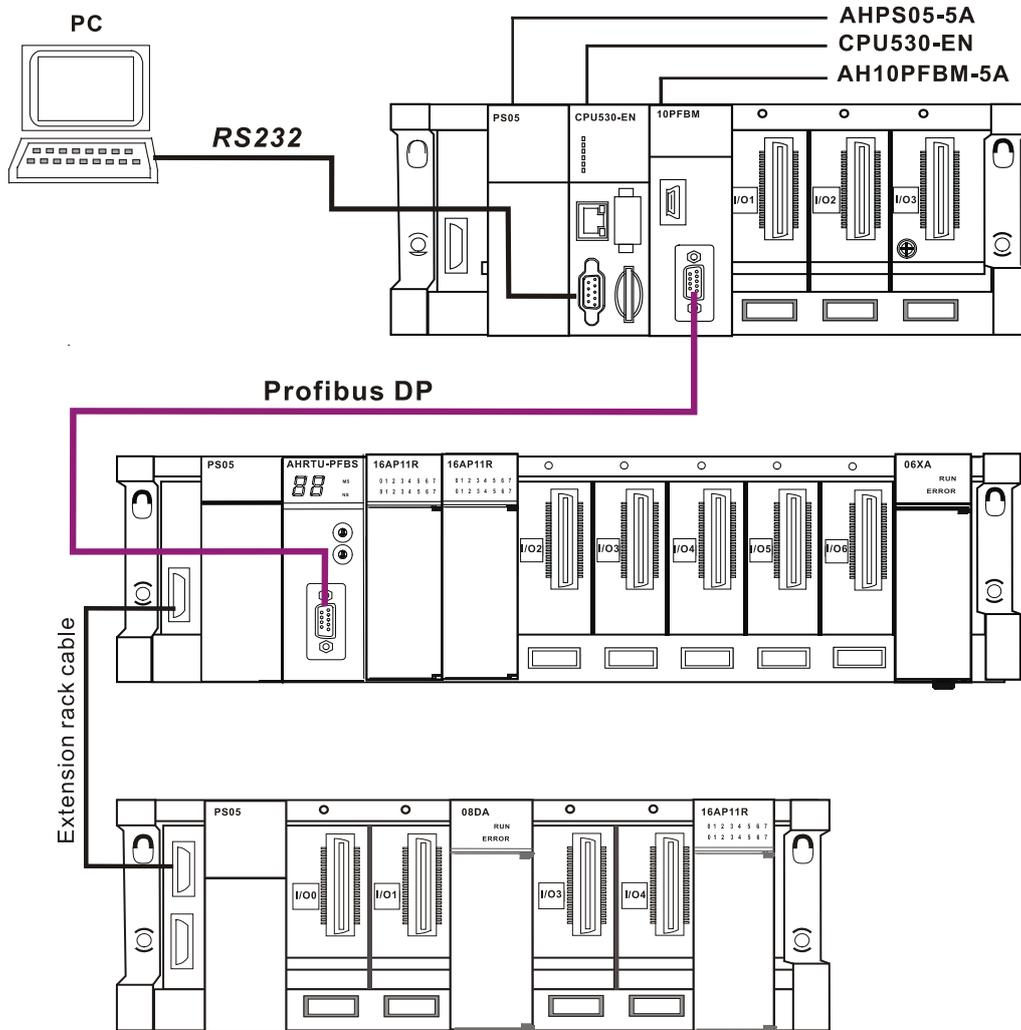
14.4.2 Terminal Resistor

When AHRTU-PFBS-5As are installed at the two ends of the PROFIBUS network, their PROFIBUS interfaces need connect the terminal resistors including the following 3 resistors, Rt, Ru and Rd. The standard PROFIBUS connector contains the built-in terminal resistor which user could select whether to connect to the station or not via the switch. User could purchase the standard PROFIBUS connector to add the terminal resistor.
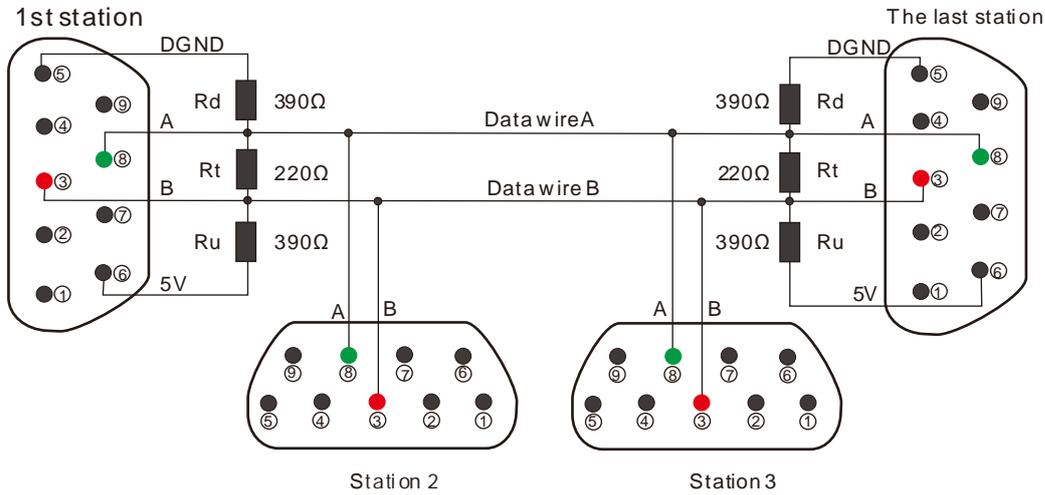
14.4.3 Model and Specification of I/O Modules

● The following table lists the model and specification of the power module, main rack, extension racks and extension communication cable.

Model	Description
AHPS05-5A	Power module: 100-240VAC 50/60HZ
AHBP04M1-5A	4-slot main rack specially used by CPU/RTU
AHBP06M1-5A	6-slot main rack specially used by CPU/RTU
AHBP08M1-5A	8-slot main rack specially used by CPU/RTU
AHBP12M1-5A	12-slot main rack specially used by CPU/RTU
AHBP06E1-5A	6-slot extension rack specially used by CPU/RTU
AHBP08E1-5A	8-slot extension rack specially used by CPU/RTU
AHACAB06-5A	The 0.6m communication cable specially used by the extension rack
AHACAB10-5A	The 1.0m communication cable specially used by the extension rack
AHACAB15-5A	The 1.5m communication cable specially used by the extension rack
AHACAB30-5A	The 3.0m communication cable specially used by the extension rack
AHACAB50-5A	The 5.0m communication cable specially used by the extension rack
AHACABA0-5A	The 10.0m communication cable specially used by the extension rack
AHACABA5-5A	The 15.0m communication cable specially used by the extension rack
AHACABB0-5A	The 20.0m communication cable specially used by the extension rack
AHACABC0-5A	The 30.0m communication cable specially used by the extension rack

Model	Description
AHACABD0-5A	The 40.0m communication cable specially used by the extension rack
AHACABE0	The 50.0m communication cable specially used by the extension rack
AHACABF0	The 60.0m communication cable specially used by the extension rack
AHACABG0	The 70.0m communication cable specially used by the extension rack
AHACABH0	The 80.0m communication cable specially used by the extension rack
AHACABJ0	The 90.0m communication cable specially used by the extension rack
AHACABK0	The 100.0m communication cable specially used by the extension rack

● The model and specification of the digital I/O module connectable to AHRTU-PFBS-5A

I/O module model	I/O mapping parameter and length(Unit: Byte)	
	Input mapping parameter (Length)	Output mapping parameter (Length)
AH16AM10N-5A	N/A	X0.0~X0.15 in AH16AM10N (Length=2)
AH32AM10N-5A	N/A	X0.0~X1.15 in AH32AM10N (Length=4)
AH32AM10N-5B	N/A	X0.0~X1.15in AH32AM10N (Length=4)
AH32AM10N-5C	N/A	X0.0~X1.15 in AH32AM10N (Length=4)
AH64AM10N-5C	N/A	X0.0~X3.15 in AH64AM10N (Length=8)
AH16AM30N-5A	N/A	X0.0~X0.15 in AH16AM30N (Length=2)
AH16AN01R-5A	Y0.0~Y0.15 in AH16AN01R (Length = 2)	N/A
AH16AN01T-5A	Y0.0~Y0.15 in AH16AN01T (Length = 2)	N/A
AH16AN01P-5A	Y0.0~Y0.15 in AH16AN01P (Length = 2)	N/A
AH32AN02T-5A	Y0.0~Y1.15 in AH32AN02T (Length = 4)	N/A
AH32AN02T-5B	Y0.0~Y1.15 in AH32AN02T (Length = 4)	N/A
AH32AN02T-5C	Y0.0~Y1.15 in AH32AN02T (Length = 4)	N/A
AH32AN02P-5A	Y0.0~Y1.15 in AH32AN02P (Length = 4)	N/A
AH32AN02P-5C	Y0.0~Y1.15 in AH32AN02P (Length = 4)	N/A
AH64AN02T-5C	Y0.0~Y3.15 in AH64AN02T (Length = 8)	N/A
AH32AN02P-5B	Y0.0~Y1.15 in AH32AN02P (Length = 4)	N/A
AH64AN02P-5C	Y0.0~Y3.15 in AH64AN02P (Length = 8)	N/A

I/O module model	I/O mapping parameter and length(Unit: Byte)	
	Input mapping parameter (Length)	Output mapping parameter (Length)
AH16AN01S-5A	Y0.0~Y0.15 in AH16AN01S (Length = 2)	N/A
AH16AP11R-5A	Y0.0~Y0.15 in AH16AP11R (Length = 2)	X0.0~X0.15 in AH16AP11R (Length =2)
AH16AP11T-5A	Y0.0~Y0.15 in AH16AP11T (Length = 2)	X0.0~X0.15 in AH16AP11T (Length =2)
AH16AP11P-5A	Y0.0~Y0.15 in AH16AP11P (Length = 2)	X0.0~X0.15 in AH16AP11P (Length =2)

● The model and specification of the special module connectable to AHRTU-PFBS-5A

Special module model	I/O mapping parameter and length(Unit:Bytes)	
	Input mapping parameter (Length)	Output mapping parameter (Length)
AH04AD-5A	N/A	The digital value converted from the analog quantity of input CH 0~3 of AH04AD (Length=8)
AH08AD-5B	N/A	The digital value converted from the analog quantity of input CH 0~7 of AH08AD (Length= 16)
AH08AD-5C	N/A	The digital value converted from the analog quantity of input CH 0~7 of AH08AD (Length= 16)
AH04DA-5A	The digital value of output CH0~3 of AH04DA (Length=8)	N/A
AH08DA-5B	The digital value of output CH0~7 of AH08DA (Length= 16)	N/A
AH08DA-5C	The digital value of output CH0~7 of AH08DA (Length= 16)	N/A
AH06XA-5A	The digital value of output CH0~1 of AH06XA (Length=4)	The digital value converted from the analog quantity of input CH 0~3 of AH06XA (Length=8)
AH04PT-5A	N/A	The digital value converted from the collected temperature of input CH 0~3 of AH04PT (Length=8)
AH04TC-5A	N/A	The digital value converted from the collected temperature of input CH 0~3 of AH04TC (Length=8)
AH08TC-5A	N/A	The digital value converted from the collected temperature of input CH 0~7 of AH08TC (Length=16)

Note:
1. Each channel of all analog modules corresponds to 2 bytes of digital value. For example, the corresponding relationship of each channel of AH04AD is shown below.

Special module model	Mapping parameter (length)	Arrangement of mapping parameters in each channel (Length)
AH04AD-5A	Digital value converted from the analog quantity of input CH0~CH3 of AH04AD(Length=8)	Digital value in Byte0~ Byte1 that the input channel 0 corresponds to(Length=2)
		Digital value in Byte2~ Byte3 that the input channel 1 corresponds to(Length=2)
		Digital value in Byte4~ Byte5 that the input channel 2 corresponds to(Length=2)
		Digital value in Byte6~ Byte7 that the input channel 3 corresponds to(Length=2)

2. Conversion between analog modules and digital modules that AHRTU-PFBS supports:
    When the input / output mode of the analog module is positive voltage or positive current, the corresponding digital value is 0 ~32000; for example, if the modes are 0V~10V and 4mA~20mA, the corresponding digital values are both 0~32000.
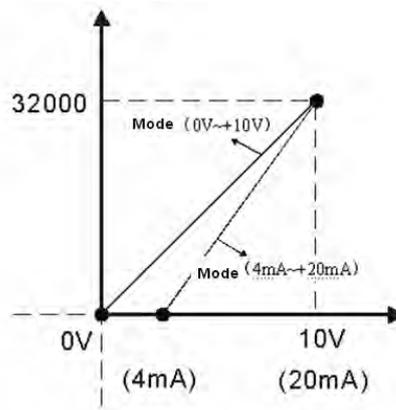
When the input /output mode of the analog module is negative voltage or negative current, the corresponding digital value is -32000~32000; for example, the modes are -10V~+10V, and -20mA~20mA, the corresponding digital values are both -32000~32000.
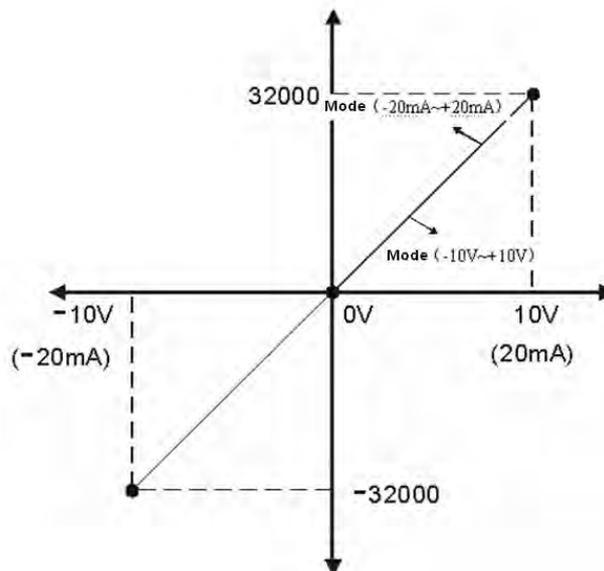
3. AHRTU-PFBS-5A must be installed to the CPU slot of the main rack; supports maximum 8 racks including 1 main rack and maximum 7 extension racks and 48 I/O modules.

4. The total lengths of input and output mapping for all configured I/O modules are both 244 bytes at most and the total length of all configured I/O module parameters is maximum 244 bytes. Therefore, different input and output mapping lengths of different modules and parameter lengths will decide the number of the configured I/O modules.

14.5 Transmission Distance and Baud Rate

The PROFIBUS DP baud rate ranges from 9.6Kbps to 12Mbps. The transmission distance depends on the baud rate. The range of the transmission distance is between 100m to 1,200m.

The baud rate and the corresponding transmission distance that AHRTU-PFBS-5A supports are shown in the following table.

Baud rate(bps)	9.6k	19.2k	93.75k	187.5k	500k	1.5M	3M	6M	12M
Transmission distance(m)	1200	1200	1200	1 000	400	200	100	100	100

14.6 GSD File

The GSD file, a text file, is used to recognize the PROFIBUS device (master or slave). GSD file includes all necessary data information for configuration of one slave in the standard PROFIBUS DP master. The GSD file usually contains the supplier's information, supported transmission speed and available I/O information. Before using AHRTU-PFBS-5A, import its GSD file to the configuration software of the PROFIBUS DP master. After the GSD file is imported, AHRTU-PFBS-5A and other configuration options will show up in the master configuration software. The GSD file of AHRTU-PFBS-5A can be downloaded from the following Delta website.

http://www.deltaww.com/

14.7 Mapping Areas in AHRTU-PFBS-5A

This section is going to describe the configuration of the PROFIBUS DP network and the data mapping relationships by using AH10PFBM-5A as the master and AHRTU-PFBS-5A as the slave.

14.7.1 Configuration of AH10PFBM-5A Master in Hardware

As the PROFIBUS DP master module of AH series PLC, AH10PFBM-5A should be used with AH CPU together. The hardware configuration of AH10PFBM-5A is conducted in the ISPSoft software and the detailed configuration is shown below.

(Take the communication with the master PLC by means of USB as an example for explanation here. For the usage and operation of ISPSoft, please refer to the user manual of ISPSof)

1. Open ISPSoft as below
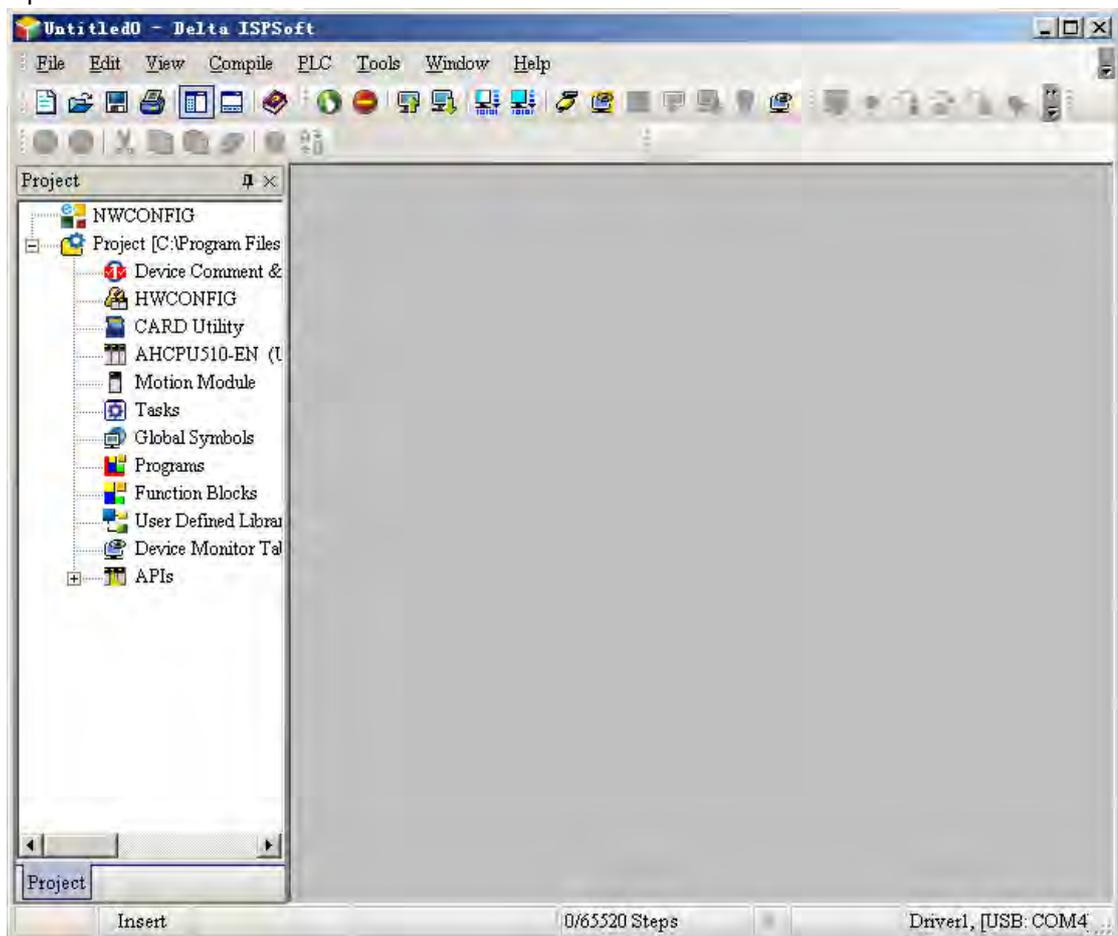
2. Click "Tool" > "Communication Settings…" and the communication setting dialog box appears as below.
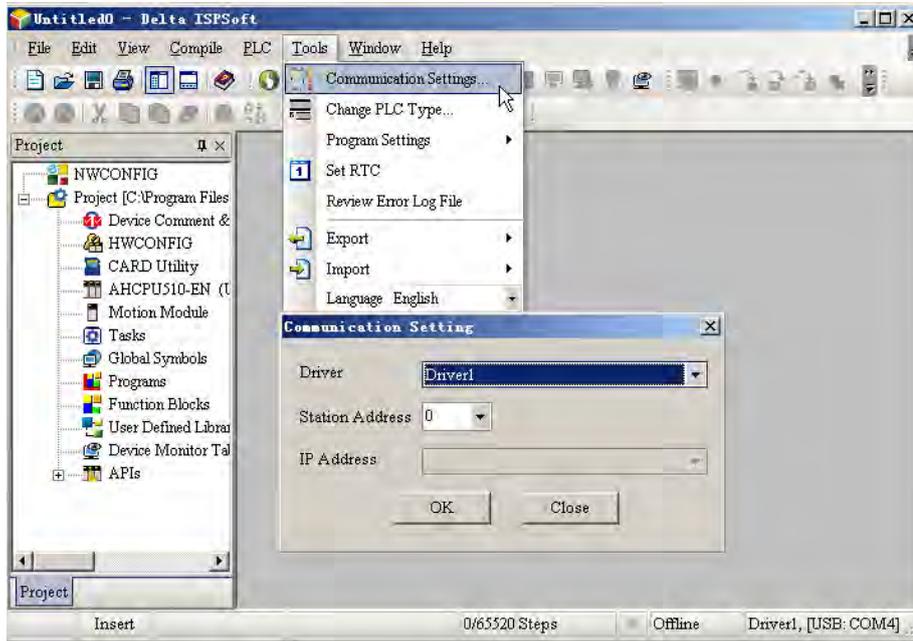
3. Select the driver name from the drop-down menu of Driver same as that in COMMRG. Set the station address to 0 or to the MODBUS station address identical to that of PLC. The station address 0 indicates the broadcast search. Finally, click "OK" to return to the main interface as below.
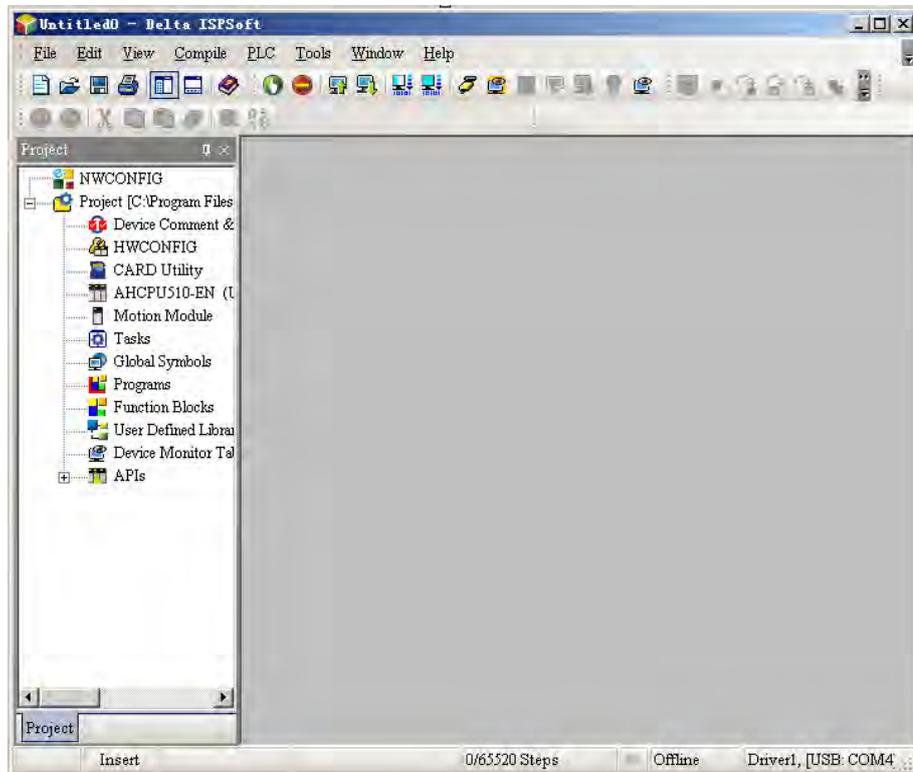
4. Double click HWCONFIG under Project and the following dialog box appears.
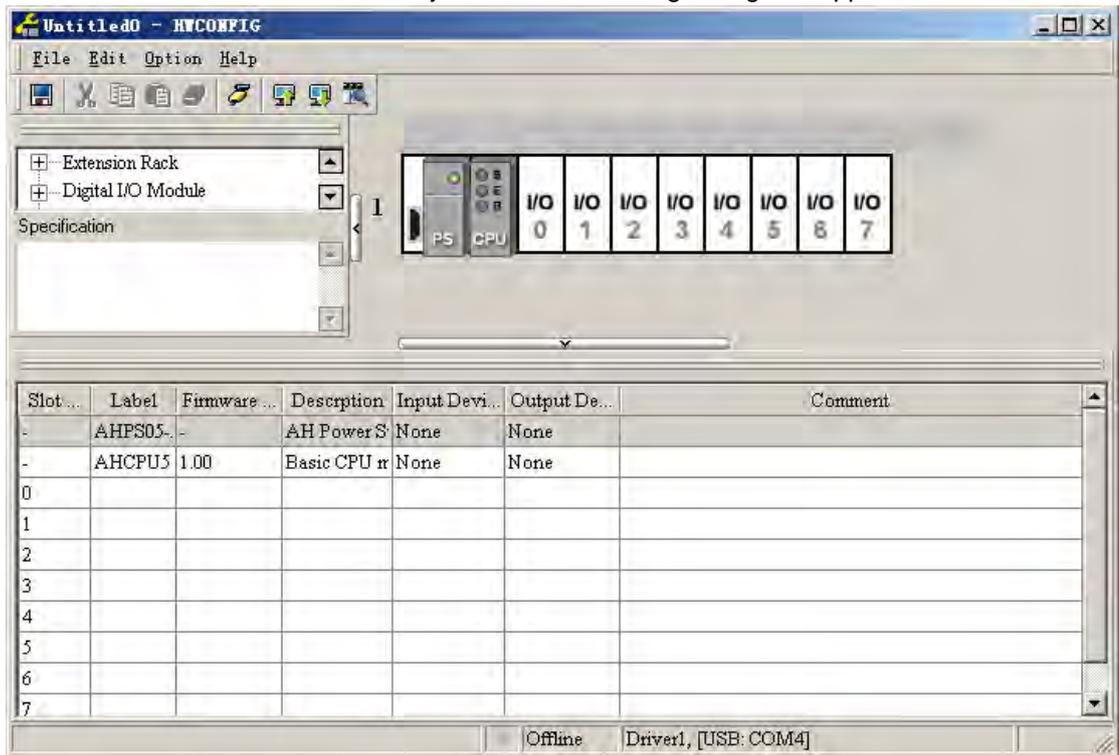
5. Click the I/O Scan button to scan all modules on the rack.
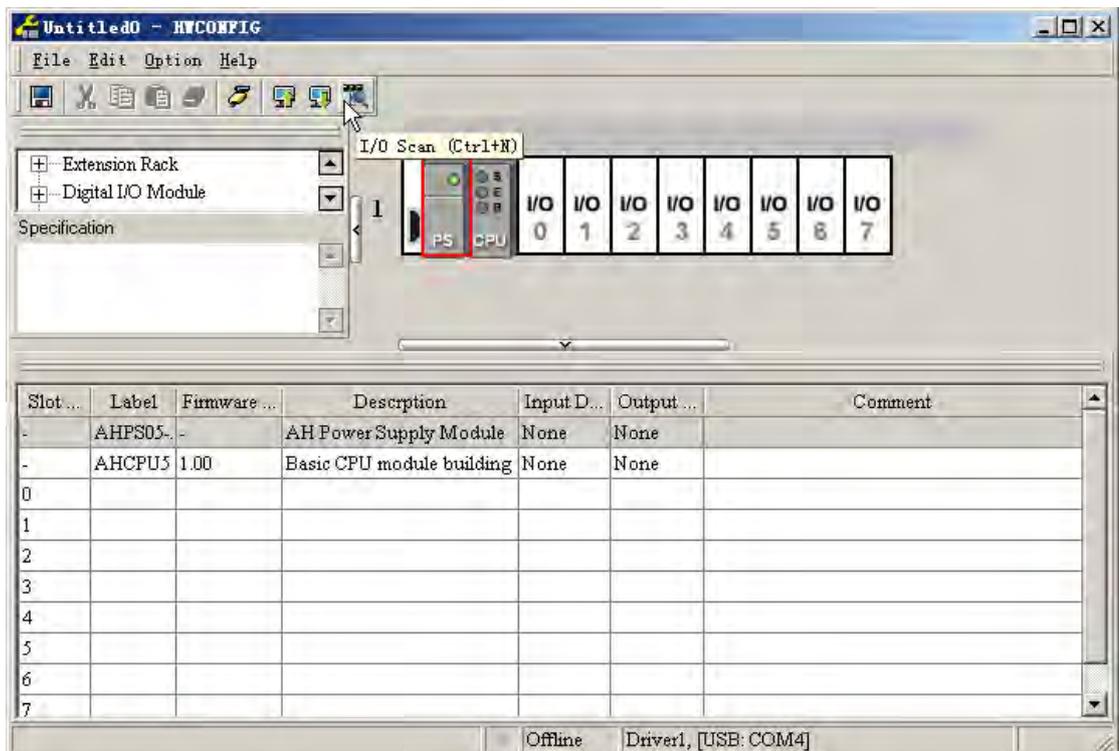
6. After scanning is over, 10PFBM module will show up beside the PLC CPU module on the rack.

7. Double click the 10PFBM icon and then the Parameter Setting dialog box pops up.
   Set Input Area D Begin Address, Input Area D Length, Output Area D Begin Address and Output Area D Length by clicking the place marked in red box below. (If the selected D device range is occupied, the system will remind that the device range setting conflicts and user should reset it). Click "OK" to complete the parameter configuration.
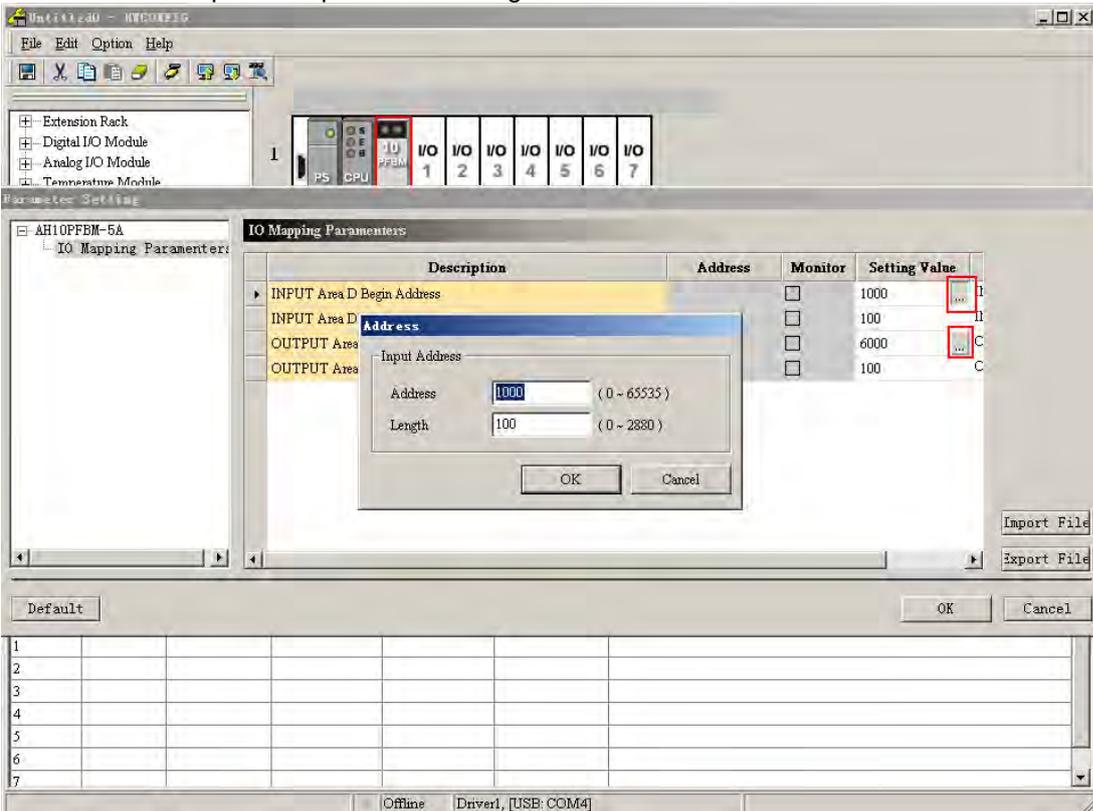
8. Click "Download" and the current configuration is downloaded to PLC then.
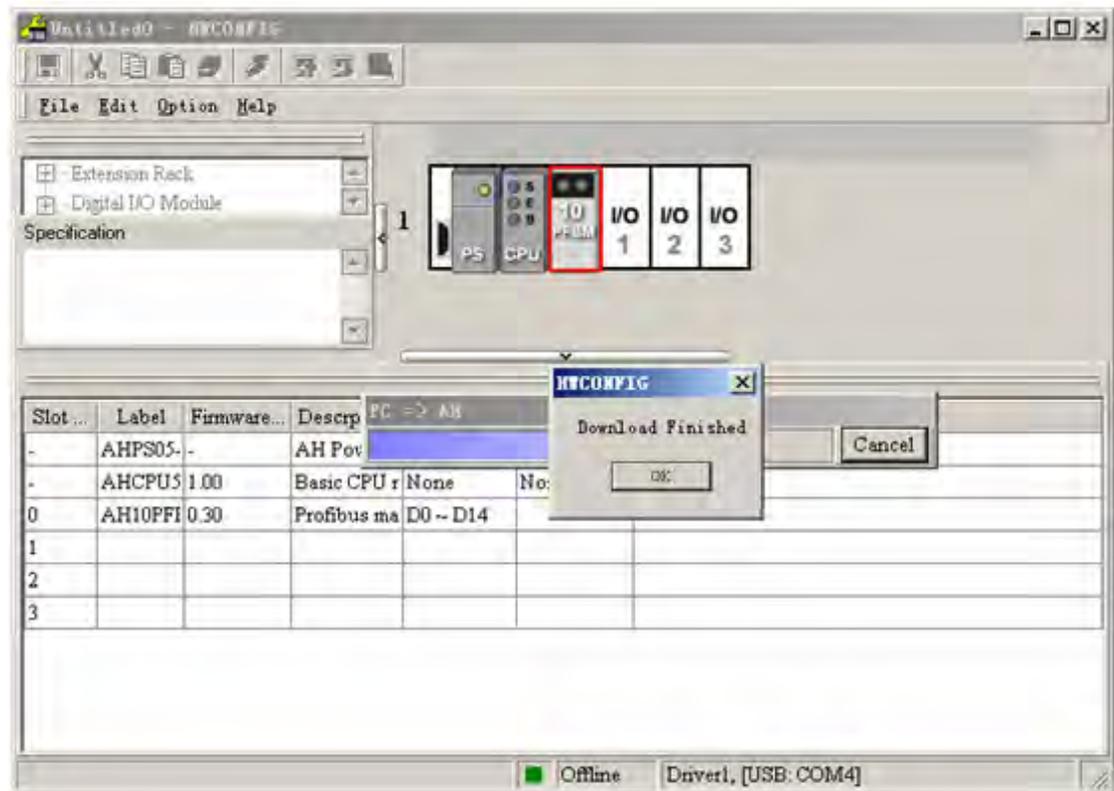
14.7.2 Configuration of PROFIBUS DP Network

When AH10PFBM-5A is used as the master, the configuration of the PROFIBUS DP network will be implemented in the PROFIBUS DP configuration tool SYCON.net. Before configuration, ensure that the GSD files of related devices have been updated.

(For the details on the SYCON.net software, please refer to the SYCON.net help）

● **Addition of the network nodes**

   1. Open the SYCON.net software as below.
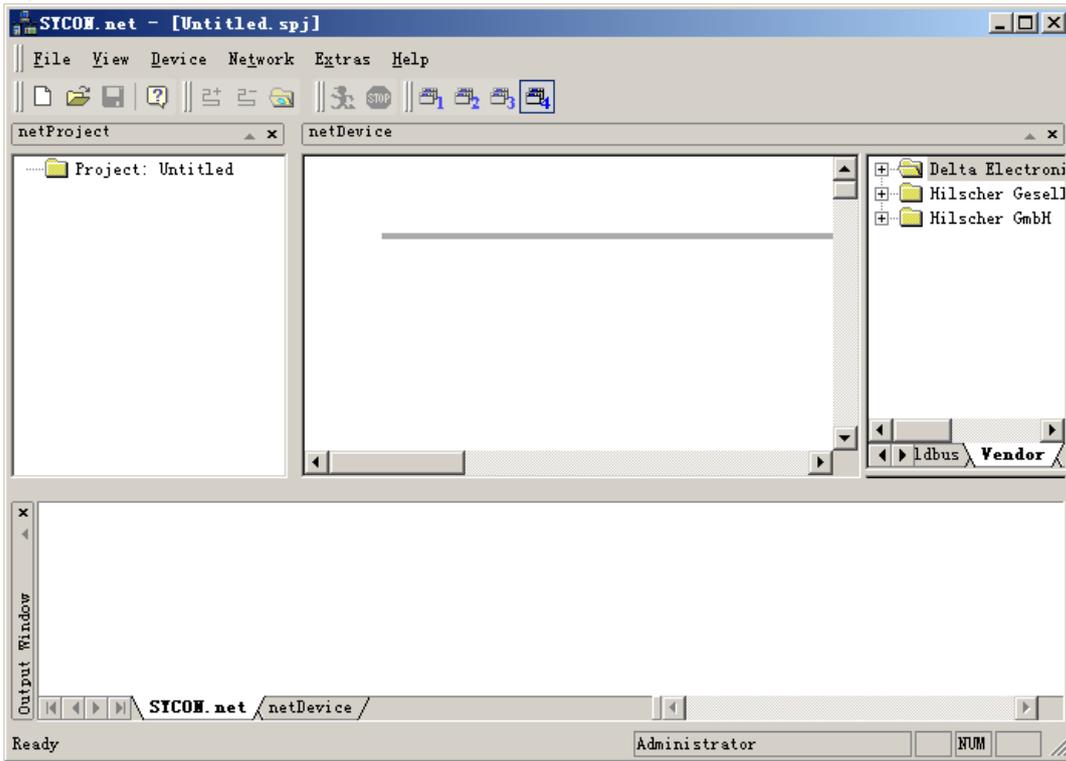
   2. Select the master module AH10PFBM-5A on the right-side interface of the software and meanwhile drag it to the position as shown below.
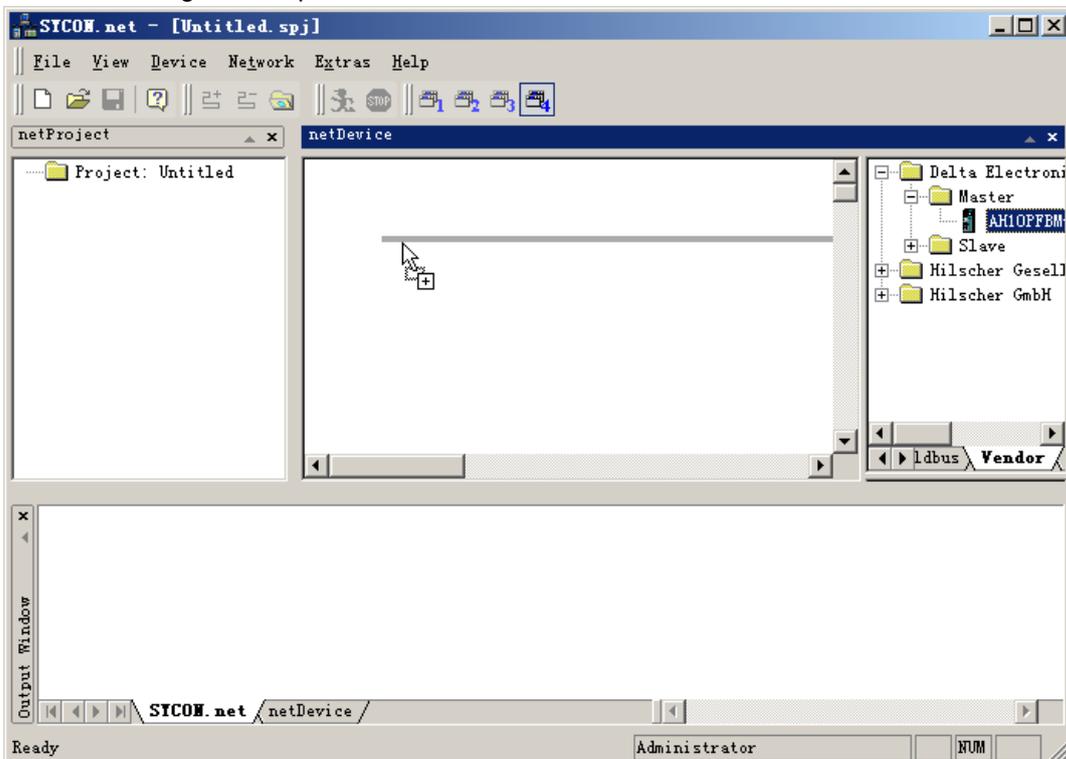
3. Release the mouse when the mark [+] appears with the arrow and then the master module is added as follows.
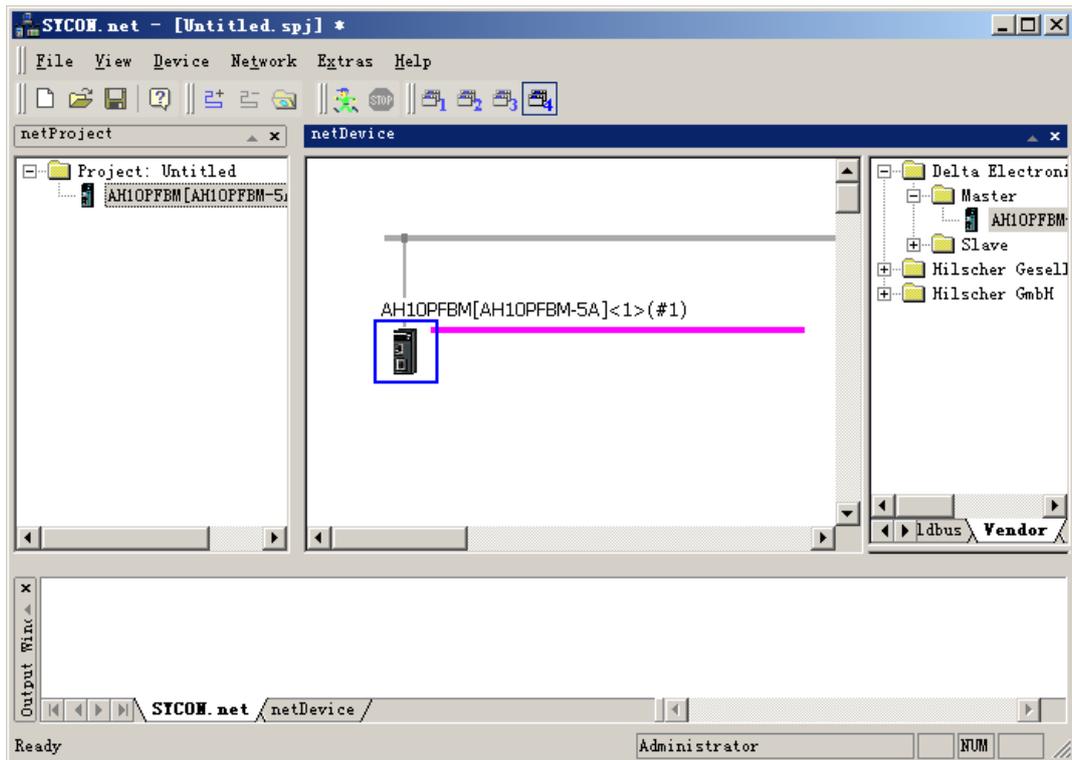
4. Add the slave AHRTU-PFBS-5A in the same way.
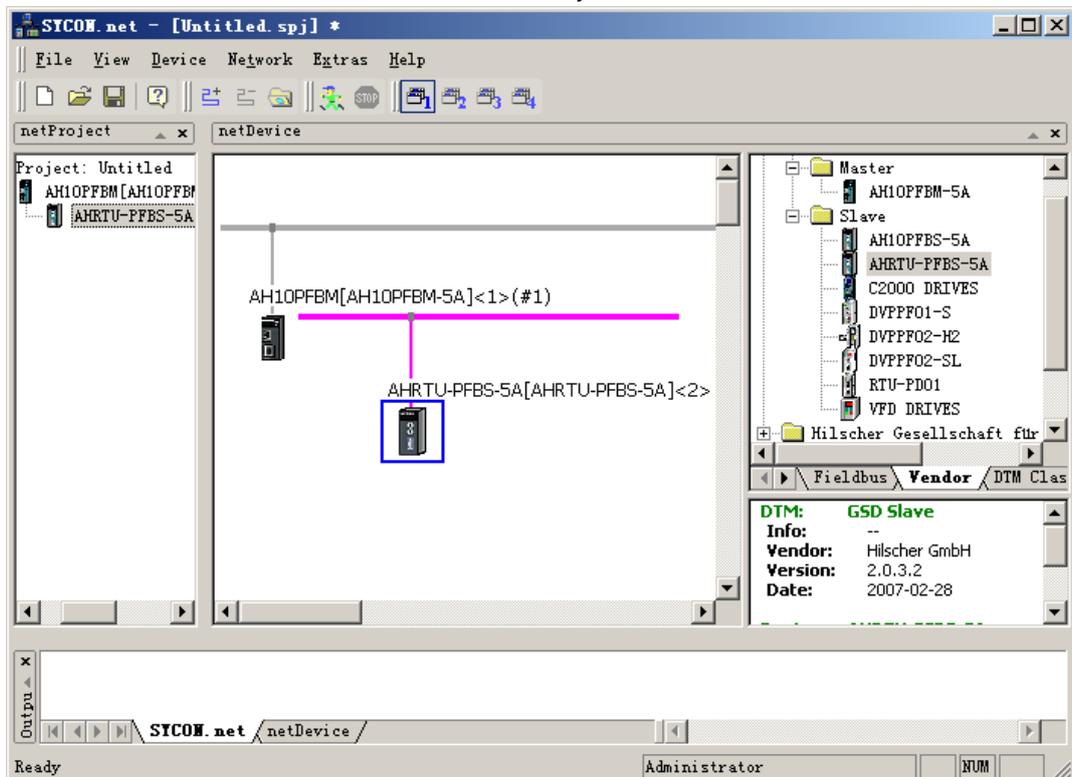
● **Configuration of AHRTU-PFBS-5A Slave**

1. Double click AHRTU-PFBS-5A slave icon and the slave configuration interface is opened. "Available Modules" includes all configuration options that AHRTU-PFBS-5A supports. "Configured Modules" includes the actual configuration options. The inputs and Outputs of AHRTU-PFBS-5A are the sum of the inputs and outputs of all configuration options respectively with byte as the unit.
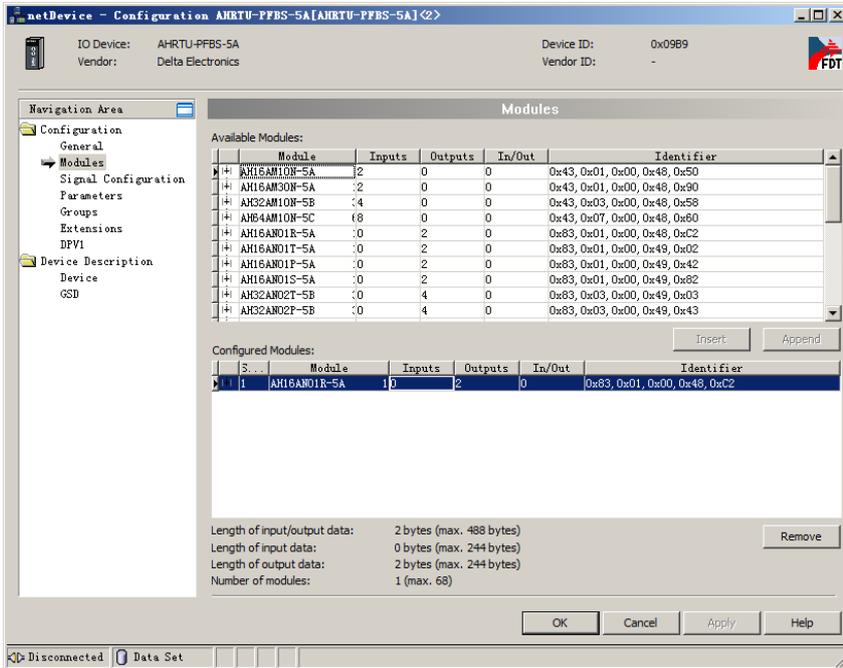
2. Add I/O module as below.

Select the desired module in "Available Modules"; then click "Insert" button and the desired module is added to the "Configured Modules". If there is no module in "Configured Modules", the selected module can be added to "Configured Modules" directly. If there are modules added in "Configured Modules", the desired module will be added to the previous line of the selected module in "Configured Module" by clicking "Insert" button.

Select the desired module in "Available Modules"; then add the selected module to the last line in "Configured Modules" by clicking "Appendix" button or by double clicks on the desired module in "Available Modules".
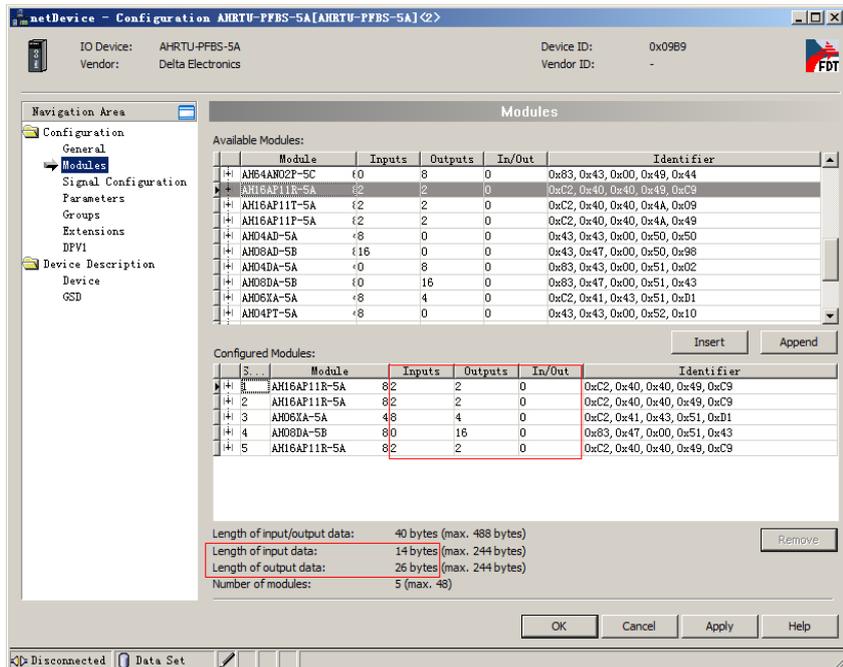
3. Click left-side "Parameter" item after adding I/O module. Click the Common place marked in red to set the parameters of each I/O module connected to the slave AHRTU-PFBS-5A.
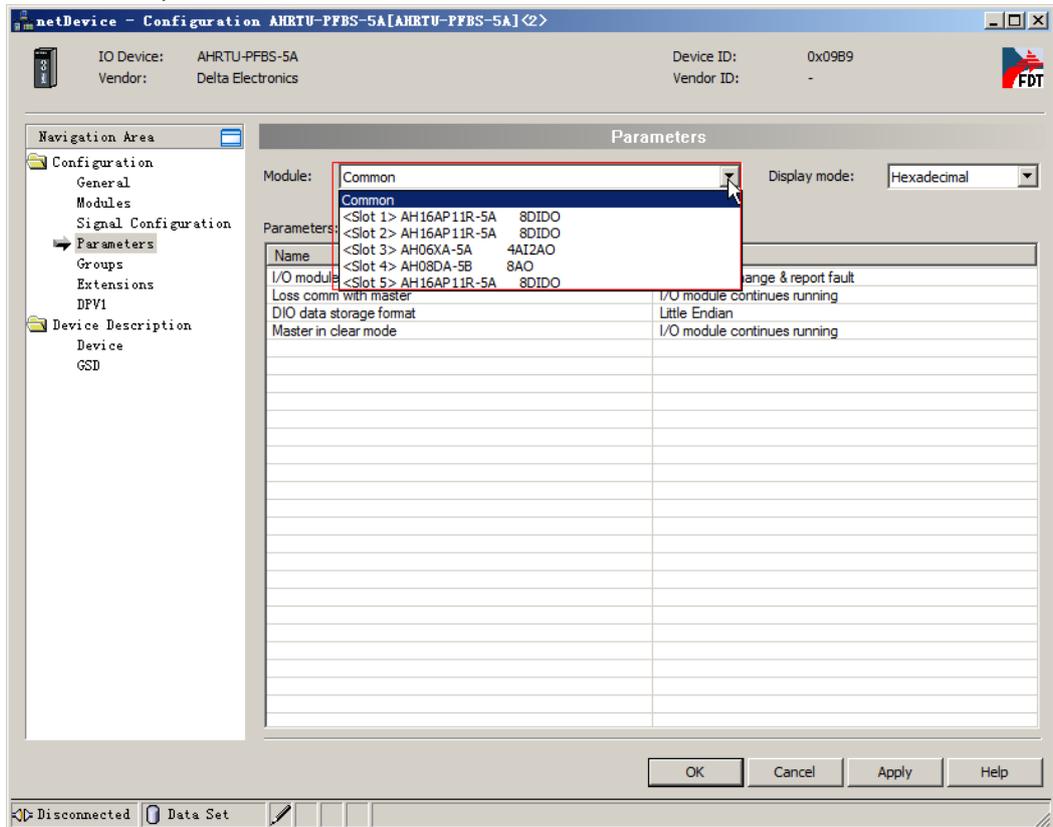
Pick "Common" and the parameters of AHRTU-PFBS-5A are displayed for setting as follows.

Explanation of the options above

Name	Setting	Explanation
I/O module error	Stop I/O exchange & report fault	When an error in some I/O module connected to AHRTU-PFBS-5A occurs, AHRTU-PFBS-5A stops the data exchange between other I/O modules and the master and meanwhile reports the E4 error.
	Continue & report fault	When an error in some I/O module connected to AHRTU-PFBS-5A occurs, other I/O modules continue running and AHRTU-PFBS-5A reports the E4 fault.
Loss comm with master	I/O module stops running	When the communication between AHRTU-PFBS-5A and the master is disrupted, AHRTU-PFBS-5A stops all I/O modules running and reports the F6 error.
	I/O module continues running	When the communication between AHRTU-PFBS-5A and the master is disrupted, AHRTU-PFBS-5A continues running and reports the F6 error.
DIO data storage format	Little Endian	Little Endian: valid only for digital modules. Take the 32-point output module for example. If AH10PFBM-5A is the master and D6000 & D6001 correspond to the 32-point output module, in D6000, bit0~bit7 correspond to Y0.0~Y0.7 and bit8~bit15 to Y0.8~Y0.15; in D6001, bit0~bit7 correspond to Y1.0~Y1.7 and bit8~bit15 to Y1.8~Y1.15. If a Siemens PLC is used as the master and PQD256（containing PQB256, PQB257, PQB258 and PQB259） corresponds to the 32-point output module, PQB256 corresponds to Y0.8~Y0.15, PQB257 to Y00.~Y0.7, PQB258 to Y1.8~Y1.17, PQB259 to Y1.0~Y1.7. All digital input and output modules follow the corresponding relationships above. The option is recommended to select when AH10PFBM-5A is the master.
	Big Endian	Big Endian: valid only for digital modules. Take the 32-point output module

Name	Setting	Explanation
		for example. If a Siemens PLC is used as the master and PQD256（containing PQB256, PQB257, PQB258 and PQB259） corresponds to the 32-point output module, PQB256 corresponds to Y0.0~Y0.7, PQB257 to Y0.8~Y0.15, PQB258 to Y1.0~Y1.7, PQB259 to Y1.8~Y1.15. If AH10PFBM-5A is the master and D6000 & D6001 correspond to the 32-point output module, in D6000, bit0~bit7 correspond to Y0.8~Y0.15 and bit8~bit15 to Y0.0~Y0.7; in D6001, bit0~bit7 correspond to Y1.8~Y1.15 and bit8~bit15 to Y1.0~Y1.7. The option is recommended to select when the Siemens PLC is used as the master.
Master in Clear mode	I/O module continues running	AHRTU-PFBS-5A continues running when the option "Slave receives no data in Clear Mode" under "Fail-Safe Behavior" is selected and meanwhile the master is in STOP state.
	I/O module stops running	AHRTU-PFBS-5A stops all I/O modules from running when the option "Slave receives no data in Clear Mode" under "Fail-Safe Behavior" is selected and meanwhile the master is in STOP state.

As shown in the following figure, the option "Slave receives no data in Clear Mode" is selected as the "Fail-Safe Behavior" when the master is in STOP state.
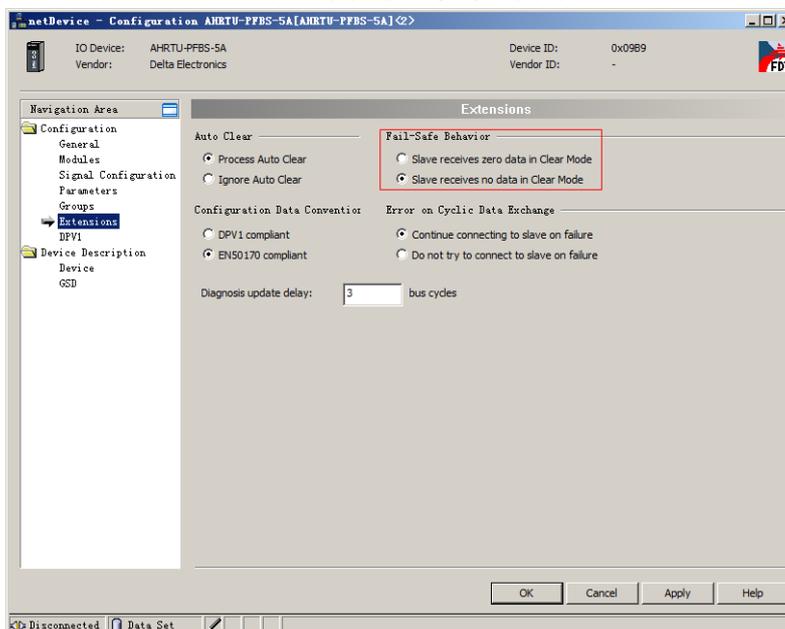
When some I/O module has a fault and the master is disconnected or stops, the DO and AO modules added to AHRTU-PFBS-5A are set as the above two figures shows. Besides, anyone of them can also be set separately. Take a DO module for example as below.

Name	Setting	Explanation
rack	0x01	The number of the rack where the I/O module is (Rack number ranges from 1 to 8, 1 represents the main rack, 2~8 stand for extension racks and the slot number is 0~11.)
slot	0x00	The number of the slot on the rack where the I/O module is. (Rack number ranges from 1 to 8, 1 represents the main rack, 2~8 stand for extension racks and the slot number is 0~11).
Output hold	disable/enable	Output hold options: Enable: the output of other I/O modules of AHRTU-PFBS-5A is held when some I/O module has a fault and the master is disconnected or stops running. Disable: the output of other I/O modules of AHRTU-PFBS-5A is cleared to 0 when some I/O module has a fault and the master is disconnected or stops running.

The settings in the above three figures affect the output result of DO and AO modules as follows.

Fail-Safe Behavior	Master in Clear mode	Output hold	Output result
Slave receives zero data in Clear Mode	I/O module continues running	disable	DO and AO are cleared.
		enable	DO and AO are held.
	I/O module stops running	disable	DO and AO are cleared.
		enable	DO and AO are held.
Slave receives no data in Clear Mode	I/O module continues running	disable	DO and AO are held.
		enable	DO and AO are held.
	I/O module stops running	disable	DO and AO are cleared.
		enable	DO and AO are held.

IO module error	Output hold	Output result
Stop I/O exchange & report fault	disable	DO and AO are cleared
	enable	DO and AO are held.
Continue & report fault	disable	DO and AO are held.
	enable	DO and AO are held.

Loss comm with master	Output hold	Output result
I/O module stops running	disable	DO and AO are cleared.
	enable	DO and AO are held.
I/O module continues running	disable	DO and AO are held.
	enable	DO and AO are held.

Settings of the digital modules and special modules connectable to AHRTU-PFBS-5A are introduced below.

Settings of all digital modules are same and the following will make the introduction of the setting by taking AH16AP11R-5A as an example.

➢ Setting of AH16AP11R-5A

After configuring AH16AP11R-5A, refer to Figure 0 for the related parameters setting.
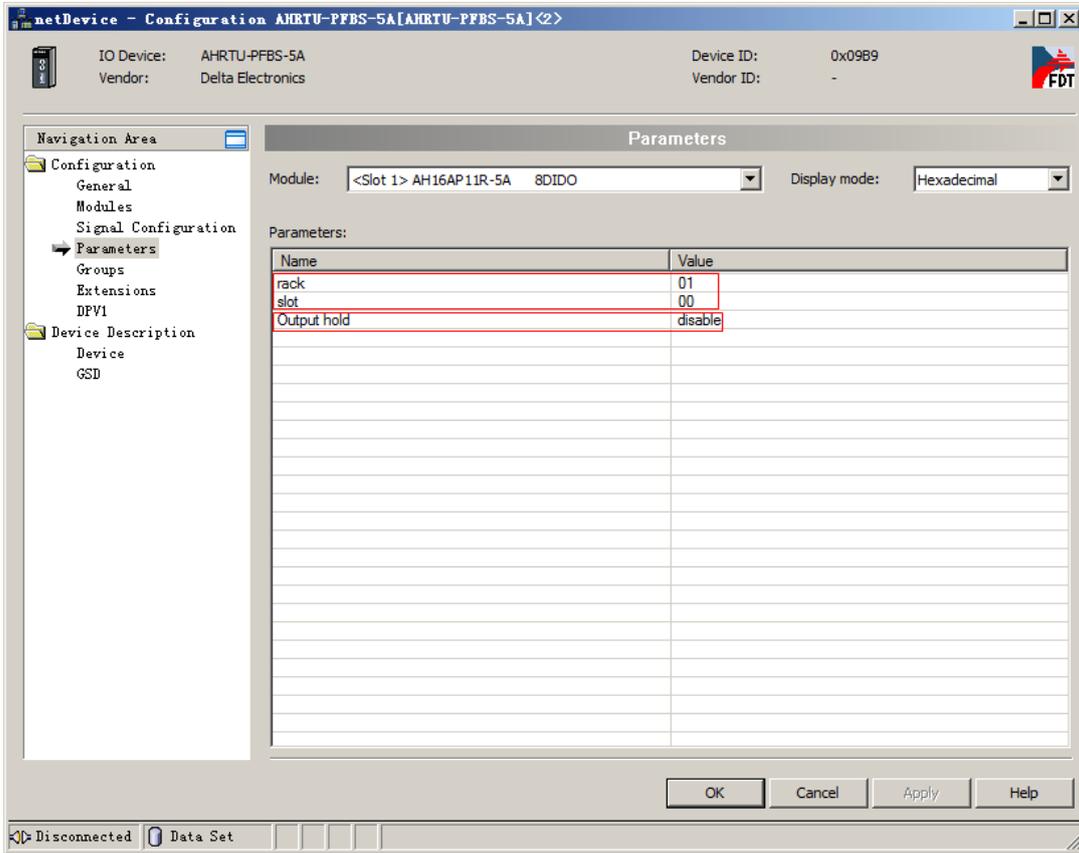
Figure 0

Explanation of the options above

Name	Setting	Explanation
rack	0x01	The number of the rack where the I/O module is (Rack number ranges from 1 to 8, 1 represents the main rack, 2~8 stand for extension racks and the slot number is 0~11.)
slot	0x00	The number of the slot on the rack where the I/O module is. (Rack number ranges from 1 to 8, 1 represents the main rack, 2~8 stand for extension racks and the slot number is 0~11).
Output hold	disable/enable	Output hold options: Enable: the output of other I/O modules of AHRTU-PFBS-5A is held when some I/O module has a fault and the master is disconnected or stops running. Disable: the output of other I/O modules of AHRTU-PFBS-5A is cleared to 0 when some I/O module has a fault and the master is disconnected or stops running.

➢ Setting of AH04AD-5A

After configuring AH04AD-5A, refer to Figure 1 for the related parameters setting.
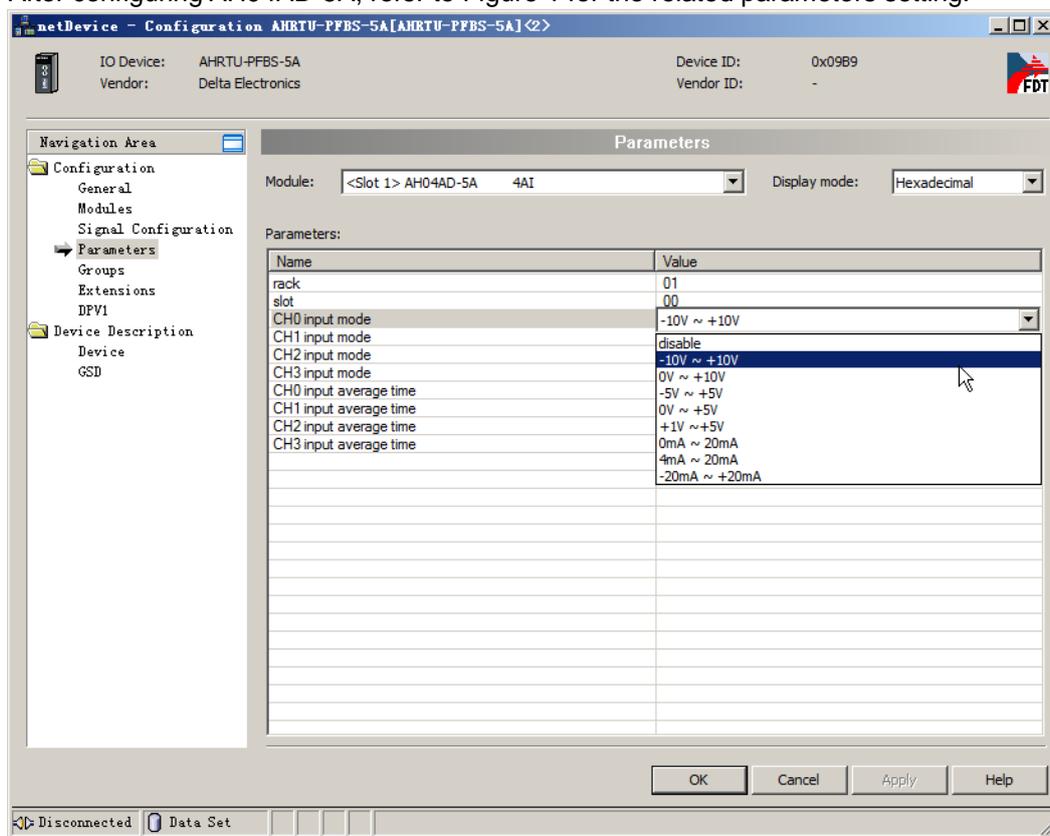
Figure 1

Explanation of the options above

Name	Setting	Explanation
rack	0x01	The number of the rack where the I/O module is (Rack number ranges from 1 to 8, 1 represents the main rack, 2~8 stand for extension racks and the slot number is 0~11.)
slot	0x00	The number of the slot on the rack where the I/O module is. (Rack number ranges from 1 to 8, 1 represents the main rack, 2~8 stand for extension racks and the slot number is 0~11).
CH0~CH3 Input mode	disable -10V~+10V 0V~10V 5V~+5V 0V~+5V 1V~+5V 0mA~20mA 4mA~20mA +20mA~-20mA	The input channel mode of AH04AD-5A is disabled by default. Mode: disable Mode: -10V~+10V Mode: 0V~10V Mode: -5V~+5V Mode: 0V~+5V Mode: 1V~+5V Mode: 0mA~20mA Mode: 4mA~20mA Mode: +20mA~-20mA
CH0~CH3 Input average time	0x0A	Average times setting for CH0~ CH3 input

➢ Setting of AH08AD-5B

After configuring AH08AD-5B, refer to Figure 2 for the related parameters setting.
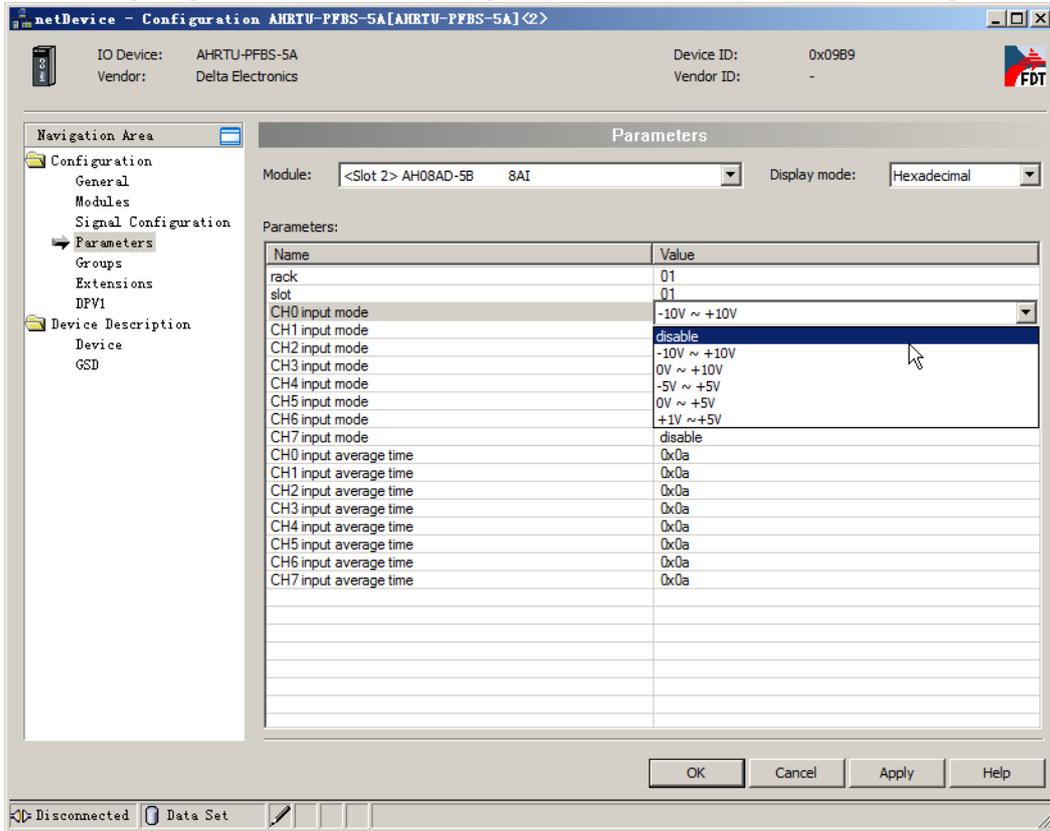
Figure 2

Explanation of the options above

Name	Setting	Explanation
rack	0x01	The number of the rack where the I/O module is (Rack number ranges from 1 to 8, 1 represents the main rack, 2~8 stand for extension racks and the slot number is 0~11.)
slot	0x01	The number of the slot on the rack where the I/O module is. (Rack number ranges from 1 to 8, 1 represents the main rack, 2~8 stand for extension racks and the slot number is 0~11).
CH0~CH7 Input mode	disable -10V~+10V 0V~10V 5V~+5V 0V~+5V 1V~+5V	The input channel mode of AH08AD-5B is disabled by default. Mode: disable Mode: -10V~+10V Mode: 0V~10V Mode: -5V~+5V Mode: 0V~+5V Mode: 1V~+5V
CH0~CH7 Input average time	0x0A	Average times setting for CH0~ CH7 input

> Setting of AH08AD-5C

After configuring AH08AD-5C, refer to Figure 3 for the related parameters setting.
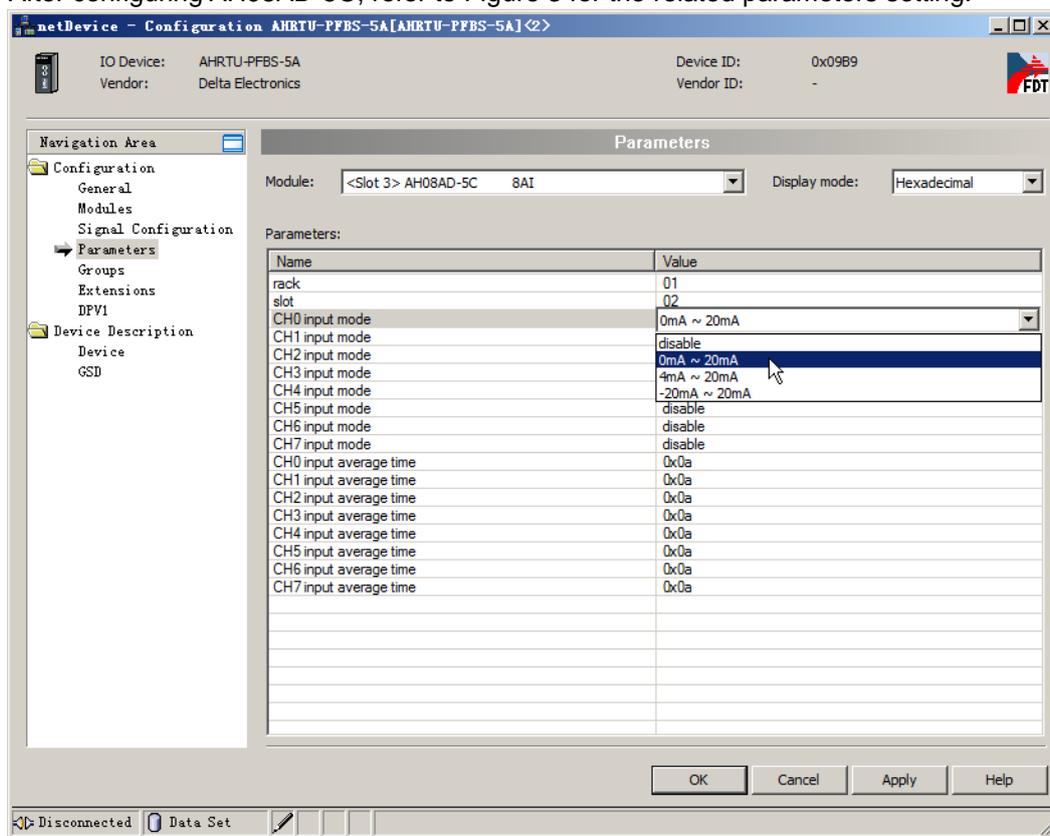
Figure 3

Explanation of the options above

Name	Setting	Explanation
rack	0x01	The number of the rack where the I/O module is (Rack number ranges from 1 to 8, 1 represents the main rack, 2~8 stand for extension racks and the slot number is 0~11.)
slot	0x02	The number of the slot on the rack where the I/O module is. (Rack number ranges from 1 to 8, 1 represents the main rack, 2~8 stand for extension racks and the slot number is 0~11).
CH0~CH7 Input mode	disable 0mA~20mA 4mA~20mA +20mA~-20mA	The input channel mode of AH08AD-5C is disabled by default. Mode: disable Mode: 0mA~20mA Mode: 4mA~20mA Mode: +20mA~-20mA
CH0~CH7 Input average time	0x0A	Average times setting for CH0~ CH7 input

➢ Setting of AH04DA-5A

After configuring AH04DA-5A, refer to Figure 4 for the related parameters setting.
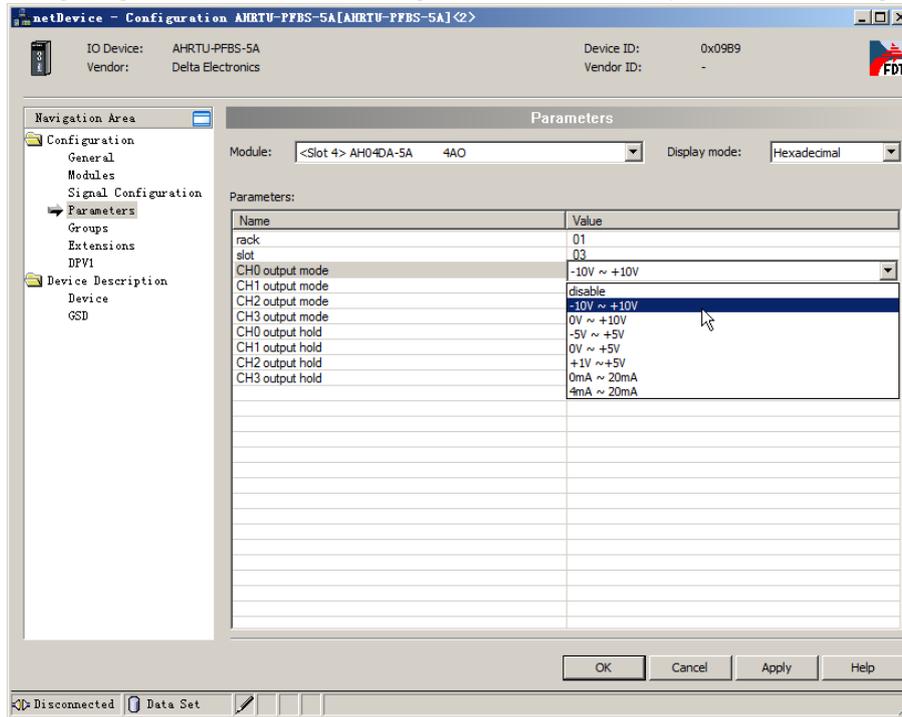
Figure 4

Explanation of the options above

Name	Setting	Explanation
rack	0x01	The number of the rack where the I/O module is (Rack number ranges from 1 to 8, 1 represents the main rack, 2~8 stand for extension racks and the slot number is 0~11.)
slot	0x03	The number of the slot on the rack where the I/O module is. (Rack number ranges from 1 to 8, 1 represents the main rack, 2~8 stand for extension racks and the slot number is 0~11).
CH0~CH3 output mode	disable -10V~+10V 0V~10V 5V~+5V 0V~+5V 1V~+5V 0mA~20mA 4mA~20mA	The output channel mode of AH04DA-5A is disabled by default. Mode: disable Mode: -10V~+10V Mode: 0V~10V Mode: -5V~+5V Mode: 0V~+5V Mode: 1V~+5V Mode: 0mA~20mA Mode: 4mA~20mA
CH0~CH3 output hold	disable/enable	Output hold options Enable: When the master PLC stops running, the output value of the output channel of the module remains the same as that before the master PLC stops running. Disable: The output value of the output channel of the module is 0 when the master PLC stops running.

> Setting of AH08DA-5B

After configuring AH08DA-5B, refer to Figure 5 for the related parameters setting.
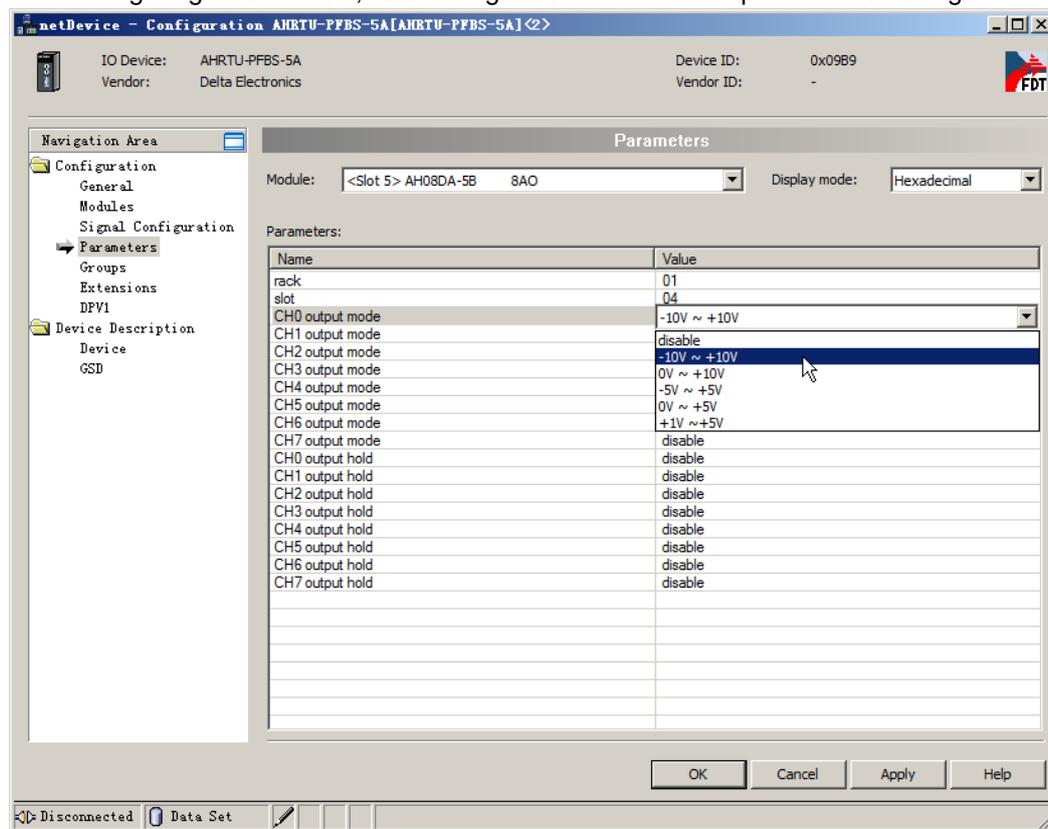
Figure 5

Explanation of the options above

Name	Setting	Explanation
rack	0x01	The number of the rack where the I/O module are placed (Rack number is 1~8, 1 represents the main rack, 2~8 are extension racks and the slot number is 0~11.)
slot	0x04	The number of the slot on the rack where the I/O module is. (Rack number is 1~8, 1 represents the main rack, 2~8 are extension racks and the slot number is 0~11).
CH0~CH7 output mode	disable -10V~+10V 0V~10V 5V~+5V 0V~+5V 1V~+5V	The output channel mode of AH08DA-5B is disabled by default. Mode: disable Mode: -10V~+10V Mode: 0V~10V Mode: -5V~+5V Mode: 0V~+5V Mode: 1V~+5V
CH0~CH7 output hold	disable/enable	Output hold options Enable: the output of other I/O modules of AHRTU-PFBS-5A is held when some I/O module has a fault and the master is disconnected or stops running. Disable: the output of other I/O modules of AHRTU-PFBS-5A is cleared to 0 when some I/O module has a fault and the master is disconnected or stops running.

➤ Setting of AH08DA-5C

After configuring AH08DA-5C, refer to Figure 6 for the related parameters setting.
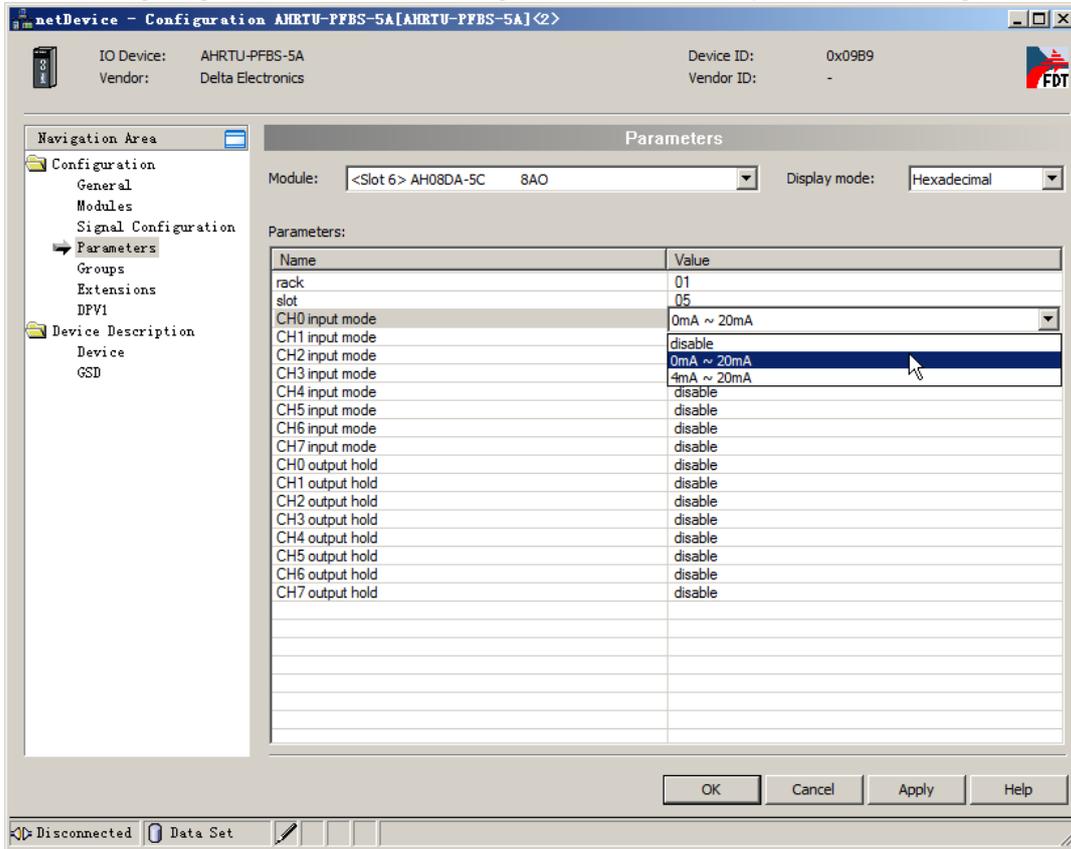
Figure 6

Explanation of the options above

Name	Setting	Explanation
rack	0x01	The number of the rack where the I/O module is (Rack number ranges from 1 to 8, 1 represents the main rack, 2~8 stand for extension racks and the slot number is 0~11.)
slot	0x05	The number of the slot on the rack where the I/O module is. (Rack number ranges from 1 to 8, 1 represents the main rack, 2~8 stand for extension racks and the slot number is 0~11).
CH0~CH7 output mode	disable 0mA~20mA 4mA~20mA	The output channel mode of AH08DA-5C is disabled by default. Mode: disable Mode: 0mA~20mA Mode: 4mA~20mA
CH0~CH7 output hold	disable/enable	Output hold options: Enable: the output of other I/O modules of AHRTU-PFBS-5A is held when some I/O module has a fault and the master is disconnected or stops running. Disable: the output of other I/O modules of AHRTU-PFBS-5A is cleared to 0 when some I/O module has a fault and the master is disconnected or stops running.

➢ Setting of AH06XA-5A

After configuring AH06XA-5A, refer to Figure 7 for the related parameters setting.
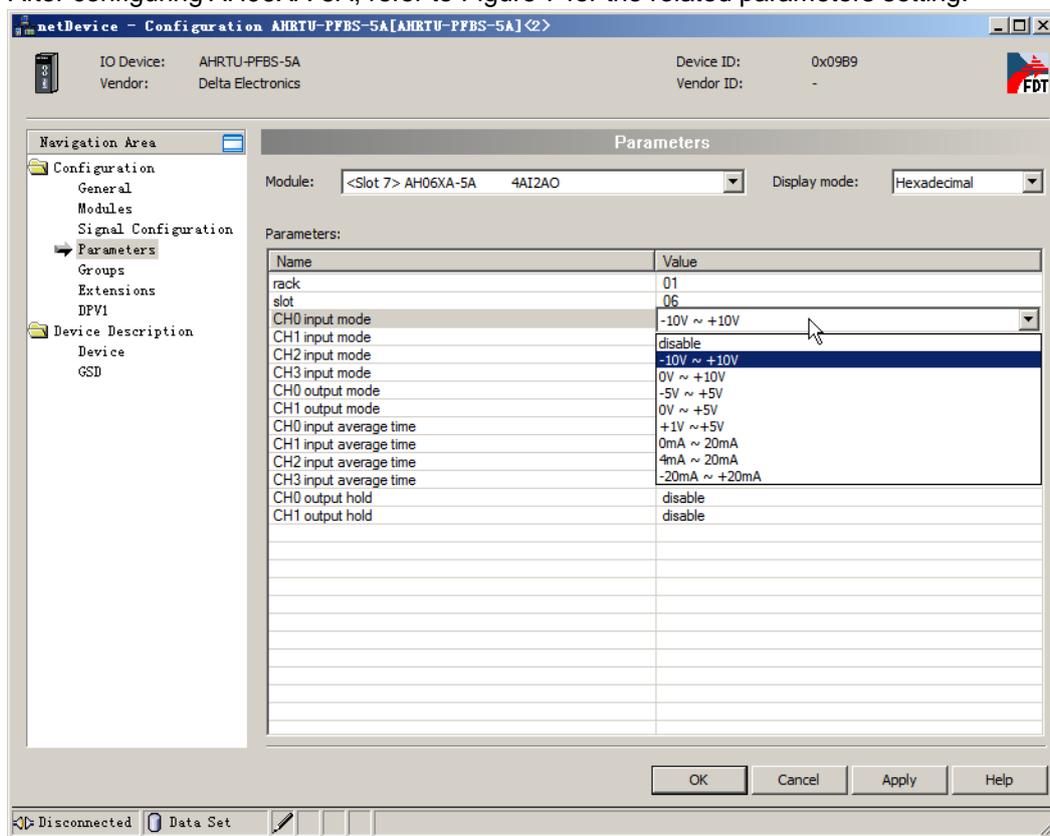
Figure 7

Explanation of the options above

Name	Setting	Explanation
rack	0x01	The number of the rack where the I/O module is (Rack number ranges from 1 to 8, 1 represents the main rack, 2~8 stand for extension racks and the slot number is 0~11.)
slot	0x06	The number of the slot on the rack where the I/O module is. (Rack number ranges from 1 to 8, 1 represents the main rack, 2~8 stand for extension racks and the slot number is 0~11).
CH0~CH3 Input mode	disable -10V~+10V 0V~10V 5V~+5V 0V~+5V 1V~+5V 0mA~20mA 4mA~20mA +20mA~-20mA	The input channel mode of AH06XA-5A is disabled by default. Mode: disable Mode: -10V~+10V Mode: 0V~10V Mode: -5V~+5V Mode: 0V~+5V Mode: 1V~+5V Mode: 0mA~20mA Mode: 4mA~20mA Mode: +20mA~-20mA
CH0~CH1 output mode	disable -10V~+10V 0V~10V 5V~+5V 0V~+5V	The output channel mode of AH06XA-5A is disabled by default. Mode: disable Mode: -10V~+10V Mode: 0V~10V

Name	Setting	Explanation
	1V~+5V 0mA~20mA 4mA~20mA	Mode: -5V~+5V Mode: 0V~+5V Mode: 1V~+5V Mode: 0mA~20mA Mode: 4mA~20mA
CH0~CH3 Input average time	0x0A	Average times setting for CH0~ CH3 input
CH0~CH1 output hold	disable/enable	Output hold options: Enable: the output of other I/O modules of AHRTU-PFBS-5A is held when some I/O module has a fault and the master is disconnected or stops running. Disable: the output of other I/O modules of AHRTU-PFBS-5A is cleared to 0 when some I/O module has a fault and the master is disconnected or stops running.

➢ Setting of AH04PT-5A

After configuring AH04PT-5A, refer to Figure 8 for the related parameters setting.
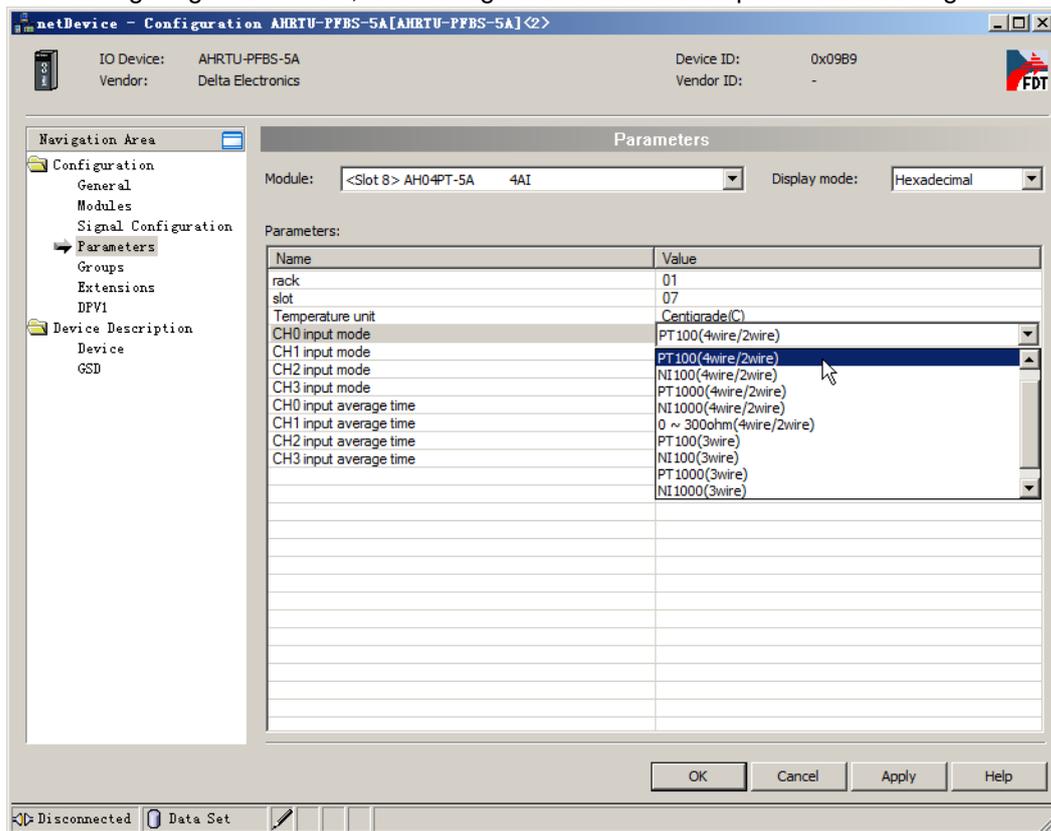
Figure 8

Explanation of the options above

Name	Setting	Explanation
rack	0x01	The number of the rack where the I/O module is (Rack number ranges from 1 to 8, 1 represents the main rack, 2~8 stand for extension racks and the slot number is 0~11.)
slot	0x07	The number of the slot on the rack where the I/O module is. (Rack number ranges from 1 to 8, 1 represents the main rack, 2~8 stand for extension racks and the slot number is 0~11).
Temperature unit	Centigrade/Fahrenheit	Centigrade: collect the temperature with centigrade as the unit Fahrenheit: collect the temperature with Fahrenheit as the unit.
CH0~CH3 Input mode	disable PT100 (4Wire/2Wire) NI100 (4Wire/2Wire) PT1000 (4Wire/2Wire) NI1000(4Wire/2Wire) 0~300Ω(4Wire/2Wire) PT100 (3Wire) NI100 (3Wire) PT1000 (3Wire) NI1000 (3Wire) 0~300Ω(3Wire)	Select each channel mode of AH04PT-5A according to the temperature sensor and the mode of each channel is disabled by default. Mode: disable Mode: PT100 (4wire/2wire) Mode: NI100 (4wire/2wire) Mode: PT1000 (4wire/2wire) Mode: NI1000 (4wire/2wire) Mode: 0~300Ω(4wire/2wire) Mode: PT100 (3wire) Mode: NI100 (3wire) Mode: PT1000 (3wire) Mode: NI1000 (3wire) Mode: 0~300Ω (3wire)
CH0~CH3 Input average time	0x0A	Average times setting for CH0~ CH3 input

➢ Setting of AH08TC-5A

The setting of AH08TC-5A is same as that of AH04TC-5A. Refer to Figure 9 for the related parameters setting.
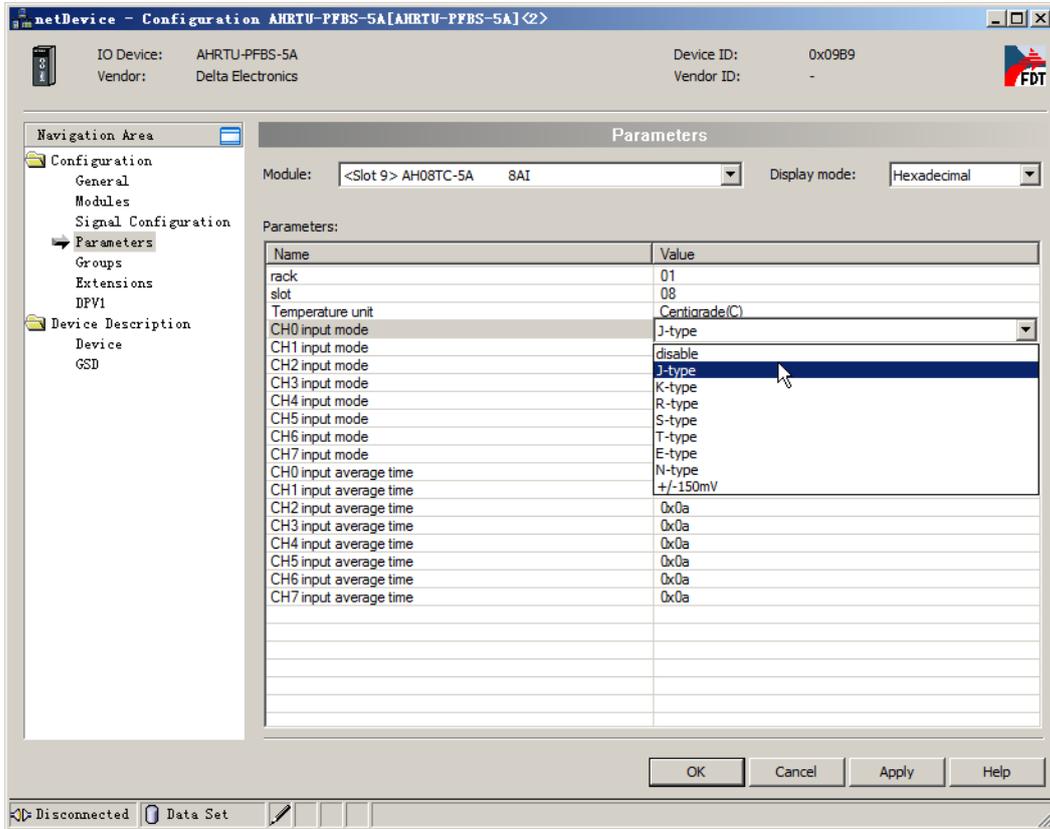
Figure 9

Explanation of the options above

Name	Setting	Explanation
rack	0x01	The number of the rack where the I/O module is (Rack number ranges from 1 to 8, 1 represents the main rack, 2~8 stand for extension racks and the slot number is 0~11.)
slot	0x08	The number of the slot on the rack where the I/O module is. (Rack number ranges from 1 to 8, 1 represents the main rack, 2~8 stand for extension racks and the slot number is 0~11).
Temperature unit	Centigrade/Fahrenheit	Centigrade: collect the temperature with centigrade as the unit Fahrenheit: collect the temperature with Fahrenheit as the unit.
CH0~CH7 Input mode	disable J-Type K-Type R-Type S-Type T-Type E-Type N-Type ±150mV	Select input channel mode of AH08TC-5A according to the type of the connected thermocouple and the mode of each input channel is disabled by default. Mode: disable Mode: J-Type Mode: K-Type Mode: R-Type Mode: S-Type

Name	Setting	Explanation
		Mode: T-Type Mode: E-Type Mode: -Type Mode:±150mV
CH0~CH7 Input average time	0x0A	Average times setting for CH0~ CH7 input

Ensure that all I/O module parameters settings are correct. Otherwise, the module will report the error or the communication error of AHRTU-PFBS-5A occurs.

4. Click "Extensions" on the left-side window and then the following settings are done. (The settings here are default. For the meaning of each option, please refer to section 10.2 in the SYCON.net help.)
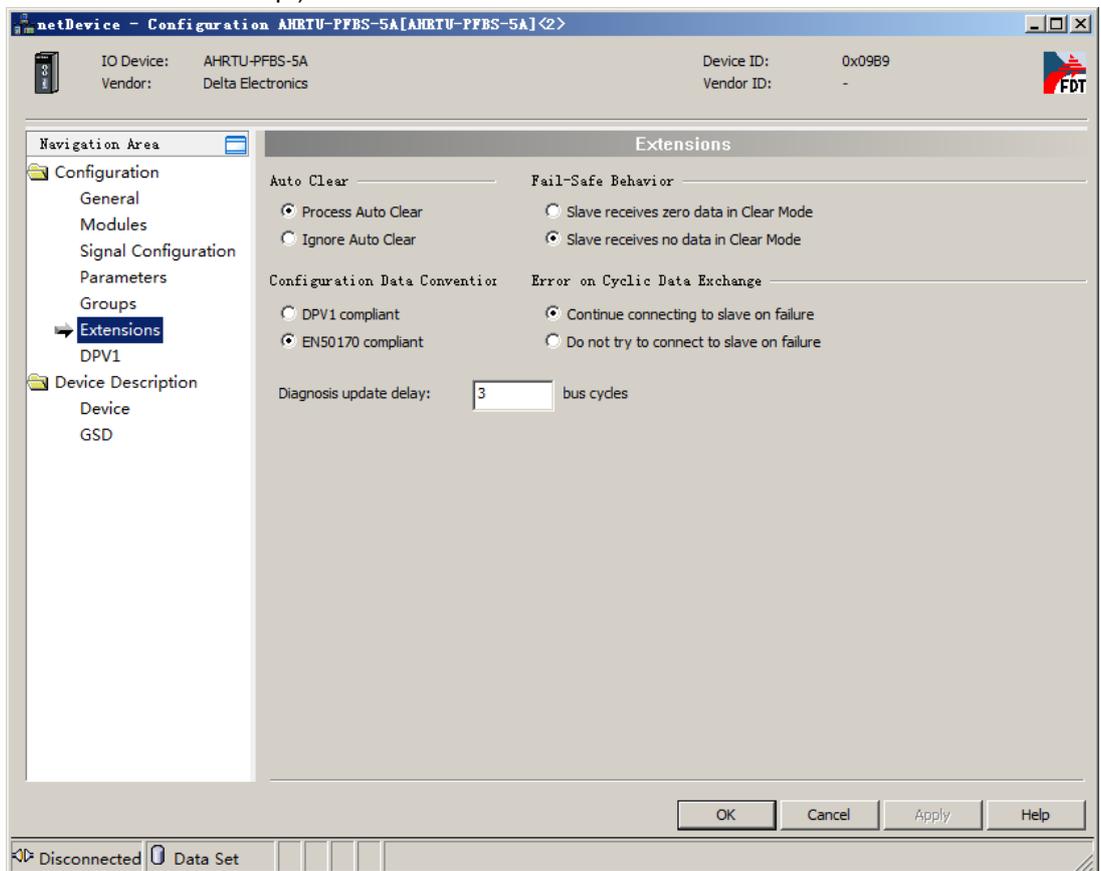
5. After configuration of the slave module is completed, click "OK" to exit from the configuration interface and return to the main interface of the software.
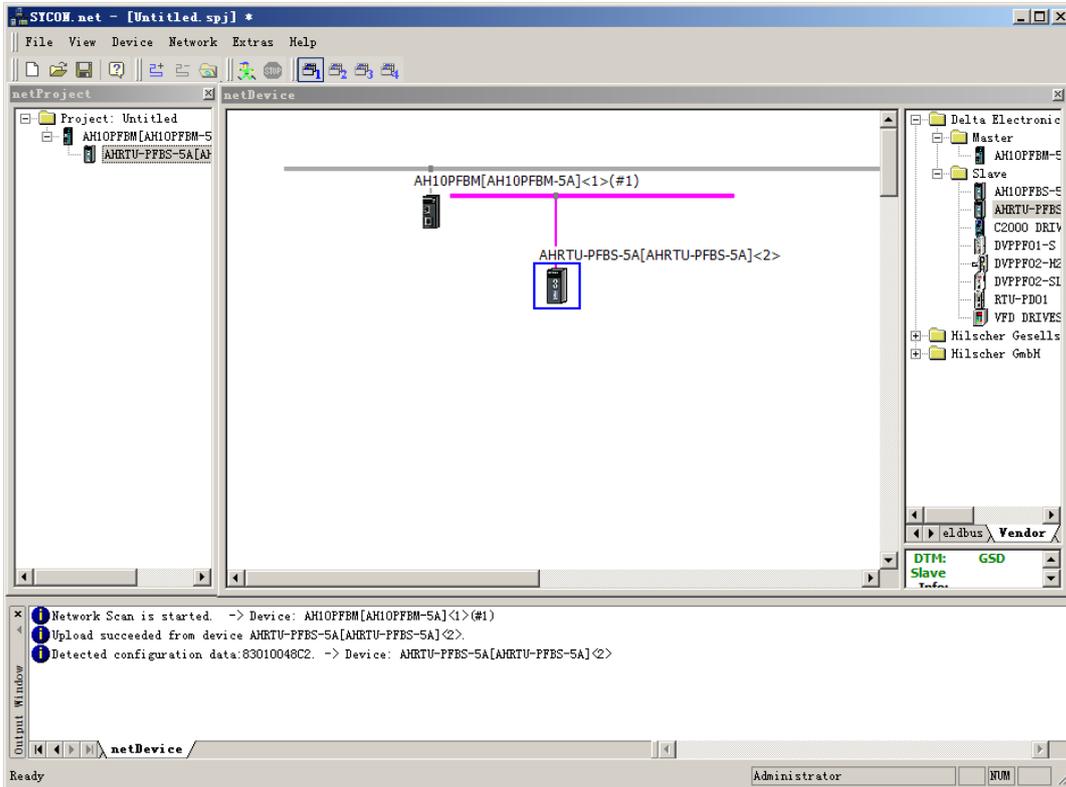
● Configuration of AH10PFBM-5A parameters

1. Double click the master icon to enter the master configuration interface and start to set the master parameters.
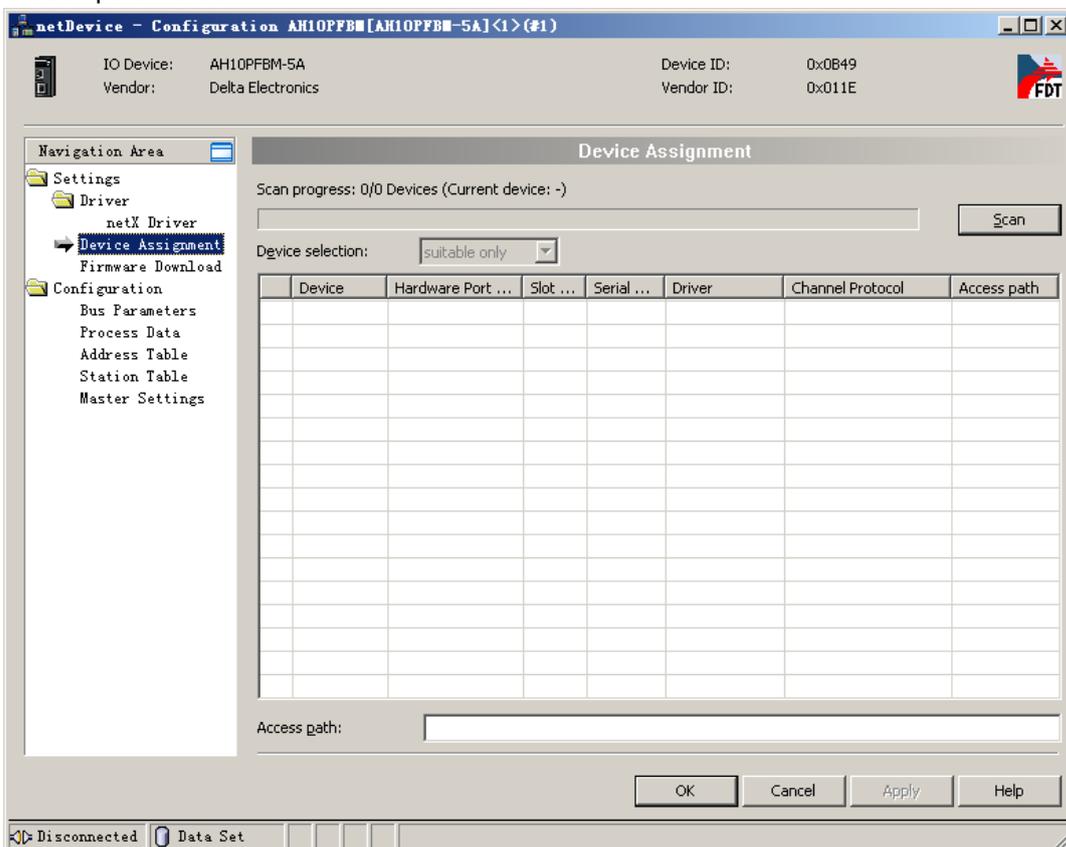
2. Click "Driver" on the left-side window and then select the communication driver marked in red on the right-side window. Ensure that the USB connector of the USB cable is inserted to the CONF port of AH10PFBM-5A.
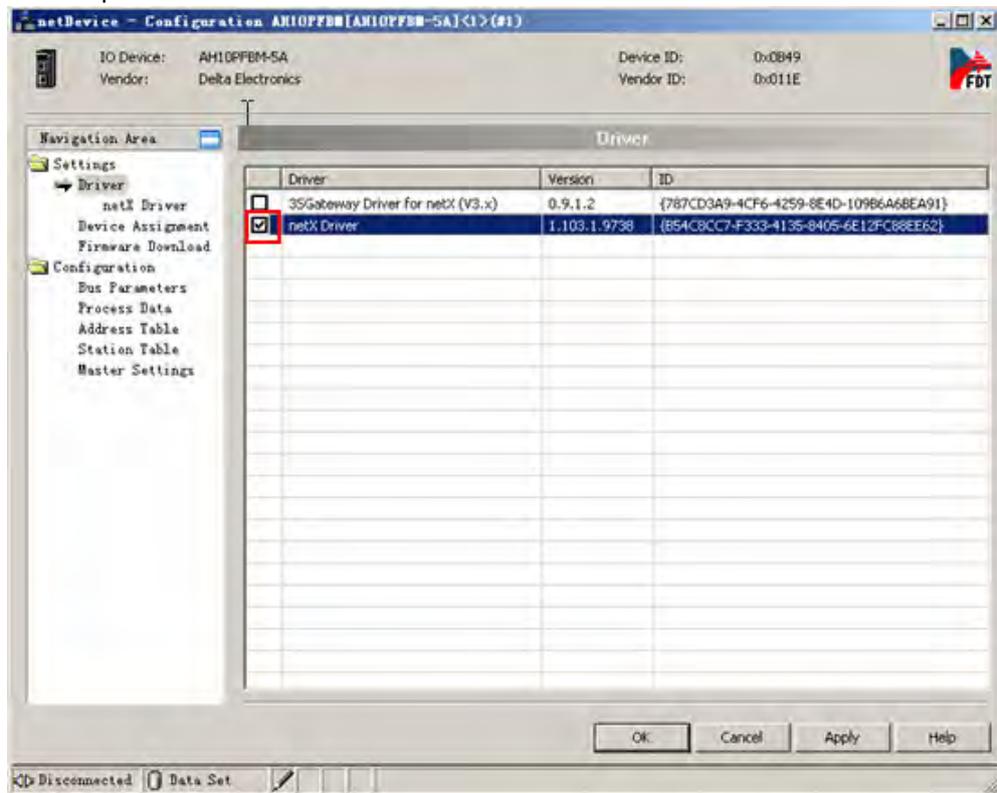
3. Click "Scan" button on the right-side window after clicking "Device Assignment" item on the left-side window and then select "All" from the Device Selection box on the right-side window.
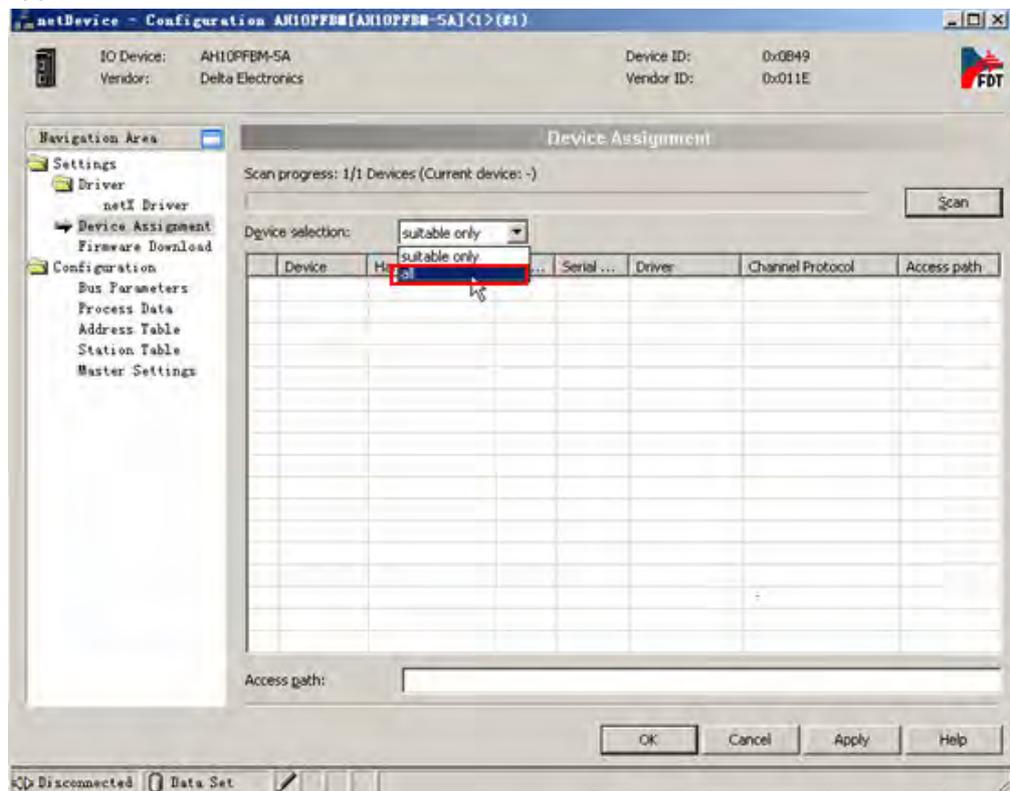
4. After the master is scanned, pick the box marked in red below for the scanned master.
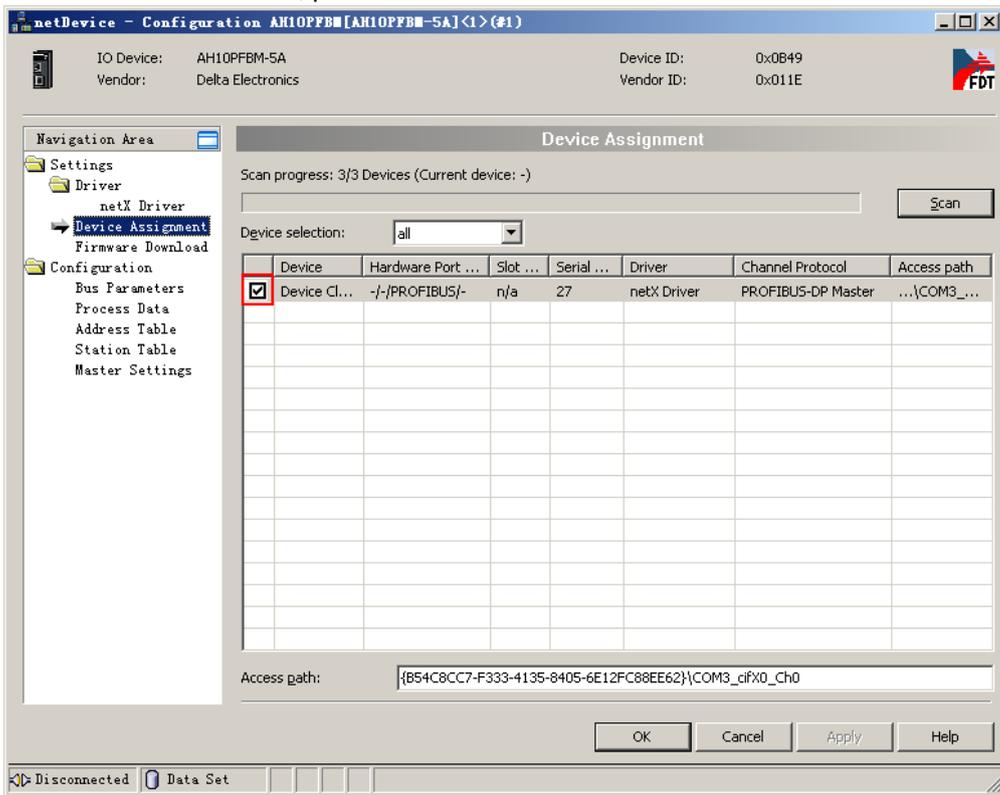
5. Click "Bus Parameters" on the left-side window to do the setting of the parameters.
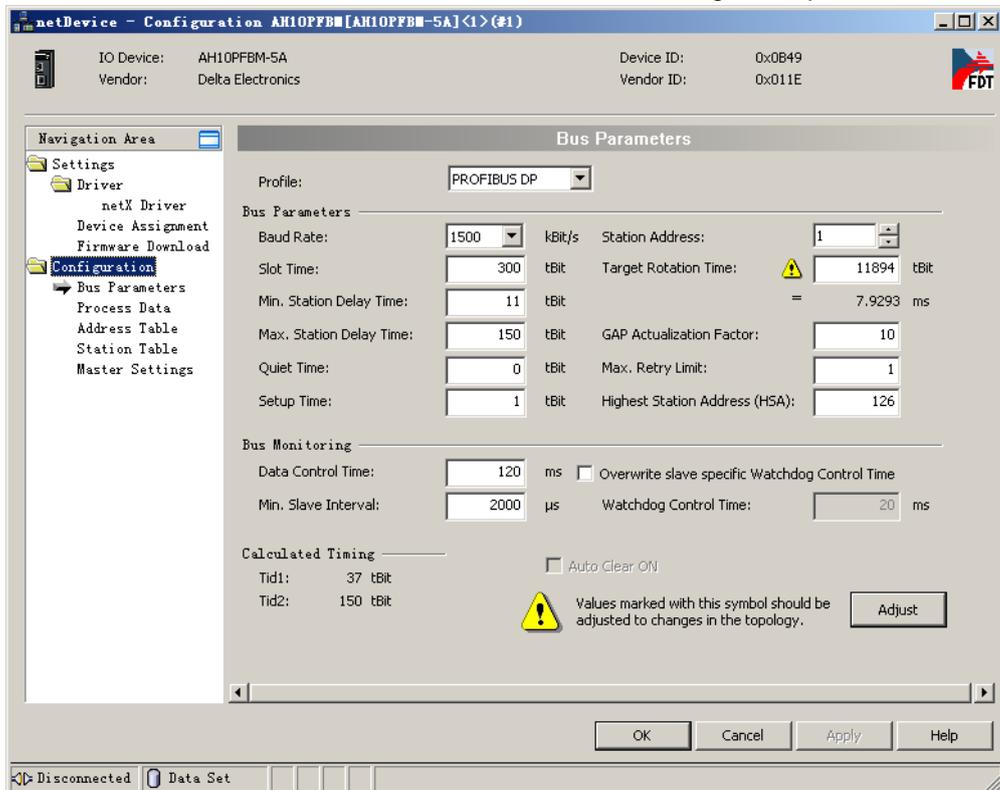
6. Pick "Overwrite slave specific Watchdog Control Time" and then click "Adjust" button to make an automatic adjustment of the bus parameters.
(For the meaning of each item, please refer to the user manual of AH10PFBM-5A.)
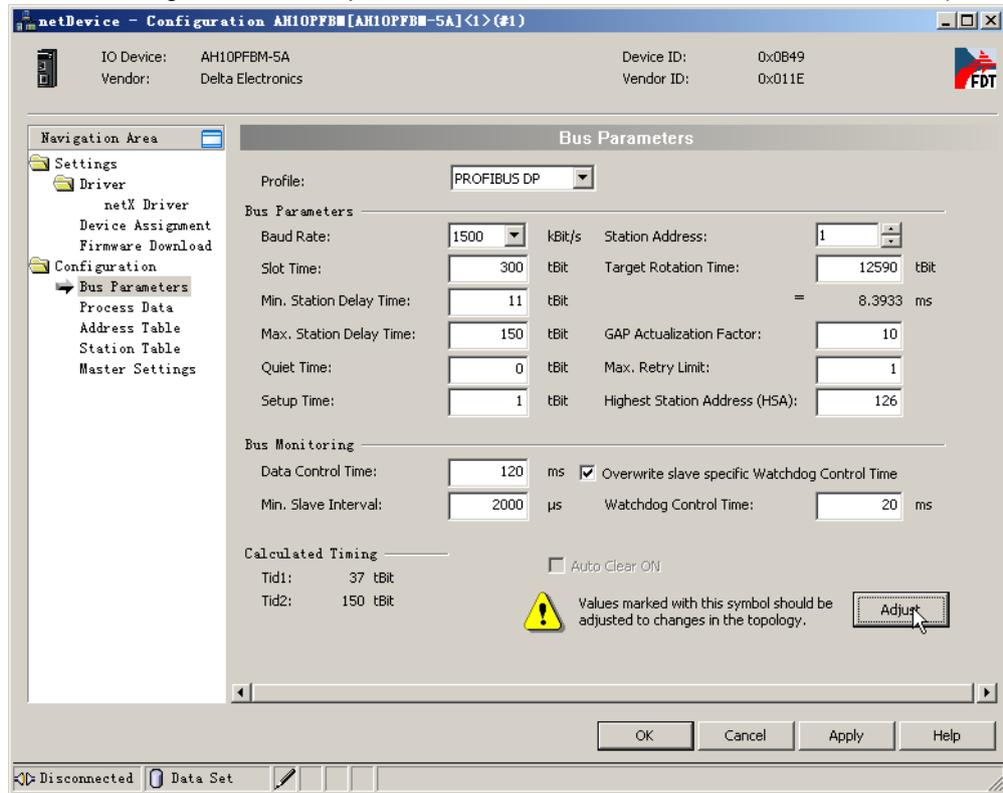
7. Click "Address Table" on the left-side window to set the offset addresses of master.

For details, please refer to "Mapping relationships between master PLC and slave PLC" in the following section.

If the offset address of the IW or QW-type module is not even, it should be adjusted to start at the even number for the purpose of easy control via the program.

We suggest user tick "2 Byte boundaries" to adjust the offset address or not pick "Auto addressing" in the following figure and directly input the offset address value in "Address" column.

8. Click "Station Table" on the left-side window and then click the red box on the right-side window to modify the node address of the slave on the software.
(Note: Pick the place of "Activate" column as below. Otherwise, the configuration data of the slave will be invalid)

9. Click "Master Settings" on the left-side window to set the master parameters.
   (The settings here are default. For the meaning of each item, please refer to the user manual of AH10PFBM-5A.)
   When there is an IW or QW-type module and its offset address does not start at 0 or an even number, user could tick "2 Byte boundaries" to adjust and make the offset address of each module start at 0 or an even number for the purpose of easy program control.
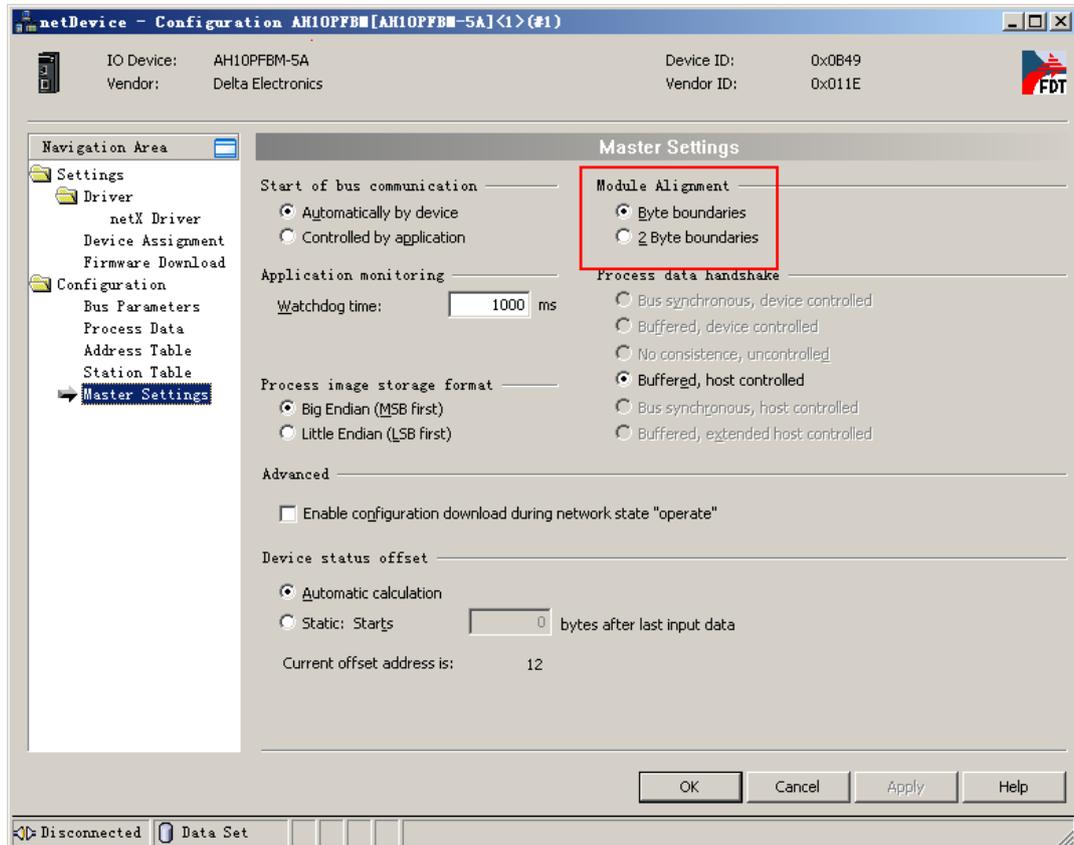
10. After setting the master parameters is over, click "OK" to exit from the master parameters setting interface and return to the main interface of the software.
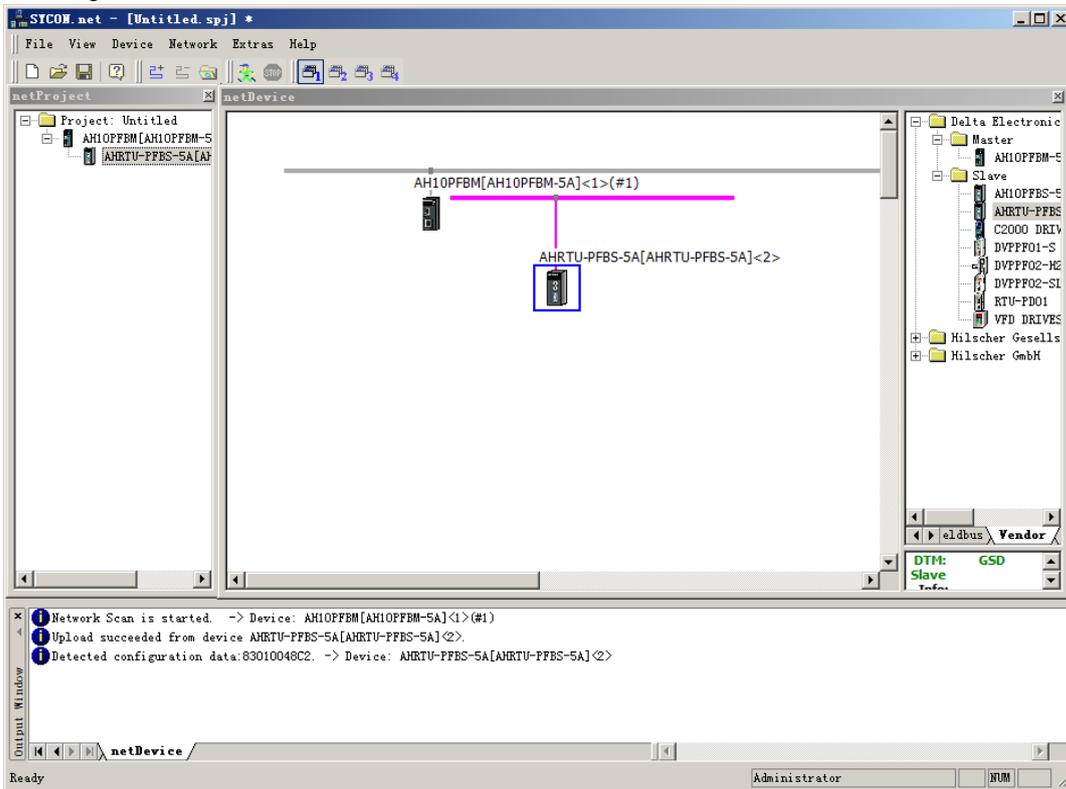
● Download of network configuration
   1. Right click the master module and select "Download" from the menu which pops up to download the configuration data to the master.
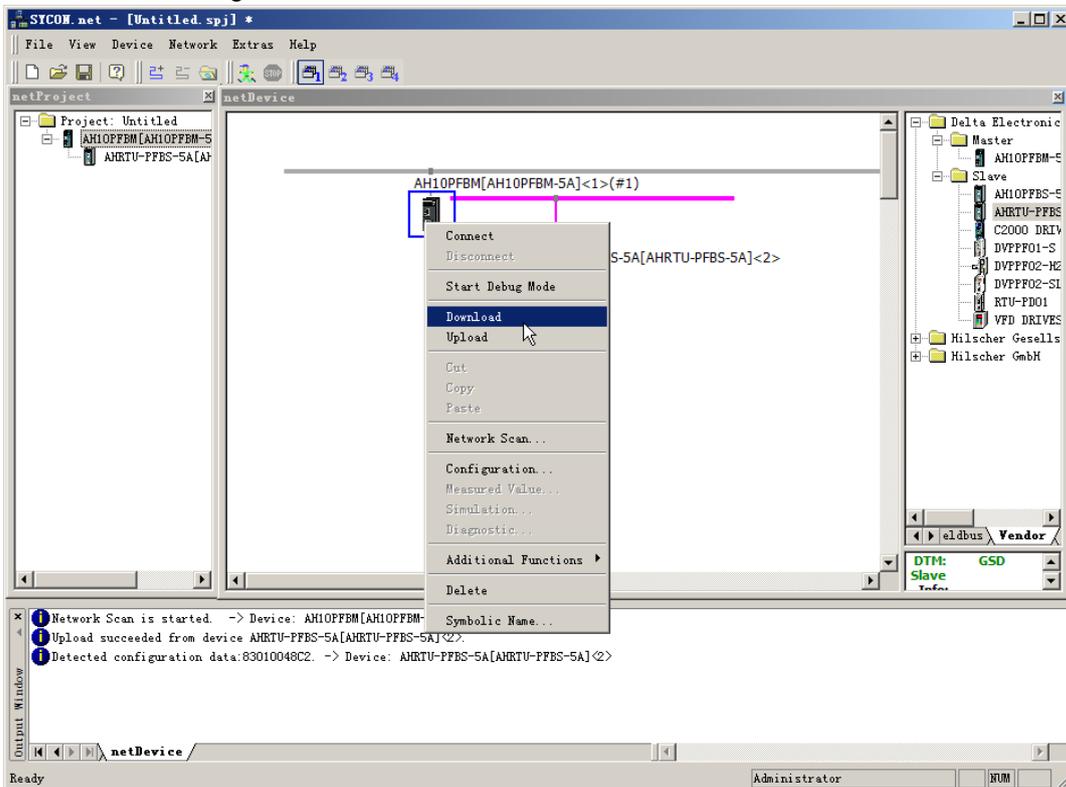
2. The following window appears; then click "Yes" to continue to download.
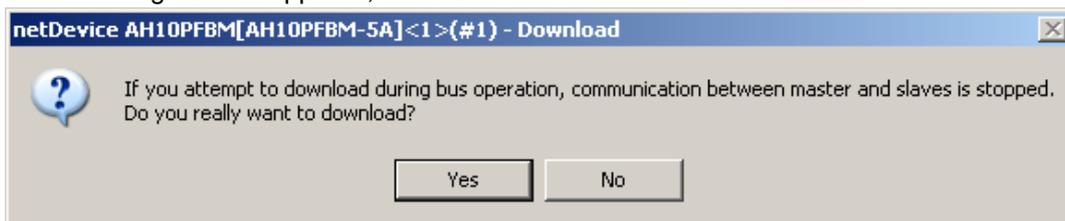
3. Return to the main interface of the software after downloading is completed.
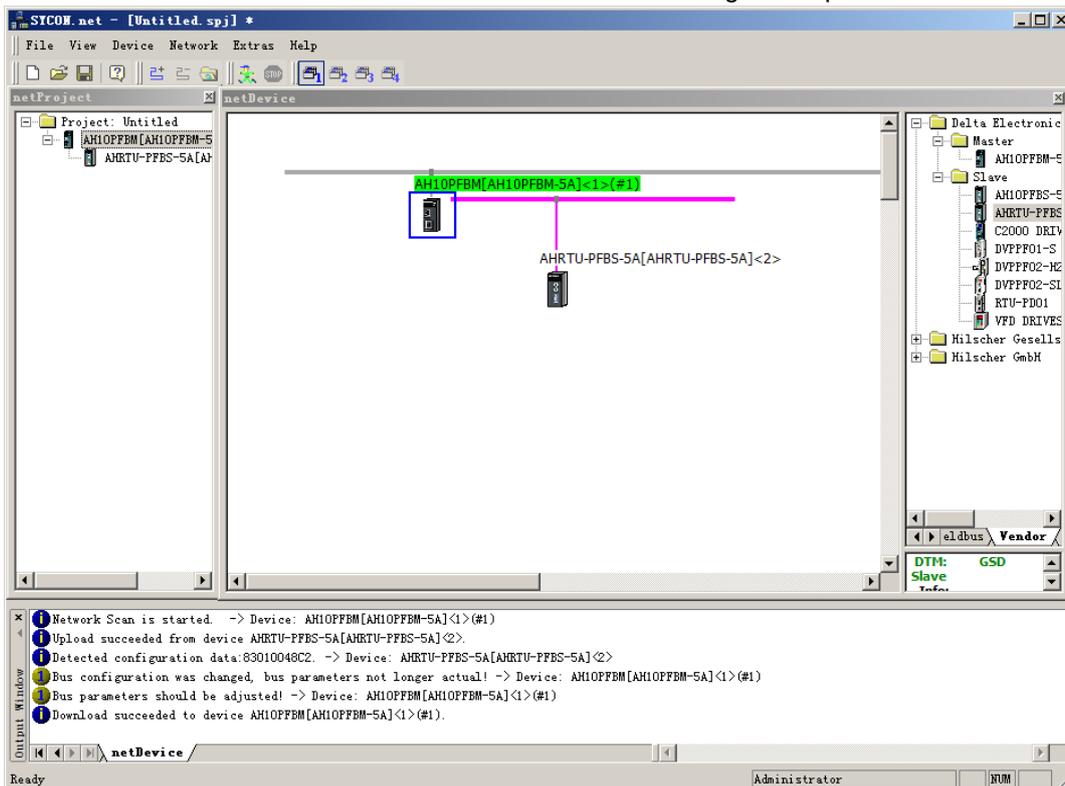
14.7.3 Mapping relationships between AHRTU-PFBS-5A and Master

The following interface shows the starting addresses and lengths of the OUTPUT area and INPUT area that PLC CPU assigns to the master module. The data in OUTPUT area are sent to the slave and the INPUT area receives the data from the slave. The starting addresses of INPUT area and OUTPUT area that AH master PLC assigns to the master module are D1000 and D6000 respectively in the example.
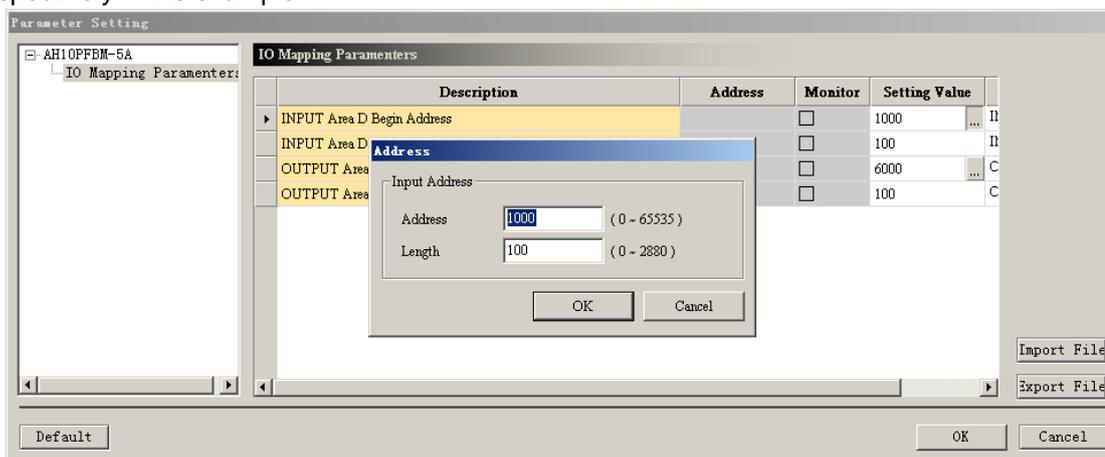
The following figure shows the I/O modules that AHRTU-PFBS-5A configures and the input and output data length that each I/O module corresponds to.
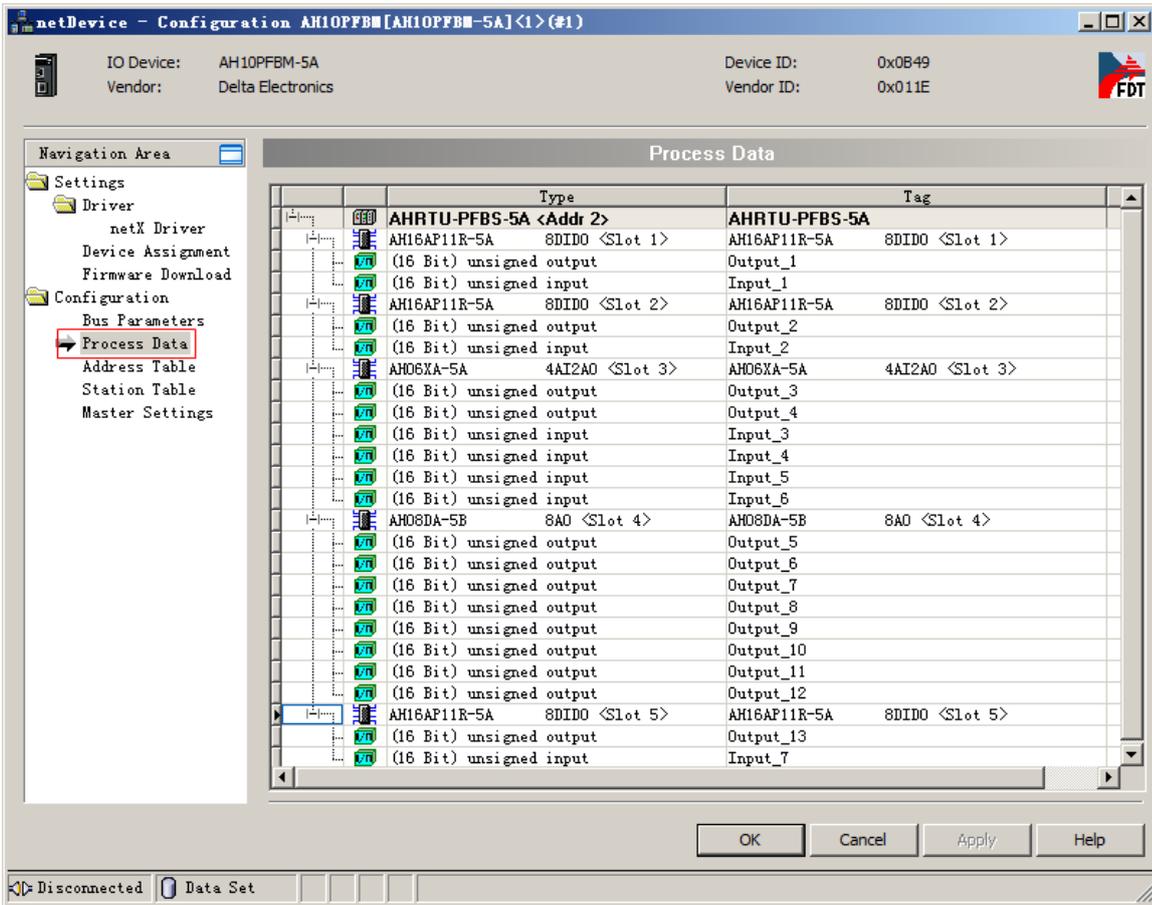
The following window contains the offset address of I/O modules that AHRTU-PFBS-5A configures. That is the offsets of the starting addresses of INPUT area and OUTPUT area that AH master PLC assigns to the master module with Byte as the unit.

The D device in PLC regards Word as the unit, the offset address regards Byte as the unit and therefore the counting of the starting D register in the master PLC that the configured module of the slave corresponds to:

The starting number of the D registers in OUTPUT area of the master PLC corresponding to the slave configured module = the starting address in OUTPUT area + (Address/2).

The starting number of the D registers in INPUT area of the master PLC corresponding to the slave configured module = the starting address in INPUT area + (Address/2).

The offset address of each module can also be assigned manually by not ticking "Auto addressing" on the ablove interface but inputing the value of offset address in Address column.

IO mapping relationships between master PLC and the I/O modules connected to AHRTU-PFBS-5A

Register in master PLC		Devices connected to AHRTU-PFBS-5A	Offset
D6000（bit0~bit7）		Y0.0~Y0.7 of 16AP	0
D6001（bit0~bit7）		Y0.0~Y0.7 of 16AP	2
D6002		Digital value that output channel 0 in 06XA corresponds to	4
D6003		Digital value that output channel 1 in 06XA corresponds to	
D6004		Digital value that channel 0 in 08DA corresponds to	8
D6005		Digital value that channel 1 in 08DA corresponds to	
D6006		Digital value that channel 2 in 08DA corresponds to	
D6007		Digital value that channel 3 in 08DA corresponds to	
D6008		Digital value that channel 4 in 08DA corresponds to	
D6009		Digital value that channel 5 in 08DA corresponds to	
D6010		Digital value that channel 6 in 08DA corresponds to	
D6011		Digital value that channel 7 in 08DA corresponds to	
D6012（bit0~bit7）		Y0.0~Y0.7 of 16AP	24
D1000（bit0~bit7）		X0.0~X0.7 of 16AP	0
D1001（bit0~bit7）		X0.0~X0.7 of 16AP	2
D1002		Digital value that input channel 0 in 06XA corresponds to	4
D1003		Digital value that input channel 1 in 06XA corresponds to	
D1004		Digital value that input channel 2 in 06XA corresponds to	
D1005		Digital value that input channel 3 in 06XA corresponds to	
D1006（bit0~bit7）		X0.0~X0.7 of 16AP	12

14.8 LED Indicator and Trouble-shooting

14.8.1 RUN and NET Indicators

● **RUN LED**

RUN LED displays the work status of AHRTU-PFBS-5A.

LED state	Indication	How to deal with
Green light ON	AHRTU-PFBS-5A is in RUN state and is communicating with the master.	--
Green light flickers	AHRTU-PFBS-5A is in STOP state and has not made the connection with the master (When the digital display shows F1.)	1. Turn the RUN/STOP switch of the master PLC to RUN 2. Check if AHRTU-PFBS-5A has been configured in the PROFIBUS DP master configuration software. 3. Check if the communication cable between the PROFIBUS DP master and AHRTU-PFBS-5A is normal. 4. Check if the PROFIBUS DP master works normally. 5. Verify that both of the two ends of the PROFIBUS DP network have the terminal resistors.
Green light OFF	No power	Check if the power module PS05 works normally.

● **NET LED**

NET LED displays if the connection between AHRTU-PFBS-5A and the PROFIBU DP master is normal.

LED state	Indication	How to deal with
Green light ON	The master makes the connection with the slave.	--
Red light ON	AHRTU-PFBS-5A does not make the connection with the master (while reporting F1) or is offline after making the connection with the master (while reporting F6)	1. Check if AHRTU-PFBS-5A has been connected to the PROFIBUS DP bus 2. Check if the communication cable between the PROFIBUS DP master and AHRTU-PFBS-5A is normal. 3. Check if the actual address of AHRTU-PFBS-5A is consistent with that configured in the software. 4. Check if the GSD file used is correct.
Green light OFF	No power	Check if the power module PS05 works normally.

14.8.2 Digital Display

● **The digital display displays the status of AHRTU-PFBS-5A.**

Code	Indication	How to deal with
1~ 7D	When AHRTU-PFBS-5A works normally, the digital display displays its node address.	--
80	AHRTU-PFBS-5A is in STOP status.	Turn the RUN/STOP switch of the master PLC to RUN.
F0	The node address of AHRTU-PFBS-5A exceeds the valid range.	Set the node address of AHRTU-PFBS-5A between 1～125.
F1	1. AHRTU-PFBS-5A has not been connected to the PFOFIBUS-DP network. 2. The PFOFIBUS-DP master has not configured AHRTU-PFBS-5A	1. Check if AHRTU-PFBS-5A has been configured to the PROFIBUS DP master configuration software. 2. Check if the communication cable between the PROFIBUS DP master and AHRTU-PFBS-5A is normal. 3. Check if the PROFIBUS DP master works normally. 4. Check if the two terminal nodes at both ends of the PROFIBUS DP network have been added with the terminal resistors.
F2	Parameter error	Check if the GSD file AHRTU-PFBS-5A is using is correct.
F3	1. An configuration error 2. No configuration of I/O modules for AHRTU-PFBS-5A	1. Check if the GSD file AHRTU-PFBS-5A is using is correct. 2. Check if the I/O modules for AHRTU-PFBS-5A are configured in the Profibus DP configuration software
F4	An error in initialization of AHRTU-PFBS-5A	Contact the factory if the error still exists after AHRTU-PFBS-5A is repowered.
F5	An error in internal memory units	Contact the factory if the error still exists after AHRTU-PFBS-5A is repowered.
F6	AHRTU-PFBS-5A loses the communication with the master.	Check if the communication cable between the PROFIBUS DP master and AHRTU-PFBS-5A is normal.
E4	Inconsistency between the actual I/O modules connected to the rack and those configured via the software	1. Check if the actual I/O modules connected to the rack are consistent.with those configured via the software. 2. Check if any I/O module connected to the rack is damaged or does not exist.
E5	1. An error in an extension rack 2. The actually connected rack is not consistent with that configured in the software.	1. Check if the extension rack communication cable is connected properly. 2. Check if the extension rack is normal. 3. Check if the actually connected rack is consistent with that configured in the software.
E6	An error alarmed from the modules connected to AHRTU-PFBS-5A	1. Check if there is any error in the module hardware. 2. Check if the power supply works normally. 3. Check if the input signal exceeds the hardware range.

● The display mechanism of the digital display:
   ➢ When AHRTU-PFBS-5A is in normal state and the master PLC is in RUN state, the digital display of AHRTU-PFBS-5A only displays its node address.
   ➢ When AHRTU-PFBS-5A is in normal state and the master PLC is in STOP state, the digital display of AHRTU-PFBS-5A displays its node address and 80 (the STOP state code of the master PLC) alternately.
   ➢ When AHRTU-PFBS-5A is initializing or the master PLC is in RUN state, the digital display of AHRTU-PFBS-5A displays its node address, initialization code and the error code alternately.
   ➢ When the I/O module connected to AHRTU-PFBS-5A alarms or is offline and meanwhile the master PLC is in RUN state, the display of AHRTU-PFBS-5A displays the position of I/O module and error code E4; when the extension rack alarms or is offline, AHRTU-PFBS-5A displays its node address and error code E5 alternately.
   ➢ When an error occurs in multiple I/O modules or extension rack or the master PLC is in RUN state, the display of AHRTU-PFBS-5A displays the error codes in cycle. For example, E4 12 E5 02, E4 12 E5 02 appears, the meaning of the error is shown below.
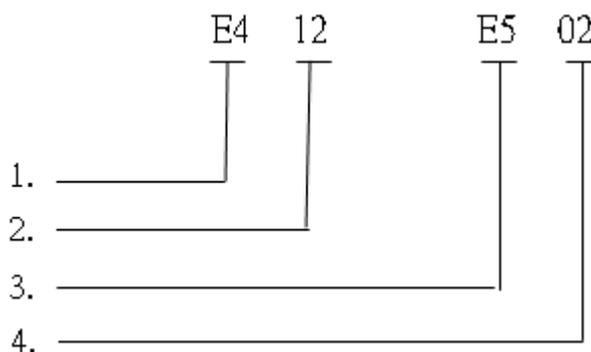
1. E4 indicates that the actual I/O module connected to the rack is not consistent with that configured in the software.
2. The 12 represents the position of the module in which the fault occurs. The first number is the number of the extension rack and the second number is the number of the slot, for example, 12 stands for the module of the rack 1 and slot 2. (The number of rack is 1~8. 1 represents the main rack and 2~8 refer to the extension racks. The number of slot is 0~11.)
3. E5 means that the extension rack has a fault or is offline.
4. The 02 indicates that an error occurs or the number of the offline rack. (The number of rack is 1~8. 1 represents the main rack and 2~8 refer to the extension racks.)

14.9 Application Example 1

14.9.1 Control Requirement

To achieve the data exchange between AH CPU and the remote I/O modules connected to AHRTU-PFBS-5A through the PROFIBUS DP network.

➢ Make Y0.0~Y0.3 of all 16AP11R modules connected on the main rack and extension rack ON.

➢ Control all AH08DA-5B modules and make channels 0 ~ 3 output the 5V voltage respectively.

➢ Monitor input voltages of the input channels 0 ~ 3 of all AH06XA-5A modules.

14.9.2 Connection Figure
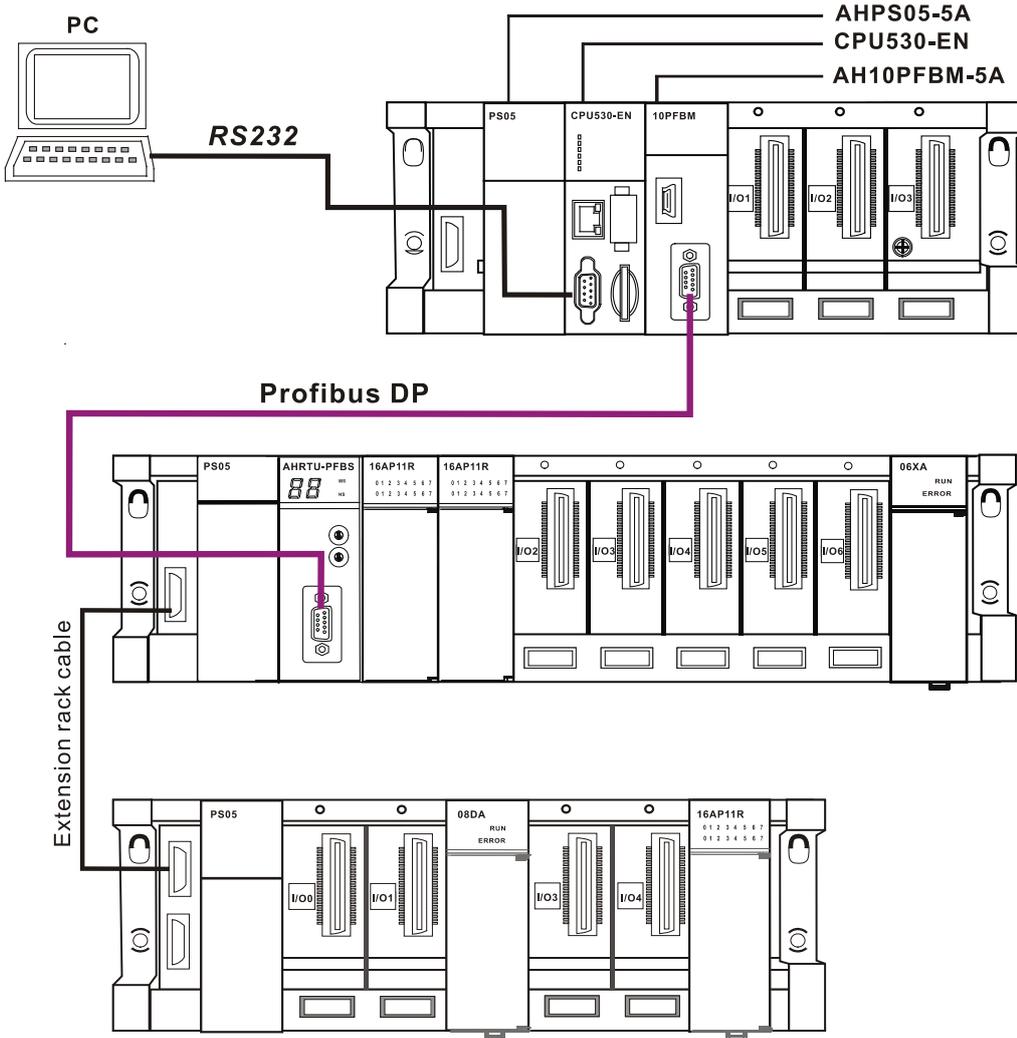
Note: Slave module AHRTU-PFBS-5A setting

Set the node address of AHRTU-PFBS-5A to 2 with its rotary switches.

14.9.3 Setup of INPUT and OUTPUT Areas that AH PLC CPU Assigns to Master Module

The INPUT and OUTPUT areas that AH PLC CPU assigns to the master module AH10PFBM-5A are shown below. (Please refer to section 15.1 in the SYCON.net help for the detailed setting)
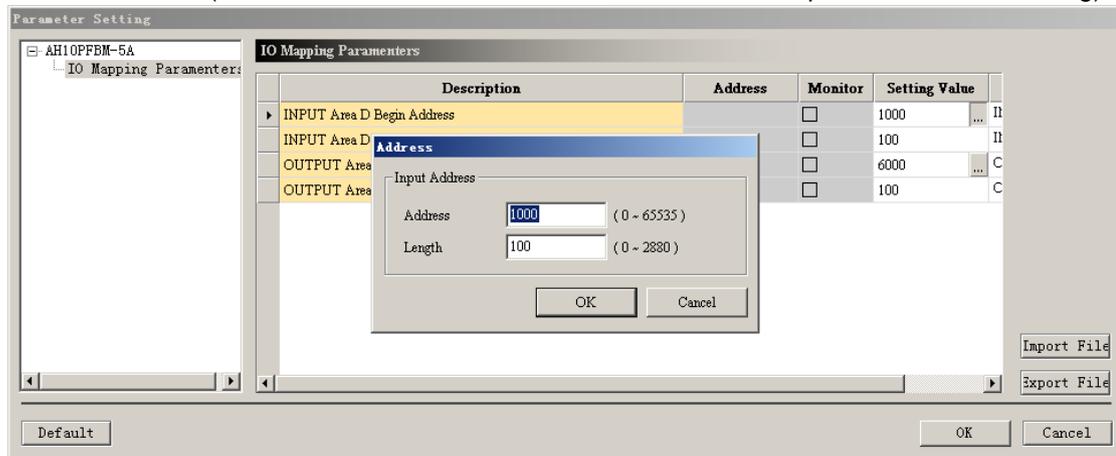
14.9.4 Configuration of the Master

1. Open the SYCON.net software for configuration of the master and the User Login dialog appears as follows. Please select "Administrator" for User Name and do not input anything for Password since the default password is blank.

   For the details on the setting and purpose, please refer to section 7.1 in the SYCON.net help.
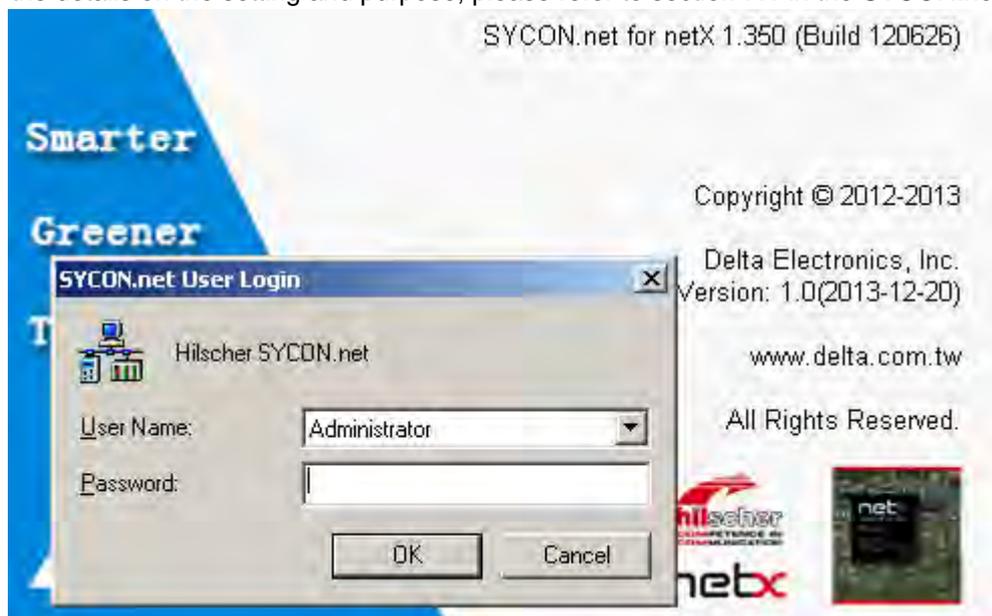
2. Click "OK" and then enter the initial interface of the SYCON.net as below.

3. Select the master module AH10PFBM-5A on the right-side interface of the software and meanwhile drag it to the position as shown below.

4. Release the mouse when the mark [+] appears with the arrow and then the master module is added as follows.

5. Double click the master icon to enter the master configuration interface.
(Note: The PC and the CONF communication port of the master have correctly finished connection in hardware before the communication parameters are set.)

6. Click Driver on the left-side window and then tick the box marked in red on the right-side window to select the USB driver for the communication between the master and PC.

7. Click "Scan" button on the right-side window after clicking "Device Assignment" item on the left-side window and then select "All" from the Device Selection box on the right-side window.

8. After the master is scanned, pick the box marked in red below for the scanned master.

9. Click "OK" to exit from the master configuration interface and return to the main interface of the software after the master communication parameters settings are over.
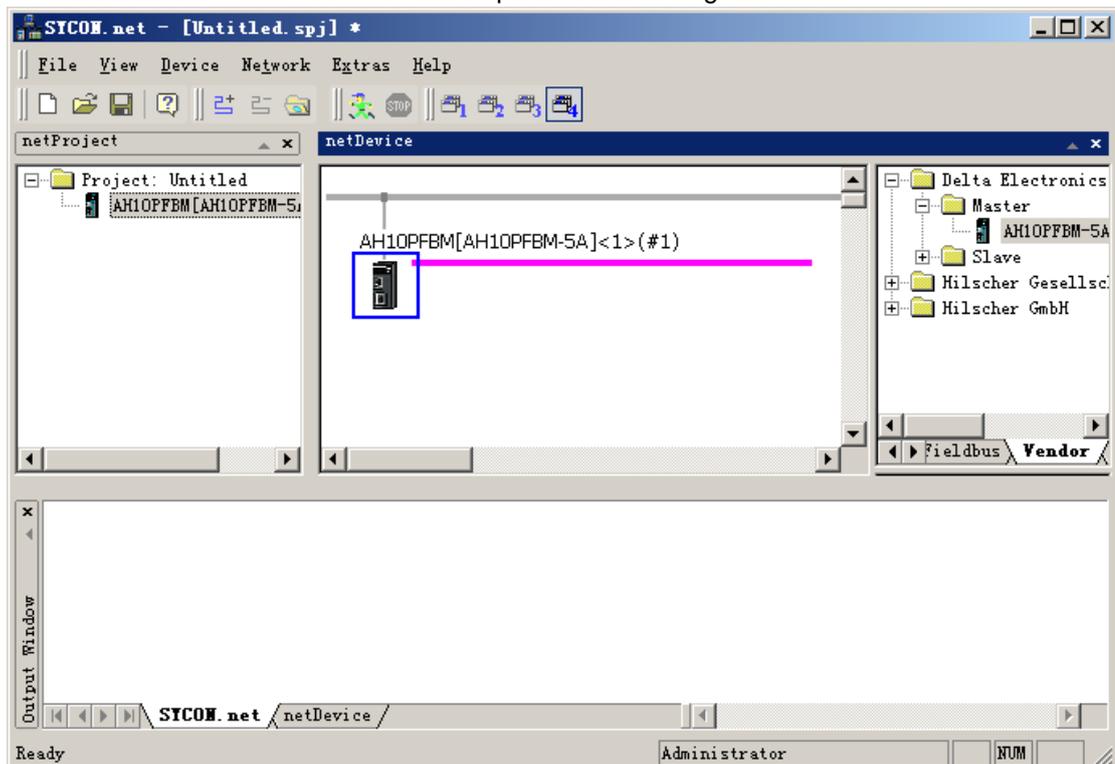
10. Right click the master and select "Network Scan…" from the menu which pops up to scan the network.
    (Note: If it is the first time to use the product after it left the factory, please download the master configuration before use. For details, please refer to the user manual of AH10PFBM-5A.)
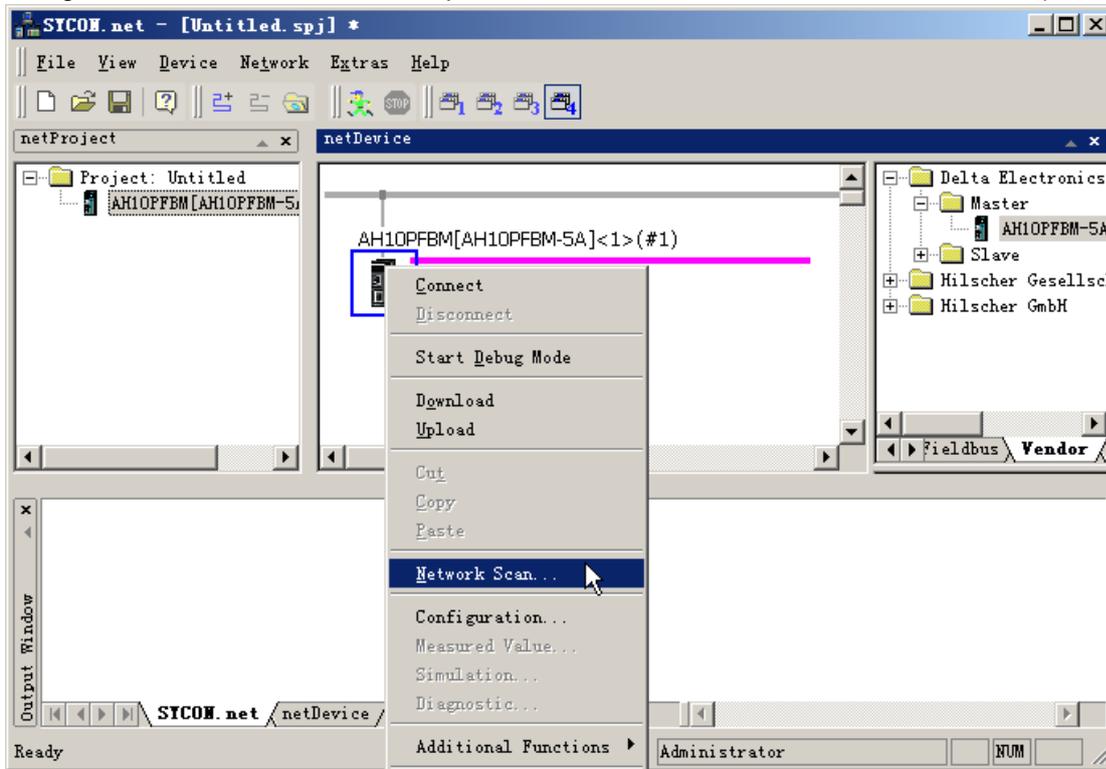
11. The slave connected to the master has been scanned as below.
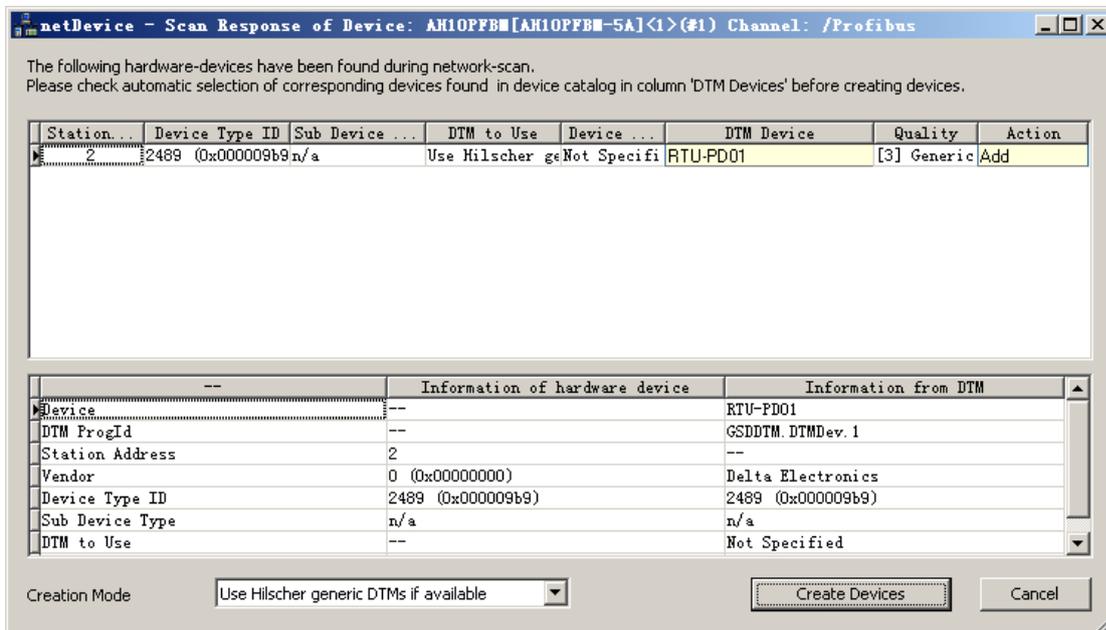
12. Select the DTM device AHRTU-PFBS-5A which is consistent with the actual slave.
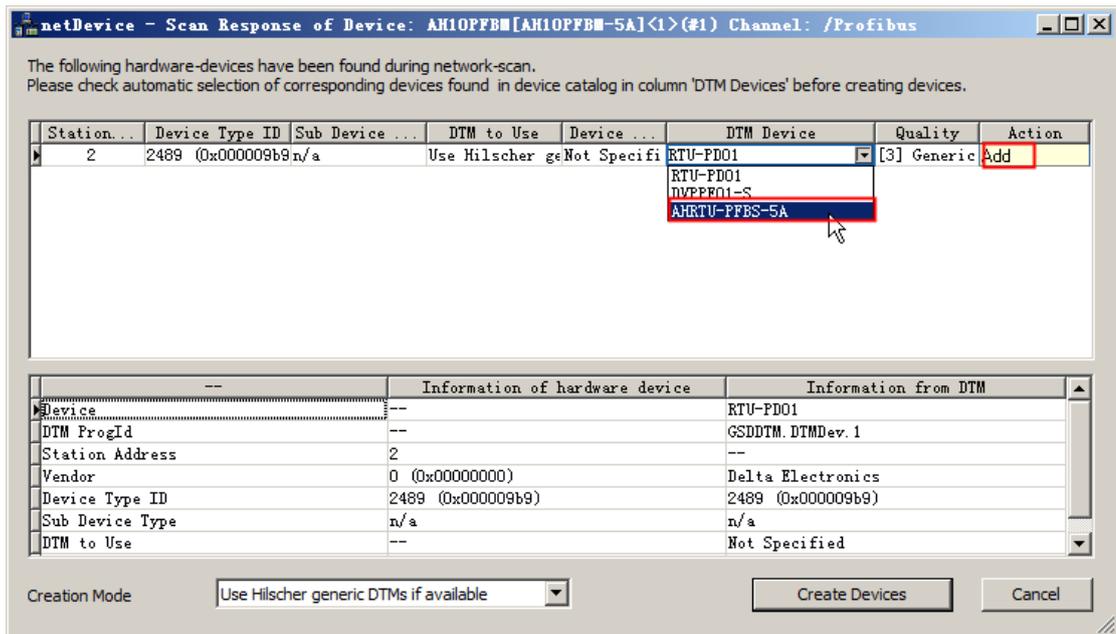
13. Click "Create devices" button to add the slave device as below.
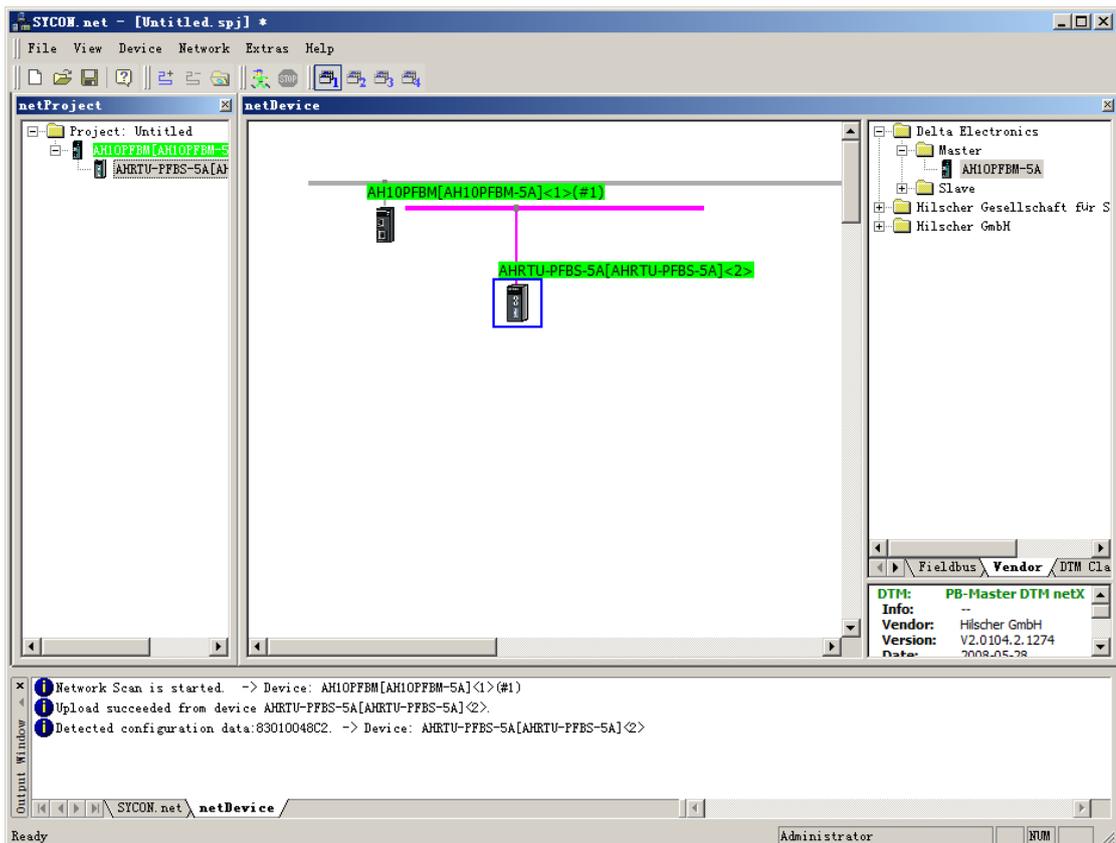
14. Right click the master and select "Disconnect" from the menu which pops up.
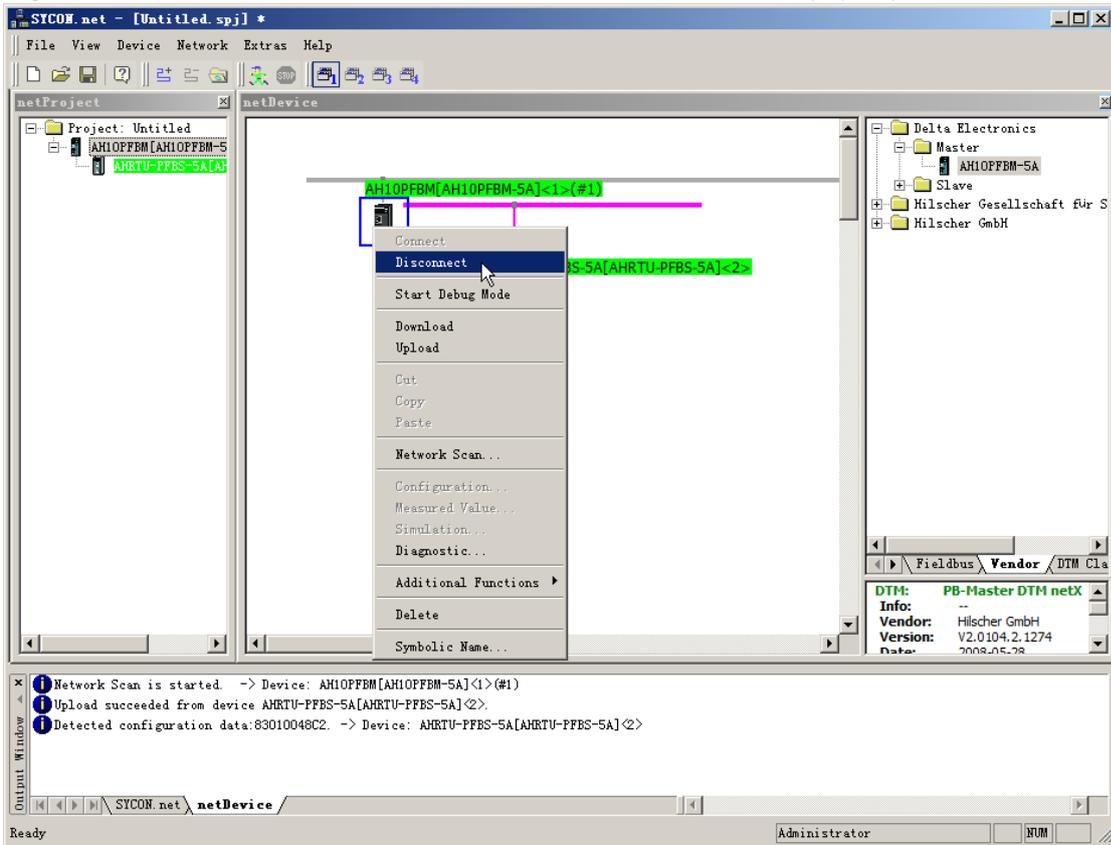
15. And then return to the main interface of the software.
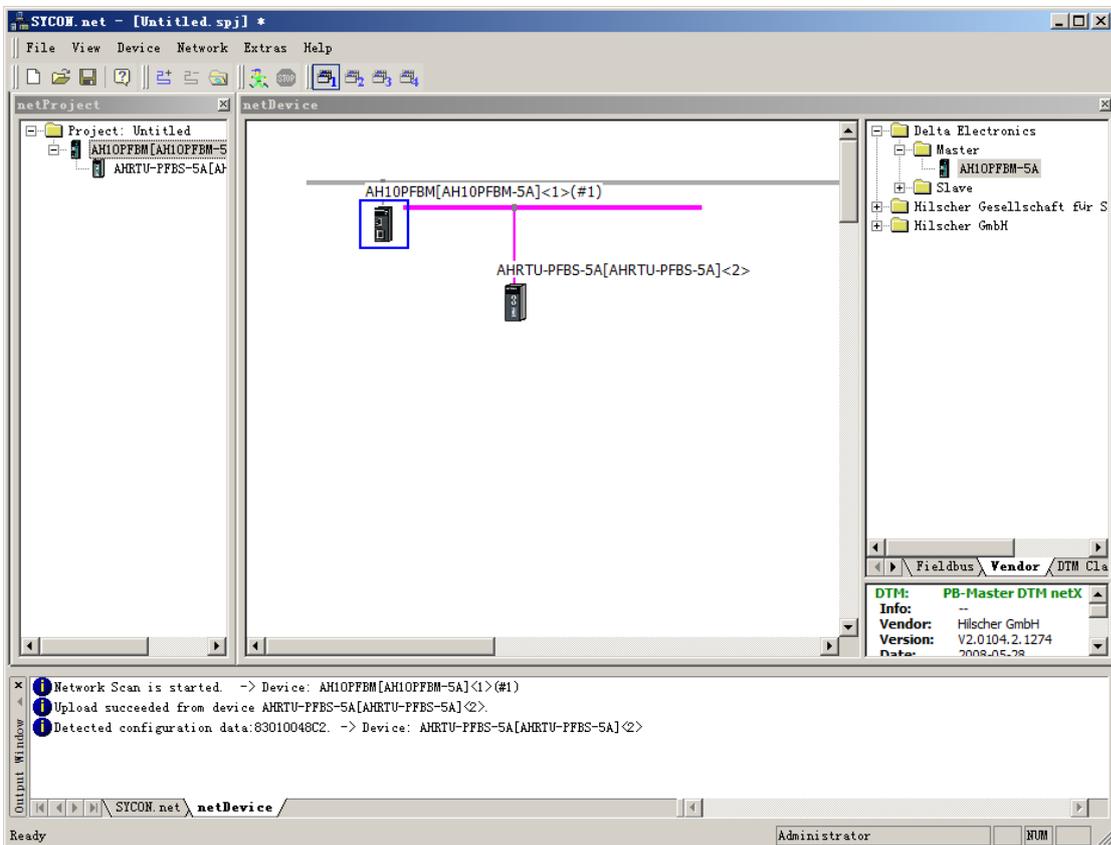
16. Double click the slave AHRTU-PFBS-5A icon and then the slave configuration interface is opened as follows.

Add AH16AP11R-5A, AH08DA-5B, and AH06XA-5A; "Available Modules" contains all configuration options that AHRTU-PFBS-5A supports and "Configured Modules" includes actually configured configuration options.

The input length and output length of AHRTU-PFBS-5A refer to the sum of input lengths and output lengths of all configuration options respectively. The following Inputs, Outputs and In/Out marked in red regard Byte as their unit and In/Out refer to the length of input and output.

In the following configuration, the sum of input lengths and output lengths of AHRTU-PFBS-5A are 14 bytes and 26 bytes respectively.

Insert: When there is no module in "Configured Modules", select the desired module in "Available Module"; click "Insert" and then the selected module is added to "Configured Module". When there are modules existing in "Configured Modules", select the desired module in "Available Module"; click "Insert" and then the selected module is inserted above the selected module in "Configured Module".

Append: Select the desired module from "Available Modules" and add it to the last row in "Configured Modules" clicking "Append" button. Or double click the desired module in "Available Modules" and then the module is directly added to the last row in "Configured Modules".

Remove: Select the module to be deleted in "Configured Modules" and delete it clicking "Remove".

Note: The same module in "Available Modules" can be added to "Configured Modules" multiple times. Click multiple modules in "Available Modules" or "Configured Modules" while pressing Ctrl key and then the multiple modules are selected.

See the above input and output lengths of each configuration option in the following table.

Module	Input length	Output length	Data type
AH16AP11R-5A	2	2	Byte
AH16AP11R-5A	2	2	Byte
AH06XA-5A	8	4	Byte
AH08DA-5B	0	16	Byte
AH16AP11R-5A	2	2	Byte

17. Click "Parameters" item on the left-side window, click the place marked in red box below.

A menu pops up then; select each I/O module connected to AHRTU-PFBS-5A to set the parameters as the following red box shows.

➢ Pick "Common" to set the parameters of AHRTU-PFBS-5A itself as below.

To revise the parameter, double click the location marked in red. The parameter can be revised directly if the mouse arrow becomes "I" symbol. Click the symbol and select the desired parameter from the menu which pops up if the symbol [▼] appears to the right of the parameter.

(Note: here are default settings in the figure and the detailed explanation of each option can be seen in section 14.7.2 in this manual.)
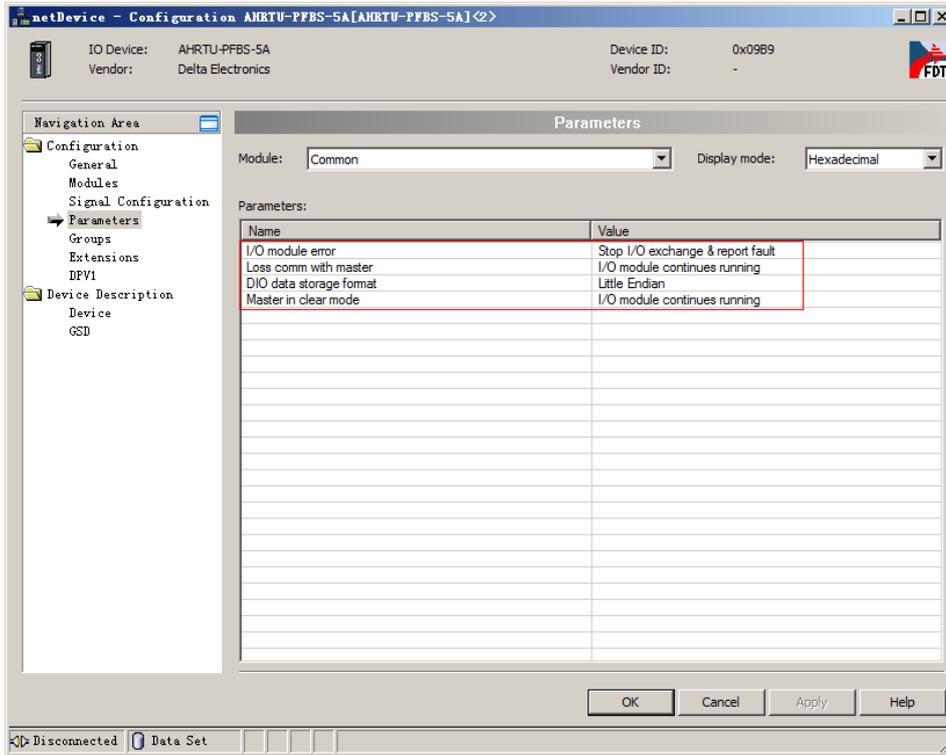
Pick "AH16AP11R-5A" and the related parameters are displayed as follows.

Explanation of the options above

Name	Setting	Explanation
rack	0x01	The number of the rack where the I/O module are placed (Rack number is 1~8, 1 represents the main rack, 2~8 are extension racks and the slot number is 0~11.)
slot	0x00	The number of the slot on the rack where the I/O module is. (Rack number is 1~8, 1 represents the main rack, 2~8 are extension racks and the slot number is 0~11).
Output hold	disable/enable	Output hold options: Enable: the output of other I/O modules of AHRTU-PFBS-5A is held when some I/O module has a fault and the master is disconnected or stops running. Disable: the output of other I/O modules of AHRTU-PFBS-5A is cleared to 0 when some I/O module has a fault and the master is disconnected or stops running.

➢ Pick "AH06XA-5A" and the related parameters are displayed as follows. The input modes of CH0~CH3 are all set to -10V~+10V。

Explanation of the options above

Name	Setting	Explanation
rack	0x01	The number of the rack where the I/O module are placed (Rack number is 1~8, 1 represents the main rack, 2~8 are extension racks and the slot number is 0~11.)
slot	0x07	The number of the slot on the rack where the I/O module is. (Rack number is 1~8, 1 represents the main rack, 2~8 are extension racks and the slot number is 0~11).
CH0~CH3 Input mode	disable -10V~+10V 0V~10V -5V~+5V 0V~+5V 1V~+5V 0mA~20mA 4mA~20mA -20mA~20mA	The input channel mode of AH06XA-5A is disabled by default. Mode: disable Mode: -10V~+10V Mode: 0V~10V Mode: -5V~+5V Mode: 0V~+5V Mode: 1V~+5V Mode: 0mA~20mA Mode: 4mA~20mA Mode: -20mA~20mA
CH0~CH1 Output mode	disable -10V~+10V 0V~10V -5V~+5V 0V~+5V 1V~+5V 0mA~20mA 4mA~20mA	The output channel mode of AH06XA-5A is disabled by default. Mode: disable, Mode: -10V~+10V Mode: 0V~10V Mode: -5V~+5V Mode: 0V~+5V Mode: 1V~+5V Mode: 0mA~20mA Mode: 4mA~20mA
CH0~CH3 Input average time	1～100	Average times setting, default value 10
CH0 output hold	disable/enable	Output hold options Enable: the output of other I/O modules of AHRTU-PFBS-5A is held when some I/O module has a fault and the master is disconnected or stops running. Disable: the output of other I/O modules of AHRTU-PFBS-5A is cleared to 0 when some I/O module has a fault and the master is disconnected or stops running.
CH1 output hold	disable/enable	Output hold options Enable: the output of other I/O modules of AHRTU-PFBS-5A is held when some I/O module has a fault and the master is disconnected or stops running. Disable: the output of other I/O modules of AHRTU-PFBS-5A is cleared to 0 when some I/O module has a fault and the master is disconnected or stops running.

The conversion between the analog quantity and digital quantity for all modules that AHRTU-PFBS-5A supports:

When the input/ output mode of the analog module is positive voltage or positive current, the corresponding digital value is 0 ~32000; for example, if the modes are 0V~10V and 4mA~20mA, the corresponding digital values are both 0~32000.

When the input /output mode of the analog module is negative voltage or negative current, the corresponding digital value is -32000~32000; for example, the modes are -10V~+10V, and -20mA~20mA, the corresponding digital values are both -32000~32000.

➢ Pick "AH08DA-5B" and the related parameters are displayed as follows. The output modes of CH0~ CH3 are all set to -10V~+10V. Double click the parameters in "Name" column. The setting value can be revised directly if the mouse arrow becomes the "I" symbol. And select hexadecimal or decimal as Display mode.

Explanation of the options above

Name	Setting	Explanation
rack	0x02	The number of the rack where the I/O module are placed (Rack number is 1~8, 1 represents the main rack, 2~8 are extension racks and the slot number is 0~11.)
slot	0x02	The number of the slot on the rack where the I/O module is. (Rack number is 1~8, 1 represents the main rack, 2~8 are extension racks and the slot number is 0~11).
CH0~CH7 Output mode	disable -10V~+10V 0V~10V 5V~+5V 0V~+5V 1V~+5V	The output channel mode of AH08DA-5B is disabled by default. Mode: disable Mode: -10V~+10V Mode: 0V~10V Mode: -5V~+5V Mode: 0V~+5V Mode: 1V~+5V
CH0~CH7 output hold	disable/enable	Output hold options: Enable: the output of other I/O modules of AHRTU-PFBS-5A is held when some I/O module has a fault and the master is disconnected or stops running. Disable: the output of other I/O modules of AHRTU-PFBS-5A is cleared to 0 when some I/O module has a fault and the master is disconnected or stops running.

The conversion between the analog quantity and digital quantity for all modules that AHRTU-PFBS-5A supports:

When the input/ output mode of the analog module is positive voltage or positive current, the corresponding digital value is 0 ~32000; for example, if the modes are 0V~10V and 4mA~20mA, the corresponding digital values are both 0~32000.

When the input /output mode of the analog module is negative voltage or negative current, the corresponding digital value is -32000~32000; for example, the modes are -10V~+10V, and -20mA~20mA, the corresponding digital values are both -32000~32000.

18. Click "Extensions" on the left-side window and then the following settings are done.
    (The settings here are default. For the meaning of each option, please refer to section 10.2 in the SYCON.net help.)

19. After configuration of the slave module is completed, click "OK" to exit from the configuration interface and return to the main interface of the software.

20. Double click the master icon to enter the master configuration interface and start to set the master parameters.

21. Click "Bus Parameters" on the left-side window to do the setting of the parameters.

22. Pick "Overwrite slave specific Watchdog Control Time" and then click "Adjust" button to make an automatic adjustment of the bus parameters.
    (For the meaning of each item, please refer to section 10.3.2 in the SYCON.net help.）

23. Click "Address Table" on the left-side window to set the offset addresses of master.

   For details, please refer to "Mapping relationships between master PLC and slave PLC" in the following section.

   For the IW or QW-type module, try to adjust the offset address to start at 0 or an even number for the purpose of easy control via the program.

   User could tick "2 Byte boundaries" to adjust the offset address or not pick "Auto addressing" in the following figure and directly input the offset address value in "Address" column.
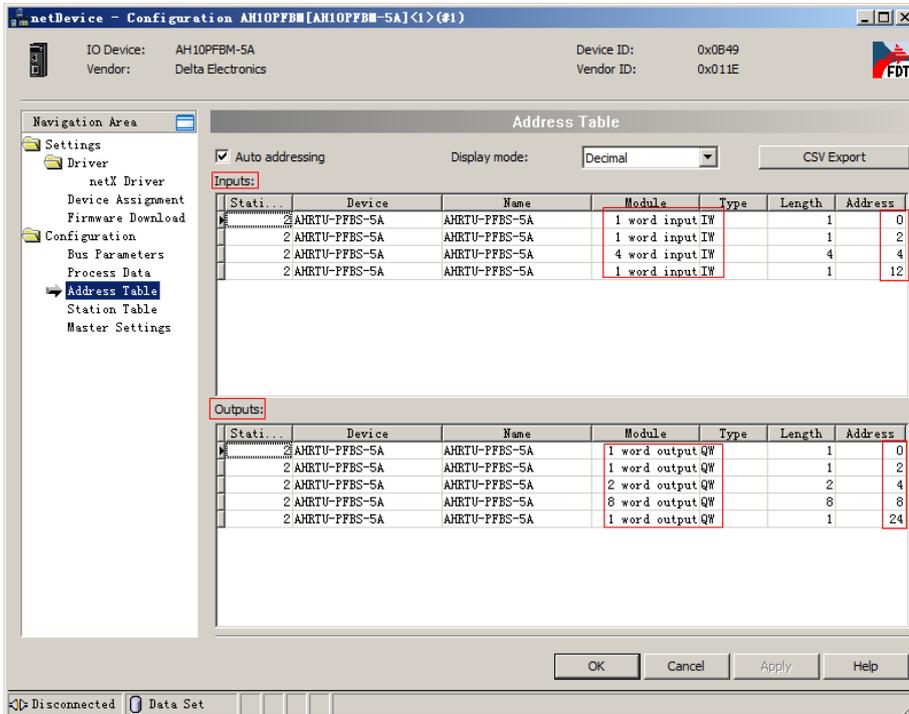
Click "Process Data" on the left-side window and the details about the slave configuration pop out on the right-side window. The corresponding relationships between the configured modules of the slave and the modules in the Input list and the Output list in the above figure are shown in the following window.
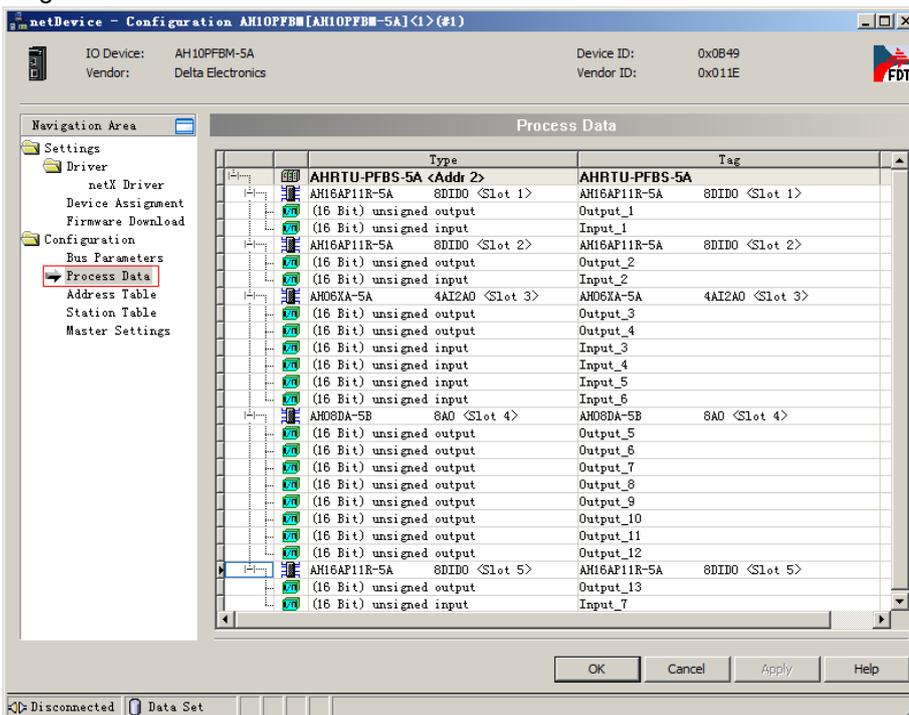
24. Click "Station Table" on the left-side window and then click the red box on the right-side window to modify the node address of the slave on the software.
    (Note: Pick the place of "Activate" column as below. Otherwise, the configuration data of the slave will be invalid.)
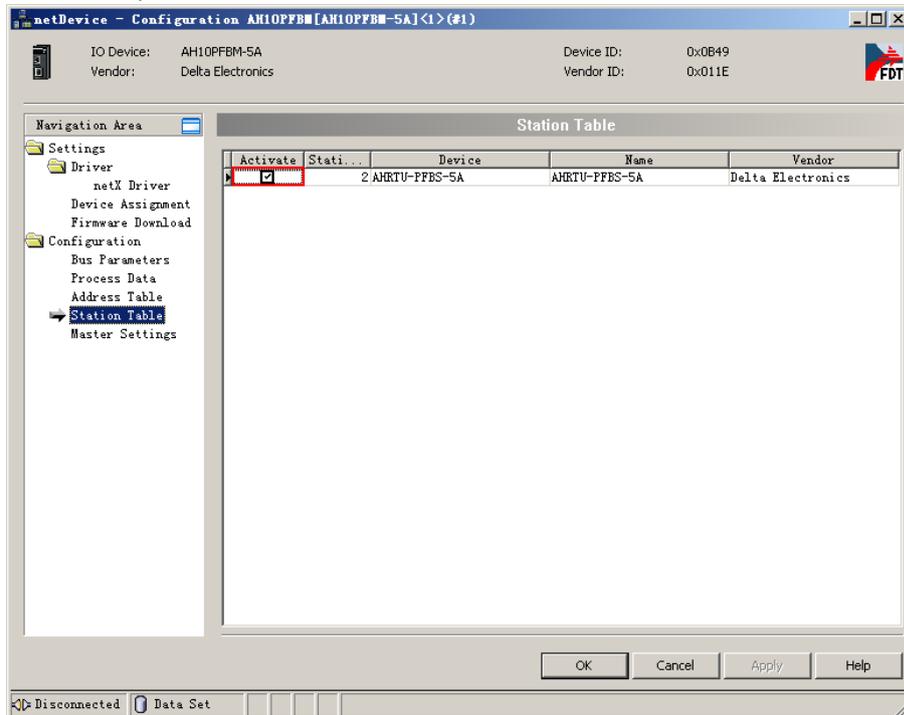
25. Click "Master Settings" on the left-side window to set the master parameters.
    (The settings here are default. For the meaning of each item, please refer to section 10.3.2 in the SYCON.net help.)
    When there is an IW or QW-type module and its offset address does not start at 0 or an even number, user could tick "2 Byte boundaries" to adjust and make the offset address of each module start at 0 or an even number for the purpose of easy program control.
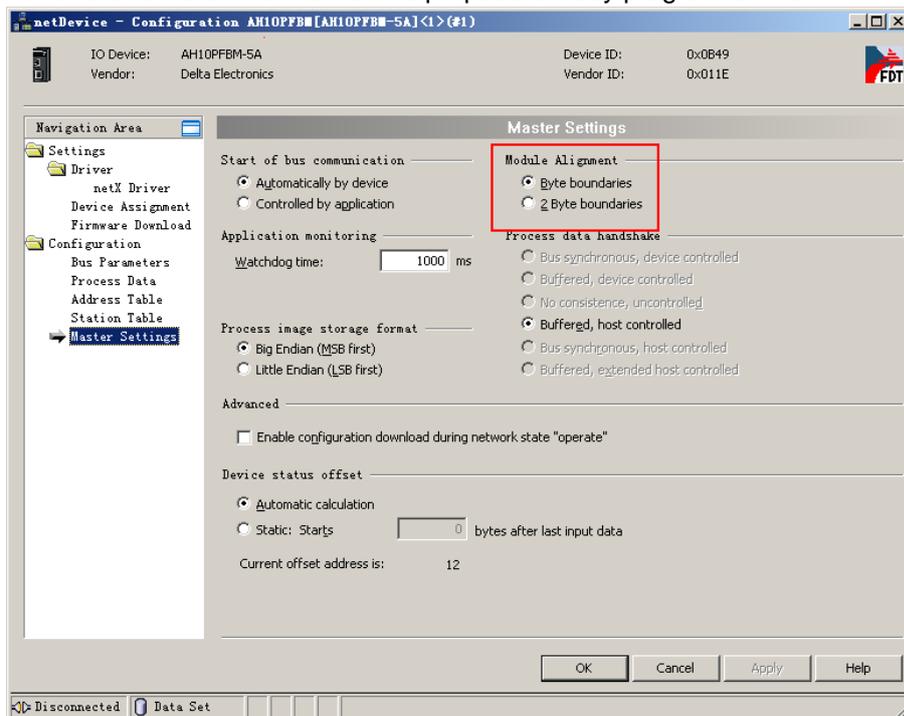
26. After setting the master parameters is over, click "OK" to exit from the master parameters setting interface and return to the main interface of the software.

27. Right click the master module and select "Download" from the menu which pops up to download the configuration data to the master.
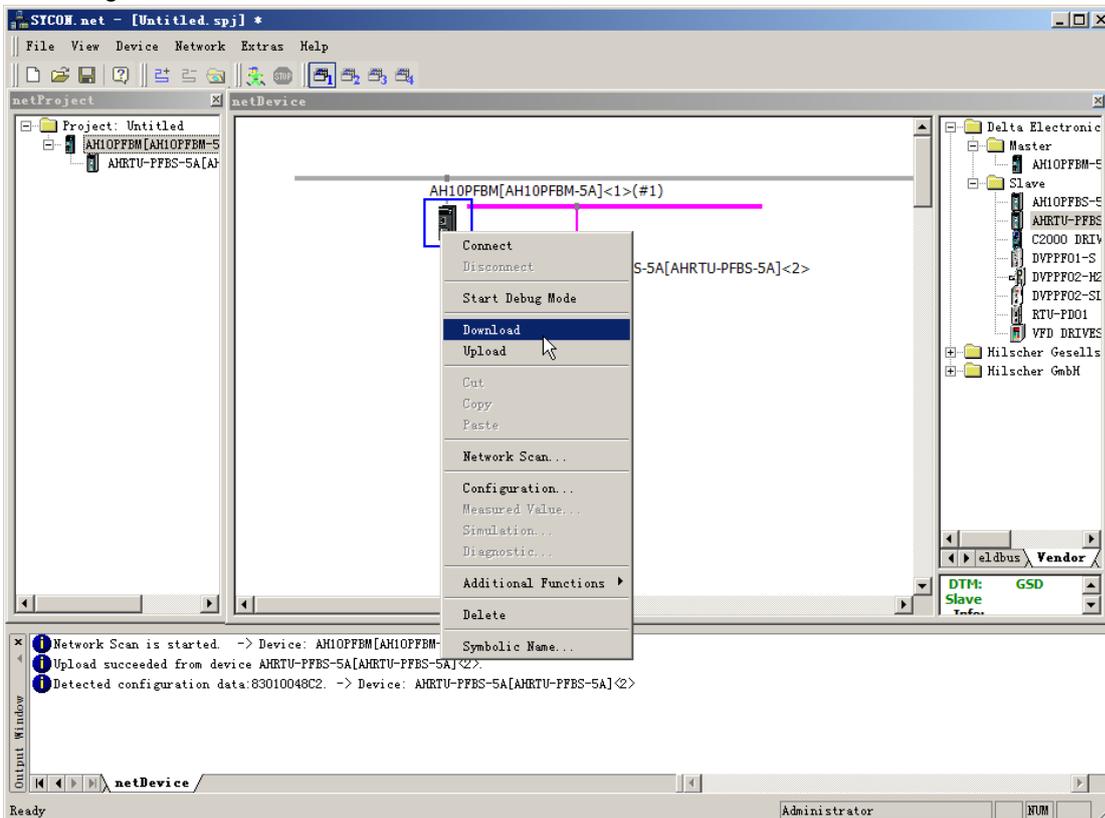
28. The following window appears; then click "Yes" to continue to download.
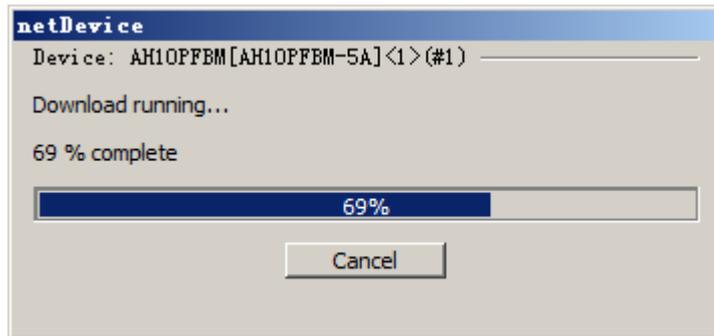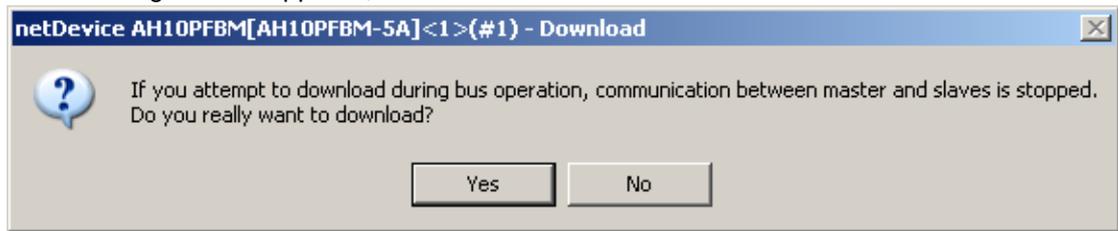
29. Return to the main interface of the software after downloading is completed.

(Note: After downloading is completed, the three indicators of the master are all green and the digital display shows the node address of the master, which indicates that the network communication is normal.)
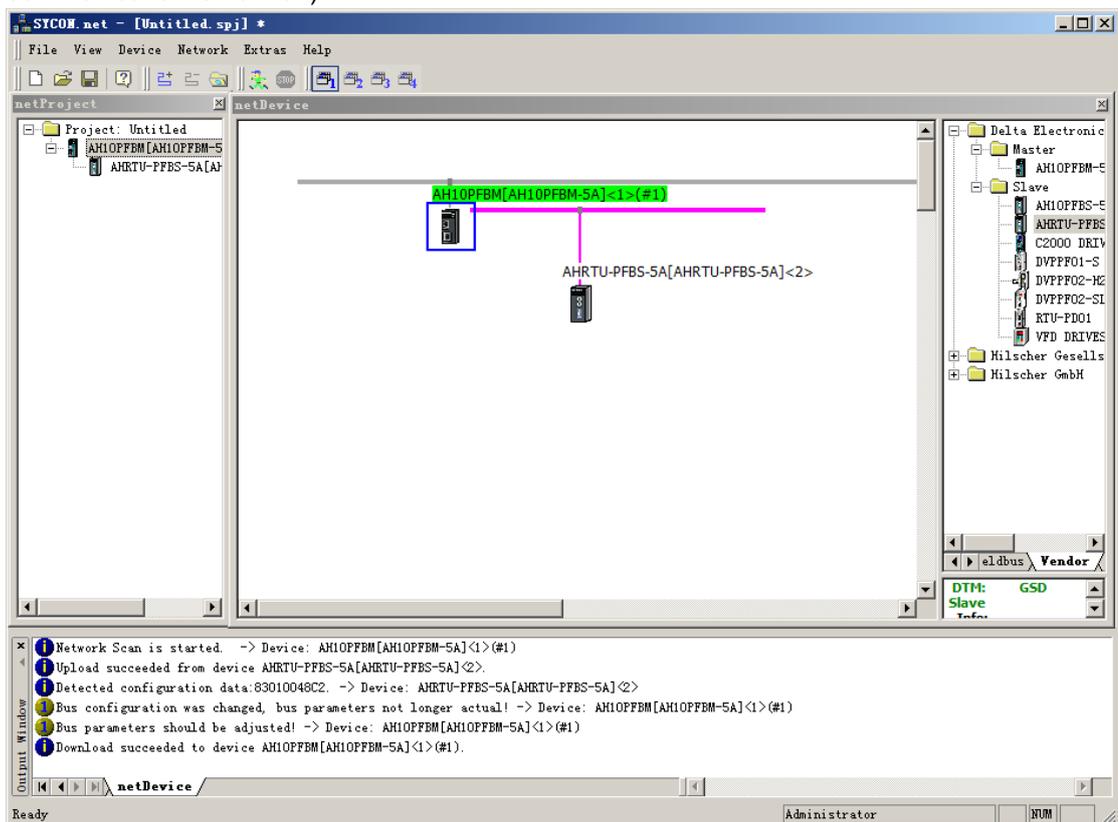
14.9.5 IO Mapping Relationships between Master PLC and Remote I/O modules

The following interface shows the starting addresses and lengths of the OUTPUT area and INPUT area that PLC CPU assigns to the master module. The data in OUTPUT area are sent to the slave and the INPUT area receives the data from the slave
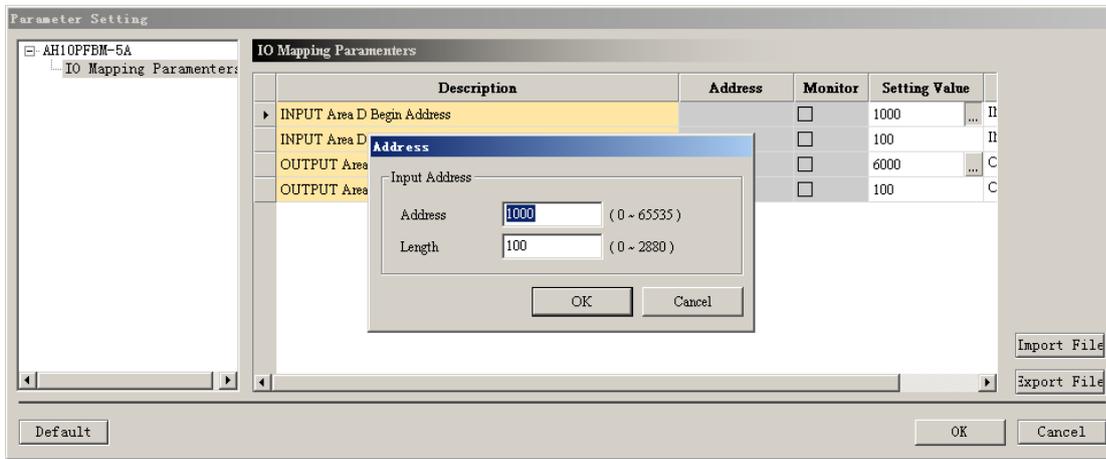
The mapping addresses the master assigns to the configured modules of the slave are shown on the following interface. It can be seen that the configured modules of the slave corrspond to the starting number of D registers in OUTPUT and INPUT area of the master PLC through the interfaces above and below.

Address: it is the offset of the starting addresses in INPUT and OUT areas that the AH master PLC

assigns to the master module with the Unit: byte.

The counting of the starting D register in the master PLC corresponding to the configured module of

the slave:

The starting number of the D registers in OUTPUT area of the master PLC corresponding to the

slave configured module = the starting address in OUTPUT area + (Address/2).

The starting number of the D registers in INPUT area of the master PLC corresponding to the slave

configured module = the starting address in INPUT area + (Address/2).

The above explanation is based on the connection between master and AHRTU-PFBS-5A. The mapping relationships between D registers in the master PLC and the configured modules of the slave are related with the master parameters settings. For more details on setting, please refer to section 10.3.2 in the SYCON.net help.
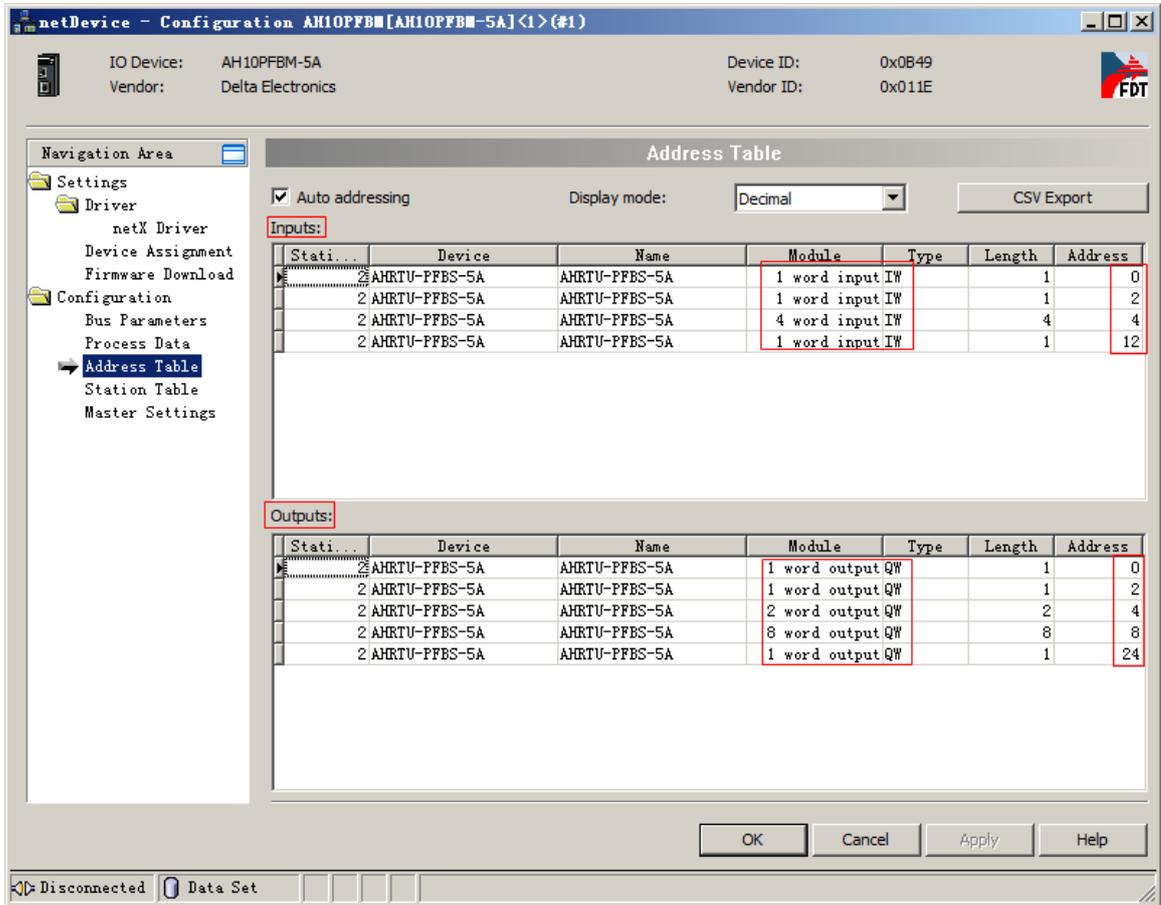
The starting addresses of the INPUT and OUTPUT areas that AH PLC assigns to the master module are D1000 and D6000 respectively as the two figures show above.

IO mapping relationships between master PLC and the I/O modules connected to AHRTU-PFBS-5A:

Register in master PLC		Devices connected to AHRTU-PFBS-5A	Offset
D6000（bit0~bit7）		Y0.0~Y0.7 of 16AP	0
D6001（bit0~bit7）		Y0.0~Y0.7 of 16AP	2
D6002		Digital value that output channel 0 in 06XA corresponds to	4
D6003		Digital value that output channel 1 in 06XA corresponds to	
D6004		Digital value that channel 0 in 08DA corresponds to	8
D6005		Digital value that channel 1 in 08DA corresponds to	
D6006		Digital value that channel 2 in 08DA corresponds to	
D6007		Digital value that channel 3 in 08DA corresponds to	
D6008		Digital value that channel 4 in 08DA corresponds to	
D6009		Digital value that channel 5 in 08DA corresponds to	
D6010		Digital value that channel 6 in 08DA corresponds to	
D6011		Digital value that channel 7 in 08DA corresponds to	
D6012（bit0~bit7）		Y0.0~Y0.7 of 16AP	24
D1000　（bit0~bit7）		X0.0~X0.7 of 16AP	0
D1001（bit0~bit7）		X0.0~X0.7 of 16AP	2
D1002		Digital value that input channel 0 in 06XA corresponds to	4
D1003		Digital value that input channel 1 in 06XA corresponds to	
D1004		Digital value that input channel 2 in 06XA corresponds to	
D1005		Digital value that input channel 3 in 06XA corresponds to	
D1006（bit0~bit7）		X0.0~X0.7 of 16AP	12

14.9.6 PLC Programs Writing

【Control program in master PLC】

After the master PLC runs and M0 is ON, the master PLC controls the modules connected to AHRTU-PFBS-5A; when M1 is ON, the master PLC reads the values of the modules connected to AHRTU-PFBS-5A.
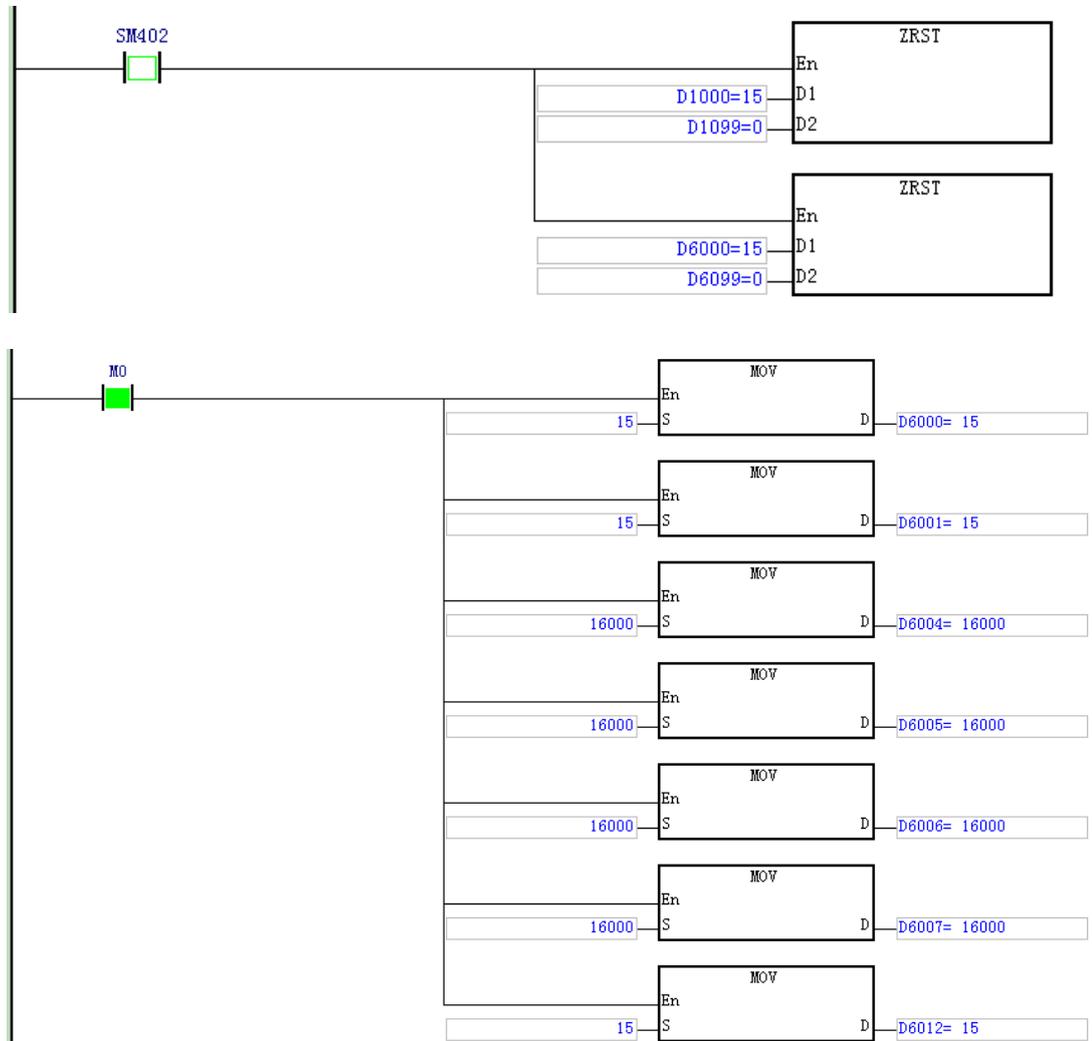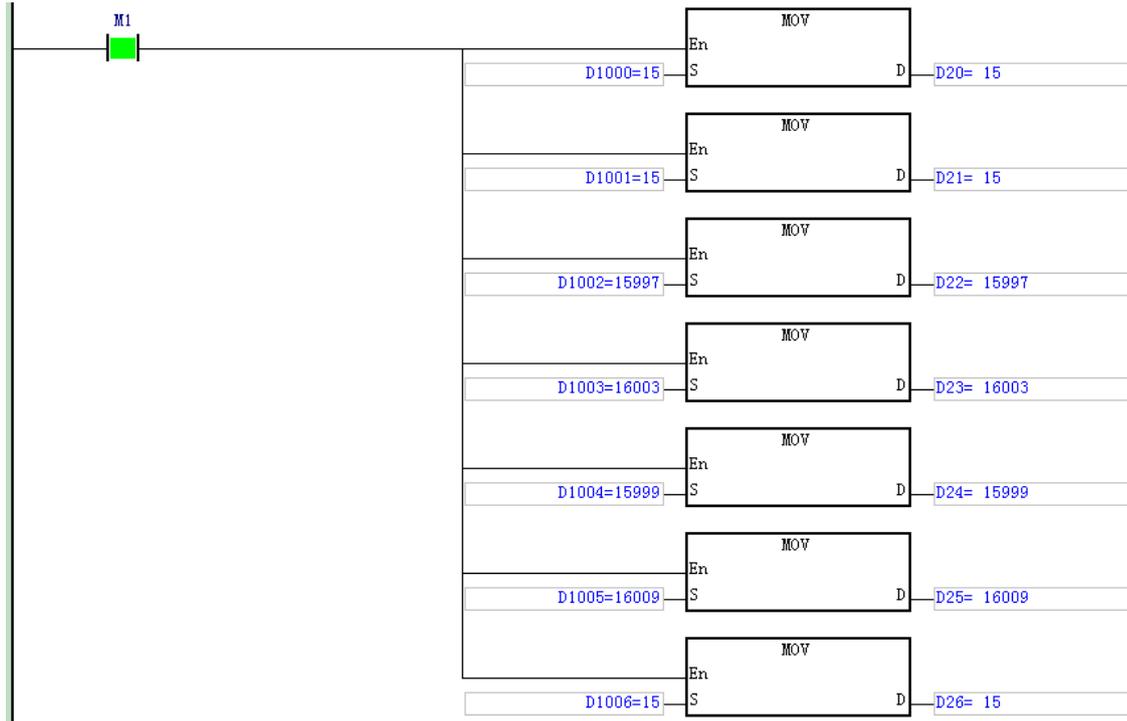
M1

MOV		
En		
D1000=15 —S	D	—D20= 15

MOV		
En		
D1001=15 —S	D	—D21= 15

MOV		
En		
D1002=15997 —S	D	—D22= 15997

MOV		
En		
D1003=16003 —S	D	—D23= 16003

MOV		
En		
D1004=15999 —S	D	—D24= 15999

MOV		
En		
D1005=16009 —S	D	—D25= 16009

MOV		
En		
D1006=15 —S	D	—D26= 15

【**Program Execution**】

Before the master establishes the communication with the slave, the data in registers D in the master PLC and the state of the modules connected to AHRTU-PFBS-5A are shown as the following table.

Register in master PLC	Value (Decimal)	No data transmitted	Devices connected to AHRTU-PFBS-5A	Value (Decimal)
D6000 (bit0~bit7)	15		Y0.0~Y0.7 of the 1st 16AP on the main rack	0
D6001 (bit0~bit7)	15		Y0.0~Y0.7 of the 2nd 16AP on the main rack	0
D6004	16000		Digital value that channel 0 in 08DA corresponds to	0
D6005	16000		Digital value that channel 1 in 08DA corresponds to	0
D6006	16000		Digital value that channel 2 in 08DA corresponds to	0
D6007	16000		Digital value that channel 3 in 08DA corresponds to	0
D6012 (bit0~bit7)	15		Y0.0~Y0.7 of the 1st 16AP on the extension rack	
D1000 (bit0~bit7)	0		X0.0~X0.7 of the 1st 16AP on the main rack	0
D1001 (bit0~bit7)	0		X0.0~X0.7 of the 2nd 16AP on the main rack	0
D1002	0		Digital value that the input channel 0 in 06XA corresponds to	0
D1003	0		Digital value that the input channel 1 in 06XA corresponds to	0
D1004	0		Digital value that the input channel 2 in 06XA corresponds to	0
D1005	0		Digital value that the input channel 3 in 06XA corresponds to	0
D1006 (bit0~bit7)	0		X0.0~X0.7 of the 1st 16AP on the extension rack	0

After the master establishes the communication with the slave, the data in registers D in the master PLC and the state of the modules connected to AHRTU-PFBS-5A are shown as the following table.

Register in master PLC	Value	Data transmitted through PROFIBUS	Devices connected to AHRTU-PFBS-5A	Value/ State
D6000 (bit0~bit7)	15		Y0.0~Y0.7 of the 1st 16AP on the main rack	Y0.0~Y0.3 ON and others OFF
D6001 (bit0~bit7)	15		Y0.0~Y0.7 of the 2nd 16AP on the main rack	Y0.0~Y0.3 ON and others OFF
D6004	16000		Digital value that channel 0 in 08DA corresponds to	Channel 0 outputs 5V voltage
D6005	16000		Digital value that channel 1 in 08DA corresponds to	Channel 1 outputs 5V voltage
D6006	16000		Digital value that channel 2 in 08DA corresponds to	Channel 2 outputs 5V voltage
D6007	16000		Digital value that channel 3 in 08DA corresponds to	Channel 3 outputs 5V voltage
D6012 (bit0~bit7)	15		Y0.0~Y0.7 of the 1st 16AP on the extension rack	Y0.0~Y0.3 ON and others OFF
D1000 (bit0~bit7)	15		X0.0~X0.7 of the 1st 16AP on the main rack	X0.0~X0.3 ON and others OFF
D1001 (bit0~bit7)	15		X0.0~X0.7 of the 2nd 16AP on the main rack	X0.0~X0.3 ON and others OFF
D1002	About 16000		Digital value that the input channel 0 in 06XA corresponds to	Channel 0 inputs 5V voltage
D1003	About 16000		Digital value that the input channel 1 in 06XA corresponds to	Channel 1 inputs 5V voltage
D1004	About 16000		Digital value that the input channel 2 in 06XA corresponds to	Channel 2 inputs 5V voltage
D1005	About 16000		Digital value that the input channel 3 in 06XA corresponds to	Channel 3 inputs 5V voltage
D1006 (bit0~bit7)	15		Y0.0~Y0.7 of the 1st 16AP on the extension rack	X0.0~X0.3 ON and others OFF
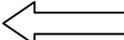
Chapter 15 CANopen Communication Module AH10COPM

Table of Contents

15.1 Introduction

AH10COPM-5A is connected to the right side of an AH500 series CPU module, and forms a CANopen master station or CANopen slave station with the AH500 series CPU module.

15.1.1 Characteristics

- AH10COPM-5A and an AH500 series CPU module form CANopen communication, and support a CANopen protocol.
- CANopen Builder provides a simple graphic interface. It automatically scans and identifies all the slave stations on a bus.
- AH10COPM-5A supports CANopen master stations and CANopen slave stations.
- An AH500 series CPU module can be connected to eight AH10COPM-5A modules at most.
- The eight transmission speeds which are supported are 10 kbps, 20 kbps, 50 kbps, 125 kbps, 250 kbps, 500 kbps, 800 kbps, and 1 Mbps.

15.1.2 Functions

AH10COPM-5A can be used as a CANopen master station, or a CANopen slave station.

When AH10COPM-5A is used as a master station, it has the following functions.

- It conforms to the CANopen protocol DS301 V4.02.
- It supports a NMT master.
- Error control: It supports a heartbeat and node guarding protocol.
- It supports PDOs.
  The maximum number of RxPDOs it supports is 200, and the maximum quantity of data it supports is 960 bytes.
  The maximum number of TxPDOs it supports is 200, and the maximum quantity of data it supports is 960 bytes.
  Every slave station can be assigned eight TxPDOs and eight RxPDOs.
  PDO transmission type: The transmission triggered by an event, the transmission triggered by time, synchronous cyclic transmission, and synchronous acyclic transmission are supported.
  PDO mapping: Every PDO can be mapped to 32 parameters at most.
  Data types supported:

Storage	Data type
1-bit	BOOL
8-bit	SINT, USINT, BYTE
16-bit	INT, UINT, WORD
32-bit	DINT, UDINT, REAL, DWORD
64-bit	LINT, ULINT, LREAL, LWORD

- It supports SDOs.
  Number of SDO servers: 0
  Number of SDO clients: 3
  It supports a standard SDO expedited transfer.
  It supports automatic SDO. Twenty automatic SDOs at most can be executed in a slave station.
  In a PLC diagram, SDOs can be used to write data to slave station, and read data from a slave station.
- It supports an emergency protocol.
  It can store five latest emergency messages for every slave station.
  It can indicate that there is an emergency message in a slave station by means of a digital display.
  It can read an emergency message by means of a PLC diagram.
- Sync-Producer (Range: 0~65535 ms)
- It functions as the interface between Delta CANopen Builder and a CANopen network.
  CANopen builder can directly configure a network through AH10COPM-5A.
- When AH10COPM-5A exchanges PDOs with an AH500 series CPU module, users only need to write a program for the D registers in the AH500 series CPU module which are mapped, and do

not need to use FROM/TO. The users can set the D registers by means of software.

When AH10COPM-5A is used as a slave station, it has the following functions.

- It conforms to the CANopen protocol DS301 V4.02.
- It supports a NMT slave.
- Error control: It supports a heartbeat and node guarding protocol.
- It supports PDOs. Every slave station can be assigned eight TxPDOs and eight RxPDOs.
- PDO transmission type: The transmission triggered by an event, the transmission triggered by time, synchronous cyclic transmission, and synchronous acyclic transmission are supported.
- It supports SDOs.

  Number of SDO servers: 1

  Number of SDO clients: 0

  It supports a standard SDO expedited transfer.
- It supports an emergency protocol.

15.1.3 Functional Specifications

- **AH500 series CPU modules which are supported**

Item	Specifications
Model name	AH500 series CPU modules

- **CANopen interface**

Item	Specifications
Transmission method	CAN
Electrical isolation	500 V DC
Connector	Removable connector (5.08 mm)
Communication cable	It is suggested that users should use the Delta standard cables UC-DN01Z-01A and UC-DN01Z-02A. The communication cable used should be away from the power cable used, and the shielded cables used should be connected to the ground.

- **CANopen communication**

Item	Specifications
Message type	PDO, SDO, SYNC, EMCY, NMT
Transmission speed	10 kbps, 20 kbps, 50 kbps, 125 kbps, 250 kbps, 500 kbps, 800 kbps, 1 Mbps

- **Electrical specifications**

Item	Specifications
Supply voltage	A CPU module supplies 24 V DC (-15%~20%) power through an internal bus.
Electric energy consumption	1.7 W
Insulation voltage	500 V

- **Environment**

Item	Specifications
Noise immunity	ESD (IEC 61131-2, IEC 61000-4-2): 8 kV air discharge, 4 kV contact discharge EFT (IEC 61131-2, IEC 61000-4-4): Power line: 2 kV, Digital I/O: 1 kV Analog & Communication I/O: 1 kV Damped-oscillatory wave: Power line: 1 kV, Digital I/O: 1 kV RS (IEC 61131-2, IEC 61000-4-3): 80 MHz~1000 MHz, 1.4 GHz~2.0 GHz, 10 V/m

Item	Specifications
Operation temperature	0ºC~55ºC (Temperature), 5~95% (Humidity), pollution level 2
Storage temperature	-25ºC~70ºC (Temperature), 5~95% (Humidity)
Vibration/ Shock resistance	International standard IEC 61131-2, IEC 68-2-6 (TEST Fc)/IEC 61131-2 & IEC 68-2-27 (TEST Ea)
Certifications	IEC 61131-2, UL508

15.2 Profile and Outline

15.2.1 Profile and Dimensions
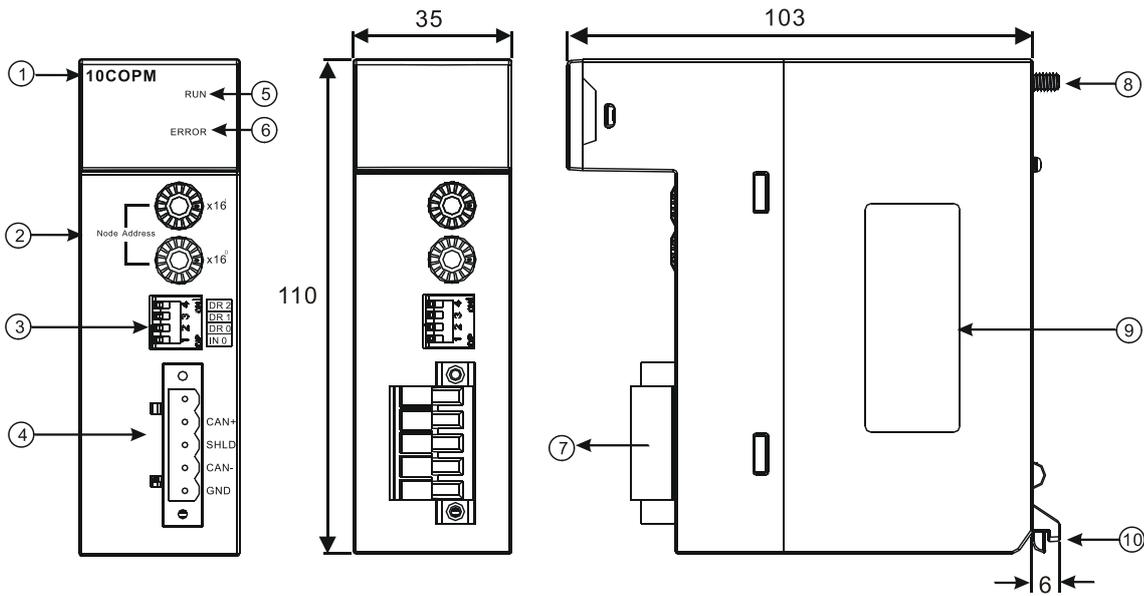
Unit: mm

15.2.2 Parts
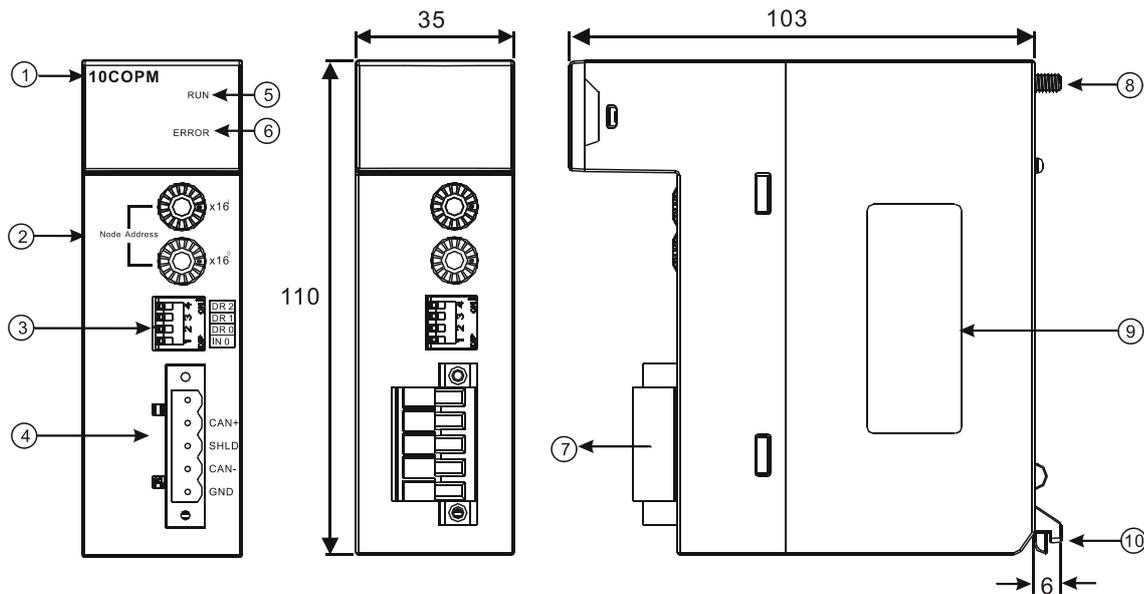
Number	Name	Description
1	Model name	Model name of the module
2	Address switches	For setting an address
3	Function switch	For setting a function
4	CANopen connector	For a CANopen connection
5	RUN LED indicator	Operating status of the module
6	ERROR LED indicator	Error status of the module
7	Removable terminal block	Terminals
8	Set screw	Fixing the module
9	Label	Nameplate
10	Projection	Fixing the module

15.2.3 CANopen Communication Connector

A CANopen connector is connected to a CANopen network. Please wire AH10COPM-5A by using the connector attached to AH10COPM-5A.

Pin	Signal	Description
5	-	Reserved
4	CAN+	CAN_H
3	SHLD	Shielded cable
2	CAN-	CAN_L
1	GND	0 V DC
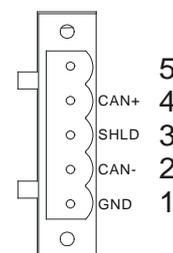
15.2.4 Address Switches

The address switches on AH10COPM-5A are used to set the node address of AH10COPM-5A on a CANopen network. Setting range: 1~7F (0 and 80~FF can not be used.)

Setting	Description
1~7F	Valid CANopen node address
0, 80~FF	Invalid CANopen node address
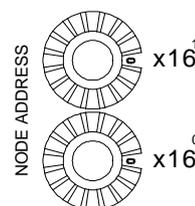
Example: If the station address of AH10COPM-5A is 16#26, users have to rotate the switch corresponding to $x16^1$ to position 2, and rotate the switch corresponding to $x16^0$ to position 6.

Points for attention:
- After the station address of AH10COPM-5A is changed, users have to power AH10COPM-5A again, otherwise the change will not take effect.
- To prevent the address switches on AH10COPM-5A from being scratched, please carefully use a slotted screwdriver to rotate the address switches on AH10COPM-5A.

15.2.5 Function Switch

The function switch on AH10COPM-5A is used to set the communication speed at which AH10COPM-5A is connected to a CANopen network. There is a limit on the maximum communication distance to which a communication speed corresponds.

DR2	DR1	DR0	Communication speed	Maximum communication distance
OFF	OFF	OFF	10 kbps	5000 m
OFF	OFF	ON	20 kbps	2500 m
OFF	ON	OFF	50 kbps	1000 m
OFF	ON	ON	125 kbps	500 m
ON	OFF	OFF	250 kbps	250 m
ON	OFF	ON	500 kbps	100 m
ON	ON	OFF	800 kbps	50 m
ON	ON	ON	1 Mbps	25 m
IN0			Reserved	
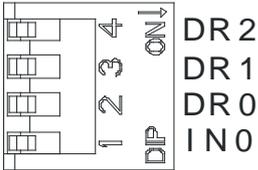
- After users change the communication speed at which AH10COPM-5A is connected to a CANopen network, they have to power AH10COPM-5A again, otherwise the change will not take effect.
- To prevent the DIP switch on AH10COPM-5A from being scratched, please carefully use a slotted screwdriver to rotate the DIP switch on AH10COPM-5A.
-

15.3 Installation

15.3.1 Installing a Module

1. Insert the projection under a module into a hole in a backplane.
2. Push the module in the direction indicated by the arrow until it clicks.
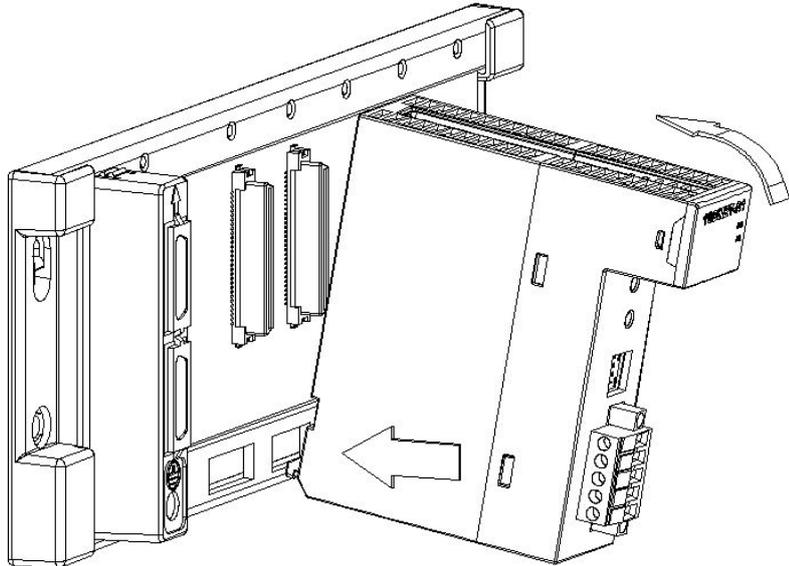
3. Tighten the screw on the module.
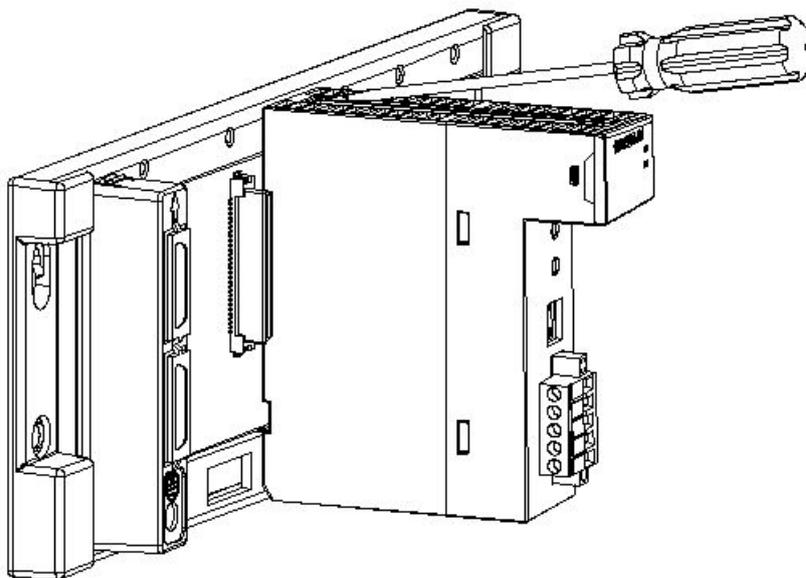
15.3.2 Connecting a CANopen Connector

1. Remove the 30 millimeter plastic jacket of a cable with a professional tool. Please do not damage the shielded cable when the plastic jacket is removed.
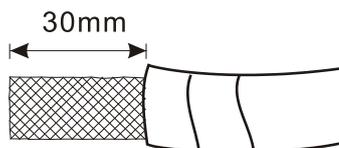
2. After users remove the metallic shield and the foil, they can see two power cables (in red and black respectively), two signal cables (in blue and white respectively), and one shielded cable.
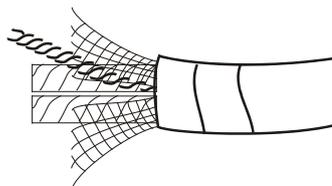
3. After the metallic shield and the foil are removed, the users need to remove the plastic jackets of the power cables and the plastic jackets of the signal cables properly.
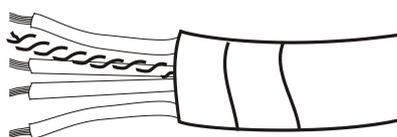
4. Insert the communication cable into the holes in the CANopen connector on AH10COPM-5A, and then tighten the screws on the CANopen connector with a slotted screwdriver.
5. SHLD is connected to the shielded cable. In order to strengthen the protection of communication signals, it is suggested that SHLD should be connected to the ground.

6. To reduce the reflection of a communication signal on a network, a terminal resistor must connect CAN+ and CAN-. (Specifications for a terminal resistor: 121 Ω; precision: 1%; power: Greater than 1/4 W)
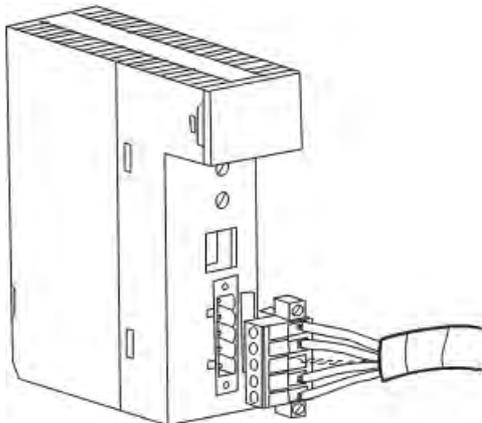
15.4 Configuration

15.4.1 Selecting a Mode

Before AH10COPM-5A operates normally, users have to set AH10COPM-5A to **Master** or **Slave** by means of HWCONFIG in ISPSoft. After AH10COPM-5A is set, the setting needs to be downloaded to AH10COPM-5A.

If the users select **Master**, they have to use CANopen Builder to configure a network.
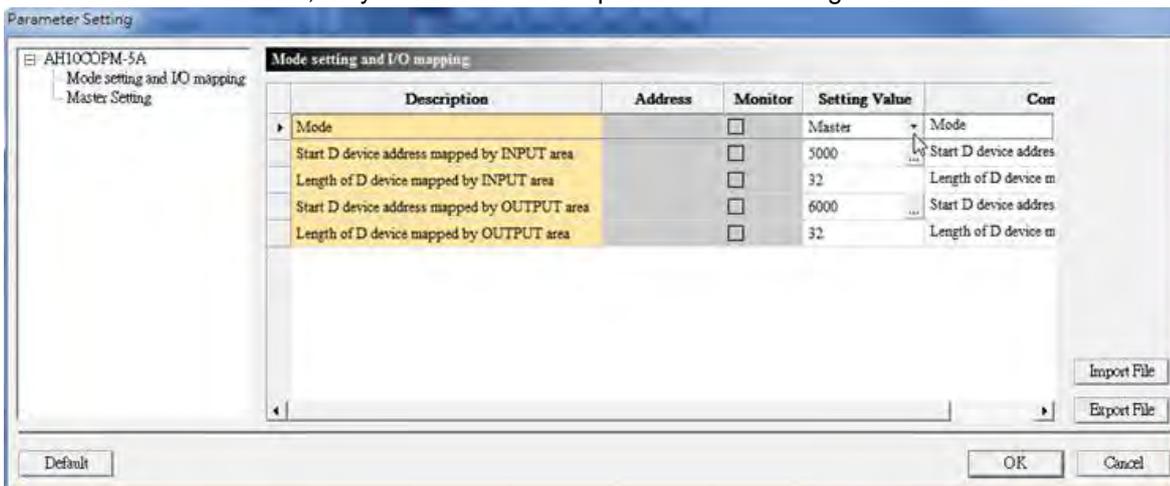
● **Creating a CANopen network**

An AH500 series CPU module can be connected to eight AH10COPM-5A modules at most. Before users create a network, they have to know the requirements for creating the network, and plan data exchange, including the slave stations which need to be used, the data which needs to be exchanged, transmission methods, the total quantity of data which needs to be exchanged, and response time. All the information determines whether the network created is reasonable, and whether the network created meets the requirements. It even affects the maintainability at a later stage, and the convenience of upgrading the capacity of the network created.

After the users select a mode, and save the setting, they can start CANopen Builder by means of **Intelligent Module Configuration**.
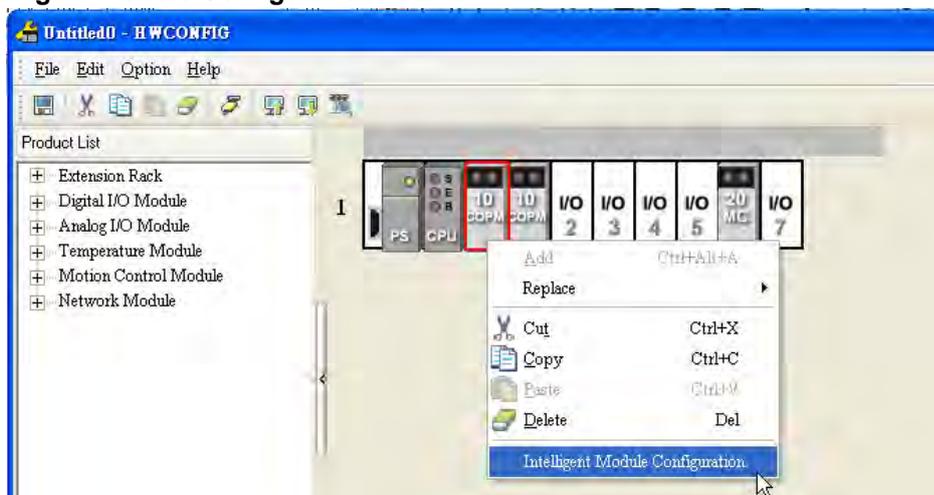
15.4.2 Using CANopen Builder to Configure a Network

1. After users click **Online**, the software will read the settings in AH10COPM on the backplane used.
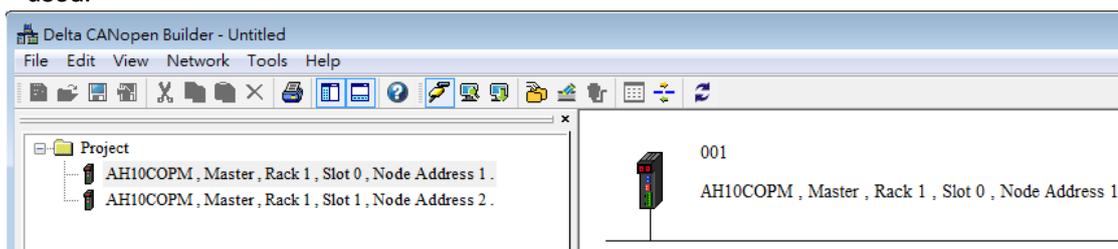
2. After **Online** is clicked, the mode, backplane number, slot number, and node address of the module will be brought out by the software. After the users right-click the master station selected, and click **Scan DeviceNet Network** on the context menu which appears, the information about the node devices on the network created will be scanned.
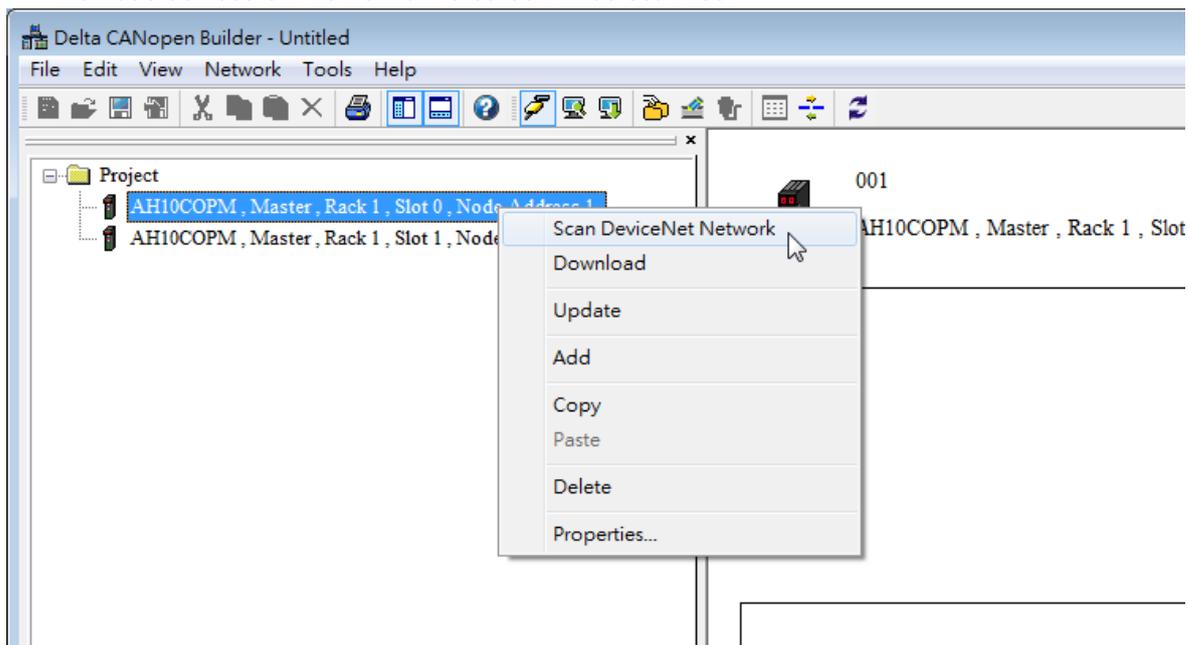
3. After the scan is complete, the icons representing the slave stations on the CANopen network created will appear. The users can select devices on the device list, and add slave stations manually.
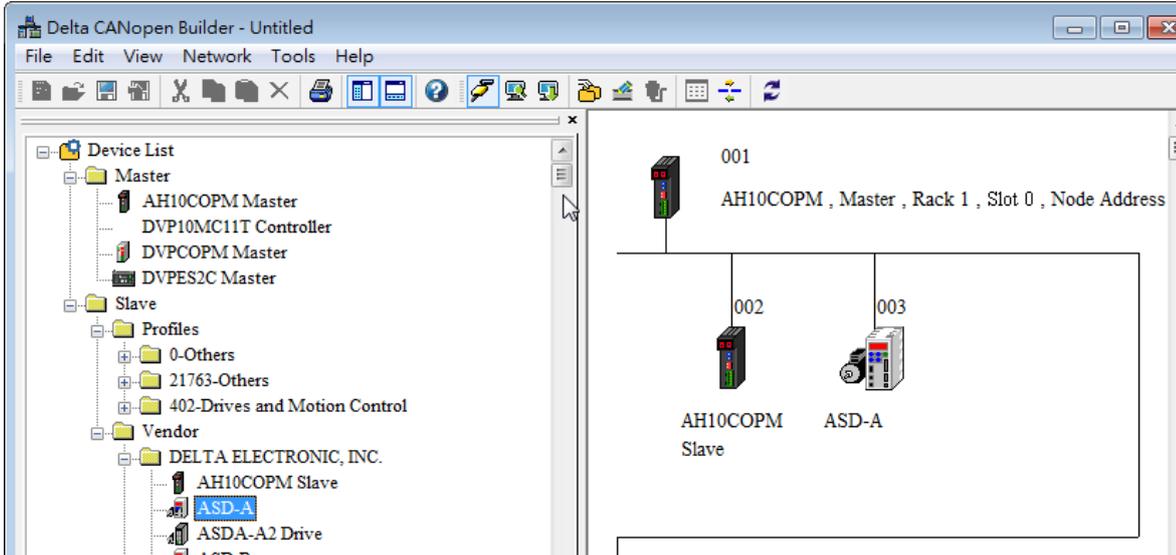
- Setting the parameters in the master station on a CANopen network
  After users click **Master parameter** on the **Network** menu, or right click the icon representing the AH10COPM module functioning as a master, and then click **Properties…** on the context menu which appears, the **Master Configuration…** window will appear.
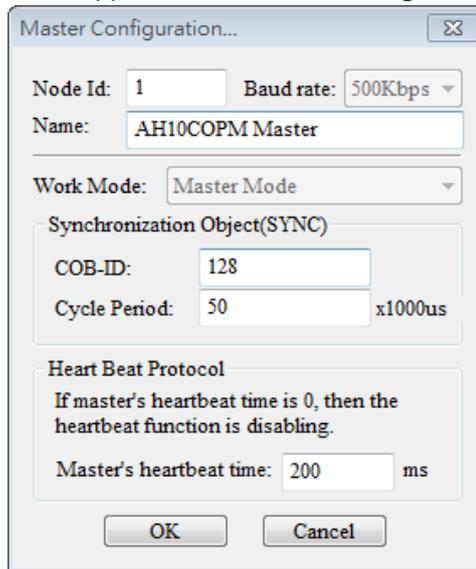
COB-ID: Setting the COB-ID used to send synchronous messages
Cycle Period: Setting the period of time needed for sending synchronous messages
Master's heartbeat time: Setting the period of time needed for AH10COPM-5A to send a heartbeat message
After the users set the parameters in the window, they have to click **OK**.

● Setting the parameters in a slave station on a CANopen network

Setting the parameters in an ASDA-A2 series AC servo drive: After users double-click the icon representing the ASDA-A2 series AC servo drive functioning as a slave, the **Node Configuration…** window will appear.
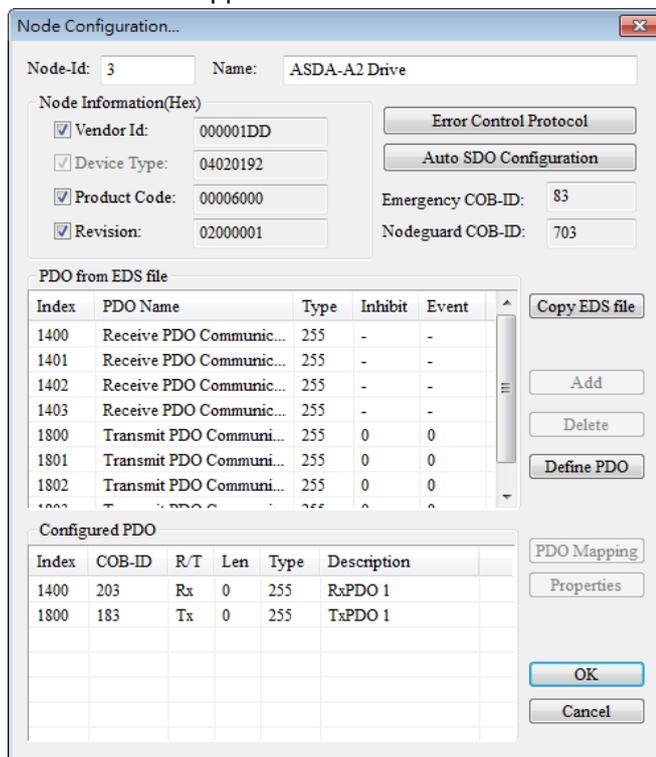
Setting the parameters:

Error Control Protocol: After users click **Error Control Protocol**, the **Error Control Setting** window will appear.
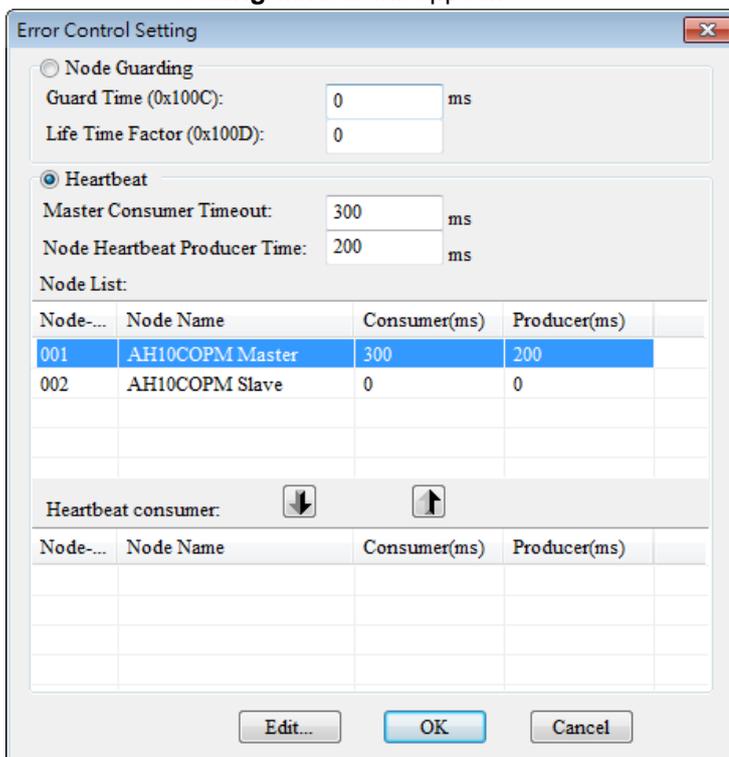
The parameters are described below.

Parameter name		Description	Remark
Node Guarding	Guard Time	A master station polls slave stations according to the interval set in the **Guard Time** box.	If the **Heartbeat** option button is selected, the **Node Guarding** option button can not be selected.
	Life Time Factor	Life time=Guard time×Life time factor If a slave station does not respond to a master station in a life time, the master station will consider the slave station offline.	
Heartbeat	Node Heartbeat Producer Time	A slave station send a heartbeat message to a master station according to the time set in the **Node Heartbeat Producer Time** box.	The time set in the **Master Consumer Timeout** box must be greater than the time set in the **Node Heartbeat Producer Time** box.
	Master Consumer Timeout	If a master station does not receive a heartbeat message from a slave station after the timeout period set in the **Master Consumer Timeout** box, the master station will consider the slave station offline.	
Node List		All the nodes configured on the CANopen network created are shown on the node list.	--
Heartbeat consumer		The node which is assigned an error control protocol can monitor whether the nodes under **Heartbeat consumer** are offline.	The number of nodes under **Heartbeat consumer** varies with the device used.
⬇		After users select a node on the node list, and click ⬇, the node selected will be added to the list under **Heartbeat consumer**.	--
⬆		After the users select a node on the list under **Heartbeat consumer**, and click ⬆, the node selected will be deleted from the list under **Heartbeat consumer**.	--
Edit…		After users select a node on the list under **Heartbeat consumer**, and click **Edit…**, they can change the time set in the	--

Parameter name	Description	Remark
	Consume Time box.		
OK	After users click **OK**, they will return to the **Node Configuration…** window, and the parameters set in the **Error Control Setting** window will be retained.	--	
Cancel	After users click **Cancel**, they will return to the **Node Configuration…** window, and the parameters set in the **Error Control Setting** window will not take effect.	--	

Auto SDO Configuration: After users click **Auto SDO Configuration** in the **Node Configuration…** window, the **Auto SDO Configuration** window will appear. If the users click **Add**, they can add an automatic SDO. If the users click **Edit…**, they can modify the automatic SDO selected. The maximum number of automatic SDOs which can be assigned to a slave station is 20. An automatic SDO can only write parameters, and can not read parameters. It writes parameters to a slave station once only when the slave station is ready to operate for the first time.
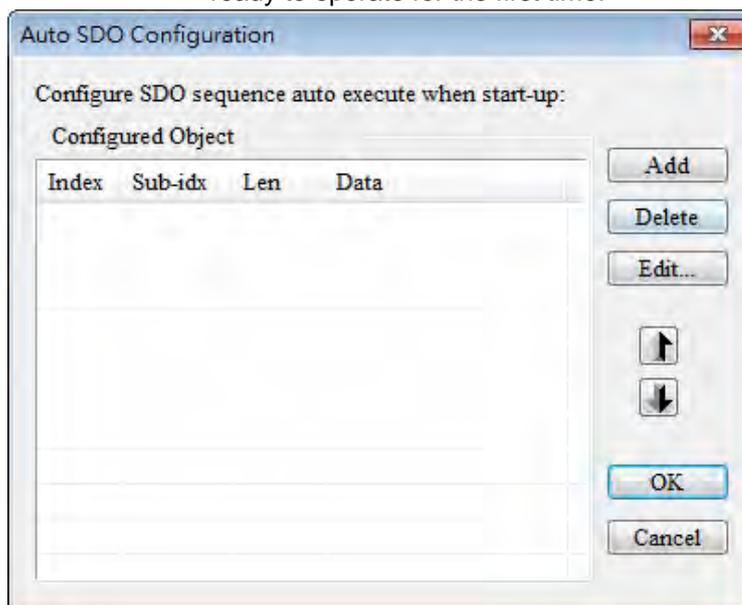
After the users click **Add**, the **Add New SDO** window will appear. The index in the **Index (hex)** box is the index of the parameter which will be accessed, and the subindex in the **Sub-Index (hex)** box is the subindex of the parameter which will be accessed. The length in the **Length (dec)** box is determined by the data type of the parameter which will be

accessed. A byte is a unit of measurement for length. The users can click , and select an object in the object dictionary defined by the EDS in the slave station selected. After the users click **OK**, the software will automatically bring out an index, a subindex, and a length.
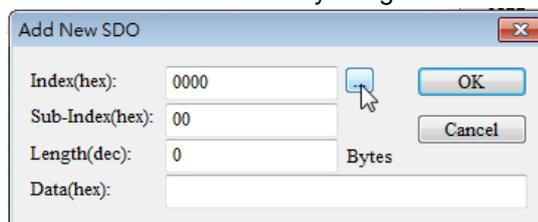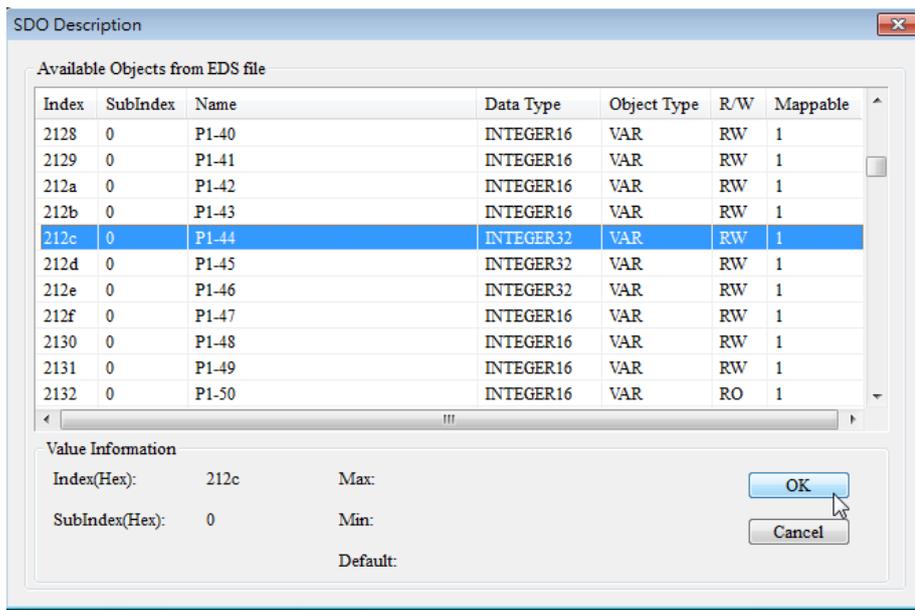
The data in the **Data (hex)** box is the data which will be written. (It is a hexadecimal value.) If the data which will be written occupies two bytes, the low byte will precede the high byte in the **Data (hex)** box, and the two bytes will be separated by a space. For example, if the data which will be written is 0x012C, "2C 01"needs to be typed in the **Data (hex)** box.
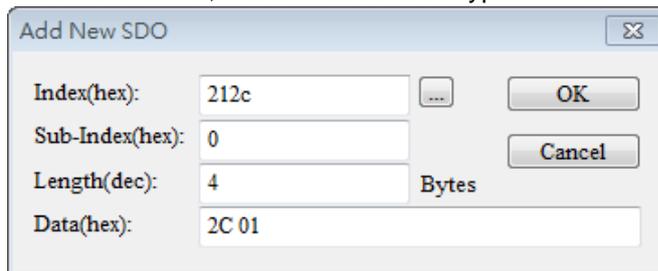
PDO Mapping: After users click the TxPDO or the RxPDO under **Configured PDO**, and click **PDO Mapping**, the **PDO Mapping…** window will appear.
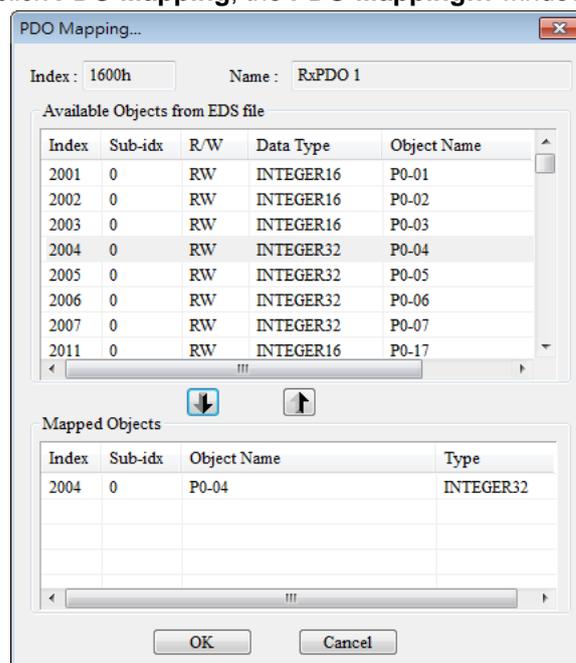
The users can add parameters in the **Available Objects from EDS file** section to the **Mapped Objects** section. The total of the data lengths of the parameters added to a PDO can not exceed eight bytes. After the users add parameters to the **Mapped Objects** section, they have to click **OK**. After the users click the TxPDO or the RxPDO under **Configured PDO**, and click **Properties**, they can modify the information in the **COB ID** box and the **Transmit type** drop-down list box in the **PDO properties** window. After the users click Define PDO, they can define a RxPDO or a TxPDO by themselves.

In this example, the default configuration is used. Finally, the users have to click **OK** in the **Node Configuration…** window.

Rule of setting a COB-ID:

RxPDO number	COB-ID (Hex)	TxPDO number	COB-ID (Hex)
RxPDO1	200+Slave station address	TxPDO1	180+Slave station address
RxPDO2	300+Slave station address	TxPDO2	280+Slave station address
RxPDO3	400+Slave station address	TxPDO3	380+Slave station address
RxPDO4	500+Slave station address	TxPDO4	480+Slave station address

Note: The COB-IDs of RxPDO5~RxPDO8 and TxPDO5~TxPDO8 can be the COB-IDs of RxPDO1~RxPDO4 and TxPDO1~TxPDO4 in an unused slave station, but they can not be the same.

Descriptions of transmission types:

Transmission type		Description	Remark
0	RxPDO	A master station sends a synchronous message to a slave station every period of synchronization. After a RxPDO is changed, the new RxPDO will be sent to the slave station. The new RxPDO that the slave station receives will not take effect until the next synchronous message is received. If a RxPDO is not changed, the master station will not send the RxPDO to the slave station.	Synchronous acyclic
	TxPDO	A master station sends a synchronous message to a slave station every period of synchronization.	

Transmission type		Description	Remark
		After a TxPDO is changed, and the slave station receives a synchronous message, the new TxPDO will be sent to the master station. The new TxPDO will take effect immediately after the master station receives it. If a TxPDO is not changed, the slave station will not send the TxPDO to the master station.	
1	RxPDO	A master station sends a synchronous message to a slave station every period of synchronization. The master station sends a RxPDO every period of synchronization. The RxPDO will not take effect until the next synchronous message is received.	Synchronous cyclic
	TxPDO	A master station sends a synchronous message to a slave station every period of synchronization. After the slave station receives a synchronous message, it will send a TxPDO to the master station. The TxPDO will take effect immediately after the master station receives it.	
2	RxPDO	A master station sends a synchronous message to a slave station every period of synchronization. It sends a RxPDO every two periods of synchronization. The RxPDO that the slave station receives will not take effect until the next synchronous message is received.	Synchronous cyclic
	TxPDO	A master station sends a synchronous message to a slave station every period of synchronization. After the slave station receives two synchronous messages, it will send a TxPDO to the master station. The TxPDO will take effect immediately after the master station receives it.	
3~240			
3~240 254	RxPDO	They can be described by analogy with transmission type 1 and transmission type 2.	Synchronous cyclic
	TxPDO	They can be described by analogy with transmission type 1 and transmission type 2.	
254 255	RxPDO	After a RxPDO is changed, the new RxPDO will be sent to a slave station. The new RxPDO will take effect immediately after the slave station receives it. If a RxPDO is not changed, it will not be sent to the slave station.	Asynchronous
	TxPDO	The value in the **Event timer** box is 0, and the value in the **Inhibit timer** box is 0. After a TxPDO is changed, the new TxPDO will be sent to a master station. The new TxPDO will take effect immediately after the master station receives it. If a TxPDO is not changed, it will not be sent to the master station. The value in the **Event timer** box is not 0, and the value in the **Inhibit timer** box is not 0. The slave station selected sends a TxPDO to a master station according to the interval set in the **Event timer** box. (After a TxPDO is sent, it can not be send again during the time set in the **Inhibit timer** box. After a TxPDO is changed, the new TxPDO will be send to the master station. The new TxPDO will take effect	

Transmission type		Description	Remark
		immediately after the master station receives it.	
	RxPDO	Same as transmission type 254	Asynchronous
	TxPDO	Same as transmission type 254	

- Setting a node list
  After users double-click the icon representing the AH10COPM module functioning as a master, the **Node List Setting** window will appear.
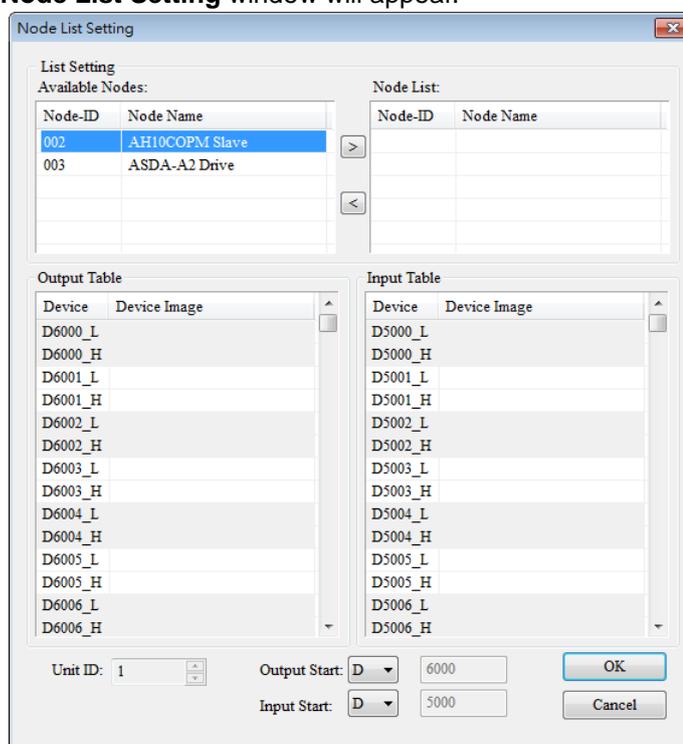
In this example, the ASDA-A2 series AC servo drive whose node ID is 3 is selected. After `>` is clicked, node ID 3 will be added to the list under **Node List**. When node ID 3 on the list under **Node List** is selected, the data registers in an AH500 series module onto which the I/O data in node ID 3 is mapped are shown in the **Output Table** section and the **Input Table** section.
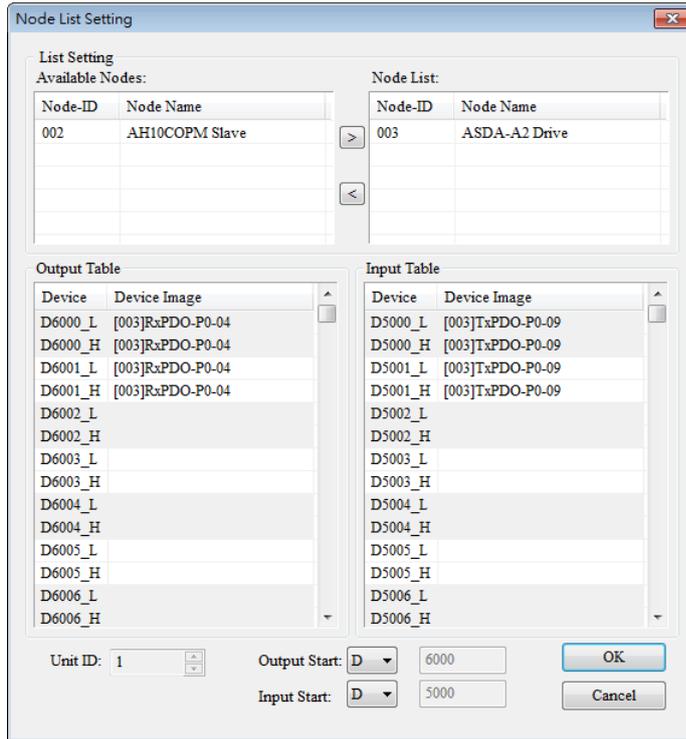
The users can add node ID 2 to the list under **Node List** in the same way. When node ID 2 on the list under **Node List** is selected, the data registers in the AH500 series module onto which the I/O data in node ID 2 is mapped are shown in the **Output Table** section and the **Input Table** section.
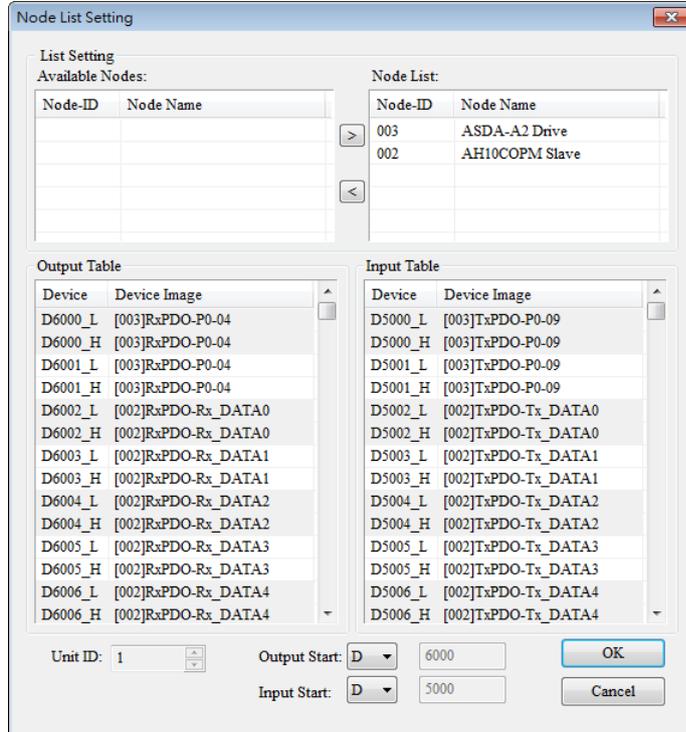
- Downloading data to a master module
  Users have to click **Download** on the **Network** menu, and then select the AH10COPM-5A module to which the configuration data set will be downloaded in the **Select Modules** window.
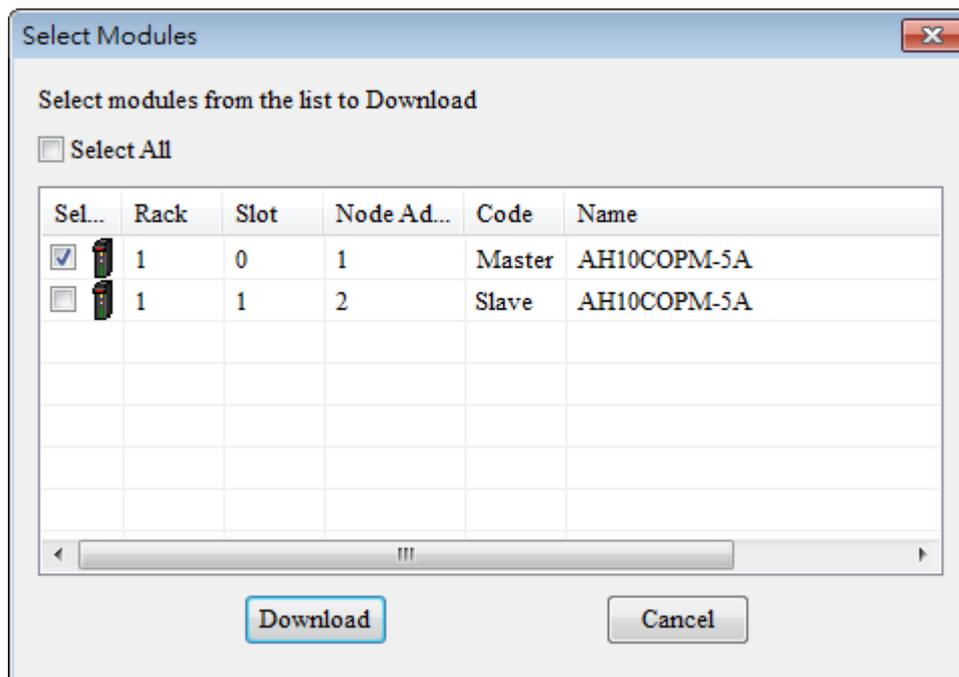
After the users click **Download**, the configuration data set will be downloaded to the AH10COPM-5A module selected. If the AH10COPM-5A module is operating, the users will be asked to stop the AH10COPM-5A module before the configuration data is downloaded.
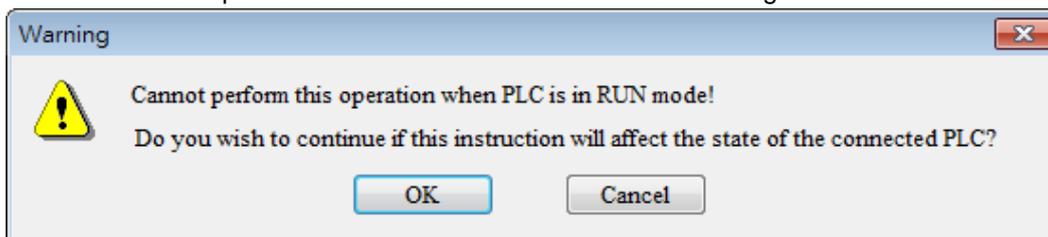
After the users click **OK**, the AH10COPM-5A module will stop running, and the configuration will be downloaded.
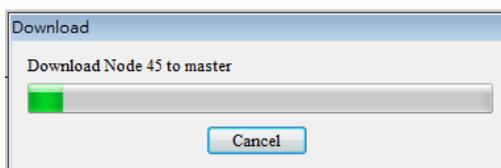
After the downloading of the configuration data is complete, the users will be asked whether they want to run the AH10COPM-5A module again. If the users click **OK** in the **Warning** window, the AH10COPM-5A module will continue operating. If the users click **Cancel** in the **Warning** window, the AH10COPM-5A module will not continue operating.
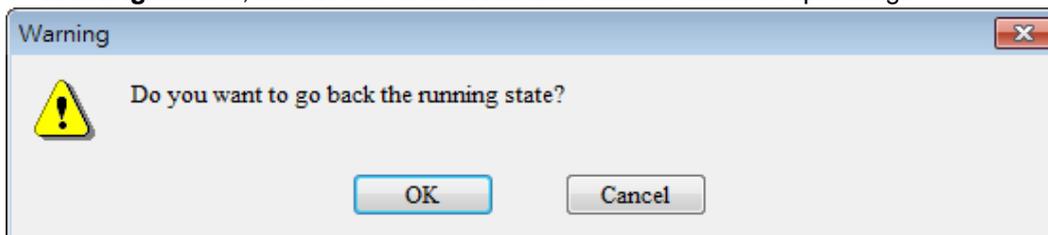
15.4.3 Assigning Mapping Areas

Users can assign mapping areas to a CANopen master/slave by means of HWCONFIG.
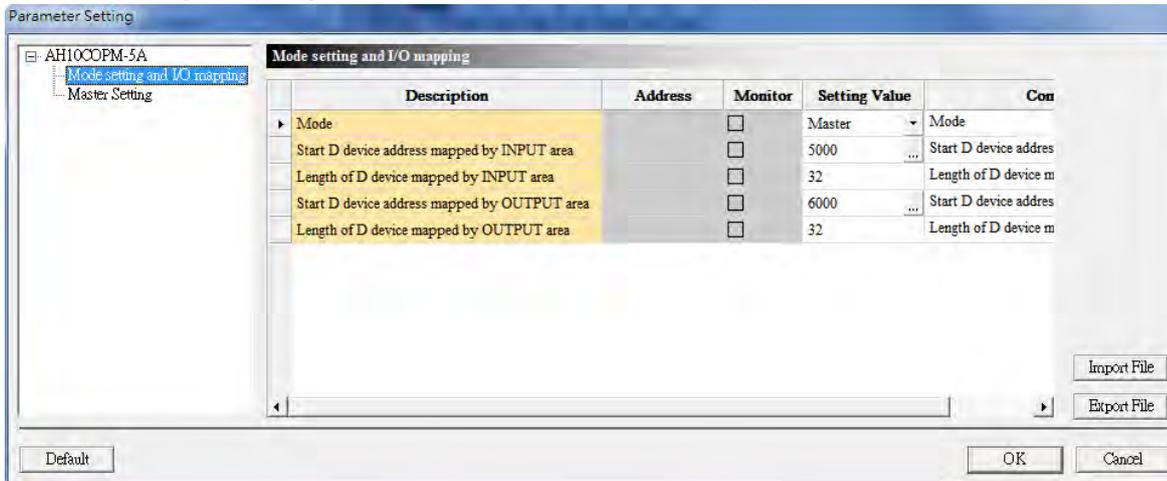
AH10COPM-5A functions as a master station. If the start input address set is D5000, and the start output address set is D6000, the mapping areas assigned will be as described below. The data lengths that the users can set must be in the range of 0 words to 480 words.

Input area: Slave station⇨Master station			Output area: Master station⇨Slave station		
Register numbers in an AH500 series CPU module	Purpose	Data length	Register numbers in an AH500 series CPU module	Purpose	Data length
D5000~D5479	A CANopen slave station sends data.	0~480 words	D6000~D6479	Data is sent to a CANopen slave station.	0~480 words

AH10COPM-5A functions as a slave station. The data lengths that the users can set must be in the range of 0 words to 32 words. The relation between the object dictionary in AH10COPM-5A and registers in an AH500 series CPU module is shown below.

Index	Subindex range	Input/Output mapping area	Access permission
H'2000	H'01~H'20	Output mapping area	Read/Write
H'2001	H'01~H'20	Input mapping area	Read-only

Besides, AH10COPM-5A is assigned a two-word normal exchange area. For example, D0~D1 are assigned to AH10COPM-5A.

Slot No.	Label	Firmware Version	Descrption	Input Device Range	Output Device Range
-	AHPS05-5A	-	AH Power Supply Module	None	None
-	AHCPU530-EN	1.00	Basic CPU module building with Etl	None	None
0	AH10COPM-5A	1.00	CANopen Communication Module	D0 ~ D1	

The mapping areas assigned are described below.

Register number in an AH500 series CPU module	Purpose	Data length
D0	State of AH10COPM-5A: 0x00: AH10COPM-5A is being initialized. 0x04: AH10COPM-5A stops running. 0x05: AH10COPM-5A is running. 0x7F: AH10COPM-5A is preparing to run. 0x0F: AH10COPM-5A is in an unknown state.	1 word
D1	Module error code	1 word

15.4.4 Setting a Master Station
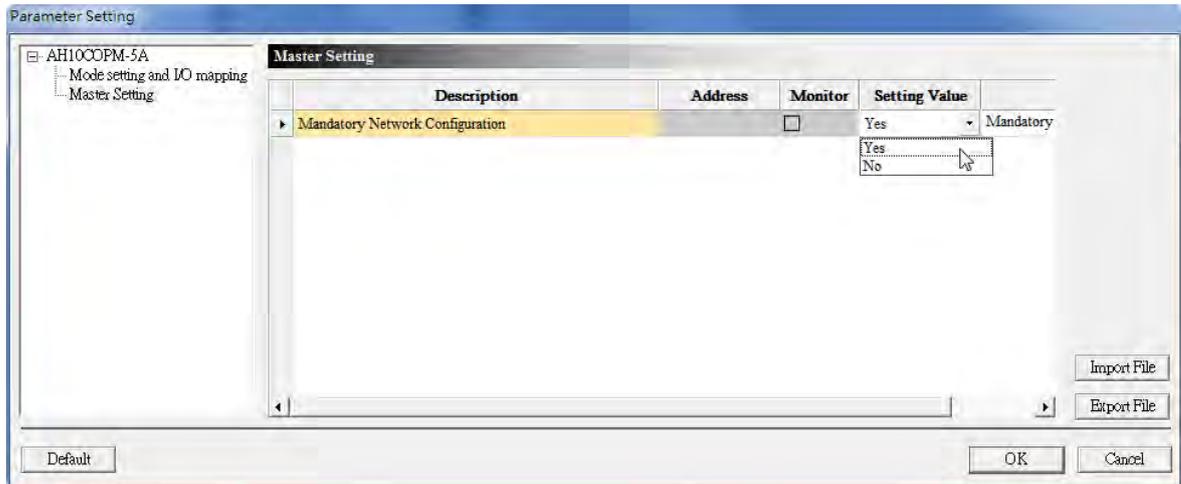
If AH10COPM-5A functions as a master station, users can determine whether the network configuration loaded is a necessary network configuration. If the network configuration loaded is a necessary network configuration, AH10COPM-5A checks whether every slave station is online and set successfully when it operates for the first time. If every slave station is online and set successfully, it is allowed to operate. If the network configuration loaded is not a necessary network configuration, AH10COPM-5A can allow the slave stations which are not online or set successfully to operate, but it will exchange data with the other slave stations which are set successfully on the network created.

15.4.5 Flowchart Representing the Action of a CANopen Master Station

```
                    ┌─────────────────┐
                    │  Powering       │
                    │  AH10COPM-5A    │
                    └────────┬────────┘
                             │
                    ◇ Whether the ◇        No    ┌─────────────┐
                      module is initialized ──────│ Error code  │
                      successfully               │ A0F5/A0F7   │
                             │ Yes              └─────────────┘
                             │
   Slave mode        ◇ Setting AH10COPM-5A ◇   Maser mode
      ┌──────────────── by HWCONFIG ────────────────┐
      │                                              │
┌─────────────┐                              ┌─────────────┐
│ Initializing │                              │ Initializing │◄──────────┐
│ the slave    │                              │ the master   │           │
│ station      │                              │ station      │           │
│ AH10COPM-5A  │                              │ AH10COPM-5A  │           │
└──────┬───────┘                              └──────┬───────┘           │
       │                                             │                   │
┌─────────────┐                              ┌─────────────┐             │
│ The slave    │                              │ The master   │           │
│ station       │                              │ station       │           │
│ AH10COPM-5A is│                              │ AH10COPM-5A is│           │
│ ready to      │                              │ ready to      │           │
│ operate.      │                              │ operate.      │           │
└──────┬───────┘                              └──────┬───────┘           │
       │                                             │ Yes               │
┌─────────────────┐                          ◇ Checking whether a ◇  No  │
│ AH10COPM-5A      │                            CANopen network is ──────┤
│ follows the NMT  │                            created            │     │
│ command sent by  │                                 │ Yes               │
│ a master station.│                                 │                   │
│ If AH10COPM-5A is│                          ◇ Checking whether the ◇ No │
│ operational, it  │                            actual network is the ───┤
│ will exchange    │                            same as the network  │   │
│ CANopen PDOs with│                            created              │   │
│ a CPU module.    │                                 │ Yes               │
└─────────────────┘                                 │                   │
```

Error code A0F1

Error code A0F6/A0F8

◇ Whether the PDOs in all slave stations are set successfully ◇ — No → Error code A0E4

◇ Whether the automatic SDOs in all slave stations are set successfully ◇ — No → Error code A0E3

◇ Whether the heartbeat or node guarding in all slave stations is set successfully ◇ — No → Error code A0E5

◇ State of a CPU module ◇

STOP → The master station AH10COPM-5A and all slave stations are ready to operate. They do not exchange data.

No

RUN → The master station AH10COPM-5A and all slave stations are operational. A CPU module exchanges CANopen PDOs with AH10COPM-5A.

15.5   Sending SDOs and NMT, and Reading Emergencies by Functions Blocks

15.5.1 Principle

The principle of sending SDOs by means of a program is described below.
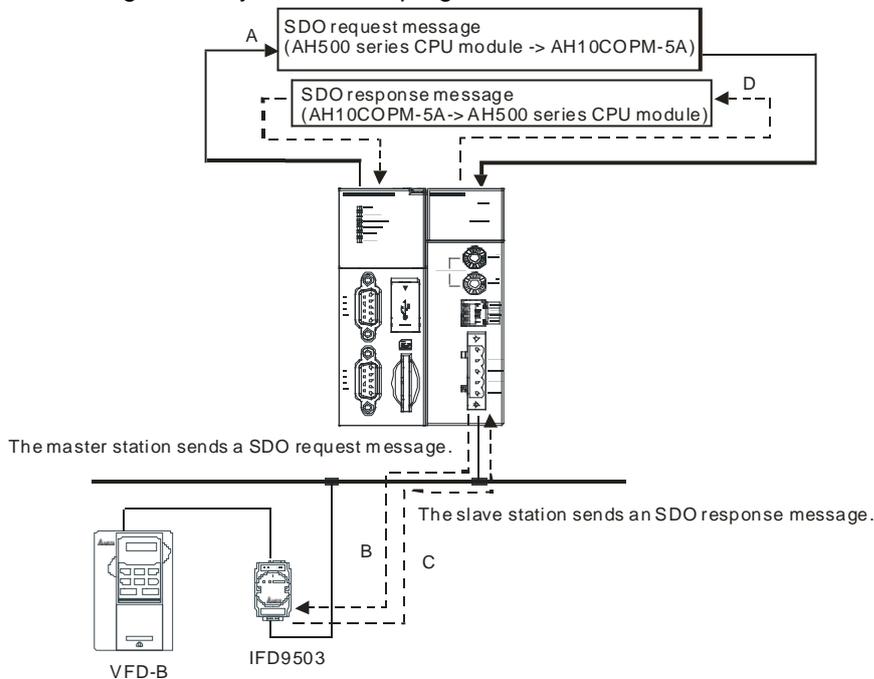
A: An AH500 series CPU module sends request information to the master station AH10COPM-5A.

B: The master station AH10COPM-5A sends the request information to target equipment.

C: The target equipment processes the request information, and sends response information to the master station AH10COPM-5A.

D: The AH500 series CPU module received the response information (SDOs, NMT, and emergencies).

15.5.2 Sending an SDO Command

1. Function block

   The AH10COPM-5A module which functions as a master station in a slot on the main backplane used can send an SDO command by means of the function block CANopen_SDO in ISPSoft.

2. Input pins/Output pins

Input pin				
Name	**Function**	**Data type**	**Setting value**	**Time when a value is valid**
SID	Slot number	WORD	K0~K11	The value of the SID input pin is valid when there is a transition in the Execute input pin's signal from low to high.
Execute	The function block is executed when there is a transition in the Execute input pin's signal from low to high.	BOOL	True/False	-
NodeID	Node address	WORD	K1~K127	-
Service	Service type	WORD	1: Reading 2: Writing	-
ODIndex	Index	WORD	-	-
ODSubIndex	Subindex	WORD	-	-
WriteLength	Length of the data which is written	WORD	K1~K8 (Unit: Byte)	The value of the WriteLength input pin is valid when there is a transition in the Execute input pin's signal from low to high.
DataWrite	Data which is written	DWORD[2]	-	The value of the DataWrite input pin is valid when there is a transition in the Execute input pin's signal from low to high.

Output pin				
Name	Function	Data type	Time when there is a transition in an output pin's signal from low to high	Time when there is a transition in an output pin's signal from high to low
Done	The execution of the function block is complete.	BOOL	• There is a transition in the Done output pin's signal from low to high when the execution of the function block is complete.	• There is a transition in the Done output pin's signal from high to low when there is a transition in the Execute input pin's signal from high to low. • If the Execute input pin is set to False when the execution of the function block is complete, the Done output pin will be set to False in the next cycle.
Busy	The function block is being executed.	BOOL	• There is a transition in the Busy output pin's signal from low to high when there is a transition in the Execute input pin's signal from low to high.	• There is a transition in the Busy output pin's signal from high to low when there is a transition in the Done output pin's signal from low to high. • There is a transition in the Busy output pin's signal from high to low when there is a transition in the Error output pin's signal from low to high. • There is a transition in the Busy output pin's signal from high to low when there is a transition in the Aborted output pin's signal from low to high.
Aborted	The execution of the function block is interrupted by a command.	BOOL	• The execution of the function block is interrupted by a command.	• There is a transition in the Aborted output pin's signal from high to low when there is a transition in the Execute input pin's signal from high to low. • If the Execute input pin is set to False when the execution of the function block is interrupted, the Aborted output pin will be set to False in the next cycle.

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Output pin				
Name	**Function**	**Data type**	**Time when there is a transition in an output pin's signal from low to high**	**Time when there is a transition in an output pin's signal from high to low**
Error	An error occurs in the function block.	BOOL	• An error occurs when the function block is executed.	• There is transition in the Error output pin's signal from high to low when there is a transition in the Execute input pin's signal from high to low. • If the Execute input pin is set to False when an error occurs, the Aborted output pin will be set to False in the next cycle.

Output pin				
Name	**Function**	**Data type**	**Output range**	**Update**
ErrorID	Error code	WORD	• Please see the status code table below. • 0B: A parameter is incorrect. 0C: The module does not support the function. • AH500 series CPU module error code	• When there is a transition in the Error output pin's signal from low to high, or a transition in the Done output pin's signal from low to high, the value of the ErrorID output pin is updated.
AbortCode	SDO interruption code	WORD		• When there is a transition in the Error output pin's signal from low to high, or a transition in the Done output pin's signal from low to high, the value of the AbortCode output pin is updated.
ReadLength	Length of the data which is read	WORD	K0~K8 (Unit: Byte)	• When there is a transition in the Done output pin's signal from low to high, the value of the ReadLength output pin is updated.
DataRead	Data which is read	DWORD[2]		• When there is a transition in the Done output pin's signal from low to high, the value of the DataRead output pin is updated.

● Status codes

Status code	Description
0	No request for data transmission
1	The sending of the SDO is successful.
2	The SDO is being transmitted.
3	Error: SDO transmission timeout
4	Error: Illegal command
5	Error: The request message is illegal.
6	Error: The response message is illegal.
7	Error: The equipment which will send a message is busy.
8	Error: Illegal type
9	Error: Incorrect node address
0A	Error message (Please see the error code in the SDO response message.)

15.5.3 Sending an NMT Command

1. Function block

   The AH10COPM-5A module which functions as a master station in a slot on the main backplane used can send an NMT command by means of the function block CANopen_NMT in ISPSoft.

2. Input pins/Output pins

Input pin				
Name	Function	Data type	Setting value	Time when a value is valid
SID	Slot number	WORD	K0~K11	The value of the SID input pin is valid when there is a transition in the Execute input pin's signal from low to high.
Execute	The function block is executed when there is a transition in the Execute input pin's signal from low to high.	BOOL	True/False	-
NodeID	Node address	WORD	K1~K127	-
Service	Service type	WORD	01 (Hex): Enabling a remote node 02 (Hex): Stopping a remote node 80 (Hex): Ready to operate 81 (Hex):	-

Input pin				
Name	**Function**	**Data type**	**Setting value**	**Time when a value is valid**
			Resetting application 82 (Hex): Resetting communication	

Output pin				
Name	**Function**	**Data type**	**Time when there is a transition in an output pin's signal from low to high**	**Time when there is a transition in an output pin's signal from high to low**
Done	The execution of the function block is complete.	BOOL	• There is a transition in the Done output pin's signal from low to high when the execution of the function block is complete.	• There is a transition in the Done output pin's signal from high to low when there is a transition in the Execute input pin's signal from high to low. • If the Execute input pin is set to False when the execution of the function block is complete, the Done output pin will be set to False in the next cycle.
Busy	The function block is being executed.	BOOL	• There is a transition in the Busy output pin's signal from low to high when there is a transition in the Execute input pin's signal from low to high.	• There is a transition in the Busy output pin's signal from high to low when there is a transition in the Done output pin's signal from low to high. • There is a transition in the Busy output pin's signal from high to low when there is a transition in the Error output pin's signal from low to high. • There is a transition in the Busy output pin's signal from high to low when there is a transition in the Aborted output pin's signal from low to high.
Error	An error occurs in the function block.	BOOL	• An error occurs when the function block is executed.	• There is a transition in the Error output pin's signal from high to low when there is a transition in the Execute input pin's signal from high to low.

Output pin				
Name	**Function**	**Data type**	**Output range**	**Update**
ErrorID	Error code	WORD	• 0B: A parameter is incorrect. 0C: The module does not support the function. • AH500 series CPU module error code	• When there is a transition in the Error output pin's signal from low to high, or a transition in the Done output pin's signal from low to high, the value of the ErrorID output pin is updated.

15.5.4 Reading Emergency Messages

1. Function block
   The AH10COPM-5A module which functions as a master station in a slot on the main backplane used can read the emergency messages received from slave stations by means of the function block CANopen_NMT in ISPSoft.
2. Input pins/Output pins

Input pin				
Name	**Function**	**Data type**	**Setting value**	**Time when a value is valid**
SID	Slot number	WORD	K0~K11	The value of the SID input pin is valid when there is a transition in the Execute input pin's signal from low to high.
Execute	The function block is executed when there is a transition in the Execute input pin's signal from low to high.	BOOL	True/False	-
NodeID	Node address	WORD	K1~K127	The value of the NodeID input pin is valid when there is a transition in the Execute input pin's signal from low to high.

Output pin				
Name	Function	Data type	Time when there is a transition in an output pin's signal from low to high	Time when there is a transition in an output pin's signal from high to low
Done	The execution of the function block is complete.	BOOL	• There is a transition in the Done output pin's signal from low to high when the execution of the function block is complete.	• There is a transition in the Done output pin's signal from high to low when there is a transition in the Execute input pin's signal from high to low. • If the Execute input pin is set to False when the execution of the function block is complete, the Done output pin will be set to False in the next cycle.
Busy	The function block is being executed.	BOOL	• There is a transition in the Busy output pin's signal from low to high when there is a transition in the Execute input pin's signal from low to high.	• There is a transition in the Busy output pin's signal from high to low when there is a transition in the Done output pin's signal from low to high. • There is a transition in the Busy output pin's signal from high to low when there is a transition in the Error output pin's signal from low to high. • There is a transition in the Busy output pin's signal from high to low when there is a transition in the Aborted output pin's signal from low to high.
Aborted	The execution of the function block is interrupted by a command.	BOOL	• The execution of the function block is interrupted by a command.	• There is a transition in the Aborted output pin's signal from high to low when there is a transition in the Execute input pin's signal from high to low. • If the Execute input pin is set to False when the execution of the function block is interrupted, the Aborted output pin will be set to False in the next cycle.
Error	An error occurs in the function block.	BOOL	• An error occurs when the function block is executed.	• There is a transition in the Error output pin's signal from high to low when there is a transition in the Execute input pin's signal from high to low.

Output pin				
Name	**Function**	**Data type**	**Output range**	**Update**
ErrorID	Error code	WORD	• 0B: A parameter is incorrect. 0C: The module does not support the function. • AH500 series CPU module error code	• When there is a transition in the Error output pin's signal from low to high, or a transition in the Done output pin's signal from low to high, the value of the ErrorID output pin is updated.
TotalNum	Total number of emergency messages	WORD	K0~K255	• When there is a transition in the Done output pin's signal from low to high, the value of the TotalNum output pin is updated.
RecordNum	Number of emergency messages recorded	WORD	K0~K5	• When there is a transition in the Done output pin's signal from low to high, the value of the RecordNum output pin is updated.
EMCY1	First emergency message	WORD[4]		• When there is a transition in the Done output pin's signal from low to high, the value of the EMCY1 output pin is updated.
EMCY2	Second emergency message	WORD[4]		• When there is a transition in the Done output pin's signal from low to high, the value of the EMCY2 output pin is updated.
EMCY3	Third emergency message	WORD[4]		• When there is a transition in the Done output pin's signal from low to high, the value of the EMCY3 output pin is updated.
EMCY4	Fourth emergency message	WORD[4]		• When there is a transition in the Done output pin's signal from low to high, the value of the EMCY4 output pin is updated.

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15.5.5 Obtaining the States of the Slave Stations on a CANopen Network
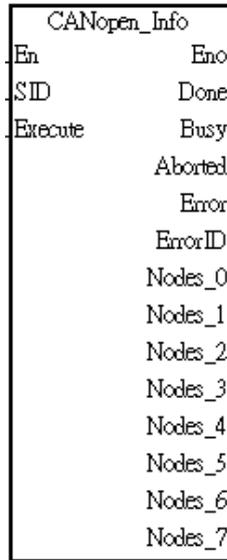
1. Function block

   Users can obtain the states of the slave stations on a CANopen network from the AH10COPM-5A module in a slot on the main backplane used by means of the function block CANopen_Info.

2. Input pins/Output pins

Input pin				
Name	**Function**	**Data type**	**Setting value**	**Time when a value is valid**
SID	Slot number	WORD	K0~K11	The value of the SID input pin is valid when there is a transition in the Execute input pin's signal from low to high.
Execute	The function block is executed when there is a transition in the Execute input pin's signal from low to high.	BOOL	True/False	-

Output pin				
Name	**Function**	**Data type**	**Time when there is a transition in an output pin's signal from low to high**	**Time when there is a transition in an output pin's signal from high to low**
Done	The execution of the function block is complete.	BOOL	• There is a transition in the Done output pin's signal from low to high when the execution of the function block is complete.	• There is a transition in the Done output pin's signal from high to low when there is a transition in the Execute input pin's signal from high to low. • If the Execute input pin is set to False when the execution of the function block is complete, the Done output pin will be set to False in the next cycle.

Busy	The function block is being executed.	BOOL	• There is a transition in the Busy output pin's signal from low to high when there is a transition in the Execute input pin's signal from low to high.	• There is a transition in the Busy output pin's signal from high to low when there is a transition in the Done output pin's signal from low to high. • There is a transition in the Busy output pin's signal from high to low when there is a transition in the Error output pin's signal from low to high. • There is a transition in the Busy output pin's signal from high to low when there is a transition in the Aborted output pin's signal from low to high.
Aborted	The execution of the function block is interrupted by a command.	BOOL	• The execution of the function block is interrupted by a command.	• There is a transition in the Aborted output pin's signal from high to low when there is a transition in the Execute input pin's signal from high to low. • If the Execute input pin is set to False when the execution of the function block is interrupted, the Aborted output pin will be set to False in the next cycle.
Error	An error occurs in the function block.	BOOL	• A parameter is incorrect.	• There is a transition in the Error output pin's signal from high to low when there is a transition in the Execute input pin's signal from high to low.

Output pin				
Name	**Function**	**Data type**	**Output range**	**Update**
ErrorID	Error code	WORD	• 0B: A parameter is incorrect. 0C: The module does not support the function. • AH500 series CPU module error	• When there is a transition in the Error output pin's signal from low to high, or a transition in the Done output pin's signal from low to high, the value of the ErrorID output pin is updated.
Nodes_0	States of station address 0~station address 15	WORD	Every bit indicates the state of a station. 0: Normal 1: Abnormal	• When there is a transition in the Done output pin's signal from low to high, the value of the Nodes_0 output pin is updated.
Nodes_1	States of station address	WORD	Every bit indicates the state of a station.	• When there is a transition in the Done

Output pin				
Name	**Function**	**Data type**	**Output range**	**Update**
	16~station address 31		0: Normal 1: Abnormal	output pin's signal from low to high, the value of the Nodes_1 output pin is updated.
Nodes_2	States of station address 32~station address 47	WORD	Every bit indicates the state of a station. 0: Normal 1: Abnormal	• When there is a transition in the Done output pin's signal from low to high, the value of the Nodes_2 output pin is updated.
Nodes_3	States of station address 48~station address 63	WORD	Every bit indicates the state of a station. 0: Normal 1: Abnormal	• When there is a transition in the Done output pin's signal from low to high, the value of the Nodes_3 output pin is updated.
Nodes_4	States of station address 64~station address 79	WORD	Every bit indicates the state of a station. 0: Normal 1: Abnormal	• When there is a transition in the Done output pin's signal from low to high, the value of the Nodes_4 output pin is updated.
Nodes_5	States of station address 80~station address 95	WORD	Every bit indicates the state of a station. 0: Normal 1: Abnormal	• When there is a transition in the Done output pin's signal from low to high, the value of the Nodes_5 output pin is updated.
Nodes_6	States of station address 96~station address 111	WORD	Every bit indicates the state of a station. 0: Normal 1: Abnormal	• When there is a transition in the Done output pin's signal from low to high, the value of the Nodes_6 output pin is updated.
Nodes_7	States of station address 112~station address 127	WORD	Every bit indicates the state of a station. 0: Normal 1: Abnormal	• When there is a transition in the Done output pin's signal from low to high, the value of the Nodes_7 output pin is updated.

If a node on the node list in a master station is normal, the bit corresponding to the node will be OFF. If a node on the node list in a master station is abnormal (a node is not initialized successfully, or is offline abnormally), the bit corresponding to the bit will be ON.

15.6 Error Diagnostics and Troubleshooting

15.6.1 LED Indicators and Troubleshooting

AH10COPM-5A has two LED indicators—a RUN LED indicator and an ERROR LED indicator. The LED indicators indicate the current states of the module.

● RUN LED indicator

LED indicator	Description	Solution
The light is OFF.	AH10COPM-5A is disconnected.	Check whether the AH500 system used is powered.
The green light flashes once.	AH10COPM-5A stops running.	AH10COPM-5A is downloading a network configuration, and waits to complete the downloading of the network configuration.
The green light blinks.	AH10COPM-5A is ready to operate.	If the green light is blinking when the AH500 series CPU module is running, users have to 1. check whether the bus cable on the CANopen network created is connected correctly. 2. check whether the serial communication speed of the master station selected is the same as the serial communication speeds of the other slave stations. 3. check whether the slave stations configured are connected to the network created. 4. check whether slave stations are offline.
The green light is ON.	AH10COPM-5A is operational.	No solution is required.

Difference between the green light which flashes once and the green light which blinks:

● ERROR LED indicator

LED indicator	Description	Solution
The light is OFF.	AH10COPM-5A is normal.	No action is needed.
The red light flashes once.	Bus fault	1. Check whether the CANopen bus cable used is a standard cable. 2. Check whether the both ends of the CANopen bus used are connected to terminal resistors. 3. Check whether the noise around the CANopen bus cable used is strong.
The red light flashes twice.	Master station: The control of the errors in a slave station is not sent after a set period of time. Slave station: AH10COPM-5A does not send a heartbeat message after a set period of time.	1. Check whether the CANopen bus cable used is a standard cable. 2. Check whether the both ends of the CANopen bus used are connected to terminal resistors.
The red light is ON.	The bus used is off.	1. Check whether the bus cable on the CANopen network created is connected correctly. 2. Check whether the serial communcation speed of AH10COPM-5A is the same as the serial communication speeds of other slave stations.

Difference between the red light which flashes once and the red light which flashes twice:
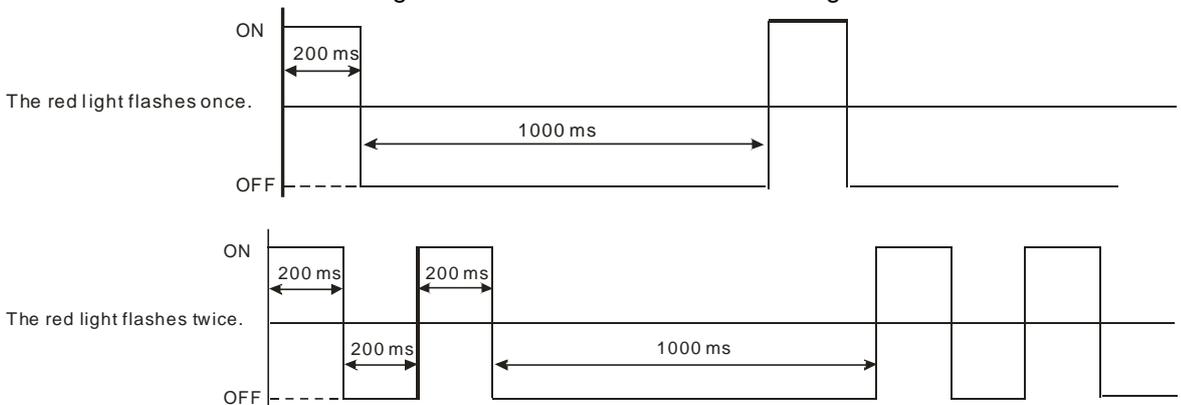
15.6.2 Error Codes

Users can monitor the error codes in the system log in ISPSoft, or the error code in the module error code register in the AH500 series CPU module used.

● AH10COPM-5A functions as a master station.

Code	Description	Solution
16#A0E0	AH10COPM-5A receives an emergency message from a slave station.	Use the function block CANopen_EMCY to read relevant information.
16#A0E1	The length of a PDO that a slave station sends is not the same as the length of the PDO set in the node list.	Set the length of the PDO in the slave station again, and then download the setting to AH10COPM-5A.

Code	Description	Solution
16#A0E2	AH10COPM-5A does not receive a PDO from a slave station.	Make sure that the PDOs in the slave station are set correctly.
16#A0E3	An automatic SDO is not downloaded successfully.	Make sure that the automatic SDO is et correctly.
16#A0E4	A PDO parameter is not set successfully.	Make sure that the setting of the PDO parameter is legal.
16#A0E5	A key parameter is set incorrectly.	Make sure that the slave stations connected are the same as the slave stations set.
16#A0E6	The actual network configuration is not the same as the network configuration set.	Make sure that the power supplied to the slave stations connected is normal and the network created is connected correctly.
16#A0E7	The control of the errors in a slave station is not sent after a set period of time.	
16#A0E8	The master station address is the same as a slave station address.	Set the master station address or the slave station address again, and make sure the new station address is not the same as a slave station address.
16#A0F1	No slave station is added to the node list in CANopen builder.	Add slave stations to the node list, and download the configuration to AH10COPM-5A.
16#A0F3	An error occurs in AH10COPM-5A.	Download parameters again. If the error still occurs, please replace AH10COPM-5A.
16#A0F4	The bus used is off.	Please check whether the bus cable on the CANopen network created is connected correctly, make sure that the serial transmission speeds of all the nodes on the network are the same, and power AH10COPM-5A again.
16#A0F5	The node address of AH10COPM-5A is set incorrectly.	The node address of AH10COPM-5A must be in the range of 1 to 127.
16#A0F6	Internal error: An error occurs in the manufacturing process in the factory.	Power AH10COPM-5A again. If the error still occurs, please replace AH10COPM-5A.
16#A0F7	Internal error: GPIO error	
16#A0F8	Internal error: Internal memory error	
16#A0F9	Low voltage	Make sure that the power supplied to AH10COPM-5A is normal.
16#A0FA	An error occurs in the firmware of AH10COPM-5A.	Power AH10COPM-5A again.
16#A0FB	The transmission registers in AH10COPM-5A are full.	Please make sure that the bus cable on the CANopen network created is connected correctly, and power AH10COPM-5A again.
16#A0FC	The reception registers in AH10COPM-5A are full.	Please make sure that the bus cable on the CANopen network created is connected correctly, and power AH10COPM-5A again.

- AH10COPM-5A functions as a slave station.

Code	Description	Solution
16#A0B0	AH10COPM-5A does not send a heartbeat message after a set period of time.	Check whether the bus cable on the CANopen network created is connected correctly.
16#A0B1	The length of a PDO that a slave station sends is not the same as the length of the PDO set in the node list.	Set the length of the PDO in the slave station again, and then download the setting to AH10COPM-5A.
16#A0B2	The master station selected does not send a node guarding message after a set period of time.	Check whether the bus cable on the CANopen network created is connected correctly.
16#A0F4	The bus used is off.	Please check whether the bus cable on the CANopen network created is connected correctly, make sure that the serial transmission speeds of all the nodes on the network are the same, and power AH10COPM-5A again.
16#A0F5	The node address of AH10COPM-5A is set incorrectly.	The node address of AH10COPM-5A must be in the range of 1 to 127.
16#A0F6	Internal error: An error occurs in the manufacturing process in the factory.	Power AH10COPM-5A again. If the error still occurs, please replace AH10COPM-5A.
16#A0F7	Internal error: GPIO error	
16#A0F8	Hardware error	
16#A0F9	Low voltage	Make sure that the power supplied to AH10COPM-5A is normal.
16#A0FA	An error occurs in the firmware of AH10COPM-5A.	Power AH10COPM-5A again.
16#A0FB	The transmission registers in AH10COPM-5A are full.	Please make sure that the bus cable on the CANopen network created is connected correctly, and power AH10COPM-5A again.
16#A0FC	The reception registers in AH10COPM-5A are full.	Please make sure that the bus cable on the CANopen network created is connected correctly, and power AH10COPM-5A again.

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Chapter 16 Remote I/O Module AHRTU-ETHN-5A

Table of Contents

16.1 Introduction to AHRTU-ETHN-5A

Thank you for choosing Delta AHRTU-ETHN-5A module. Please read the product instruction carefully before use so as to install and operate the product properly.

AHRTU-ETHN-5A is AH series remote I/O module. AH series CPU such as AHCPU5x1-EN of V2.0 and above can easily control AH digital I/O module and analog I/O module through EtherNet/IP communication protocol.

16.1.1 Function

- Supports the standard EtherNet/IP communication protocol slave, I/O connection through cyclic data exchange as well as explicit message connection through acyclic data exchange.
- Provides module status (MS), network status (NS), I/O module status and a seven-segment display showing AHRTU-ETHN-5A's status and error code.
- Provides AHRTU error processing mechanism by setting how to process I/O modules and AHCPU when an error occurs in I/O modules.
- Able to connect 1 main backplane and 7 extension backplanes. Max. 68 AH series I/O modules are connectable to AHRTU-ETHN-5A. Max. number of input and output points and max. number of channels are 3744 and 544 respectively.
- AH10SCM-5A and AH15SCM-5A are supported, availabe for AH10SCM-5A and AH15SCM-5A FW V1.02 or later and EIP Builder V1.06 or later. For serial communication master function, the PC should have DCISoft V1.20 or later installed.
- AHCPU560 redundancy system function is supported, available for AHCPU560 FW V1.02 or later.

16.1.2 Specification

- **Electrical specification**

Item	Specification
Power supply voltage	5 VDC
Power consumption	2.16 W
Weight	160g

- **Ethernet**

Item	Specification
Communication protocol	EtherNet/IP, MODBUS TCP
Service supported	BOOTP, DHCP, NTP
Baud rate	10/100 Mbps Auto-Detection
Communication interface	RJ-45 with Auto MDI/MDIX
Number of Ethernet ports	2 (X1, X2)

- **MODBUS TCP**

Item		Specification
General	Equipment type	Server
	Topology supported	Star and linear
MODBUS TCP Server	Max. number of Modbus TCP connections	32

● **EtherNet/IP**

Item		Specification
General	Equipment type	Adapter
	Topology supported	Star, linear and ring
CIP service type_ IO Connection	Max. number of CIP connections	96
	Max. number of TCP connections	48 (Servers)
	Packet transmission interval	1 ms~1000ms
	Max. communication capacity	10,000 pps
	Max. data length	500 bytes
CIP service type_ Explicit Message	Class 3（Connected Type）	48 (Servers), shared with UCMM
	UCMM （Non-Connected Type）	48 (Clients + Servers), shared with Class 3
	CIP objects supported	Identity Object (16#01) Message Router Object (16#02) Assembly Object (16#04) Connection Manager Object (16#06) DLR Object (16#47) QoS Object (16#48) Port (16#F4) TCP/IP Interface Object (16#F5) Ethernet Link Object (16#F6) Vendor specification object SR Register (16#370) RTU Input Register (16#371) AI Register (16#373) AO Register (16#374) X Register (16#375) Y Register (16#376)

● **Environment**

Noise immunity	ESD (IEC 61131-2, IEC 61000-4-2): 8KV Air Discharge EFT (IEC 61131-2, IEC 61000-4-4): Power Line: 2KV, Digital I/O: 1KV Analog & Communication I/O: 1KV Damped-Oscillatory Wave: Power Line: 1KV, Digital I/O: 1KV RS (IEC 61131-2, IEC 61000-4-3): 26MHz ~ 1GHz, 10V/m
Operation temperature	-10 ^{o}C ~ 60 ^{o}C
Storage temperature	-20 ^{o}C ~ 70 ^{o}C
Humidity	5%~95%
Other	Pollution level 2
Shock/vibration immunity	International standards: IEC 61131-2, IEC 68-2-6 (TEST Fc)/IEC 61131-2 & IEC 68-2-27 (TEST Ea)
Standard	IEC 61131-2, UL508

16.2 Parts of AHRTU-ETHN-5A

16.2.1 Profile and Dimensions
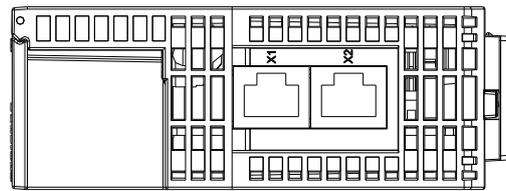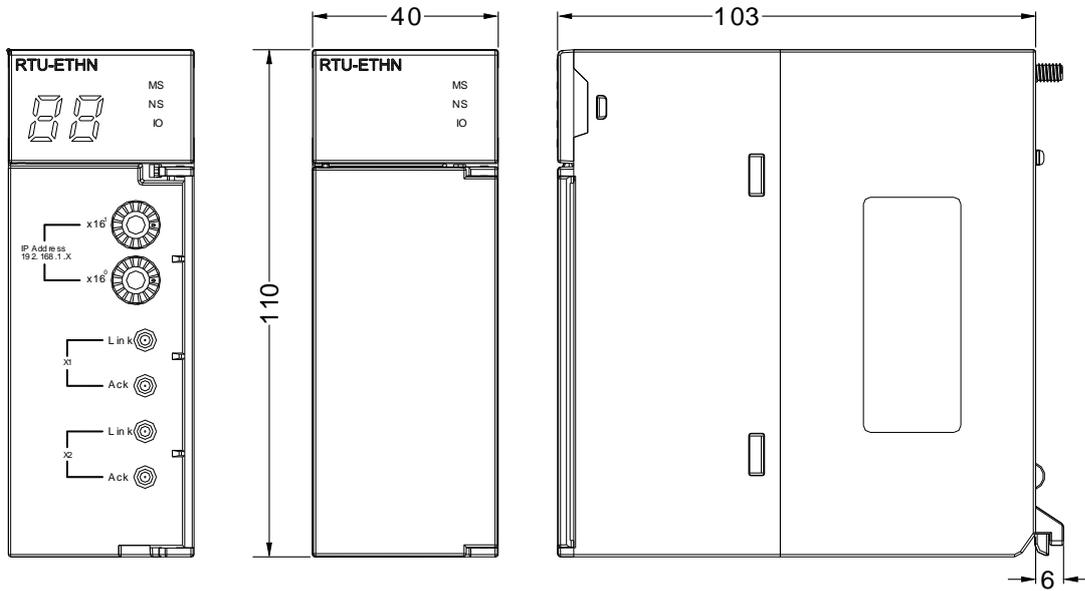
Unit: mm

16.2.2 Parts
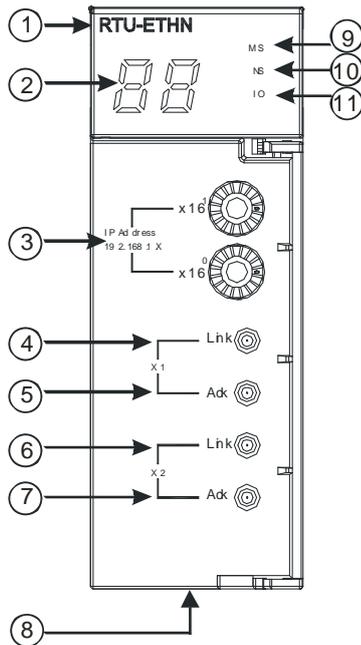
1	Module name	2	Seven-segment display
3	IP address switch (192.168.1.x)	4	X1 Link indicator
5	X1 Ack indicator	6	X2 Link indicator
7	X2 Ack indicator	8	X1/X2 of RJ-45 port
9	MS indicator	10	NS indicator
11	I/O indicator		

16.2.3 Ethernet Connector

The pins of Ethernet connector are defined in the following table.

Pin No.	Name	Description	RJ-45 figure
1	TX+	Positive pole for transmitting data	
2	TX-	Negative pole for transmitting data	
3	RX+	Positive pole for receiving data	
4	-	-	1 2 3 4 5 6 7 8
5	-	-	
6	RX-	Negative pole for receiving data	
7	-	-	
8	-	-	
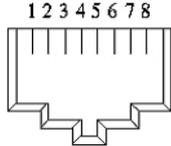
16.2.4 IP Address Switch

The rotary switch of AHRTUETHN can be used for setting its IP address. The default domain is 192.168.1.x and the range of X is 00~FF.

Setting value	Description	
00 ~ 16#FD	1. Valid IP address: 192.168.1.x, x = 1 ~ FD, (1~253) 2. 16#00: Set through the EIP Builder software.	
16#FE	Firmware update mode: The IP address will become 192.168.1.3 after connecting AHRTU-ETHN-5A to the network, switching the rotary switch to FE and repowering the module. For details, refer to Firmware update page of Network configuration in section 16.5.3.4.	x16¹ x16⁰
16#FF	The module will be restored to the factory settings and the settings are not valid until the module is restarted.	
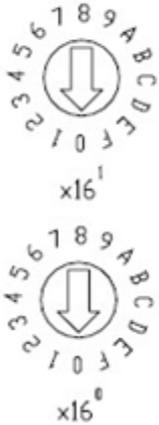
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16.3 Installation of AHRTU-ETHN-5A

16.3.1 Installed to Backplanes

AHRTU-ETHN-5A can only be inserted to the CPU slot of AH series main backplane. For details on the installation, see the instructions below.

Insert the projection at the bottom of the module to the hole of the backplane and push the module in the direction indicated by the following arrow to meet the CPU port of the backplane.
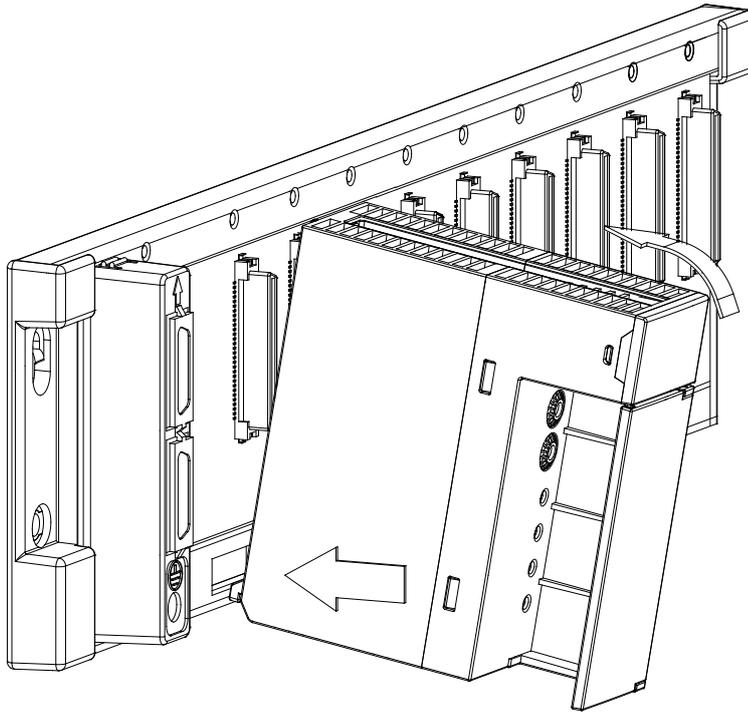
Securely tighten the screws on the top of the module after the installing is proper.
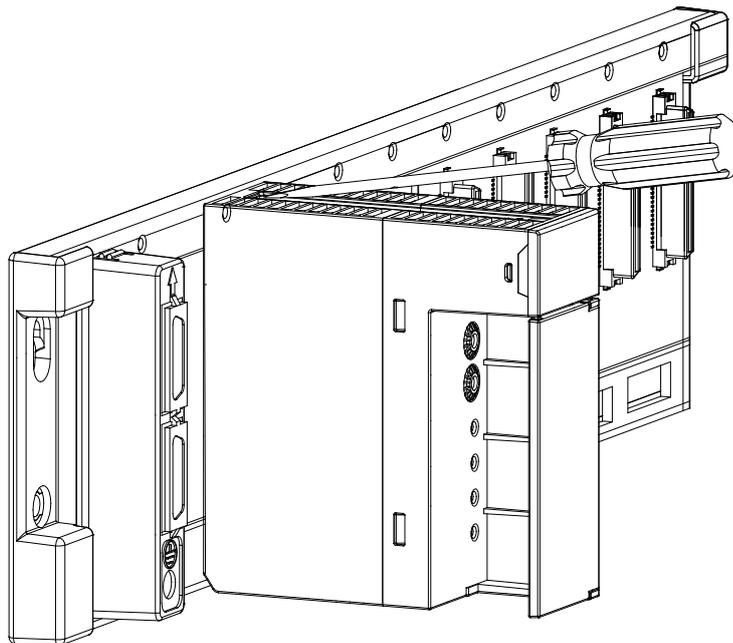
Install the power module and I/O modules in the same way as above. The power module can only be inserted to the POWER slot and I/O modules can only be placed at the I/O slots.
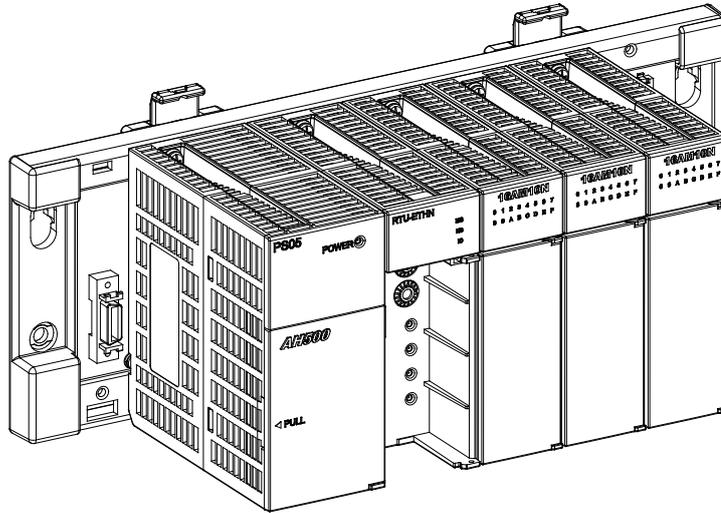
At most 1 AH series main backplane, 7 AH series extension backplanes and 68 I/O modules are connectable to AHRTU-ETHN-5A as shown in the following figure.
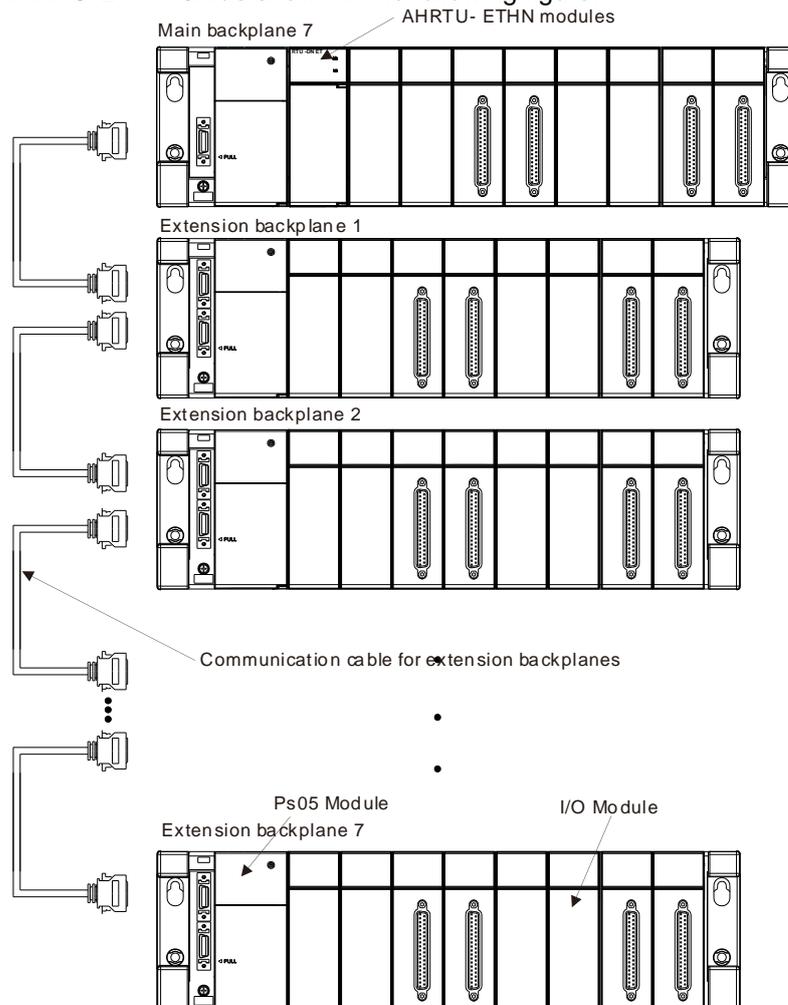
When an extension backplane is to be connected, follow the rule of connecting the first port of the extension backplane to the last backplane and connecting its second port to the next extension backplane.

16.3.2 Modules Supported

● Below is the table of AH series main backplanes and extension backplanes which AHRTU-ETHN-5A can be connected to.

Model	Description
AHBP04M1-5A	4-slot main backplane exclusively used for AHCPU5x1-EN/AHRTU-ETHN-5A
AHBP06M1-5A	6-slot main backplane exclusively used for AHCPU5x1-EN/AHRTU-ETHN-5A
AHBP08M1-5A	8-slot main backplane exclusively used for AHCPU5x1-EN/AHRTU-ETHN-5A
AHBP12M1-5A	12-slot main backplane exclusively used for AHCPU5x1-EN/AHRTU-ETHN-5A
AHBP06E1-5A	6-slot extension backplane exclusively used for AHCPU5x1-EN/AHRTU-ETHN-5A
AHBP08E1-5A	8-slot extension backplane exclusively used for AHCPU5x1-EN/AHRTU-ETHN-5A

● Digital I/O modules
Below is the table of digital I/O modules connectable to AHRTU-ETHN-5A and corresponding data lengths.

Digital I/O module	I/O Data length (Unit: words)	
	EtherNet/IP Scanner → AHRTU-ETHN-5A	AHRTU-ETHN-5A → EtherNet/IP Scanner
AH16AM10N-5A	-	1
AH16AM30N-5A	-	1
AH32AM10N-5A	-	2
AH32AM10N-5B	-	2
AH32AM10N-5C	-	2
AH64AM10N-5C	-	4
AH16AR10N-5A	-	1
AH16AN01R-5A	1	-
AH16AN01T-5A	1	-
AH16AN01P-5A	1	-
AH16AN01S-5A	1	-
AH32AN02T-5A	2	-
AH32AN02P-5A	2	-
AH32AN02T-5B	2	-
AH32AN02P-5B	2	-
AH32AN02T-5C	2	-
AH32AN02P-5C	2	-
AH64AN02T-5C	4	-
AH64AN02P-5C	4	-
AH16AP11R-5A	1	1
AH16AP11T-5A	1	1

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Digital I/O module	I/O Data length (Unit: words)	
	EtherNet/IP Scanner → AHRTU-ETHN-5A	AHRTU-ETHN-5A → EtherNet/IP Scanner
AH16AP11P-5A	1	1

- Analog I/O module
  Below is the table of analog I/O modules connectable to AHRTU-ETHN-5A and corresponding data lengths.

Special module model	I/O Data length (Unit: words)	
	EtherNet/IP Scanner → AHRTU-ETHN-5A	AHRTU-ETHN-5A → EtherNet/IP Scanner
AH04AD-5A	-	8
AH08AD-5A	-	16
AH08AD-5B	-	16
AH08AD-5C	-	16
AH04DA-5A	8	-
AH08DA-5A	16	-
AH08DA-5B	16	-
AH08DA-5C	16	-
AH06XA-5A	4	8

- Serial communication module
  Below is the table of temperature modules connectable to AHRTU-ETHN-5A and corresponding data lengths.

Special module model	I/O Data length (Unit: words)	
	EtherNet/IP Scanner → AHRTU-ETHN-5A	AHRTU-ETHN-5A → EtherNet/IP Scanner
AH10SCM-5A	20	18
AH15SCM-5A	20	18

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16.4 Devices in AHRTU-ETHN-5A

16.4.1 MODBUS Addresses

The SR, X, Y, RTU Input, AI and AO devices in AHRTU-ETHN-5A can be read via the MODBUS TCP instructions. See the table of MODBUS devices and their MODBUS addresses as below.

Attribute	Device	Data type	MODBUS address (Hex.)	MODBUS function code (Hex.)	Description
R	SR	Word	0080 ~ 0111	03, 04	Operational status of RTU module
R	X	Word	8000 ~ 80E9	03, 04	Status of X; the points are numbered in the order from small to large.
		Bit	6000 ~ 6E9F	01, 02	Status of X; the points are numbered in the order from small to large.
R	Y	Word	A000 ~ A0E9	03, 04	Status of Y; the points are numbered in the order from small to large.
		Bit	A000 ~ AE9F	01, 02	Status of Y; the points are numbered in the order from small to large.
R	RTU Input	Word	0200 ~ 020F	03, 04	Status of RTU module
R	AI	Word	1000 ~ 143F	03, 04	Input voltage/current of an analog I/O module or input temperature value of a temperature module. The channels are numbered in the order from small to large.
R	AO	Word	2000 ~ 243F	03, 04	Output voltage/current of an analog I/O module. The channels are numbered in the order from small to large.

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16.4.2 Status Register (SR)

| Number	Attribute	Name	Description
0	R	Model code	16#68C1
1	R	Firmware version	Expressed in the hex format; i.e. 16#1020 means the version is V1.02.0.
2	R	Firmware subversion	
3	R	TCP connections	The number of current TCP connections
4	R	CIP connections	The number of current CIP connections
5	R	MODBUS TCP Server connections	The number of current MODBUS TCP Server connections
6	R	System scan time	The time for system scan with the unit: 0.1ms
7	R	Operational status of RTU module	0: Normal, 1: Alarming, 2: In error 3: A fault exists but the module does not stop working.
8	R	Status of backplanes	bit0~7 = Backplanes 1~8 0: The software configuration is inconsistent with actual configuration. 1: The software configuration is consistent with actual configuration.
9-20	R	Module status of RTU's main backplane	Display the status of I/O module 0~11 on the main backplane <table><tr><td>b0 b1</td><td>00: Normal, 01: Alarming, 10: In error</td></tr><tr><td>b2</td><td>0: Stop, 1: In operation</td></tr><tr><td>b3</td><td>0: No module exists. 1: The module exists.</td></tr><tr><td>b4</td><td>0: Inconsistent with the software configuration. 1: consistent with the software configuration.</td></tr></table>
21-76	R	Module status of RTU's extension backplanes1~7	Display the states of I/O modules 0~7 on the extension backplanes 1~7. <table><tr><td>b0 b1</td><td>00: Normal, 01: Alarming, 10: In error</td></tr><tr><td>b2</td><td>0: Stop, 1: In operation</td></tr><tr><td>b3</td><td>0: No module exists. 1: The module exists.</td></tr><tr><td>b4</td><td>0: Inconsistent with the software configuration. 1: consistent with the software configuration.</td></tr></table>SR21~28: The states of I/O modules 0~7 on the extension backplane 1 SR29~36: The states of I/O modules 0~7 on the extension backplane 2. And so on…
77	R	RTU error code	Refer to Troubleshooting in section 16.7.
78-89	R	Error codes of I/O modules on RTU's main backplane	Display the error codes of I/O modules 0~11 on the main backplane. For details, refer to the explanation of error codes in modules.

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Number	Attribute	Name	Description
90-145	R	Error codes of I/O modules on RTU's extension backplanes 1~7	Display the error codes of I/O modules 0~7 on the extension backplane 1~7. SR90~97: The error codes of I/O modules 0~7 on the extension backplane 1 SR98~105: The error codes of I/O modules 0~7 on the extension backplane 2. And so on… For details, refer to the explanation of error codes in modules.

16.4.3 RTU Input Register

| Number	Attribute	Name	Description
0	R	Status	0: Normal, 1: Alarming, 2: In error, 3: A fault exists but the module does not stop working.
1	R	Reserved	
2	R	Error code	Error code in AHRTU
3~10	R	Reserved	
11~15	R	I/O module status	The status of every I/O module is expressed with one bit. (0: normal operation; 1: abnormal) Bit0 of number 11 stands for I/O module 0 on the main backplane. Bit 1 of number 11 is I/O module 1 on the main backplane and Bit 11 of number 11 is I/O module 11 on the main backplane. Bit 12 of number 11 indicates I/O module 0 on the extension module and so on.

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16.5 Software

AHRTU-ETHN-5A, an AH series EtherNet/IP remote I/O module, can connect AHCPU5x1 series CPU and be connected to the EIP Scanner from other vendors as well. While working as the remote I/O module of AHCPU5x1 series CPU, AHRTU-ETHN-5A should be set by EIP Builder software of ISPSoft. When being connected to other-brand Scanner, AHRTU-ETHN-5A should be set by EIP Builder software alone and then other-brand software is used for connection with AHRTU-ETHN-5A as the EIP slave.
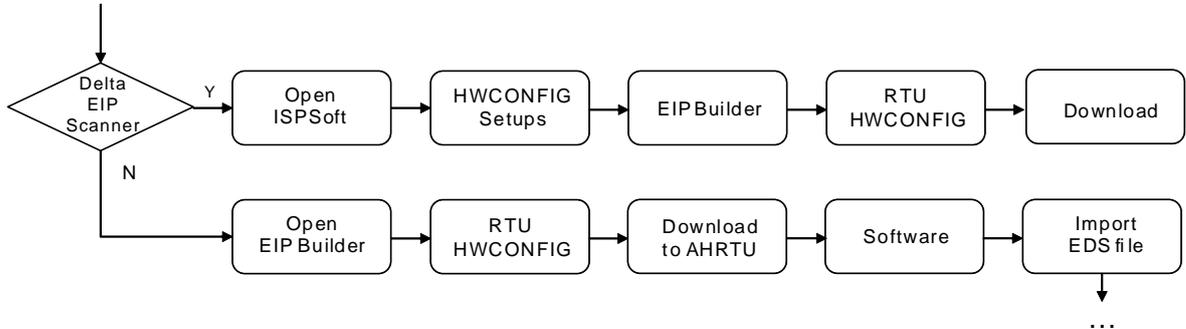
For details on operation, refer to Delta EtherNet/IP Operation Manual.

16.5.1 ISPSoft

ISPSoft provides the functions of programming for Delta products, configuration of hardware parameters and network planning. If AHRTU-ETHN-5A is used with Delta EtherNet/IP master together, open ISPSoft first to set the hardware parameters of the EtherNet/IP master and then open EIP Builder to add AHRTU-ETHN-5A to the EtherNet/IP master network and edit the I/O modules connected to AHRTU-ETHN-5A.
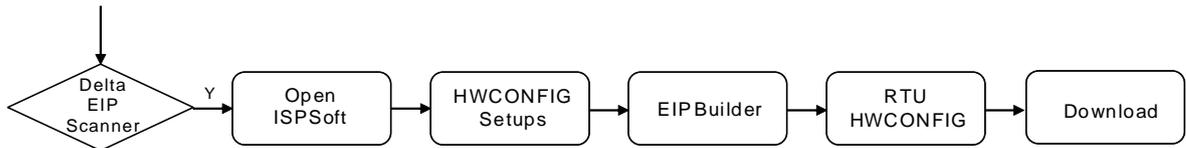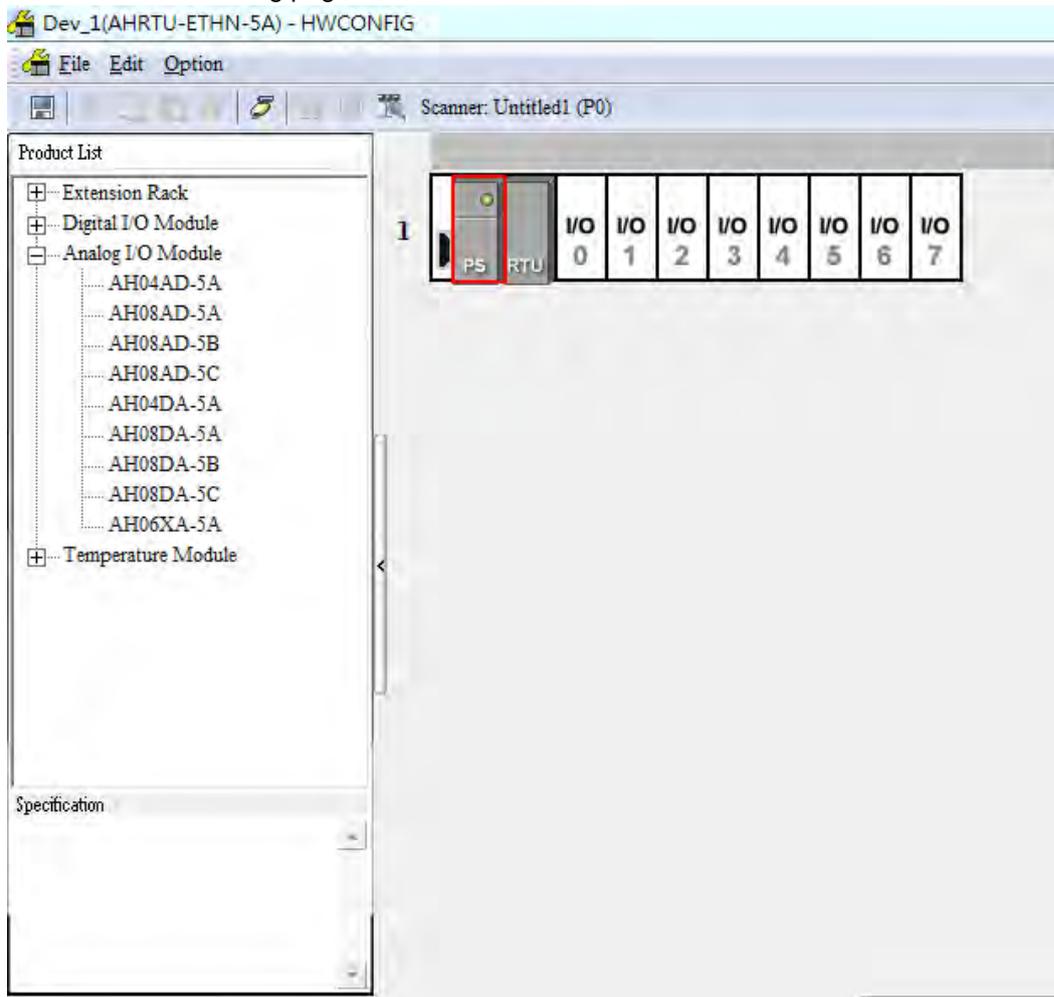

16.5.2 EIP Builder

EIP Builder provides the functions of planning the network for Delta EtherNet/IP products and setting the parameters of EtherNet/IP slaves. After building AHRTU-ETHN-5A module in the NetworkView window, create network connection lines by dragging. Double click the module icon to open the RTU HWCONFIG page to edit RTU parameters or add new RTU IO modules in. Before using EIP Builder, you need to go to ISPSoft communication setting page to make sure the communication between your PC and PLC is through EtherNet.
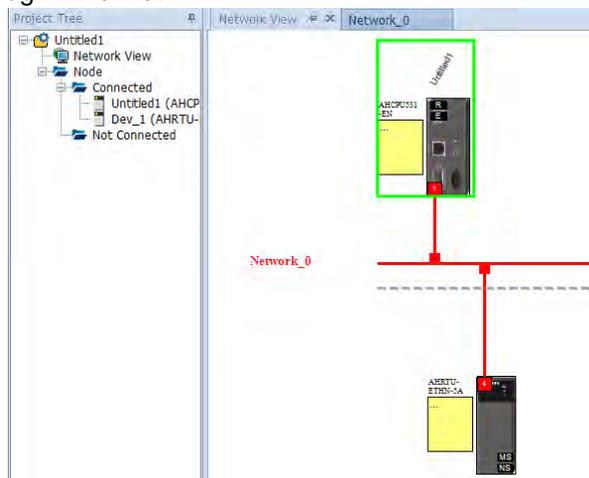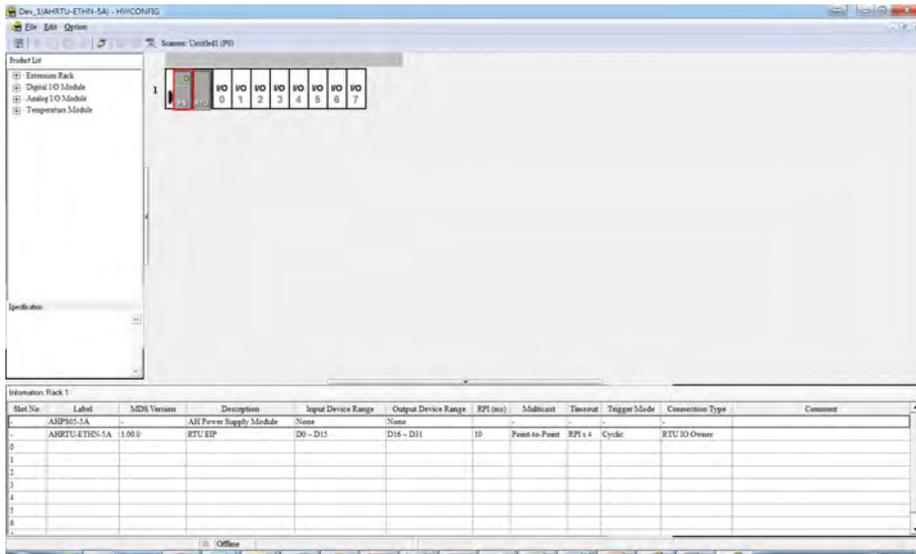
16.5.2.1 Setting up RTU Parameters

You can edit the I/O modules connected to RTU module and set the parameters of I/O modules in the **(AHRTU-ETHN-5A)-HWCONFIG** window. Double click AHRTU-ETHN-5A module to open the **RTU Parameter Setting** page where you can set the parameters on the Ethernet-Basic, Ethernet-Advance and Error Handling pages.

● **Ethernet-Basic**

Name	Description
IP Addressing Mode	Mode of getting IP address ● Static: Fixed IP address. ● DHCP: DHCP server assigns the dynamic IP address. ● BOOTP (default): BOOTP server assigns the dynamic IP address. If DHCP or BOOTP is selected, you can make the setting through IP manager in EIP Builder.
IP Address	Set an IP address; default: 192.168.1.3.
Netmask Address	Set the IP address for networkmask; default: 255.255.255.0
Gateway Address	Set the IP address for gateway; default: 192.168.1.1
Keep Alive Timer	Set the time for keeping connection alive. If the upper machine does not send the packet to AHRTU-ETHN-5A within the set time, AHRTU-ETHN-5A will automatically cut the connection with it.

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● Ethernet - Advance

The tab provides the setting of AHRTU-ETHN-5A's advanced Ethernet functions including filter and NTP.
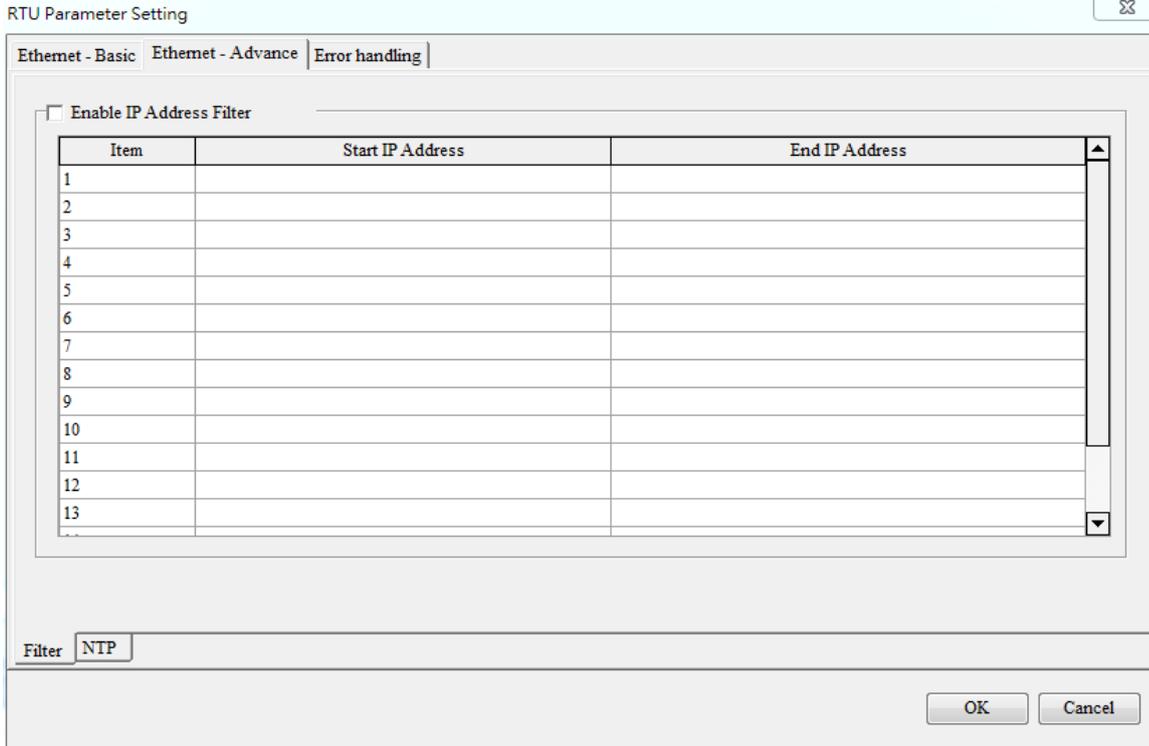

■ **Filter_IP address filter setting**

The above page sets the filter function of network devices. Only the devices of which IP addresses are in the set range are allowed to communicate with AHRTU-ETHN-5A. The packets sent by the devices of which the IP addresses are out of the set range will be discarded. At most 16 groups of IP address ranges can be set.

Steps for setting the function:

(1)   Select "**Enable IP Address Filter**" and then double click one line of the following table to open the **IP Address Filter** window.
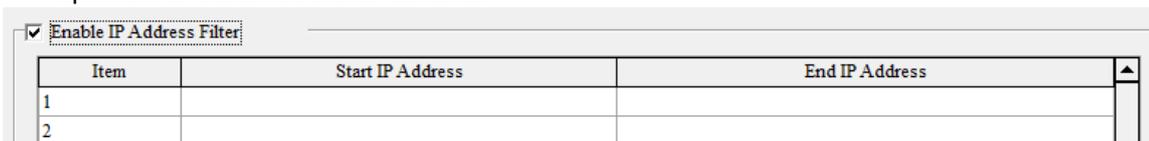
(2)   Set the range of input addresses in the following window. Note that the start IP address should be less than the end IP address. Click "**OK**" after setting is finished. For instance, after the setting, only the IP address 192.168.1.x (x= 10，11，12，13，14，15，16，17，18，19，20）is allowed to store in AHRTU-ETHN-5A.
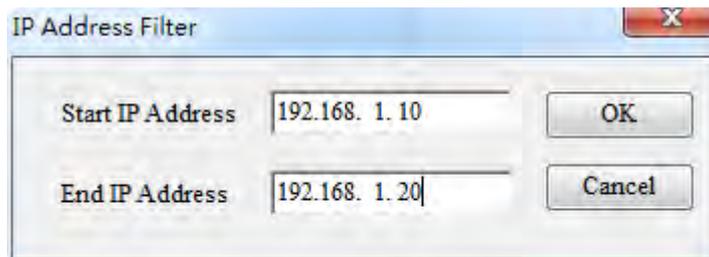
■ **NTP Client Service**

Select "**Enable NTP Client Service**" to connect AHRTU-ETHN-5A to NTP server and set the time update cycle.

Name	Description
NTP server	Set the IP address of the network NTP server. Make sure that the connection to the server is made.
Update Cycle	Set the time update cycle for the connection to the NTP server
Daylight Saving	Set daylight saving time. You can set the start date, end date and time.
Time Zone	Select a time zone

(1) Before the network time update is set, select "**Enable NTP Client Service**" and then set relevant parameters on the lower part of the following page.

- Error handling: Set the mechanism for handling errors in AHRTU-ETHN-5A through the software.

- When an error occurs in I/O modules, you can select or not select "**Trigger CPU bus fault when RTU I/O fault**".
- When the connection with the CPU fails, you can select "**Stop**" or "**Hold State**" for I/O modules.
- When the connection between AHRTU-ETHN-5A and the PLC CPU is lost, you can select or deselect "**Trigger CPU bus fault when RTU is disconnected.**"
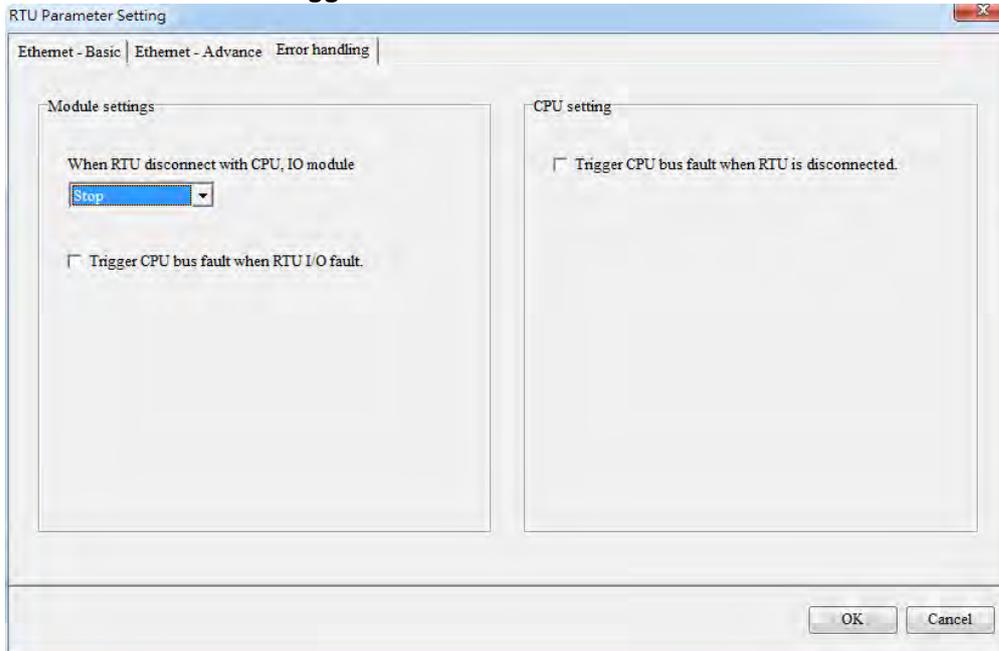
Error handling mechanism	RTU (Set via the software)	Digital input module & analog input module	Output module（set via the I/O module software）	
			Clear	Hold
The master is disconnected after connection	Stop	No data can be updated to the master.	Output value= 0	Output value unchanged
	Hold State		Output value unchanged	

16.5.2.2　Adding Modules

From the product List on the right, you can drag and drop the product that you'd like to add on the RTU main backplane or RTU extension backplane. You can also use Scanner on the toolbar to scan and add the current deployment. After that you can double click on the module icon to go to its setting page to set the parameters and to make sure the normal data exchange area is correctly set. After the setting is done, be sure to save the project. EIP Builder will update the data exchange table according to settings in HWCONFIG. After updating is done, you can download RTU configurations and the updated data exchange table from EIP Builder.

Digital I/O modules share the same CIP connection. As for analog I/O modules and serial communication modules (AH10SCM-A & AH15SCM-A), they use separate CIP connections. When using the serial communication module as Master, parameters of Modbus Advance and UD Link are set in SCMSoft (SCMSoft V1.24.06 is in DCISoft V1.20 or later). Right-click the module to see the context menu, double-click Intelligent Module Configuration to open SCMSoft. You need to upload the current module parameters to SCMSoft before editing. After setting is complete, download the parameters from SCMSoft to PLC. For more information on SCMSoft operation, refert to Chapter 8.
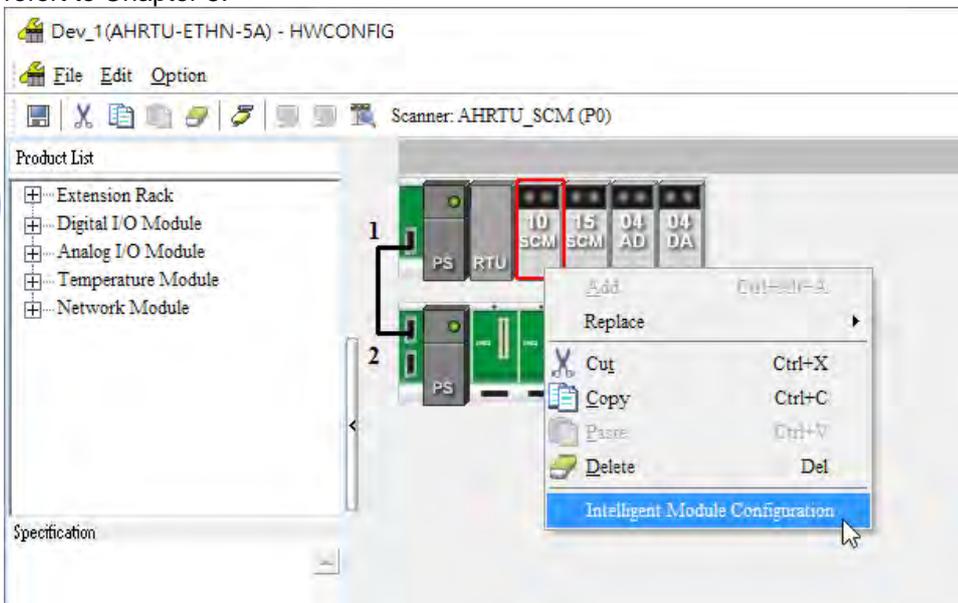
16.5.3 Functions of Web Pages

You can link to AHRTU-ETHN-5A for basic setting and monitoring through the web page. The web page consists of three parts, Login/Logout, Menu and Context after the module connection is made.
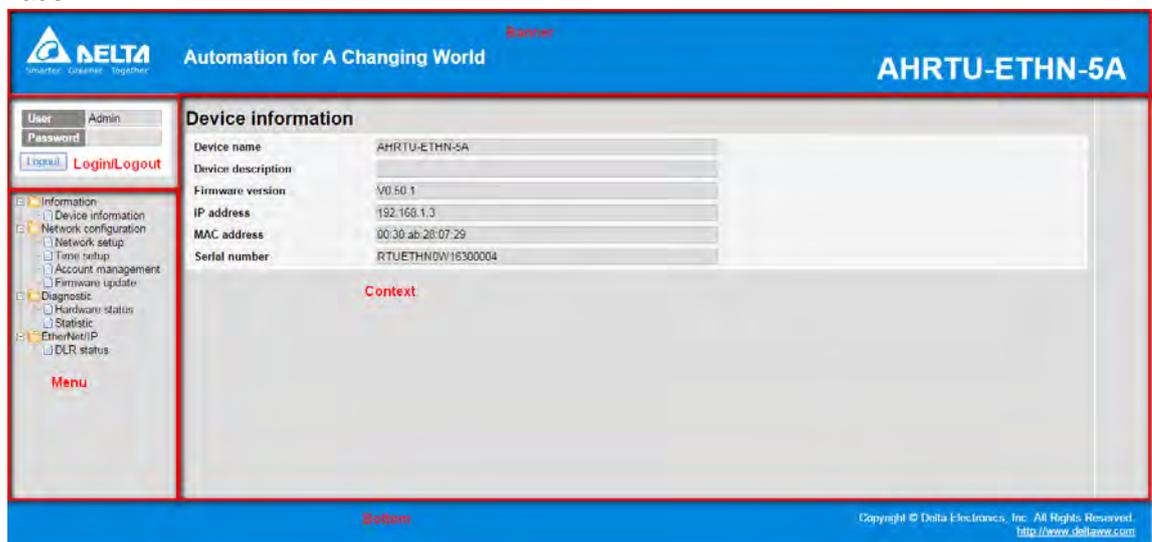
16.5.3.1 Login/Logout

Type the user name and password on the Login/Logout area and click **Login**.

After login succeeds, the user name will appear on the **User** field. Click **Logout** to log out after setting is over.

16.5.3.2 Menu

The menu area provides such items as Information, Network configuration, Diagnosis and EtherNet/IP for setting. The web page includes different items for different user ID. (Only **Admin** is supported as the user ID at present.)

Below is the table of items and explanations.

Item	Explanation	Subitem
Information	Provide the information of AHRTU-ETHN-5A	Device information
Network configuration	Set relevant network functions	Network setup
		Time setup
		Account management
		Firmware update
Diagnostic	Set diagnostic function	Hardware status
		Statistic
EtherNet/IP	Set EtherNet/IP function	DLR status
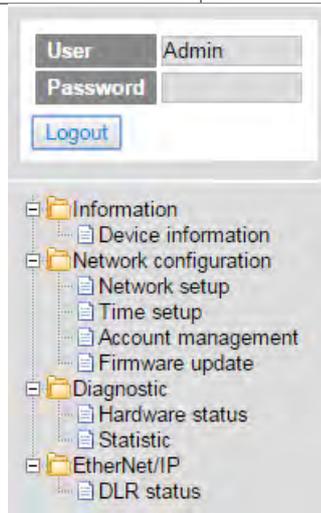
16.5.3.3 Information

- Device information

The following page introduces basic product information. The page can be opened even if you have not logged in. The page can not be revised.

16.5.3.4 Network configuration

- Network setup

The page provides IP address setting information of the product. But it is not open for setting IP addresses.

Network setup

IP mode	Static ▼
IP address	192.168.1.5
Subnet mask	255.255.255.0
Gateway	192.168.0.1

- Time setup

The page displays the product RTC time and the set NTP function.

Time setup

Product RTC	2016/9/8 14:35:6		
NTP enable	Enable ▼		
NTP server	192.168.1.10		
Update cycle (min.)	30		
Time zone	(GMT+08:00) Taipei ▼		
	Disable ▼		
Daylight saving	Start date:	1 ▼ / 1 ▼	(MM / DD)
	End date:	2 ▼ / 2 ▼	(MM / DD)
	Time:	1 ▼ o'clock	

- Account management

8 groups of user accounts at most can be set on the page. Now AHRTU-ETHN-5A only supports Admin as the user ID.

Account management

No.	User ID	Password	Access type	Delete
1	Admin		Administrator ▼	Delete
2			Administrator ▼	Delete
3			Administrator ▼	Delete
4			Administrator ▼	Delete
5			Administrator ▼	Delete
6			Administrator ▼	Delete
7			Administrator ▼	Delete
8			Administrator ▼	Delete

Save

Field	Description
User ID	Preset user ID: Admin with 16 characters at most.
Password	Default password is an empty string and the set password has 16 characters at most.
Access type	Preset account privilege: Administrator
Save	Save the information

- Firmware update

The page provides the firmware update function. Open the web browser and type the IP address (i.e. 192.168.1.3). Repower AHRTU-ETHN-5A after the firmware is updated so that the new firmware will take effect.
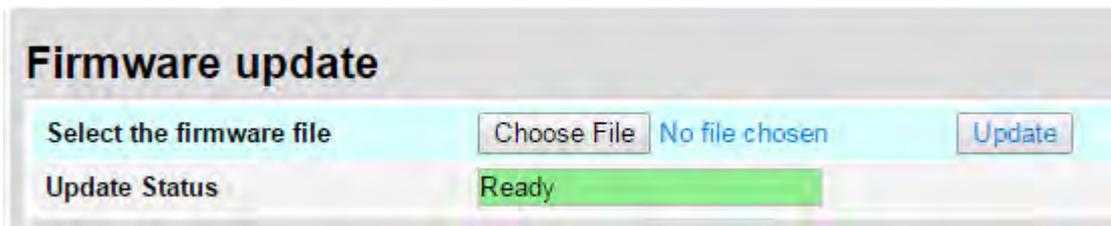
Field	Description
Select the firmware file	Select one file with the *.bin extension.
Update	Perform the firmware update.
Update Status	The status of firmware update

Use one web browser such as IE, Chrome or Firefox to update the firmware. If IE explorer is used, you should shut up the function of compatibility view first.

Select Tool > Compatibility View Settings on the tool bar of the IE explorer to open the Compatibility View Settings window. Click "**Close**" after deselecting the option "**Display intranet sites in Compatibility View**"
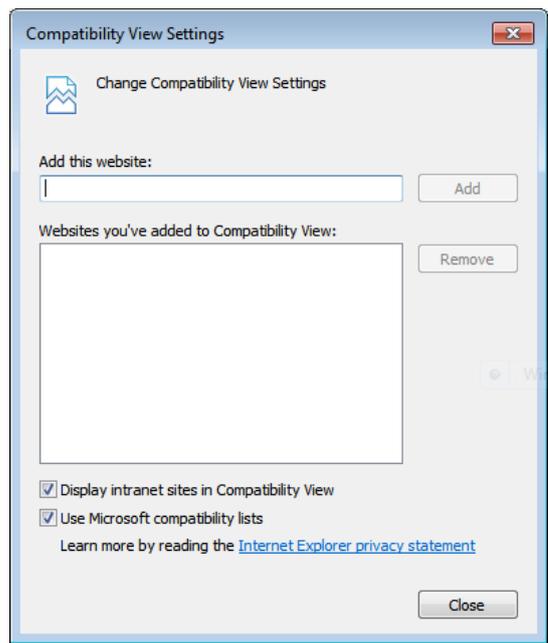
16.5.3.5 Diagnostic

- Hardware status

This page displays the status of AHRTU-ETHN-5A including RTU module and I/O modules connected. The status here is the same as that of the LED indicators of the device.

Field	Description
Rack	It indicates a backplane ID. When the set rack ID is in IO table but it is inconsistent with the actually connected rack ID, the background is red. When the actually connected rack ID can be detected but the rack ID is not in IO table, the background is yellow.
Power Name	Power ID is sent back and can be transformed into a module name.
RTU Name	Module ID is sent back and can be transformed into RTU name
RTU FW Version	The firmware version for RTU
MS LED	Module status indicator on RTU
NS LED	Network status indicator on RTU
IO LED	IO indicator on RTU
RTU Error Code	Error code in RTU
RTU Error Message	Error message in RTU
Module N Name	The module ID is sent back and can be transformed into a module name. When it is in IO table but is inconsistent with the actually connected module ID, the background is red.

Field	Description
Module N Name	When the actually connected module ID can be detected but it is not in IO table, the background is yellow.
Module Version	Firmware version of a module
RUN LED	When a module is in RUN status, the indicator is in green light. When a module is in STOP state, the indicator is OFF.
ERROR LED	When an error occurs in a module, the indicator blinks in red light. When a warning occurs in a module, the indicator is in yellow light. When no error exists in a module, the indicator is OFF.
Error Code	Error code of a module
Error Message	Error message of a module
Refresh Cycle	The default value of the refresh cycle; it is10 with the unit: seconds.
"-" button	The value of update cycle is decreased by 1 every time when clicking the button. The min. value of update cycle is 1.
"+" button	The value of update cycle is increased by 1 every time when clicking the button. The max. value of update cycle is 60.

- Statistic

The page displays the statistic information about relevant network function. The statistic information will be recalculated after repower on.

Statistic

	Ethernet statistic
Transmit packets	27690
Received packets	41888
Frame checksum error packets	0
	Network statistic
Received ARP packets	5
Received unicast packets	41532
Received multicast packets	0
Received broadcast packets	70
Received ICMP packets	0
Transmit ARP packets	5
Transmit unicast packets	27679
Transmit multicast packets	0
Transmit broadcast packets	0
	TCP connection
Used TCP connections	1
Total TCP connections	88

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	NTP statistic
NTP update success	1
NTP update fail	0
	Refresh cycle (1s ~ 60s): [-] [10] [+]

Field	Description (All field contents are read only)
Ethernet Tx packet statistic	Number of Ethernet Tx packets
Ethernet Rx packet statistic	Number of Ethernet Rx packets
Etherent frame checksum error packet statistic	Number of Etherent checksum error packets
Receive ARP packets	Number of received ARP packets
Received IP Unicast packet	Number of received packets where the IP is the same as the setting value
Received IP Multicast packet	Number of received multicast packets (excluding Broadcast)
Received IP Broadcast packet	Number of received broadcast packets.
Receive ICMP packet	Number of received ICMP packets
Transmit ARP packet	Number of transmitted ARP packets
Transmit Unicast packet	Number of transmitted Unicast packets
Transmit Multicast Packet	Number of transmitted multicast packets
Transmit Broadcast Packet	Number of transmitted broadcast packets
TCP Connection Usage	Number of TCP connections which has been used
TCP total connection	Number of TCP connections which can be used
NTP Success statistic	Number of times of NTP connection success
NTP Fail statistic	Number of times of NTP connection failure
Refresh Cycle	The default value of the refresh cycle; it is10 with the unit: seconds.
"-" button	The value of update cycle is decreased by 1 every time when clicking the button. The min. value of update cycle is 1.
"+" button	The value of update cycle is increased by 1 every time when clicking the button. The max. value of update cycle is 60.

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16.5.3.6 EtherNet/IP DLR status

The page displays the current status of EtherNet/IP DLR.

Field	Description (All field contents are read only below)
Network Topology	Linear/Star/Ring
Network status	Normal/Ring Fault
Ring Supervisor	Display Supervisor IP address
Supervisor Precedence	Display Supervisor precedence
Fault Detected	Number of times of ring topology disconnection
Supervisor Status	DLR Supervisor status 0: Supervisor as a back up
Supervisor Status	1: RTU module works under the mode of Ring Supervisor. 2: End points of ring topology. 3: Non-DLR ring topology. 4: Ring parameters are unsupported
Last Node on Port 1	The IP address of a device that Port 1 connects when the ring topology is disconnected.
Last Node on Port 2	The IP address of a device that Port 2 connects when the ring topology is disconnected.
Refresh Cycle	The default value of the refresh cycle; it is10 with the unit: seconds.
"-" button	The value of update cycle is decreased by 1 every time when clicking the button. The min. value of update cycle is 1.
"+" button	The value of update cycle is increased by 1 every time when clicking the button. The max. value of update cycle is 60.

The general browsers at market are supported. See the list of them as below.

Vendor	Browser	Version
Microsoft	Internet Explorer	V7.0 and above
Google	Chrome	V14 and above
Mozilla	Firefox	V17 and above

16.6 CIP Object

Please refer to EtherNet/IP Operation Manual for details.

16.7 Troubleshooting

16.7.1 Error Type

The error codes of AHRTU-ETHN-5A can be classified into RTU error, I/O module error, communication error and other error.

For details on error types, see the following table.

Error code classification		Description
1st Phase	2nd Phase	
Category	Item	
RTU error	Hardware error	Hardware error detected after power on
	Configuration error	IP setup error
	Firmware error	Firmware update error
I/O module error	I/O module error	I/O module error
	I/O module configuration error	Actually connected I/O module is different from that configured in the software.
	Backplane configuration error	Actually connected backplane is different from that configured in the software.
	Extension backplane offline	The main backplane and extension backplane are disconnected.
Communication error	EtherNet/IP error	EtherNet/IP communication failure.
	MODBUS TCP error	MODBUS TCP communication failure.
	NTP error	NTP communication failure.

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16.7.2 Error Codes and Troubleshooting

16.7.2.1 RTU Error

Category	Error code	7-segment display	Explanation	How to deal with
Hardware error	16#0001	F1	CPU hardware error	1. Re-install the module after power OFF and then check if the error indicator is OFF. 2. Replace the module and install a new module; check if the error indicator is OFF. 3. Contact the local distributor.
	16#0002	F1	Memory hardware error	
	16#0003	F1	Flash hardware error	
Hardware error	16#0004	F2	Nework cable link error	1. Check if the connection of two ends of the network cable is proper. 2. Reconnect the network cable and check if the Link LED is ON constantly. 3. Replace the network cable.
	16#0005	F1	RTU power supply error (LV1)	1. Check if the supply power is connected properly. 2. Re-install the product and repower on. 3. Contact the local distributor.
Configuration error	16#1000	F3	IP address setup error	Check if the IP address setup is legal.
	16#1001	F4	IP address conflicts	1. Check if there are IP addresses which are repeated in the network. 2. Modify the IP address setup.
	16#1002	F5	Network server connection error	1. Check the setup for server connection. 2. Check if the system server exists. 3. Check if the wiring for connecting the server is proper.
	16#1003	-	Modify the IP address when in RUN state.	-
Firmware error	16#1004	F7	Firmware update failure	1. Check if the two ends of the network are connected properly. 2. Perform the firmware update again.

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16.7.2.2 I/O Module Error

Category	Error code	7-segment display	Explanation	How to deal with
I/O module configuration error	16#2001	F9	Actually connected I/O module is different from that configured in the software.	1. Re-install I/O module 2. Repower ON 3. Re-download the configuration.
Backplane configuration error	16#2002	F8	Actually connected backplane is different from that configured in the software.	1. Re-install the backplane 2. Repower ON 3. Re-download the configuration.
Extension backplane offline	16#2003	FA	The connection between the main backplane and extension backplane are disconnected.	1. Check if the cable connection is normal. 2. Repower ON

16.7.2.3 Communication Error

Category	Error code	7-segment display	Explanation	How to deal with
EtherNet/IP communication error	16#0106	-	Ownership conflict	1. Check the scanner owner. 2. Modify the invalid scanner setup. 3. Change the connection into Multicast.
EtherNet/IP communication error	16#0113	-	Out of connections	1. Check if the number of product connections exceeds the limit. 2. Reduce the number of product connections.
	16#0100	-	I/O connections duplicated	1. Check if I/O connections have been built in the system configuration. 2. Change the connection type into Listen Only.
	16#0203	E3	I/O connection timeout	1. Check if the network cable connection is normal. 2. Check if the module is normal. 3. Raise the setting value of RPI.
	16#3001	E4	DLR link offline	Check if Ring network products are connected correctly.
MODBUS TCP communication error	16#5000	-	Out of connections	1. Check if the number of product connections exceeds the limit. 2. Reduce the number of product connections.
NTP communication	16#5001	-	NTP Server connection	1. Check the setup for server

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Category	Error code	7-segment display	Explanation	How to deal with
error			failure	connection. 2. Check if the system server exists. 3. Check if the wiring for connection of the server is proper.
	16#5002	-	NTP time update failure	1. Check if the network connection is normal. 2. Check if the NTP parameter setup is correct.

16.7.3 Indicator Status

● **MS/NS Indicator**

LED Status		Indication	How to deal with
MS	**NS**		
LED OFF	**LED OFF**	No supply power	Check if the supply power works normally.
Green light and red light blink alternately	**Green light and red light blink alternately**	AHRTU initializing	No correction
Green light ON	**-**	AHRTU initializing is finished.	
Red light ON	**-**	CPU hardware error	1. Check if the error indicator is OFF after re-installing the module after power OFF. 2. Replace the module and install the new module. Check if the error indicator is OFF. 3. Contact the local distributor.
		Memory hardware error	
		Flash hardware error	
-	**Green light blinks**	I/O connection is not made.	No correction.
	Green light ON	I/O connection has been made.	
-	**Red light blinks**	I/O communication timeout	1. Check if the network cable connection is proper. 2. Check if the module is normal. 3. Raise the setting value of RPI
Red light blinks	**-**	IP setup error	Check if the IP address setup is legal.
-	**Red light ON**	IP addresses conflict	1. Check if there are duplicated IP addresses in the network. 2. Modify the IP address setup.
-	**Green light blinks**	Network server connection error	1. Check the setup for connecting the server. 2. Check if the system server exists. 3. Check if the wiring for connecting the server is proper.
Red light blinks	**-**	Firmware update failure	1. Check if the two ends of the network cable are connected

LED Status		Indication	How to deal with
MS	**NS**		
			correctly. 2. Perform the firmware update once again.

Note: The frequency of blinking is 1Hz. "**-**" in the table above means to keep the original state.

● **I/O Indicator**

Status	Indication	How to deal with
Red light blink	I/O module error	Re-install the I/O module
Red light ON	The actually connected I/O module is different from that configured in the software.	1. Re-install the I/O module 2. Repower ON
	The actually connected backplane is different from that configured in the software.	1. Re-install the backplane 2. Repower ON
	The connection between the main backplane and extension backplane is offline.	1. Check the cable for connection 2. Repower ON

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MEMO

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