Modbus Utility User Manual

September 2014

Version 1.0.3

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1. Introduction

1.1. Introduction to the User Manual

Modbus is a very common protocol used in the industrial manufacturing and environment monitoring fields. The Modbus Utility provided by ICP DAS can be used to communicate with a Host controller to retrieve data from remote modules.

This manual describes how to use the Modbus Utility in conjunction with controllers that support the Modbus protocol. Also included are instructions for linking SCADA (Supervisor Control and Data Acquisition) software to Modbus devices.

This manual applies to following controllers and modules.

Model	I/O Slots	CPU	SRAM	Flash	Memory Expansion	Ethernet	RS-232 /485
I-8430	4	40 MHz	512 KB	512 KB	-	1 (10BASE-T)	3
I-8830	8						
I-8431-MTCP	4						
I-8331-MTCP	8						
I-8431-80-MTCP	4	80 MHz					
I-8831-80-MTCP	8						
I-8KE4-MTCP-G	4						1
I-8KE8-MTCP-G	8						
IP-8441-MTCP	4		768 KB		Micro SD	2 (10/100 BASE-Tx)	4
IP-8841-MTCP	8						
ET-87P4-MTCP	4	-	-	-	-		1
ET-87P8-MTCP	8						
I-7188EX(D) -MTCP	-	40 MHz	512 KB	512 KB	-	1 (10BASE-T)	2
I-7188E2(D) -MTCP	-		384 KB		-		
µPAC-7186EX(D) -MTCP	-	80 MHz	512 KB		-	1 (10/100 BASE-Tx)	

1.2. Modbus Protocol

1.2.1. What is the Modbus protocol?

Modbus is a communication protocol originally developed for Modicon controllers by Modicon Inc. in 1979. Modbus is a standard, truly open protocol and is the most widely used network communication protocol in the industrial automation field. SCADA (Supervisor Control and Data Acquisition) and HMI (Human-Machine Interface) software can be used to easily integrate serial devices via the Modbus protocol.

1.2.2. What is the Modbus/TCP protocol?

The Modbus/TCP protocol is a variant of the original Modbus protocol that was developed in 1999 to allow access to Ethernet devices by the Internet community.

1.2.3. What software supports the Modbus and Modbus/TCP protocol?

Most SCADA and HMI software packages include support for the Modbus protocol. For example: ControlMaestro, DASYLab(Section 3.2), EZ Data Logger(Section 3.3), Iconics GENESIS32/64, iFIX, InduSoft Web Studio, LabView, Trace Mode, StruxureWare SCADA Expert Vijeo Citect(Section 3.1), Wonderware Intouch, etc.

1.2.4. What are the benefits of using Modbus and Modbus/TCP?

A. Open source, no license fees
B. Widely supported by SCADA and HMI software
C. Easy to use
D. Easily integrated with a variety of devices
E. Low development cost
F. Wide knowledge base

1.2.5. Modbus Resources

A. http://www.modbus.org
A community for Modbus users.
B. http://www.modbustools.com/modbus_activex.asp
An ActiveX control that can be used to communicate with a Modbus slave device via the Modbus (RTU/ASCII) or Modbus/TCP protocols.

1.3. Default Firmware Features

When purchased, the IP-8000-MTCP/I-8000-MTCP controller already contains the default Modbus firmware installed Flash memory, and includes the following features.

1.3.1. Support for the Modbus/TCP communication protocol that allows access to I/O devices inserted in the I/O slots

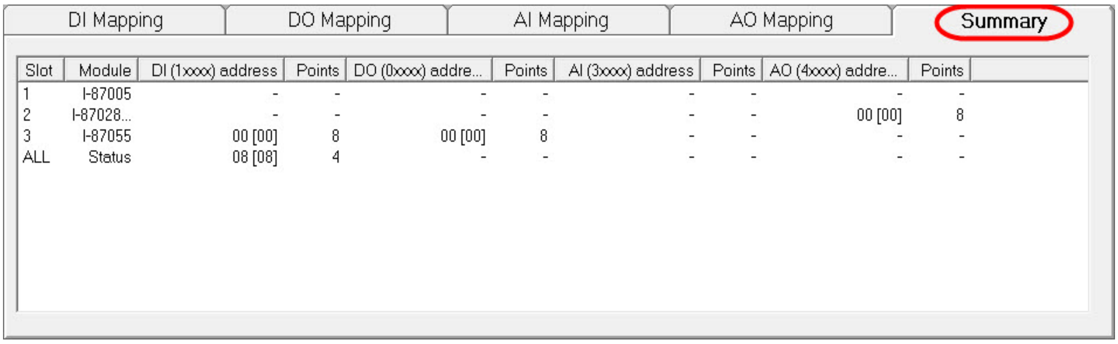
The default firmware allows the controller to be connected via Ethernet in order to transmit Modbus commands in Modbus/TCP protocol format.

1.3.2. Support for the VxComm technique for all COM ports on connected controllers

Even if a serial device doesn't support the Modbus/RTU protocol, it can still be accessed via Ethernet. However, the VxComm driver will first need to be installed on the Host PC and the COM ports assigned in order to link to the COM ports on the controller. Once installed, the serial clients will then be able to access these remote serial devices via Ethernet using standard RS-232 functions.
The latest VxComm driver for Windows XP (or later) can be downloaded from:
http://ftp.icpdas.com/pub/cd/8000cd/napdos/driver/vxcomm_driver/2k/

1.3.3. Automatic I/O module scanning

Once a connection is created, the default firmware will automatically scan all the I/O slots of any connected modules and then display the module information in the "Summary" table which will be describe in more detail in Section 2.1, as illustrated below.



Slot	Module	DI (1xxxx) address	Points	DO (0xxxx) addre...	Points	AI (3xxxx) address	Points	AO (4xxxx) addre...	Points
1	I-87005	-	-	-	-	-	-	-	-
2	I-87028...	-	-	-	-	-	-	00 [00]	8
3	I-87055	00 [00]	8	00 [00]	8	-	-	-	-
ALL	Status	08 [08]	4	-	-	-	-	-	-

1.3.4. Automatic assignment of a register address for the I/O modules

An I/O module can be inserted into any slot, and the Modbus firmware will automatically scan all slots and assign the I/O channels to the registers in a continuous range. The register mapping for all the I/O channels can be retrieved by connecting to the controller using the Modbus Utility.

1.3.5. Allows simultaneous access by multiple clients (or masters)

Different controllers support a different number of connections to a client. For more details, refer to the FAQ on the ICPDAS web site.
http://www.icpdas.com/faq/7188e/hardware/003.htm

1.3.6. Online configuration via Ethernet using the Modbus Utility

1.3.7. Supports I-8000 and I-87000 series I/O modules

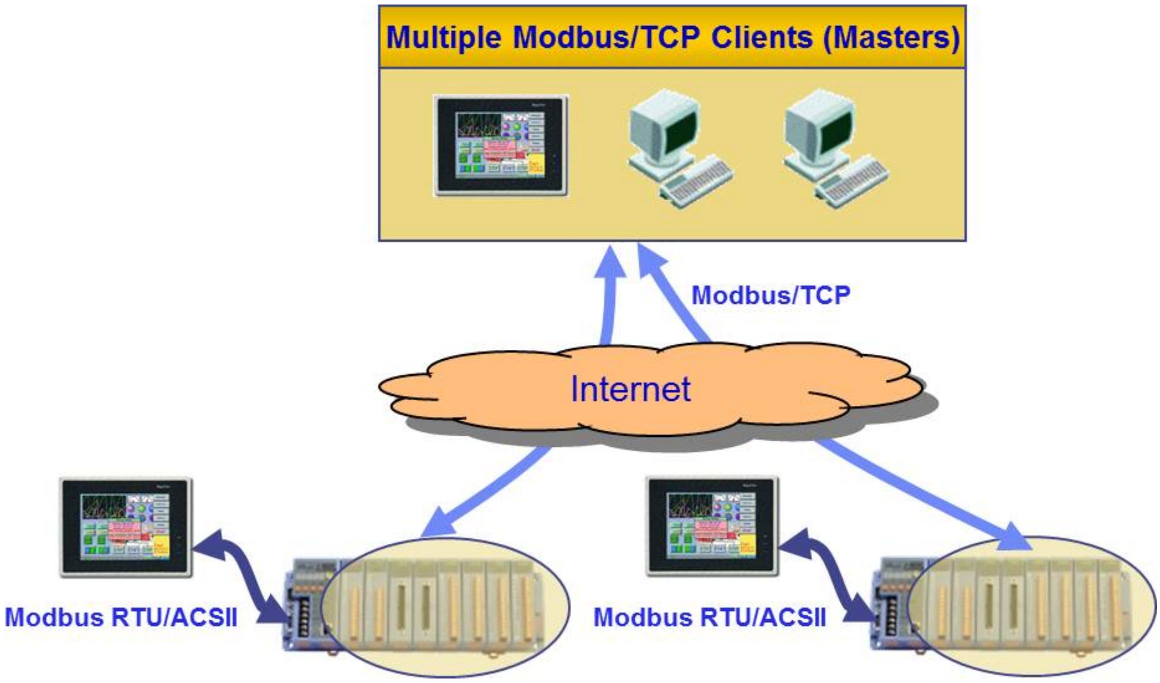
1.3.8. Updateable and programmable firmware

The Modbus SDK provided by ICP DAS allows users to develop custom Modbus firmware. For more details related to the IP-8000-MTCP, refer to the following:
http://ftp.icpdas.com/pub/cd/8000cd/napdos/modbus/ip8000/demo/bc/

1.4. Typical Applications

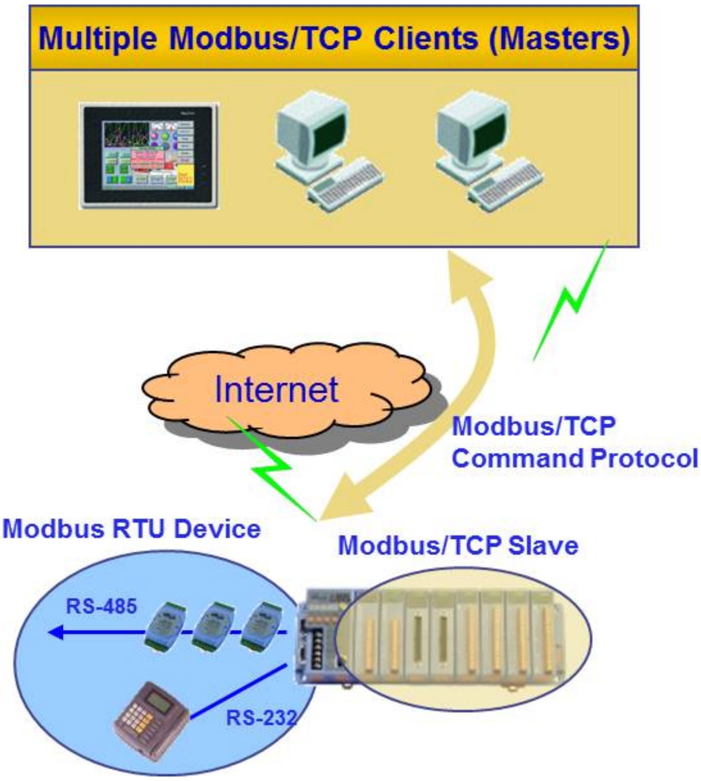
1.4.1. Basic Application 1: Modbus TCP I/O Device

An I-8000-MTCP running the default firmware operates as a Modbus/TCP slave I/O device. Use the Modbus Utility to configure the device and then create a connection between the SCADA/HMI software and the I-8000-MTCP.



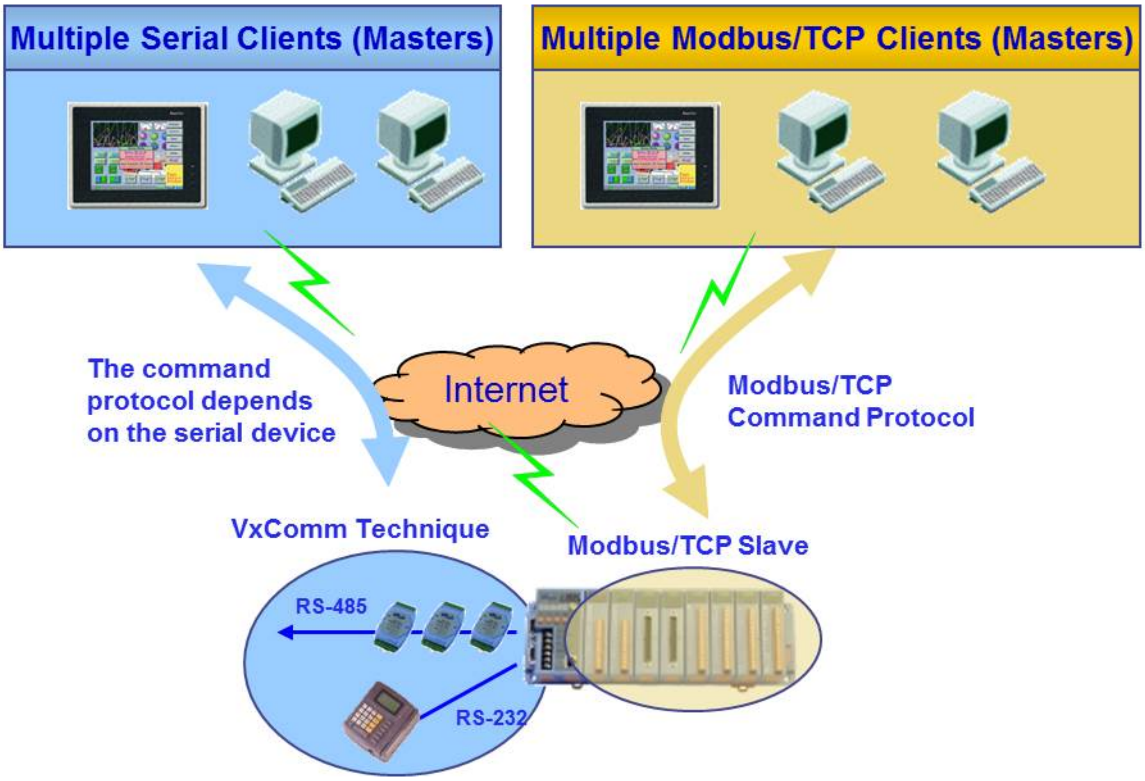
1.4.2. Basic Application 2: Modbus/RTU to Modbus/TCP Converter

After setting the COM Port to Gateway mode via the Modbus Utility, the Modbus/RTU device can be linked to the I-8000-MTCP using the Modbus/TCP protocol. The SCADA/HMI software can then be configured to convert the Modbus/RTU device to a Modbus/TCP device.



1.4.3. Basic Application 3: Modbus/TCP I/O Device using the VxComm Technique

An I-8000-MTCP is also able to link serial devices that are connected to the COM ports on the I-8000-MTCP device. To use this function, the VxComm driver first needs to be installed on the Host PC. After the driver is installed, the remote COM ports can be accessed via the standard serial driver.

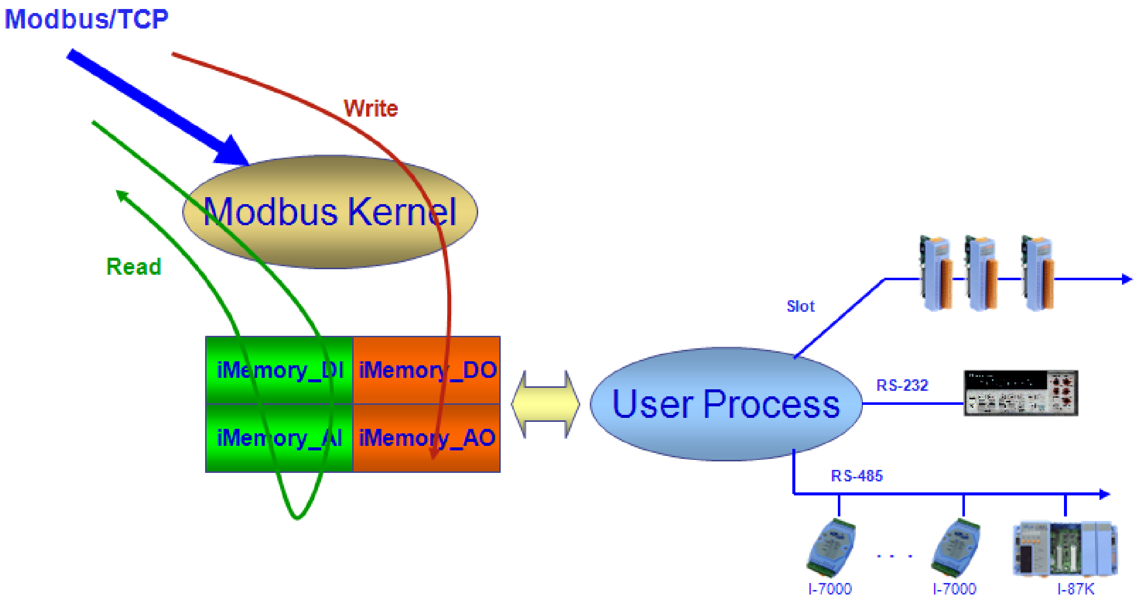

Multiple Serial Clients (Masters)
Multiple Modbus/TCP Clients (Masters)
The command protocol depends on the serial device
Internet
Modbus/TCP Command Protocol
VxComm Technique
Modbus/TCP Slave
RS-485
RS-232

1.4.4. Advanced Application 1: User-defined Modbus/TCP Controller

Using the Modbus SDK, custom firmware can be developed that allows access to additional functions, together with the integration of serial devices with the Modbus/TCP kernel, making the I-8000-MTCP a powerful controller. For demo of user-defined SDK related to the I-8000-MTCP, refer to the following: http://ftp.icpdas.com/pub/cd/8000cd/napdos/modbus/8000e/demo/bc/

1.4.5. Advanced Application 2: Modbus/TCP Controller using the VxComm Technique

If an I-8000-MTCP controller is used to link the same hardware devices as described in Advanced Application 1 above, and if any of devices connected to specific COM ports are not integrated into the custom firmware, the COM ports can still be accessed using the standard serial driver. However, in order to do this, the VxComm driver must first be installed on the Host PC.

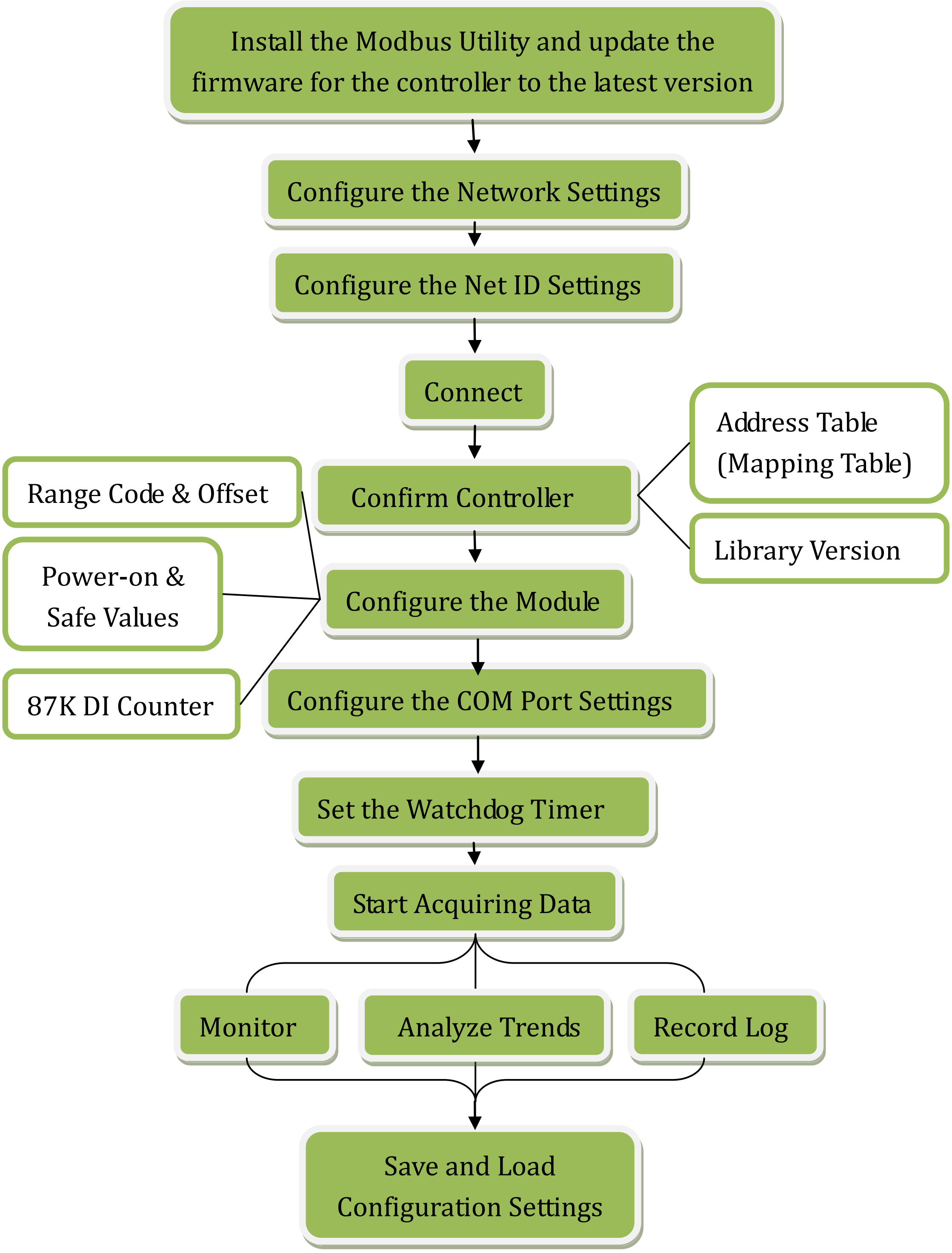


1.5. Supported Modules

For details of which I/O modules are supported by the different controllers, go to http://ftp.icpdas.com/pub/cd/8000cd/napdos/modbus/8000e/document/mbt8_support_modules.htm

2. Starting the Modbus Utility

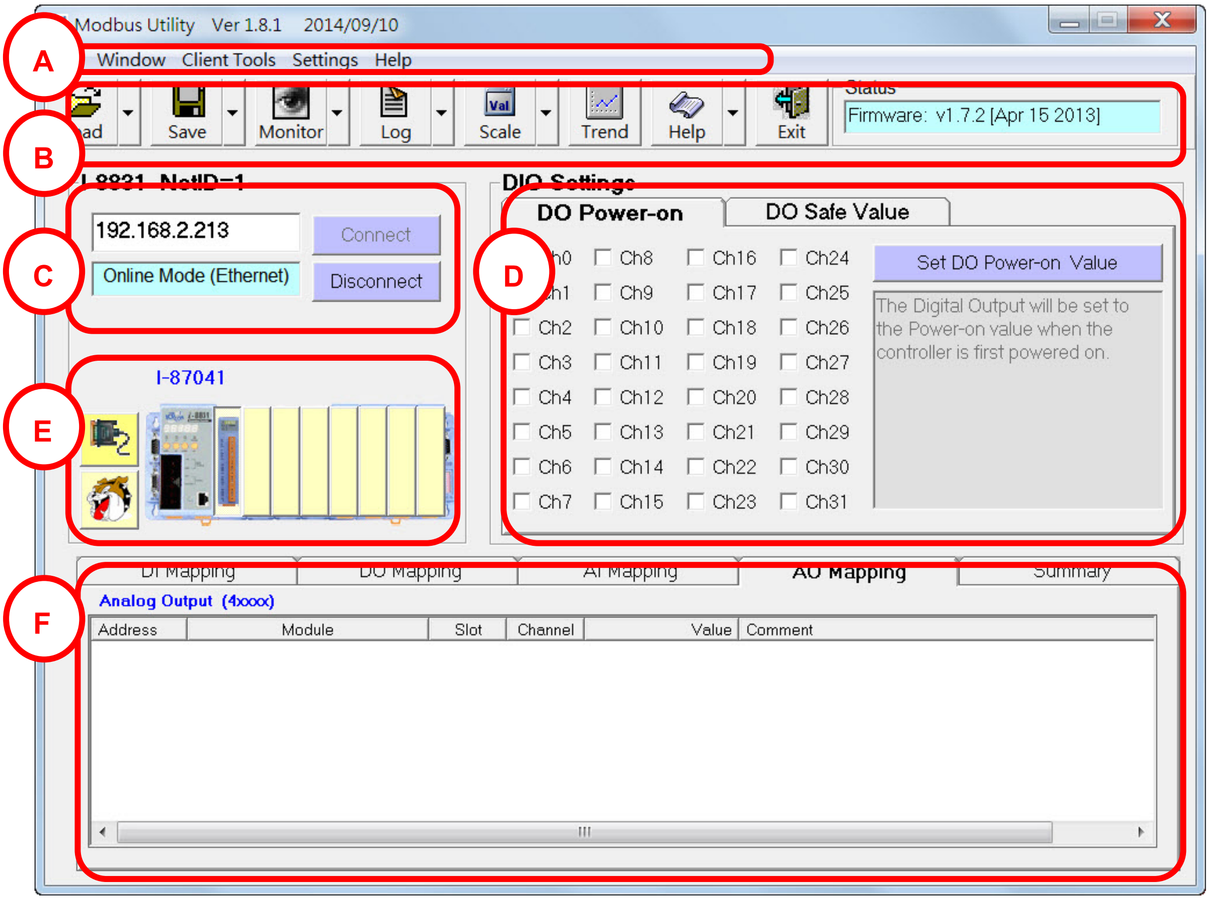
The following is an overview of the process flow used to establish a connection between the controller and the Modbus Utility, then retrieve the I/O data and set the I/O values.


Install the Modbus Utility and update the firmware for the controller to the latest version
Configure the Network Settings
Configure the Net ID Settings
Connect
Address Table (Mapping Table)
Range Code & Offset
Confirm Controller
Library Version
Power-on & Safe Values
Configure the Module
87K DI Counter
Configure the COM Port Settings
Set the Watchdog Timer
Start Acquiring Data
Monitor
Analyze Trends
Record Log
Save and Load Configuration Settings

The latest version of the Modbus Utility installation file can be downloaded from:
http://ftp.icpdas.com/pub/cd/8000cd/napdos/modbus/modbus_utility/

2.1.Introduction to the User Interface

The following is an illustration of the main user interface of the Modbus Utility.



Modbus Utility Ver 1.8.1 2014/09/10

Status

Firmware: v1.7.2 [Apr 15 2013]

I-8831 NetID=1

192.168.2.213

Online Mode (Ethernet)

The Digital Output will be set to the Power-on value when the controller is first powered on.

Analog Output (4xxxx)

Address	Module	Slot	Channel	Value	Comment

A. Menu Bar

B. Toolbar

C. Connection Panel

D. Power-on Value, Safe Value ,Offset and DI Counter Settings Panel

E. Controller Panel and Module Panel

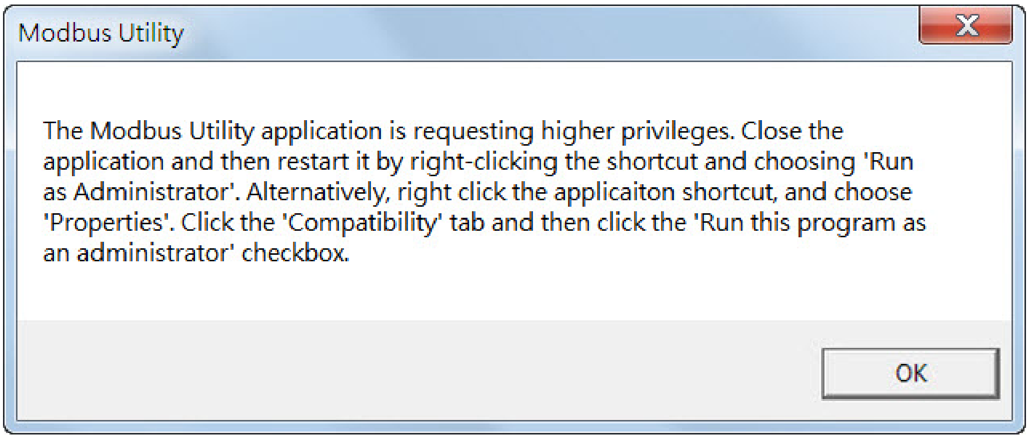
Left-hand side: COM Ports and Watchdog Timer (WDT) Settings

Right-hand side: Module Setting Panel.

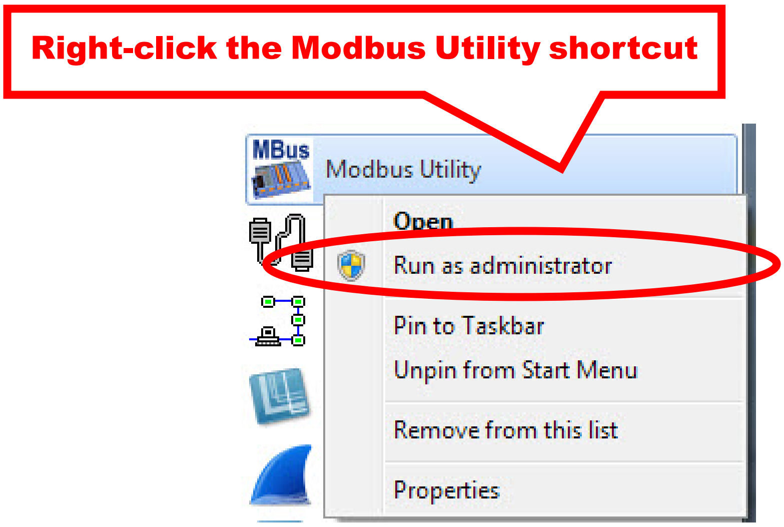
F. Address Table (Mapping Table)

Note: If the warning message shown below is displayed after executing the Modbus Utility, restart the program by right-clicking the shortcut and choosing "Run as administrator" to open the application with Administrator privileges.

Alternatively, right click the application shortcut, and choose “Properties”. Click the “Compatibility” tab and then click the “Run this program as an administrator” checkbox. This method will configure the Utility to always run with Administrator privileges.



The Modbus Utility application is requesting higher privileges. Close the application and then restart it by right-clicking the shortcut and choosing 'Run as Administrator'. Alternatively, right click the applicaiton shortcut, and choose 'Properties'. Click the 'Compatibility' tab and then click the 'Run this program as an administrator' checkbox.



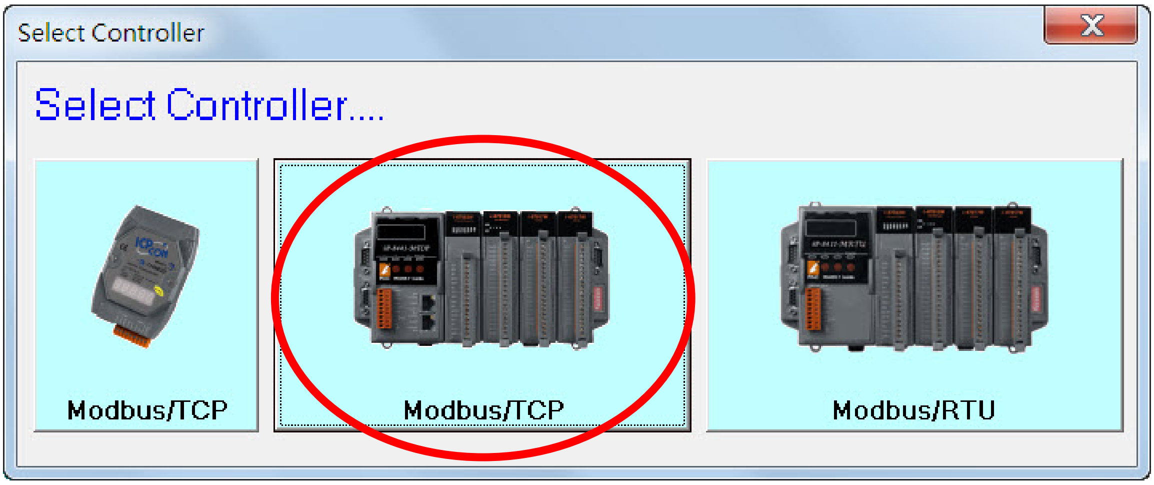
2.2. Updating the Firmware

The "Update Firmware" function is used to update the firmware to the latest version. The firmware can be updated using either a COM port or a UDP connection. However, ensure that the LAN1 on the controller is connected to the network or COM1 port on the controller is connected to the computer before attempting to update the firmware, otherwise the update process will fail.

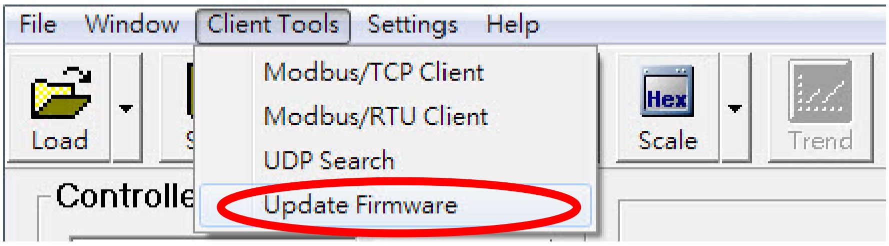
2.2.1. Updating via Ethernet

Step 1: Reboot the controller in INIT mode.
For I-8000 modules, short the INIT* and INIT*COM pins.
For IP-8000 and ET-87PN modules, move the DIP switch to the "Init" position.
For 7188E devices, short the INIT* and GND pins.

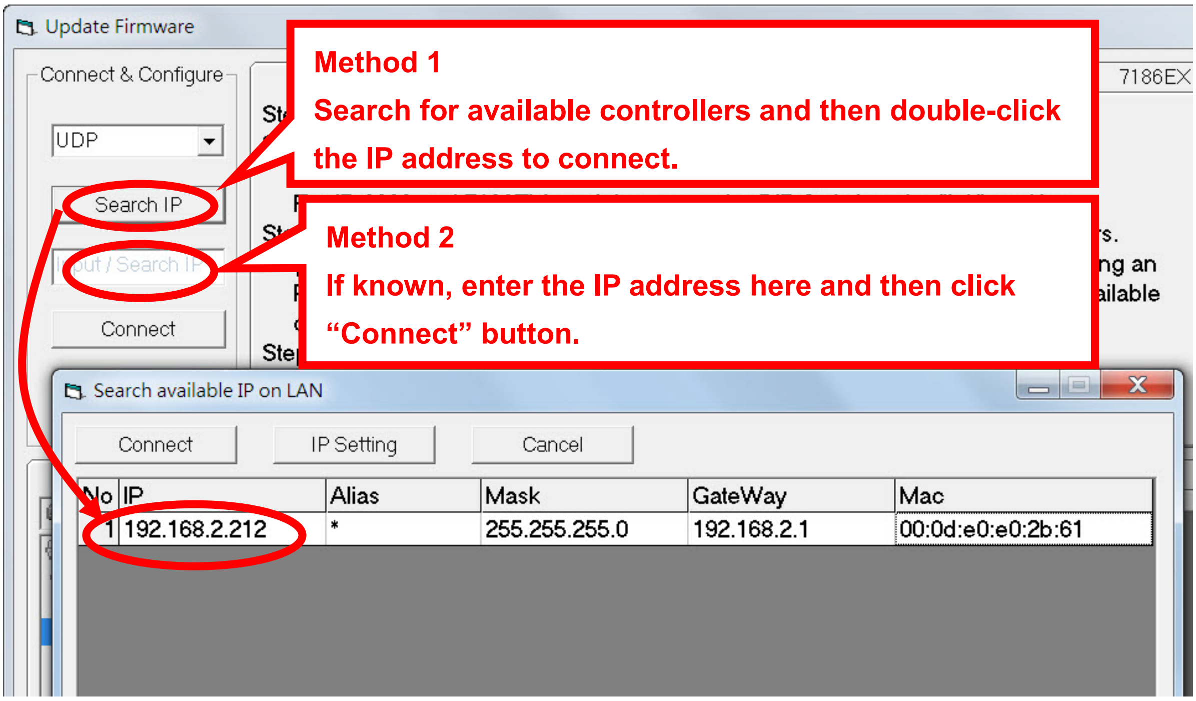
Step 2: Execute the Modbus Utility and select the Modbus/TCP controller mode.



Step 3: Select the "Update Firmware" option from the "Client Tools" menu to connect to the controller.



In the Update Firmware window, select the UDP option from the drop-down menu. If IP address is known, enter the details in the text field and then click the “Connect” button. Alternatively, click the “Search IP” button to search for available controllers on the LAN, and then double-click IP address in the search result to establish a connection to the controller.

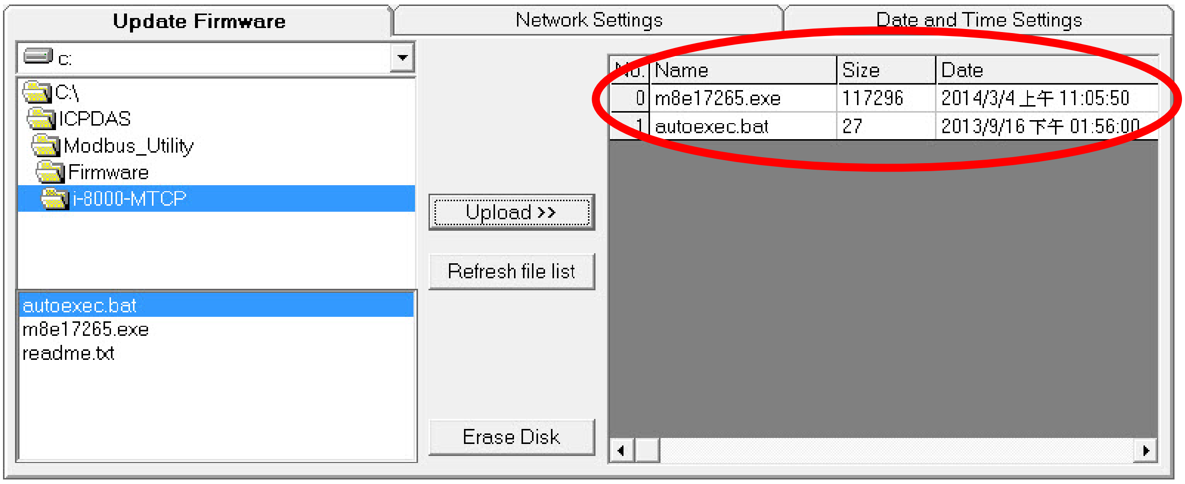


Method 1
Search for available controllers and then double-click the IP address to connect.

Method 2
If known, enter the IP address here and then click “Connect” button.

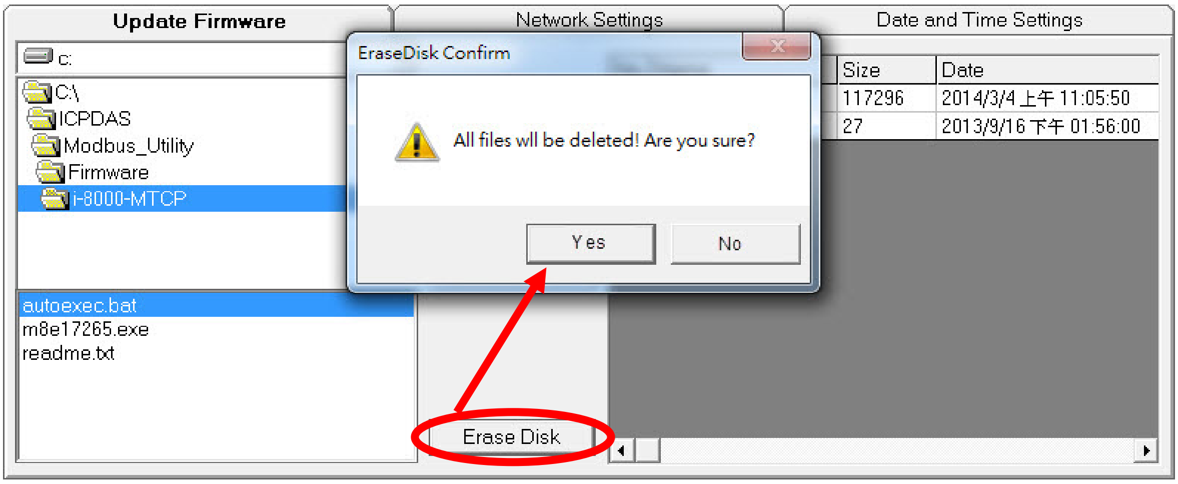
No	IP	Alias	Mask	GateWay	Mac
1	192.168.2.212	*	255.255.255.0	192.168.2.1	00:0d:e0:e0:2b:61

After a connection is establish, the firmware file for the controller will be listed in the “Update Firmware” tab, as shown in the diagram below.



No.	Name	Size	Date
0	m8e17265.exe	117296	2014/3/4 上午 11:05:50
1	autoexec.bat	27	2013/9/16 下午 01:56:00

Step 4: Before the firmware can be updated, all existing files must be deleted. Click the “Erase Disk” button to delete all the files currently existing on the controller.

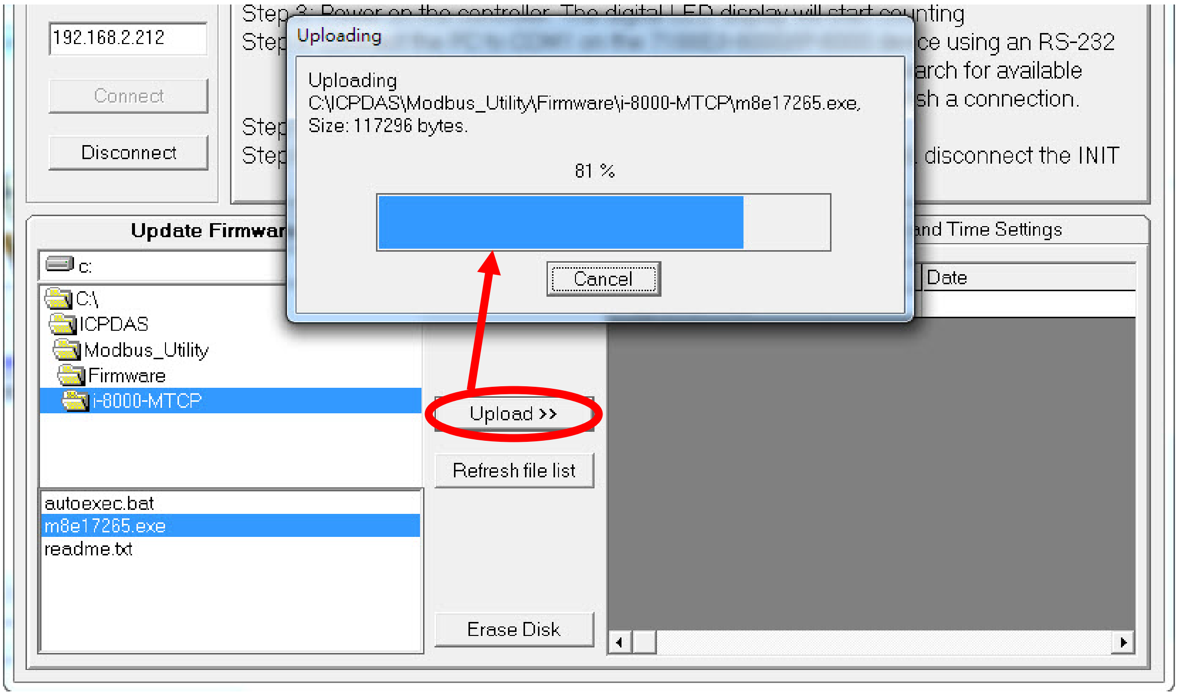


All files wll be deleted! Are you sure?

Size	Date
117296	2014/3/4 上午 11:05:50
27	2013/9/16 下午 01:56:00

Step 5: Select the new firmware file and then click the “Upload >>” button to upload the new firmware to the controller. A progress indicator will be displayed to show the status of the update. After the update process is completed, the new file will be displayed in the file list. If it is not displayed, click the “Refresh file list” button to display the latest files.

The firmware has now been successfully updated. The device must be rebooted before the new firmware becomes effective. If the update fails, go to step4 to update again.



192.168.2.212

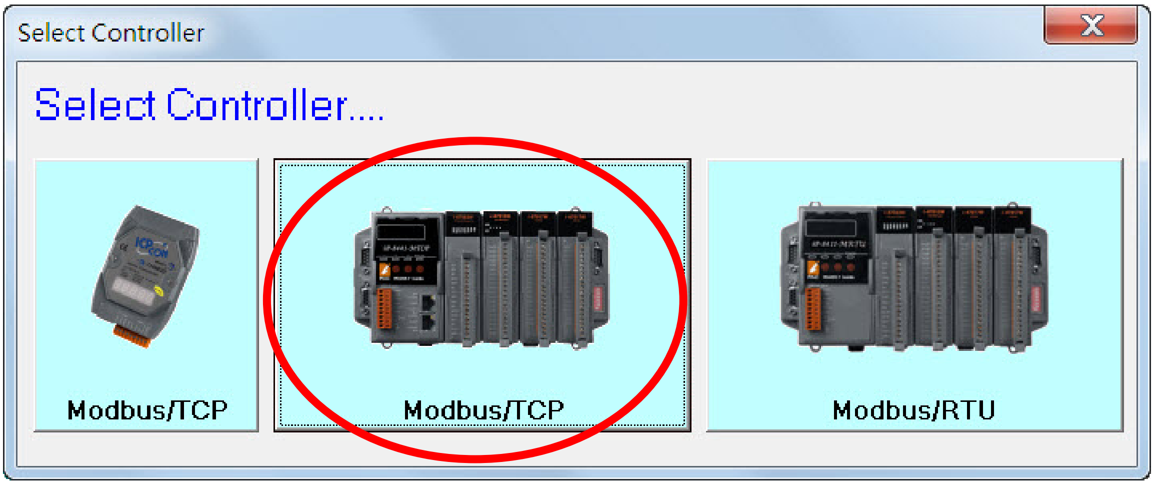
Uploading
C:\ICPDAS\Modbus_Utility\Firmware\i-8000-MTCP\m8e17265.exe,
Size: 117296 bytes.

81 %

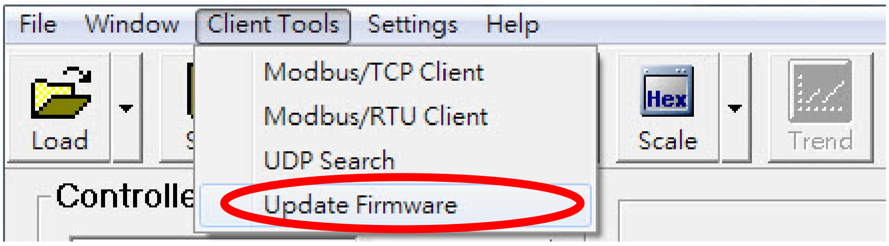
2.2.2. Updating via a Serial Port

Step 1: Reboot the controller in INIT mode.
For I-8000 modules, short the INIT* and INIT*COM pins.
For IP-8000 and ET-87PN modules, move the DIP switch to the “Init” position.
For 7188E devices, short the INIT* and GND pins.

Step 2: Execute the Modbus Utility and select the Modbus/TCP controller mode.

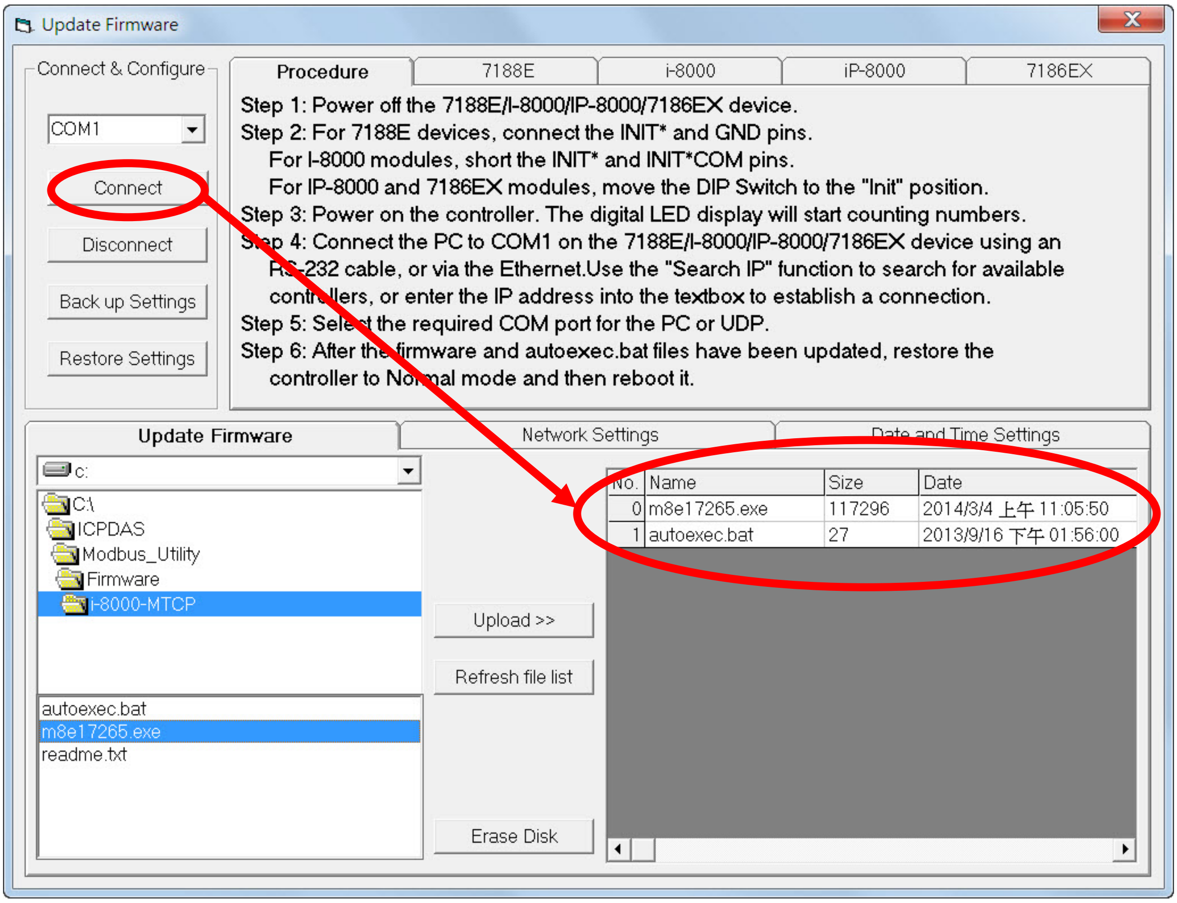


Step 3: Select the “Update Firmware” option from the “Client Tools” menu to connect to the controller.



In the Update Firmware window, select the required COM port from the drop-down menu and then click the "Connect" button. After a connection is established, the firmware file for the controller will be listed in the "Update Firmware" tab, as shown in the diagram below.

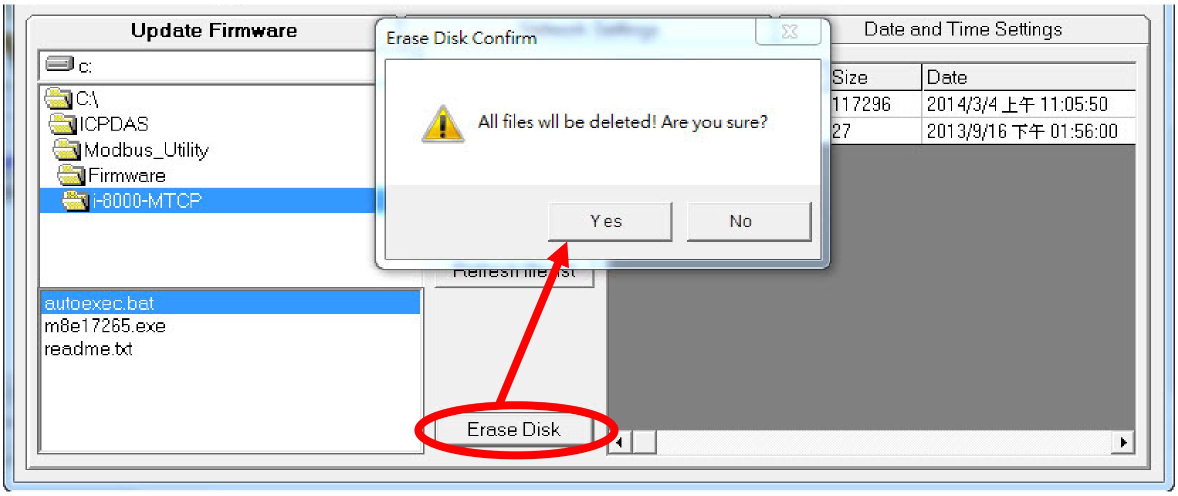
Note: The default COM port settings are "115200, N, 8, 1”.



Step 1: Power off the 7188E/I-8000/IP-8000/7186EX device.
Step 2: For 7188E devices, connect the INIT* and GND pins.
For I-8000 modules, short the INIT* and INIT*COM pins.
For IP-8000 and 7186EX modules, move the DIP Switch to the "Init" position.
Step 3: Power on the controller. The digital LED display will start counting numbers.
Step 4: Connect the PC to COM1 on the 7188E/I-8000/IP-8000/7186EX device using an RS-232 cable, or via the Ethernet.Use the "Search IP" function to search for available controllers, or enter the IP address into the textbox to establish a connection.
Step 5: Select the required COM port for the PC or UDP.
Step 6: After the firmware and autoexec.bat files have been updated, restore the controller to Normal mode and then reboot it.

No.	Name	Size	Date
0	m8e17265.exe	117296	2014/3/4 上午 11:05:50
1	autoexec.bat	27	2013/9/16 下午 01:56:00

Step 4: Before the firmware can be updated, all existing files must be deleted. Click the “Erase Disk” button to delete all the files currently existing on the controller.

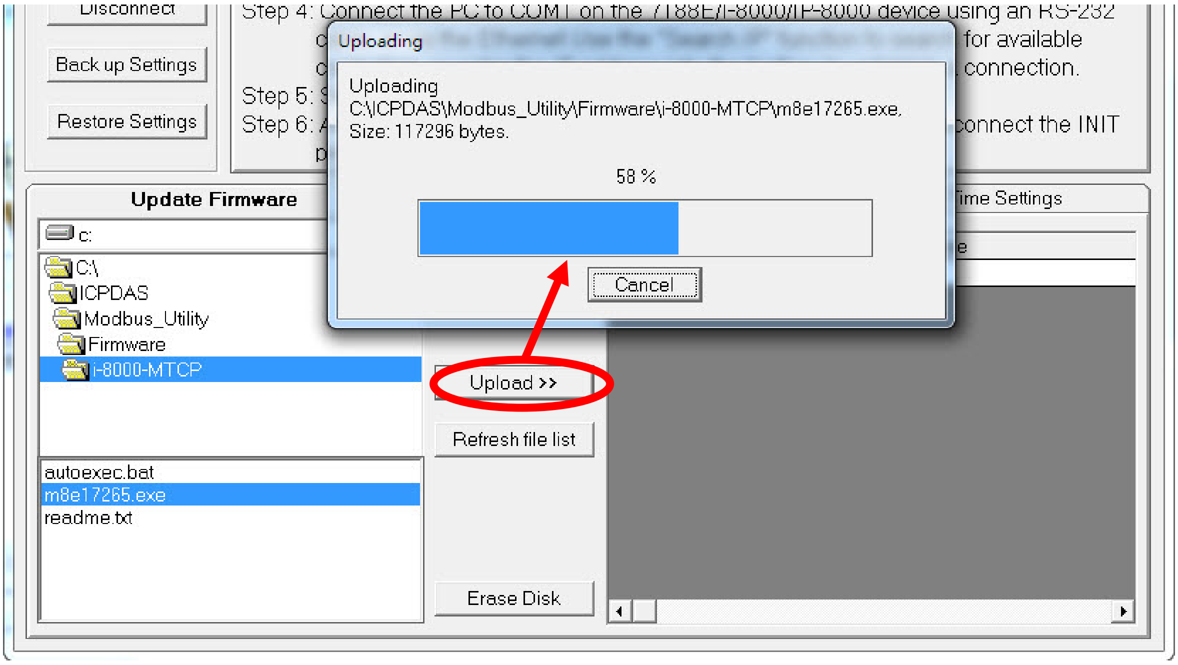


All files wll be deleted! Are you sure?

Size	Date
117296	2014/3/4 上午 11:05:50
27	2013/9/16 下午 01:56:00

Step 5: Select the new firmware file and then click “Upload >>” button to upload the new firmware to the controller. A progress indicator will be displayed to show the status of the update. Once the update process is completed, the new file will be displayed in the file list. If it is not displayed, click the “Refresh file list” button to display the latest files.

The firmware has now been successfully updated. The device must be rebooted before the new firmware becomes effective. If the update fails, go to step4 to update again



Uploading

Uploading C:\ICPDAS\Modbus_Utility\Firmware\i-8000-MTCP\m8e17265.exe.
Size: 117296 bytes.

58 %

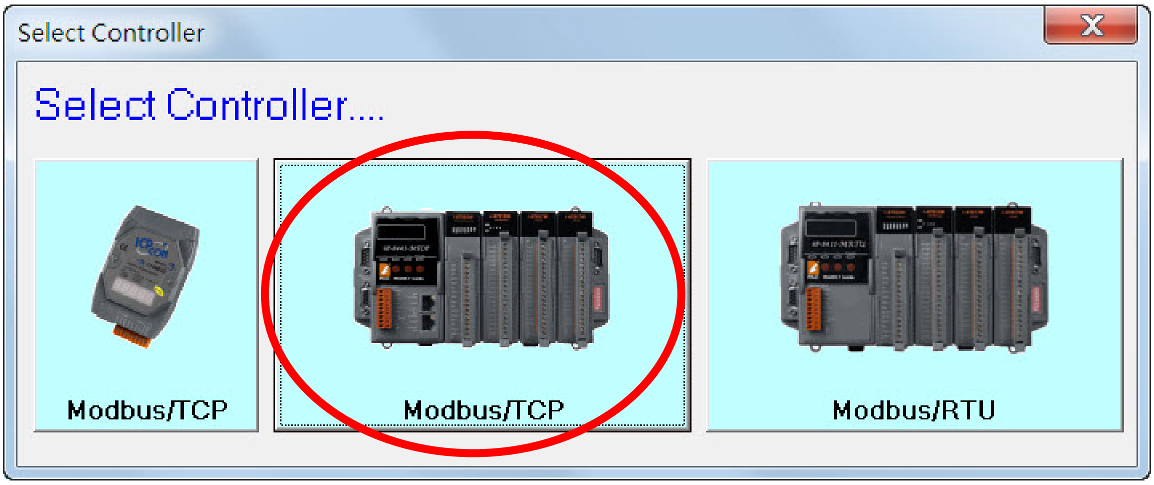
2.3. Network Settings

Before beginning the configuration process, ensure that eitherLAN1 or LAN2 ports on the controller are connected to your network. Two methods can be used to configure the network using a UDP connection.

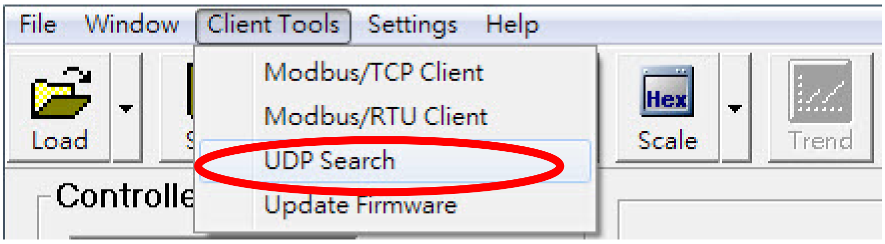
2.3.1. Method 1: Under Running Firmware Mode

Step 1: Make the controller under the running firmware mode.

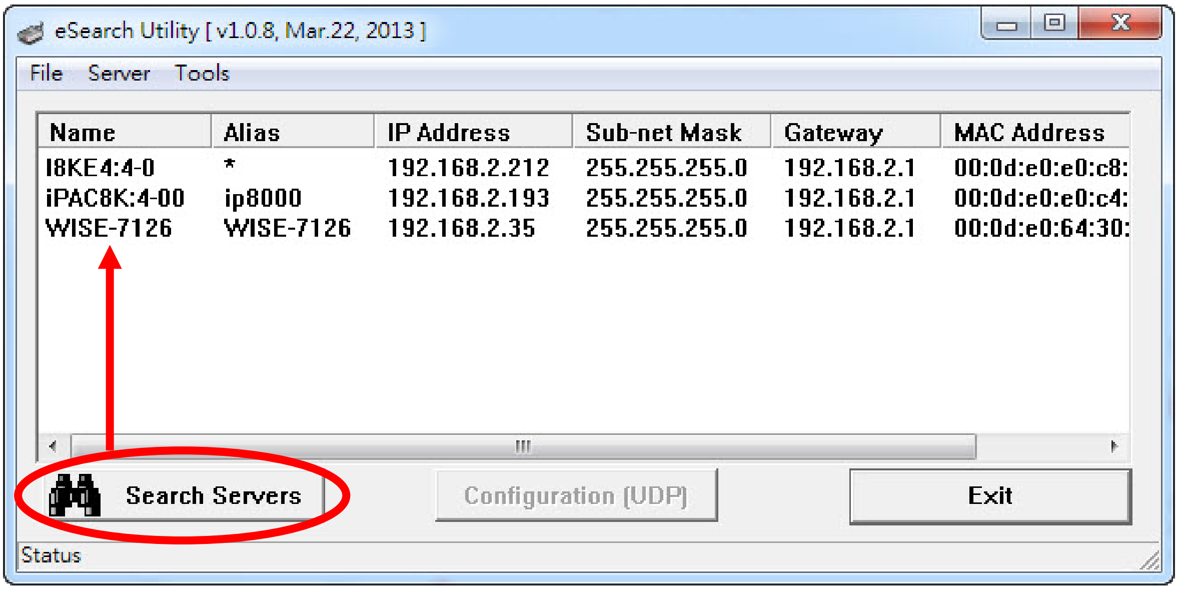
Step 2: Execute the Modbus Utility and select the Modbus/TCP controller mode.



Step 3: Select the "UDP Search" option from the "Client Tools" menu to open the eSearch Utility.

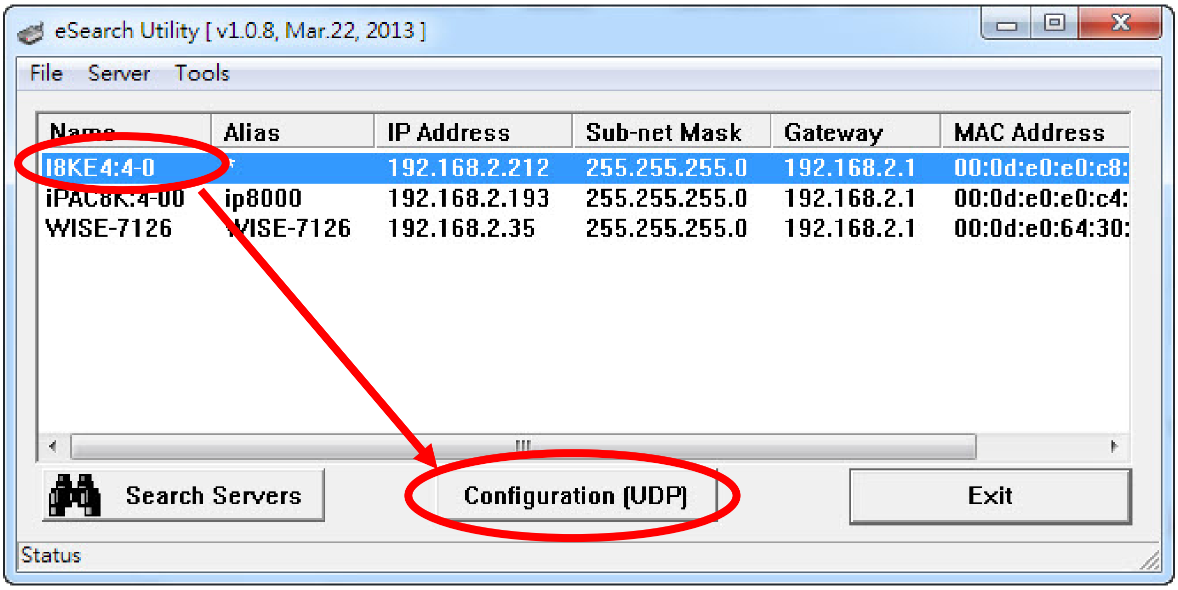


Step 4: In the eSearch Utility window, click the “Search Servers” button to search for any controller connected to the LAN.



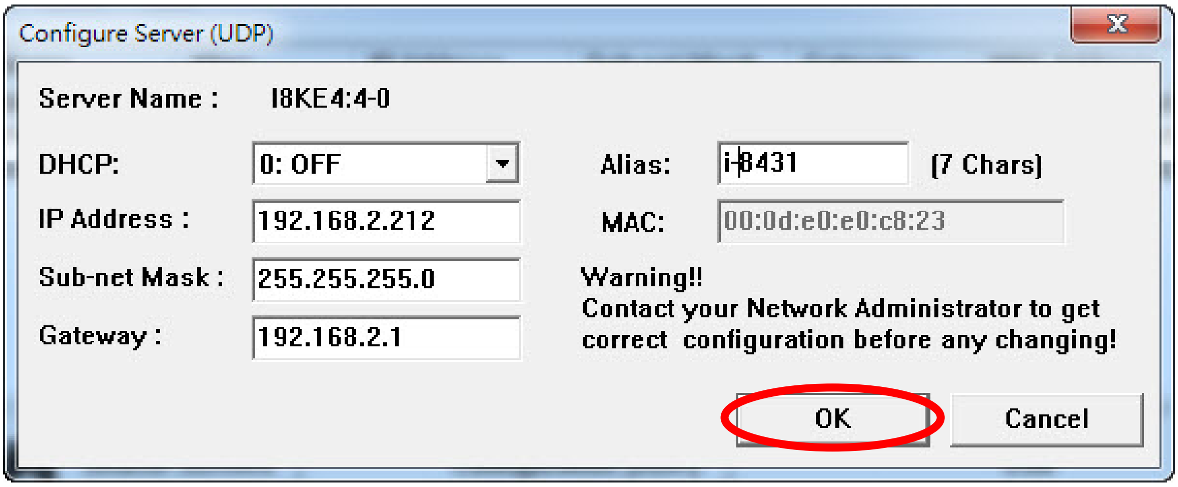
Name	Alias	IP Address	Sub-net Mask	Gateway	MAC Address
I8KE4:4-0	*	192.168.2.212	255.255.255.0	192.168.2.1	00:0d:e0:e0:c8:
iPAC8K:4-00	ip8000	192.168.2.193	255.255.255.0	192.168.2.1	00:0d:e0:e0:c4:
WISE-7126	WISE-7126	192.168.2.35	255.255.255.0	192.168.2.1	00:0d:e0:64:30:

Step 5: Once the search is complete, select the controller that is to be configured and then click the “Configuration (UDP)” button.



Name	Alias	IP Address	Sub-net Mask	Gateway	MAC Address
I8KE4:4-0	*	192.168.2.212	255.255.255.0	192.168.2.1	00:0d:e0:e0:c8:
iPAC8K:4-00	ip8000	192.168.2.193	255.255.255.0	192.168.2.1	00:0d:e0:e0:c4:
WISE-7126	WISE-7126	192.168.2.35	255.255.255.0	192.168.2.1	00:0d:e0:64:30:

Enter the required details in the DHCP, IP Address, Sub-net Mask, Gateway, and Alias fields, and then click the "OK" button to save the settings.



Server Name : I8KE4:4-0

DHCP: 0: OFF

IP Address : 192.168.2.212

Sub-net Mask : 255.255.255.0

Gateway : 192.168.2.1

Alias: i-8431 (7 Chars)

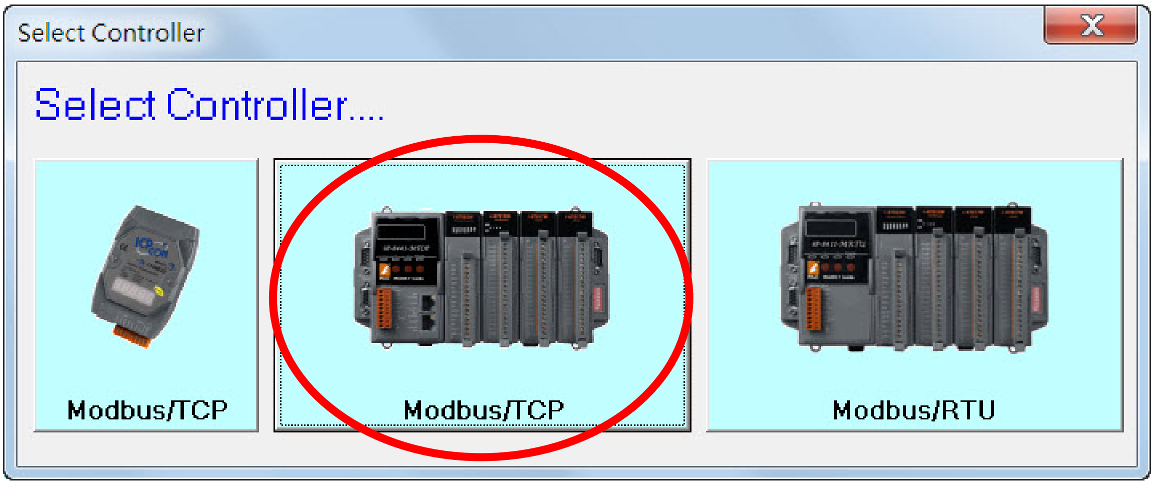
MAC: 00:0d:e0:e0:c8:23

Warning!!
Contact your Network Administrator to get correct configuration before any changing!

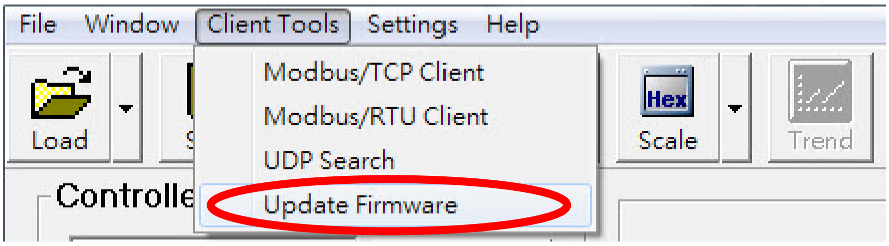
2.3.2. Method 2: While Operating in INIT Mode

Step 1: Reboot the controller in INIT mode.
For I-8000 modules, short the INIT* and INIT*COM pins.
For IP-8000 and ET-87PN modules, move the DIP switch to the "Init" position.
For 7188E devices, short the INIT* and GND pins.

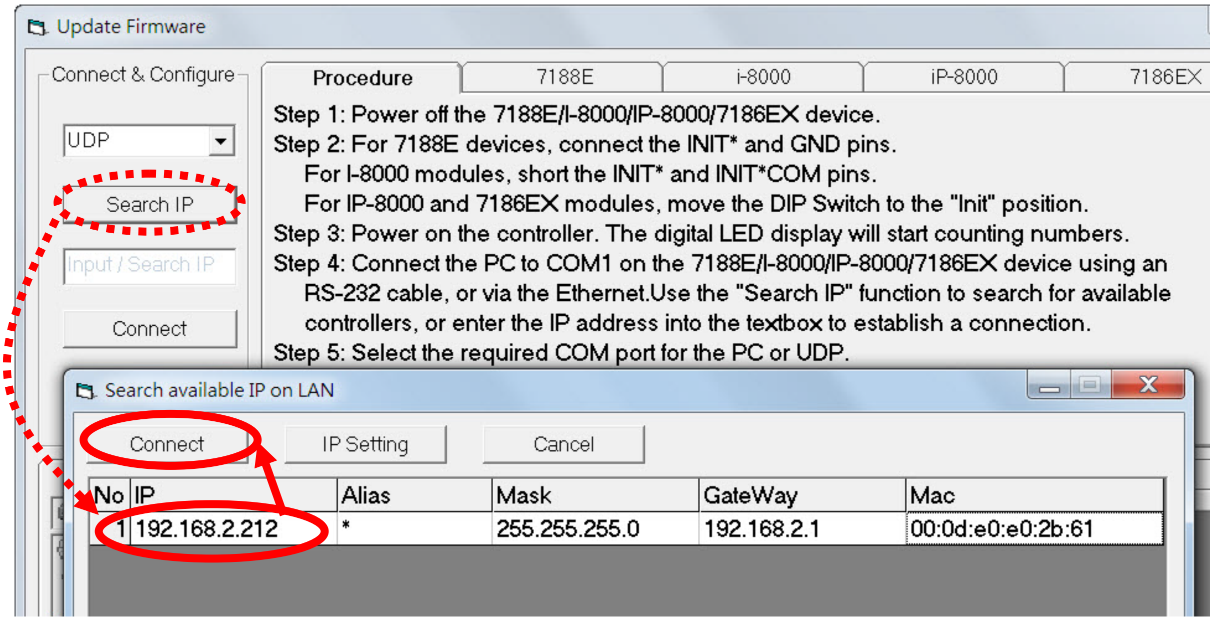
Step 2: Execute the Modbus Utility and select the Modbus/TCP controller mode.



Step 3: Select the "Update Firmware" option from the "Client tools" menu.



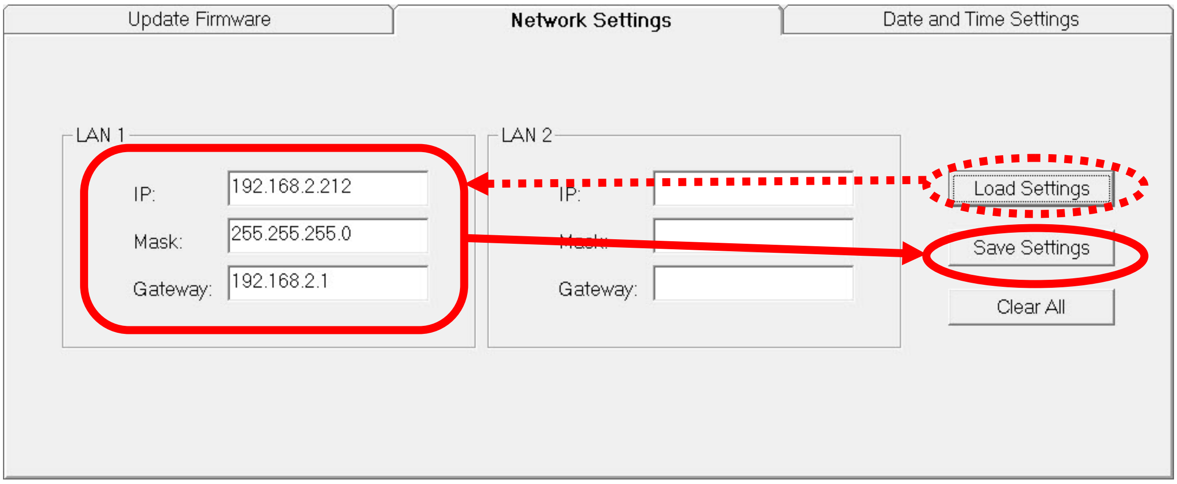
Step 4: In the Update Firmware window, select the UDP option from the drop-down menu, and click the "Search IP" button to search for available controllers connected to the LAN. Once the search is complete, select an IP address and then click the “Connect” button to establish a connection.



Step 1: Power off the 7188E/I-8000/IP-8000/7186EX device.
Step 2: For 7188E devices, connect the INIT* and GND pins.
For I-8000 modules, short the INIT* and INIT*COM pins.
For IP-8000 and 7186EX modules, move the DIP Switch to the "Init" position.
Step 3: Power on the controller. The digital LED display will start counting numbers.
Step 4: Connect the PC to COM1 on the 7188E/I-8000/IP-8000/7186EX device using an RS-232 cable, or via the Ethernet.Use the "Search IP" function to search for available controllers, or enter the IP address into the textbox to establish a connection.
Step 5: Select the required COM port for the PC or UDP.

No	IP	Alias	Mask	GateWay	Mac
1	192.168.2.212	*	255.255.255.0	192.168.2.1	00:0d:e0:e0:2b:61

Step 5: In the Update Firmware window, select the “Network Settings” tab and then click the “Get Settings” button. The current network settings will be displayed in the text fields for LAN1. Edit the settings as required and then click the "Save Settings" button to save the new settings.



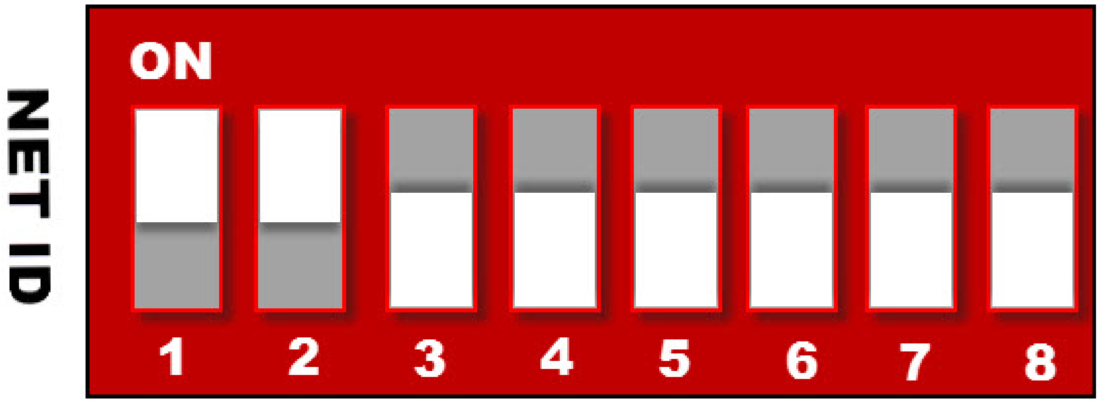
LAN 1
IP: 192.168.2.212
Mask: 255.255.255.0
Gateway: 192.168.2.1

After the new network are saved, the Modus Utility will automatically connect to the controller using the new IP address.

2.4. Net ID (Station Number) Settings

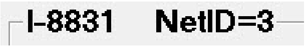
The Net ID is a hexadecimal value that can be range from 01 to FF and must be unique in the network. Set the Net ID by following the procedure described below.

Step 1: The Net ID is set using the 8-bit DIP switch located on the right-hand side of the controller. To set the Net ID, move the DIP switch for the required bit to the ON position. The following figure shows the Net ID for the controller. Bits 1 and 2 are in the ON position and the others are set to OFF, meaning that the Net ID for the controller is 3.



Step 2: Reboot the controller to enable the new Net ID

Step 3: After reconnecting to the controller, the Net ID for the controller will be displayed in the connection panel as described in Introduction to the User Interface (Item C).

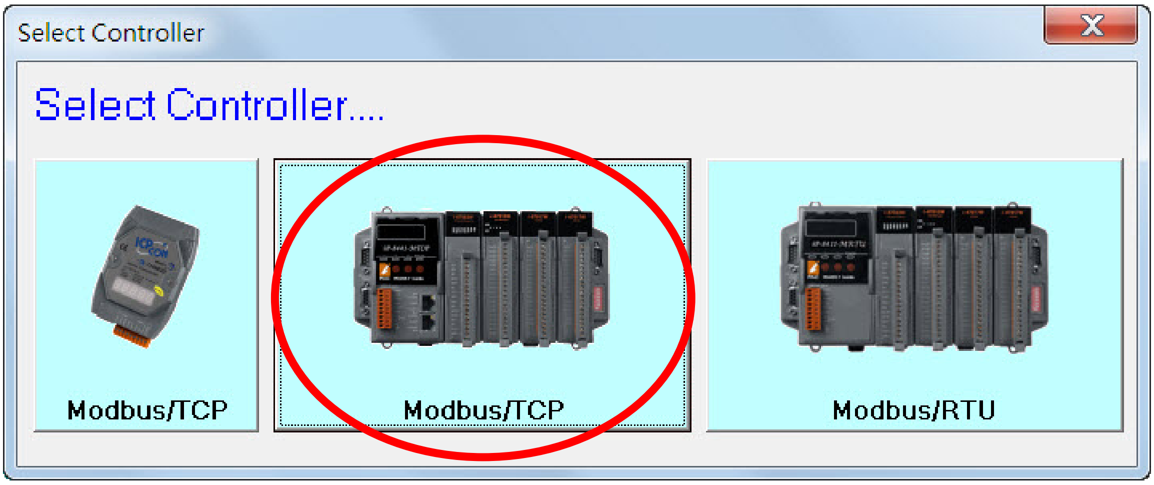

I-8831 NetID=3

2.5. Connecting to the Controller

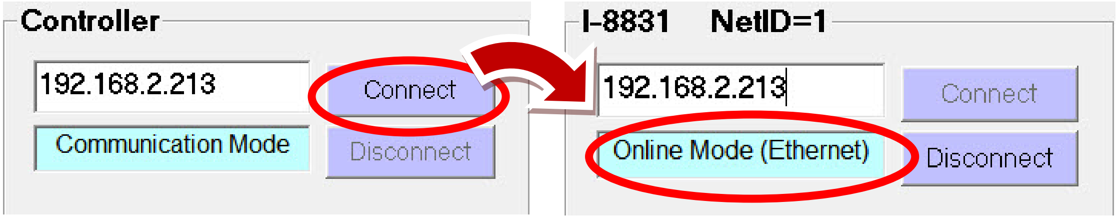
Before performing the following operation, ensure that the controller is set to "Run Firmware" mode, insert the modules, and then turn on the power.

2.5.1. Connecting via the Ethernet (Modbus/TCP)

Step 1: Execute the Modbus Utility and select the Modbus/TCP controller mode.



Step 2: Enter the IP address for the controller in the Connection Panel described in Introduction to the User Interface (Item C), and then click the “Connect” button. If a connection is successfully established, the connection status will be displayed in the text field indicated in the image below.


Controller

192.168.2.213

Communication Mode

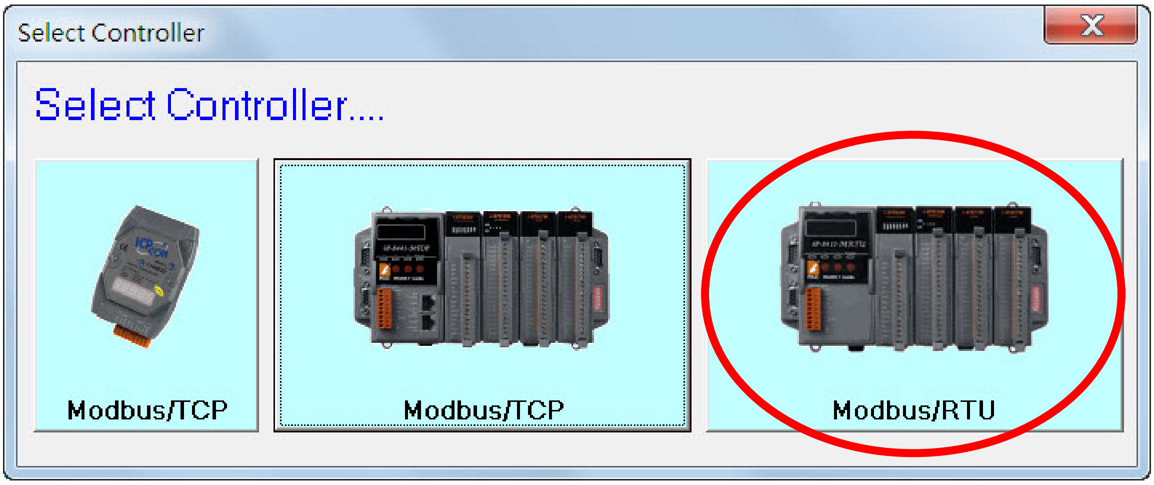
I-8831 NetID=1

192.168.2.213

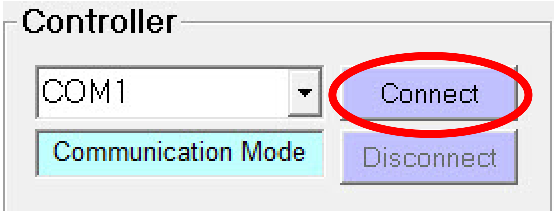
Online Mode (Ethernet)

2.5.2. Connecting via a Serial Port (Modbus/RTU)

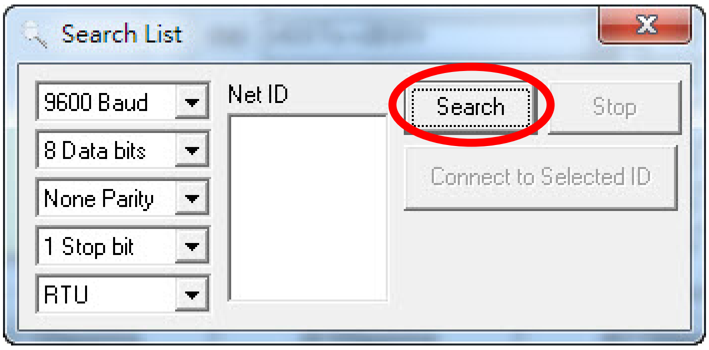
Step 1: Execute the Modbus Utility and select the Modbus/RTU controller mode.



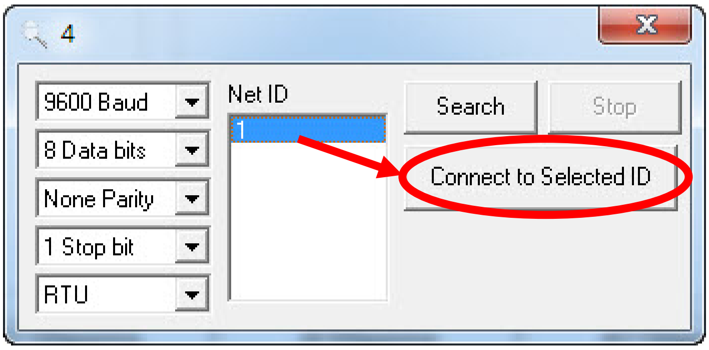
Step 2: In the Connection Panel described in Introduction to the User Interface (Item C), select the COM port and click "Connect" on the connect panel. It will open a Search List window in the next step to search for required device on the selected COM port.



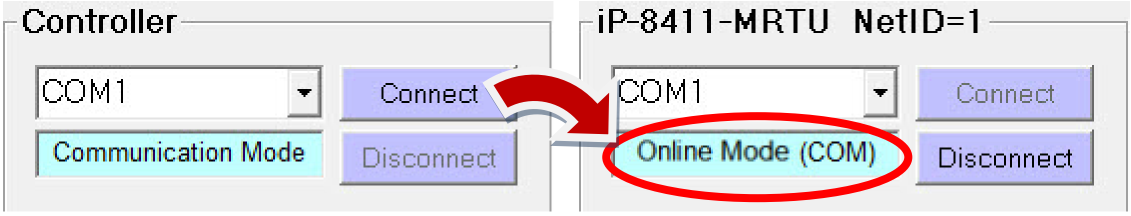
Step 3: Click the "Search" button to search for any available devices. Once the required device has been located, click the "Stop" button to stop searching.



Step 4: Select the Net ID from the search result list, and then click the "Connect to Selected ID" button to establish a connection.

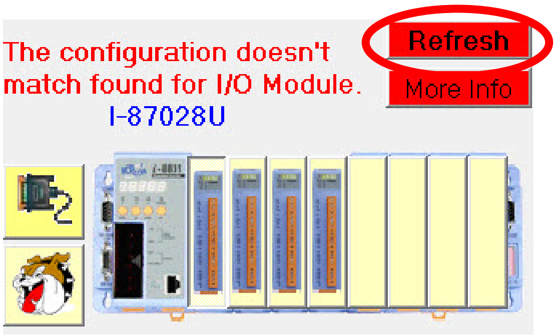


If COM port is successfully opened, the status will be displayed in the text field indicated in the image below.



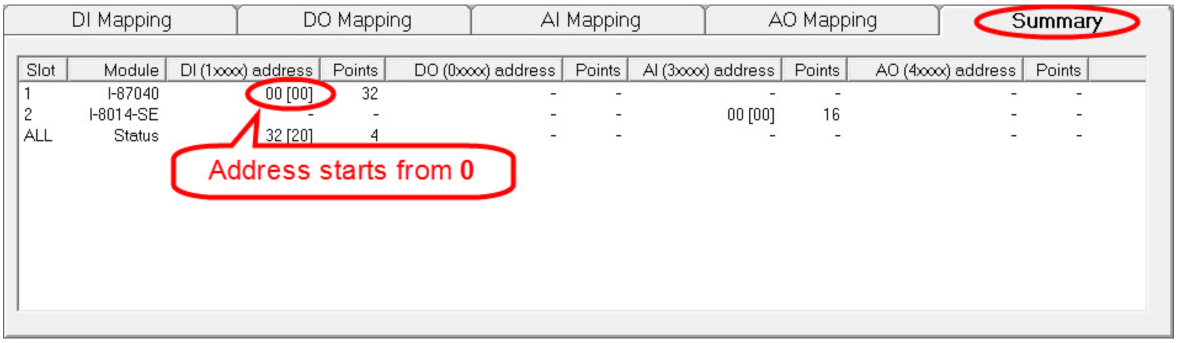
2.5.3. Refreshing the Configuration after Connecting

If the current configuration for any of the modules on the controller does not match the setting stored in the EEPROM, click the "Refresh" button to save the current configuration to the EEPROM.


The configuration doesn't match found for I/O Module.
I-87028U

2.6. Address Table (Mapping Table)

After connecting to the module, click the **Summary** tab in the address/mapping table dialog to check the information related to the module, including the slot number for the module and addresses of the I/O channels (points).
Note: The I/O addresses listed here are Base 0.



Slot	Module	DI (1xxxx) address	Points	DO (0xxxx) address	Points	AI (3xxxx) address	Points	AO (4xxxx) address	Points
1	I-87040	00 [00]	32	-	-	-	-	-	-
2	I-8014-SE	-	-	-	-	00 [00]	16	-	-
ALL	Status	32 [20]	4	-	-	-	-	-	-

2.7. Library Version

The library version depends on the version of the installed firmware. The latest version of the firmware can be obtained from the following locations.

For 7188E:
http://ftp.icpdas.com/pub/cd/8000cd/napdos/modbus/7188e/firmware/

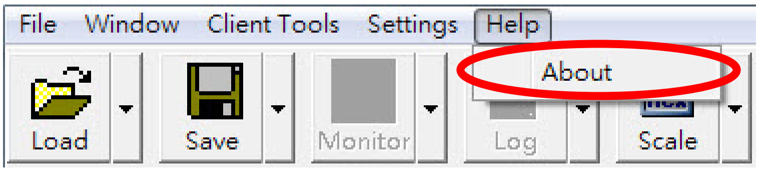
For ET-87PN:
http://ftp.icpdas.com/pub/cd/8000cd/napdos/modbus/et87pn/firmware/

For I-8000-MTCP:
http://ftp.icpdas.com/pub/cd/8000cd/napdos/modbus/8000e/firmware/

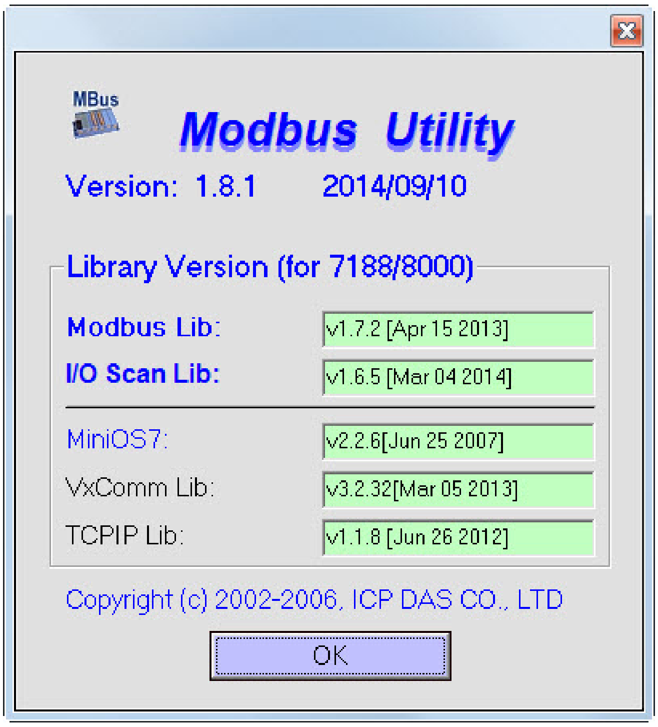
For IP-8000-MTCP:
http://ftp.icpdas.com/pub/cd/8000cd/napdos/modbus/ip8000/firmware/

Use the procedure described below to check the version information for the current library:

Step 1: Select the "About" option from the "Help" menu.



Step 2: The version information will be displayed in the Modbus Utility "About" dialog box.



MBus

Modbus Utility

Version: 1.8.1 2014/09/10

Library Version (for 7188/8000)

Modbus Lib:	v1.7.2 [Apr 15 2013]
I/O Scan Lib:	v1.6.5 [Mar 04 2014]
MiniOS7:	v2.2.6[Jun 25 2007]
VxComm Lib:	v3.2.32[Mar 05 2013]
TCPIP Lib:	v1.1.8 [Jun 26 2012]

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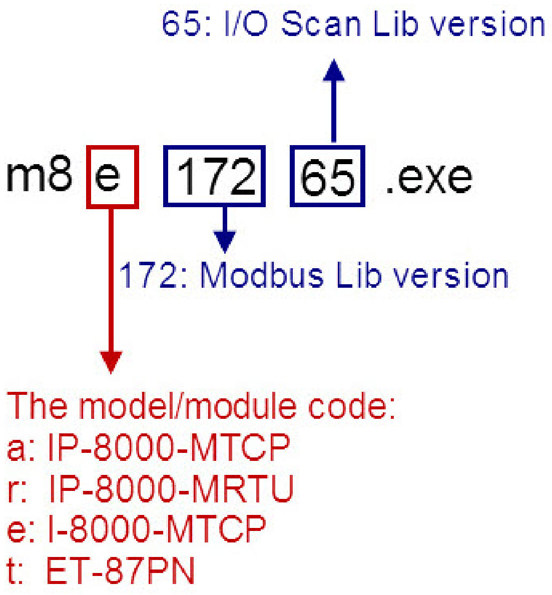
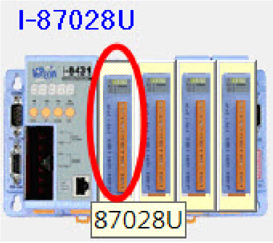
The Modbus Library and the I/O scan Library are related to the firmware name. The version information is shown in the firmware name.



2.8. Analog Module Range Code and Offset Settings

To change the Range Code and Offset settings of Analog modules, click the module that is to be configured to display the Range Code Settings Panel.

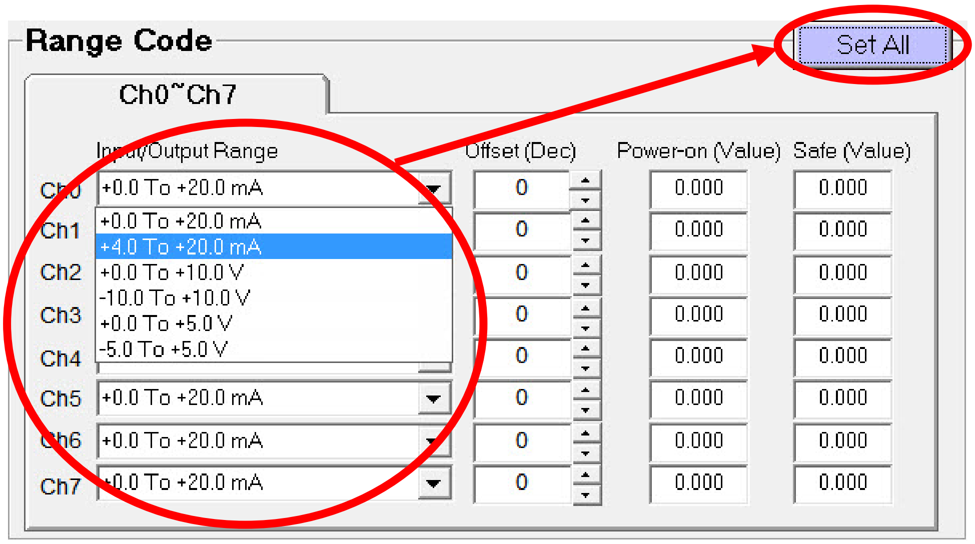


The example shown here is for the I-87028U module.

2.8.1. Range Code

The Range code is used to set the maximum and minimum input/output range for the Analog modules and only valid signals within this range will be transmitted.

Configure the Range Code settings in the Settings Panel by selecting the appropriate Input/Output Range from the drop-down menu(s) for the respective channel(s), and then click the "Set All" button to apply the new settings.

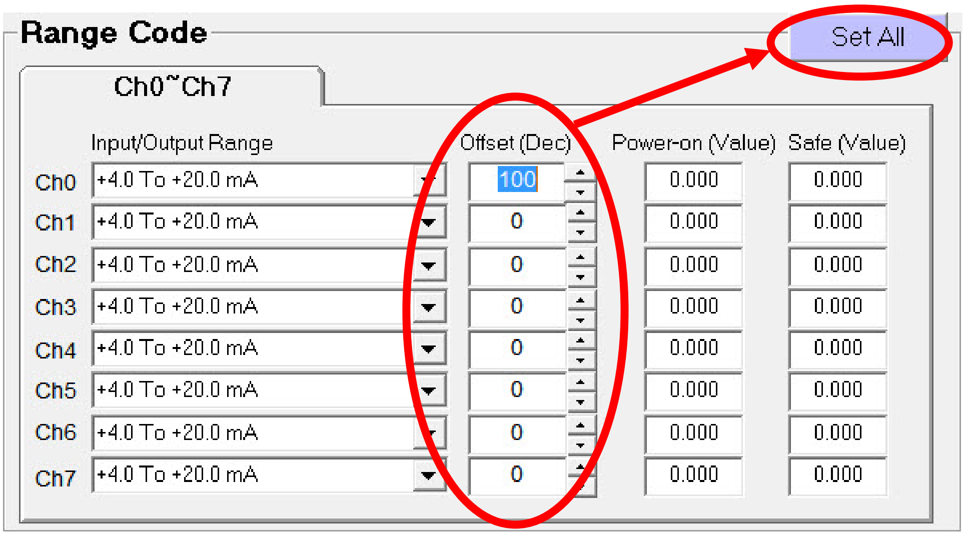


	Input/Output Range	Offset (Dec)	Power-on (Value)	Safe (Value)
Ch0	+0.0 To +20.0 mA	0	0.000	0.000
Ch1		0	0.000	0.000
Ch2		0	0.000	0.000
Ch3		0	0.000	0.000
Ch4		0	0.000	0.000
Ch5	+0.0 To +20.0 mA	0	0.000	0.000
Ch6	+0.0 To +20.0 mA	0	0.000	0.000
Ch7	+0.0 To +20.0 mA	0	0.000	0.000

The Range Code types and definitions for Analog modules are shown in Appendix C: Range Codes for Analog Modules.

2.8.2. Offset Settings

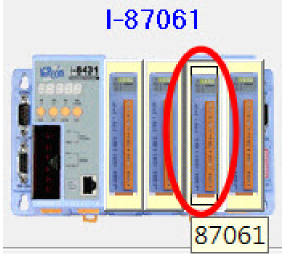
An offset value can be set to compensate for any inaccuracies that exist in the module. To configure the Offset value in the Range Code Settings Panel, enter the required value in the Offset text field(s) for the respective channel(s), and then click the “Set All” button to apply the new settings.



	Input/Output Range	Offset (Dec)	Power-on (Value)	Safe (Value)
Ch0	+4.0 To +20.0 mA	100	0.000	0.000
Ch1	+4.0 To +20.0 mA	0	0.000	0.000
Ch2	+4.0 To +20.0 mA	0	0.000	0.000
Ch3	+4.0 To +20.0 mA	0	0.000	0.000
Ch4	+4.0 To +20.0 mA	0	0.000	0.000
Ch5	+4.0 To +20.0 mA	0	0.000	0.000
Ch6	+4.0 To +20.0 mA	0	0.000	0.000
Ch7	+4.0 To +20.0 mA	0	0.000	0.000

2.9. Digital Output Power-on and Safe Values

To change the Digital Output Power-on and Safe values, click the module that is to be configured to open the DIO Settings Panel.

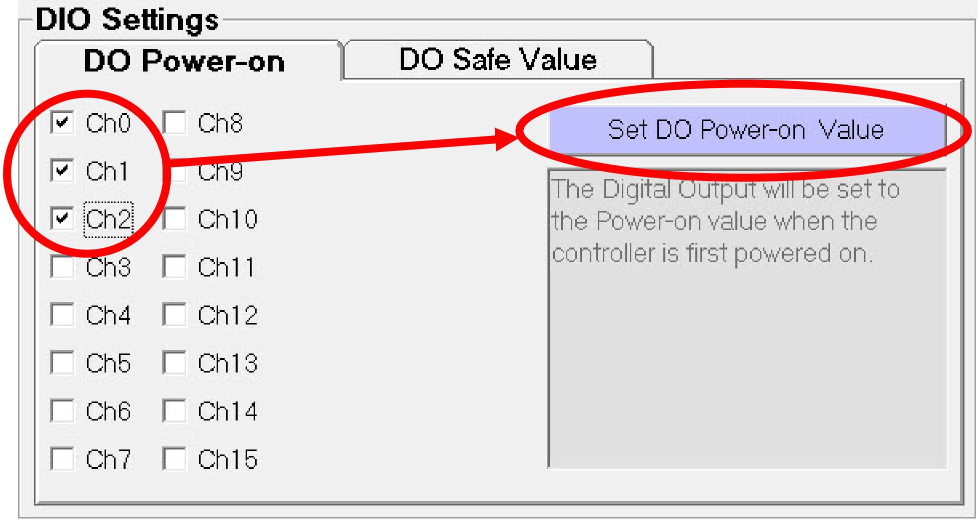


The example shown here is for the I-87061 module.

2.9.1. Digital Output Power-on Value

The Power-on value is the Digital Output value that will be set for the module every time the controller is powered on.

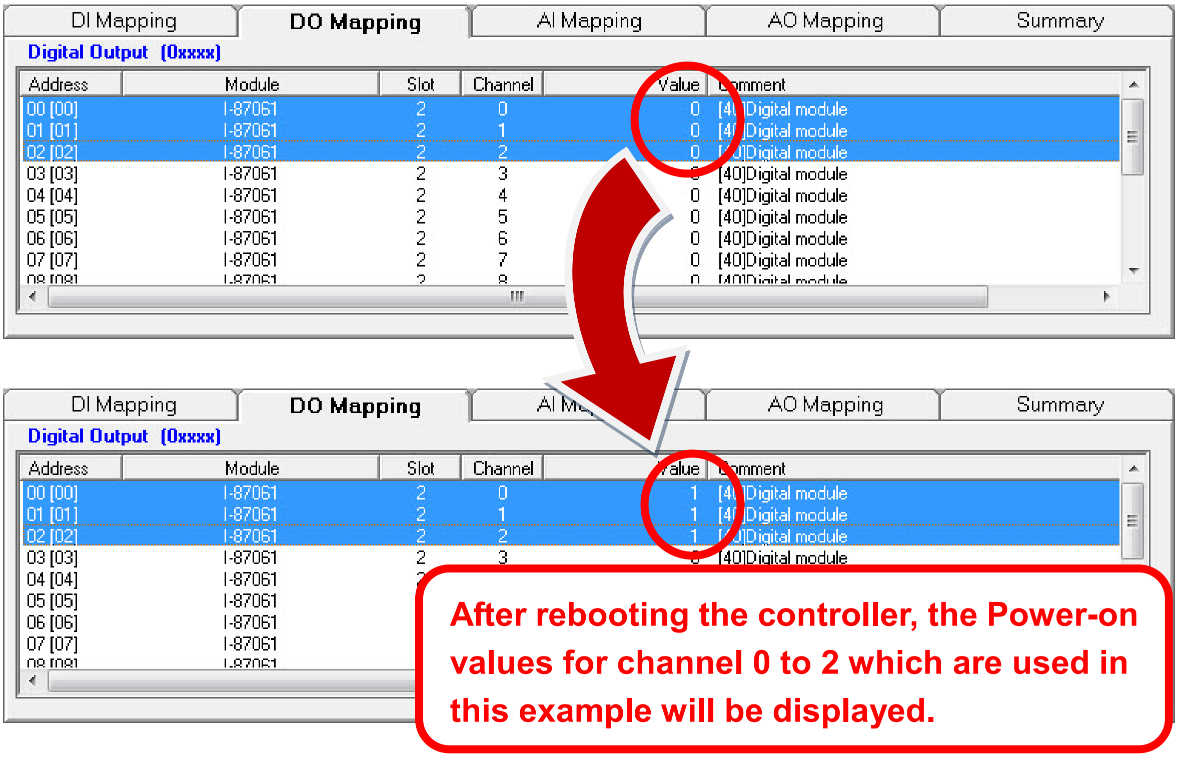
Step 1: In the DIO Settings Panel, click the "DO Power-on" tab, check the checkbox(es) for the channel(s) to be set, and then click the "Set DO Power-on Value" button to apply the new Power-on value(s).



☑ Ch0 ☐ Ch8
☑ Ch1 ☐ Ch9
☑ Ch2 ☐ Ch10
☐ Ch3 ☐ Ch11
☐ Ch4 ☐ Ch12
☐ Ch5 ☐ Ch13
☐ Ch6 ☐ Ch14
☐ Ch7 ☐ Ch15

The Digital Output will be set to the Power-on value when the controller is first powered on.

Step 2: The controller must be rebooted before the new Power-on value settings become effective. After rebooting, the Power-on value(s) for the channel(s) will be displayed in the table on the DO Mapping tab in monitoring mode, or check the output LEDs.



Address	Module	Slot	Channel	Value	Comment
00 [00]	I-87061	2	0	0	[40]Digital module
01 [01]	I-87061	2	1	0	[40]Digital module
02 [02]	I-87061	2	2	0	[40]Digital module
03 [03]	I-87061	2	3	0	[40]Digital module
04 [04]	I-87061	2	4	0	[40]Digital module
05 [05]	I-87061	2	5	0	[40]Digital module
06 [06]	I-87061	2	6	0	[40]Digital module
07 [07]	I-87061	2	7	0	[40]Digital module

Address	Module	Slot	Channel	Value	Comment
00 [00]	I-87061	2	0	1	[40]Digital module
01 [01]	I-87061	2	1	1	[40]Digital module
02 [02]	I-87061	2	2	1	[40]Digital module
03 [03]	I-87061	2	3	0	[40]Digital module
04 [04]	I-87061				
05 [05]	I-87061				
06 [06]	I-87061				
07 [07]	I-87061				

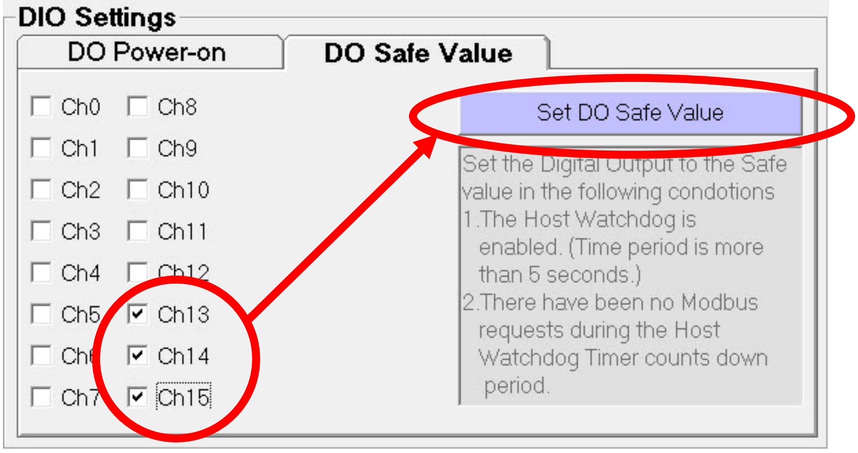
After rebooting the controller, the Power-on values for channel 0 to 2 which are used in this example will be displayed.

E-mail: service@icpdas.com

2.9.2. Digital Output Safe Value

If Modbus communication with the controller is lost for longer than the defined timeout period, the Host Watchdog will be triggered and all modules will be set to a preset Safe Value.

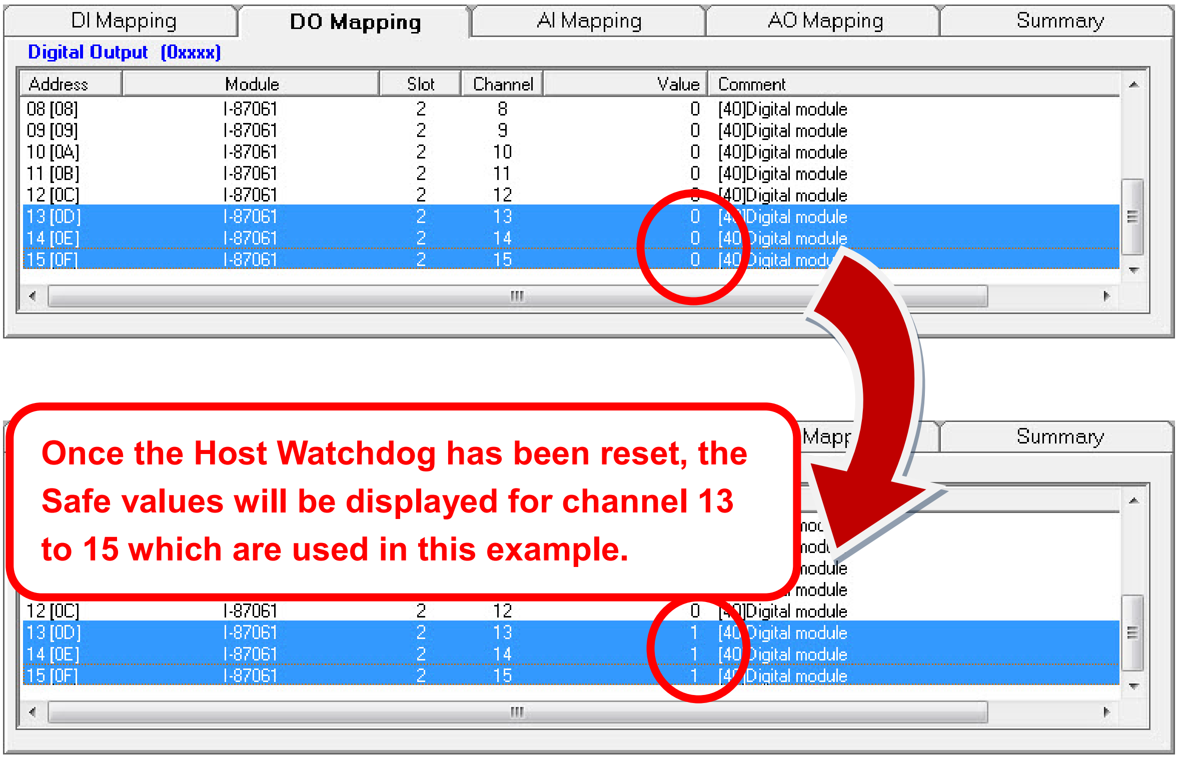
In the DIO Settings Panel, click the “DO Safe Value” tab, check the checkbox(es) for the channel(s) to be set, and then click the “Set DO Safe Value” button to apply the Safe value(s).



☐ Ch0 ☐ Ch8
☐ Ch1 ☐ Ch9
☐ Ch2 ☐ Ch10
☐ Ch3 ☐ Ch11
☐ Ch4 ☐ Ch12
☐ Ch5 ☑ Ch13
☐ Ch ☑ Ch14
☐ Ch7 ☑ Ch15

Set the Digital Output to the Safe value in the following condotions
1.The Host Watchdog is enabled. (Time period is more than 5 seconds.)
2.There have been no Modbus requests during the Host Watchdog Timer counts down period.

Once the Host Watchdog has been reset the modules, the DO value will be set to the Safe value.



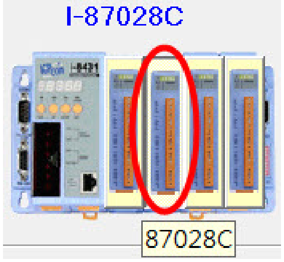
Address	Module	Slot	Channel	Value	Comment
08 [08]	I-87061	2	8	0	[40]Digital module
09 [09]	I-87061	2	9	0	[40]Digital module
10 [0A]	I-87061	2	10	0	[40]Digital module
11 [0B]	I-87061	2	11	0	[40]Digital module
12 [0C]	I-87061	2	12	0	[40]Digital module
13 [0D]	I-87061	2	13	0	[4]Digital module
14 [0E]	I-87061	2	14	0	[40 Digital module
15 [0F]	I-87061	2	15	0	[40 Digital modu

Once the Host Watchdog has been reset, the Safe values will be displayed for channel 13 to 15 which are used in this example.

12 [0C]	I-87061	2	12	0	[ ]Digital module
13 [0D]	I-87061	2	13	1	[40 Digital module
14 [0E]	I-87061	2	14	1	[40 Digital module
15 [0F]	I-87061	2	15	1	[4 Digital module

2.10. Analog Output Power-on and Safe Values

To change the Analog Output Power-on and Safe values, click the module that is to be configured to open the Range Code Settings Panel.

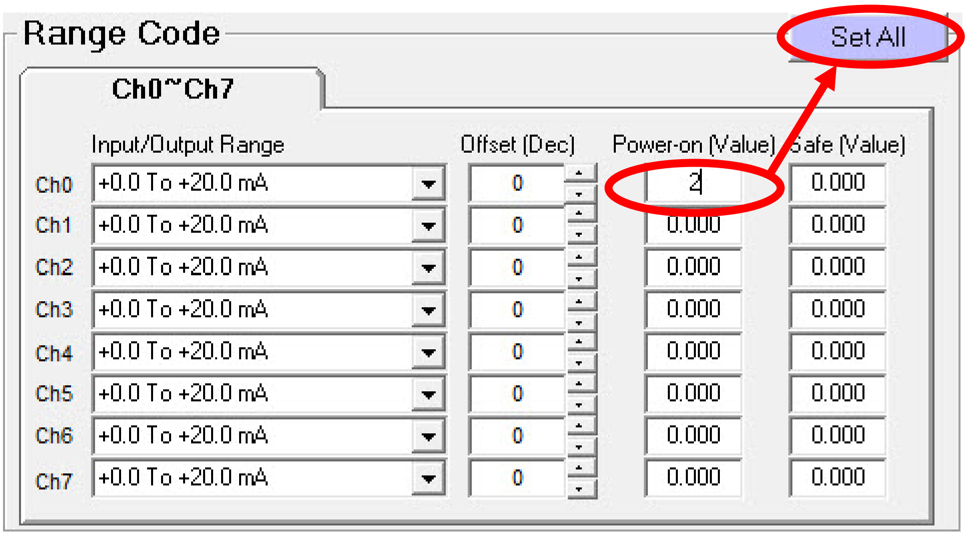


The example shown here is for I-87028C module.

2.10.1. Analog Output Power-on value

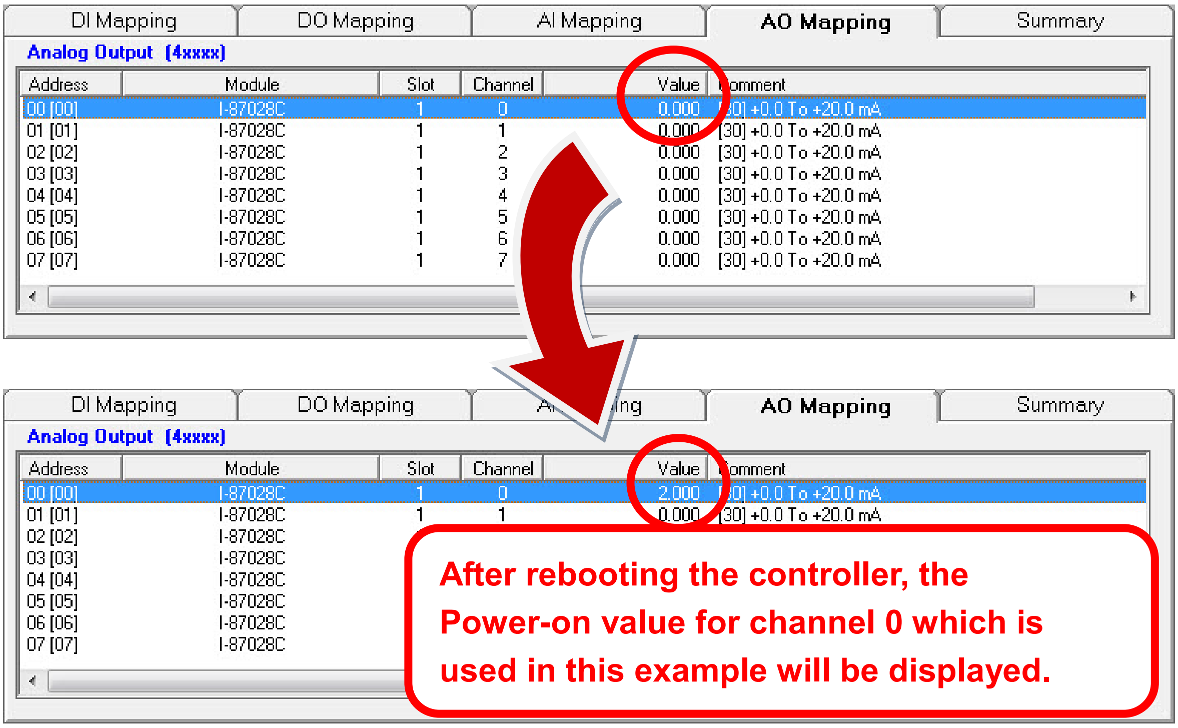
The Power-on value is the Analog Output value that will be set for the module every time the controller is powered on.

Step 1: In the Range Code Settings Panel, configure the Power-on value(s) by entering the required Power-on value in the Power-on field(s) for the respective channel(s), and then click the “Set All” button to apply the new settings.



	Input/Output Range	Offset (Dec)	Power-on (Value)	Safe (Value)
Ch0	+0.0 To +20.0 mA	0	2	0.000
Ch1	+0.0 To +20.0 mA	0	0.000	0.000
Ch2	+0.0 To +20.0 mA	0	0.000	0.000
Ch3	+0.0 To +20.0 mA	0	0.000	0.000
Ch4	+0.0 To +20.0 mA	0	0.000	0.000
Ch5	+0.0 To +20.0 mA	0	0.000	0.000
Ch6	+0.0 To +20.0 mA	0	0.000	0.000
Ch7	+0.0 To +20.0 mA	0	0.000	0.000

Step 2: The controller must be rebooted before the new Power-on value settings become effective. After rebooting, the Power-on value for the channel will be displayed in the AO Mapping tab in monitoring mode, or a monitoring tool can be used to detect the value.



Address	Module	Slot	Channel	Value	Comment
00 [00]	I-87028C	1	0	0.000	[30] +0.0 To +20.0 mA
01 [01]	I-87028C	1	1	0.000	[30] +0.0 To +20.0 mA
02 [02]	I-87028C	1	2	0.000	[30] +0.0 To +20.0 mA
03 [03]	I-87028C	1	3	0.000	[30] +0.0 To +20.0 mA
04 [04]	I-87028C	1	4	0.000	[30] +0.0 To +20.0 mA
05 [05]	I-87028C	1	5	0.000	[30] +0.0 To +20.0 mA
06 [06]	I-87028C	1	6	0.000	[30] +0.0 To +20.0 mA
07 [07]	I-87028C	1	7	0.000	[30] +0.0 To +20.0 mA

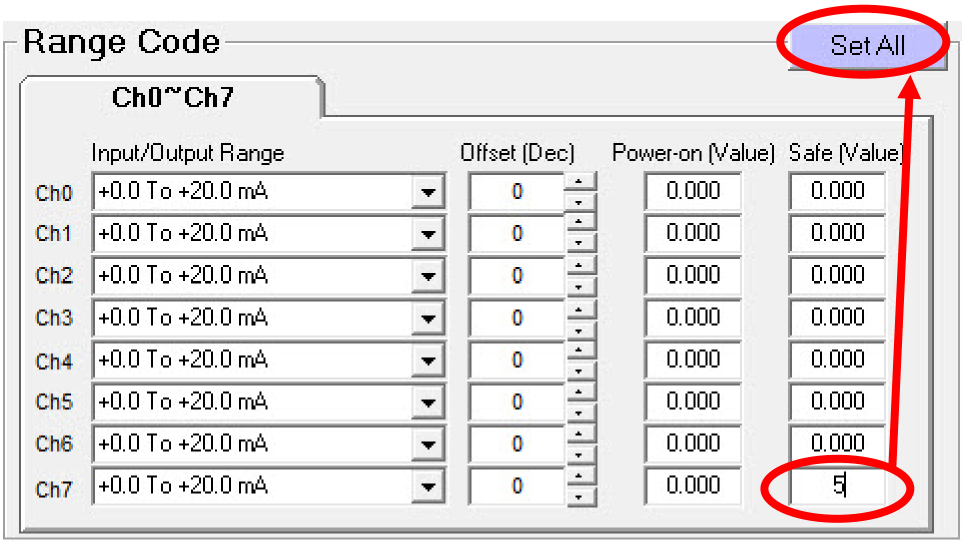
Address	Module	Slot	Channel	Value	Comment
00 [00]	I-87028C	1	0	2.000	[30] +0.0 To +20.0 mA
01 [01]	I-87028C	1	1	0.000	[30] +0.0 To +20.0 mA
02 [02]	I-87028C				
03 [03]	I-87028C				
04 [04]	I-87028C				
05 [05]	I-87028C				
06 [06]	I-87028C				
07 [07]	I-87028C				

After rebooting the controller, the Power-on value for channel 0 which is used in this example will be displayed.

2.10.2. Analog Output Safe Value

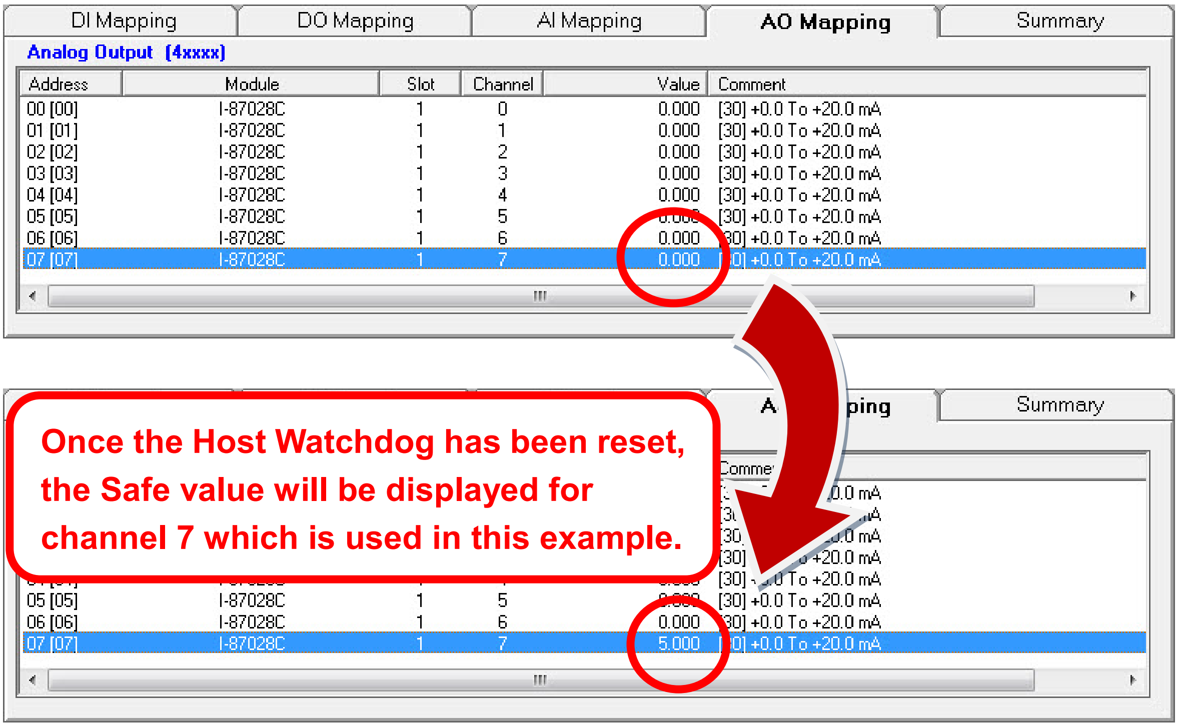
If Modbus communication with the controller is lost for longer than the defined timeout period, the Host Watchdog will be triggered and all modules will be set to a preset Safe Value.

In the Range Code Settings Panel, configure the Safe value(s) by entering the required value in the Safe Value field(s) for the respective channel(s), and then click the "Set All" button to apply the new settings.



	Input/Output Range	Offset (Dec)	Power-on (Value)	Safe (Value)
Ch0	+0.0 To +20.0 mA	0	0.000	0.000
Ch1	+0.0 To +20.0 mA	0	0.000	0.000
Ch2	+0.0 To +20.0 mA	0	0.000	0.000
Ch3	+0.0 To +20.0 mA	0	0.000	0.000
Ch4	+0.0 To +20.0 mA	0	0.000	0.000
Ch5	+0.0 To +20.0 mA	0	0.000	0.000
Ch6	+0.0 To +20.0 mA	0	0.000	0.000
Ch7	+0.0 To +20.0 mA	0	0.000	5

Once the Host Watchdog has been reset, the DO value will be set to the Safe value.



Analog Output (4xxxx)

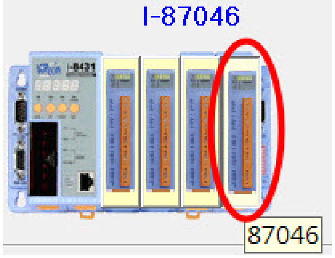
Address	Module	Slot	Channel	Value	Comment
00 [00]	I-87028C	1	0	0.000	[30] +0.0 To +20.0 mA
01 [01]	I-87028C	1	1	0.000	[30] +0.0 To +20.0 mA
02 [02]	I-87028C	1	2	0.000	[30] +0.0 To +20.0 mA
03 [03]	I-87028C	1	3	0.000	[30] +0.0 To +20.0 mA
04 [04]	I-87028C	1	4	0.000	[30] +0.0 To +20.0 mA
05 [05]	I-87028C	1	5	0.000	[30] +0.0 To +20.0 mA
06 [06]	I-87028C	1	6	0.000	[30] +0.0 To +20.0 mA
07 [07]	I-87028C	1	7	0.000	[30] +0.0 To +20.0 mA

Address	Module	Slot	Channel	Value	Comment
05 [05]	I-87028C	1	5	0.000	[30] +0.0 To +20.0 mA
06 [06]	I-87028C	1	6	0.000	[30] +0.0 To +20.0 mA
07 [07]	I-87028C	1	7	5.000	[30] +0.0 To +20.0 mA

Once the Host Watchdog has been reset, the Safe value will be displayed for channel 7 which is used in this example.

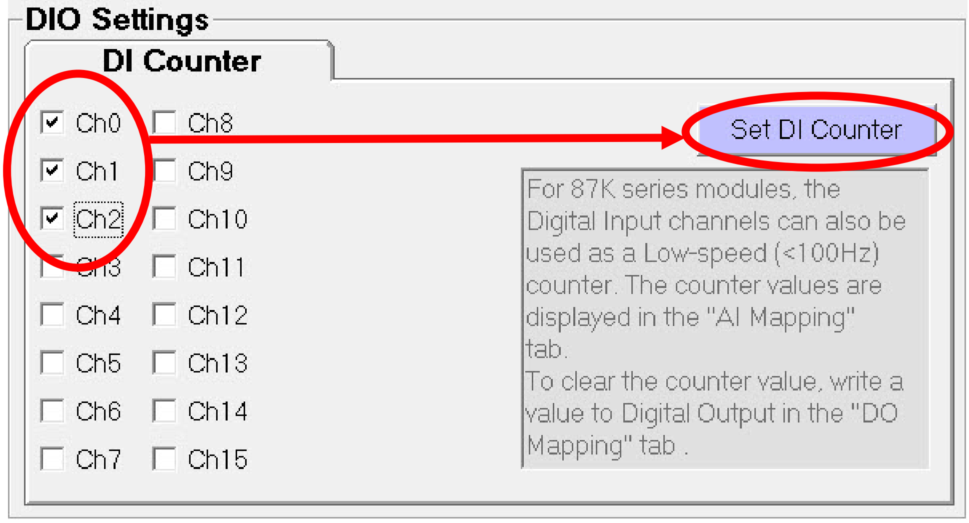
2.11. 87K Digital Input Counter

Each Digital Input channel on an 87K series module can also be used as a Low-speed (<100 Hz) counter. Click the module that is to be configured to open the DIO Settings Panel.



The example shown here is for the I-87046 module.

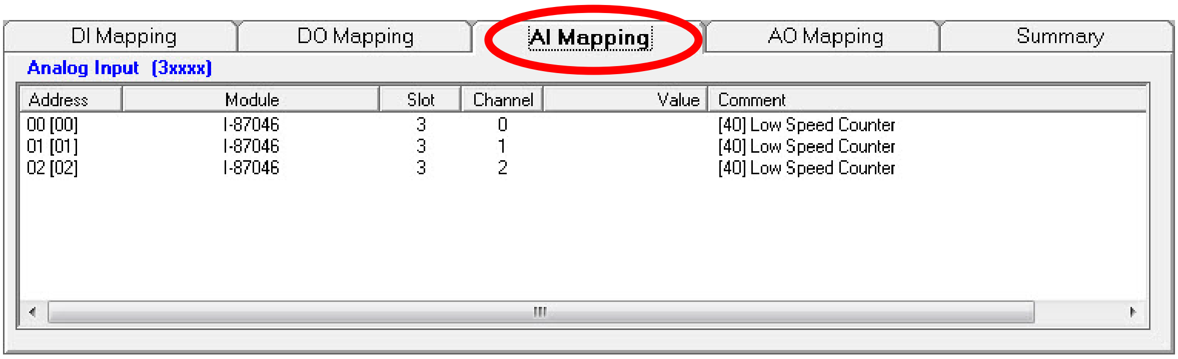
Step 1: In the DIO Settings Panel, click the “DI Counter” tab, check the checkbox(es) for the channel(s) to be set, and then click the “Set DI Counter” button to apply the new Counter Settings.



☑ Ch0 ☐ Ch8
☑ Ch1 ☐ Ch9
☑ Ch2 ☐ Ch10
☐ Ch3 ☐ Ch11
☐ Ch4 ☐ Ch12
☐ Ch5 ☐ Ch13
☐ Ch6 ☐ Ch14
☐ Ch7 ☐ Ch15

For 87K series modules, the Digital Input channels can also be used as a Low-speed (<100Hz) counter. The counter values are displayed in the "AI Mapping" tab.
To clear the counter value, write a value to Digital Output in the "DO Mapping" tab .

Any channel that have been set as a DI counter will be displayed in the “AI Mapping” tab.

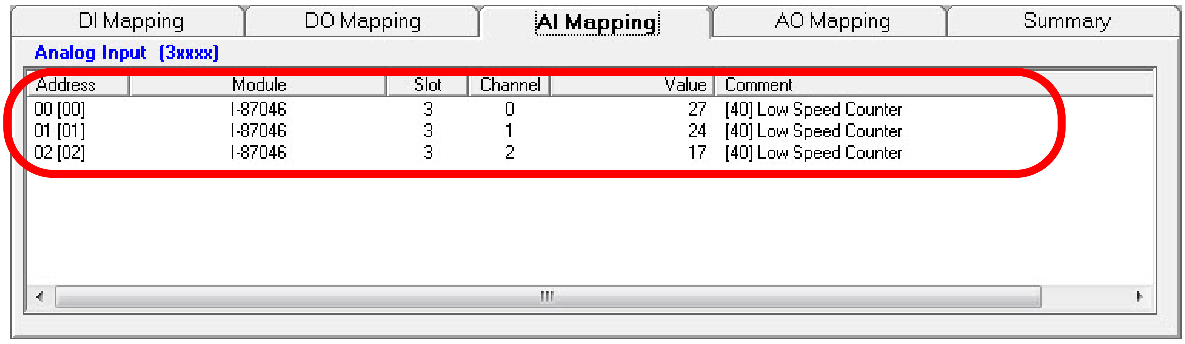


Analog Input (3xxxx)

Address	Module	Slot	Channel	Value	Comment
00 [00]	I-87046	3	0		[40] Low Speed Counter
01 [01]	I-87046	3	1		[40] Low Speed Counter
02 [02]	I-87046	3	2		[40] Low Speed Counter

Step 2: After the counter(s) for the DI channel(s) have been set, click the "AI Mapping" tab to display the channels that have associated counters, together with the current values for the counter.

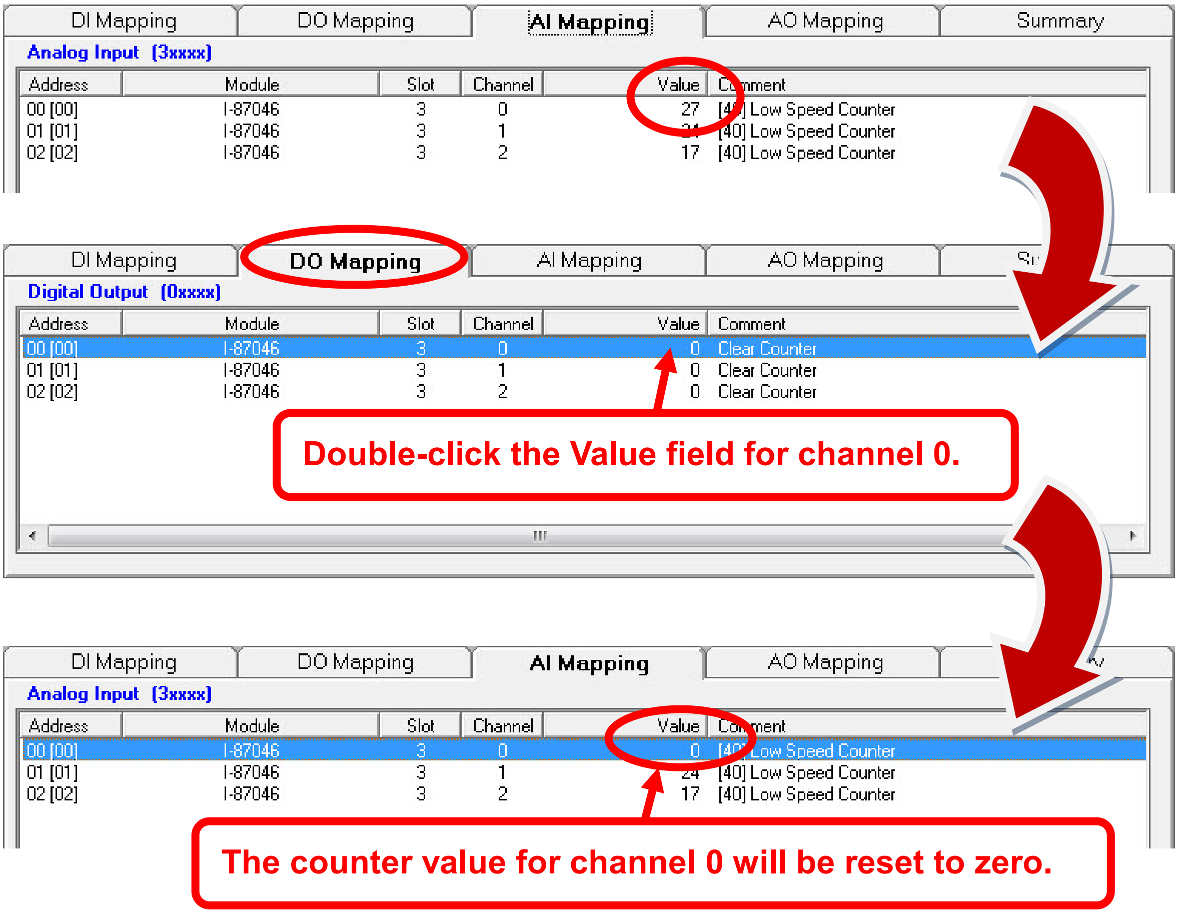
Note: Before the current counter values can be read, the Monitoring function needs to be enabled.



Analog Input (3xxxx)

Address	Module	Slot	Channel	Value	Comment
00 [00]	I-87046	3	0	27	[40] Low Speed Counter
01 [01]	I-87046	3	1	24	[40] Low Speed Counter
02 [02]	I-87046	3	2	17	[40] Low Speed Counter

Step 3: To clear counter value, click the "DO Mapping" tab and then **double-click** the value for the relevant channel. The counter value for that channel will then be set to 0. Channel 0 is used as an example here.



Analog Input (3xxxx)

Address	Module	Slot	Channel	Value	Comment
00 [00]	I-87046	3	0	27	[40] Low Speed Counter
01 [01]	I-87046	3	1	24	[40] Low Speed Counter
02 [02]	I-87046	3	2	17	[40] Low Speed Counter

Digital Output (0xxxx)

Address	Module	Slot	Channel	Value	Comment
00 [00]	I-87046	3	0	0	Clear Counter
01 [01]	I-87046	3	1	0	Clear Counter
02 [02]	I-87046	3	2	0	Clear Counter

Double-click the Value field for channel 0.

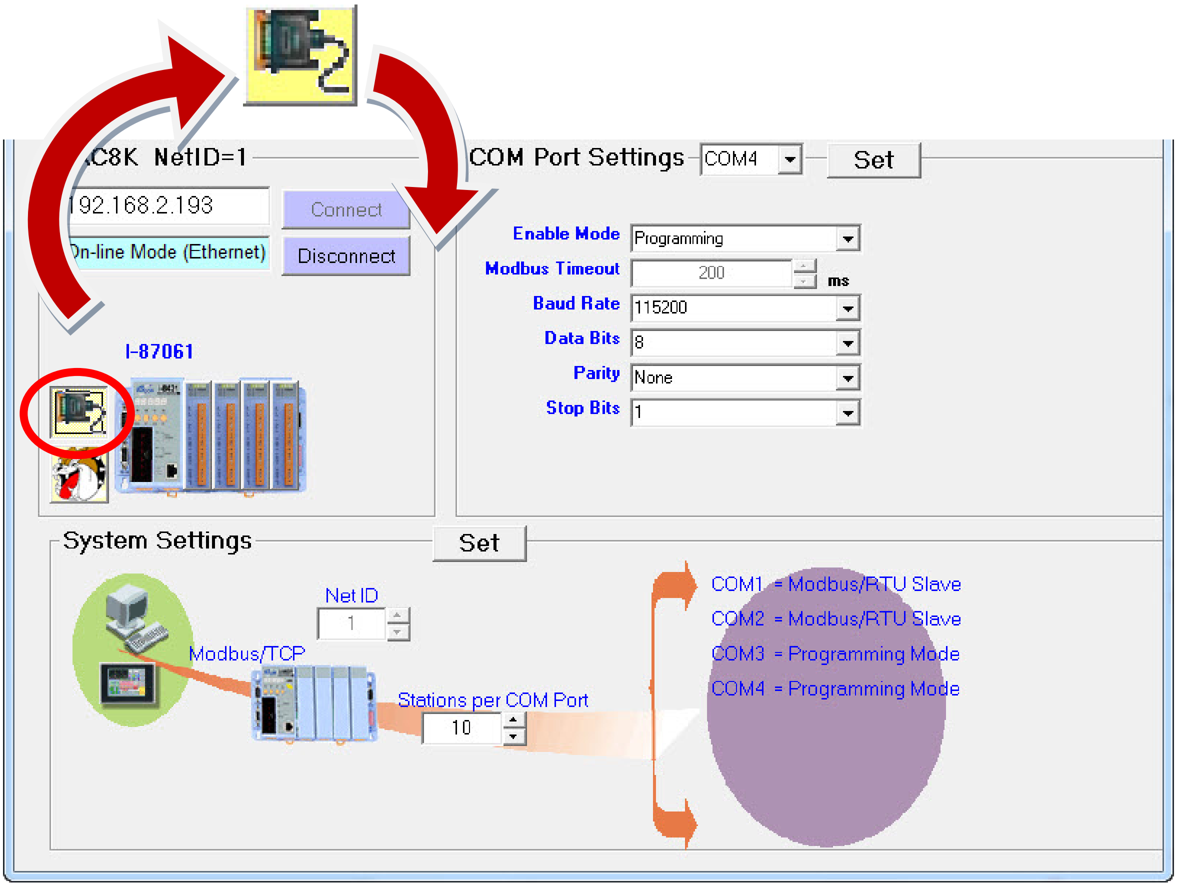
Analog Input (3xxxx)

Address	Module	Slot	Channel	Value	Comment
00 [00]	I-87046	3	0	0	[40] Low Speed Counter
01 [01]	I-87046	3	1	24	[40] Low Speed Counter
02 [02]	I-87046	3	2	17	[40] Low Speed Counter

The counter value for channel 0 will be reset to zero.

2.12. COM Port Settings

To adjust the configuration for the COM ports, click the COM port icon in the Controller Panel described in Introduction to the User Interface (Item E) to display the “COM Port Settings” panel.



192.168.2.193

On-line Mode (Ethernet)

COM Port Settings: COM4

Enable Mode: Programming

Modbus Timeout: 200 ms

Baud Rate: 115200

Data Bits: 8

Parity: None

Stop Bits: 1

Net ID: 1

Stations per COM Port: 10

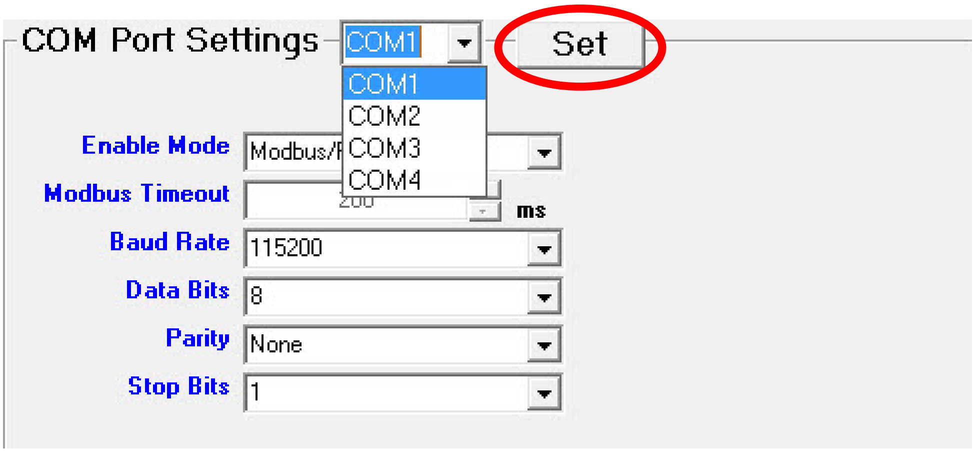
COM1 = Modbus/RTU Slave

COM2 = Modbus/RTU Slave

COM3 = Programming Mode

COM4 = Programming Mode

Step 1: Select the COM port to be configured from the drop-down menu, and then select the Enable mode, and the Modbus timeout, and select the appropriate values for the other settings. Seven modes can be selected for the COM port. Once all the relevant values have been selected, click the “Set” button to apply the new settings.



COM Port Settings: COM1

Enable Mode: Modbus/R

Modbus Timeout: 200 ms

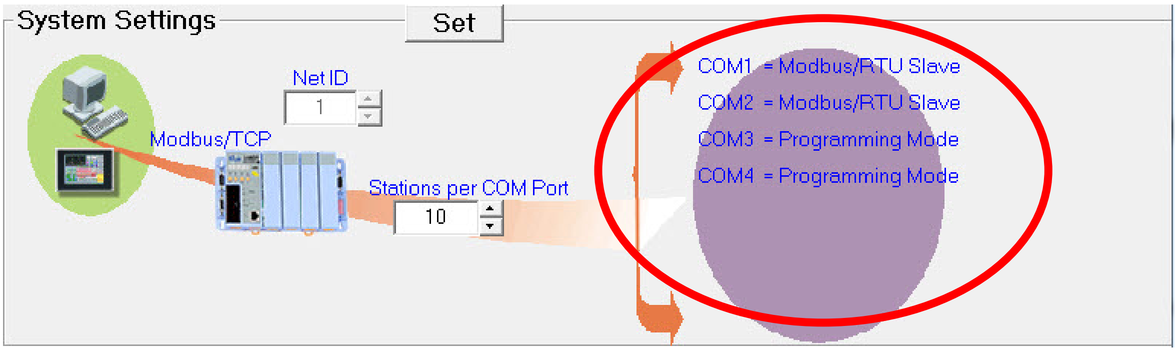
Baud Rate: 115200

Data Bits: 8

Parity: None

Stop Bits: 1

The new settings will be displayed in the “System Settings” panel immediately.



Net ID: 1

Stations per COM Port: 10

COM1 = Modbus/RTU Slave

COM2 = Modbus/RTU Slave

COM3 = Programming Mode

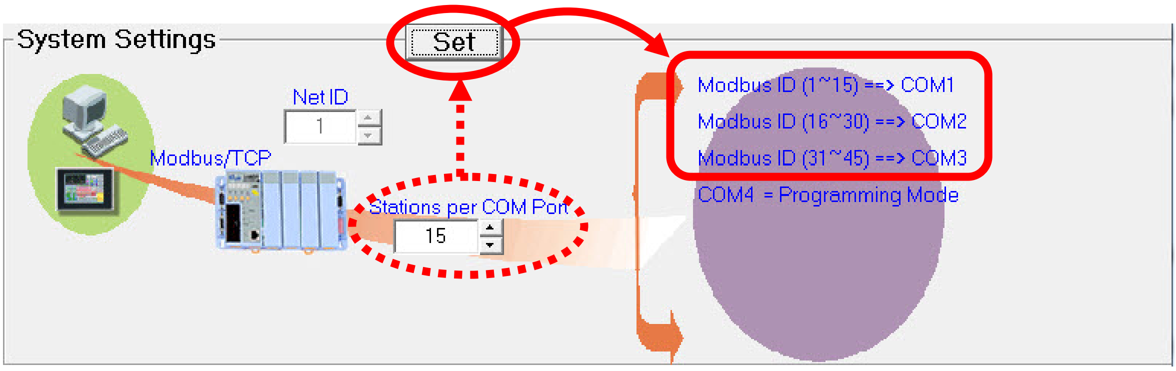
COM4 = Programming Mode

2.12.1. COM Port Enable Modes

Seven modes can be selected for the COM port, each of which are described below.

A. VxComm: This option creates virtual COM ports and maps them to the Ethernet ports on the serial modules.

B. Modbus RTU Gateway: This option allows the COM port to connect to up to 255 RTU slaves (stations). Enter the number of devices connected to the Modbus RTU gateway in the “Stations per COM Port” text field and then click the “Set” button. The Modbus Utility will automatically assign the Slave ID if more than one port is set to the Modbus RTU gateway mode.



Net ID: 1

Stations per COM Port: 15

Modbus ID (1~15) ==> COM1

Modbus ID (16~30) ==> COM2

Modbus ID (31~45) ==> COM3

COM4 = Programming Mode

C. Modbus RTU Slave: This option is used to set the device to operate as a Modbus RTU Slave.

D. Modbus ASCII Slave: This option is used to set the device to operate as a Modbus ASCII Slave.

E. Programming: This option is used for programming purpose only and will not automatically detect Modbus requests.

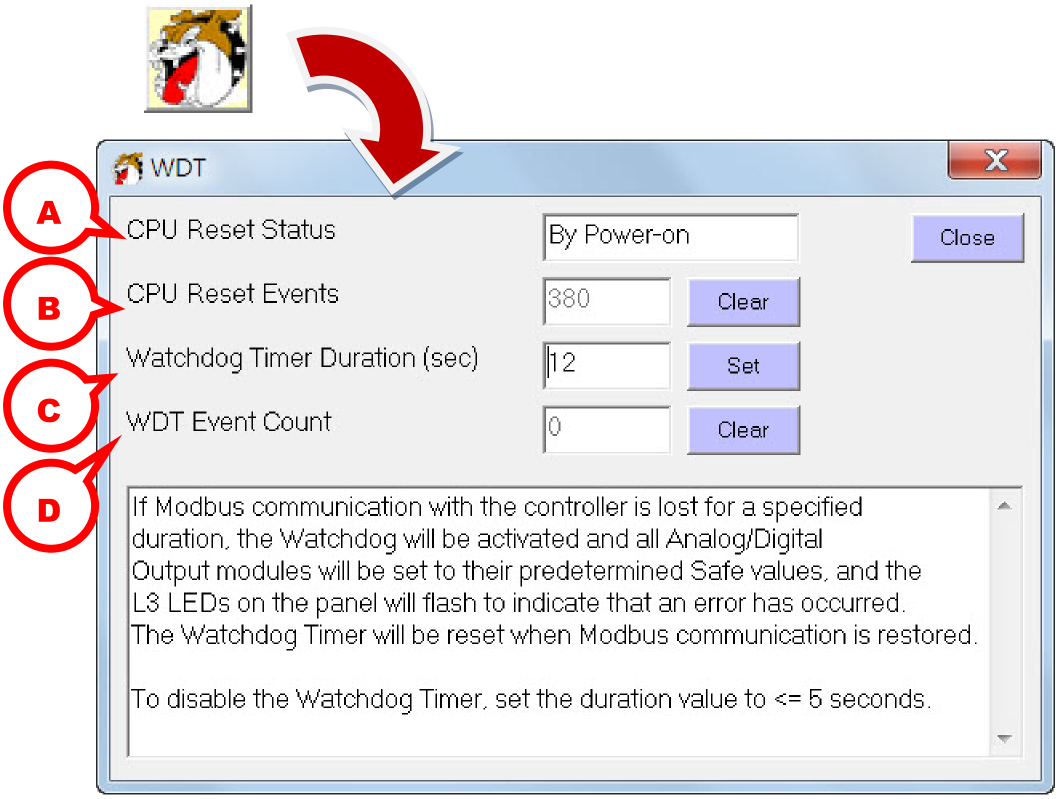
F. Debug: This option is used to display debug messages relating to Modbus requests, or communication messages, etc. while communicating with a Modbus master or Modbus clients.

G. Console: This option is used to perform configuration for file uploads, or updating the firmware for the device.

2.13. Watchdog Timer (WDT) Settings

Each ICP DAS controller contains a Host Watchdog that will be activated if the controller either crashes or otherwise malfunctions for some reason. The Watchdog Timer can be set to a specified period and is used to count the time since Modbus communication with the controller was lost. When the Watchdog Timer counter reaches zero, the Host Watchdog will be activated and all Analog/Digital Output modules will be set to their predetermined Safe values and the L3 LEDs on the panel will flash to indicate that an error has occurred.

Click the Watchdog icon in the Controller Panel described in Introduction to the User Interface (Item E) to open the WDT Settings panel.



CPU Reset Status: By Power-on

CPU Reset Events: 380

Watchdog Timer Duration (sec): 12

WDT Event Count: 0

If Modbus communication with the controller is lost for a specified duration, the Watchdog will be activated and all Analog/Digital Output modules will be set to their predetermined Safe values, and the L3 LEDs on the panel will flash to indicate that an error has occurred. The Watchdog Timer will be reset when Modbus communication is restored.

To disable the Watchdog Timer, set the duration value to <= 5 seconds.

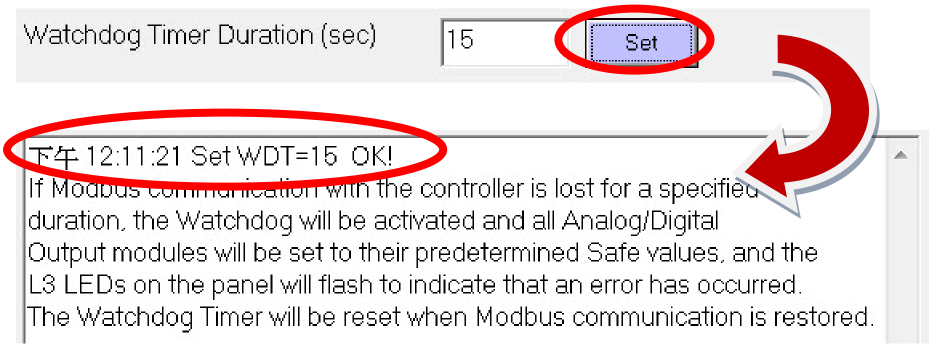
A. CPU Reset Status: This parameter is used to indicate whether the current system status was set during a normal power-on event or whether it was reset by the CPU Watchdog.

During Power on: This status message will be displayed if the controller was started normally.

By CPU WDT: This status message will be displayed if the controller encountered an error that caused the CPU Watchdog to reboot the controller.

B. CPU Reset Event: This parameter is used to indicate the number of times the controller has been reset due to CPU and power-on events. Clicking the "Clear" button will reset the counter to 0.

C. Watchdog Timer Duration: This parameter is used to set the duration of the Watchdog Timer and must be set between 0 and 65535 seconds. To enable the Watchdog Timer, enter the required duration (must be set to more than 5 seconds) and then click the "Set" button to apply the new duration.



Watchdog Timer Duration (sec) 15

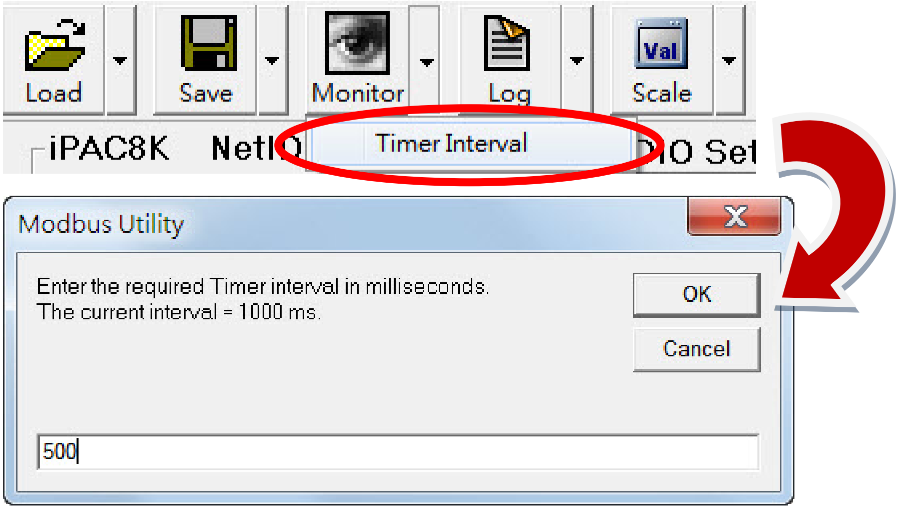
下午 12:11:21 Set WDT=15 OK!
If Modbus communication with the controller is lost for a specified duration, the Watchdog will be activated and all Analog/Digital Output modules will be set to their predetermined Safe values, and the L3 LEDs on the panel will flash to indicate that an error has occurred.
The Watchdog Timer will be reset when Modbus communication is restored.

D. WDT Event Count: This parameter is used to indicate the number of times the controller has been reset due to Watchdog Timer events. Clicking the "Clear" button will reset the counter to 0.

2.14. Monitoring

The Monitor function is used to timely retrieve the current I/O values and to also set the output values for modules.

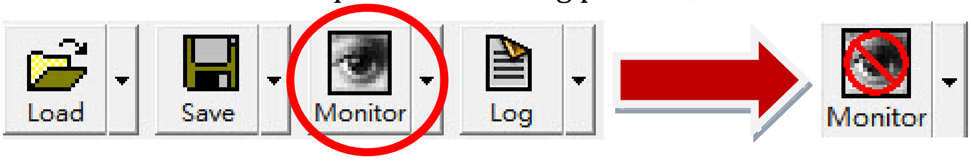
Step 1: To set the timer scan interval, click the arrow on right-hand side of the "Monitor" button in the toolbar and then click “Timer Interval”.



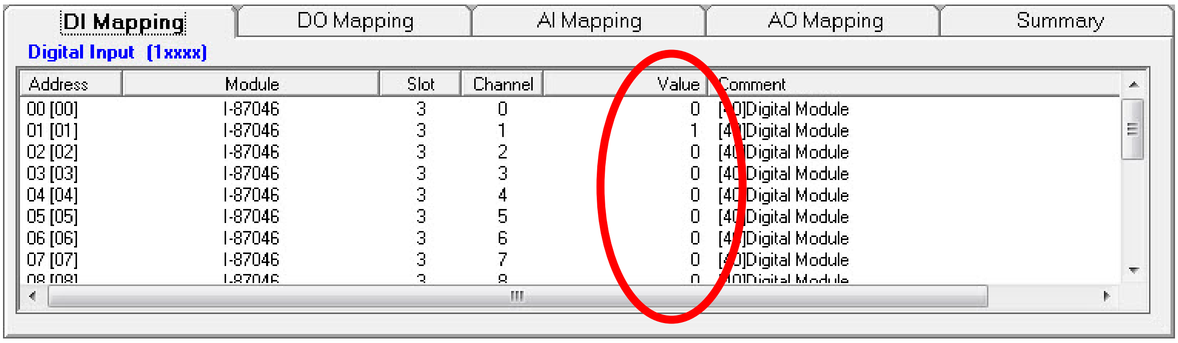
Enter the required Timer interval in milliseconds.
The current interval = 1000 ms.

500

Step 2: Click the “Monitor” button in the tool bar to begin scanning. After the monitoring process begins, the "Monitor" button will be displayed as active, as illustrated below. To stop the monitoring process, click the “Monitor” button again.



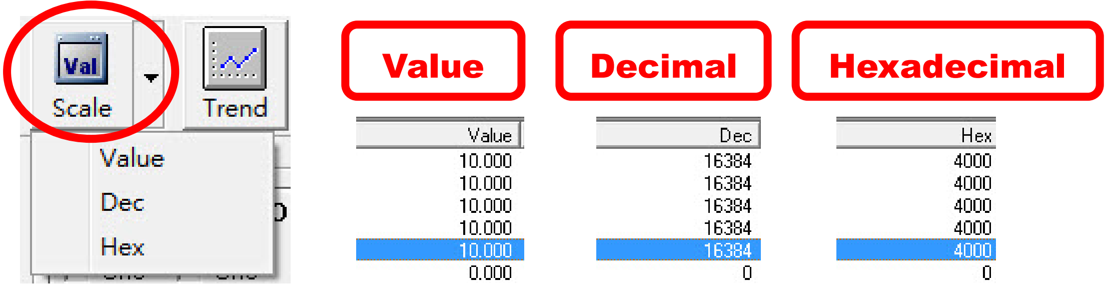
The I/O values displayed in the Mapping table will be automatically refreshed periodically, but the frequency of the updates depends on the value set for the timer interval. Here use the DI Mapping Table as an example.



Digital Input (1xxxx)

Address	Module	Slot	Channel	Value	Comment
00 [00]	I-87046	3	0	0	[40]Digital Module
01 [01]	I-87046	3	1	1	[40]Digital Module
02 [02]	I-87046	3	2	0	[40]Digital Module
03 [03]	I-87046	3	3	0	[40]Digital Module
04 [04]	I-87046	3	4	0	[40]Digital Module
05 [05]	I-87046	3	5	0	[40]Digital Module
06 [06]	I-87046	3	6	0	[40]Digital Module
07 [07]	I-87046	3	7	0	[40]Digital Module
08 [08]	I-87046	3	8	0	[40]Digital Module

Step 3: The display mode for analog modules can be changed to either Value, Decimal or Hexadecimal format. Click the arrow for the "Scale" button in the toolbar and select the desired option from the drop-down list.



Value

Decimal

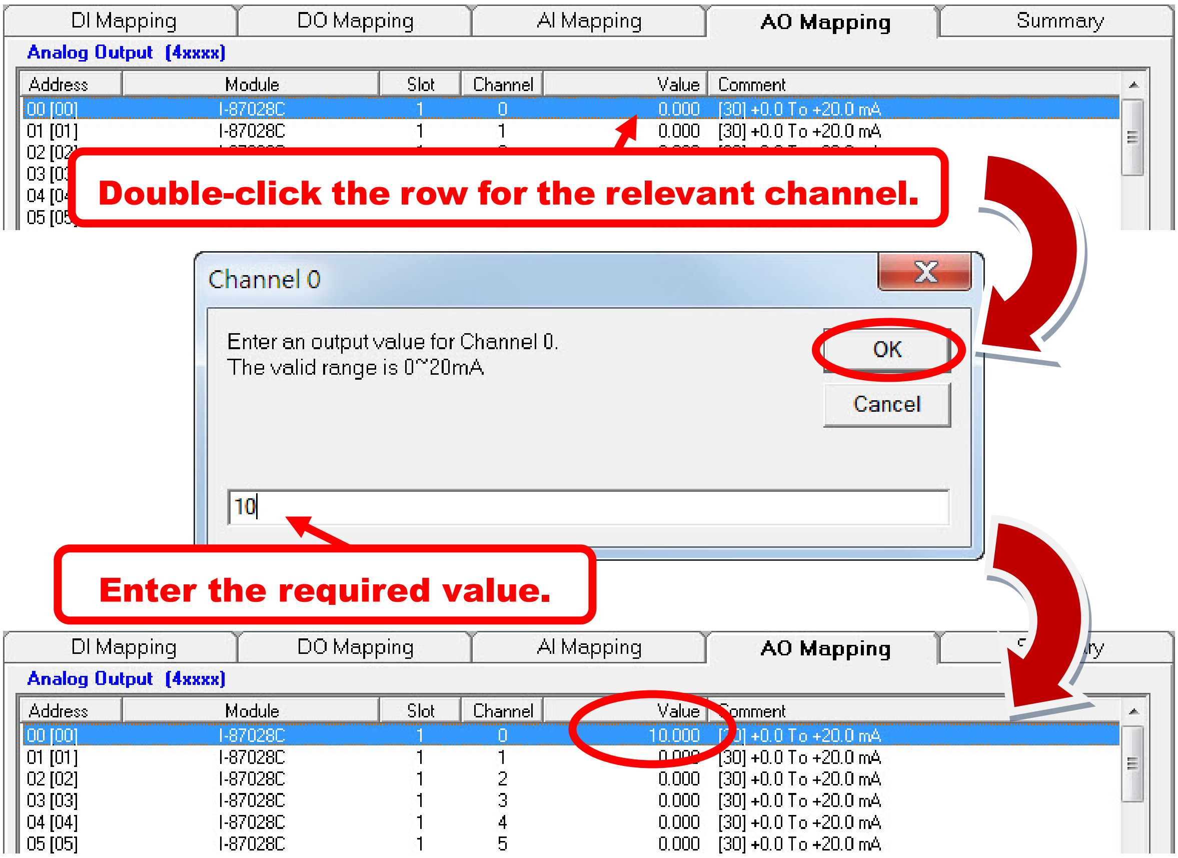
Hexadecimal

Value
10.000
10.000
10.000
10.000
0.000

Dec
16384
16384
16384
16384
0

Hex
4000
4000
4000
4000
0

Step 4: To change the output values for a specific channel on an Analog Output module, click the "AO Mapping" tab and then double-click the row to relevant channel to open the "Channel" dialog box for that channel. Enter the required value and then click the "OK" button. The value for the channel will be changed immediately.



Address	Module	Slot	Channel	Value	Comment
00 [00]	I-87028C	1	0	0.000	[30] +0.0 To +20.0 mA
01 [01]	I-87028C	1	1	0.000	[30] +0.0 To +20.0 mA
02 [02]					
03 [03]					
04 [04]					
05 [05]					

Double-click the row for the relevant channel.

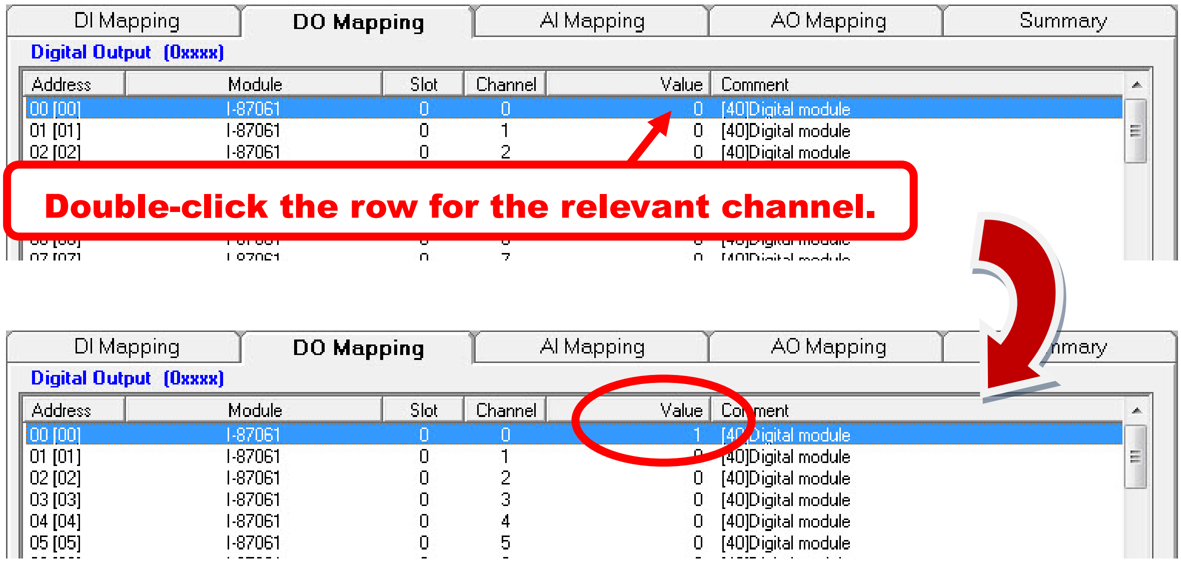
Enter an output value for Channel 0.
The valid range is 0~20mA

10

Enter the required value.

Address	Module	Slot	Channel	Value	Comment
00 [00]	I-87028C	1	0	10.000	[30] +0.0 To +20.0 mA
01 [01]	I-87028C	1	1	0.000	[30] +0.0 To +20.0 mA
02 [02]	I-87028C	1	2	0.000	[30] +0.0 To +20.0 mA
03 [03]	I-87028C	1	3	0.000	[30] +0.0 To +20.0 mA
04 [04]	I-87028C	1	4	0.000	[30] +0.0 To +20.0 mA
05 [05]	I-87028C	1	5	0.000	[30] +0.0 To +20.0 mA

Step 5: To change the output value for a specific channel on a Digital Output module, click the "DO Mapping" tab and then double-click the row for the relevant channel. The value to the channel will be changed immediately. The value, 0, represents the status OFF, and the value, 1, represents the status ON.

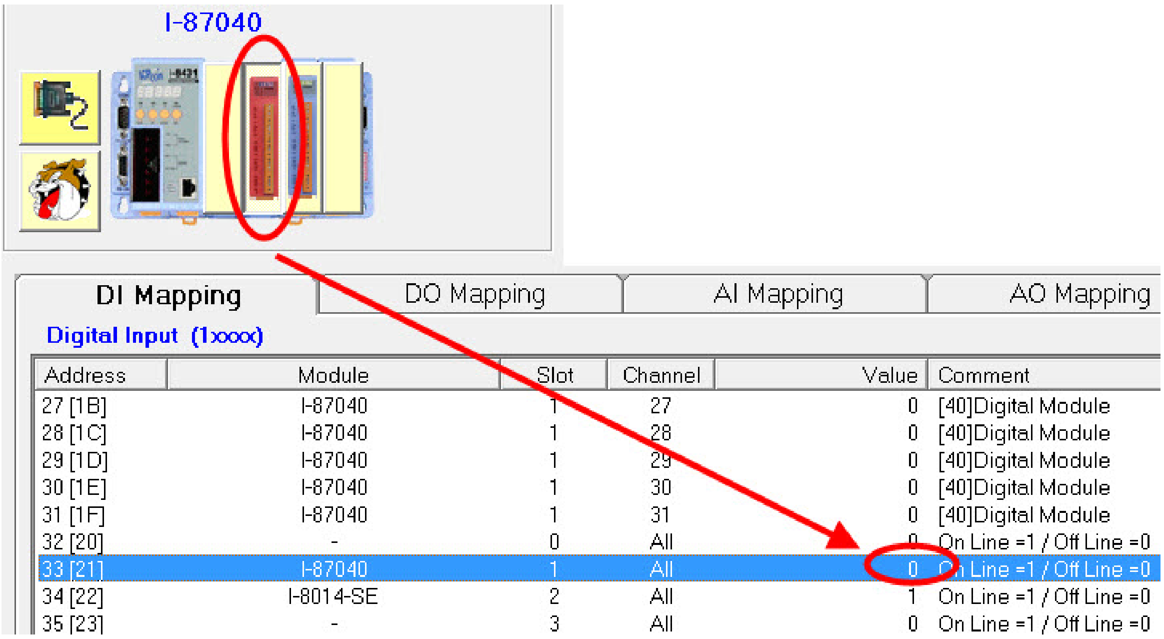


Double-click the row for the relevant channel.

Address	Module	Slot	Channel	Value	Comment
00 [00]	I-87061	0	0	0	[40]Digital module
01 [01]	I-87061	0	1	0	[40]Digital module
02 [02]	I-87061	0	2	0	[40]Digital module

Address	Module	Slot	Channel	Value	Comment
00 [00]	I-87061	0	0	1	[40]Digital module
01 [01]	I-87061	0	1	0	[40]Digital module
02 [02]	I-87061	0	2	0	[40]Digital module
03 [03]	I-87061	0	3	0	[40]Digital module
04 [04]	I-87061	0	4	0	[40]Digital module
05 [05]	I-87061	0	5	0	[40]Digital module

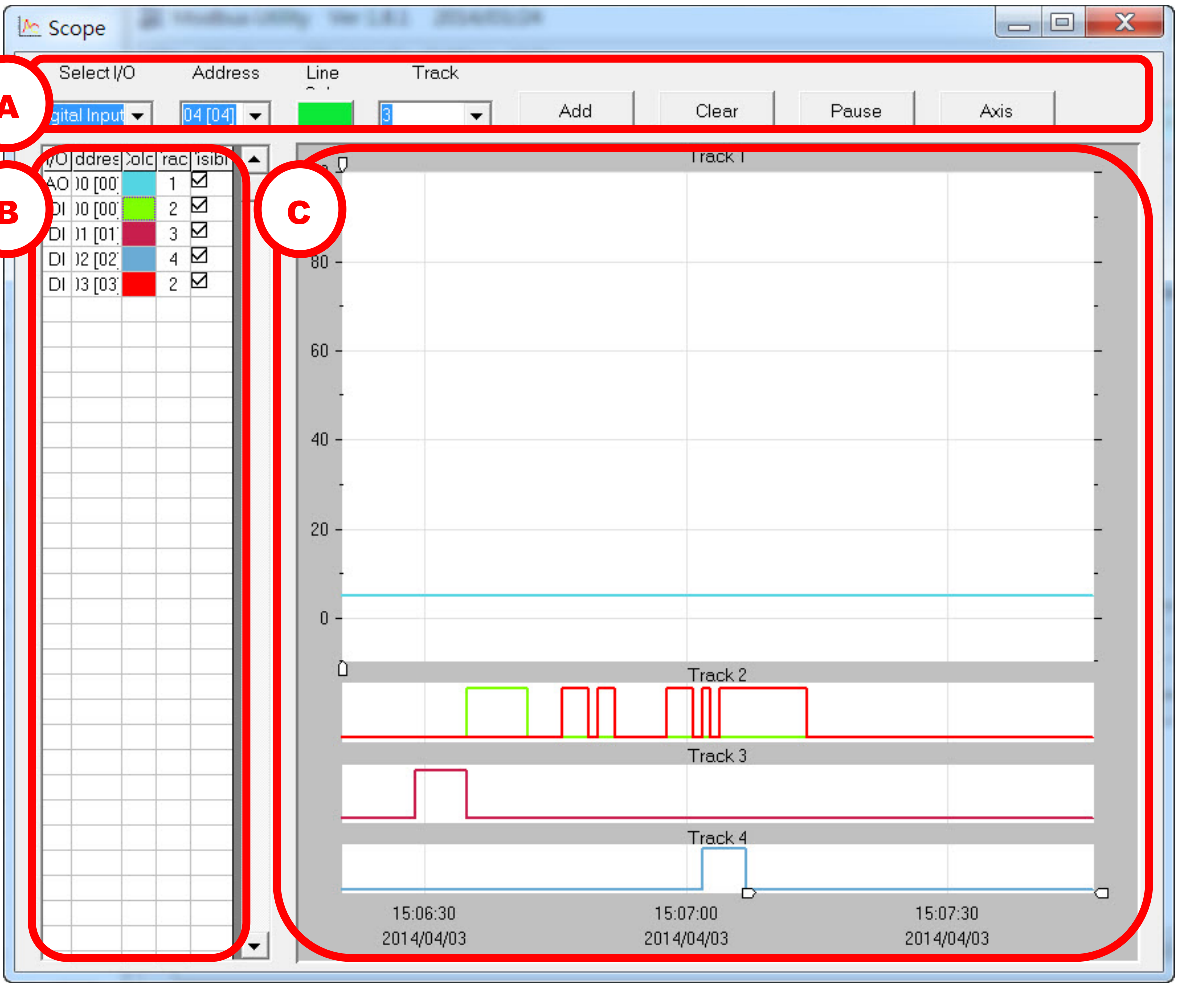
Note: The Modbus Utility also includes an alert system that warns when an 87K module is offline. If the module is offline, the image for the module will be displayed in red and the value in the DI Mapping table will be shown as 0. Both the image and the value will return to normal once the module is online.



Address	Module	Slot	Channel	Value	Comment
27 [1B]	I-87040	1	27	0	[40]Digital Module
28 [1C]	I-87040	1	28	0	[40]Digital Module
29 [1D]	I-87040	1	29	0	[40]Digital Module
30 [1E]	I-87040	1	30	0	[40]Digital Module
31 [1F]	I-87040	1	31	0	[40]Digital Module
32 [20]	-	0	All	0	On Line =1 / Off Line =0
33 [21]	I-87040	1	All	0	On Line =1 / Off Line =0
34 [22]	I-8014-SE	2	All	1	On Line =1 / Off Line =0
35 [23]	-	3	All	0	On Line =1 / Off Line =0

2.15. Trend Chart

In addition to retrieving data values from the address table, the Trend function can be used to monitor data and display it as a trend chart. The following illustration is the interface for the Trend function.



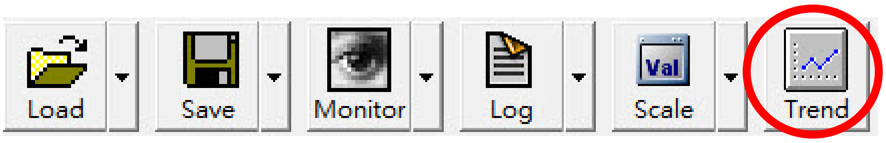
A. Settings and control area: This area is used to set the conditions for the monitoring functions, such as adding an address to be tracked, starting, pausing or stopping the monitoring, and adjusting the scope of the trend chart.

B. Trend Chart List area: this area is used to display details of the addresses and other settings that have been selected to be tracked. The settings for the respective address can be adjusted, and the output values for the DO/AO addresses can be set.

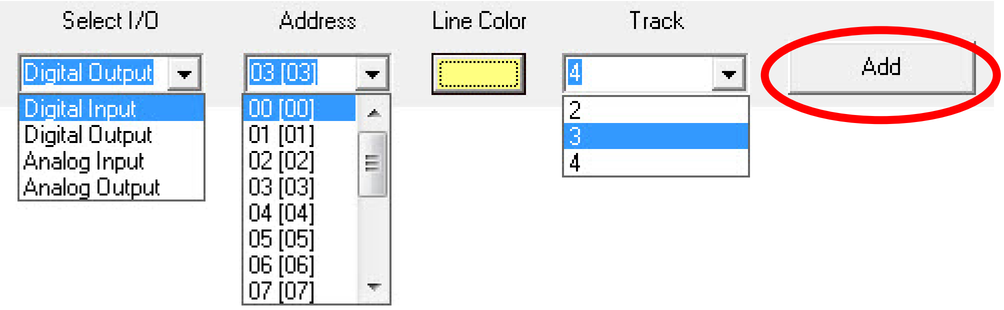
C. Track area: There are four areas that the Trend function uses to monitor and display the tracked data, indicated as Track 1, Track 2, Track 3 and Track 4 in the image above. Note that Track 1 can only be used to display trend lines for analog modules, while Track 2 to 4 are used to display the trend lines for digital modues.

The following procedures indicate that how to retrieve I/O data.

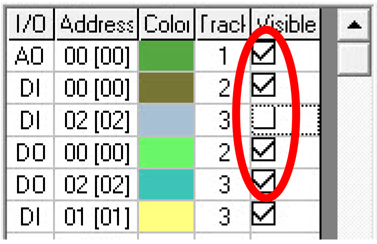
Step 1: Click the “Trend” button on the main menu to open the “Scope” dialog box.



Step 2: To record I/O data in the trend chart, select the I/O type and the address from the respective drop-down menus. Select a color for the chart line and assign a track number, and then click the “Add” button to add the record to the Track area.

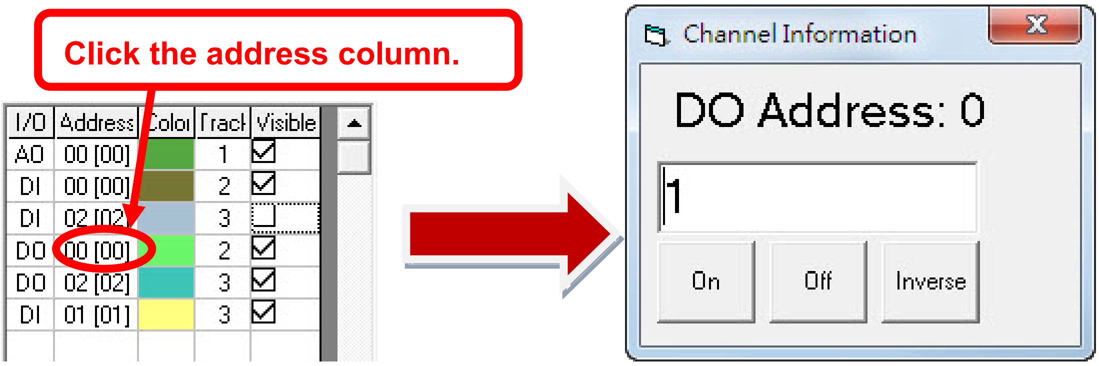

Select I/O: Digital Output
Address: 03 [03]
Line Color: 🟨
Track: 4

After adding the address to the Track area, the address can be set to be visible or not in the Track area by clicking the checkbox or the line color can be changed by clicking the color column.



I/O	Address	Color	Track	Visible
AO	00 [00]	🟩	1	☑
DI	00 [00]	🟫	2	☑
DI	02 [02]	🟦	3	☐
DO	00 [00]	🟩	2	☑
DO	02 [02]	🟦	3	☑
DI	01 [01]	🟨	3	☑

Step 3: To set the output values for the DO addresses, click the address column to display the “Channel Information” dialog box. Click the “On” button to set the value of DO address to ON and click the “Off” button to set the value to OFF, and click the “Inverse” button to set the value to the inverse of the current value.


Click the address column.

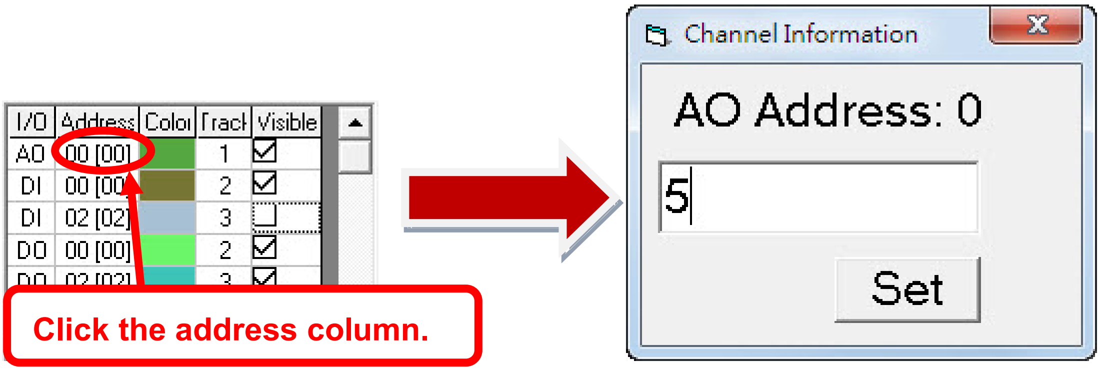
I/O	Address	Color	Track	Visible
AO	00 [00]	🟩	1	☑
DI	00 [00]	🟫	2	☑
DI	02 [02]	🟦	3	☐
DO	00 [00]	🟩	2	☑
DO	02 [02]	🟦	3	☑
DI	01 [01]	🟨	3	☑

Channel Information

DO Address: 0

1

Step 4: To set the output values for the AO addresses, click the address column to dsiplay the “Channel Information” dialog box. Enter the output value and then click the “Set” button to apply the new settings.



I/O	Address	Colo	Trac	Visible
AO	00 [00]	🟩	1	☑
DI	00 [00]	🟫	2	☑
DI	02 [02]	🟦	3	☐
DO	00 [00]	🟩	2	☑
DO	02 [02]	🟦	3	☑

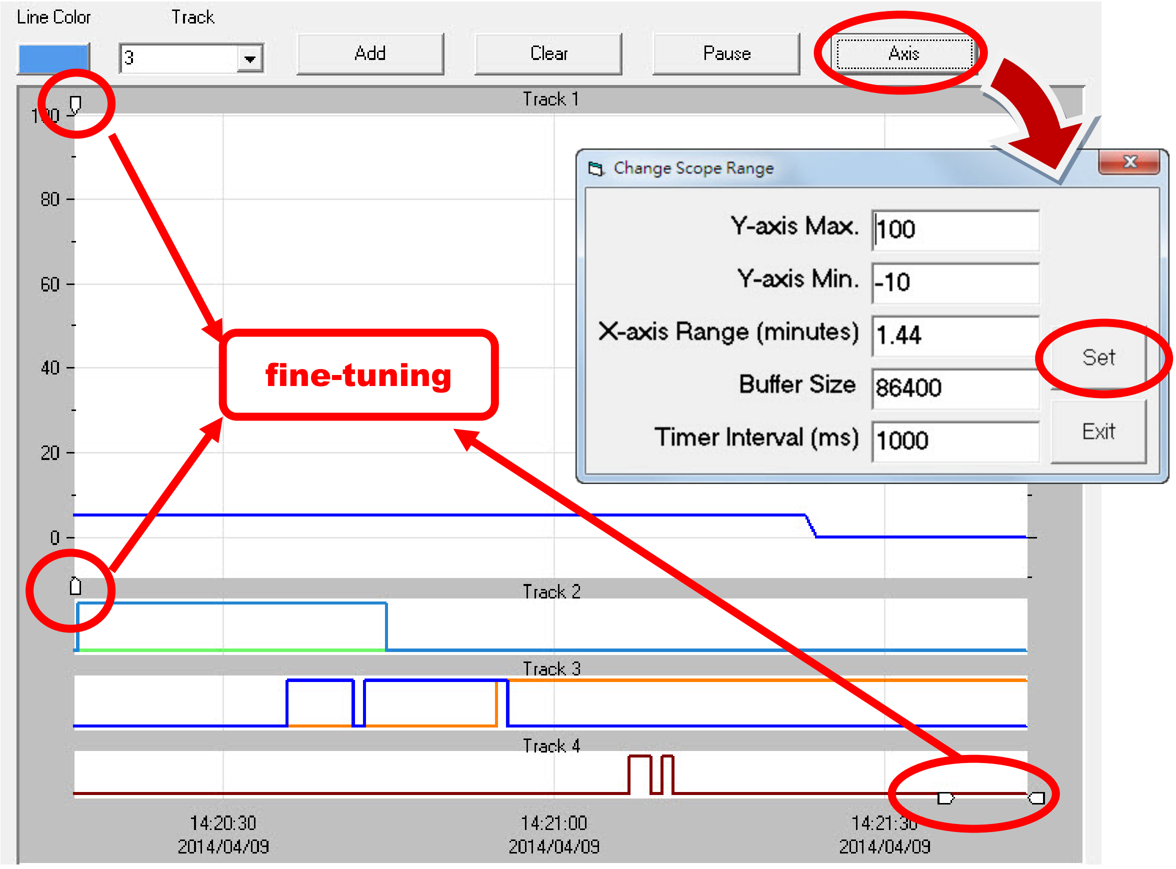
Click the address column.

Channel Information

AO Address: 0

5

Step 5: To change the scope range, click the “Axis” button to open the “Change Scope Range” dialog box. Adjust the settings as necessary and then click the “Set” button. The details shown in the “Change Scope Range” dialog box can also be fine-tuned by dragging either of the scale arrows illustrated in the image below.



fine-tuning

Change Scope Range

Y-axis Max. 100

Y-axis Min. -10

X-axis Range (minutes) 1.44

Buffer Size 86400

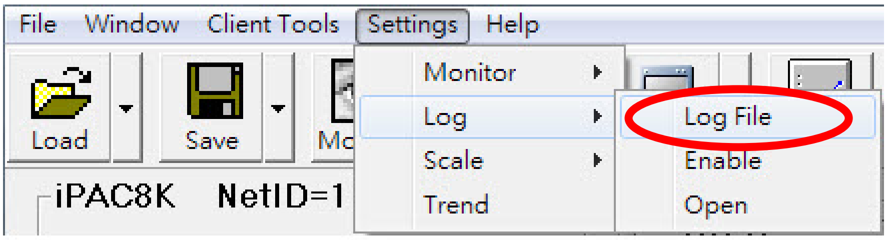
Timer Interval (ms) 1000

2.16. Data Log

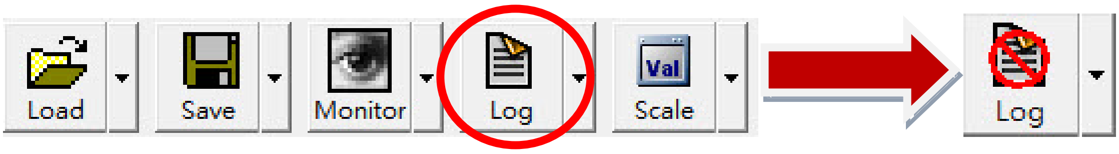
The data log function can be used to record the configuration of the modules, together with the current values, and then save the information as a text file.

Note: The Monitoring function must be active before the Data Log function can be activated.

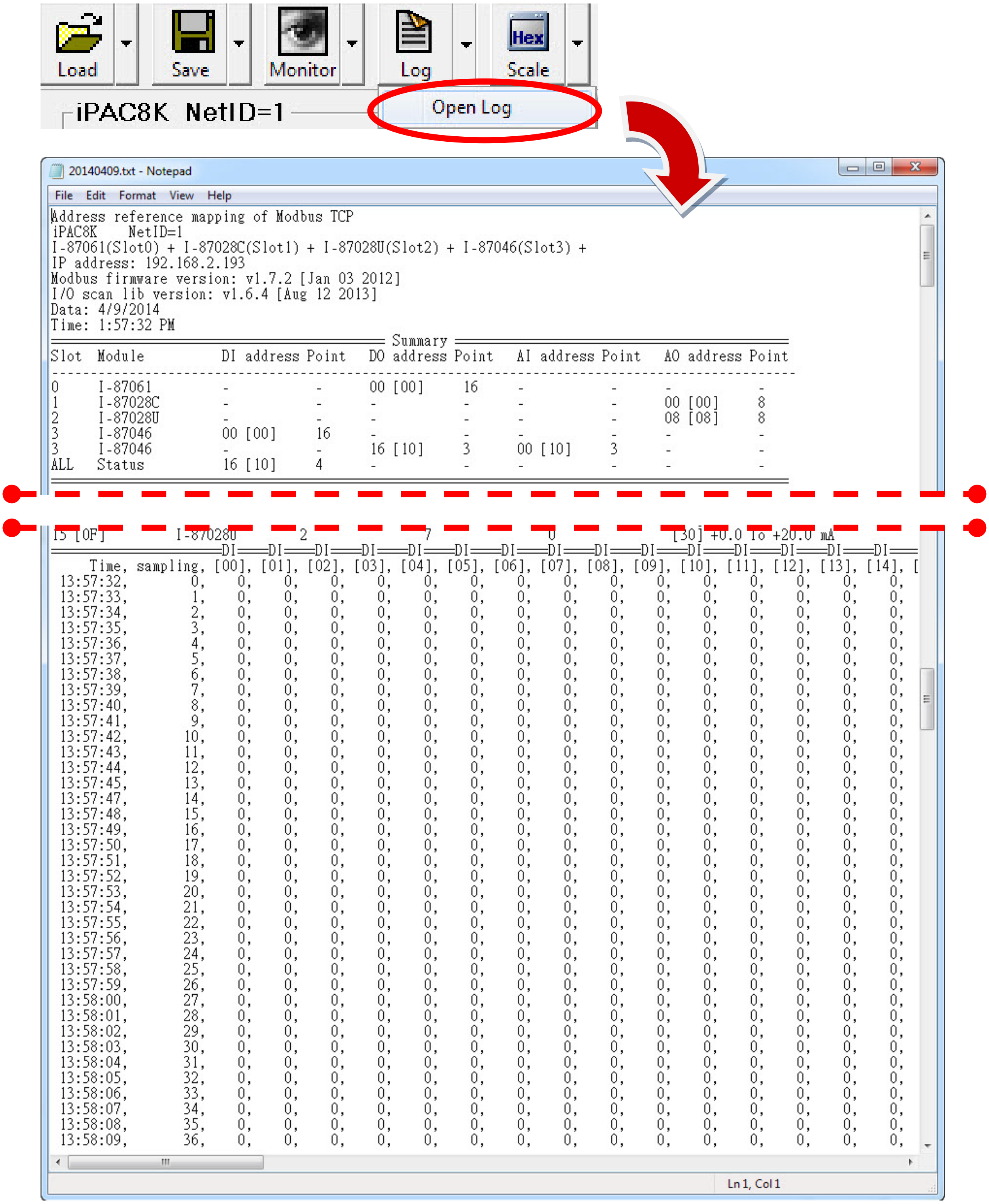
Step 1: First, set a name for the log file by clicking the “Log File” option from the “Log” drop-down menu in the “Settings” menu to open an “Open” dialog box. If a name is not set for the log file, the default file name "yyyymmdd.txt" will be used and stored in the "log" subdirectory.



Step 2: Click the “Log” icon to begin recording log data. Once recording begins, the Log icon will change to indicate data logging is active, as shown below.



Step 3: To open the data log file, first click the “Log” icon to stop data recording, and then click the “Open Log” option in the “Log” drop-down menu to open the data log. The I/O data will be displayed in the data log text file.



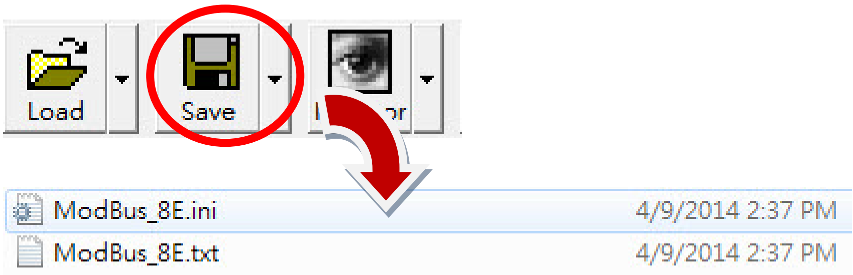
```
Address reference mapping of Modbus TCP
iPAC8K     NetID=1
I-87061(Slot0) + I-87028C(Slot1) + I-87028U(Slot2) + I-87046(Slot3) +
IP address: 192.168.2.193
Modbus firmware version: v1.7.2 [Jan 03 2012]
I/O scan lib version: v1.6.4 [Aug 12 2013]
Data: 4/9/2014
Time: 1:57:32 PM
═══════════════════════════════════════════ Summary ═════════════════════════════════════════════
Slot  Module          DI address Point   DO address Point   AI address Point   AO address Point
------------------------------------------------------------------------------------------------
0      I-87061        -          -       00 [00]     16     -          -       -          -
1      I-87028C       -          -       -           -      -          -       00 [00]    8
2      I-87028U       -          -       -           -      -          -       08 [08]    8
3      I-87046        00 [00]    16      -           -      -          -       -          -
3      I-87046        -          -       16 [10]     3      00 [10]    3       -          -
ALL    Status         16 [10]    4       -           -      -          -       -          -
════════════════════════════════════════════════════════════════════════════════════════════════

15 [0F]          I-87028U          2             7            0             [30] +0.0 To +20.0 mA
═══════════════════════════════DI═══DI═══DI═══DI═══DI═══DI═══DI═══DI═══DI═══DI═══DI═══DI═══DI═══DI═══DI═══
    Time, sampling, [00], [01], [02], [03], [04], [05], [06], [07], [08], [09], [10], [11], [12], [13], [14], [
 13:57:32,        0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
 13:57:33,        1,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
 13:57:34,        2,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
 13:57:35,        3,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
 13:57:36,        4,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
 13:57:37,        5,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
 13:57:38,        6,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
 13:57:39,        7,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
 13:57:40,        8,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
 13:57:41,        9,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
 13:57:42,       10,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
 13:57:43,       11,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
 13:57:44,       12,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
 13:57:45,       13,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
 13:57:47,       14,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
 13:57:48,       15,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
 13:57:49,       16,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
 13:57:50,       17,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
 13:57:51,       18,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
 13:57:52,       19,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
 13:57:53,       20,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
 13:57:54,       21,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
 13:57:55,       22,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
 13:57:56,       23,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
 13:57:57,       24,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
 13:57:58,       25,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
 13:57:59,       26,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
 13:58:00,       27,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
 13:58:01,       28,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
 13:58:02,       29,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
 13:58:03,       30,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
 13:58:04,       31,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
 13:58:05,       32,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
 13:58:06,       33,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
 13:58:07,       34,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
 13:58:08,       35,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
 13:58:09,       36,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
```

2.17. Save and Load the Configuration Settings

The Modbus Utility allows the configuration of the module to be saved for future use, meaning that it can be loaded the next time the Modbus Utility is used without needing to set the configuration again.

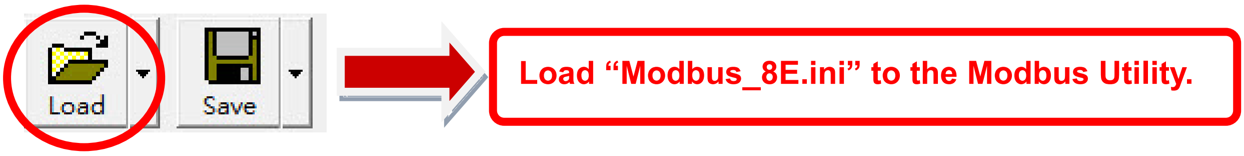
After clicking the “Save” icon, the Modbus Utility will generate two files. The default file names are Modbus_8E.ini and Modbus_8E.txt.



ModBus_8E.ini 4/9/2014 2:37 PM
ModBus_8E.txt 4/9/2014 2:37 PM

Two methods can be used to review the settings of both a specific controller and each module that is inserted in it.

A. Using the Modbus Utility: Click the “Load” icon to load the .ini file into the Modbus Utility.



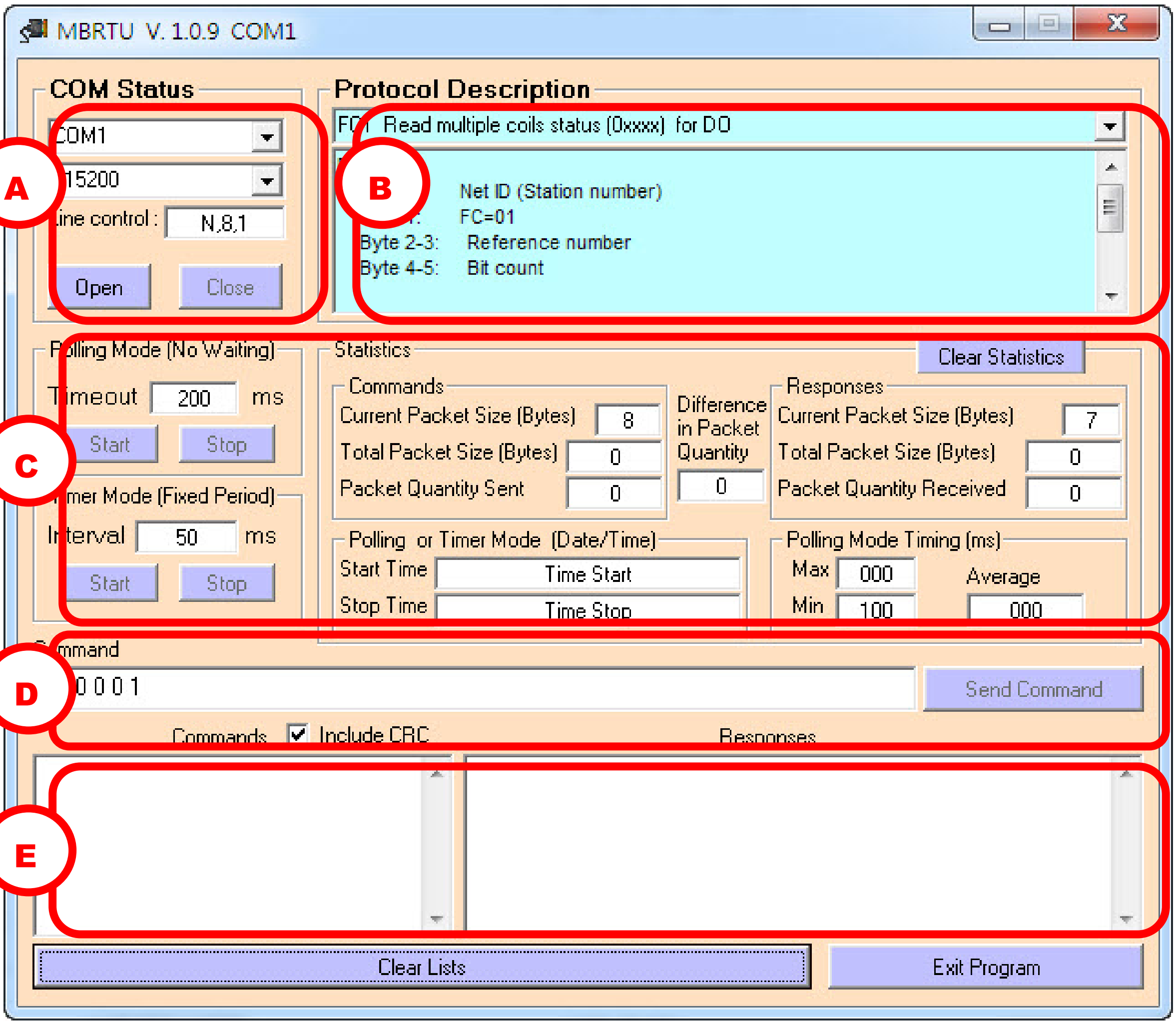
Load “Modbus_8E.ini” to the Modbus Utility.

B. Using a text editor (such as Notepad): Open the .txt file in the text editor to view the details.

Open “Modbus_8E.txt” in Notepad.

2.18. Modbus RTU Master Tool

The Modbus RTU (MBRTU) Master Tool can be used to send Modbus message to read or write I/O values via the COM port. The following image provides an overview of the MBRTU Master Tool interface.


MBRTU V. 1.0.9 COM1

COM1

15200

ine control : N,8,1

FC1 Read multiple coils status (0xxxx) for DO

Net ID (Station number)
FC=01
Byte 2-3: Reference number
Byte 4-5: Bit count

Polling Mode (No Waiting): Timeout 200 ms

Timer Mode (Fixed Period): Interval 50 ms

Commands: Current Packet Size (Bytes) 8; Total Packet Size (Bytes) 0; Packet Quantity Sent 0

Difference in Packet Quantity 0

Responses: Current Packet Size (Bytes) 7; Total Packet Size (Bytes) 0; Packet Quantity Received 0

Polling or Timer Mode (Date/Time): Start Time: Time Start; Stop Time: Time Stop

Polling Mode Timing (ms): Max 000; Min 100; Average 000

Command: 0 0 0 1

☑ Include CRC

A. COM Status: Click the "Open" button to connect to the controller using the selected COM Port and parameter values. Click the "Close" button to terminate the connection.

B. Protocol Description: This section provides a description of the request and the response. For more detailed information regarding this section, see Appendix B: Function Codes (FC)

C. Polling Mode: Set the timeout and then click the “Start” button to activate Polling Mode. Click the “Stop” button to cancel it.

Timer Mode: Used to set the timer interval (in million second) that must elapse before a command is sent. Enter a value for the "Interval" and click the "Start" button to activate Timer Mode. Click the "Stop" button to cancel it.

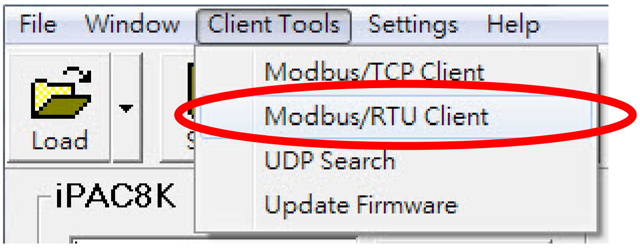
D. Command: This section is used to enter commands. After entering a command, click the "Send Command" button to transmit the command.

E. Command/Response: Commands sent to the controller will be displayed in the left-hand text field, and the related response will be displayed on the right.

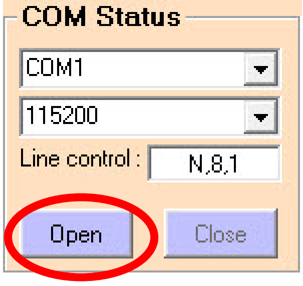
Use the following procedure to send a Modbus command.

Step 1: Set the COM Port mode to Modbus RTU Slave. For more details of the procedure, see Section 2.12 COM Port Settings.

Step 2: Click the "Modbus/RTU Client" option from the "Clients tools" menu.



Step 3: In the COM Status section, select the COM Port and Baud Rate from the respective drop-down menus and then click the "Open" button to establish a connection to the COM Port.

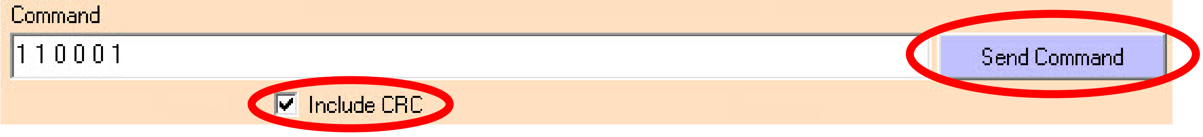

COM Status

COM1

115200

Line control : N,8,1

Step 4: In the Command section, enter a command and then click the "Send Command" button to transmit the command. Ensure that the "Include CRC" option is checked to automatically add a Checksum to the end of the command.

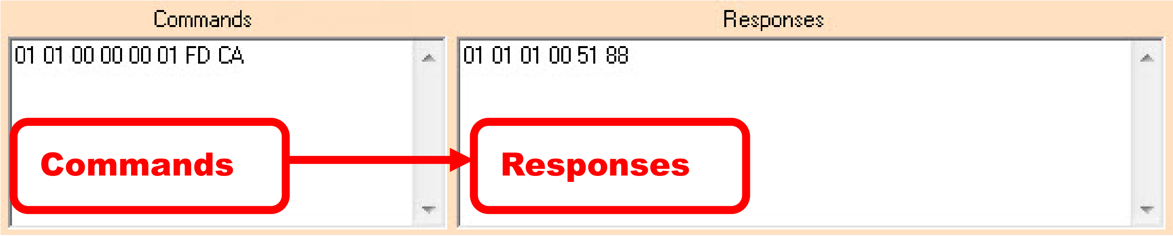

Command

1 1 0 0 0 1

☑ Include CRC

Step 5: The command will be displayed on the left-hand side of the

Command/Response window, and the response will be shown on the right-hand side. Note that the last two bytes are the CRC.

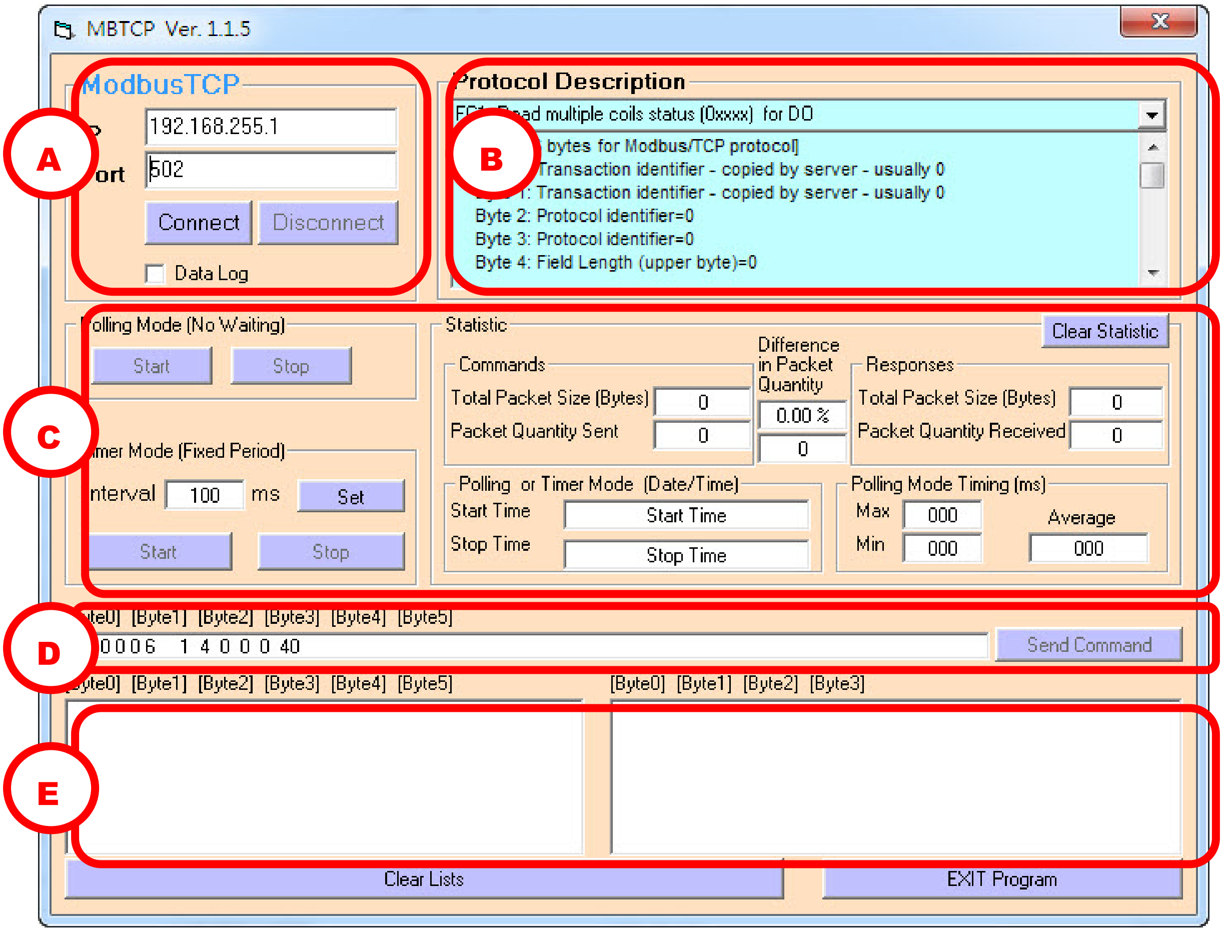


```
01 01 00 00 00 01 FD CA
```

```
01 01 01 00 51 88
```

2.19. Modbus TCP Client Tool

The Modbus TCP (MBTCP) Client Tool can be used to send Modbus messages to read or write I/O values via the Ethernet. The following image provides an overview of the MBTCP Client Tool interface.



192.168.255.1

502

FC1 ead multiple coils status (0xxxx) for DO

bytes for Modbus/TCP protocol]
Transaction identifier - copied by server - usually 0
1: Transaction identifier - copied by server - usually 0
Byte 2: Protocol identifier=0
Byte 3: Protocol identifier=0
Byte 4: Field Length (upper byte)=0

Total Packet Size (Bytes) 0
Packet Quantity Sent 0
0.00 %
0
Total Packet Size (Bytes) 0
Packet Quantity Received 0
Interval 100 ms
Start Time: Start Time
Stop Time: Stop Time
Max 000
Min 000
Average 000

0006 1 4 0 0 0 40

A. Modbus TCP: Click the “Connect” button to connect to the controller using the selected IP address and Port number. Click the “Disconnect” button to terminate the connection.

B. Protocol Description: This section provides a description of the request and the response. Note that a 6-byte prefix must be used for the Modbus TCP protocol. For more detailed information regarding this section, see Appendix B: Function Codes (FC).

C. Polling Mode: Click the “Start” button to activate Polling Mode and click the “Stop” button to cancel it.

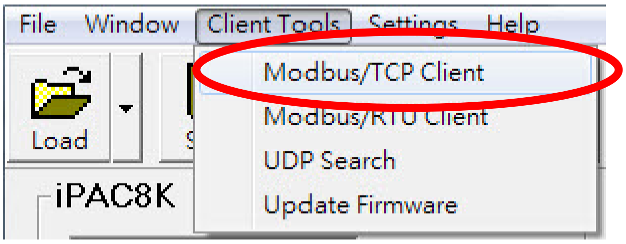
Timer Mode: Used to set the timer interval (in million second) that must elapse before a command is sent. Enter a value for the "Interval" and then click the "Set" button. Click the "Start" button to activate Timer Mode and click the "Stop" button to cancel it

D. Command: This section is used to enter commands. Enter the command, including the 6-byte Modbus TCP prefix, and then click the “Send Command” button to transmit the command.

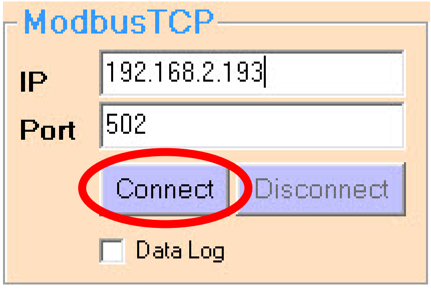
E. Command/Response: Commands sent to the controller will be displayed in the left-hand text field, and the related response will be displayed on the right.

Use the following procedure to send a Modbus command.

Step 1: Click the "Modbus/TCP Client" option from the "Clients Tools" menu.

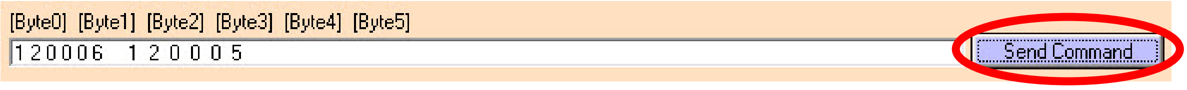


Step 2: In the Modbus TCP section, enter the IP address and the Port number in the respective text fields and then click the "Connect" button to establish a connection. If you also wish to create a data log, click the "Data Log" checkbox.



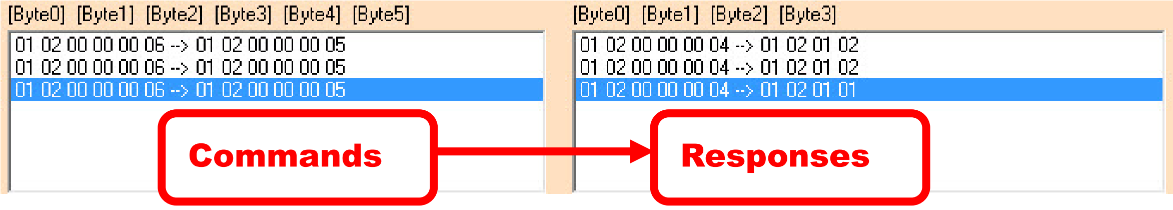
IP 192.168.2.193
Port 502
☐ Data Log

Step 3: Enter a command in the command line field and then click the "Send Command" button to transmit the command.



[Byte0] [Byte1] [Byte2] [Byte3] [Byte4] [Byte5]
1 2 0 0 0 6   1 2 0 0 0 5

Step 4: The command will be displayed on the left-hand side of the text box area, and the response will be shown on the right-hand side of the text box area.



```
[Byte0] [Byte1] [Byte2] [Byte3] [Byte4] [Byte5]
01 02 00 00 00 06 --> 01 02 00 00 00 05
01 02 00 00 00 06 --> 01 02 00 00 00 05
01 02 00 00 00 06 --> 01 02 00 00 00 05
```

```
[Byte0] [Byte1] [Byte2] [Byte3]
01 02 00 00 00 04 --> 01 02 01 02
01 02 00 00 00 04 --> 01 02 01 02
01 02 00 00 00 04 --> 01 02 01 01
```

3. Linking to SCADA Software via Modbus

This chapter provides a description of how to connect to SCADA (Supervisor Control and Data Acquisition) applications via Modbus in order to retrieve I/O values using the Modbus/TCP protocol. The SCADA applications that will be described in this chapter are:

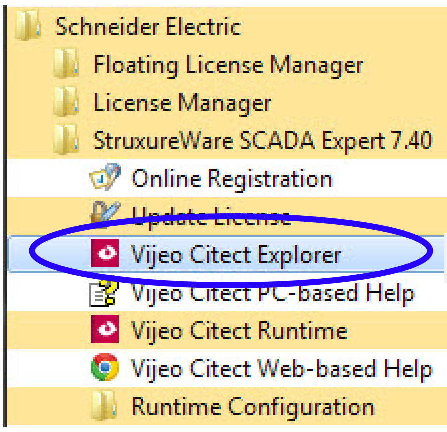
- SCADA Expert Vijeo Citect
- DASYLab
- EZ Data Logger

3.1. SCADA Expert Vijeo Citect

In this section, a detailed description of the procedure for connecting the Vijeo Citect solution to a controller using the Modbus/TCP protocol is presented. In this example, Vijeo Citect version 7.40 is used.

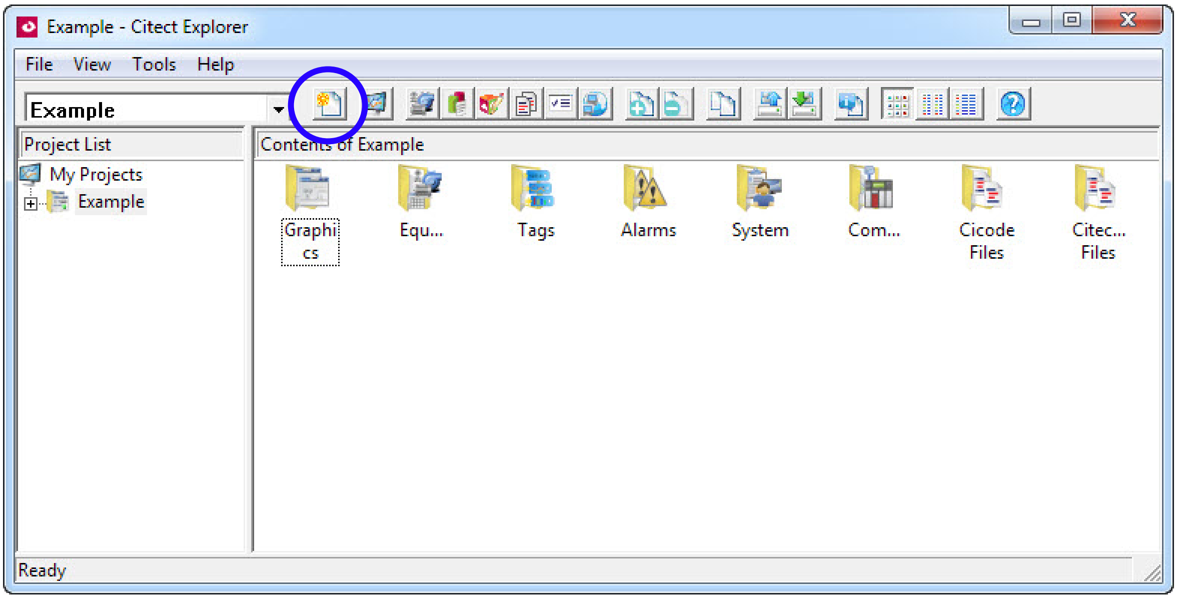
3.1.1. Creating a New Project, an I/O Server and an I/O Device

Step 1: Open the Vijeo Citect Explorer application from the Programs Menu.

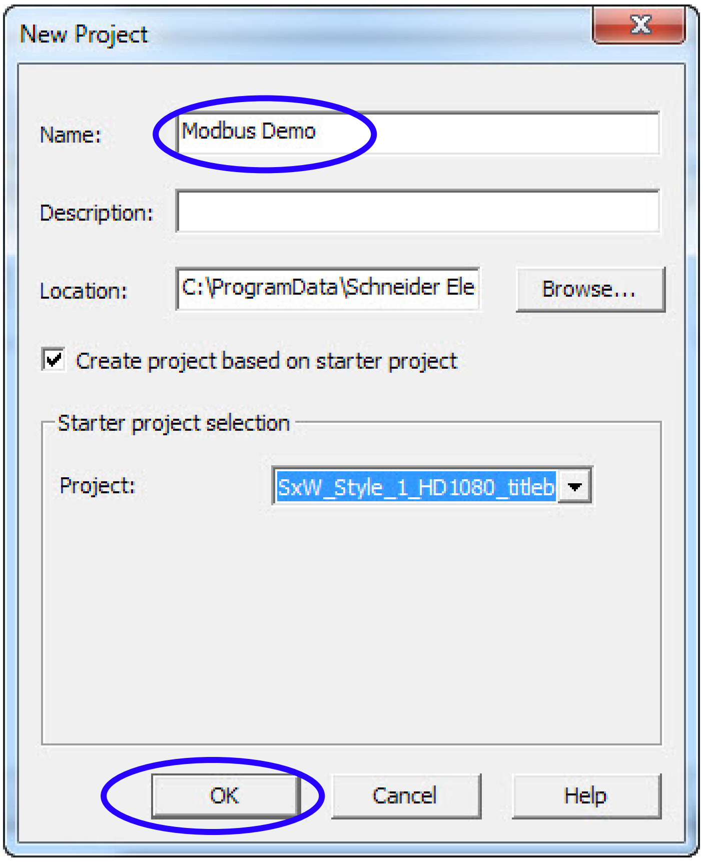


Schneider Electric
Floating License Manager
License Manager
StruxureWare SCADA Expert 7.40
Online Registration
Update License
Vijeo Citect Explorer
Vijeo Citect PC-based Help
Vijeo Citect Runtime
Vijeo Citect Web-based Help
Runtime Configuration

Step 2: In the “Citect Explorer” window, click the “New” button to create a new project.



Step 3: In the "New Project" dialog box, enter a name for the new project. The name "Modbus Demo" is used in this example. Leave all other parameters at their default values, and then click the "OK" button to continue.


New Project

Name: Modbus Demo

Description:

Location: C:\ProgramData\Schneider Ele

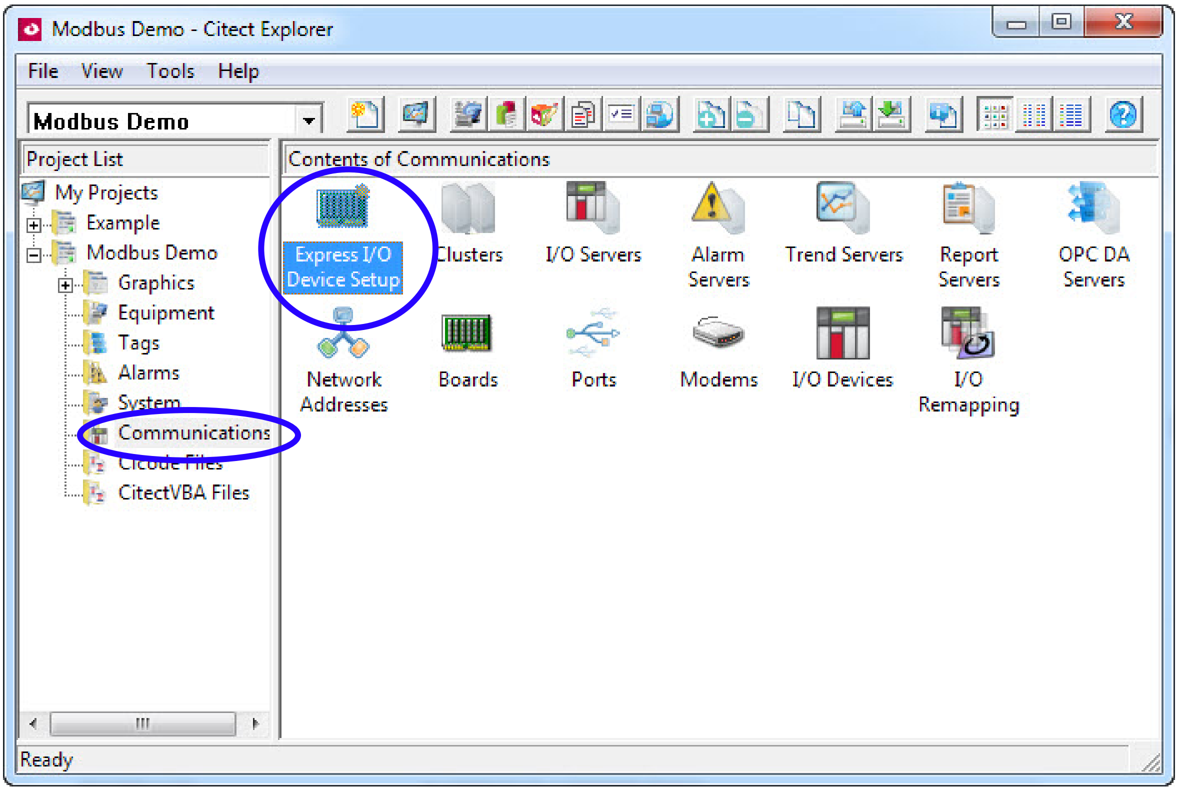
☑ Create project based on starter project

Starter project selection

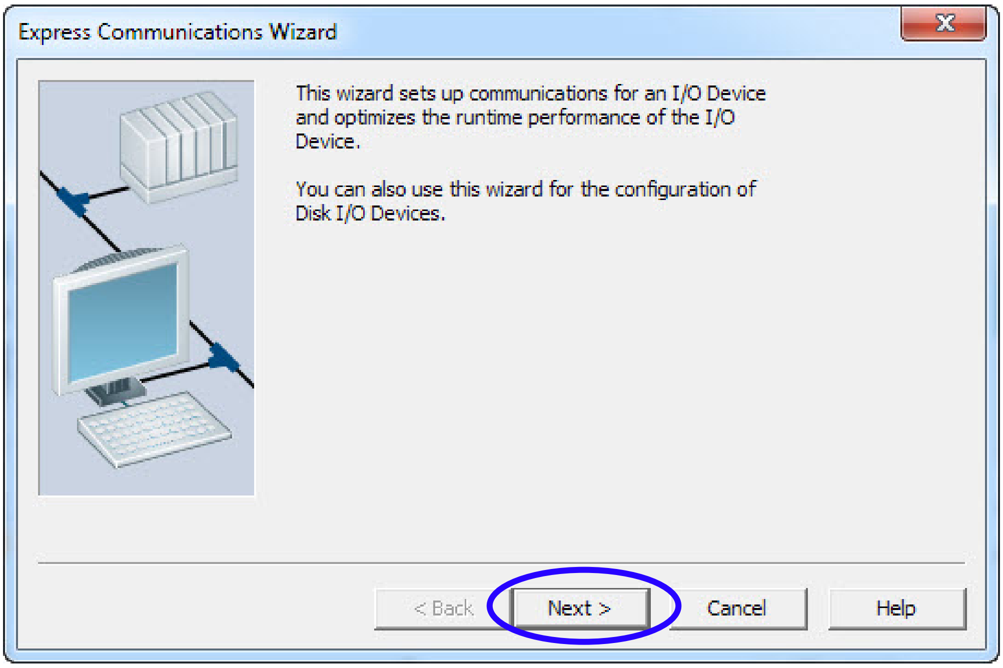
Project: SxW_Style_1_HD1080_titleb

E-mail: service@icpdas.com

Step 4: In the Project List panel, expand the "Modbus Demo" folder, and then double-click the "Express I/O Device Setup" icon in the "Communications" folder to create a new I/O Server and I/O Device.



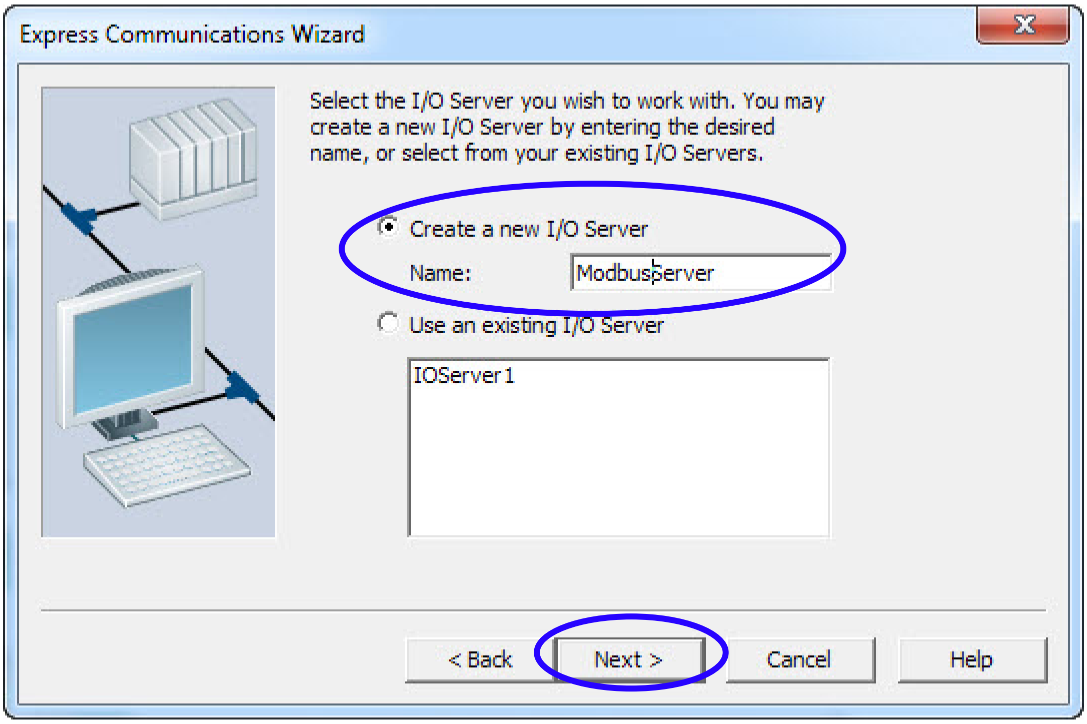
Step 5: Once the "Express Communications Wizard" screen is displayed, click the "Next >" button to continue.



This wizard sets up communications for an I/O Device and optimizes the runtime performance of the I/O Device.

You can also use this wizard for the configuration of Disk I/O Devices.

Step 6: Click the "Create a new I/O Server" radio button, and enter "ModbusServer" in the Name field as the name of I/O Server, and then click the "Next >" button to continue.



Express Communications Wizard

Select the I/O Server you wish to work with. You may create a new I/O Server by entering the desired name, or select from your existing I/O Servers.

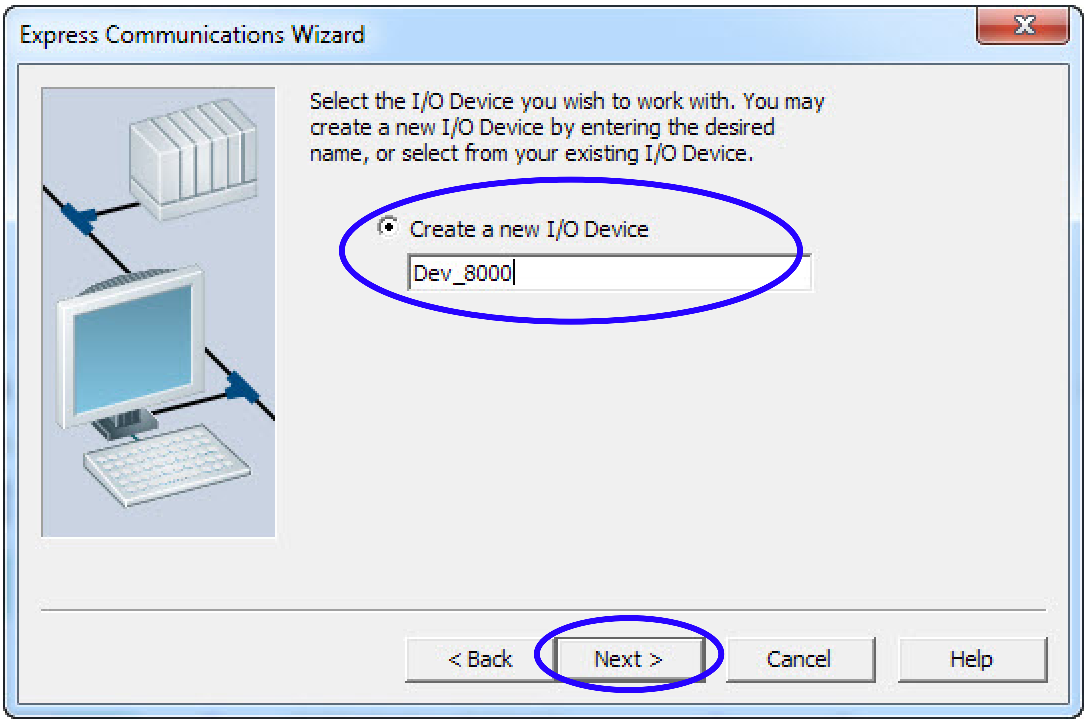
● Create a new I/O Server

Name: ModbusServer

○ Use an existing I/O Server

IOServer1

Step 7: Click the "Create a new I/O Device" radio button, and enter "Dev_8000" as the name of the I/O Device in the text field, and then click the "Next >" button to continue.



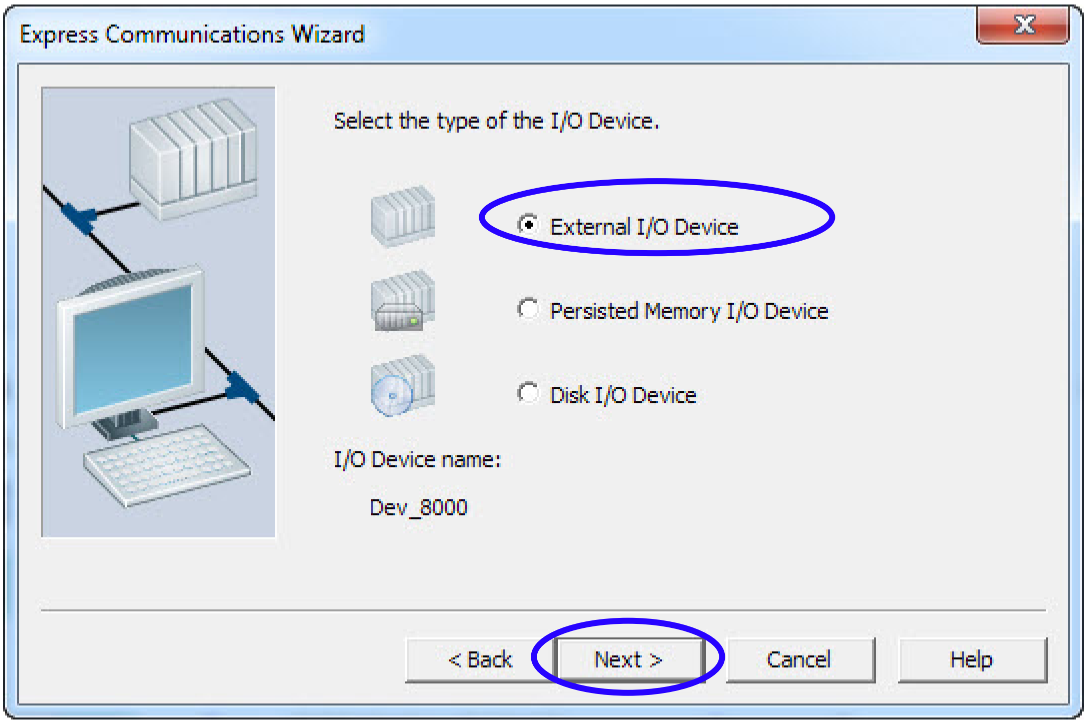
Express Communications Wizard

Select the I/O Device you wish to work with. You may create a new I/O Device by entering the desired name, or select from your existing I/O Device.

● Create a new I/O Device

Dev_8000

Step 8: Click the "External I/O Device" radio button to select the I/O Device type, and then click the "Next >" button to continue.



Select the type of the I/O Device.

● External I/O Device

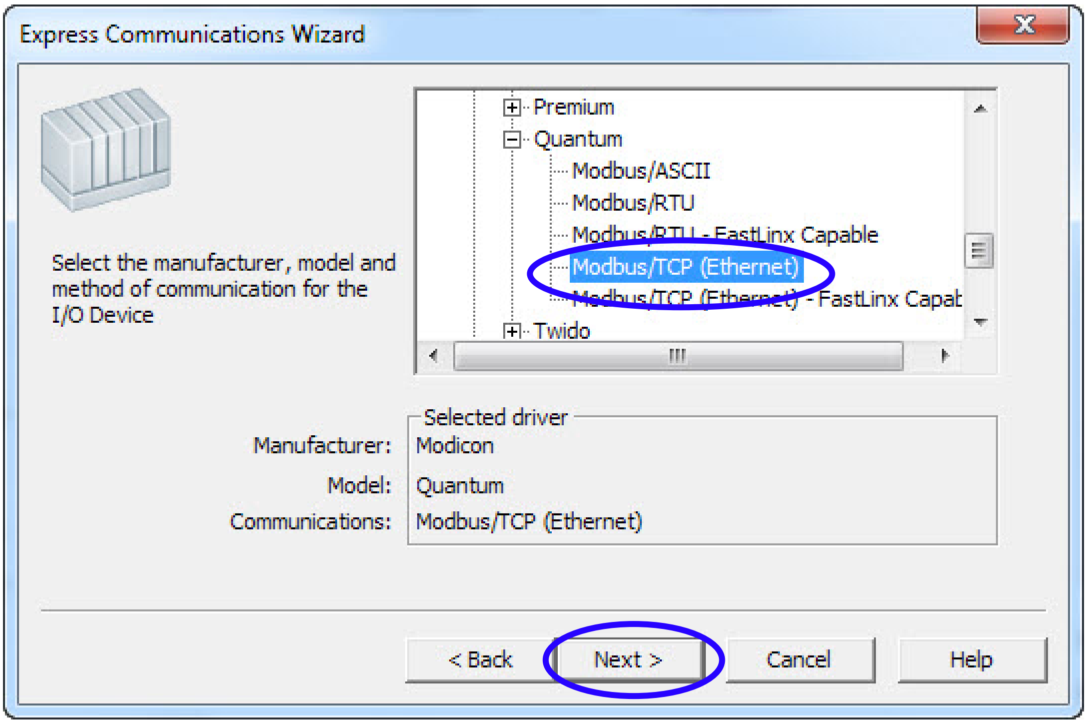
○ Persisted Memory I/O Device

○ Disk I/O Device

I/O Device name:

Dev_8000

Step 9: Select the communication protocol by expanding the "Modicon" item, expanding "Quantum" item, and then clicking the "Modbus/TCP (Ethernet)" option. Click the "Next >" button to continue.



Select the manufacturer, model and method of communication for the I/O Device

Selected driver

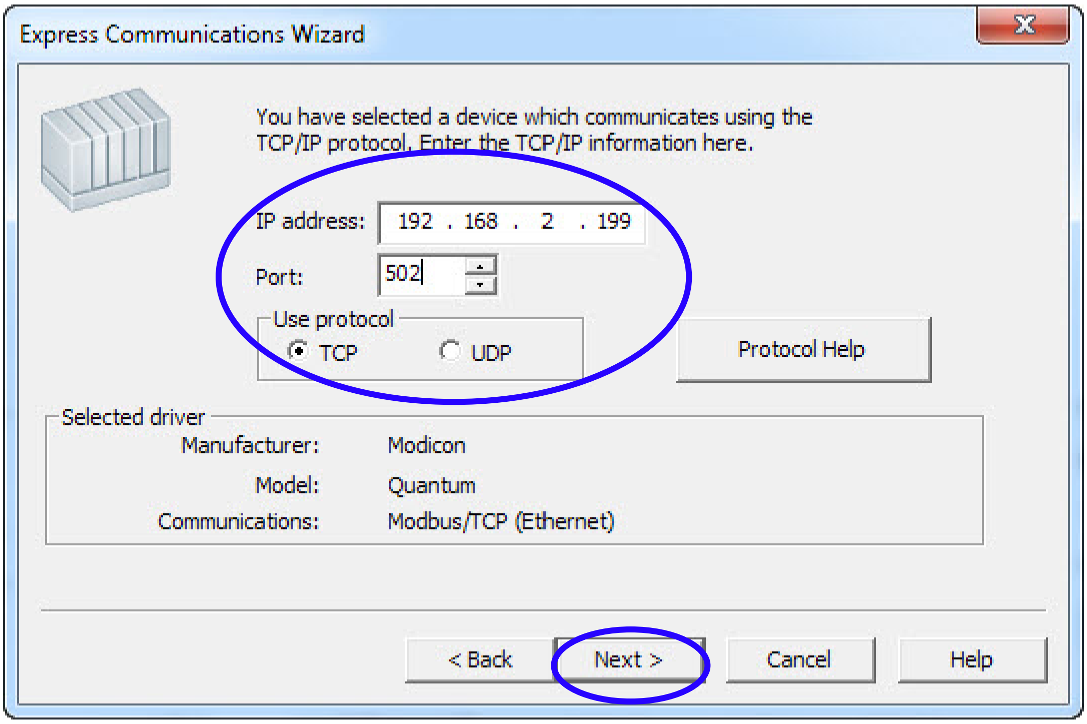
Manufacturer: Modicon

Model: Quantum

Communications: Modbus/TCP (Ethernet)

Express Communications Wizard
Premium
Quantum
Modbus/ASCII
Modbus/RTU
Modbus/RTU - FastLinx Capable
Modbus/TCP (Ethernet)
Modbus/TCP (Ethernet) - FastLinx Capab
Twido
< Back
Next >
Cancel
Help

Step 10: Determine the IP address by checking the LED on the left-hand side of the controller, and then enter it in the "IP address" field. In this example, the IP address "192.168.2.199" is used. Enter the Port number in the "Port" field, "502" in this example, and then click the "Next >" button to continue.



Express Communications Wizard

You have selected a device which communicates using the TCP/IP protocol. Enter the TCP/IP information here.

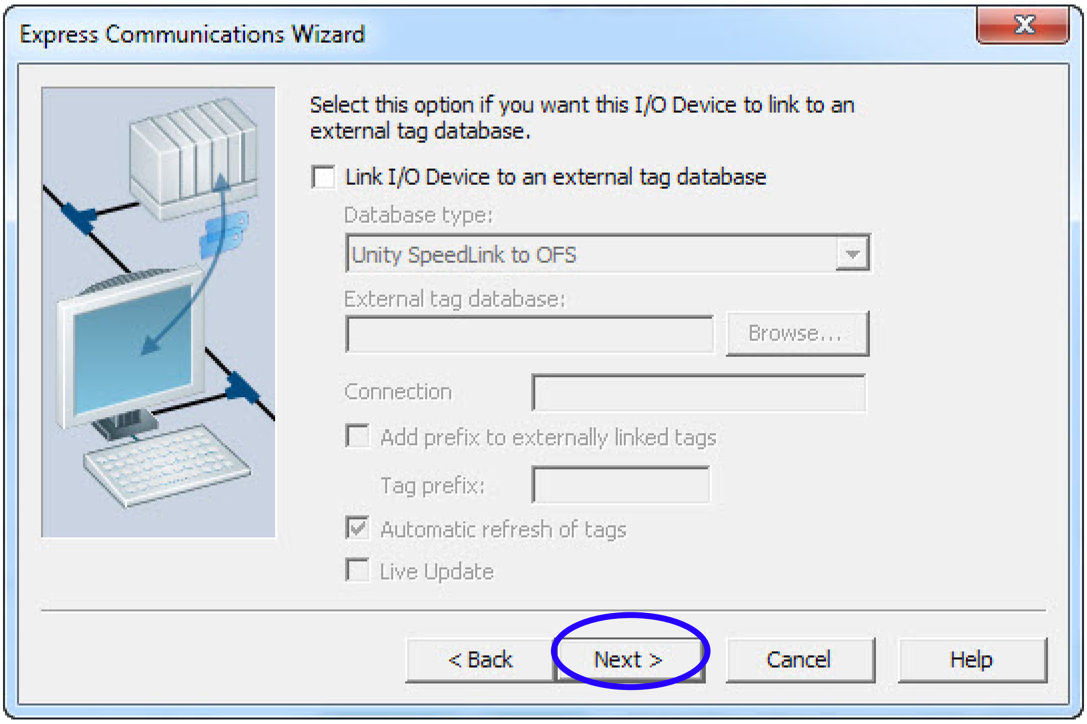
IP address: 192 . 168 . 2 . 199

Port: 502

Use protocol: ● TCP ○ UDP

Selected driver
Manufacturer: Modicon
Model: Quantum
Communications: Modbus/TCP (Ethernet)

Step 11: There is no need to select any options on the following screen, so click the "Next >" button to continue.



Express Communications Wizard

Select this option if you want this I/O Device to link to an external tag database.

☐ Link I/O Device to an external tag database

Database type: Unity SpeedLink to OFS

External tag database:

Connection

☐ Add prefix to externally linked tags

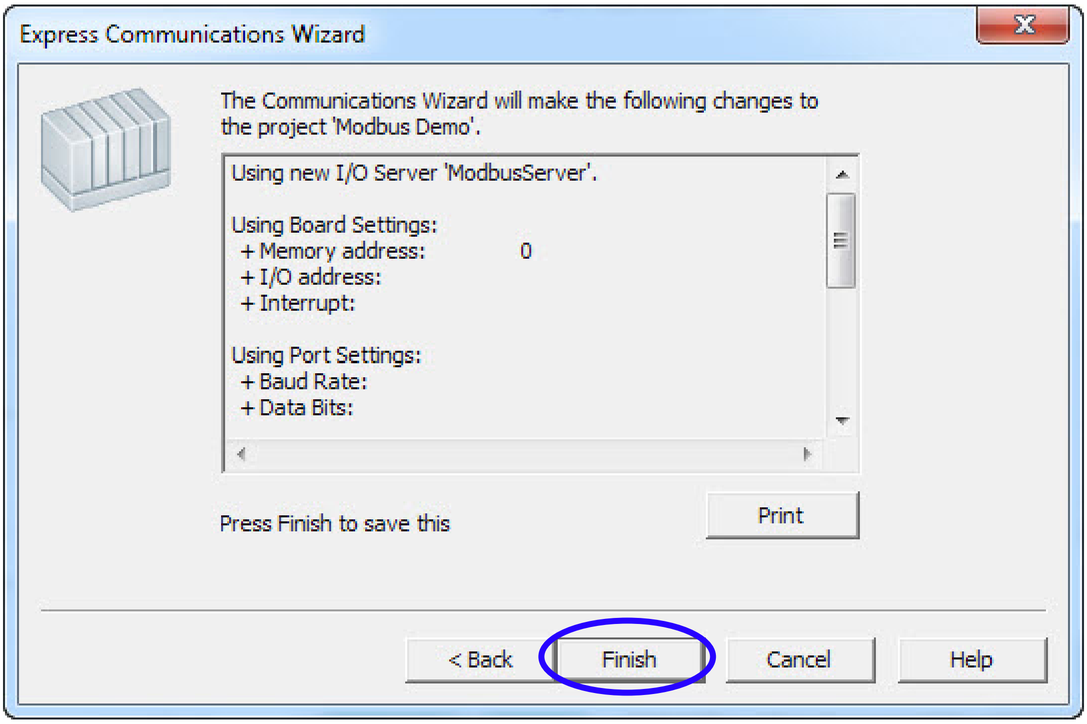
Tag prefix:

☑ Automatic refresh of tags

☐ Live Update

E-mail: service@icpdas.com

Step 12: Verify that the details for the new I/O Server are correct, and then click the "Finish" button to complete the configuration.



Express Communications Wizard

The Communications Wizard will make the following changes to the project 'Modbus Demo'.

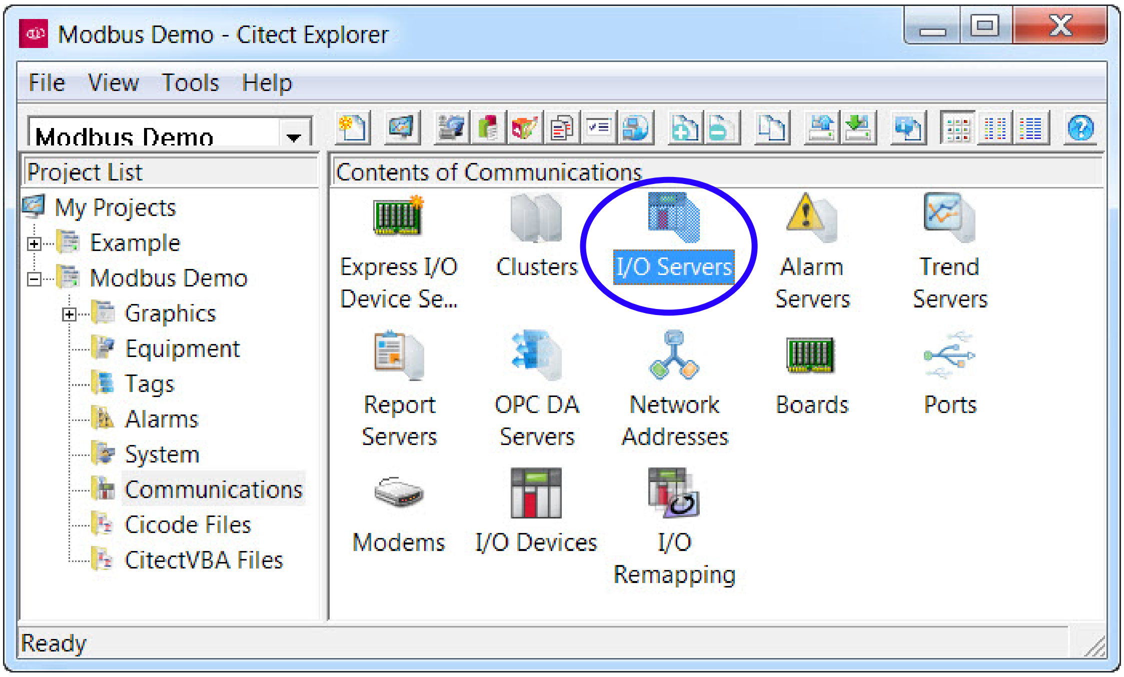
Using new I/O Server 'ModbusServer'.

Using Board Settings:
+Memory address: 0
+I/O address:
+Interrupt:

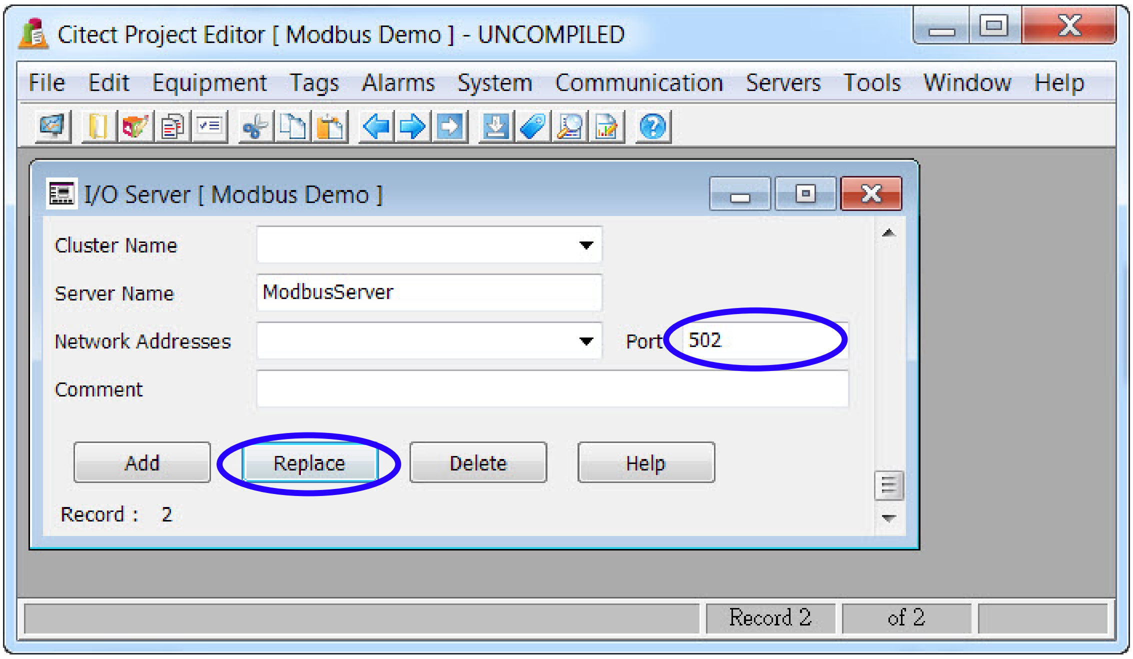
Using Port Settings:
+Baud Rate:
+Data Bits:

Press Finish to save this

Step 13: In the “Communication” folder, double-click the “I/O Servers” icon to open the “I/O Server [Modbus Demo]” dialog box in the “Citect Project Editor” window.



Step 14: Find the Server named "ModbusServer" that was created in previous step. Enter the port number "502" in the "Port" text field and then click the "Replace" button to complete the I/O Server configuration.



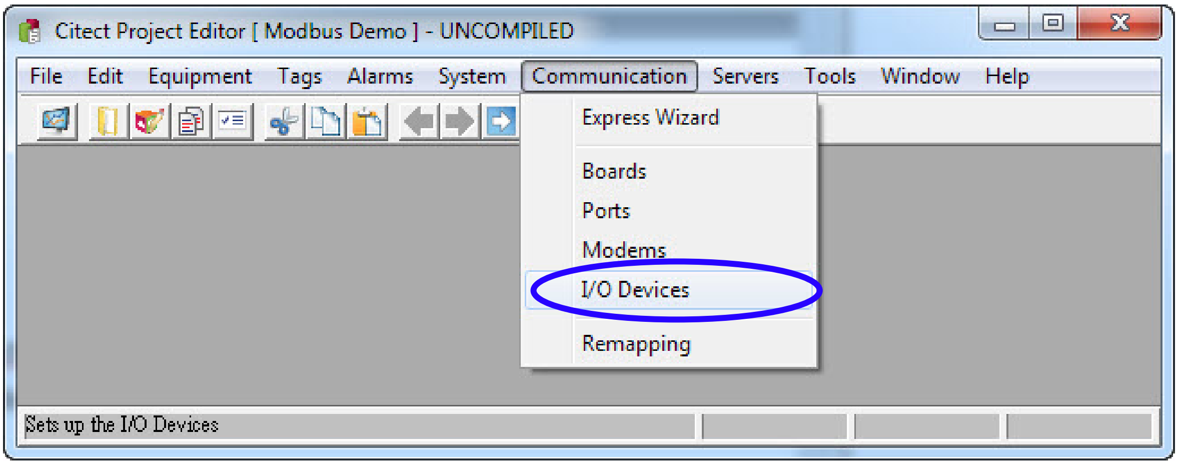
Server Name: ModbusServer

Port: 502

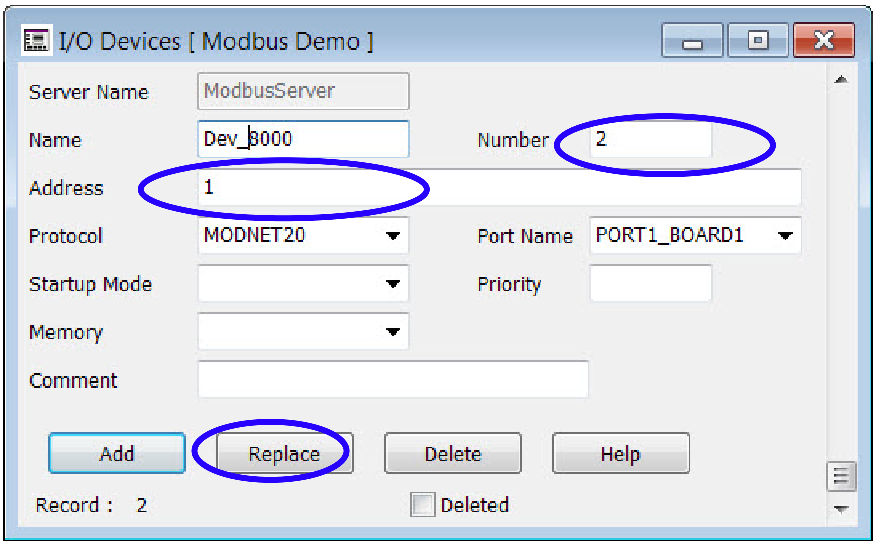
Record : 2

3.1.2. Designing the Layout and Acquiring the Data

Step 1: Open the “Citect Project Editor” window, and then select the “I/O Devices” option from the Communication menu in order to modify the parameters for the I/O device that was created in Section 3.1.1 above.



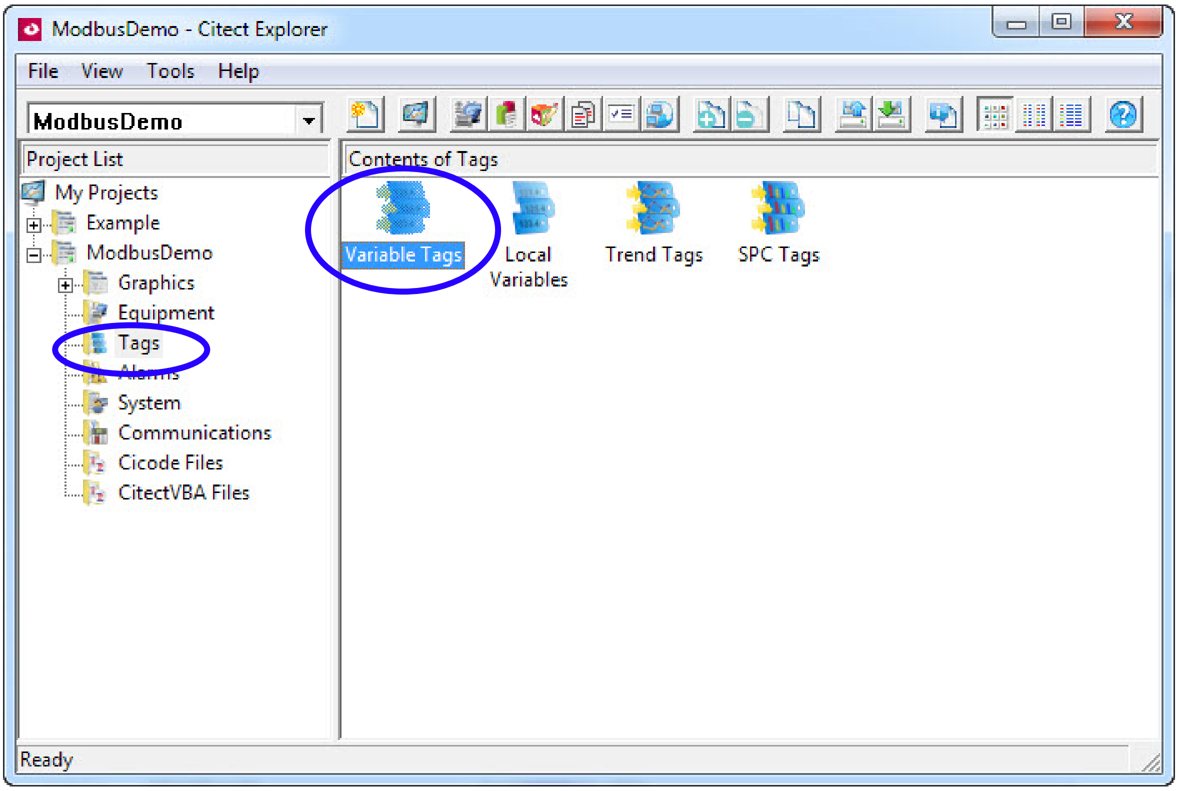
Step 2: Once the “I/O Devices [Modbus Demo]” dialog box is displayed, find the “Dev_8000” device that was created in Section 3.1.1. Determine the station number by checking the DIP switch on the right-hand side of the controller, and enter the value in the "Address" field. In this example, the station number "1" is used. To prevent the “Number” value entered in the “Address” field from being the same as the existing Server Number, enter “2” in the “Number” field. When all the relevant values have been entered, click the "Replace" button to complete the configuration.



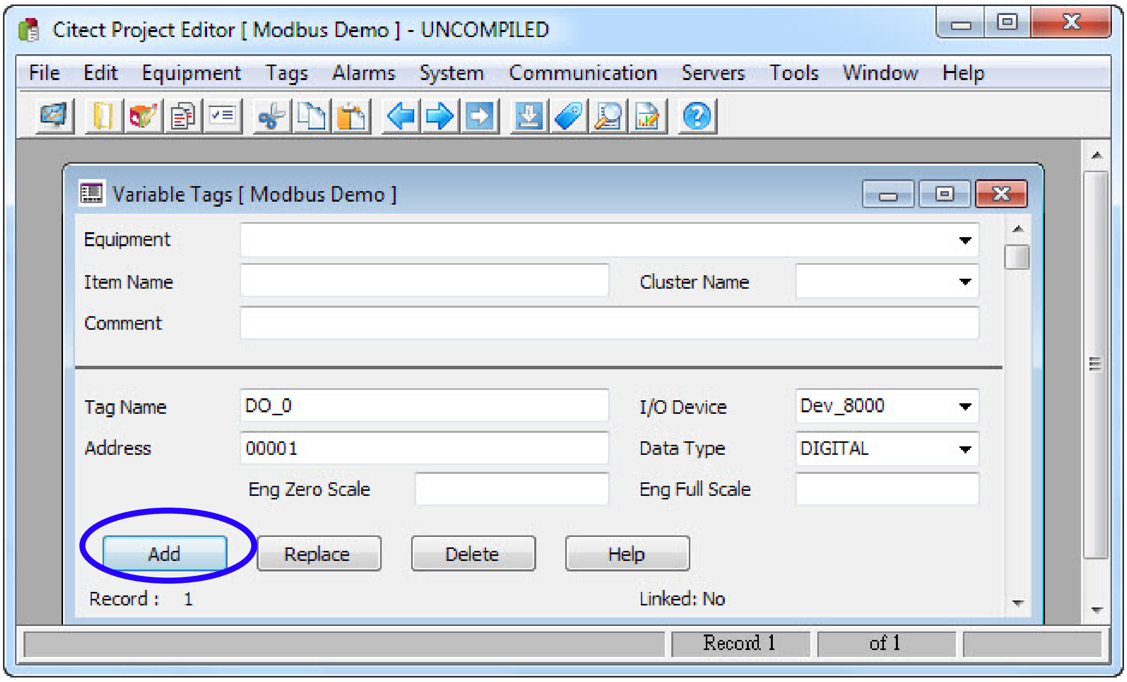
Server Name	ModbusServer		
Name	Dev_8000	Number	2
Address	1		
Protocol	MODNET20	Port Name	PORT1_BOARD1
Startup Mode		Priority	
Memory			
Comment			

Record : 2 ☐ Deleted

Step 3: Open the "Citect Explorer" window, and expand the "Modbus Demo" folder in the Project List panel. Click the "Tags" folder and then double-click the "Variable Tags" icon in the Content pane to create a new variable tags.

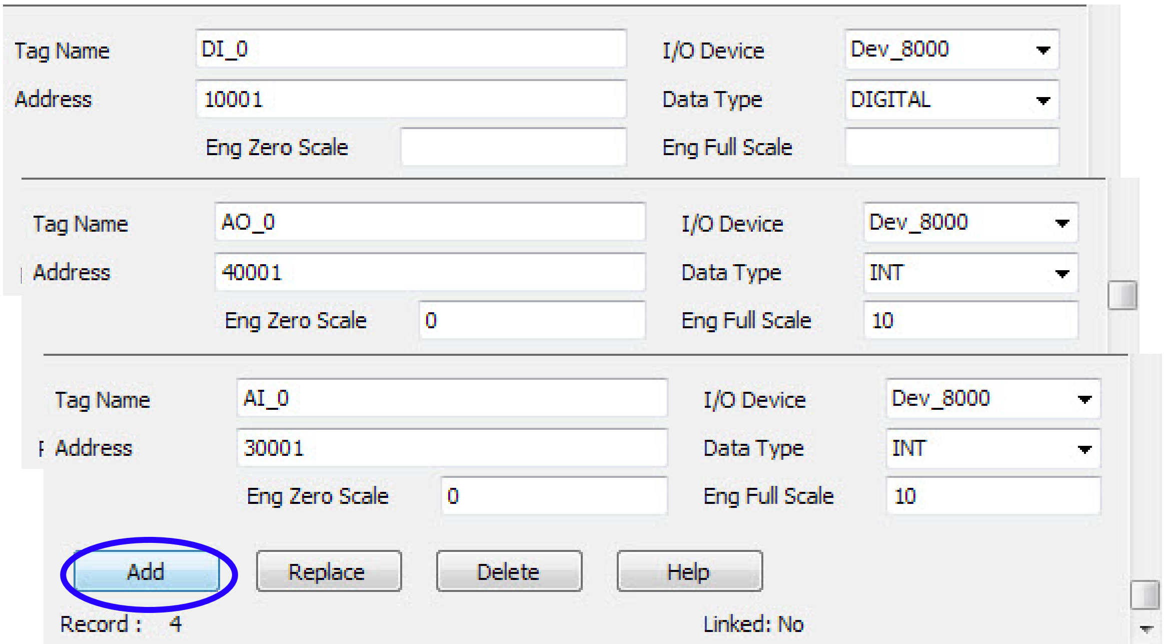


Step 4: Open the "Citect Project Editor" window, enter a name for the tag in the "Tag Name" field in the "Variable Tags [Modbus Demo]" dialog box. Select the I/O device from the "I/O Device" drop-down menu, enter the correct address in the "Address" field, and select the appropriate "Data Type" from the drop-down menu. After the details for the first tag have been entered, click the "Add" button to save it.


Citect Project Editor [Modbus Demo] - UNCOMPILED
File Edit Equipment Tags Alarms System Communication Servers Tools Window Help
Variable Tags [Modbus Demo]
Add
Replace
Delete
Help
Record 1
of 1

Equipment:
Item Name:
Cluster Name:
Comment:
Tag Name: DO_0
I/O Device: Dev_8000
Address: 00001
Data Type: DIGITAL
Eng Zero Scale:
Eng Full Scale:
Record : 1
Linked: No

Repeat the procedure to create the next tag.



Tag Name: DI_0
I/O Device: Dev_8000
Address: 10001
Data Type: DIGITAL
Eng Zero Scale:
Eng Full Scale:

Tag Name: AO_0
I/O Device: Dev_8000
Address: 40001
Data Type: INT
Eng Zero Scale: 0
Eng Full Scale: 10

Tag Name: AI_0
I/O Device: Dev_8000
Address: 30001
Data Type: INT
Eng Zero Scale: 0
Eng Full Scale: 10
Record : 4
Linked: No

The parameters for all tags used in this example are shown in the table below.

Tag Name	I/O Device Name	Data Type	Address	Eng. Scale
DO_0	Dev_8000	DIGITAL	00001	X
DI_0	Dev_8000	DIGITAL	10001	X
AO_0	Dev_8000	INT	40001	0~10
AI_0	Dev_8000	INT	30001	0~10

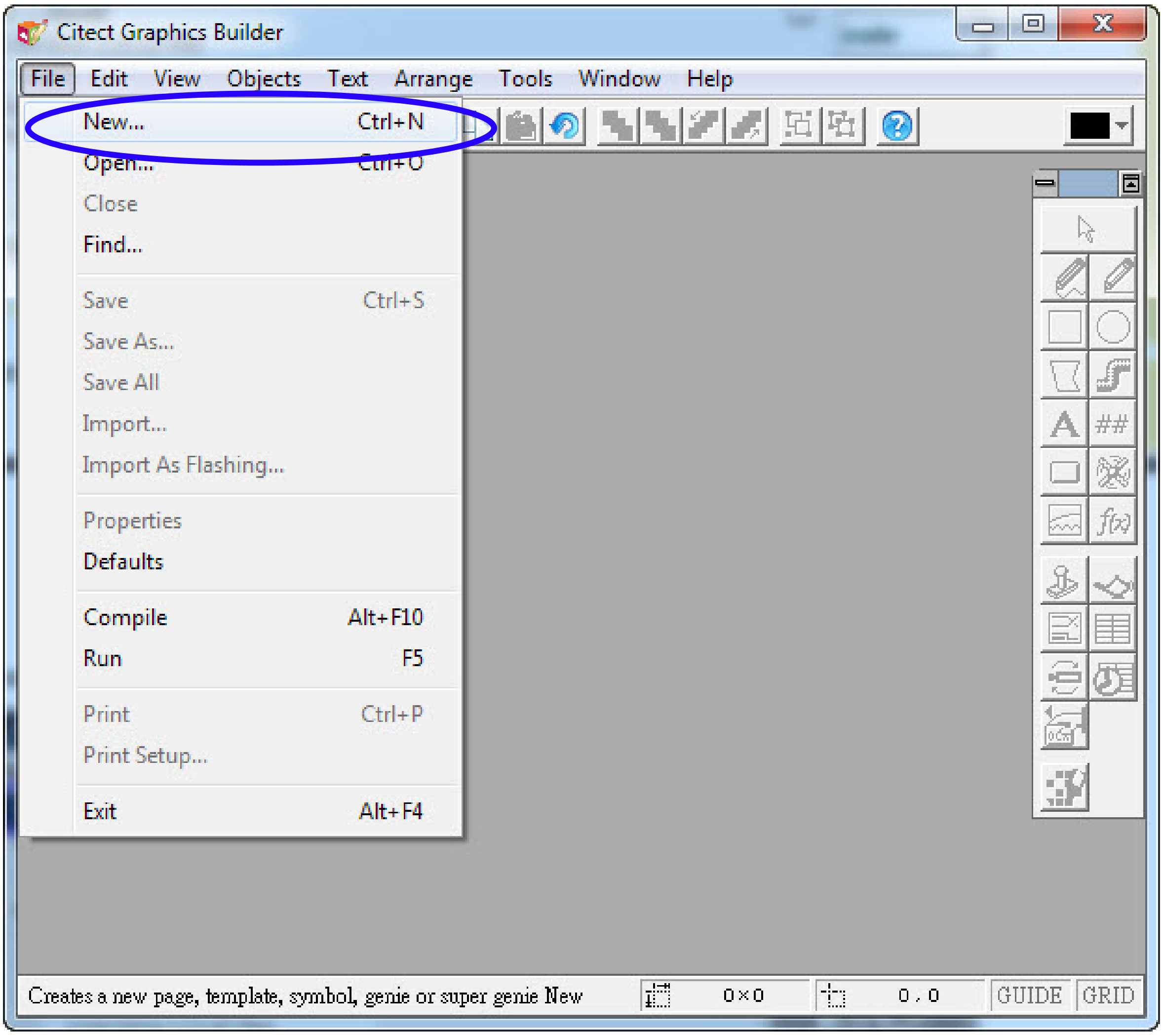
Notes

- When using the Modbus protocol, the Address Type must be set to “0xxxx” for Digital Output, “1xxxx” for Digital Input, “3xxxx” for Analog Input, and “4xxxx” for Analog Output.

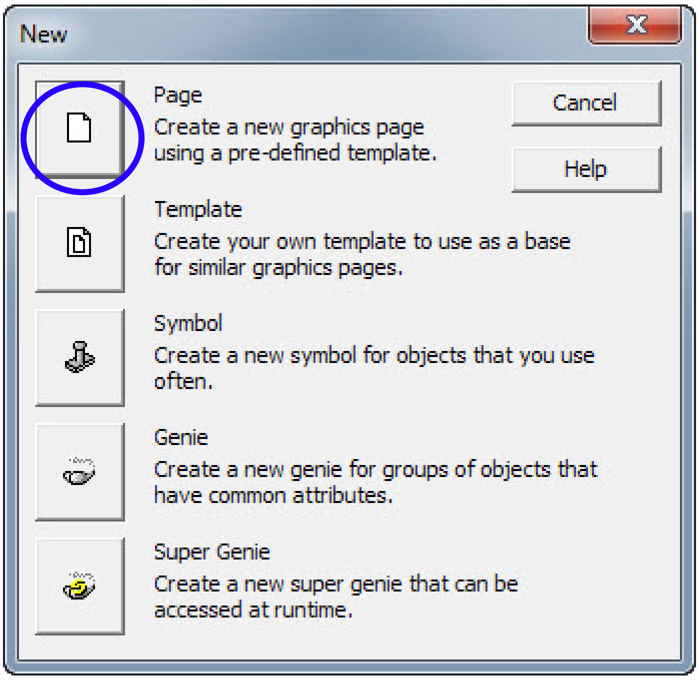
- The Digital Input and Digital Output are declared as Boolean data, and the Analog Input and Analog Output are declared as unsigned integer data.

- The “Starting Address” begins at “0001”. Thus, to use the 5th Digital Output channel, the “Address” filed must be set to “10005”, and the Data Type must be set to “DIGITAL”. To use the 15th Analog Input channel, enter “30015” in the “Address” field, and set the Data Type to “INT”.

Step 5: Open the “Citect Graphics Builder” window, and click the “New...” option from the “File” menu to create a new page.



Step 6: In the "New" dialog box, click the "Page" button to create a new page using a pre-defined template.



Page
Create a new graphics page using a pre-defined template.

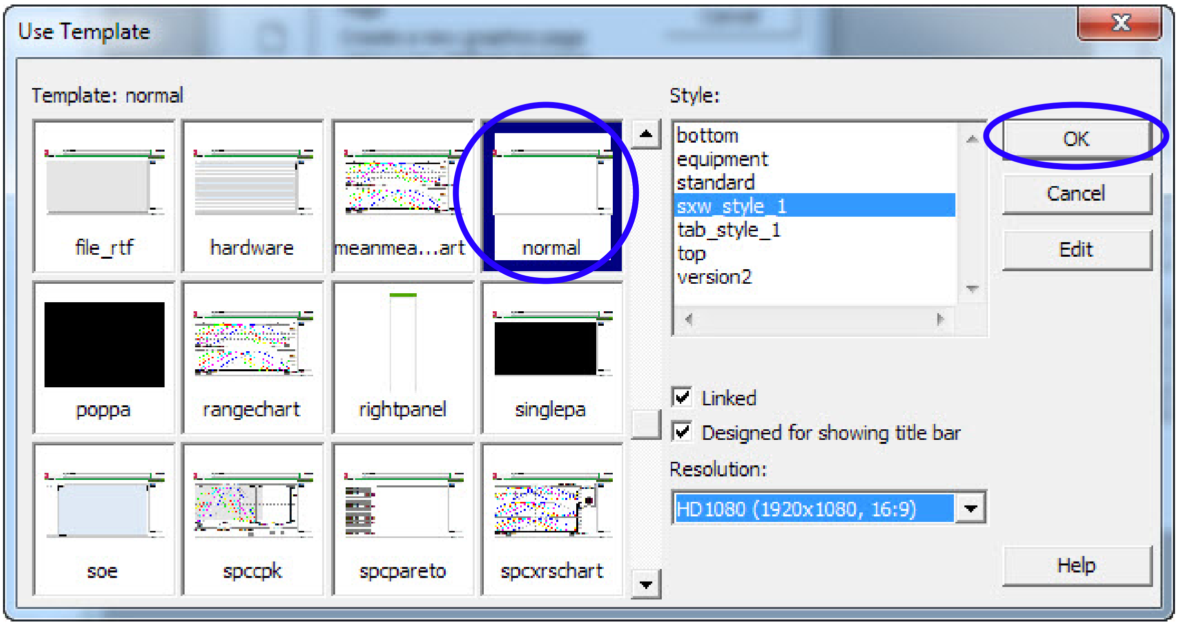
Template
Create your own template to use as a base for similar graphics pages.

Symbol
Create a new symbol for objects that you use often.

Genie
Create a new genie for groups of objects that have common attributes.

Super Genie
Create a new super genie that can be accessed at runtime.

Step 7: In the "Template" dialog box, click the "normal" option to select the template to be used for the page, and then click the "OK" button to continue.



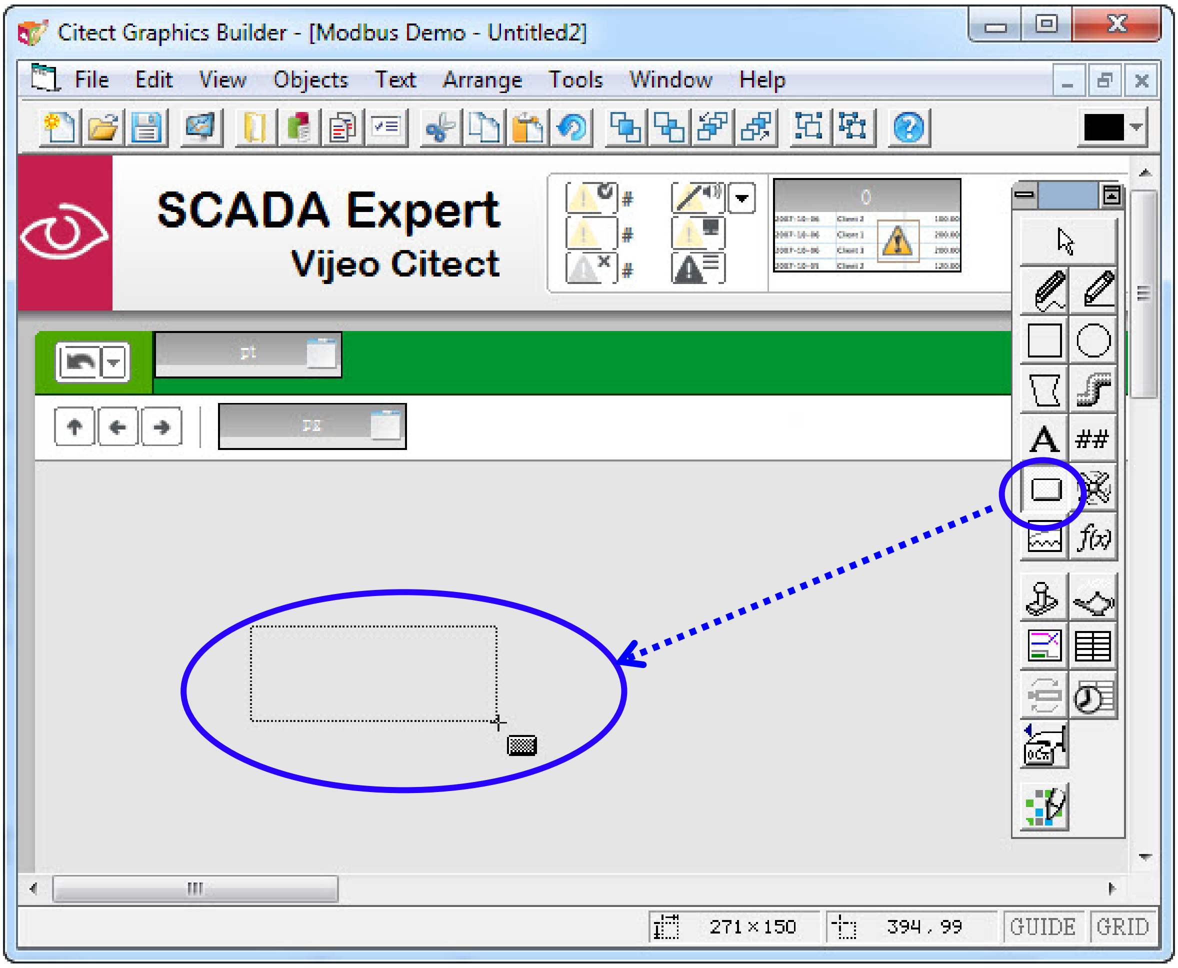
Template: normal

☑ Linked

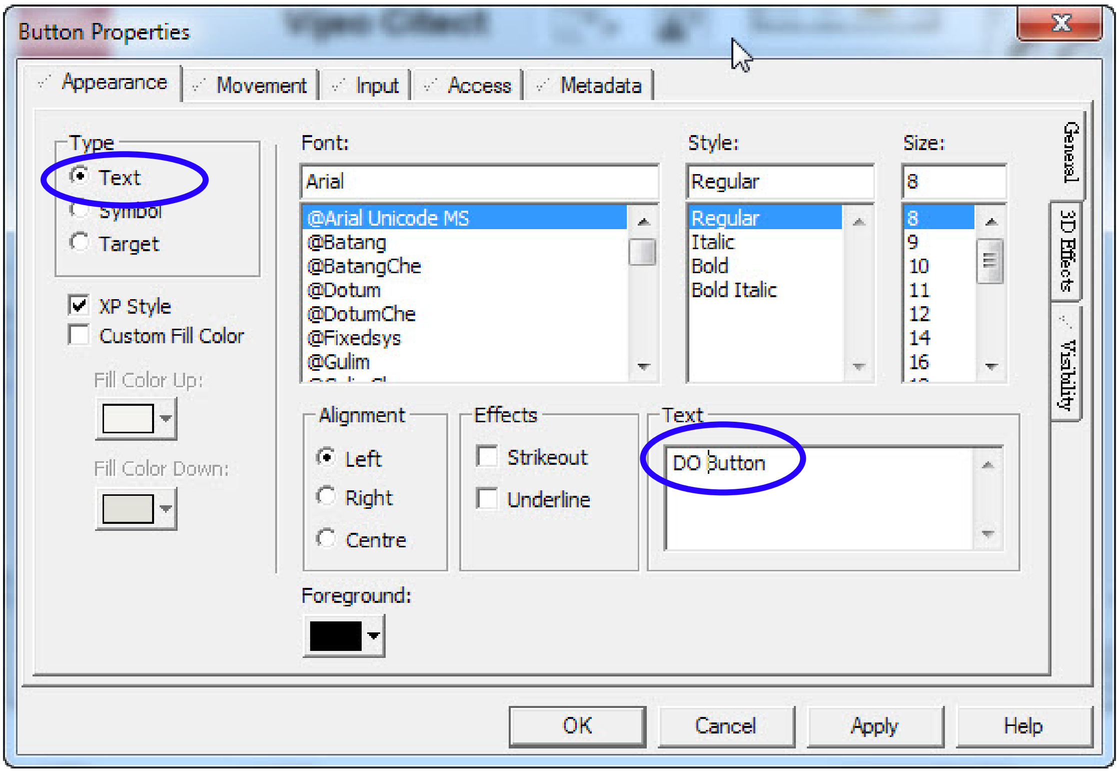
☑ Designed for showing title bar

Resolution: HD1080 (1920x1080, 16:9)

Step 8: Click and hold the "New Button" icon and then drag and drop it onto the blank page to add a new button to the page.



Step 9: After releasing the mouse button, the "Button Properties" dialog box will be displayed. Click the "Appearance" tab and click the "Text" radio button and then enter "DO Button" in the "Text" field. This will be the label displayed on the button.



Button Properties

Type: ● Text ○ Symbol ○ Target

☑ XP Style

☐ Custom Fill Color

Font: Arial

Style: Regular

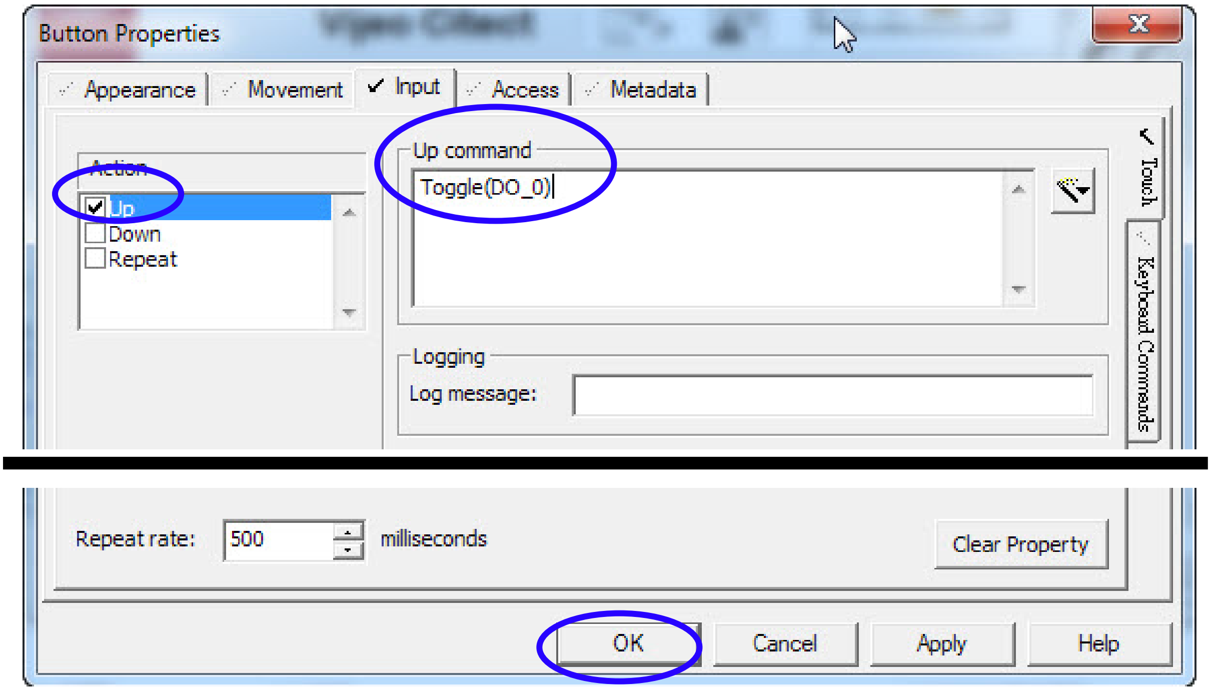
Size: 8

Alignment: ● Left ○ Right ○ Centre

Effects: ☐ Strikeout ☐ Underline

Text: DO Button

Click the "Input" tab and check the "Up" checkbox then enter "Toggle(DO_0)" in the "UP command" text field. Click the "OK" button to save the changes.



Button Properties

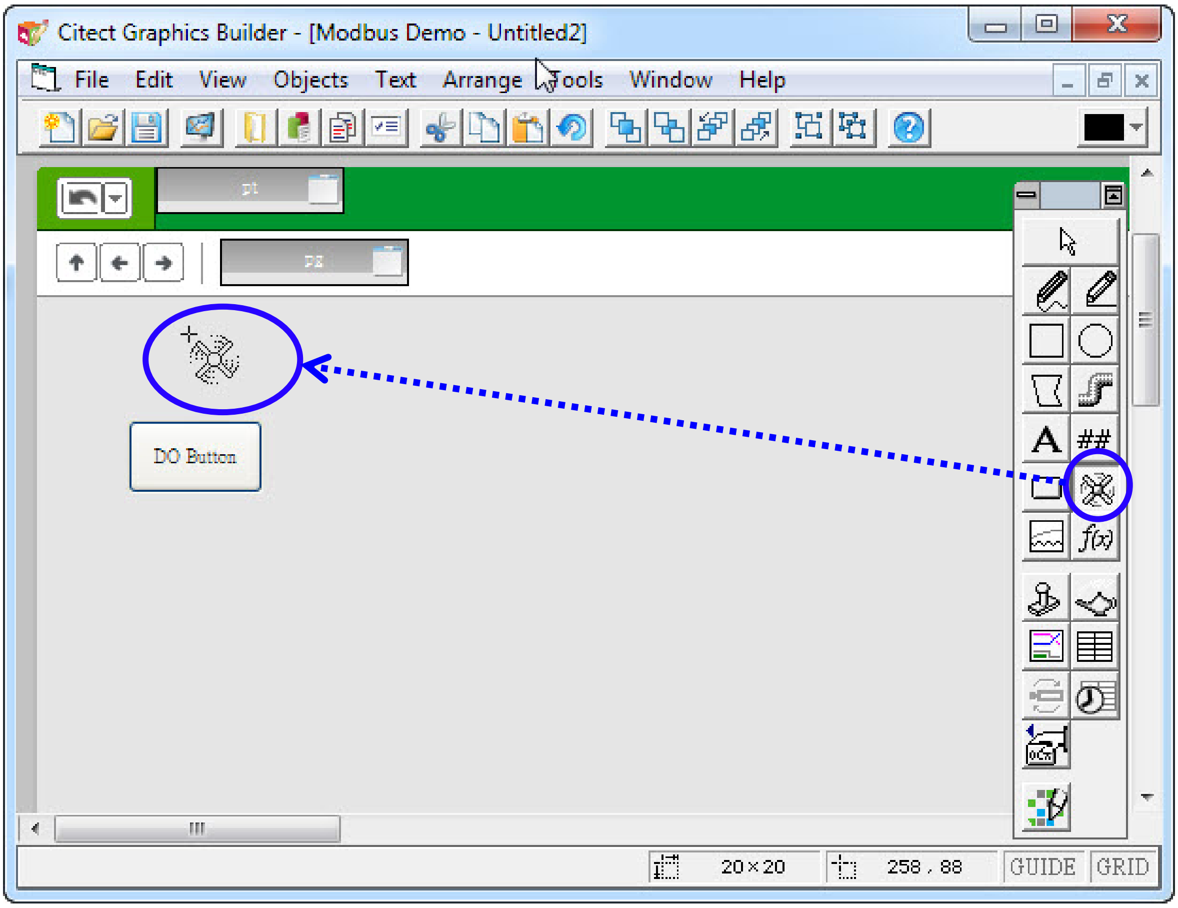
Action: ☑ Up ☐ Down ☐ Repeat

Up command: Toggle(DO_0)

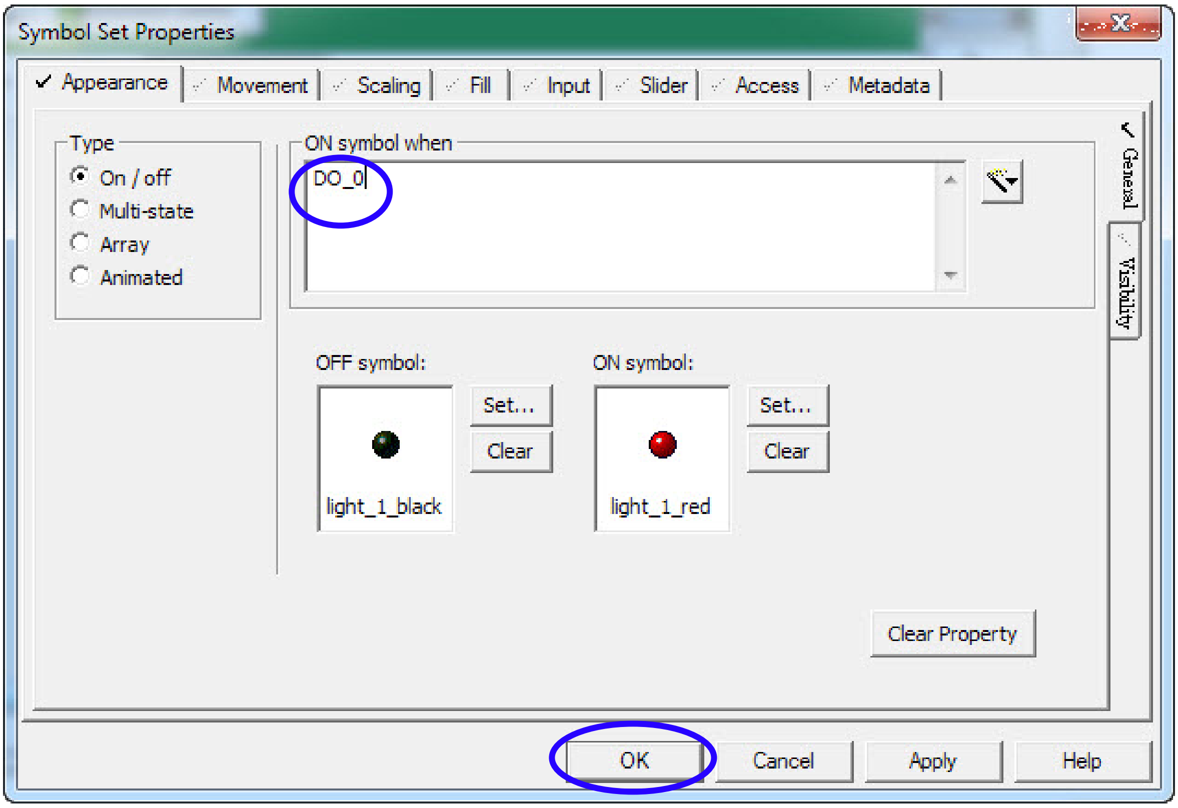
Logging – Log message:

Repeat rate: 500 milliseconds

Step 10: Click and hold the "LED Object" icon and then drag and drop it onto the page to add a new LED object to the page.



Step 11: After releasing the mouse button, the “Symbol Set Properties” dialog box will be displayed. Click the "Appearance" tab and click the "On/off" radio button in the "Type" section, then enter "DO_0" in the "ON symbol when" text field. Click the "OK" button to save the changes.



Symbol Set Properties

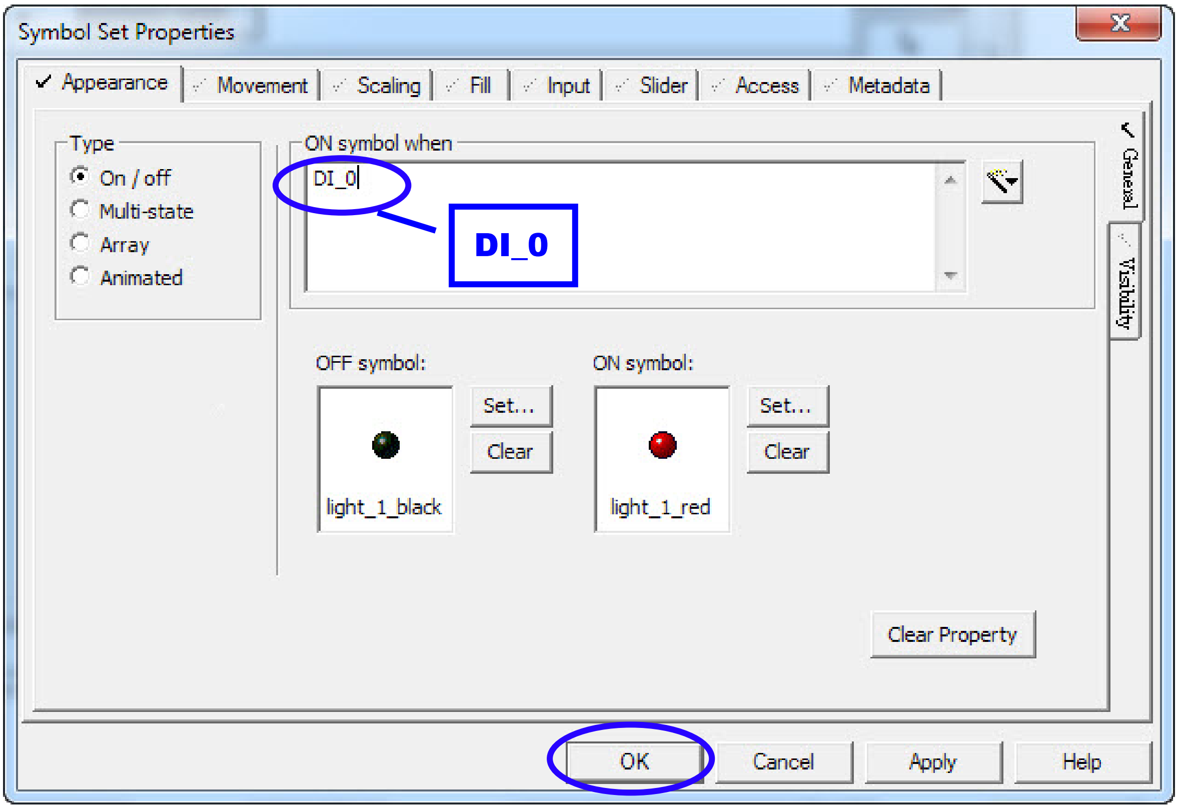
Type: ● On / off

ON symbol when: DO_0

OFF symbol: light_1_black

ON symbol: light_1_red

Step 12: Repeat Steps 10 and 11 to create a second LED object. Use the parameters shown in the image below for this LED object.



Symbol Set Properties

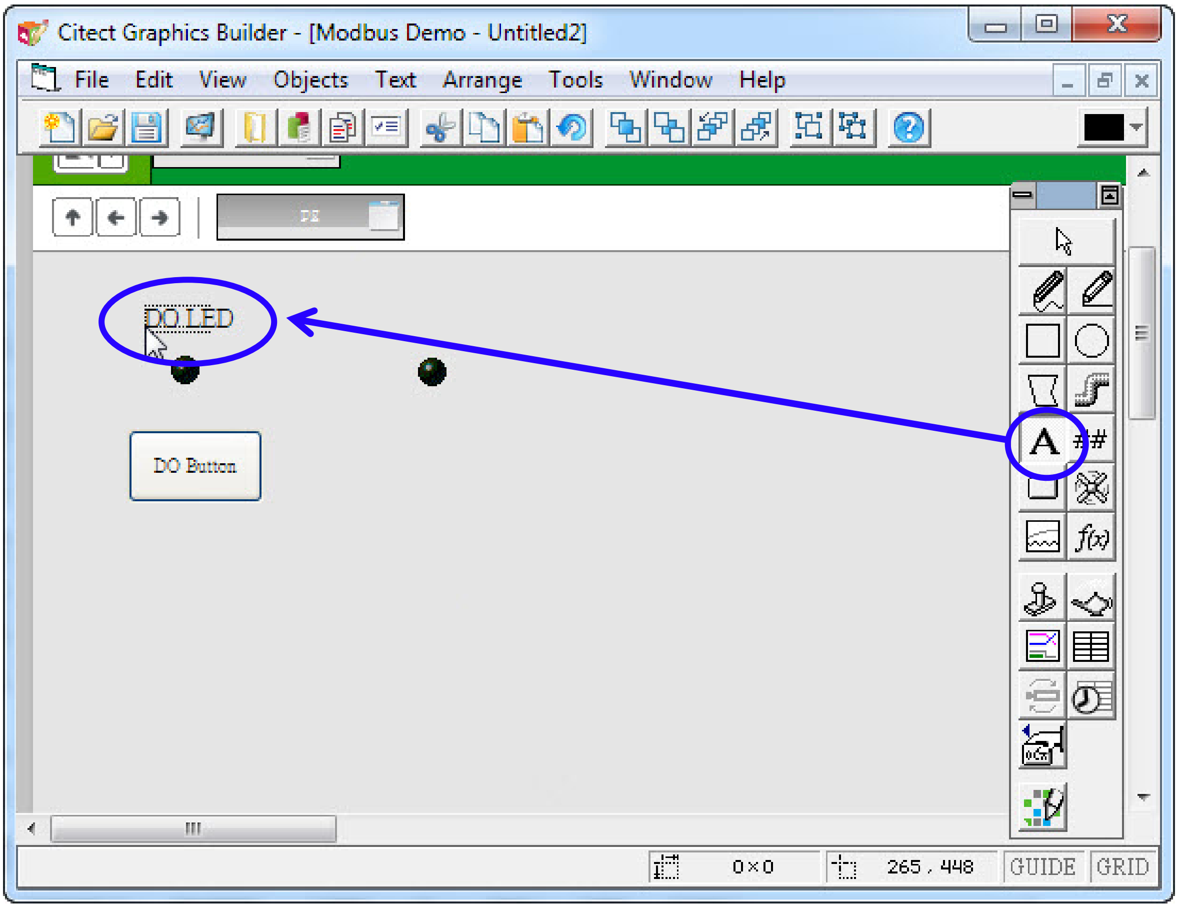
Type: ● On / off

ON symbol when: DI_0

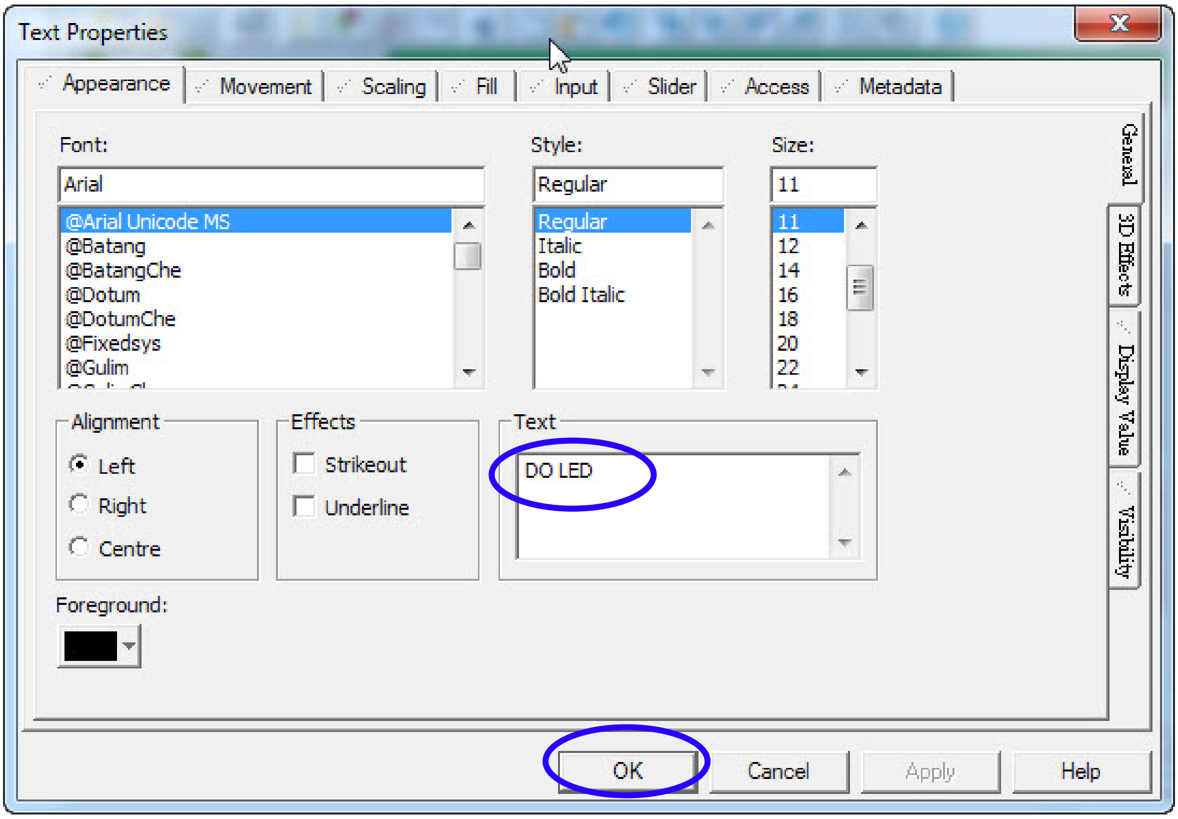
OFF symbol: light_1_black

ON symbol: light_1_red

Step 13: Click the "Text" button and then click a blank area on the page above the left-hand LED object, and enter “DO LED” in the text field.


Citect Graphics Builder - [Modbus Demo - Untitled2]
File Edit View Objects Text Arrange Tools Window Help
DO LED
DO Button
0×0
265 , 448
GUIDE
GRID

Step 14: After entering the Text, click the text again and the “Text Properties” dialog box will be displayed. Verify that the details in the “Text” field are correct and change the font or other parameter as required, and then click the “OK” button to save the settings.



Text Properties

Font: Arial

Style: Regular

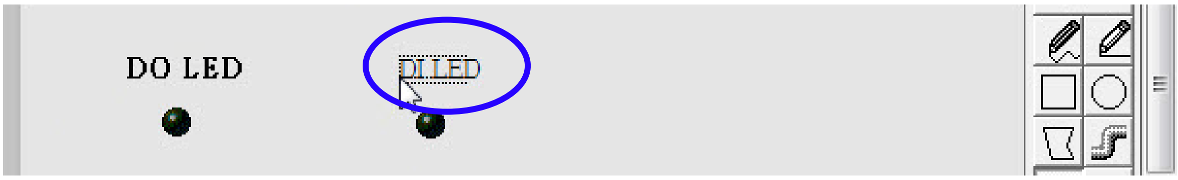
Size: 11

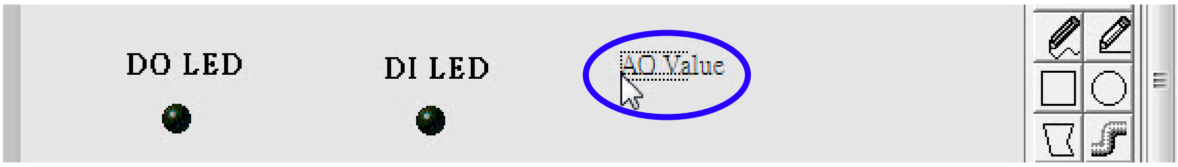
Alignment: ● Left ○ Right ○ Centre

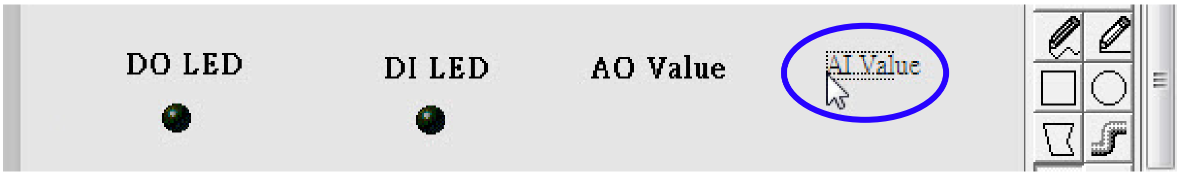
Effects: ☐ Strikeout ☐ Underline

Text: DO LED

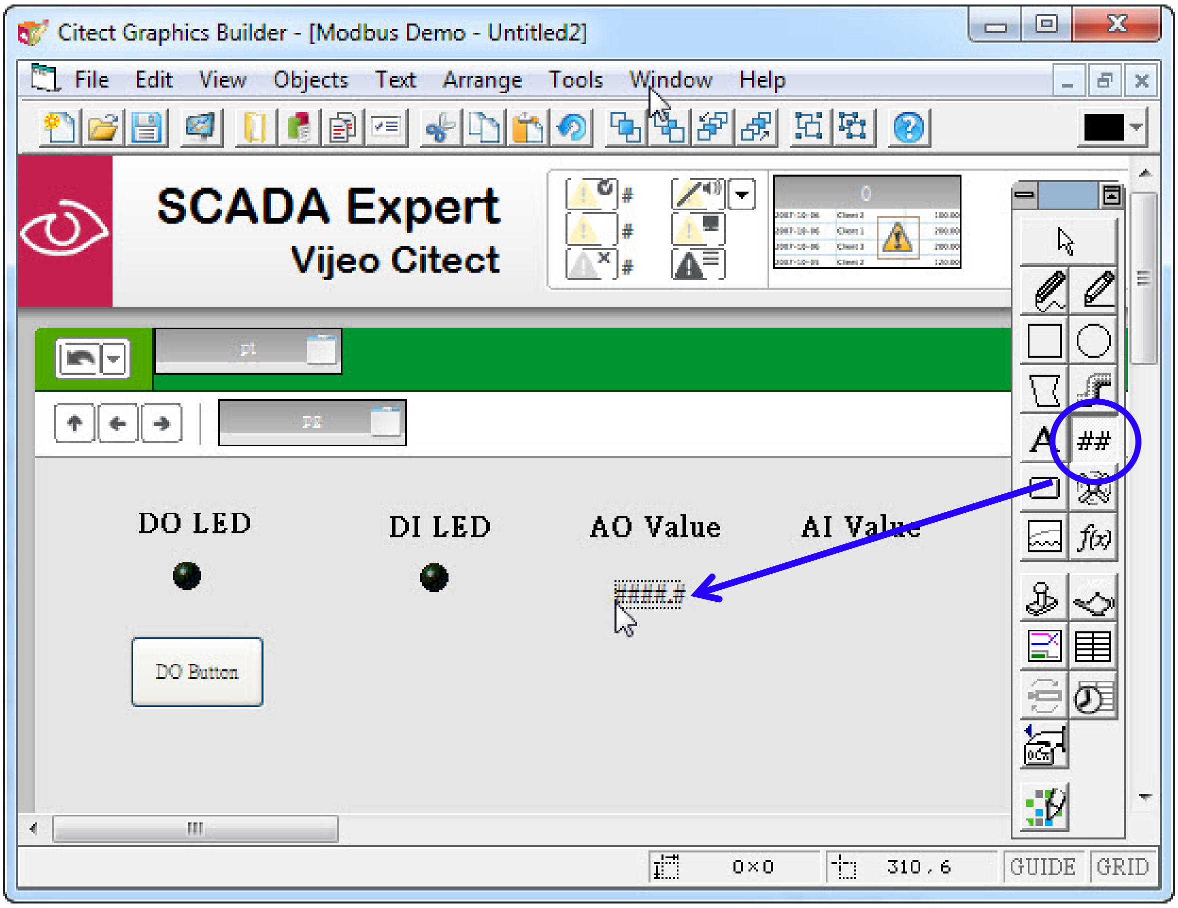
Step 15: Repeat Steps 13 and 14 to create three more Text objects and place them in the appropriate locations. Use the parameters shown in the image below for these Text objects.



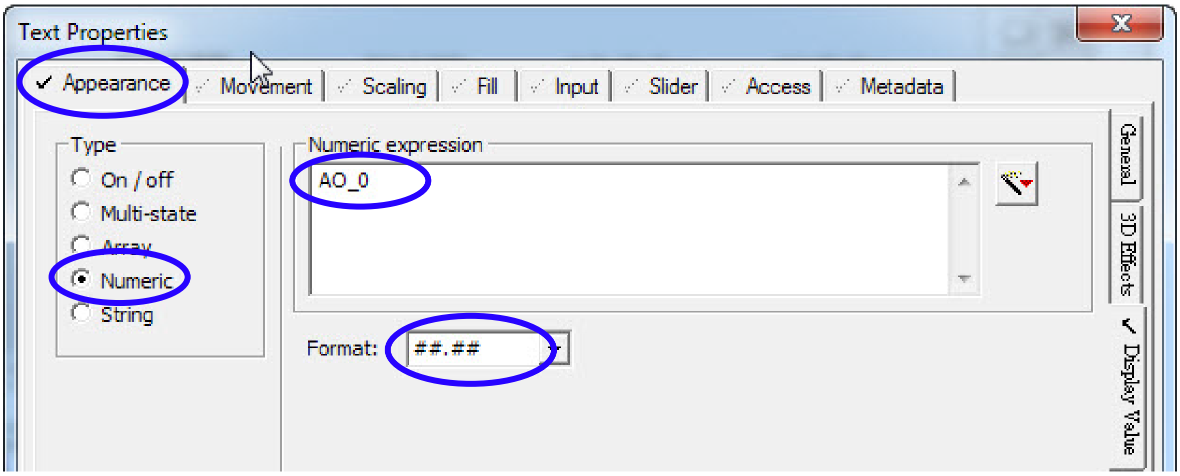




Step 16: The layout of the page at this stage is shown in the image below. Click and hold the "Number" button and then drag and it onto the page below the "AO Value" text object to create a new number object.



Step 17: After releasing the mouse, the “Text Properties” dialog box will be displayed. Click the "Appearance" tab, and click the "Numeric" radio button in the "Type" section. Enter "AO_0" in the "Numeric expression" field, and set the "Format" to "##.##".

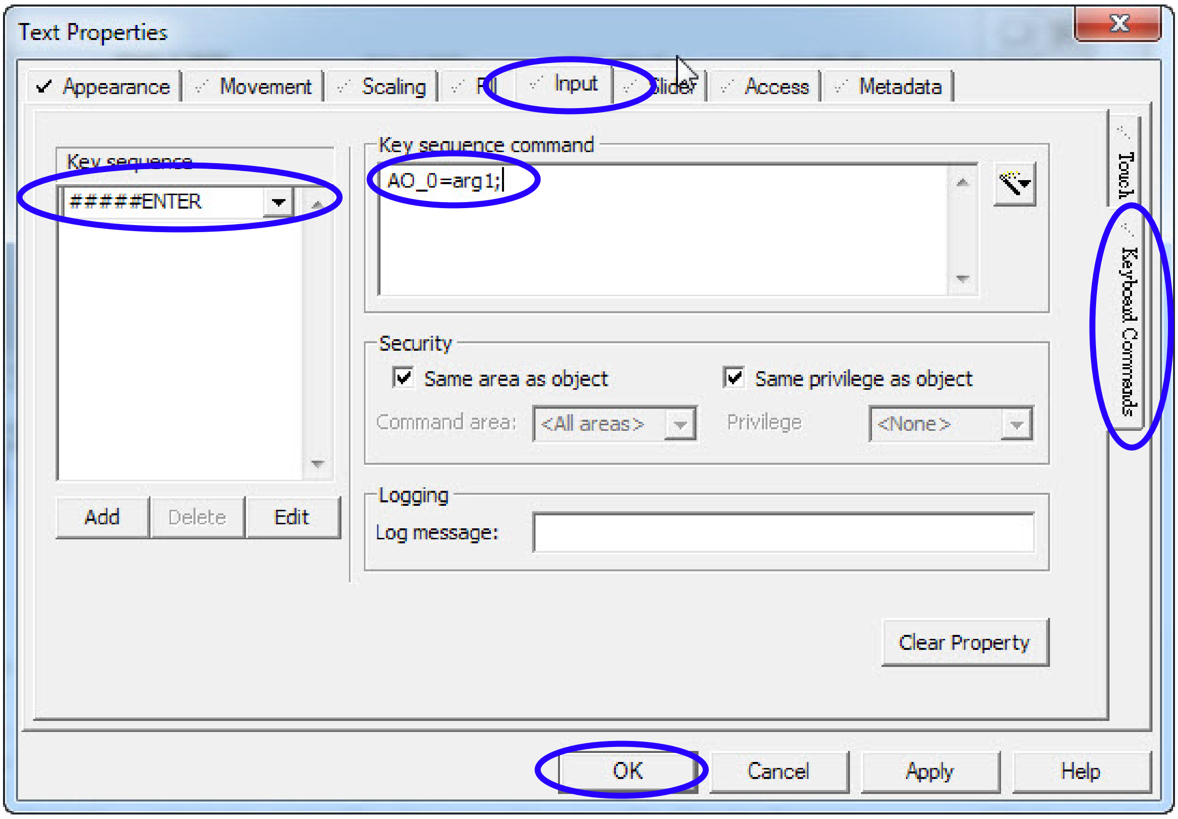


Type:
○ On / off
○ Multi-state
○ Array
● Numeric
○ String

Numeric expression: AO_0

Format: ##.##

Click the "Input" tab and select the “Keyboard Commands” tab, and then enter "#####ENTER" in the "Key sequence" field. Enter "AO_0=arg1;" in the "Key sequence command" field, and then click the "OK" button to save the changes.



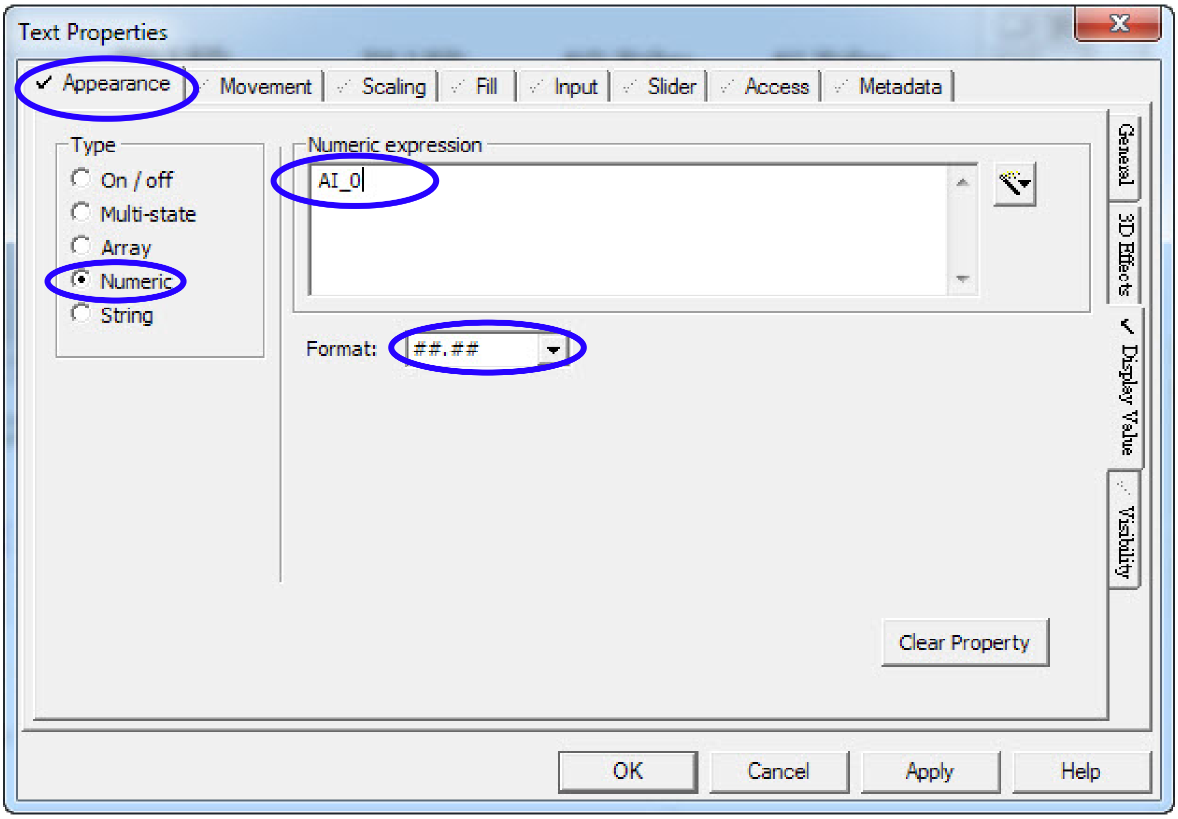
Key sequence: #####ENTER

Key sequence command: AO_0=arg1;

Security:
☑ Same area as object
☑ Same privilege as object
Command area: <All areas>
Privilege: <None>

Logging:
Log message:

Step 18: Repeat Step 16 to create another new number object and place it below the "AI Value" text object. When the "Text Properties" dialog box for the new Number object is displayed, click the "Appearance" tab. Click the "Numeric" radio button in the "Type" section, then enter "AI_0" in the "Numeric expression" field, and set the "Format" to "##.##". In this case, there is no need to set the Input parameters, so click the "OK" button to save the changes.

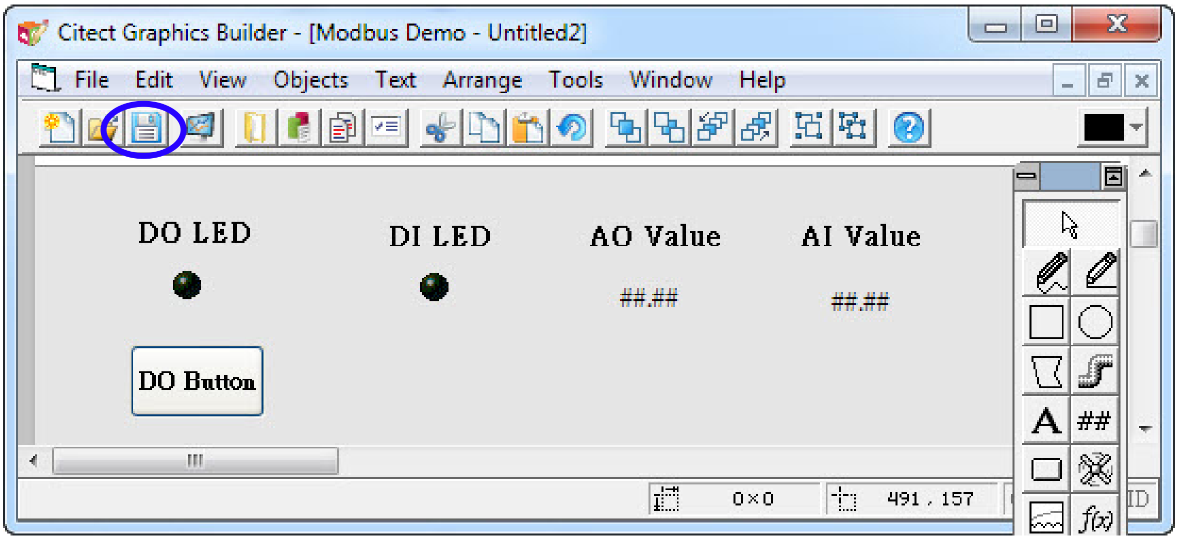


Type: ○ On / off ○ Multi-state ○ Array ● Numeric ○ String

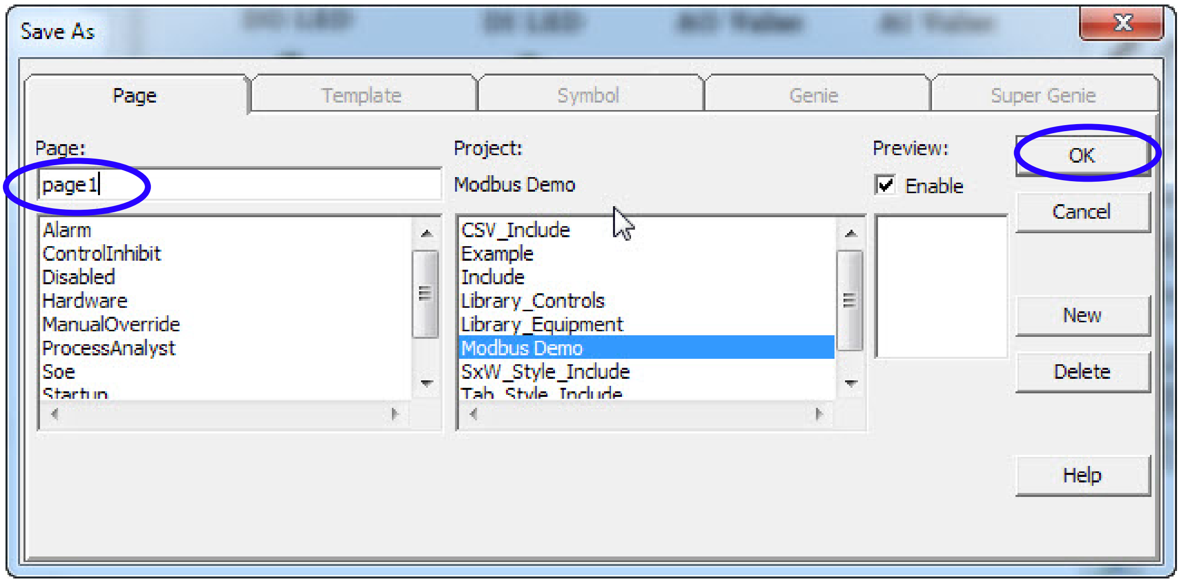
Numeric expression: AI_0

Format: ##.##

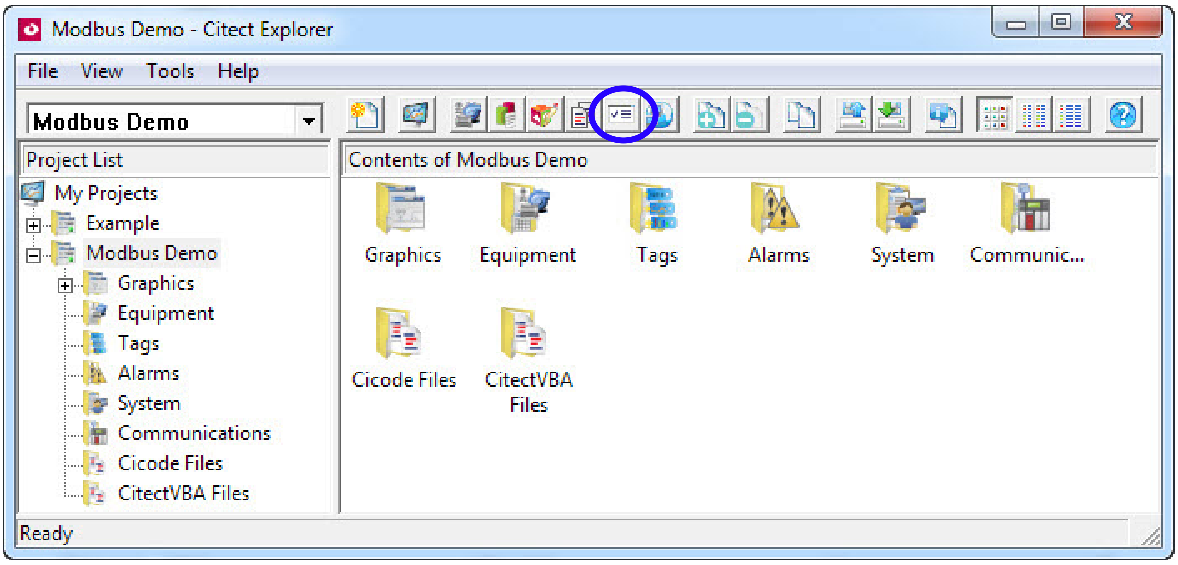
Step 19: The layout for the finished page is shown below. Click the "Save" button to save the page.



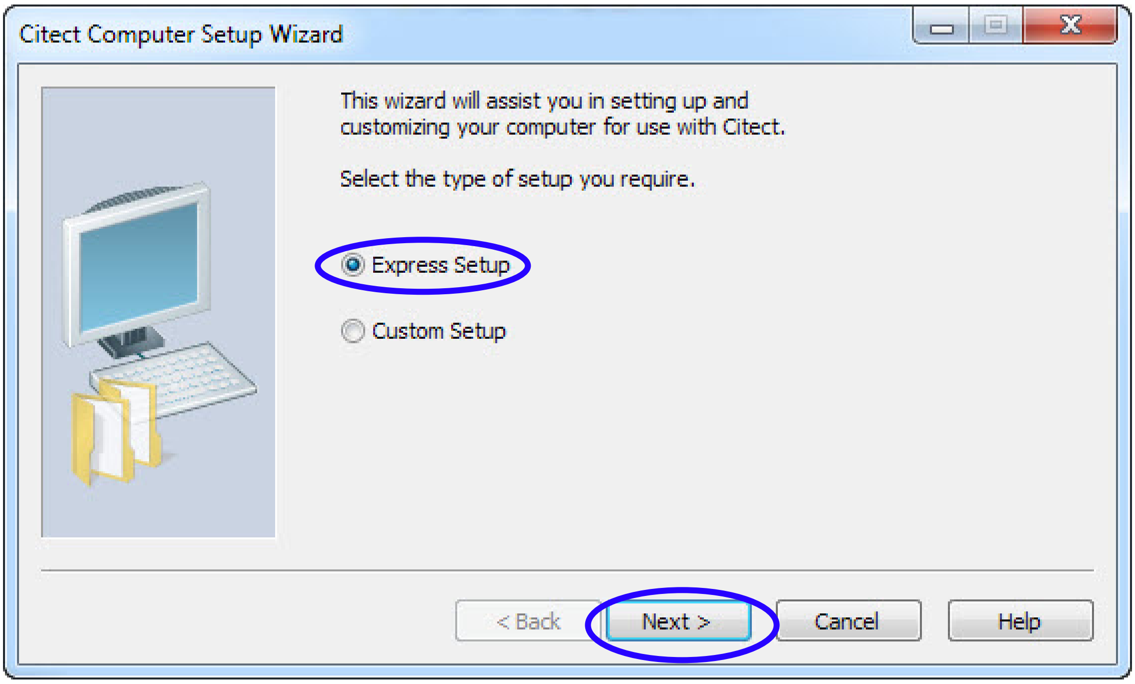
Step 20: In the “Save As” dialog box, enter "page1" in the "Page" field as the name of the page and then click the “OK” button.



Step 21: Open the “Citect Explorer” window, and then click the "Computer Setup Wizard" button to open the "Computer Setup Wizard".



Step 22: Click the "Express Setup" radio button and then click the "Next >" button to continue.



Citect Computer Setup Wizard

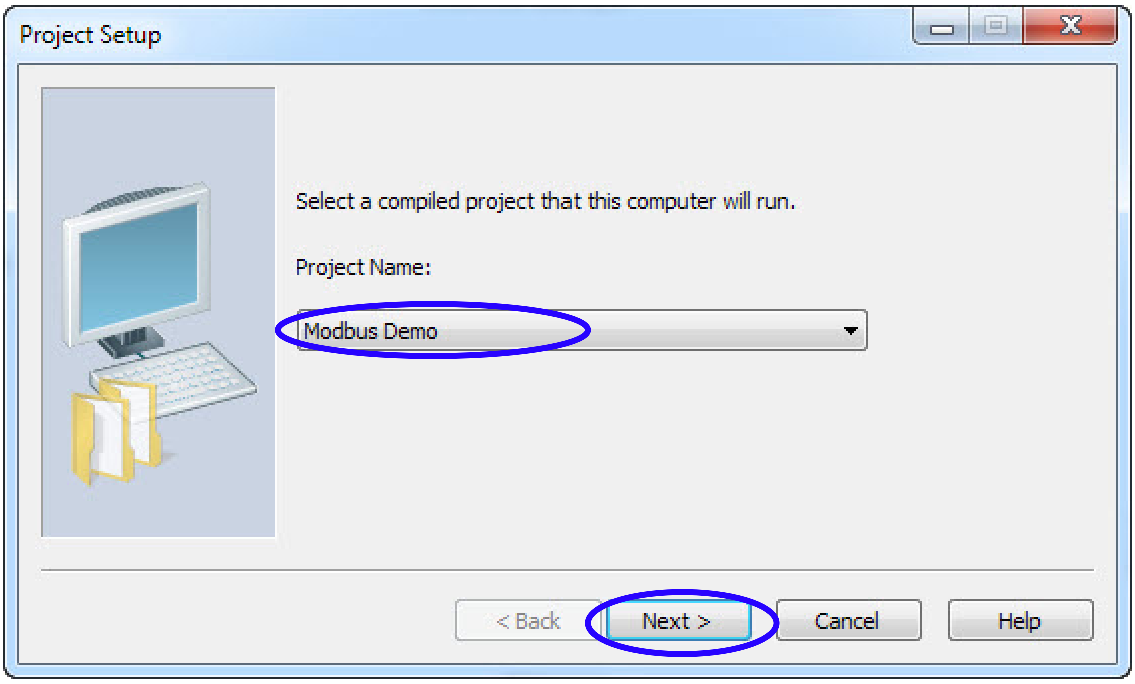
This wizard will assist you in setting up and customizing your computer for use with Citect.

Select the type of setup you require.

● Express Setup

○ Custom Setup

Step 23: Select "Modbus Demo" from the "Project Name" drop-down menu and then click the "Next >" button to continue.

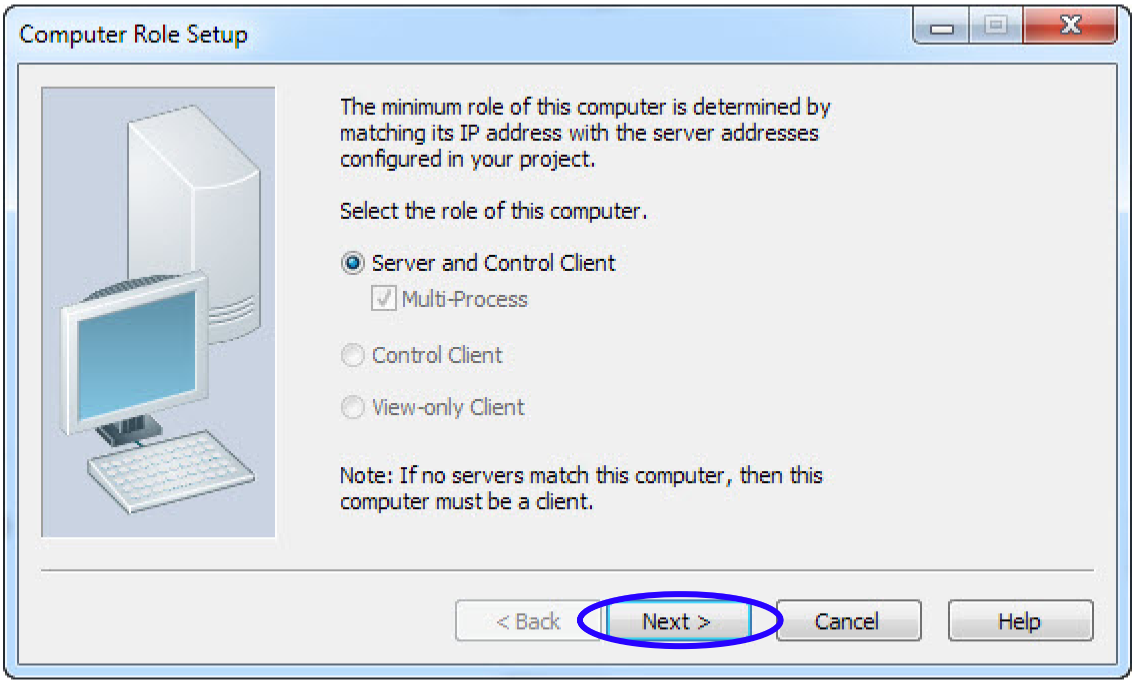


Project Setup

Select a compiled project that this computer will run.

Project Name: Modbus Demo

Step 24: Click the "Server and Control Client" radio button, and then click the "Next >" button to continue.



The minimum role of this computer is determined by matching its IP address with the server addresses configured in your project.

Select the role of this computer.

● Server and Control Client

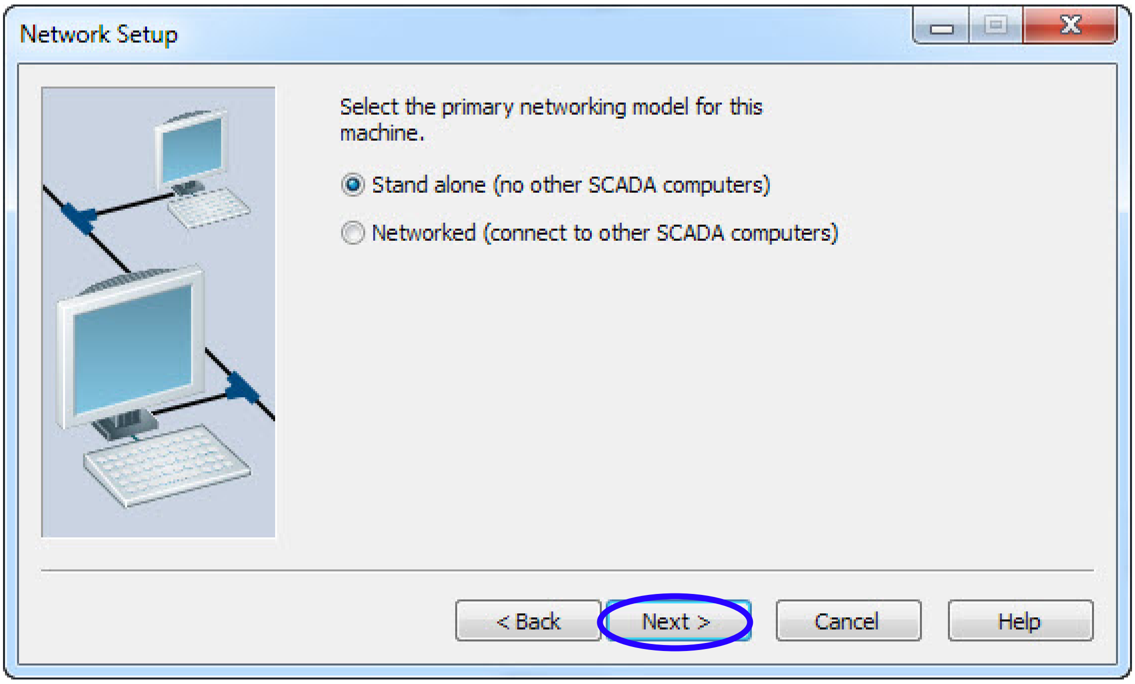
☑ Multi-Process

○ Control Client

○ View-only Client

Note: If no servers match this computer, then this computer must be a client.

Step 25: Click the “Stand alone (no other SCADA computers)” radio button and then click the “Next >” button to continue.

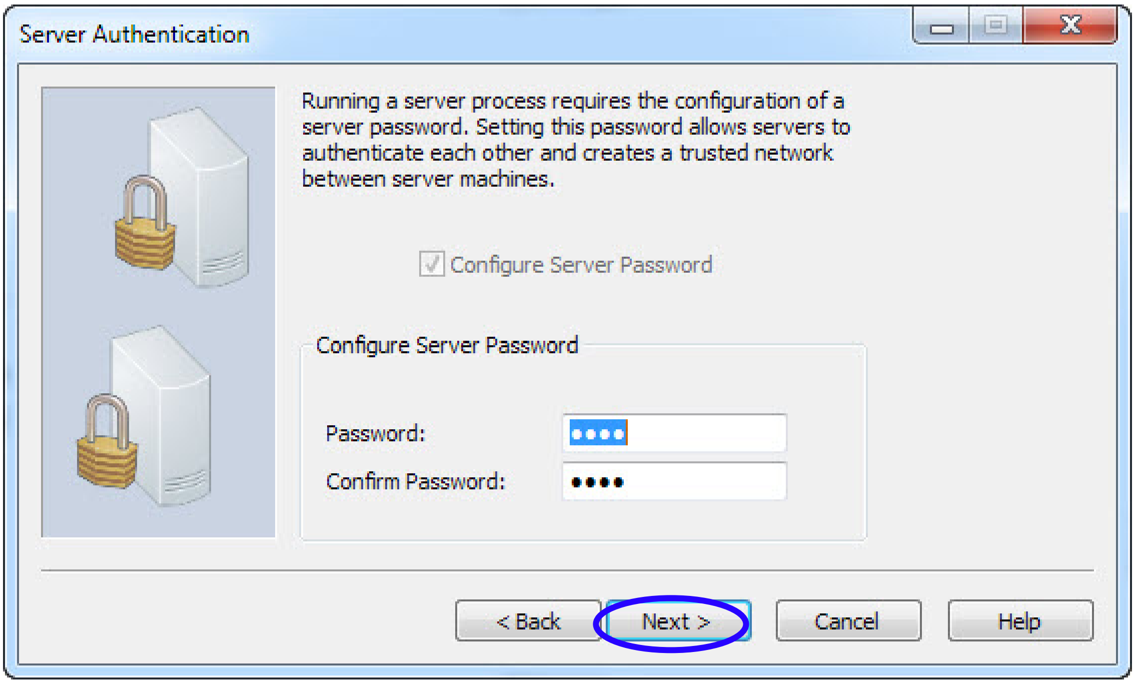


Select the primary networking model for this machine.

● Stand alone (no other SCADA computers)

○ Networked (connect to other SCADA computers)

Step 26: Configure a password for the Server by entering a password in the "Password" text field. Enter the same password in the "Confirm Password" field and then click the "Next >" button to continue.



Running a server process requires the configuration of a server password. Setting this password allows servers to authenticate each other and creates a trusted network between server machines.

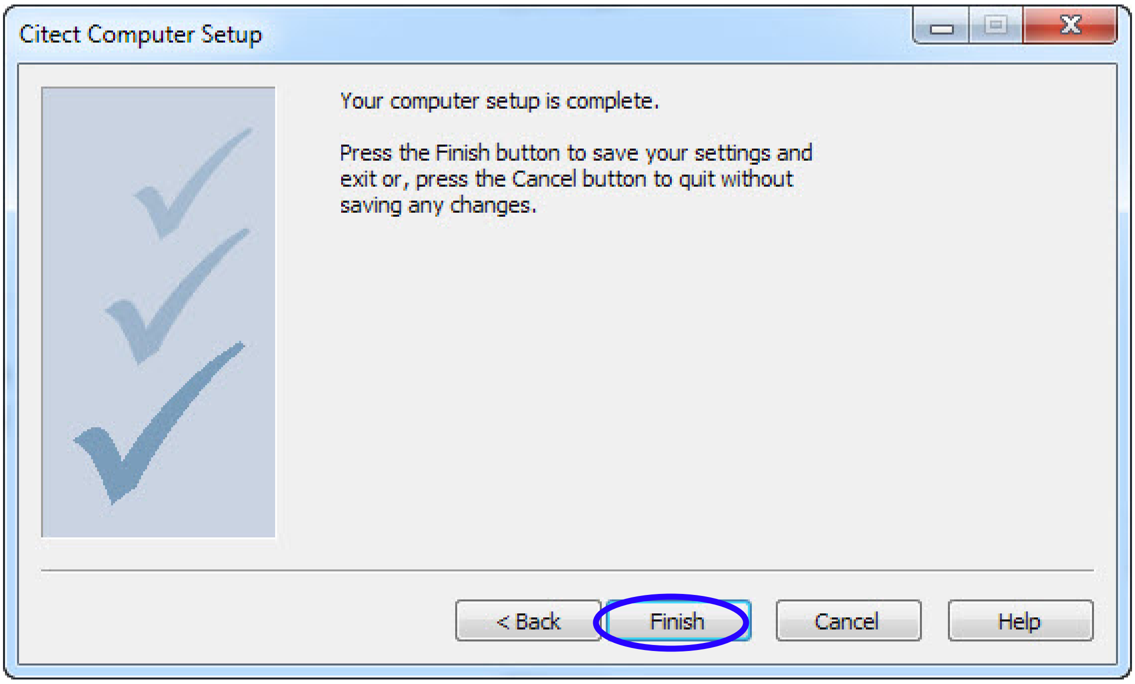
☑ Configure Server Password

Configure Server Password

Password: ••••

Confirm Password: ••••

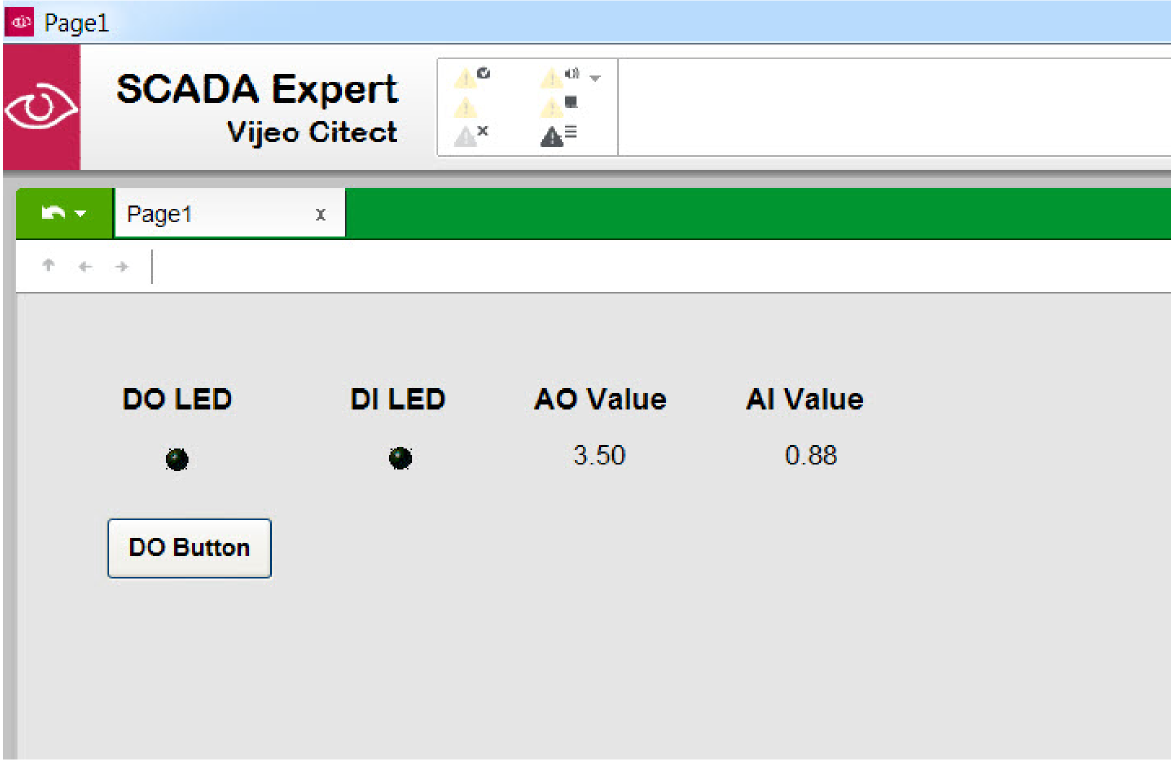
Step 27: Click the "Finish" button to complete the computer setup.



Your computer setup is complete.

Press the Finish button to save your settings and exit or, press the Cancel button to quit without saving any changes.

Step 28: Press F5 to execute the project. Verify that clicking the "DO Button" button to write DO LED status to on or off. Clicking the AO value "Number object" and enter a value to change the AO Value.



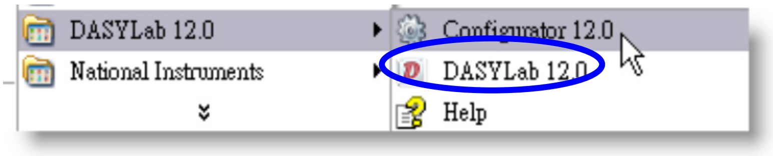
3.2. DASYLab

In this section, a detailed description of the procedure for connecting the DASYLab solution to an I-8000-MTCP/ IP-8000-MTCP controller using the Modbus/TCP protocol is presented. In this example, DASYLab version 12 is used. This solution can also be used to request data from external devices such as the ET-7000, I-7188-MTCP, or WISE-7000 using the Modbus protocol.

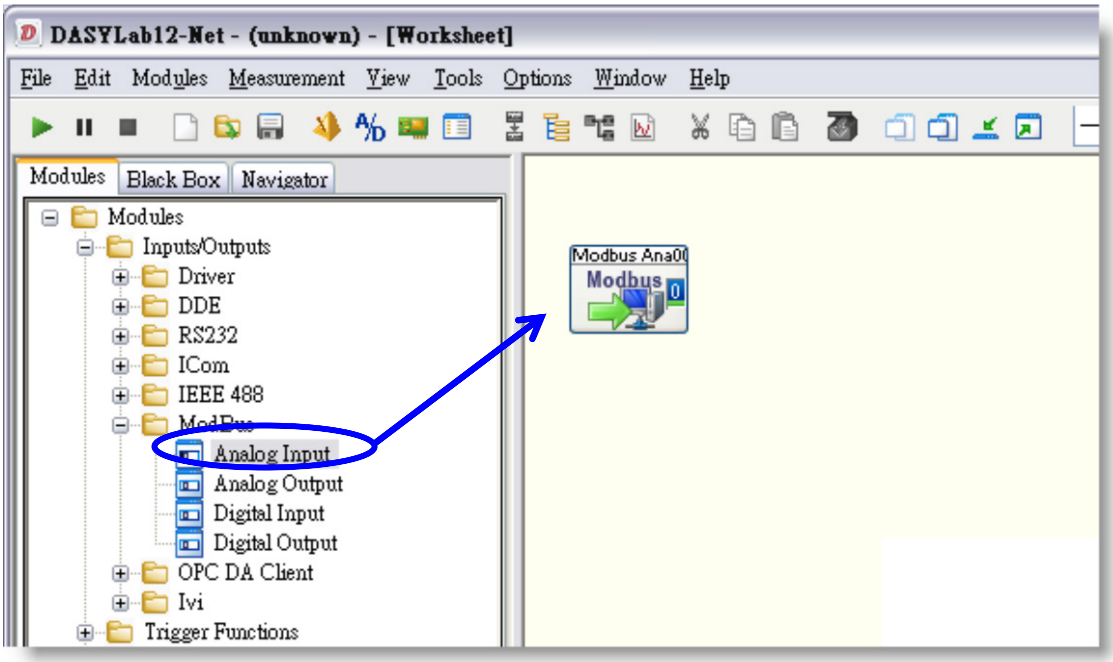
Before using DASYLab, the controller should be correctly configured using the Modbus Utility. The Net ID is set using the DIP switch located on the right-hand side of the controller (see Section 2.4 Net ID (Station Number) Setting for more information).

3.2.1. Adding an Analog Input Channel

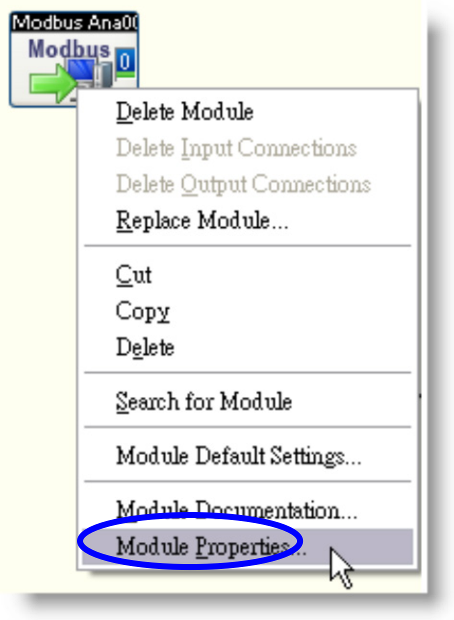
Step 1: Open the DASYLab application from the Programs Menu.



Step 2: Click the "Modules" tab and then expand the “Inputs/Outputs” folder found in the “Modules” folder. Expand the “ModBus” folder and drag an Analog Input object to the worksheet pane on the right-hand side of the window.



Step 3: Right-click the object icon and click the "Module Properties" option.



Step 4: Configure the object properties in the Modbus Analog Input dialog box using the values shown in the image below.

A. In the "Interfaces" section, set the Interface to TCP/IP and enter the IP address.

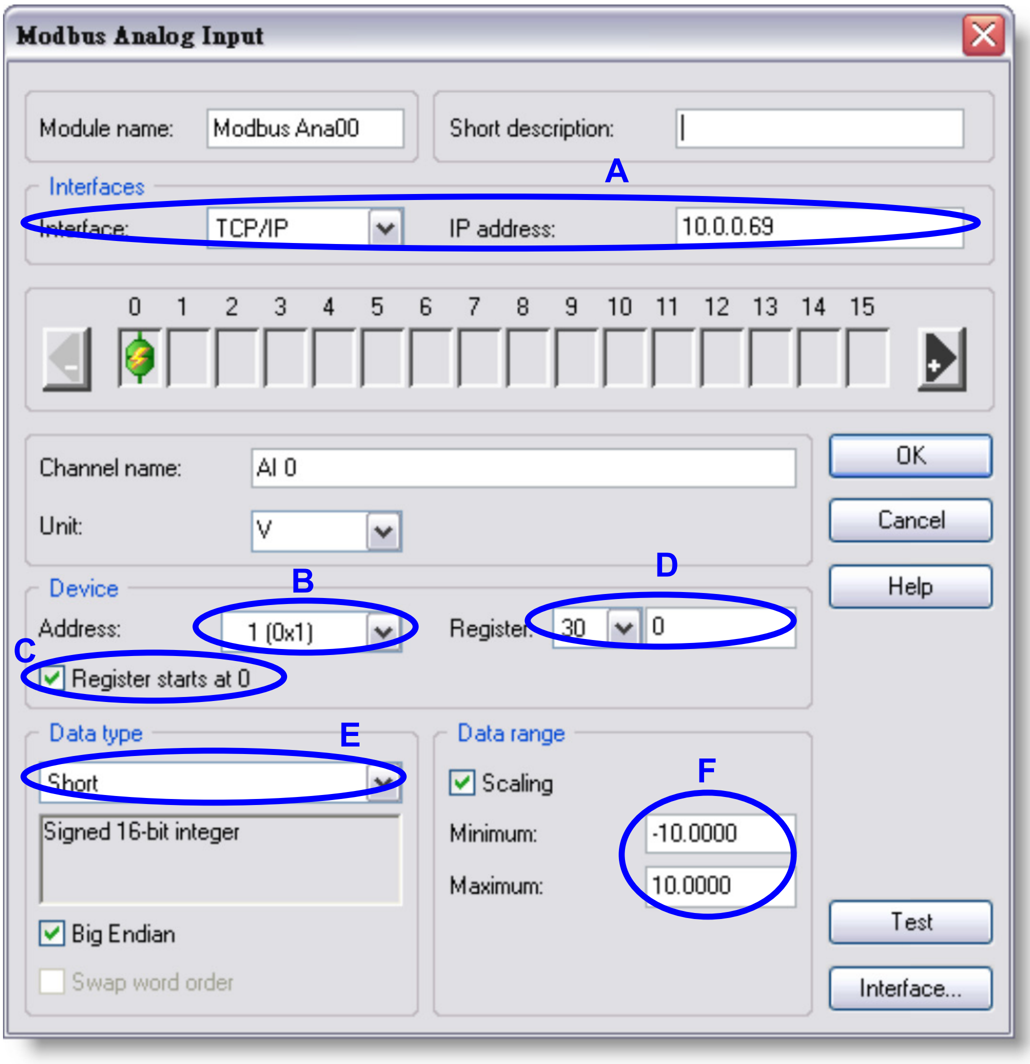
B. In the "Device" section, select the Address of the controller from the "Address" drop-down menu. This will be the same as the Net ID of the controller.

C. Check the "Register starts at 0" checkbox.

D. Select a Register address from the "Register" drop-down menu. The Register address can be found from the AI Mapping table in the Modbus Utility. Select "30" for Analog Input channels. In this demo, the register is set to 30000.

E. Set the Data Type from the drop-down menu, which is a signed 16-bit integer in this demo.

F. In the "Data range" section, enable Scaling by checking the "Scaling" checkbox, and set the minimum and maximum values, which are -10 to +10V in this demo.



Modbus Analog Input

Module name: Modbus Ana00

Short description:

Interfaces

Interface: TCP/IP

IP address: 10.0.0.69

Channel name: AI 0

Unit: V

Device

Address: 1 (0x1)

Register: 30 0

☑ Register starts at 0

Data type

Short

Signed 16-bit integer

☑ Big Endian

☐ Swap word order

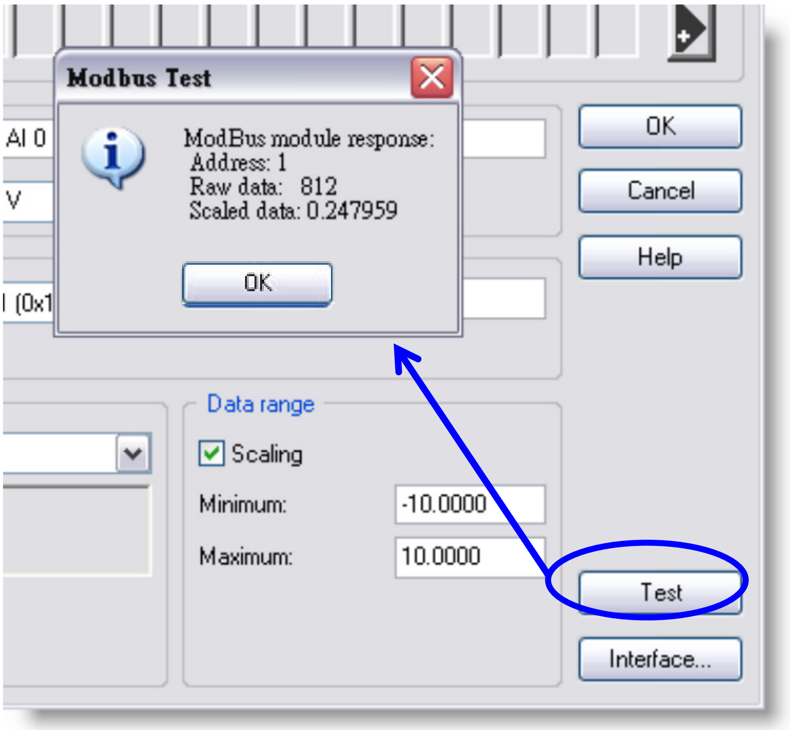
Data range

☑ Scaling

Minimum: -10.0000

Maximum: 10.0000

Step 5: Click the “Test” button to verify that the settings are correct, and then click the “OK” button in the Modbus Analog Input dialog box to save the configuration.



ModBus module response:
Address: 1
Raw data: 812
Scaled data: 0.247959

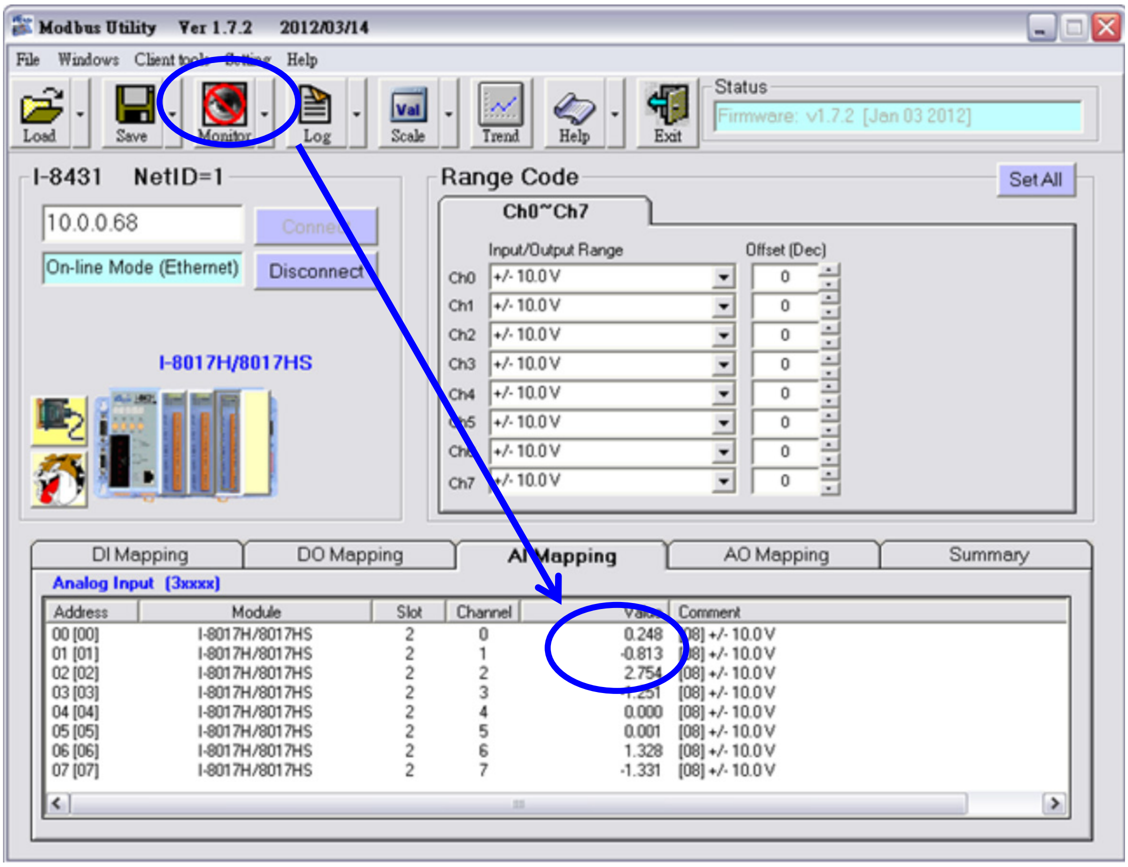
Data range

☑ Scaling

Minimum: -10.0000

Maximum: 10.0000

The data can also be checked using the “Monitor” function of the Modbus Utility and then clicking the “AI Mapping” tab.



Status: Firmware: v1.7.2 [Jan 03 2012]

I-8431 NetID=1

10.0.0.68

On-line Mode (Ethernet)

Range Code — Ch0~Ch7

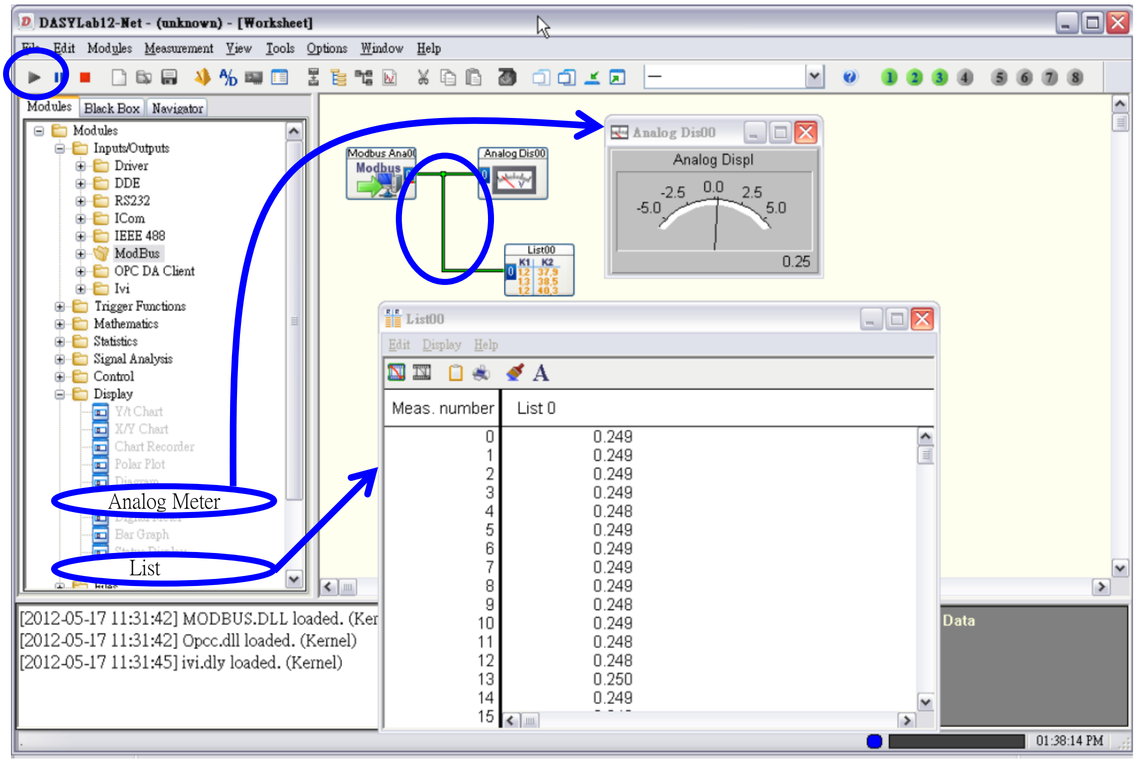
	Input/Output Range	Offset (Dec)
Ch0	+/- 10.0 V	0
Ch1	+/- 10.0 V	0
Ch2	+/- 10.0 V	0
Ch3	+/- 10.0 V	0
Ch4	+/- 10.0 V	0
Ch5	+/- 10.0 V	0
Ch6	+/- 10.0 V	0
Ch7	+/- 10.0 V	0

Analog Input (3xxxx)

Address	Module	Slot	Channel	Value	Comment
00 [00]	I-8017H/8017HS	2	0	0.248	[08] +/- 10.0 V
01 [01]	I-8017H/8017HS	2	1	-0.813	[08] +/- 10.0 V
02 [02]	I-8017H/8017HS	2	2	2.754	[08] +/- 10.0 V
03 [03]	I-8017H/8017HS	2	3	-1.251	[08] +/- 10.0 V
04 [04]	I-8017H/8017HS	2	4	0.000	[08] +/- 10.0 V
05 [05]	I-8017H/8017HS	2	5	0.001	[08] +/- 10.0 V
06 [06]	I-8017H/8017HS	2	6	1.328	[08] +/- 10.0 V
07 [07]	I-8017H/8017HS	2	7	-1.331	[08] +/- 10.0 V

Step 6: Click the "Modules" tab and then expand the "Display" folder. Drag an Analog Meter or a List to the worksheet pane on the right-hand side of the window. Drag a line from the "ModBus Ana00" object to the "Analog Dis00" object to establish a connection between the Analog Input, and then drag a line from the line to "List00" to connect these three objects.

Click the "Run" button to connect to the module and begin acquiring data.

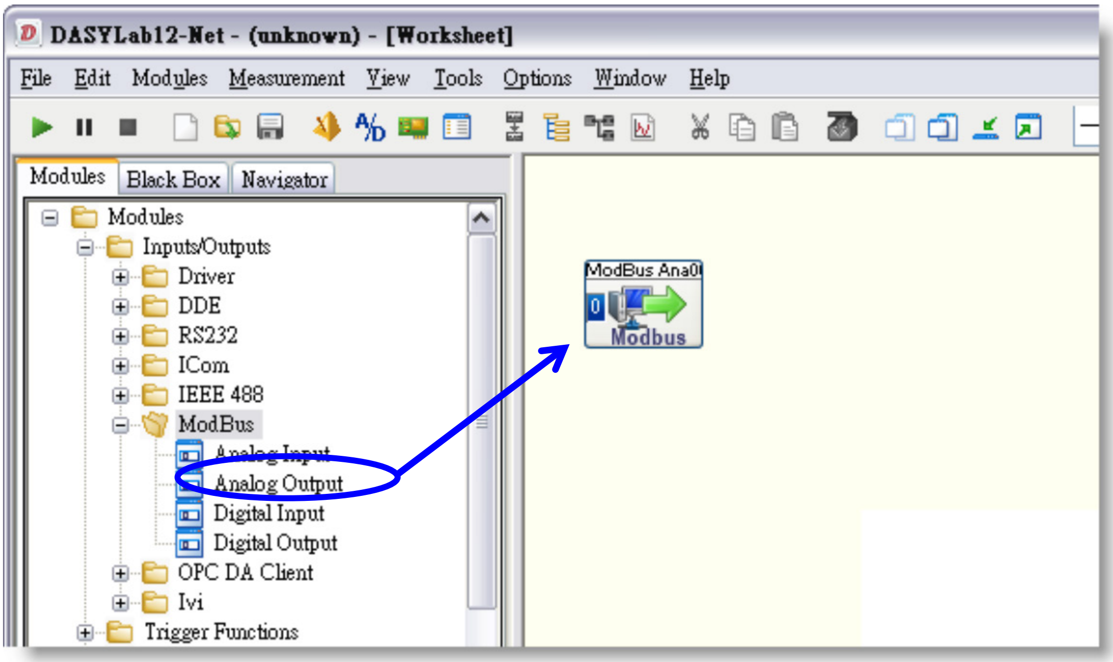


Meas. number	List 0
0	0.249
1	0.249
2	0.249
3	0.249
4	0.248
5	0.249
6	0.249
7	0.249
8	0.249
9	0.248
10	0.249
11	0.248
12	0.248
13	0.250
14	0.249
15	

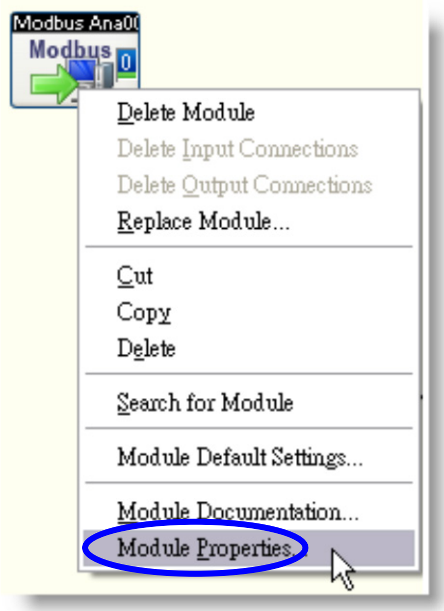
```
[2012-05-17 11:31:42] MODBUS.DLL loaded. (Ker
[2012-05-17 11:31:42] Opcc.dll loaded. (Kernel)
[2012-05-17 11:31:45] ivi.dly loaded. (Kernel)
```

3.2.2. Adding an Analog Output Channel

Step 1: Click the "Modules" tab and then expand the “Inputs/Outputs” folder found in the “Modules” folder. Expand the “ModBus” folder and then drag a Digital Input object to the worksheet pane on the right-hand side of the window.



Step 2: Right-click the object icon and click the “Module Properties” option.



Step 3: Configure the object properties in the Modbus Analog Output dialog box using the values shown in the image.

A. In the "Interfaces" section, set the Interface to TCP/IP and enter the IP address.

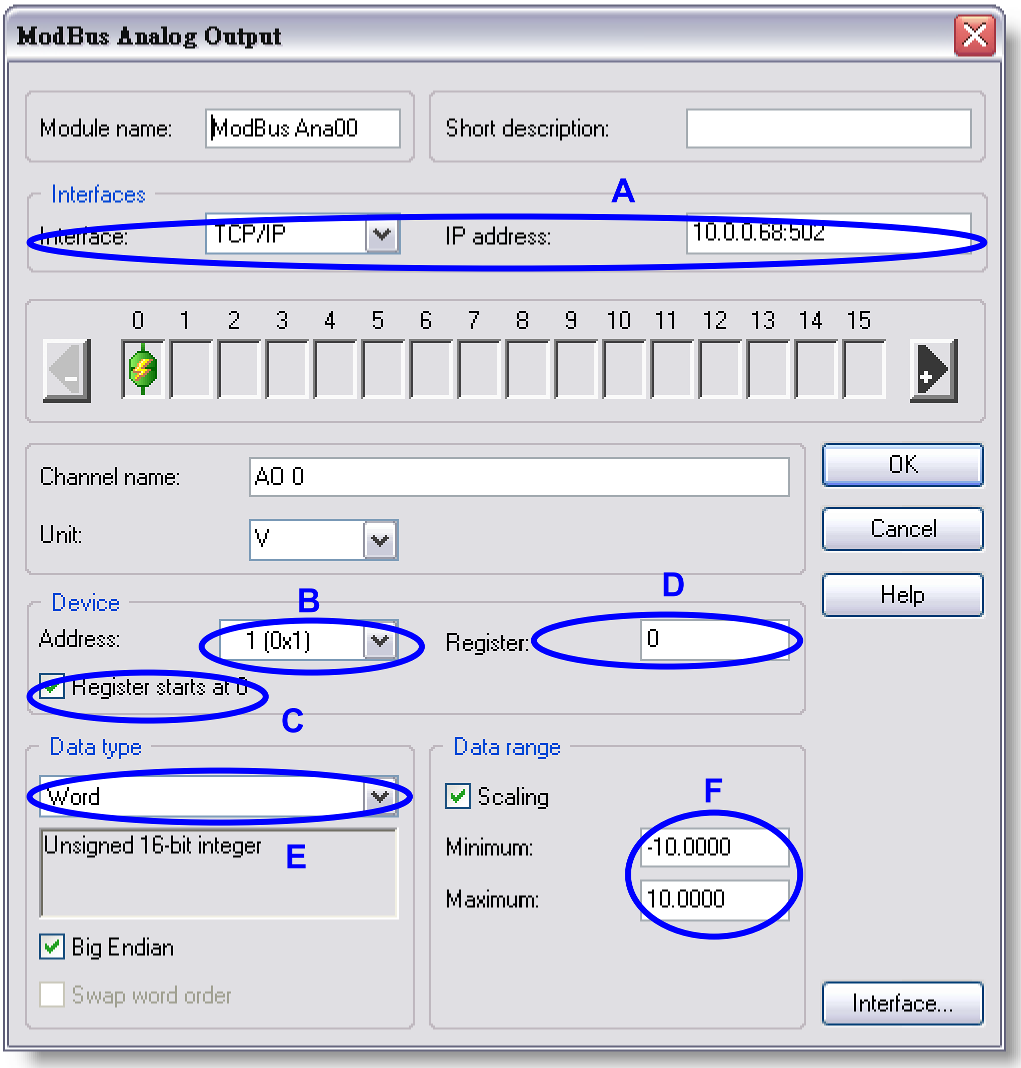
B. In the "Device" section select the Address of the "Address" drop-down menu. This will be the same as the Net ID of the controller.

C. Check the "Register starts at 0" checkbox.

D. Enter the register address, which can be found from the AO Mapping table in the Modbus Utility.

E. Select the Data Type from the drop-down menu, which is a Word unsigned 16-bit integer in this demo.

F. In the "Data range" section, enable Scaling by checking the "Scaling" checkbox, and set the minimum and maximum values, which are -10 to +10V in this demo.



Module name: ModBus Ana00
Short description:

Interfaces
Interface: TCP/IP
IP address: 10.0.0.68:502

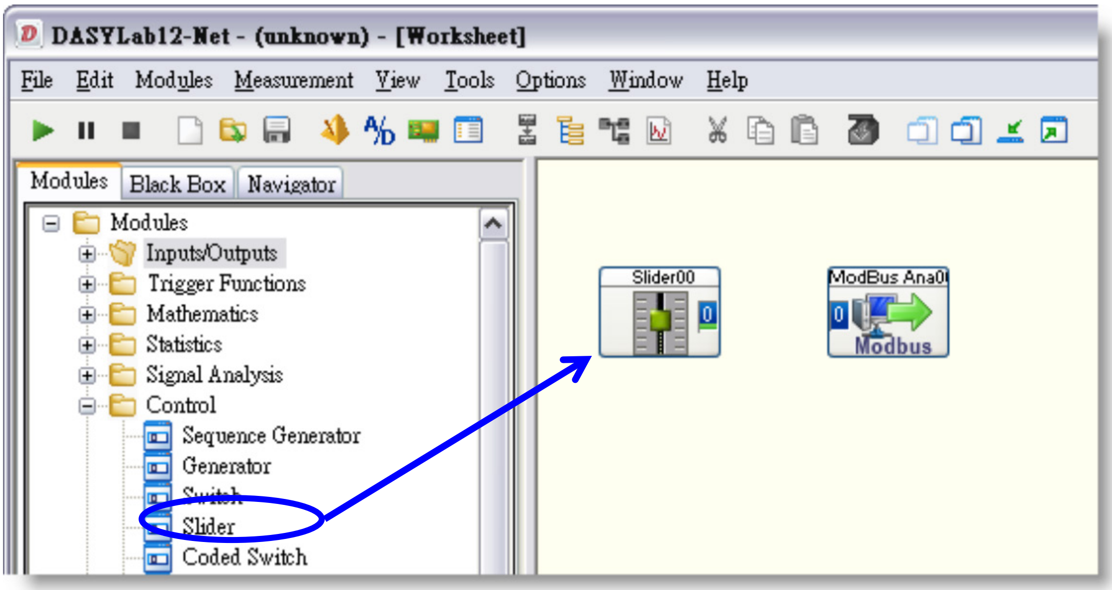
Channel name: AO 0
Unit: V

Device
Address: 1 (0x1)
Register: 0
☑ Register starts at 0

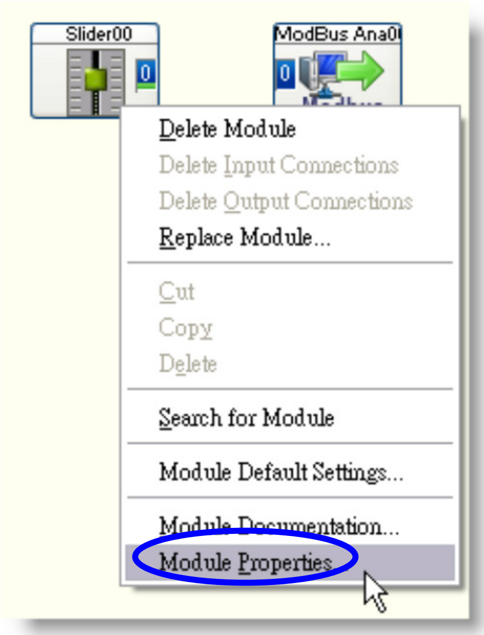
Data type
Word
Unsigned 16-bit integer
☑ Big Endian
☐ Swap word order

Data range
☑ Scaling
Minimum: -10.0000
Maximum: 10.0000

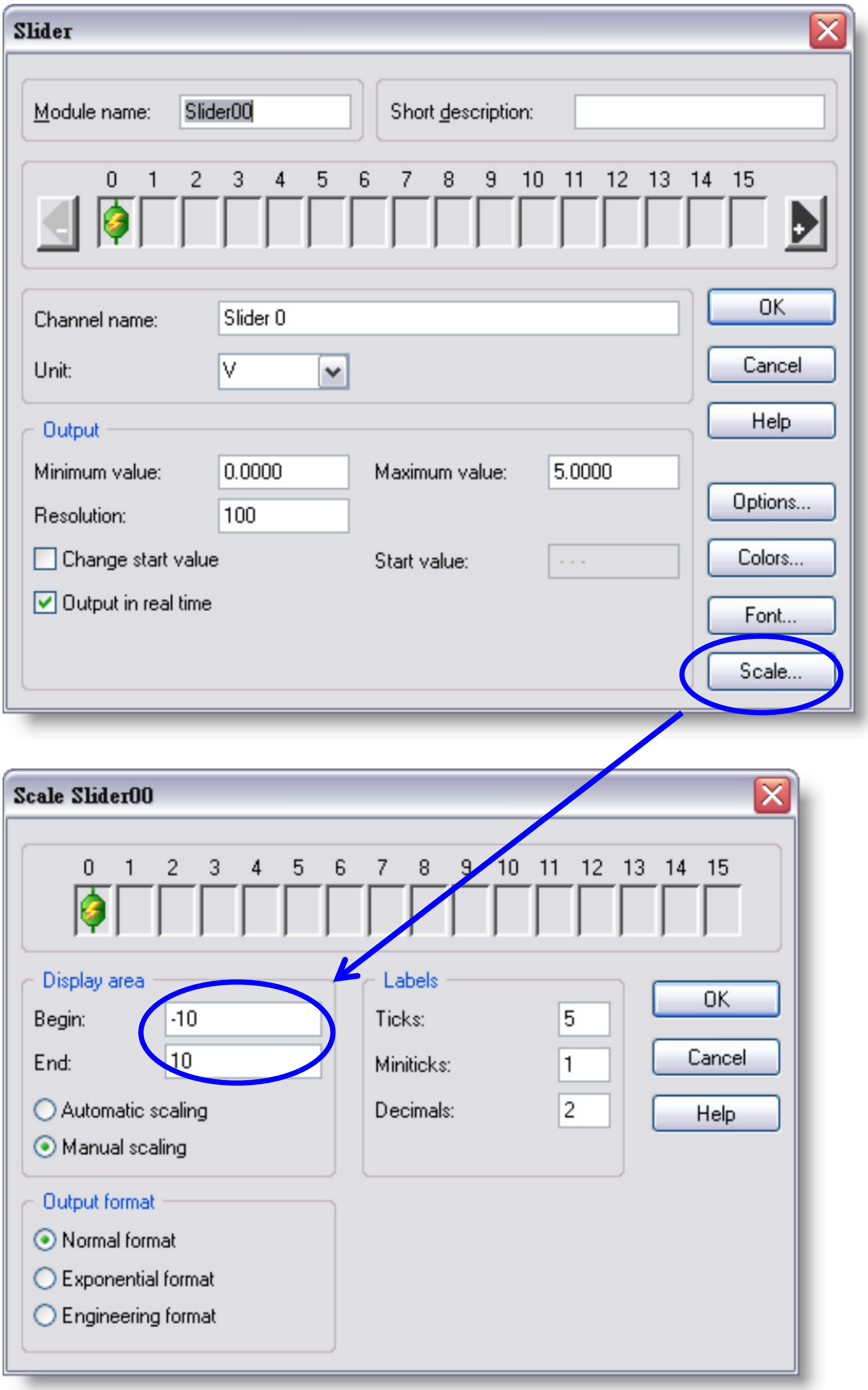
Step 4: Click the "Modules" tab and then expand the “Control” folder found in the “Modules” folder. Drag a Slider Control object to the worksheet pane on the right-hand side of the window.



Step 5: Right-click the Slider Control icon and click the “Module Properties” option.



Step 6: Click the “Scale” button to open the “Scale” dialog box for the slider and set the Begin and End values in the “Display area” section of the “Scale” dialog box. In this demo, -10 to +10 are used. Click the “OK” button to continue.



Slider

Module name: Slider00

Short description:

Channel name: Slider 0

Unit: V

Output

Minimum value: 0.0000

Maximum value: 5.0000

Resolution: 100

☐ Change start value

Start value: ---

☑ Output in real time

Scale Slider00

Display area

Begin: -10

End: 10

○ Automatic scaling

● Manual scaling

Labels

Ticks: 5

Miniticks: 1

Decimals: 2

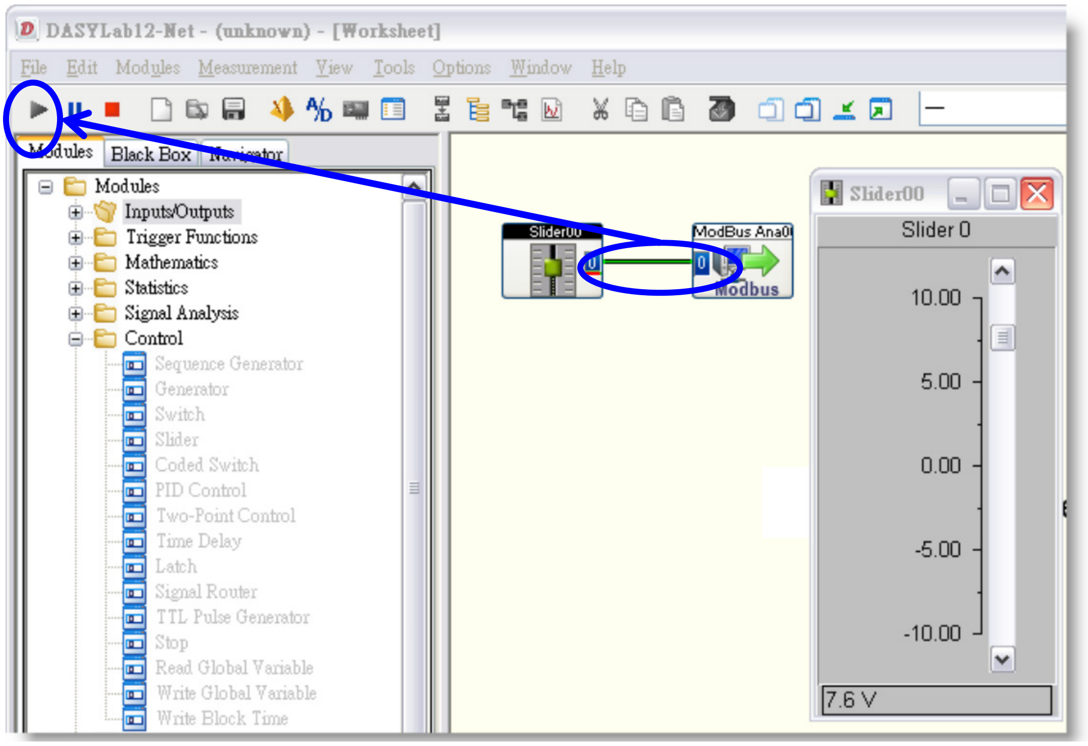
Output format

● Normal format

○ Exponential format

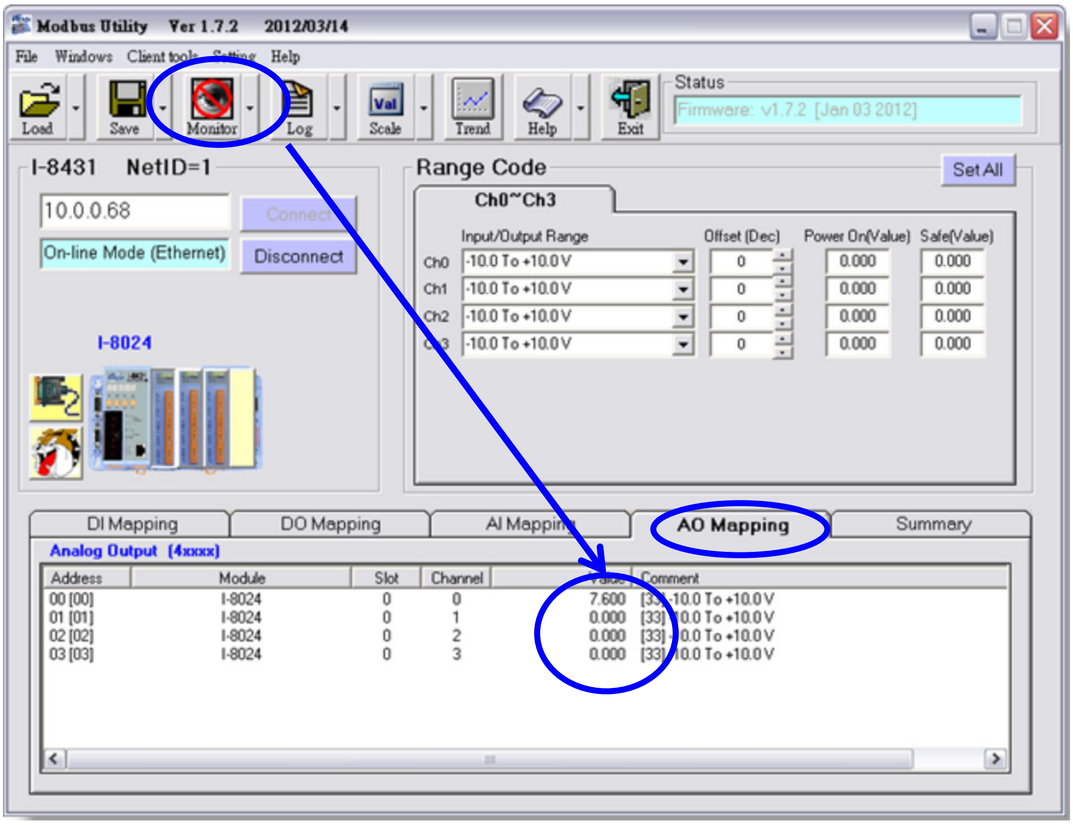
○ Engineering format

Step 7: Drag a line from the “Slider00” icon to the “ModBus Ana00” icon to establish a connection between the Slider Control and the Analog Output object. Click the “run” button to begin doing output value by the Slider Control.



7.6 V

The value can also be checked using the Modbus Utility.



Firmware: v1.7.2 [Jan 03 2012]

I-8431 NetID=1

10.0.0.68

On-line Mode (Ethernet)

Range Code

	Input/Output Range	Offset (Dec)	Power On(Value)	Safe(Value)
Ch0	-10.0 To +10.0 V	0	0.000	0.000
Ch1	-10.0 To +10.0 V	0	0.000	0.000
Ch2	-10.0 To +10.0 V	0	0.000	0.000
Ch3	-10.0 To +10.0 V	0	0.000	0.000

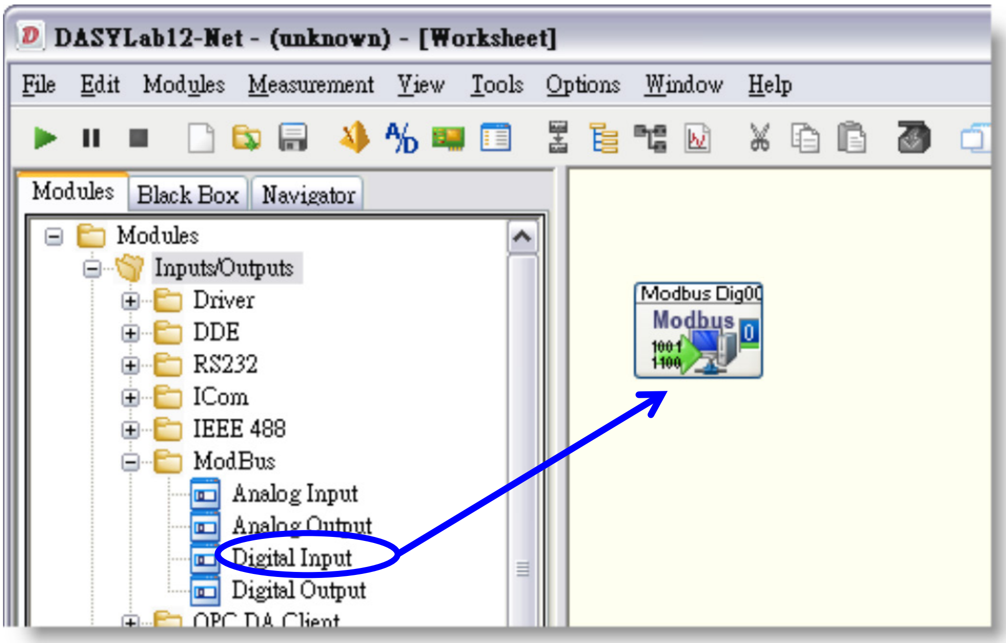
Analog Output (4xxxx)

Address	Module	Slot	Channel	Value	Comment
00 [00]	I-8024	0	0	7.600	[33] -10.0 To +10.0 V
01 [01]	I-8024	0	1	0.000	[33] -10.0 To +10.0 V
02 [02]	I-8024	0	2	0.000	[33] -10.0 To +10.0 V
03 [03]	I-8024	0	3	0.000	[33] -10.0 To +10.0 V

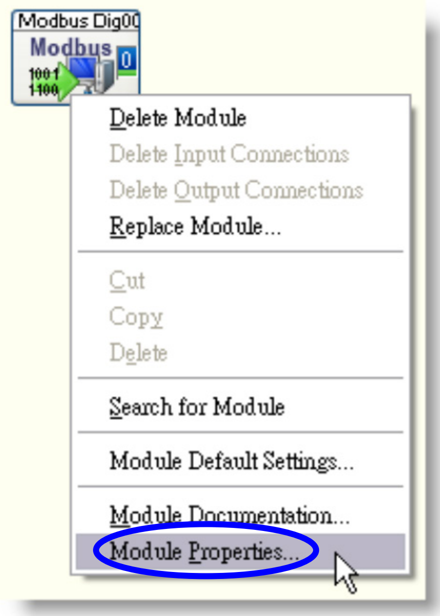
E-mail: service@icpdas.com

3.2.3. Adding a Digital Input Channel

Step 1: Click the "Modules" tab and then expand the “Inputs/Outputs” folder found in the “Modules” folder. Expand the “ModBus” folder and then drag a Digital Input object to the worksheet pane on the right-hand side of the window.



Step 2: Right-click the object icon and click the “Module Properties” option.



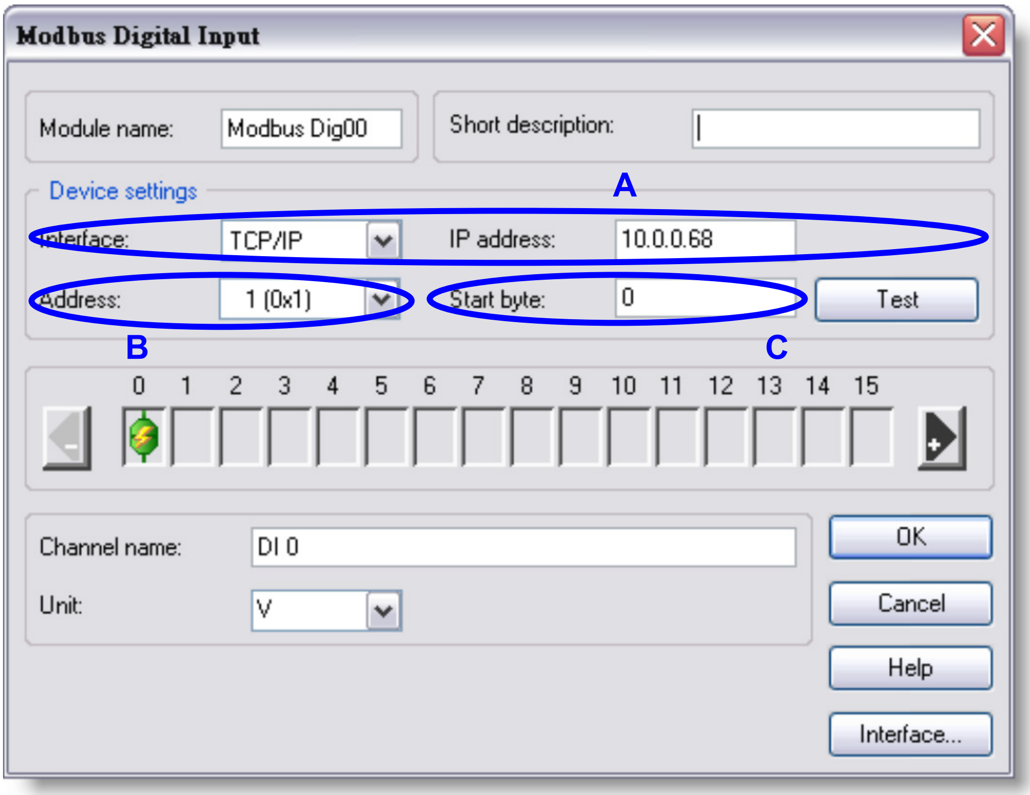
E-mail: service@icpdas.com

Step 3: Configure the object properties in the Modbus Digital Input dialog box using the values shown in the image below. And then click the "OK" button to set the properties.

A. In the "Device settings" section, set the Interface to TCP/IP and enter the IP address.

B. In the "Device settings" section, select the Address of the controller from the "Address" drop-down menu. This will be the same as the Net ID of the controller.

C. Enter a value for the Start byte, which can be found from the DI Mapping table in the Modbus Utility.


Modbus Digital Input

Module name: Modbus Dig00

Short description:

Device settings

Interface: TCP/IP

IP address: 10.0.0.68

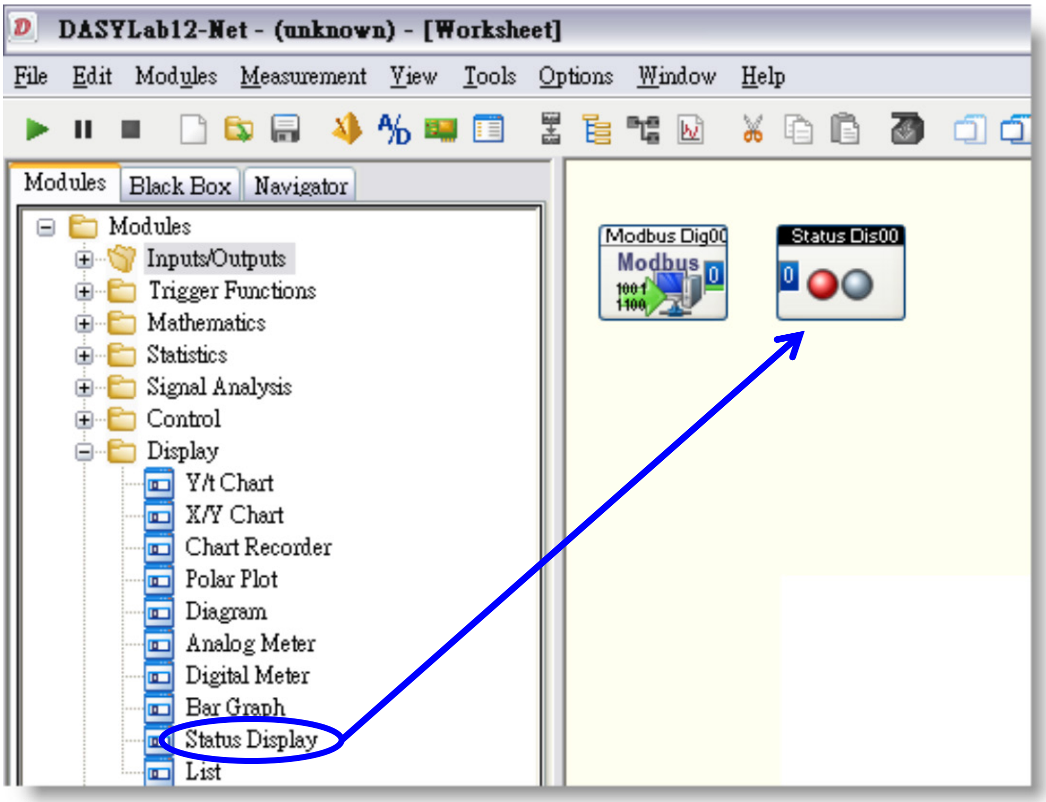
Address: 1 (0x1)

Start byte: 0

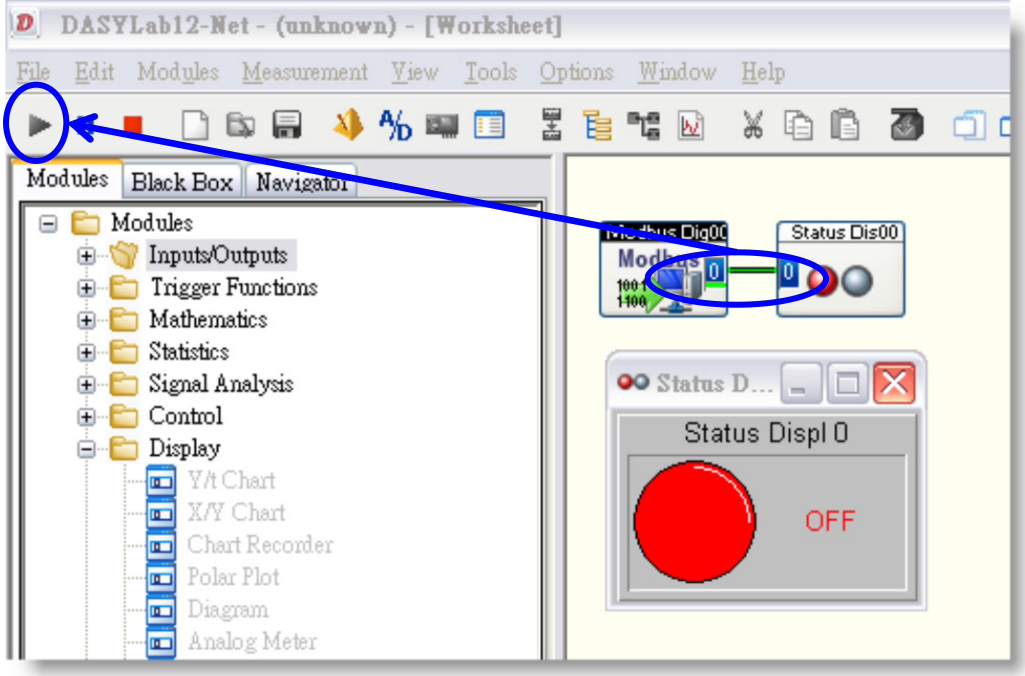
Channel name: DI 0

Unit: V

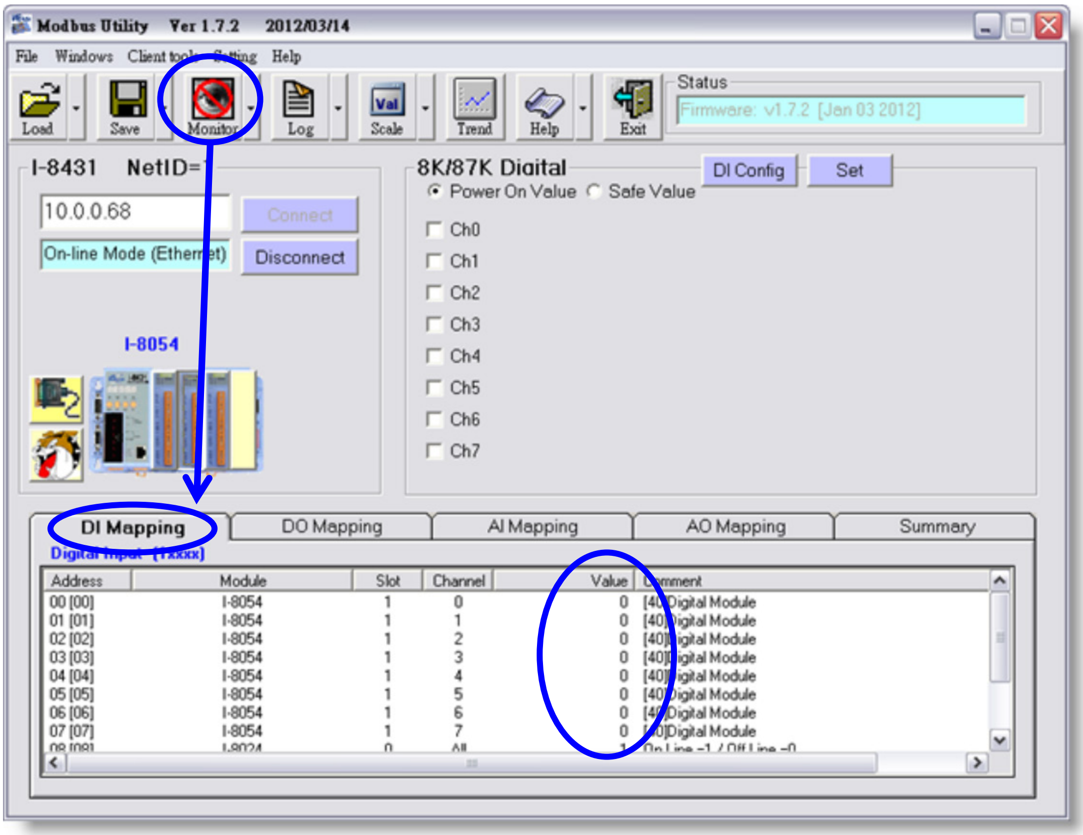
Step 4: Click the "Modules" tab and then expand the “Display” folder found in the “Modules” folder. Drag a Status Display object to the worksheet pane on the right-hand side of the window.



Step 5: Drag a line from the “Status Dis00” icon to the ”Modbus Dig00” icon to establish a connection between the Status Display object and the Digital Input object. Click the “Run” button to connect to the module and begin acquiring data.



The data can also be checked using the "Monitor" function of the Modbus Utility and then clicking the “DI Mapping” tab.



Firmware: v1.7.2 [Jan 03 2012]

10.0.0.68

On-line Mode (Ethernet)

● Power On Value ○ Safe Value

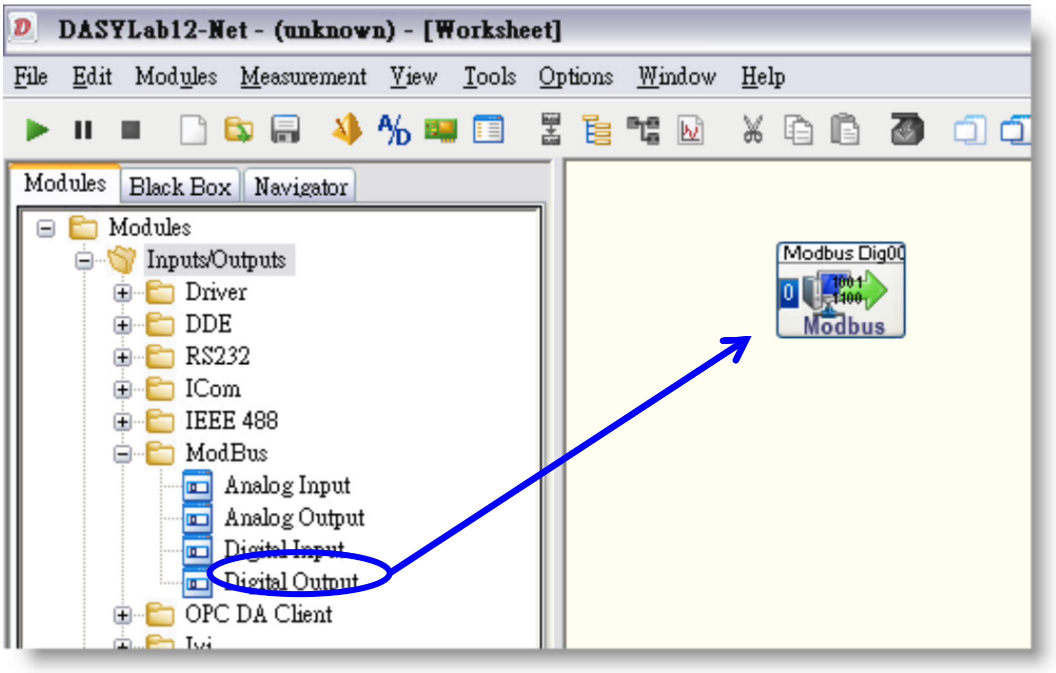
☐ Ch0
☐ Ch1
☐ Ch2
☐ Ch3
☐ Ch4
☐ Ch5
☐ Ch6
☐ Ch7

Digital Input (1xxxx)

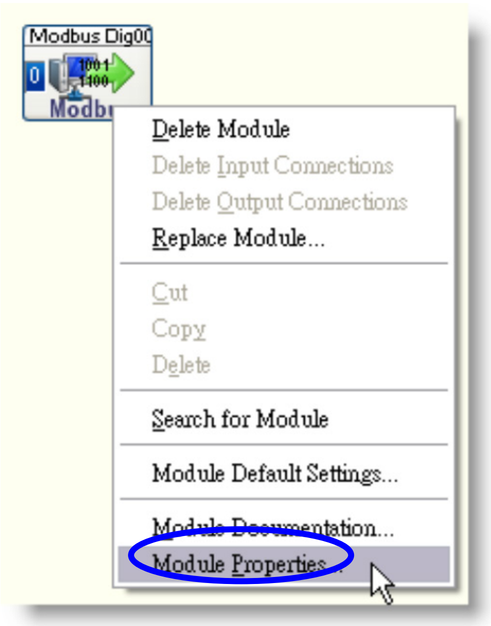
Address	Module	Slot	Channel	Value	Comment
00 [00]	I-8054	1	0	0	[40]Digital Module
01 [01]	I-8054	1	1	0	[40]Digital Module
02 [02]	I-8054	1	2	0	[40]Digital Module
03 [03]	I-8054	1	3	0	[40]Digital Module
04 [04]	I-8054	1	4	0	[40]Digital Module
05 [05]	I-8054	1	5	0	[40]Digital Module
06 [06]	I-8054	1	6	0	[40]Digital Module
07 [07]	I-8054	1	7	0	[40]Digital Module
08 [08]	I-8024	0	All	1	On Line =1 / Off Line =0

3.2.4. Adding a Digital Output Channel

Step 1: Click the "Modules" tab and then expand the “Inputs/Outputs” folder found in the “Modules” folder. Expand the “ModBus” folder and then drag a Digital Output object to the worksheet pane on the right-hand side of the window.



Step 2: Right-click the object and click the “Module Properties” option.

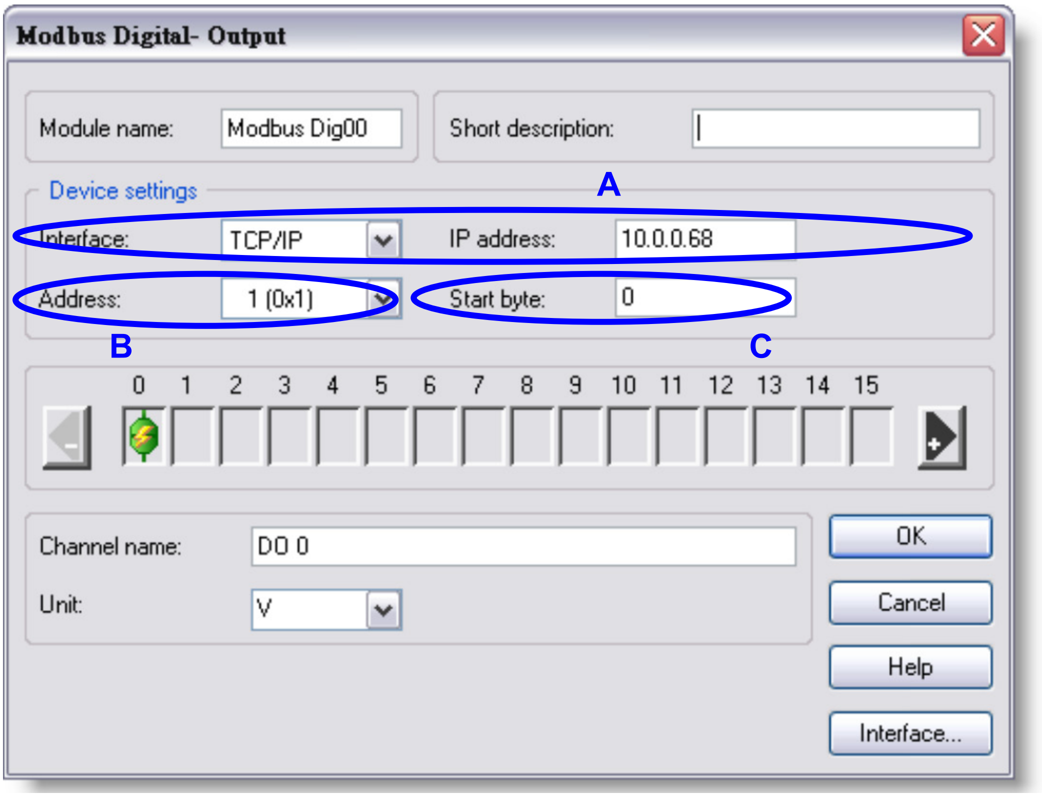


Step 3: Configure the object properties in the Modbus Digital Output dialog box using the values shown in the image below. And then click the “OK” button to set the properties.

A. In the “Device settings” section, set the Interface to TCP/IP and enter the IP address.

B. In the “Device settings” section, select the Address of the controller from the “Address” drop-down menu. This will be the same as the Net ID of the controller.

C. Enter the Start byte, which can be found from the DO Mapping table in the Modbus Utility.



Modbus Digital- Output

Module name: Modbus Dig00

Short description:

Device settings

Interface: TCP/IP

IP address: 10.0.0.68

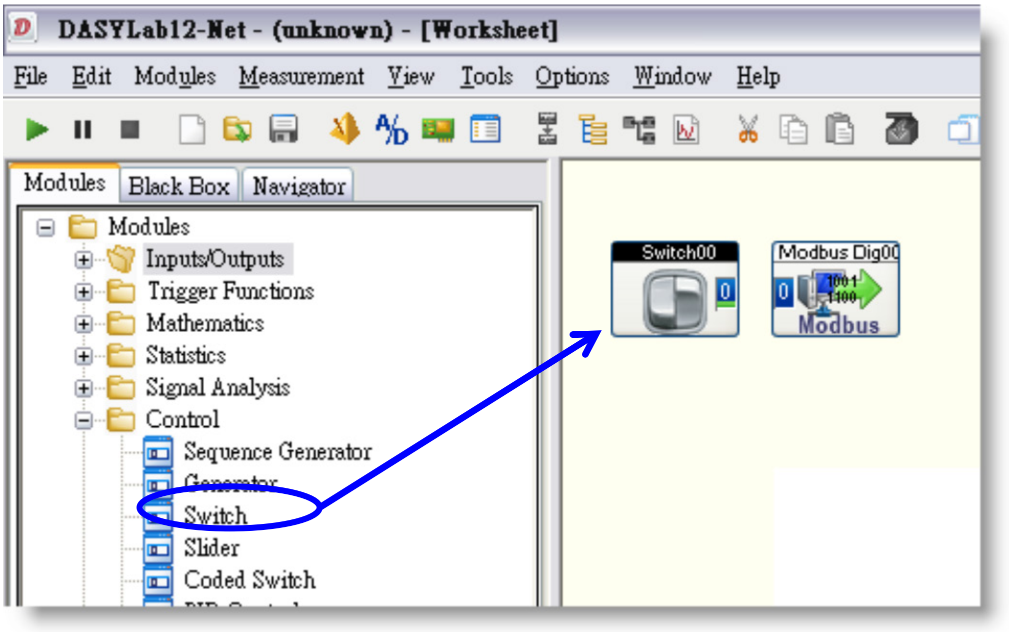
Address: 1 (0x1)

Start byte: 0

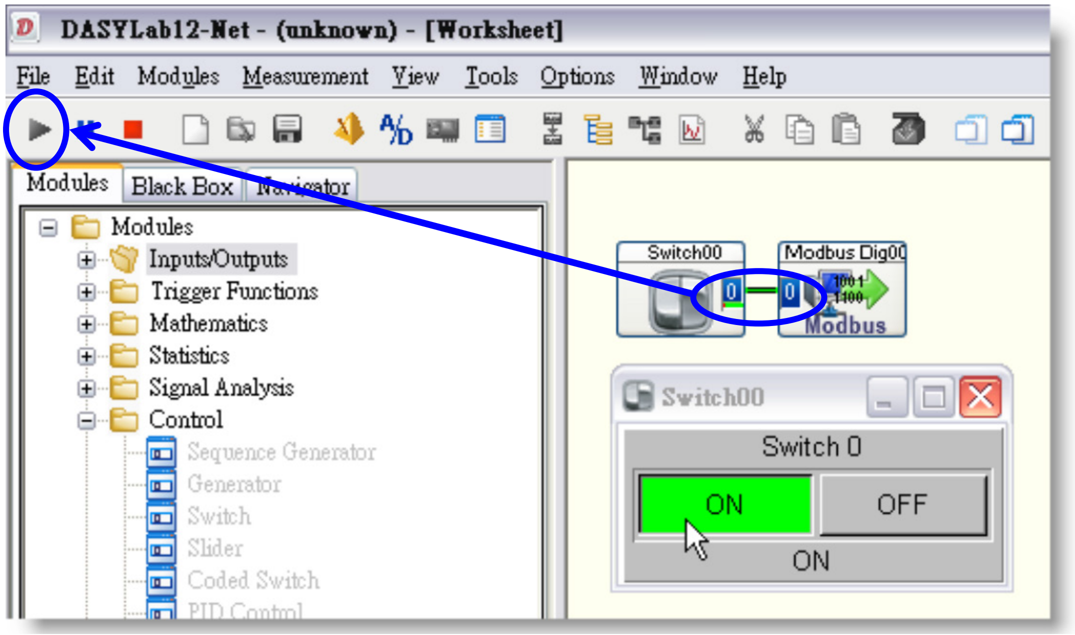
Channel name: DO 0

Unit: V

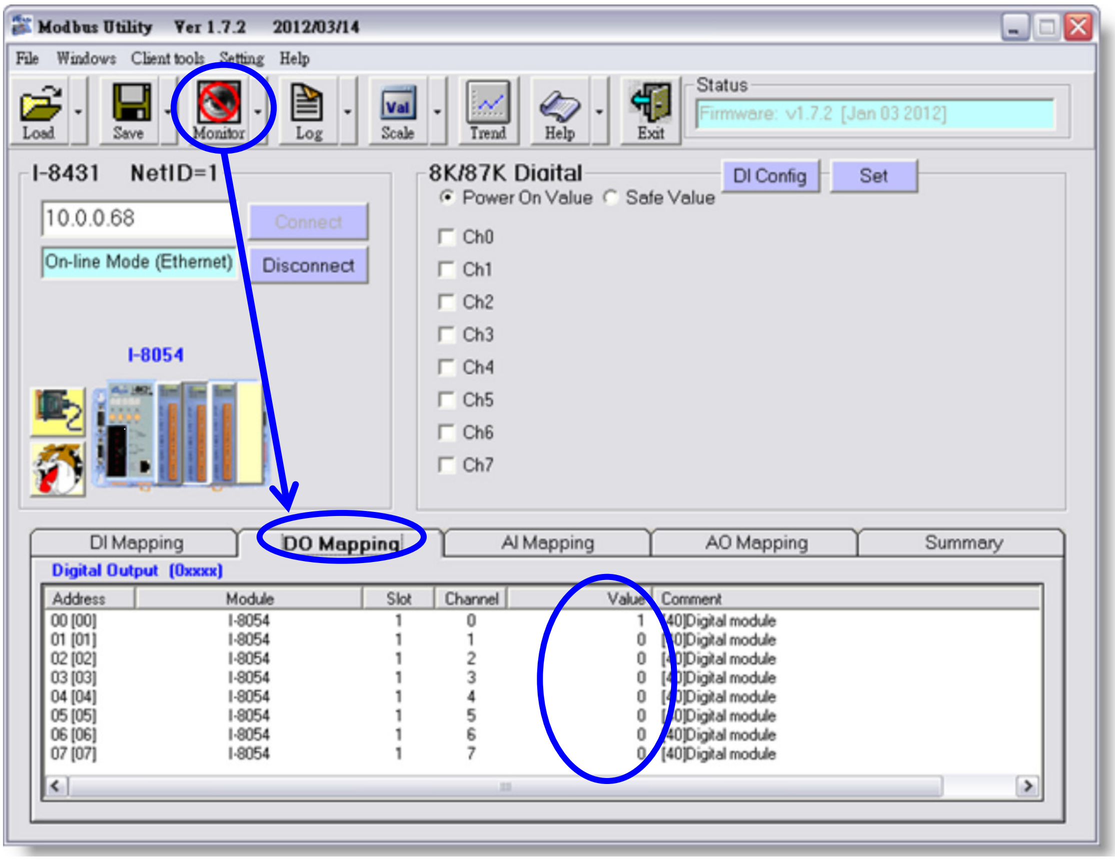
Step 4: Click the "Modules" tab and then expand the “Control” folder found in the “Modules” folder. Drag a Switch Control object to the worksheet pane on the right-hand side of the window.



Step 5: Drag a line from the “Switch00” icon to the “Modbus Dig00” icon to establish a connection between the Switch Control object and the Digital Output object. Click the “Run” button to connect to the module and begin exporting data by the Switch00.



The data can also be set on the “DO Mapping” using the “Monitor” function of the Modbus Utility.



Firmware: v1.7.2 [Jan 03 2012]

I-8431 NetID=1

10.0.0.68

On-line Mode (Ethernet)

● Power On Value ○ Safe Value

Digital Output (0xxxx)

Address	Module	Slot	Channel	Value	Comment
00 [00]	I-8054	1	0	1	[40]Digital module
01 [01]	I-8054	1	1	0	[40]Digital module
02 [02]	I-8054	1	2	0	[40]Digital module
03 [03]	I-8054	1	3	0	[40]Digital module
04 [04]	I-8054	1	4	0	[40]Digital module
05 [05]	I-8054	1	5	0	[40]Digital module
06 [06]	I-8054	1	6	0	[40]Digital module
07 [07]	I-8054	1	7	0	[40]Digital module

3.3. EZ Data Logger

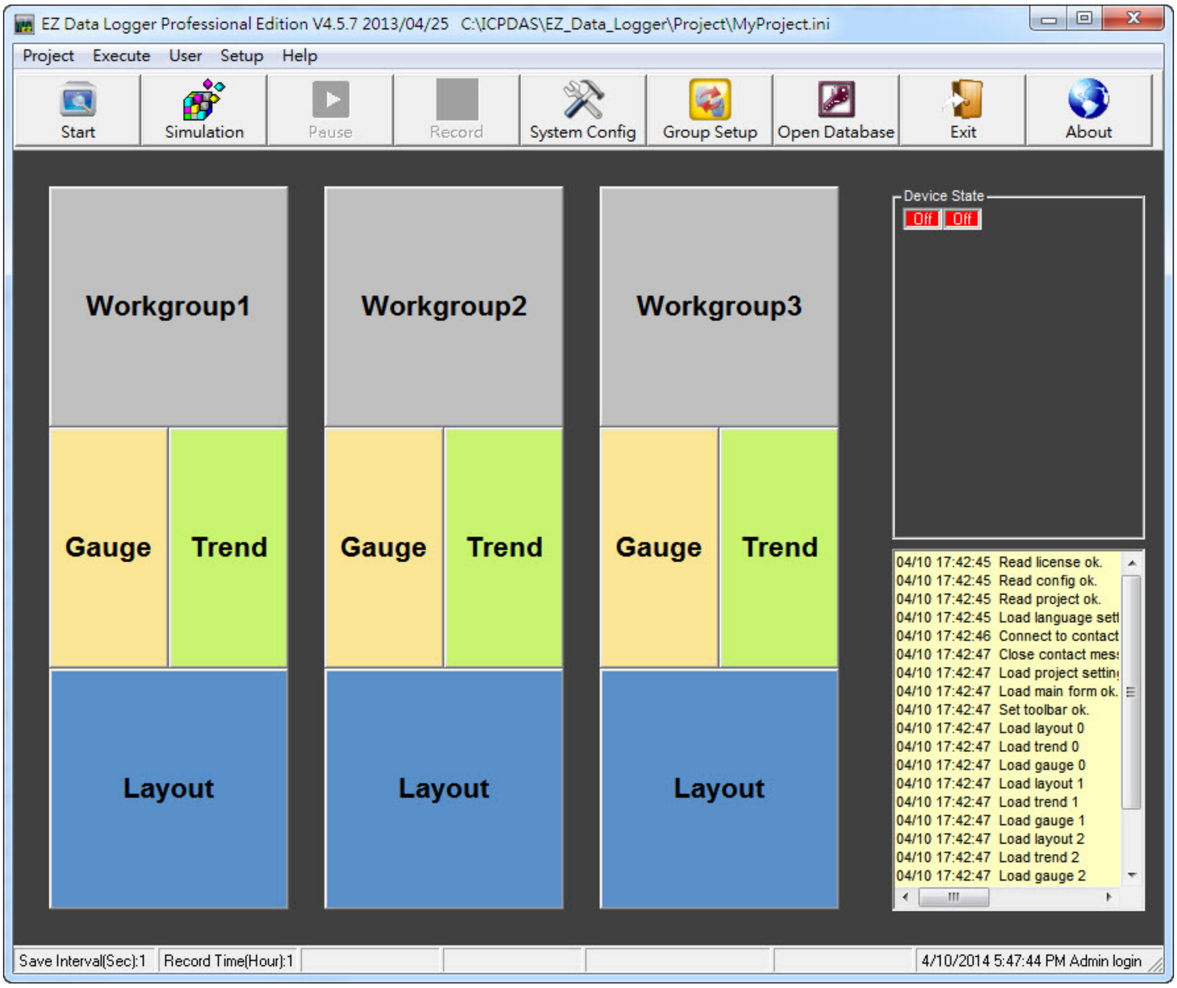
In this section, a detailed description of the procedure for connecting the EZ Data Logger solution to a controller using the Modbus/TCP protocol is presented. In this example, EZ Data Logger version 4.5.7 is used.

Before using the EZ Data Logger, the controller should be correctly configured using the Modbus Utility. The Net ID is set using the 8-bit DIP switch located on the right-hand side of the controller (see [Section 2.4 Net ID (Station number) Setting]() for more information).

The EZ Data Logger can be downloaded from:
http://ftp.icpdas.com/pub/cd/8000cd/napdos/driver/ez_data_logger/

3.3.1. Adding the I/O Modules to the Workgroup

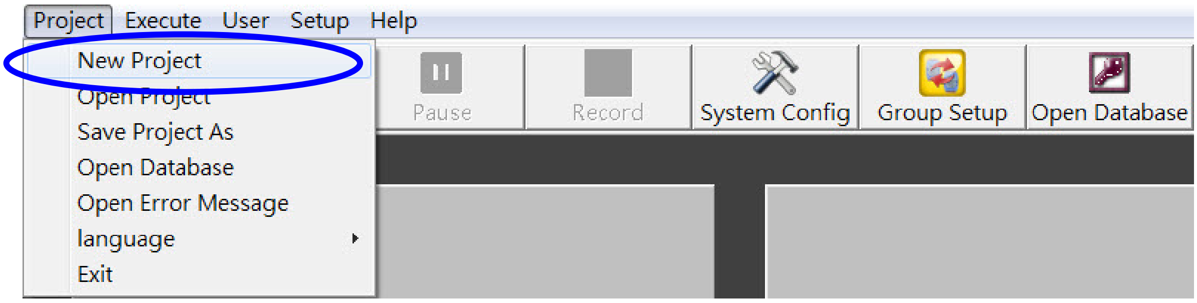
Step 1: Open the EZ Data Logger software and the main project window will be displayed containing a default project named "MyProject".



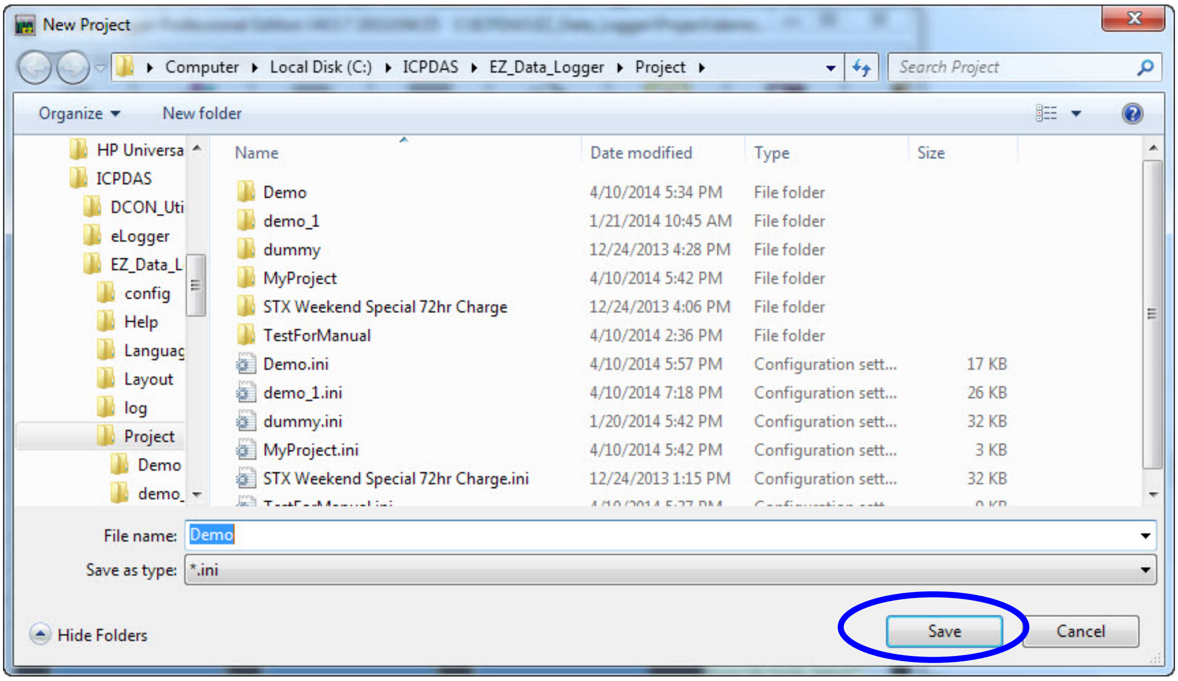
```
04/10 17:42:45  Read license ok.
04/10 17:42:45  Read config ok.
04/10 17:42:45  Read project ok.
04/10 17:42:45  Load language sett
04/10 17:42:46  Connect to contact
04/10 17:42:47  Close contact mes
04/10 17:42:47  Load project settin
04/10 17:42:47  Load main form ok.
04/10 17:42:47  Set toolbar ok.
04/10 17:42:47  Load layout 0
04/10 17:42:47  Load trend 0
04/10 17:42:47  Load gauge 0
04/10 17:42:47  Load layout 1
04/10 17:42:47  Load trend 1
04/10 17:42:47  Load gauge 1
04/10 17:42:47  Load layout 2
04/10 17:42:47  Load trend 2
04/10 17:42:47  Load gauge 2
```

Save Interval(Sec):1 | Record Time(Hour):1 | 4/10/2014 5:47:44 PM Admin login

To create a new project, click the “New Project” item in the “Project” menu.



Step 2: Enter a name for the project and click the “Save” button.

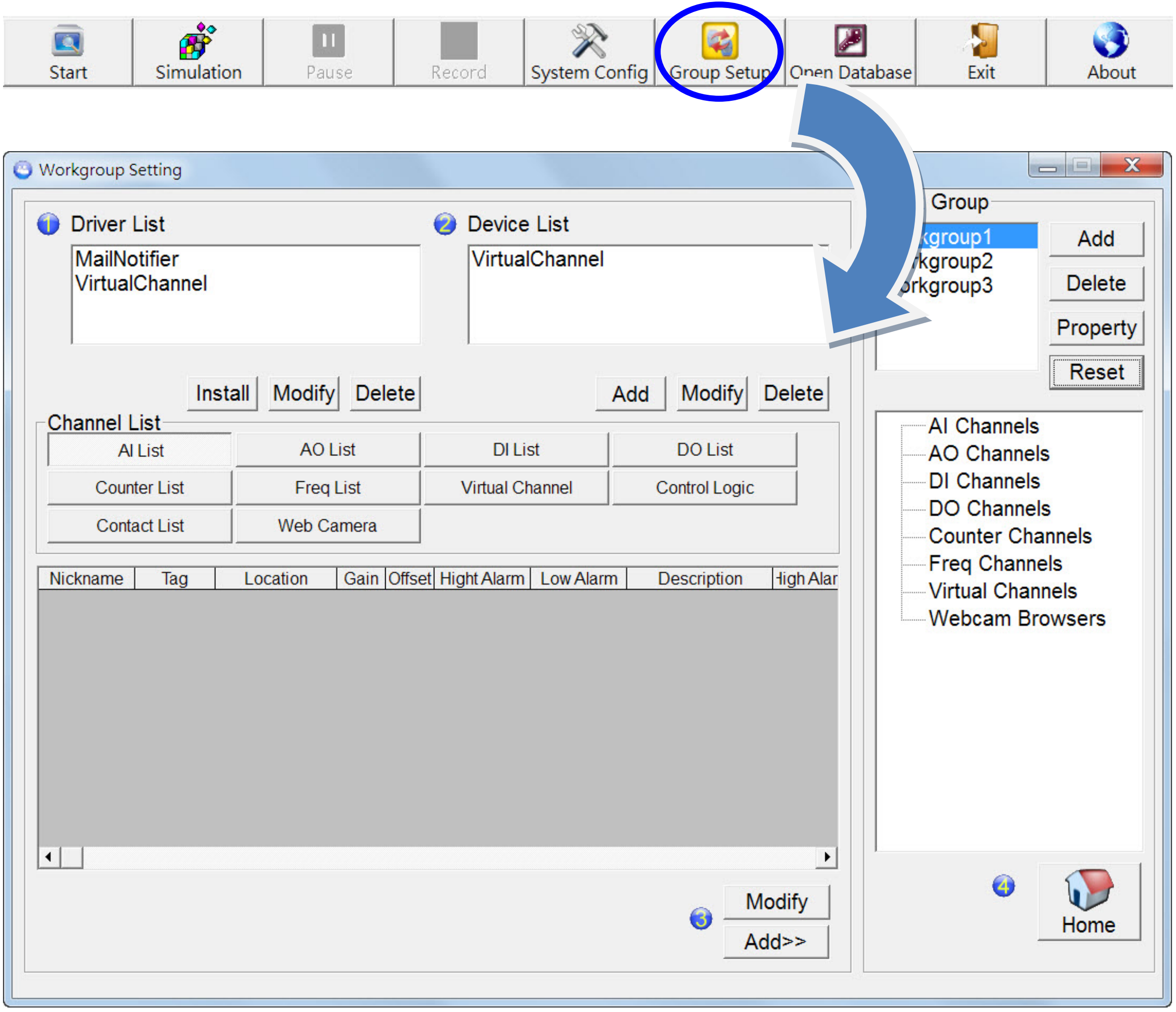


Name	Date modified	Type	Size
Demo	4/10/2014 5:34 PM	File folder	
demo_1	1/21/2014 10:45 AM	File folder	
dummy	12/24/2013 4:28 PM	File folder	
MyProject	4/10/2014 5:42 PM	File folder	
STX Weekend Special 72hr Charge	12/24/2013 4:06 PM	File folder	
TestForManual	4/10/2014 2:36 PM	File folder	
Demo.ini	4/10/2014 5:57 PM	Configuration sett...	17 KB
demo_1.ini	4/10/2014 7:18 PM	Configuration sett...	26 KB
dummy.ini	1/20/2014 5:42 PM	Configuration sett...	32 KB
MyProject.ini	4/10/2014 5:42 PM	Configuration sett...	3 KB
STX Weekend Special 72hr Charge.ini	12/24/2013 1:15 PM	Configuration sett...	32 KB

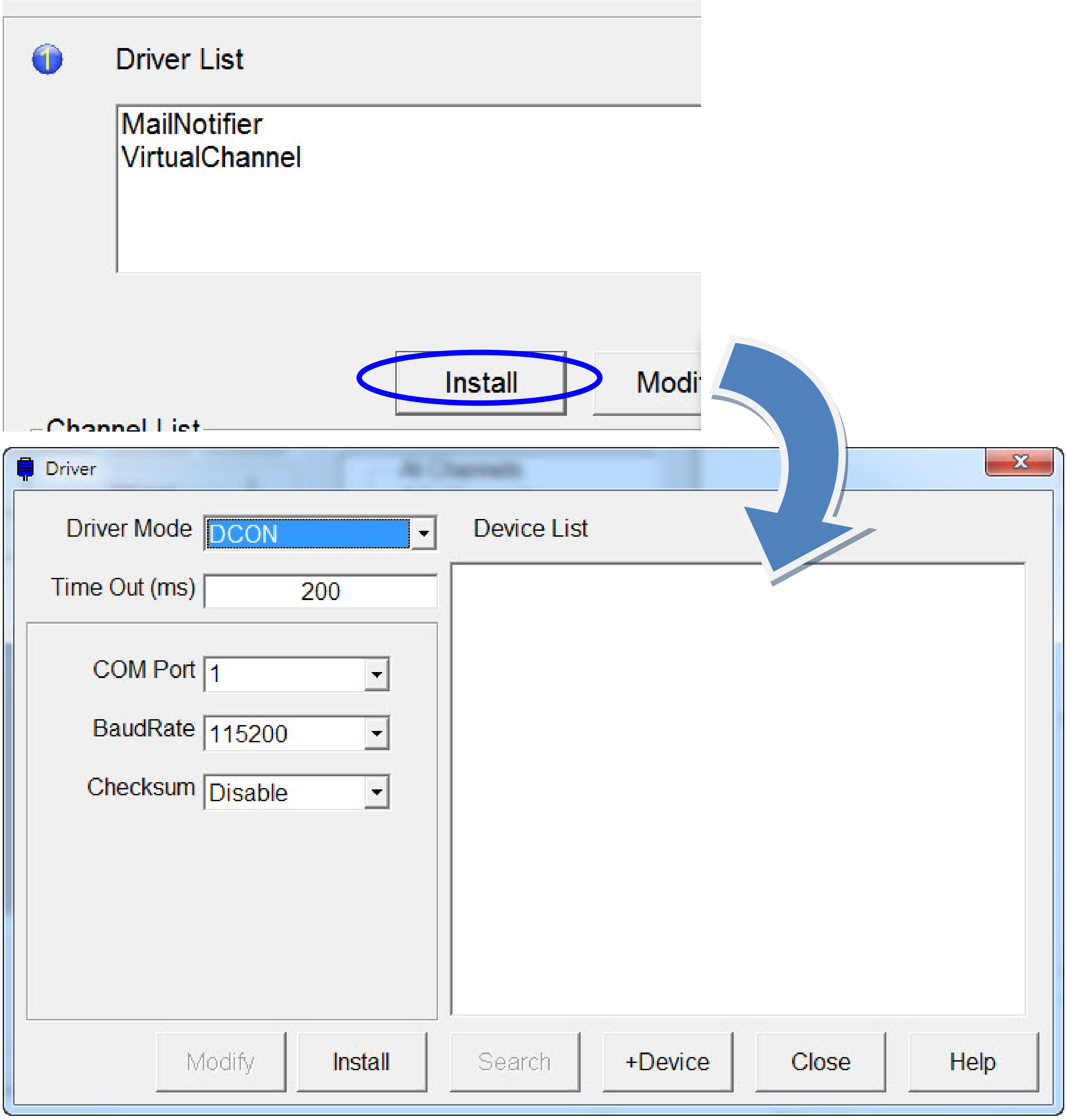
File name: Demo

Save as type: *.ini

Step 3: Click the “Group Setup” button in the main toolbar to open the “Workgroup Setting” dialog box, and begin adding the controller and I/O channels to the workgroup list.



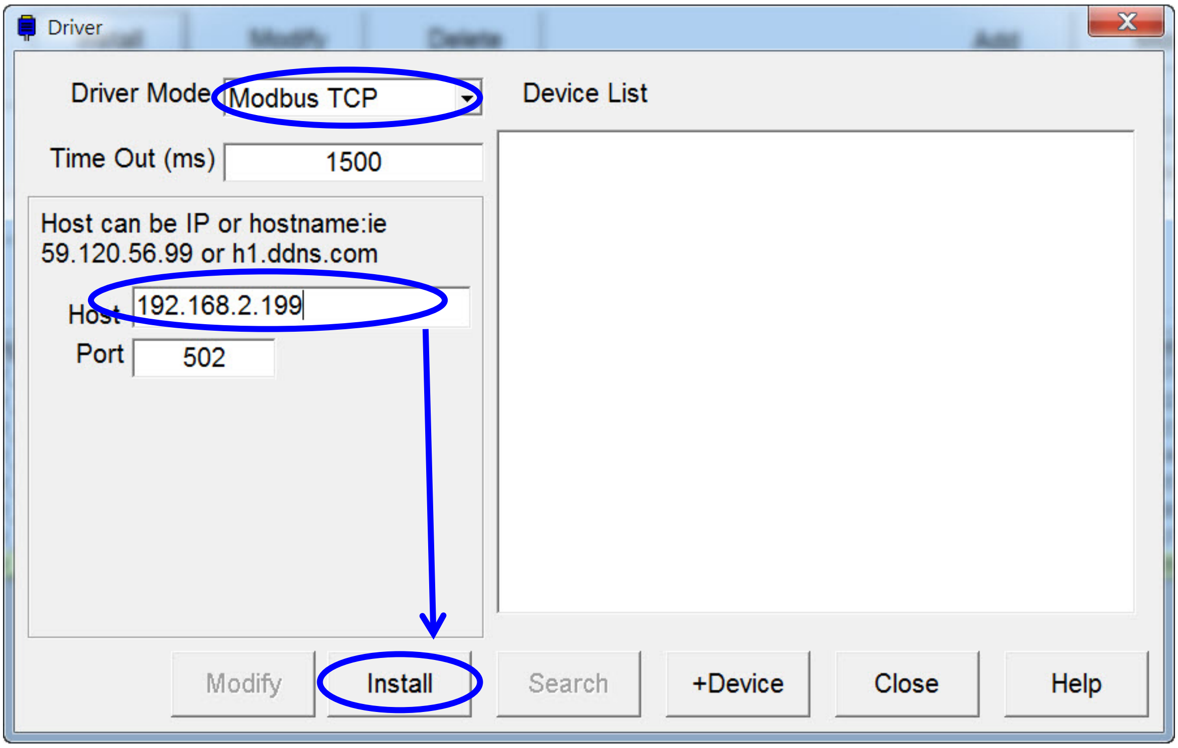
Step 4: Click the "Install" button in the "Driver List" section to display the "Driver" dialog box.



MailNotifier
VirtualChannel

Driver Mode: DCON
Time Out (ms): 200
COM Port: 1
BaudRate: 115200
Checksum: Disable

Step 5: Select the “Modbus TCP” option from the “Driver Mode” drop-down menu, and enter the IP address for the controller in the “Host” text field, and then click the “Install” button.



Driver Mode: Modbus TCP

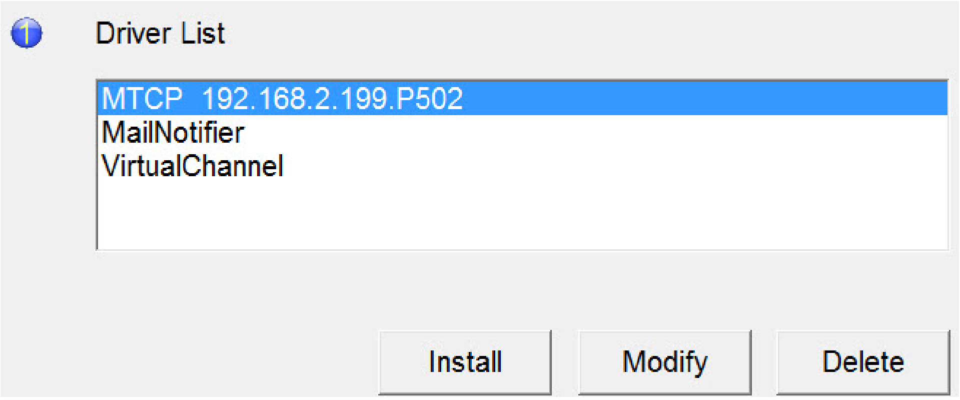
Time Out (ms): 1500

Host can be IP or hostname:ie 59.120.56.99 or h1.ddns.com

Host: 192.168.2.199

Port: 502

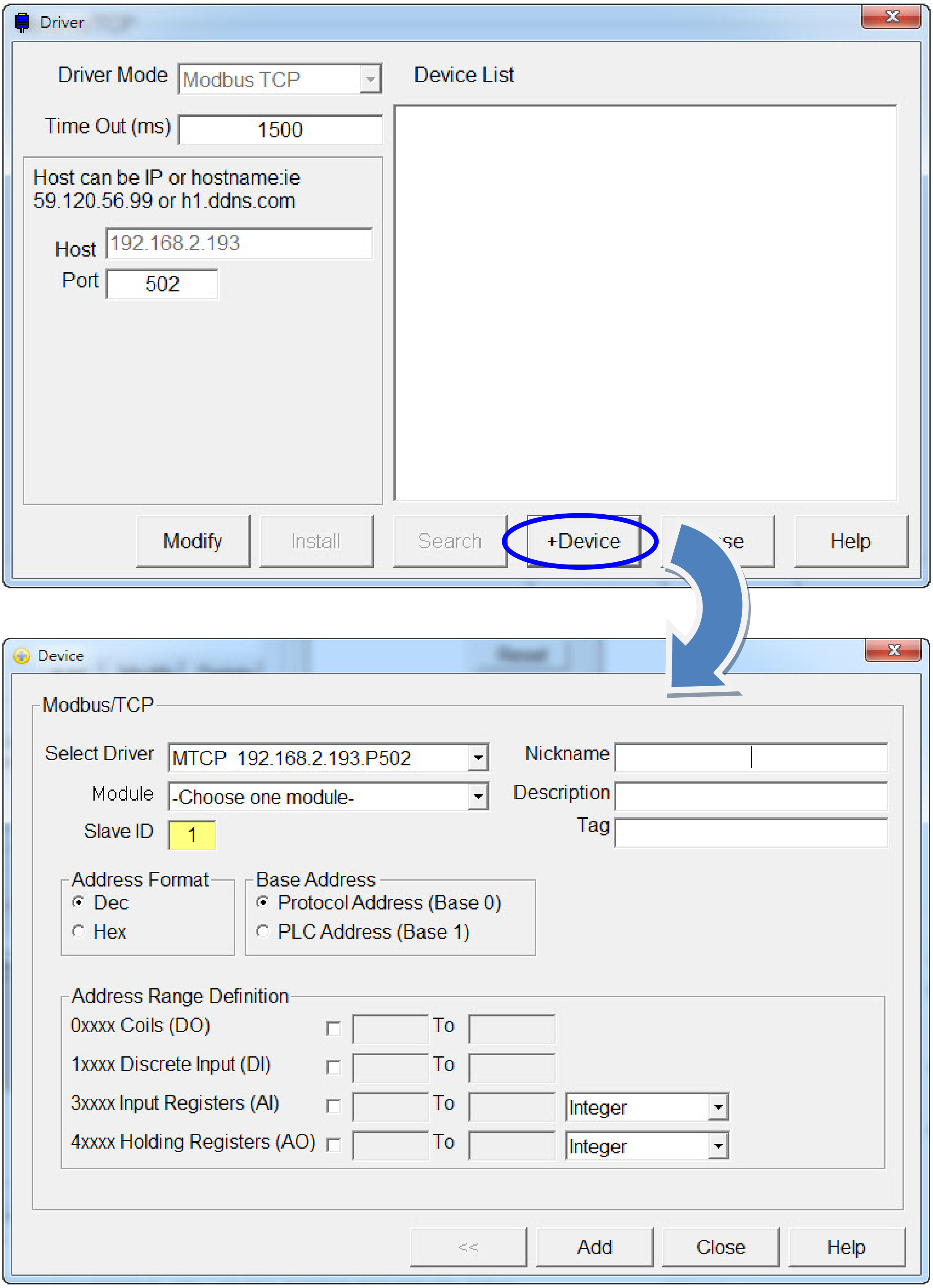
The new driver will be added to the Driver List, as shown below.



Driver List

MTCP 192.168.2.199.P502
MailNotifier
VirtualChannel

Step 6: Click the "+Device" button in the "Driver" dialog box to display the "Device" dialog box.



Driver Mode: Modbus TCP

Time Out (ms): 1500

Host can be IP or hostname:ie 59.120.56.99 or h1.ddns.com

Host: 192.168.2.193

Port: 502

Modbus/TCP

Select Driver: MTCP 192.168.2.193.P502

Module: -Choose one module-

Slave ID: 1

Address Format: ● Dec ○ Hex

Base Address: ● Protocol Address (Base 0) ○ PLC Address (Base 1)

0xxxx Coils (DO) ☐ To

1xxxx Discrete Input (DI) ☐ To

3xxxx Input Registers (AI) ☐ To Integer

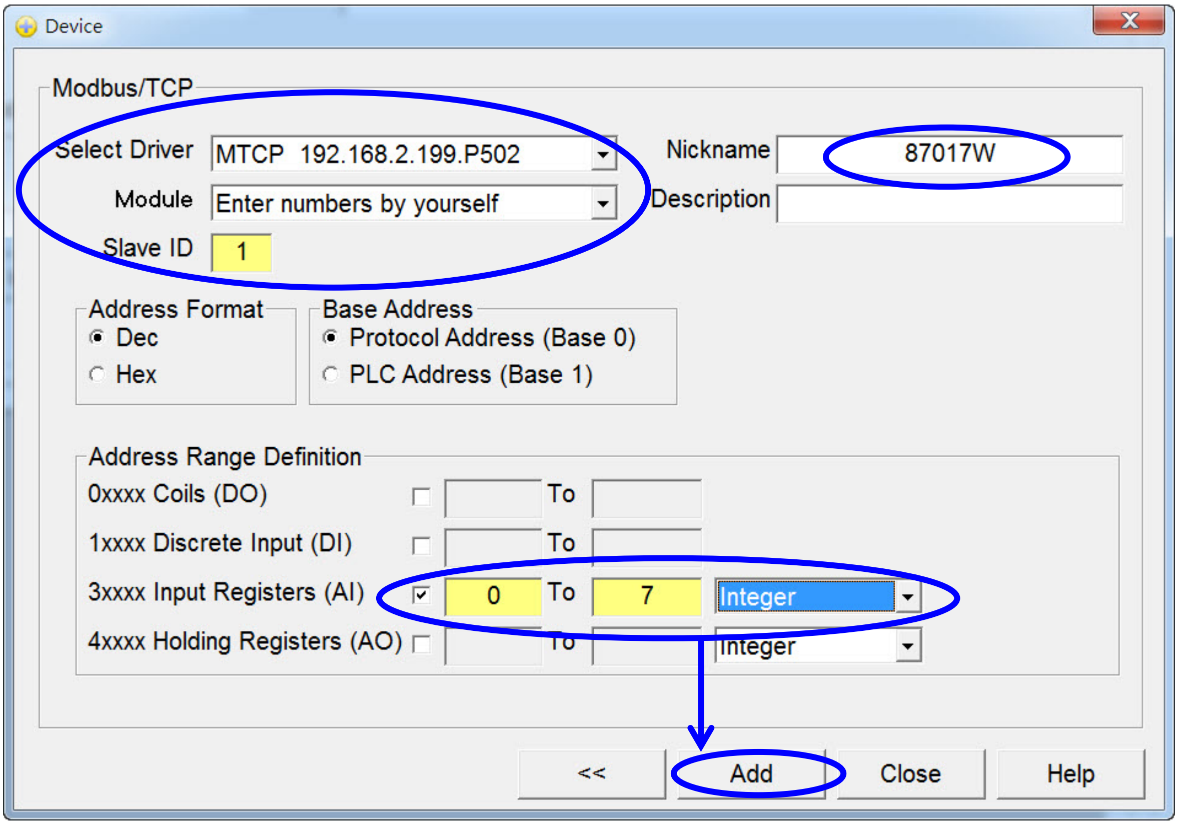
4xxxx Holding Registers (AO) ☐ To Integer

Step 7: In the "Select Driver" drop-down menu, select the "MTCP" driver that was added earlier and select "Enter numbers by yourself" from the "Module" drop-down menu.

Enter the name of the Analog Input module, 87017W in this example, in the "Nickname" text field and set the "Slave ID" to "1".

Check the "3xxxx Input Registers (AI)" checkbox in the "Address Range Definition" section and enter the channel numbers 0 to 7 then select "Integer" as the type.

Click the "Add" button to add the new module configuration to the Device List section and the Channel List section.



Select Driver: MTCP 192.168.2.199.P502

Module: Enter numbers by yourself

Slave ID: 1

Nickname: 87017W

Description:

Address Format: ● Dec ○ Hex

Base Address: ● Protocol Address (Base 0) ○ PLC Address (Base 1)

Address Range Definition:

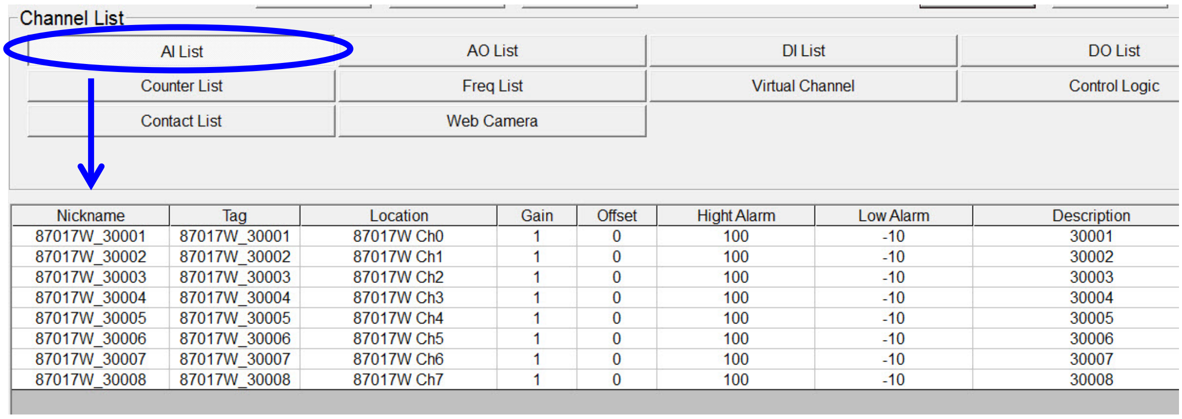
0xxxx Coils (DO) ☐ To

1xxxx Discrete Input (DI) ☐ To

3xxxx Input Registers (AI) ☑ 0 To 7 Integer

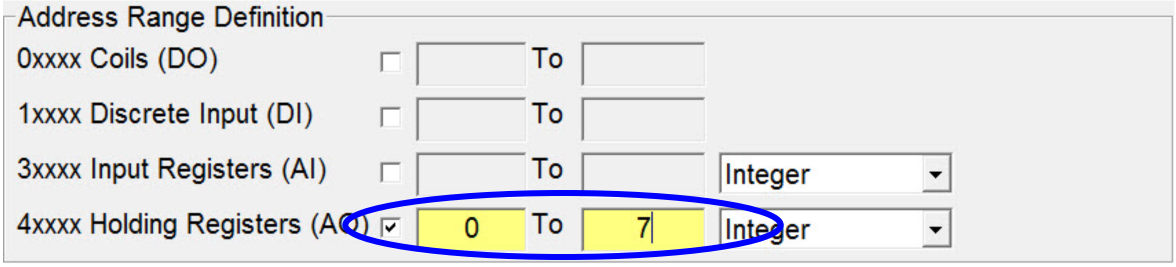
4xxxx Holding Registers (AO) ☐ To Integer

Once the new device has been configured, the new channels will be displayed in the "Channel List" section, as shown in the following figure.

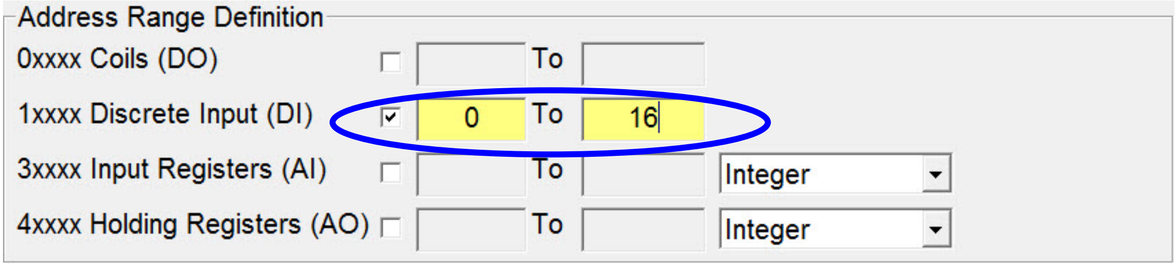


Nickname	Tag	Location	Gain	Offset	Hight Alarm	Low Alarm	Description
87017W_30001	87017W_30001	87017W Ch0	1	0	100	-10	30001
87017W_30002	87017W_30002	87017W Ch1	1	0	100	-10	30002
87017W_30003	87017W_30003	87017W Ch2	1	0	100	-10	30003
87017W_30004	87017W_30004	87017W Ch3	1	0	100	-10	30004
87017W_30005	87017W_30005	87017W Ch4	1	0	100	-10	30005
87017W_30006	87017W_30006	87017W Ch5	1	0	100	-10	30006
87017W_30007	87017W_30007	87017W Ch6	1	0	100	-10	30007
87017W_30008	87017W_30008	87017W Ch7	1	0	100	-10	30008

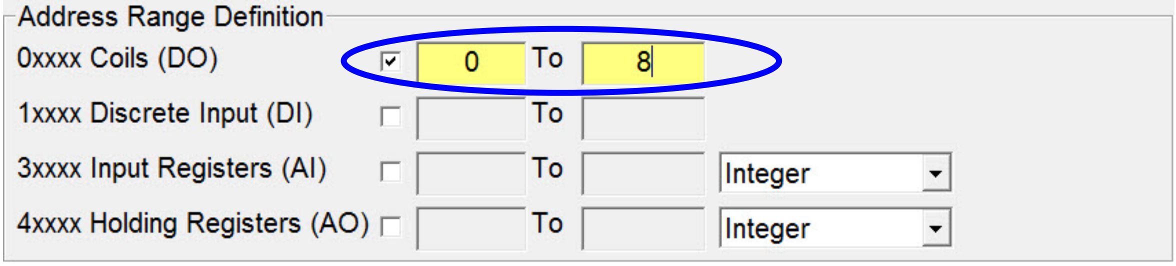
Step 8: Repeat the procedure described in Step 6 and 7 to add the details for AO, DI and DO channels to the Channel List using the details illustrated in the images below.



Address Range Definition
0xxxx Coils (DO) ☐ To
1xxxx Discrete Input (DI) ☐ To
3xxxx Input Registers (AI) ☐ To Integer
4xxxx Holding Registers (AO) ☑ 0 To 7 Integer

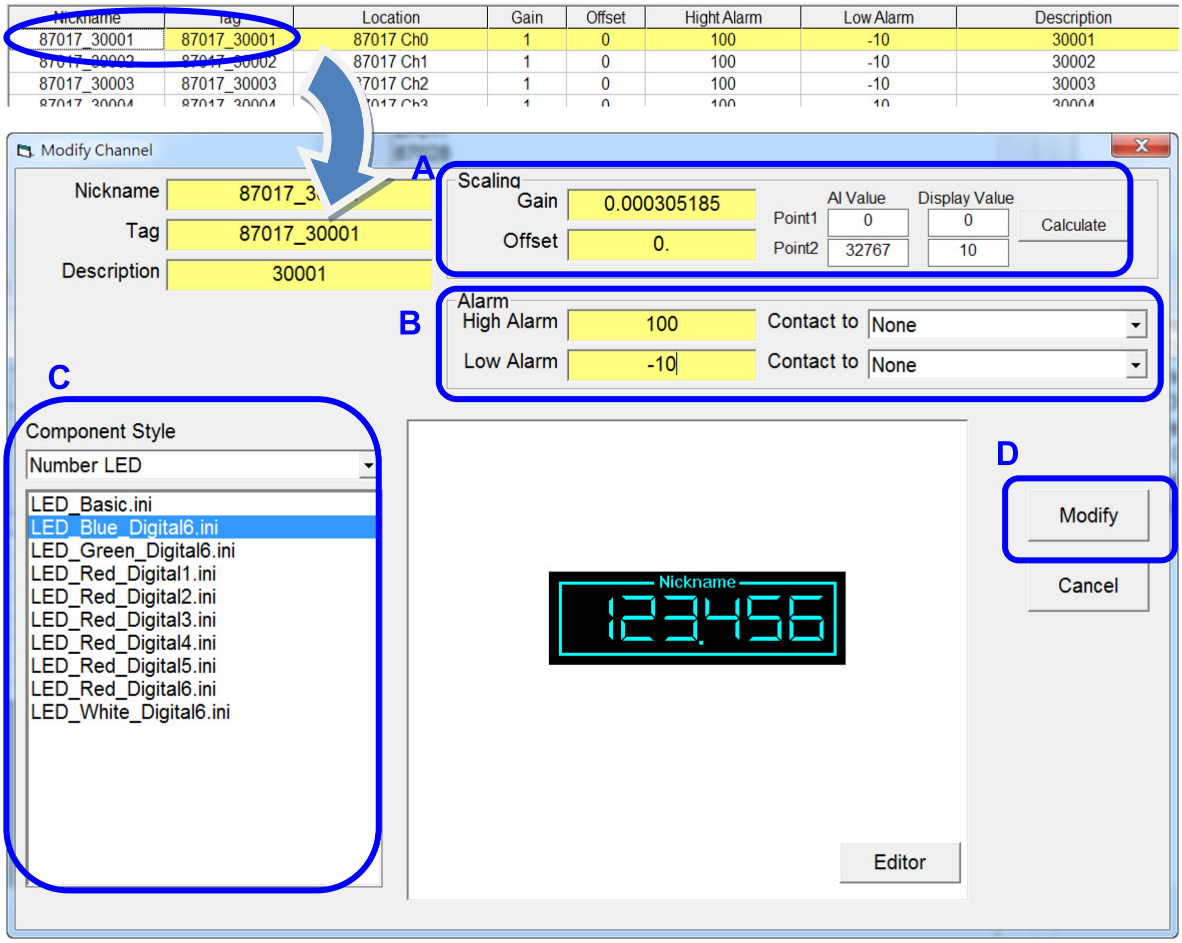


Address Range Definition
0xxxx Coils (DO) ☐ To
1xxxx Discrete Input (DI) ☑ 0 To 16
3xxxx Input Registers (AI) ☐ To Integer
4xxxx Holding Registers (AO) ☐ To Integer



Address Range Definition
0xxxx Coils (DO) ☑ 0 To 8
1xxxx Discrete Input (DI) ☐ To
3xxxx Input Registers (AI) ☐ To Integer
4xxxx Holding Registers (AO) ☐ To Integer

Step 9: The output style for the component and the alarms for a channel can be edited by double-clicking the Nickname of the channel in the Channel List to open the “Modify Channel” dialog box. The example illustrated below uses AI channel 0. The AO, DI and DO channels can be edited in the same way.



Nickname	Tag	Location	Gain	Offset	Hight Alarm	Low Alarm	Description
87017_30001	87017_30001	87017 Ch0	1	0	100	-10	30001
87017_30002	87017_30002	87017 Ch1	1	0	100	-10	30002
87017_30003	87017_30003	7017 Ch2	1	0	100	-10	30003

Modify Channel

Nickname: 87017_3
Tag: 87017_30001
Description: 30001

Scaling
Gain: 0.000305185
Offset: 0.

	AI Value	Display Value
Point1	0	0
Point2	32767	10

Alarm
High Alarm: 100 Contact to: None
Low Alarm: -10 Contact to: None

Component Style: Number LED

- LED_Basic.ini
- LED_Blue_Digital6.ini
- LED_Green_Digital6.ini
- LED_Red_Digital1.ini
- LED_Red_Digital2.ini
- LED_Red_Digital3.ini
- LED_Red_Digital4.ini
- LED_Red_Digital5.ini
- LED_Red_Digital6.ini
- LED_White_Digital6.ini

Configure the properties for the channel in the “Modify Channel” dialog box.

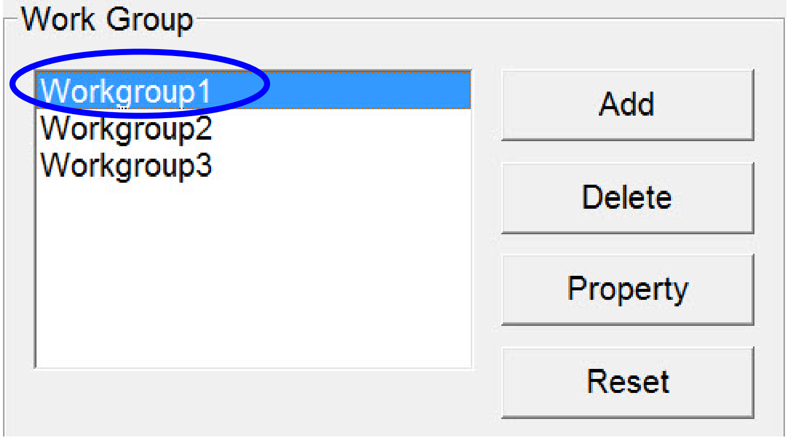
A. To get the Gain and Offset values, enter a Value for Point 1 and Point 2 and then click the “Calculate” button in the “Scaling” section.

B. Set the High and Low alarm values in the “Alarm” section. These values will be used to notify the System Administrator of any abnormal events if the “MailNotifier” driver has been enabled. The procedure for enabling the “MailNotifier” function can be downloaded from: http://ftp.icpdas.com/pub/cd/8000cd/napdos/driver/ez_data_logger/faq_en/ezdl1-003-03_how_to_set_alarm_notifies_by_sending_email_en.pdf

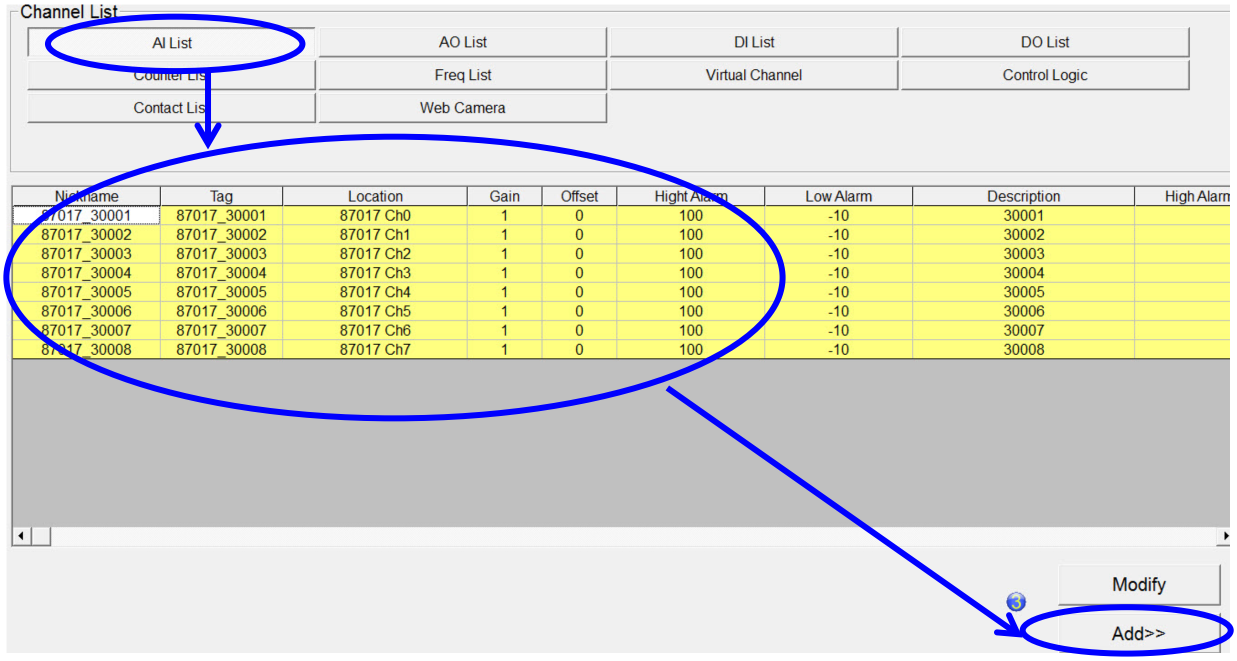
C. Select the desired style to be used for AI channel 0 from the “Component Style” section.

D. Click the “Modify” button to save the modified configuration.

Step 10: Click the “Workgroup1” entry in the “Work Group” section to highlight it. This ensures that all I/O channels selected later in the procedure will be added to the Channel List for the “Workgroup1”.

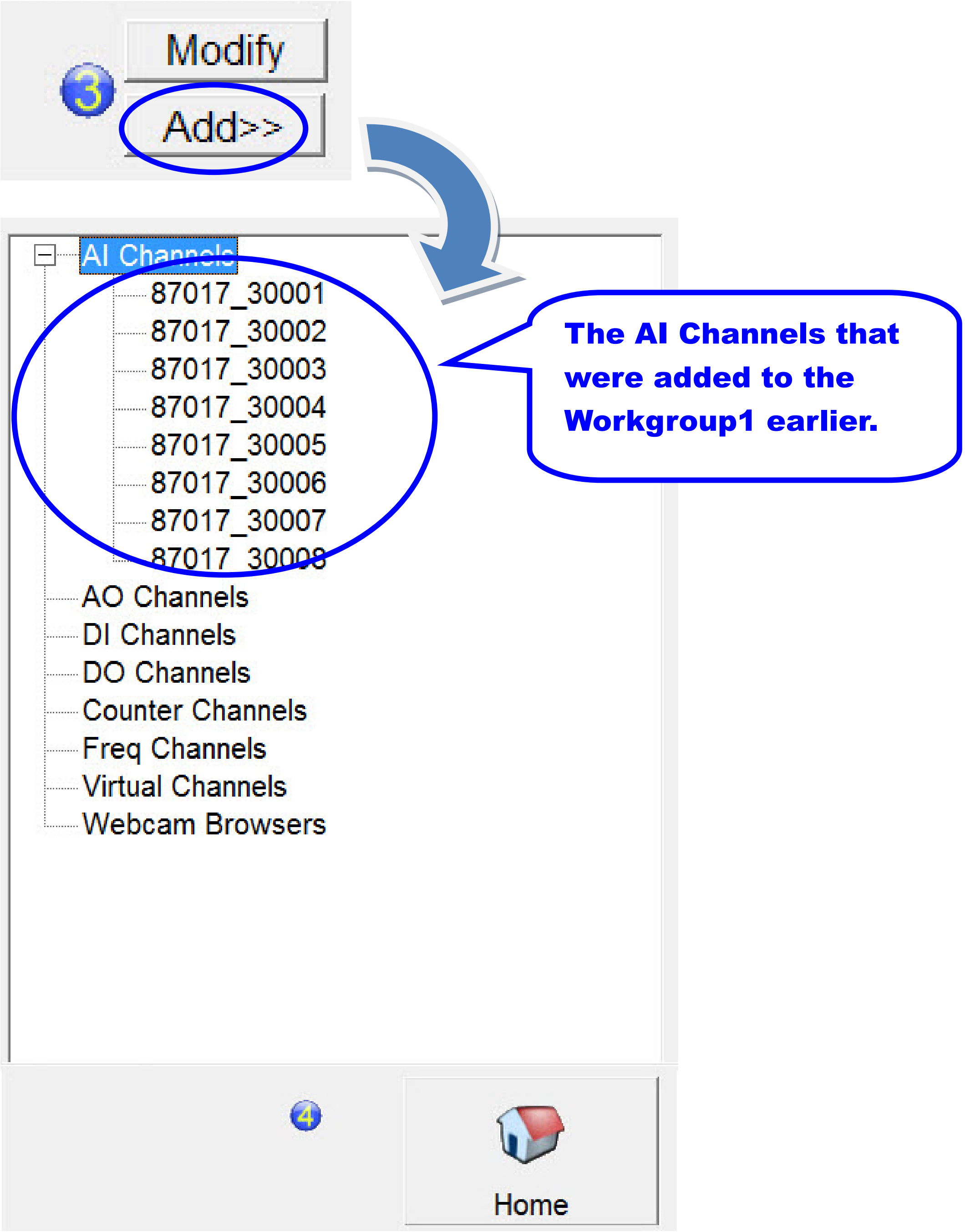


Step 11: Click the “AI List” button in the “Channel List” section to display the AI channels that were configured earlier. Select all AI channels and then click the “Add>>” button.



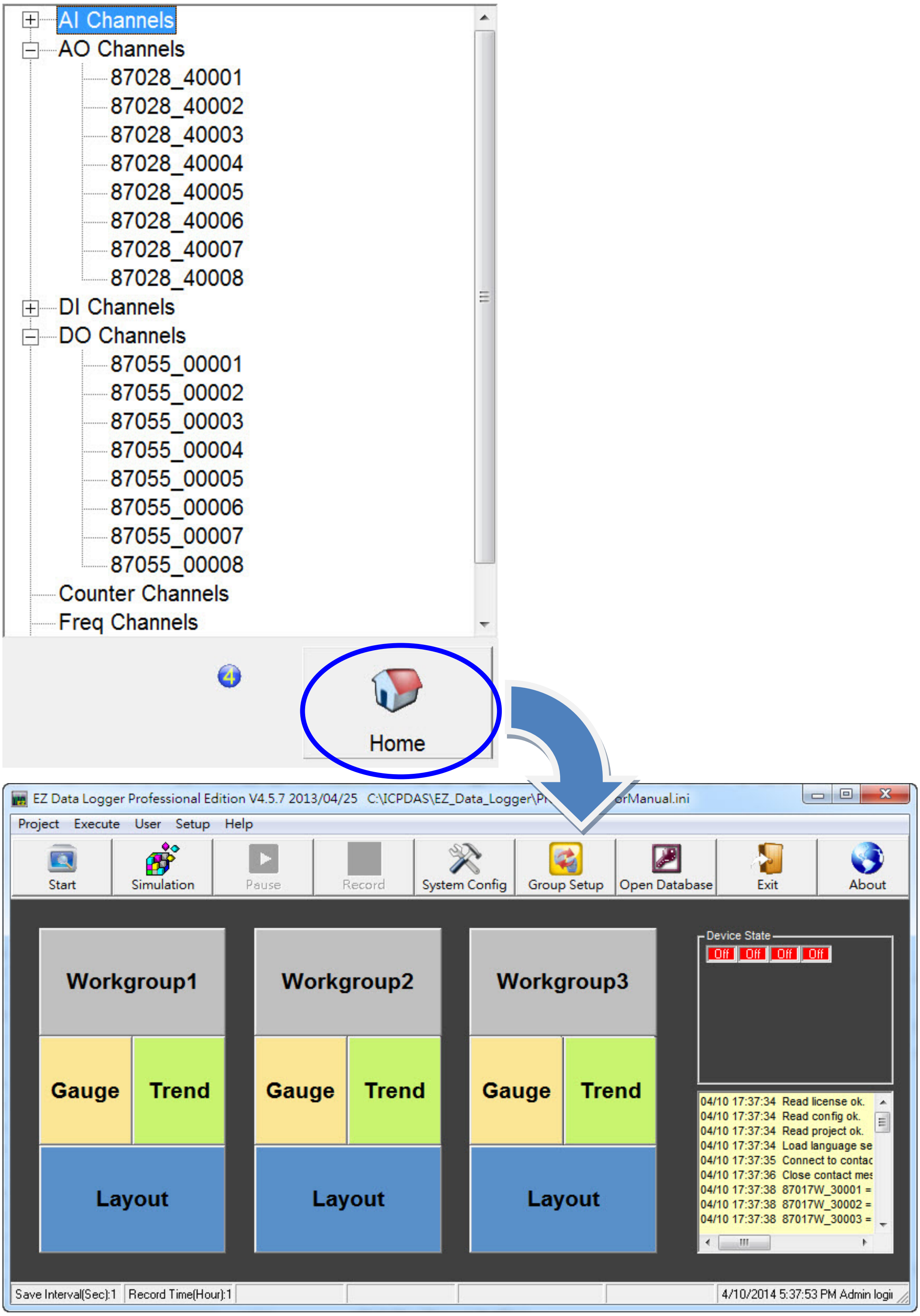
Nickname	Tag	Location	Gain	Offset	Hight Alarm	Low Alarm	Description	High Alarm
87017_30001	87017_30001	87017 Ch0	1	0	100	-10	30001	
87017_30002	87017_30002	87017 Ch1	1	0	100	-10	30002	
87017_30003	87017_30003	87017 Ch2	1	0	100	-10	30003	
87017_30004	87017_30004	87017 Ch3	1	0	100	-10	30004	
87017_30005	87017_30005	87017 Ch4	1	0	100	-10	30005	
87017_30006	87017_30006	87017 Ch5	1	0	100	-10	30006	
87017_30007	87017_30007	87017 Ch6	1	0	100	-10	30007	
87017_30008	87017_30008	87017 Ch7	1	0	100	-10	30008	

After clicking the “Add>>” button, the selected channels will be added to the channel list panel for Workgroup1, as shown in the following figure. These channels will be used for monitoring purposes later.



The AI Channels that were added to the Workgroup1 earlier.

Step 12: Repeat the procedure described in Step 10 and 11 to add the other I/O channels to the channel list for Workgroup1. After all channels have been added, click the “Home” button to return to the main page.

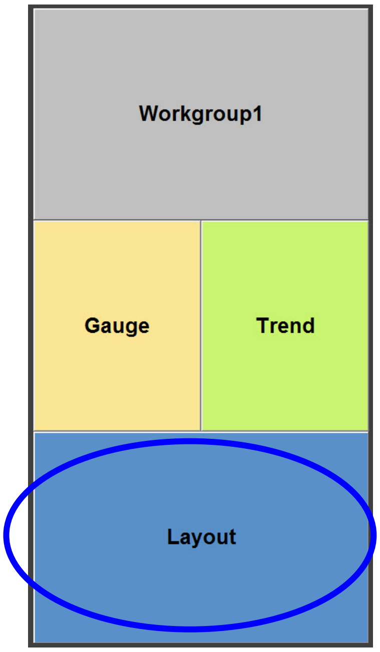


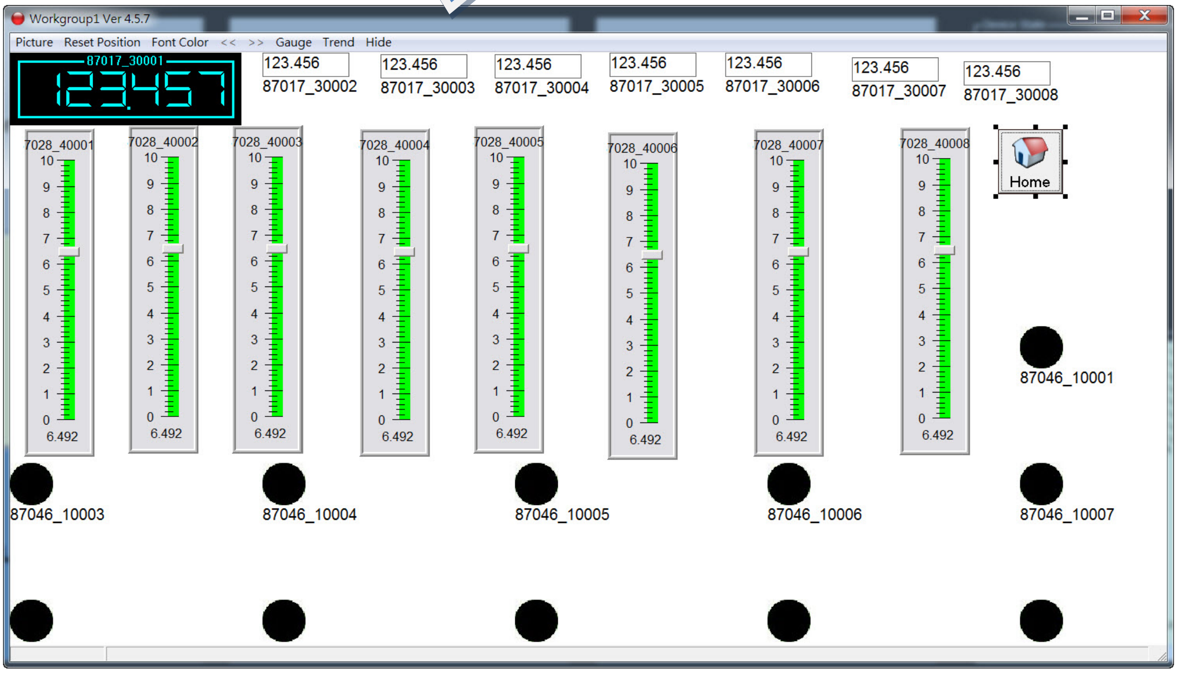
```
04/10 17:37:34  Read license ok.
04/10 17:37:34  Read config ok.
04/10 17:37:34  Read project ok.
04/10 17:37:34  Load language se
04/10 17:37:35  Connect to contac
04/10 17:37:36  Close contact mes
04/10 17:37:38  87017W_30001 =
04/10 17:37:38  87017W_30002 =
04/10 17:37:38  87017W_30003 =
```

3.3.2. Designing the Layout and Acquiring Data

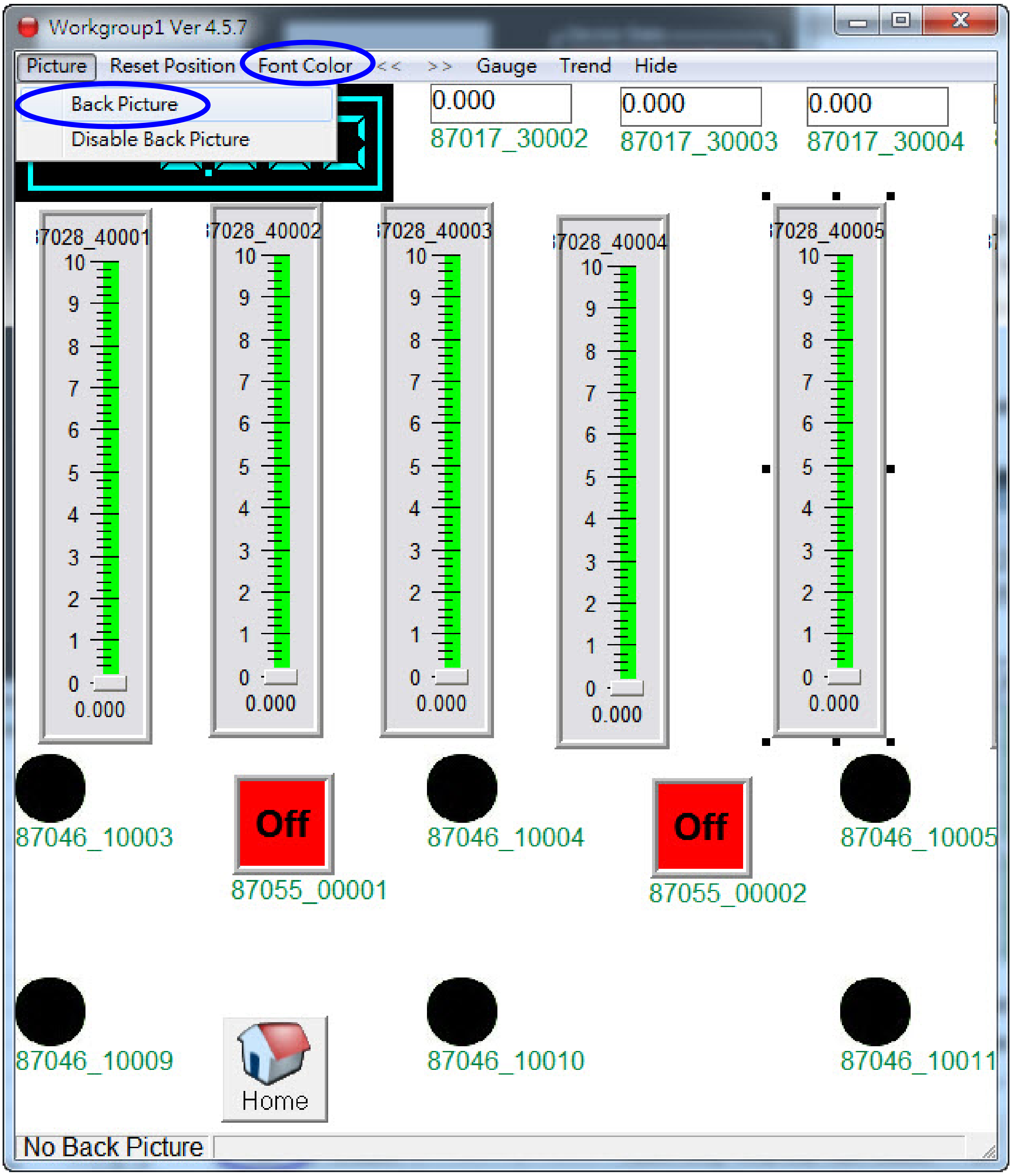
Once the configuration process described in Section3.3.1 has been completed, the layout of the interface can be adjusted and the data can be acquired.

Step 1: To adjust the layout of the interface, click the "Layout" button for "Workgroup1" on the main page of the EZ Data Logger.

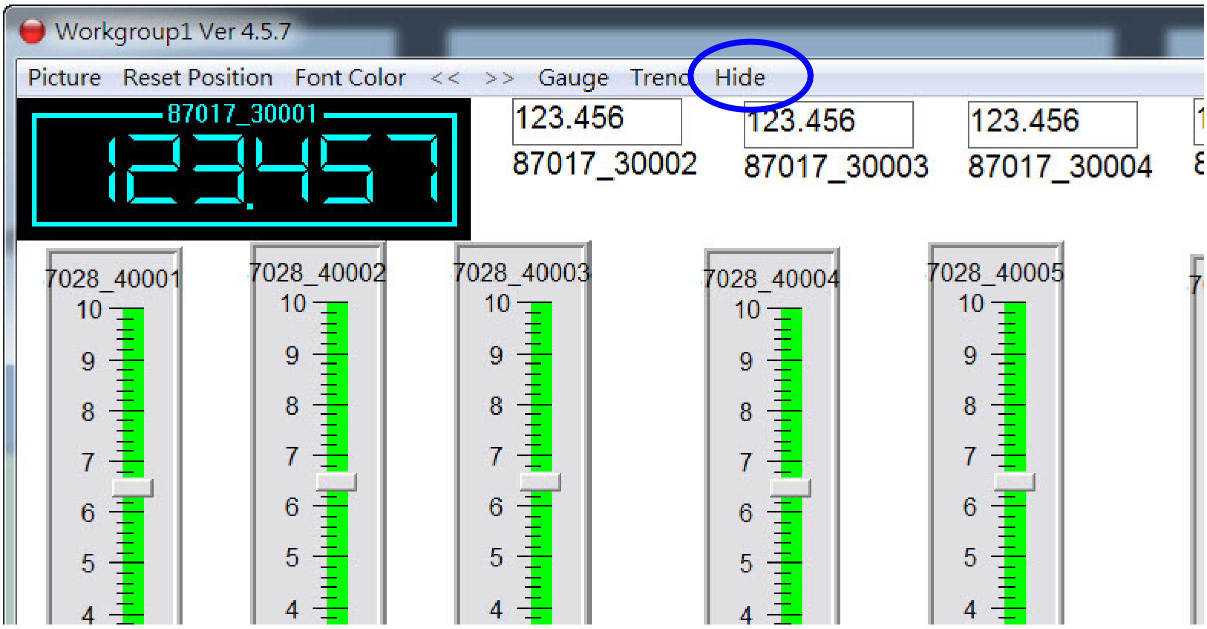




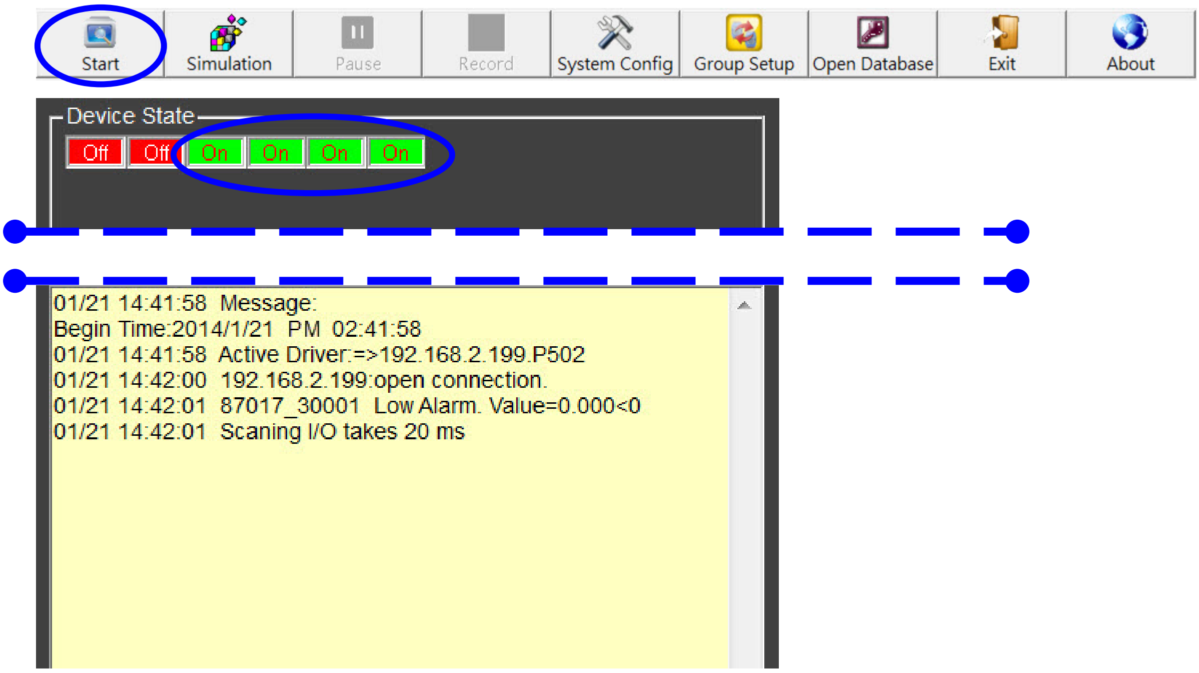
Step 2: The layout of the interface can be designed by dragging the relevant I/O objects to the desired position on the form. A background image can be added by clicking the “Back Picture” item in the “Picture” menu, or the color of the font can be changed by clicking the “Font Color” menu.



Step 3: After the interface design is complete, click the “Hide” menu item to close the design window.

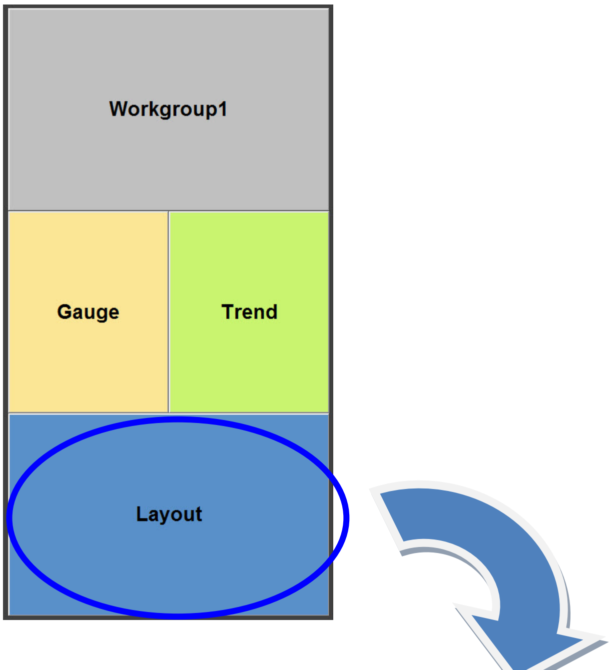


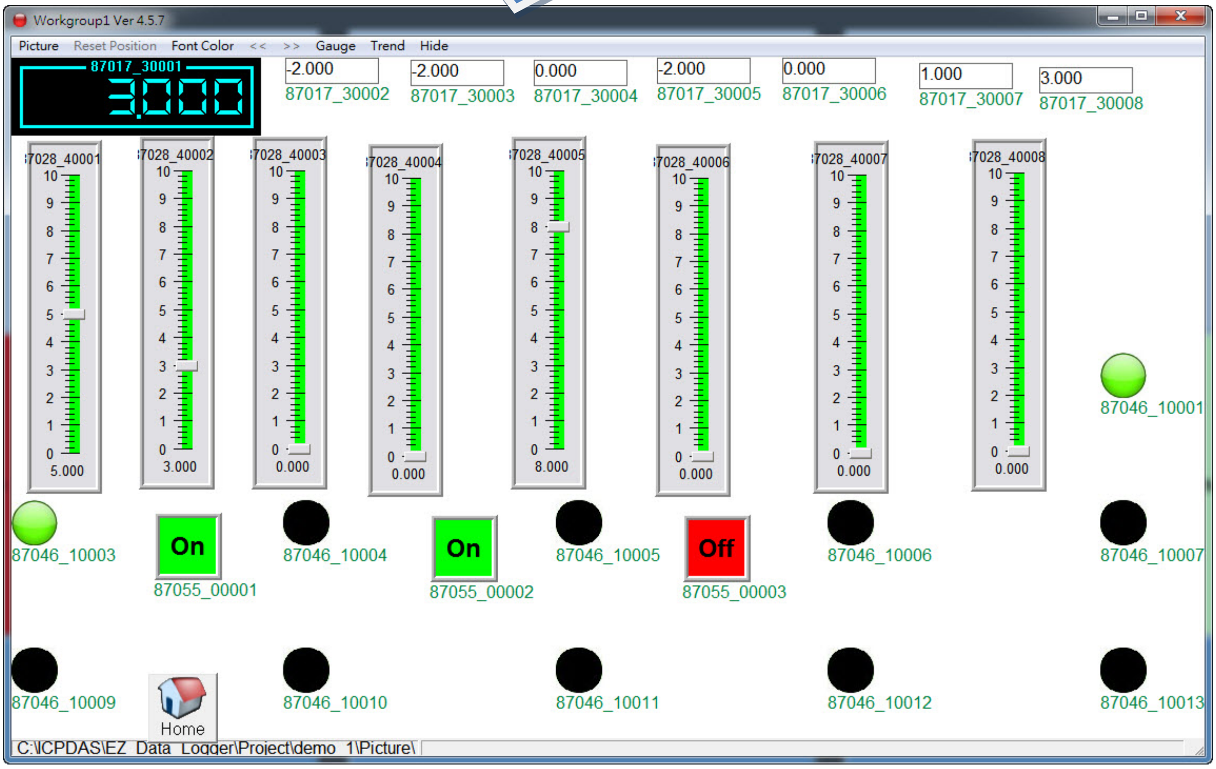
Step 4: Click the “Start” button on the main toolbar to establish a connection to the controller and begin acquiring data. Once a connection has been successfully established, the device state indicators will change to “ON” and the connection status messages will be displayed in the yellow message filed.



```
01/21 14:41:58  Message:
Begin Time:2014/1/21  PM  02:41:58
01/21 14:41:58  Active Driver:=>192.168.2.199.P502
01/21 14:42:00  192.168.2.199:open connection.
01/21 14:42:01  87017_30001  Low Alarm. Value=0.000<0
01/21 14:42:01  Scaning I/O takes 20 ms
```

Step 5: To acquire the I/O data, click either of the “Gauge”, “Trend” or “Layout” buttons. In the example illustrated below, the “Layout” button has been clicked, and the values for the relevant modules is displayed interface design window.





Appendix A: Backing Up and Restoring the EEPROM Settings

The EEPROM is a memory component that is used to store network, system, COM port and module configuration information .The Back Up/Restore functions could be used to restore configuration information for a controller where the data has been lost and can also be used to duplicate EEPROM data from one controller to another.

The size of the EEPROM is different in every controller and each block in the EEPROM stores different types of data. The following table provides an overview of the writable blocks and the reserved blocks. The writable blocks contains information related to the library version, COM port configuration, watchdog timer, module settings, and the reserved blocks contains details of the IP address, Mask, Gateway and MAC address.

Controller	Writable Blocks	Reserved Blocks	Number of Blocks
I-8000	1-7	0	8 (blocks 0-7)
IP-8000	8-14	0-7	64 (blocks 0-63)
7188E	1-7	0	8 (blocks 0-7)

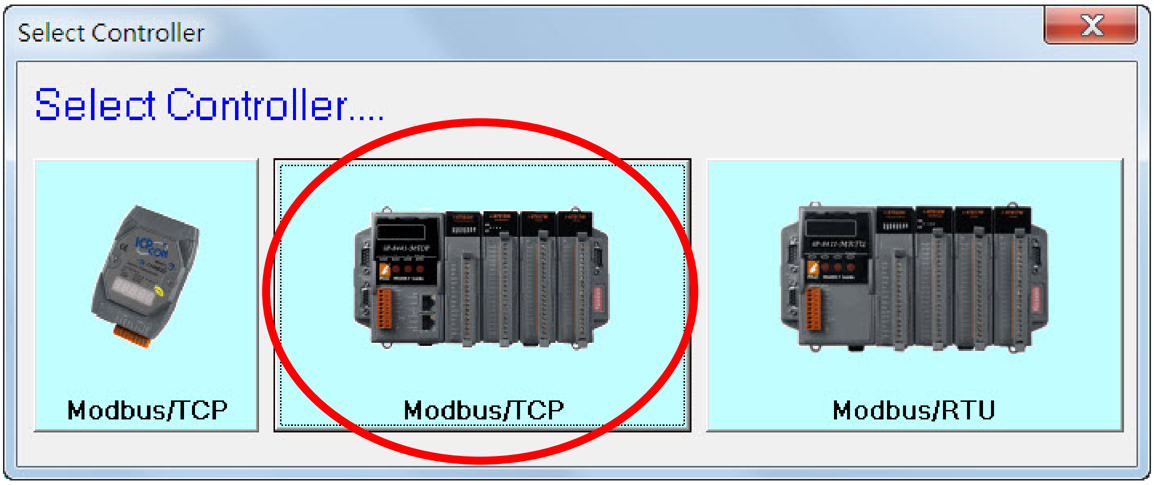
Note 1: Before attempting to read or write EEPROM data, ensure that the version number of the I/O Scan Library is 1.6.0 or later.

Note 2: This function only supports connections via the COM port. Before attempting to perform this function, ensure that COM1 on the controller is connected to the computer.

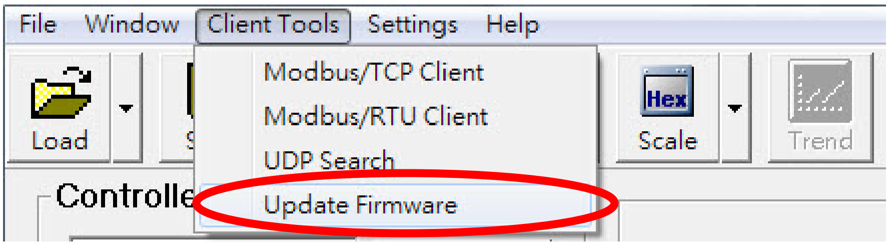
1. Backing up the Settings

Step 1: Reboot the controller in INIT mode.
For I-8000 modules, short the INIT* and INIT*COM pins.
For IP-8000 modules, move the DIP switch to the "Init" position.
For 7188E devices, short the INIT* and GND pins.

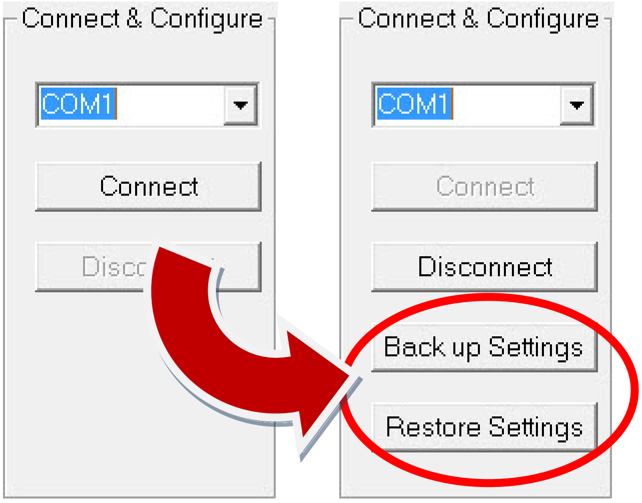
Step 2: Execute the Modbus Utility and select Modbus/TCP controller mode.



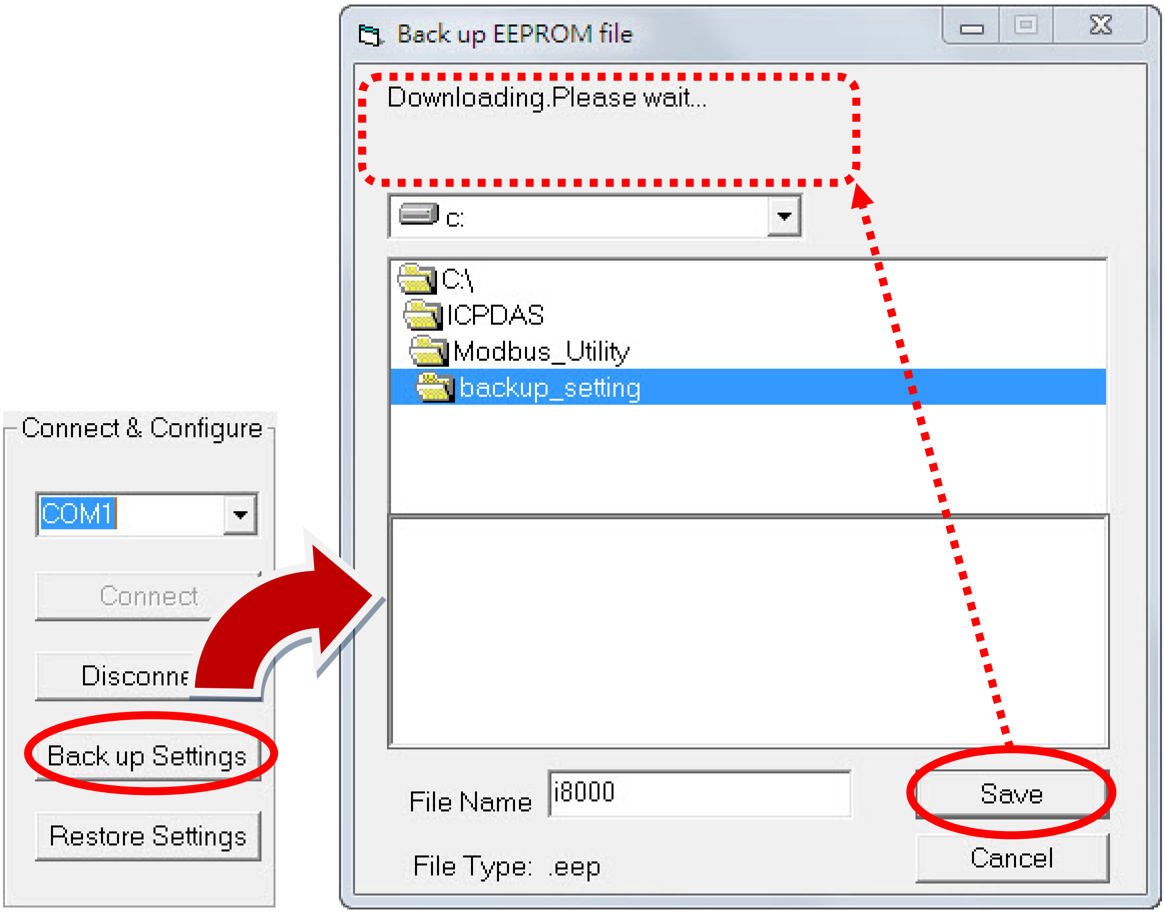
Step 3: Select the "Update Firmware" option from the "Client Tools" menu to connect to the controller.



Select the COM port from the drop-down menu and then click the “Connect” button. Once a connection is established, the “Back up Settings” and “Restore Settings” buttons will be displayed.



Step 4: Click the “Back up Settings” button and the “Back up EEPROM file” dialog box will be displayed. Click the "Save" button to save the current configuration of the controller to the default root folder named “backup_setting”. The status message "Downloading. Please wait..." will be displayed while the file is being saved.

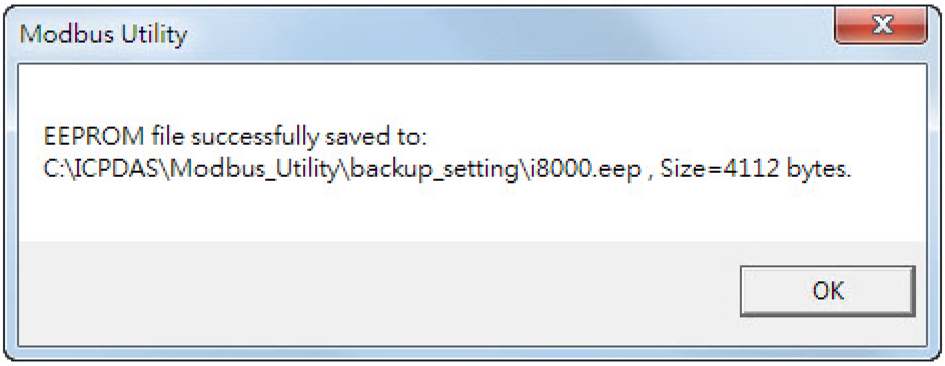


Downloading.Please wait...

File Name i8000

File Type: .eep

Once the download is complete, a message will be displayed to notify that the file was saved successfully. Click the "OK" button to continue.

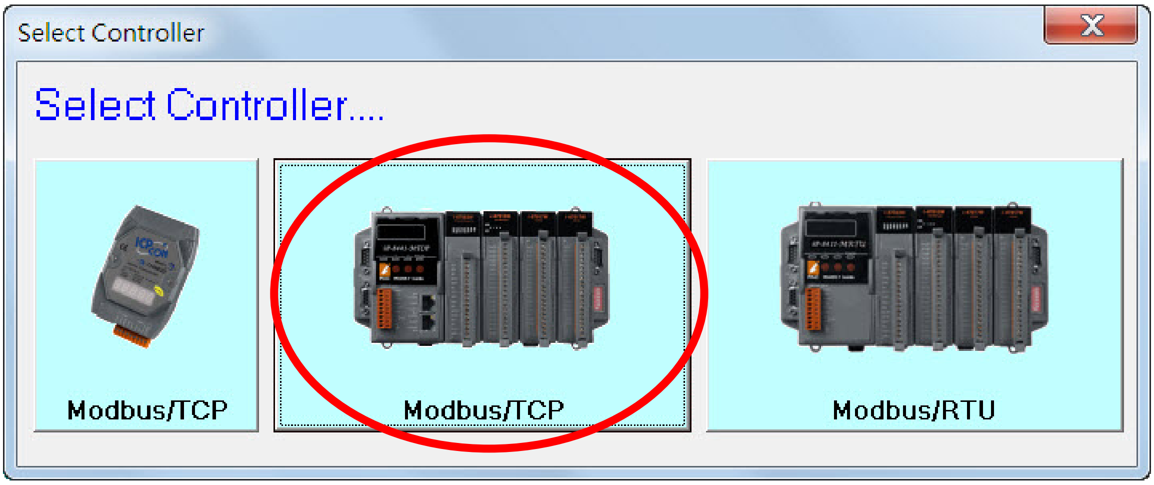


EEPROM file successfully saved to:
C:\ICPDAS\Modbus_Utility\backup_setting\i8000.eep , Size=4112 bytes.

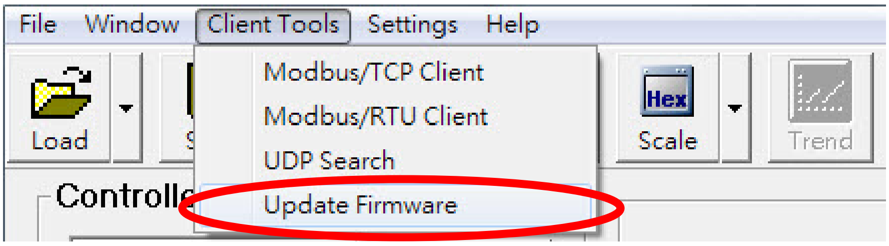
2. Restoring the Settings

Step 1: Reboot the controller in INIT mode.
For I-8000 modules, short the INIT* and INIT*COM pins.
For IP-8000 modules, move the DIP switch to the “Init” position.
For 7188E devices, short the INIT* and GND pins.

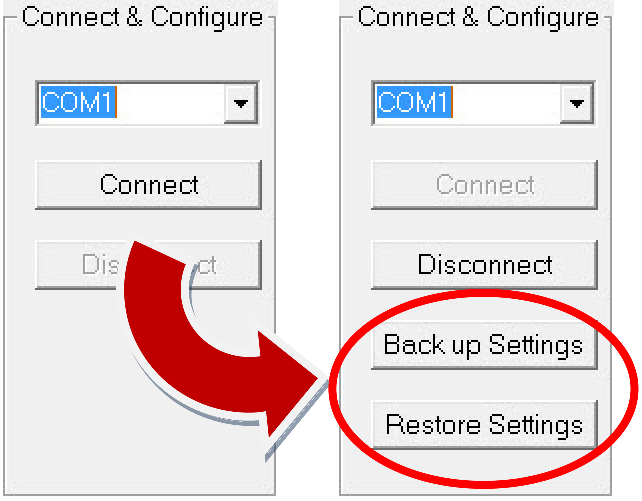
Step 2: Execute the Modbus Utility and select the Modbus/TCP controller mode.



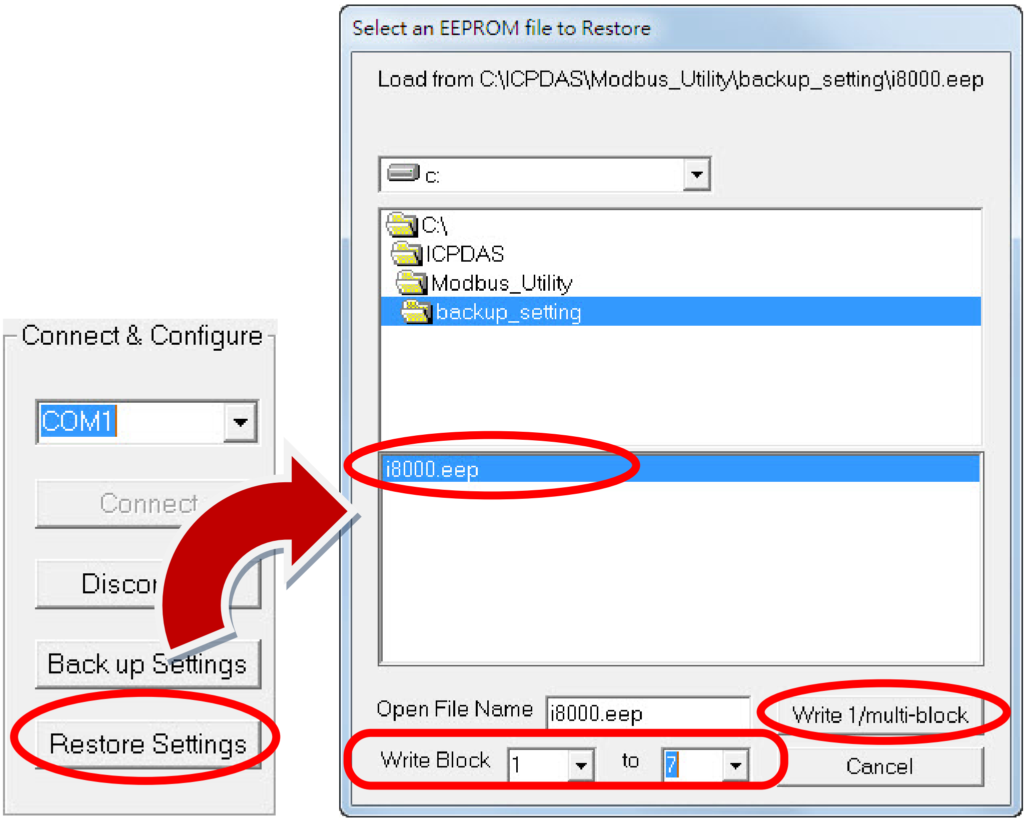
Step 3: Select the “Update Firmware” option from the “Client Tools” menu to connect to the controller.



Select the COM port from the drop-down menu and then click the “Connect” button. Once a connection is established, the “Back up Settings” and “Restore Settings” buttons will be displayed.



Step 4: To configure a controller to the same settings as another, click the “Recover Settings” button and the "Select an EEPROM file to Restore" dialog box will be displayed. Click the name of the file that contains the configuration to be uploaded, and then select the blocks to be duplicated from the "Write Block" drop-down menus. Click the "Write 1/multi-block" button to write the configuration to the EEPROM.

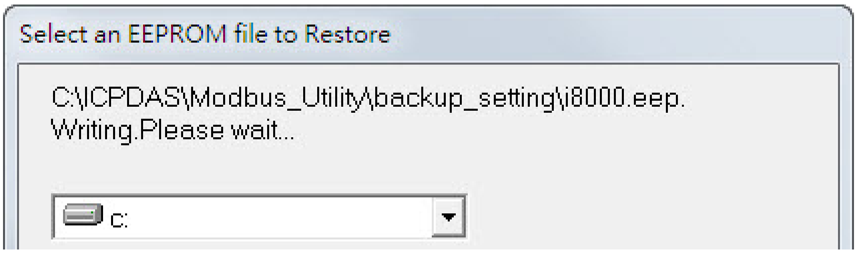


Load from C:\ICPDAS\Modbus_Utility\backup_setting\i8000.eep

Open File Name i8000.eep

Write Block 1 to 7

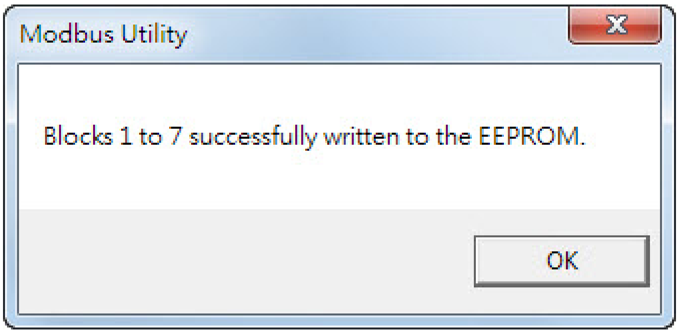
The status message "Writing. Please wait..." will be displayed while the configuration is being duplicated.



Select an EEPROM file to Restore

C:\ICPDAS\Modbus_Utility\backup_setting\i8000.eep.
Writing.Please wait...

Once the duplication process is complete, a message will be displayed to notify that the file was written successfully. Click the "OK" button to continue.



Modbus Utility

Blocks 1 to 7 successfully written to the EEPROM.

Appendix B: Function Codes (FC)

All data addresses in a Modbus message **start at zero** and are transmitted **in hexadecimal** format. For example:

A. Input register 30001 is addressed as 0 in the data address field of the Modbus message.

B. Coil 24 (decimal) in an I/O module is addressed as coil 0017 (hexadecimal) in the Modbus message (Equivalent to 23 in decimal.).

As the function code already specifies whether the operation is DO, DI, AO or AI, the references '0xxxx, 1xxxx, 4xxxx, 3xxxx' are implicit. Function codes are used in both the Modbus RTU Master Tool and the Modbus TCP Client Tool.

1. Read DO (0xxxx)

Function Code 01=Read Coil Status

Request							
Byte		0	1	2	3	4	5
		Net ID	FC=01	Starting Address		Bit Count	
Example: Net ID = 20(*1), Read Coils 18-30(*2)	Hex	14	1	0	11	0	D
	Command		14 1 0 11 0 D				

Response					
Byte	0	1	2	3	~Byte Count+2
	Net ID	FC=01	Byte Count	Bits Values	
Response	14	01	2(*3)	5C (Coils 25-18)	1B (Coils 30-26)
Binary				0101 1100(*4)	0001 1011(*5)

*1: Net ID decimal 20 = hexadecimal 14.

*2: Coils 18-30 are addressed as 17-29 (decimal), with a total of 13 coils in Modbus.

*3: If the number of coils returned isn't a multiple of 8, the remaining bits in the last byte will be filled with 0.

*4: 5C= 0101 1100 refers to coils 18 to 25 (from right to left). The status values are: OFF (25), ON (24), OFF (23), ON (22), ON (21), ON (20), OFF (19), OFF (18).

*5: 1B= 0001 1011, refers to coils 26 to 30 (from right to left). The status values are: ON (30), ON (29), OFF (28), ON (27), ON (26).

2. Read DI (1xxxx)

Function Code 02=Read Input Status

Request							
Byte		0	1	2	3	4	5
		Net ID	FC=02	Starting Address		Bit Count	
Example: Net ID = 1, Read the status of inputs 1-8(*1)	Hex	1	2	0	0	0	8
	Command		1 2 0 0 0 8				

Response					
Byte	0	1	2	3	~Byte Count+2
	Net ID	FC=02	Byte Count	Bits Values	
Response	1	2	1	FF (Coils 8-1)	
Binary				1111 1111(*2)	

*1: Inputs 1-8 are addressed as 0-7 (decimal), there are a total of 8 inputs.

*2: FF=1111 1111, refers to coils 8 to 1 (from right to left), and the status of each coil is set to ON.

3. Read AO (4xxxx)

Function Code 03=Read Holding Registers

Request							
Byte		0	1	2	3	4	5
		Net ID	FC=03	Starting Address		Word Count	
Example: Net ID = 25, Read registers 40027-40028(*1)	Hex	19	3	0	1A	0	2
	Command	19 3 0 1A 0 2					

Response							
Byte	0	1	2	3		~Byte Count+2	
	Net ID	FC=03	Byte Count	Register Values			
Response	19	3	4	2	17	0	C8
Register				40027(*2)		40028(*2)	

*1: Holding registers 40027-40028 are addressed as 26-27 in Modbus.

*2: The value of register 40027 is shown as a 2-byte value: 02 17 (hexadecimal) = 535 (decimal), the value of register 40028 is 00 C8 (hexadecimal) = 200 (decimal). For details of how to convert these values to float format, see Appendix C: Range Codes for Analog Modules.

4. Read AI (3xxxx)

Function Code 04=Read Input Registers

Request							
Byte		0	1	2	3	4	5
		Net ID	FC=04	Starting Address		Word Count	
Example: Net ID = 2, Read registers 30001-30002(*1)	Hex	2	4	0	0	0	2
	Command	2 4 0 0 0 2					

Response							
Byte	0	1	2	3		~Byte Count+2	
	Net ID	FC=04	Byte Count	Register Values			
Response	2	4	4	0	0	0	64
Register				30001(*2)		30002(*2)	

*1: Input registers 30001-30002 are addressed as 0-1 in Modbus.

*2: The value of register 30001 is shown as a 2-byte value: 00 00 (hexadecimal) = 0 (decimal), the value of register 30002 is 00 64 (hexadecimal) = 100 (decimal). For details of how to convert these values to float format, see Appendix C: Range Codes for Analog Modules.

5. Write Single DO (0xxxx)

Function Code 05=Write Single Coil

Request							
Byte		0	1	2	3	4	5
		Net ID	FC=05	Write Address		FF 00=ON, 00 00=OFF	
Example: Net ID = 1, set coil 5 to ON(*1)	Hex	1	5	0	4	FF	0
	Command	1 5 0 4 FF 0					

Response						
Byte	0	1	2	3	4	5
	Net ID	FC=05	Write Address		FF 00=ON, 00 00=OFF	
Response	1	5	0	4	FF	0
If the request is successful, the function will return an echo of the request.						

*1: Coil 5 is addressed as 4 in Modbus.

A value of FF 00 sets the coil to ON, and a value of 00 00 sets it to OFF. All other values are treated as invalid..

6. Write Single AO (4xxxx)

Function Code 06= Write Single Register

<table>
<tr><th colspan="8">Request</th></tr>
<tr><td colspan="2">Byte</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td colspan="2"></td><td>Net ID</td><td>FC=06</td><td colspan="2">Write Address</td><td colspan="2">Register Value</td></tr>
<tr><td rowspan="2">Example: Net ID = 1, set register 40003(*1) to 155(*2)</td><td>Hex</td><td>1</td><td>6</td><td>0</td><td>2</td><td>0</td><td>9B</td></tr>
<tr><td>Command</td><td colspan="6">1 6 0 2 0 9B</td></tr>
<tr><th colspan="8">Response</th></tr>
<tr><td colspan="2">Byte</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td colspan="2"></td><td>Net ID</td><td>FC=06</td><td colspan="2">Write Address</td><td colspan="2">Register Value</td></tr>
<tr><td colspan="2">Response</td><td>1</td><td>6</td><td>0</td><td>4</td><td>0</td><td>9B</td></tr>
<tr><td colspan="8">If the request is successful, the function will return an echo of the request.</td></tr>
</table>

*1: Register 40003 is addressed as 2 in Modbus.

*2: Register value 155 = 9B (hexadecimal).

7. Write DO (0xxxx)

Function Code 15=Write Multiple Coils

Request									
Byte	0	1	2	3	4	5	6	7	~Byte Count+6
	Net ID	FC=15	Write Address		Bit Count		Byte Count	Data to be Written	
Hex	1	F	0	0	0	C	2	FE(*2)	05(*2)
Example: Net ID = 1, write coils 1 to 12(*1)								1111 1110	0000 0101
Command			1 F 0 0 0 C 2 FE 5						

Response						
Byte	0	1	2	3	4	5
	Net ID	FC=15	Write Address		Bit Count	
Response	1	F	0	0	0	C

*1: Coils 1-12 are addressed as 0-11, there are a total of 12 (hexadecimal 0C) coils in Modbus.

*2: The data is a 2-byte value. FE 05 (hexadecimal) = 1111 1110 0000 0101 (binary)

Bit	1	1	1	1	1	1	1	0	0	0	0	0	0	1	0	1
Coil	8	7	6	5	4	3	2	1	-	-	-	-	12	11	10	9

8. Write AO (4xxxx)

Function Code 16= Write Multiple Registers

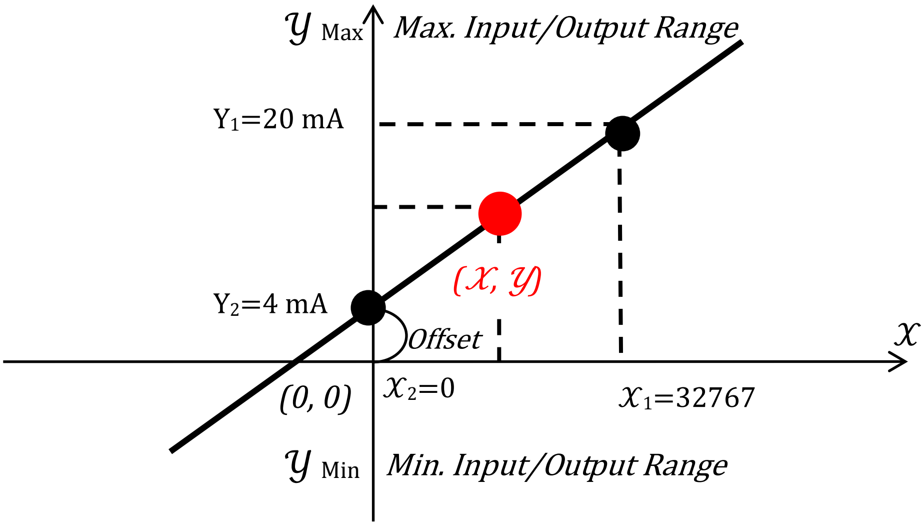
<table>
<tr><th colspan="12">Request</th></tr>
<tr><td>Byte</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td colspan="3">~Byte Count+6</td></tr>
<tr><td></td><td>Net ID</td><td>FC=16</td><td colspan="2">Write Address</td><td colspan="2">Word Count</td><td>Byte Count</td><td colspan="4">Register Values</td></tr>
<tr><td>Hex</td><td>1</td><td>10</td><td>0</td><td>0</td><td>0</td><td>2</td><td>4</td><td>0</td><td>19</td><td>0</td><td>64</td></tr>
<tr><td colspan="4">Example: Net ID = 1, write registers 40001-40002(*1)</td><td colspan="2">Command</td><td colspan="6">1 10 0 0 0 2 4 0 19 0 64</td></tr>
</table>

<table>
<tr><th colspan="7">Response</th></tr>
<tr><td>Byte</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td></td><td>Net ID</td><td>FC=16</td><td colspan="2">Write Address</td><td colspan="2">Word Count</td></tr>
<tr><td>Response</td><td>1</td><td>10</td><td>0</td><td>0</td><td>0</td><td>2</td></tr>
</table>

*1: Registers 40001-40002 are addressed as 0-1 in Modbus.
The value of register 40001 is 25 (hexadecimal 19), the value of register 40002 is 100 (hexadecimal 64).

Appendix C: Range Codes for Analog Modules

The Modbus Utility can be used to convert the input or output value to float format or other formats. An example of the operation can be seen in step 2 of 2.14 Monitoring.
The formula shown below provides details of the conversion process.



Display Value $\mathcal{Y}$ = (Gain * Memory Value $\mathcal{X}$) + Offset

Gain = $\frac{Y_1 - Y_2}{\mathcal{X}_1 - \mathcal{X}_2}$,the Slope for this Range Code type.(In the above illustration, the output range is 4 to 20mA.)

Memory Value $\mathcal{X}$ = the input or output memory value.

Offset = Y_2-(X_2*Gain), the offset value to compensate for any inaccuracies in the module.

Use I-87028W as an example, the Range code set to 31 (4-20mA), and the output memory value is 2048. What's the display value?

Step1. Calculate the Gain value. Gain= (20-4)/ (32767-0) = 0.000488296
Step2. Calculate the Offset value. Offset = 4-(0*0.000488296) = 4
Step3. Calculate the display value. Display Value $\mathcal{Y}$ = (0.000488296*2048) + 4= 5 mA.

The following tables provide the maximum and minimum values, the Gain, and the Offset for each range code type.

- 87K Analog Modules
    - ■ Current and Voltage Type Definitions
    - ■ Thermocouple Type Definitions
    - ■ RTD (Resistance Temperature Detector) Type Definitions
    - ■ Thermistor Type Definitions
- 8K Modules

1. 87K Analog Modules

1.1. Current and Voltage Type Definitions

Type Code	Type Definitions	Data Format	Max. Value	Min. Value	Gain	Offset
Analog Input Modules						
00	-15 mV to +15 mV	Input Range	+15.0 mV	-15.0 mV	0.00030518	0
		Decimal Units	+32767	-32768		
		2's Complement Hexadecimal Units	7FFF	8000		
01	-50 mV to +50 mV	Input Range	+50.0 mV	-50.0 mV	0.001525902	0
		Decimal Units	+32767	-32768		
		2's Complement Hexadecimal Units	7FFF	8000		
02	-100 mV to +100 mV	Input Range	+100.0 mV	-100.0 mV	0.003051804	0
		Decimal Units	+32767	-32768		
		2's Complement Hexadecimal Units	7FFF	8000		
03	-500 mV to +500 mV	Input Range	+500.0 mV	-500.0 mV	0.015259022	0
		Decimal Units	+32767	-32768		
		2's Complement Hexadecimal Units	7FFF	8000		
04	-1 V to +1V	Input Range	+1.0 V	-1.0 V	0.000030518	0
		Decimal Units	+32767	-32768		
		2's Complement Hexadecimal Units	7FFF	8000		
05	-2.5 V to +2.5 V	Input Range	+2.5V	-2.5V	0.025	0
		Decimal Units	+32767	-32768		
		2's Complement Hexadecimal Units	7FFF	8000		
06[*1]	-20 mA to +20 mA	Input Range	+20.0 mA	-20.0 mA	0.00061036	0
		Decimal Units	+32767	-32768		

Type Code	Type Definitions	Data Format	Max. Value	Min. Value	Gain	Offset
	(With 125 ohms resistor)	2's Complement Hexadecimal Units	7FFF	8000		
07*2	+4 mA to +20 mA	Input Range	+20.0 mA	+4.0 mA	0.00024414	+4
		Decimal Units	+65535	+0		
		2's Complement Hexadecimal Units	FFFF	0000		
08	-10 V to +10 V	Input Range	+10.0 V	-10.0 V	0.00030518	0
		Decimal Units	+32767	-32768		
		2's Complement Hexadecimal Units	7FFF	8000		
09	-5 V to +5 V	Input Range	+5.0 V	-5.0 V	0.00015259	0
		Decimal Units	+32767	-32768		
		2's Complement Hexadecimal Units	7FFF	8000		
0A	-1 V to +1V	Input Range	+1.0 V	-1.0 V	0.000030518	0
		Decimal Units	+32767	-32768		
		2's Complement Hexadecimal Units	7FFF	8000		
0B	-500 mV to +500 mV	Input Range	+500.0 mV	-500.0 mV	0.015259022	0
		Decimal Units	+32767	-32768		
		2's Complement Hexadecimal Units	7FFF	8000		
0C	-150 mV to +150 mV	Input Range	+150.0 mV	-150.0 mV	0.004577706	0
		Decimal Units	+32767	-32768		
		2's Complement Hexadecimal Units	7FFF	8000		
0D*3	-20 mA to +20 mA (with 125 ohm resistor)	Input Range	+20.0 mA	-20.0 mA	0.00061036	0
		Decimal Units	+32767	-32768		
		2's Complement Hexadecimal Units	7FFF	8000		

Type Code	Type Definitions	Data Format	Max. Value	Min. Value	Gain	Offset
1A[*2]	+0 mA to +20 mA	Input Range	+20.0 mA	+0.0 mA	0.00030518	0
		Decimal Units	+65535	+0		
		2's Complement Hexadecimal Units	FFFF	0000		
1B	-150 V to +150 V	Input Range	+150.0 V	-150.0 V	0.0045777	0
		Decimal Units	+32767	-32768		
		2's Complement Hexadecimal Units	7FFF	8000		
1C	-50 V to +50 V	Input Range	+50.0 V	-50.0 V	0.0015259	0
		Decimal Units	+32767	-32768		
		2's Complement Hexadecimal Units	7FFF	8000		
Digital Input/Output, Counter, Frequency, Encoder Modules						
40	Digital Input/ Output	N/A	N/A	N/A	N/A	N/A
50	Counter Mode	N/A	N/A	N/A	N/A	N/A
51	Frequency Mode	N/A	N/A	N/A	N/A	N/A
54	Up/Down Counter Mode	N/A	N/A	N/A	N/A	N/A
55	Pulse Mode	N/A	N/A	N/A	N/A	N/A
56	AB Phase Mode	N/A	N/A	N/A	N/A	N/A
Analog Output Modules						
0, 30	+0 mA to +20 mA	Output Range	+20.0 mA	+0.0 mA	0.00061037	0
		Decimal Units	+32767	+0		
		2's Complement Hexadecimal Units	7FFF	0000		

Type Code	Type Definitions	Data Format	Max. Value	Min. Value	Gain	Offset
		Gain^{-1} = 1638.35				
1, 31	+4 mA to +20 mA	Output Range	+20.0 mA	+4.0 mA	0.000488296	+4
		Decimal Units	+32767	+0		
		2's Complement Hexadecimal Units	7FFF	0000		
		Gain^{-1} = 2047.9375				
2, 32	+0 V to +10 V	Output Range	+10.0 V	+0.0 V	0.000305185	0
		Decimal Units	+32767	+0		
		2's Complement Hexadecimal Units	7FFF	0000		
		Gain^{-1} = 3276.7				
3, 33	-10 V to +10 V	Output Range	+10.0 V	-10.0 V	0.00030518	0
		Decimal Units	+32767	-32768		
		2's Complement Hexadecimal Units	7FFF	8000		
		Gain^{-1} = 3276.75				
4, 34	+0 V to +5 V	Output Range	+5.0 V	+0.0 V	0.00015259	0
		Decimal Units	+32767	0		
		2's Complement Hexadecimal Units	7FFF	0000		
		Gain^{-1} = 6553.4				
5, 35	-5 V to +5 V	Output Range	+5.0 V	-5.0 V	0.00015259	0
		Decimal Units	+32767	-32768		
		2's Complement Hexadecimal Units	7FFF	8000		
		Gain^{-1} = 6553.4				
6, 36	+0 V to +20 V	Output Range	+20.0 V	+0.0 V	0.00061037	0
		Decimal Units	+32767	0		
		2's Complement Hexadecimal Units	7FFF	0000		

Type Code	Type Definitions	Data Format	Max. Value	Min. Value	Gain	Offset
		$Gain^{-1}$ = 1638.35				

Notes

*1: When I-87018 and I-87018R are connecting to a current source set to the 06 type code, an optional external 125 Ohms resistor is required.

*2: I-87017RC has built-in 125 Ohms resistors for each channel. When connecting to a current source, no add any external resistors required.

*3: When I-87017 and I-87017R are connecting to a current source set to 0D type code, an optional external 125 Ohms resistor is required. On the other hand, I-87017RC has built-in 125 Ohms resistors for each channel, so require no external resistors.

1.2. Thermocouple Type Definitions

Type Code	Thermocouple Type	Data Format	Max. Value	Min. Value	Gain	Offset
0E	J Type	Input Range (Celsius)	+760.0	-210.0	0.023194089	0
		Decimal Units	+32767	-9054		
		2's Complement Hexadecimal Units	7FFF	DCA2		
0F	K Type	Input Range (Celsius)	+1372.0	-270.0	0.0418717327	0
		Engineer Units	+32767	-6448		
		2's Complement Hexadecimal Units	7FFF	E6D0		
10	T Type	Input Range (Celsius)	+400.0	-270.0	0.0122073426	0
		Decimal Units	+32767	-22118		
		2's Complement Hexadecimal Units	7FFF	A99A		
11	E Type	Input Range (Celsius)	+1000.0	-270.0	0.030518575	0
		Decimal Units	+32767	-8847		
		2's Complement Hexadecimal Units	7FFF	DD71		
12	R Type	Input Range (Celsius)	+1768.0	+0.0	0.0539567247	0
		Decimal Units	+32767	+0		
		2's Complement Hexadecimal Units	7FFF	0000		
13	S Type	Input Range (Celsius)	+1768.0	+0.0	0.0539567247	0
		Decimal Units	+32767	+0		
		2's Complement Hexadecimal Units	7FFF	0000		

Type Code	Thermocouple Type	Data Format	Max. Value	Min. Value	Gain	Offset
14	B Type	Input Range (Celsius)	+1820.0	+0.0	0.0555436872	0
		Decimal Units	+32767	+0		
		2's Complement Hexadecimal Units	7FFF	0000		
15	N Type	Input Range (Celsius)	+1300.0	-270.0	0.0396745173	0
		Decimal Units	+32767	-6805		
		2's Complement Hexadecimal Units	7FFF	E56B		
16	C Type	Input Range (Celsius)	+2320.0	+0.0	0.0708029419	0
		Decimal Units	+32767	+0		
		2's Complement Hexadecimal Units	7FFF	0000		
17	L Type	Input Range (Celsius)	+800.0	-200.0	0.0244146585	0
		Decimal Units	+32767	-8192		
		2's Complement Hexadecimal Units	7FFF	E000		
18	M Type	Input Range (Celsius)	+100.0	-200.0	0.0061035156	0
		Decimal Units	+16384	-32768		
		2's Complement Hexadecimal Units	4000	8000		
19	L Type DIN43710	Input Range (Celsius)	+900.0	-200.0	0.0274670395	0
		Decimal Units	+32767	-7281		
		2's Complement Hexadecimal Units	7FFF	E38F		

1.3. RTD (Resistance Temperature Detector) Type Definitions

Type Code	RTD Type	Data Format	Max. Value	Min. Value	Gain	Offset
20	Platinum 100 a = 0.00385 -100°C to 100°C	Input Range (Celsius)	+100.0	-100.0	0.0030518043	0
		Decimal Units	+32767	-32768		
		2's Complement Hexadecimal Units	7FFF	8000		
		Ohm	+138.5	+60.25		
21	Platinum 100 a = 0.00385 0°C to 100°C	Input Range (Celsius)	+100.0	+0.0	0.0030518509	0
		Decimal Units	+32767	+0		
		2's Complement Hexadecimal Units	7FFF	0000		
		Ohm	+138.5	+100.0		
22	Platinum 100 a = 0.00385 0°C to 200°C	Input Range (Celsius)	+200.0	+0.0	0.0061037018	0
		Decimal Units	+32767	+0		
		2's Complement Hexadecimal Units	7FFF	0000		
		Ohm	+175.84	+100.0		
23	Platinum 100 a = 0.00385 0°C to 600°C	Input Range (Celsius)	+600.0	+0.0	0.0183111056	0
		Decimal Units	+32767	+0		
		2's Complement Hexadecimal Units	7FFF	0000		
		Ohm	+313.59	+100.0		
24	Platinum 100 a = 0.003916 -100°C to 100°C	Input Range (Celsius)	+100.0	-100.0	0.0030518043	0
		Decimal Units	+32767	-32768		
		2's Complement Hexadecimal Units	7FFF	8000		
		Ohm	+139.16	+59.58		

Type Code	RTD Type	Data Format	Max. Value	Min. Value	Gain	Offset
25	Platinum 100 a = 0.003916 0°C to 100°C	Input Range (Celsius)	+100.0	+0.0	0.0030518509	0
		Decimal Units	+32767	+0		
		2's Complement Hexadecimal Units	7FFF	0000		
		Ohm	+139.16	+100.0		
26	Platinum 100 a = 0.003916 0°C to 200°C	Input Range (Celsius)	+200.0	+0.0	0.0061037018	0
		Decimal Units	+32767	+0		
		2's Complement Hexadecimal Units	7FFF	0000		
		Ohm	+177.13	+100.0		
27	Platinum 100 a = 0.003916 0°C to 600°C	Input Range (Celsius)	+600.0	+0.0	0.01831110568	0
		Decimal Units	+32767	+0		
		2's Complement Hexadecimal Units	7FFF	0000		
		Ohm	+317.28	+100.0		
28	Nickel 120 -80°C to 100°C	Input Range (Celsius)	+100.0	-80.0	0.0030518302	0
		Decimal Units	+32767	-26214		
		2's Complement Hexadecimal Units	7FFF	999A		
		Ohm	+200.64	+120.6		
29	Nickel 120 0°C to 100°C	Input Range (Celsius)	+100.0	+0.0	0.0030518509	0
		Decimal Units	+32767	+0		
		2's Complement Hexadecimal Units	7FFF	0000		
		Ohm	+200.64	+120.6		
2A	Platinum	Input Range	+600.0	-200.0	0.0183112453	0

Type Code	RTD Type	Data Format	Max. Value	Min. Value	Gain	Offset
	1000 a =0.00385 -200°C to 600°C	(Celsius)				
		Decimal Units	+32767	-10922		
		2's Complement Hexadecimal Units	7FFF	D556		
		Ohm	+3137.1	+185.2		
2B[*1]	Cu 100 a =0.00421 -20°C to 150°C	Input Range (Celsius)	+150.0	-20.0	0.0045777	0
		Decimal Units	+32767	-4369		
		2's Complement Hexadecimal Units	7FFF	EEEF		
		Ohm	+163.17	+91.56		
2C[*1]	Cu 100 a =0.00421 0°C to 200°C	Input Range (Celsius)	+200.0	+0.0	0.0061037	0
		Decimal Units	+32767	+0		
		2's Complement Hexadecimal Units	7FFF	0000		
		Ohm	+167.75	+90.34		
2D[*1]	Cu 1000 a =0.00421 -20°C to 150°C	Input Range (Celsius)	+150.0	-20.0	0.0045777	0
		Decimal Units	+32767	-4369		
		2's Complement Hexadecimal Units	7FFF	EEEF		
		Ohm	+1631.7	+915.6		
2E[*2]	Pt 100 a =0.00385 -200°C to 200°C	Input Range (Celsius)	+200.0	-200.0	0.0061036	0
		Decimal Units	+32767	-32768		
		2's Complement Hexadecimal Units	7FFF	8000		
		Ohm	+175.84	+18.49		
2F[*2]	Pt 100 a	Input Range (Celsius)	+200.0	-200.0	0.0061036	0

Type Code	RTD Type	Data Format	Max. Value	Min. Value	Gain	Offset
	=0.003916 -200°C to 200°C	Decimal Units	+32767	-32768		
		2's Complement Hexadecimal Units	7FFF	8000		
		Ohm	+177.14	+17.14		
80[*2]	Pt 100 a =0.00385 -200°C to 600°C	Input Range (Celsius)	+600.0	-200.0	0.018311	0
		Decimal Units	+32767	-10922		
		2's Complement Hexadecimal Units	7FFF	D556		
		Ohm	+313.59	+18.49		
81[*2]	Pt 100 a =0.003916 -200°C to 600°C	Input Range (Celsius)	+600.0	-200.0	0.018311	0
		Decimal Units	+32767	-10922		
		2's Complement Hexadecimal Units	7FFF	D556		
		Ohm	+317.28	+17.14		

Notes

*1: Type code 2B, 2C and 2D are only available with I-87015.

*2: Type code 2E, 2F, 80 and 81 are only available with the I-87015 firmware version A1.10 and later, I-87013 firmware version B1.3 and later.

1.4. Thermistor Type Definitions

Type Code	Thermistor Type	Data Format	Max. Value	Min. Value	Gain	Offset
60	Precon ST-A3 -30 to 240 degree Fahrenheit	Input Range (Fahrenheit)	+240.0	-30.0	0.0073244	0
		Decimal Units	+32767	-4096		
		2's Complement Hexadecimal Units	7FFF	F000		
		Ohm	+539.4	+173600.0		
61	Type U Fenwell -50 to 150 degree Celsius	Input Range (Celsius)	+150.0	-50.0	0.004577	0
		Decimal Units	+32767	-10922		
		2's Complement Hexadecimal Units	7FFF	D556		
		Ohm	+37.2	+134020.0		
62	Type U Fenwell 0 to 150 degree Celsius	Input Range (Celsius)	+150.0	+0.0	0.004577	0
		Decimal Units	+32767	+0		
		2's Complement Hexadecimal Units	7FFF	0000		
		Ohm	+37.2	+6530.0		
63	YSI L Mix 100	Input Range (Celsius)	+100.0	-80.0	0.0030518	0
		Decimal Units	+32767	-26214		
		2's Complement Hexadecimal Units	7FFF	999A		
		Ohm	+14.3	+14470.0		
64	YSI L Mix 300	Input Range	+100.0	-80.0	0.0030518	0
		Decimal Units	+32767	-26214		
		2's Complement Hexadecimal Units	7FFF	999A		
		Ohm	+35.8	+67660.0		

Type Code	Thermistor Type	Data Format	Max. Value	Min. Value	Gain	Offset
65	YSI L Mix 1000	Input Range (Celsius)	+100.0	-70.0	0.00305	0
		Decimal Units	+32767	-22937		
		2's Complement Hexadecimal Units	7FFF	A667		
		Ohm	+106.4	+132600.0		
66	YSI B Mix 2252	Input Range (Celsius)	+150.0	-50.0	0.004577	0
		Decimal Units	+32767	-10922		
		2's Complement Hexadecimal Units	7FFF	D556		
		Ohm	+41.8	+151000.0		
67	YSI B Mix 3000	Input Range (Celsius)	+150.0	-40.0	0.004577	0
		Decimal Units	+32767	-8738		
		2's Complement Hexadecimal Units	7FFF	DDDE		
		Ohm	+55.6	+101000.0		
68	YSI B Mix 5000	Input Range (Celsius)	+150.0	-40.0	0.004577	0
		Decimal Units	+32767	-8738		
		2's Complement Hexadecimal Units	7FFF	DDDE		
		Ohm	+92.7	+168300.0		
69	YSI B Mix 6000	Input Range (Celsius)	+150.0	-30.0	0.004577	0
		Decimal Units	+32767	-6553		
		2's Complement Hexadecimal Units	7FFF	E667		
		Ohm	+111.5	+106200.0		
6A	YSI B Mix	Input Range	+150.0	-30.0	0.004577	0

Type Code	Thermistor Type	Data Format	Max. Value	Min. Value	Gain	Offset
	10K	(Celsius)				
		Decimal Units	+32767	-6553		
		2's Complement Hexadecimal Units	7FFF	E667		
		Ohm	+185.9	+177000.0		
6B	YSI H Mix 10K	Input Range (Celsius)	+150.0	-30.0	0.004577	0
		Decimal Units	+32767	-6553		
		2's Complement Hexadecimal Units	7FFF	E667		
		Ohm	+237.0	+135200.0		
6C	YSI H Mix 30K	Input Range (Celsius)	+200.0	-10.0	0.0061037	0
		Decimal Units	+32767	-1638		
		2's Complement Hexadecimal Units	7FFF	F99A		
		Ohm	+186.7	+158000.0		
70-77	User-defined -50 to 150 degree Celsius	Input Range (Celsius)	+150.0	-50.0	0.004577	0
		Decimal Units	+32767	-10922		
		2's Complement Hexadecimal Units	7FFF	D556		
		Ohm	+0.0	+0.0		

2. 8K Modules

Type Code	Type Definitions	Data Format	Max. Value	Min. Value	Gain	Offset
05	-2.5 V to +2.5 V	Input Range	+2.5 V	-2.5 V	0.000076295	0
		Decimal Units	+32767	-32768		
		2's Complement Hexadecimal Units	7FFF	8000		
06	-20 mV to +20 mV	Input Range	+20.0 mV	-20.0 mV	0.00061036	0
		Decimal Units	+32767	-32768		
		2's Complement Hexadecimal Units	7FFF	8000		
07	-1.25 V to +1.25 V	Input Range	+1.25 V	-1.25 V	0.000038147	0
		Decimal Units	+32767	-32768		
		2's Complement Hexadecimal Units	7FFF	8000		
08	-10 V to +10 V	Input Range	+10.0 V	-10.0 V	0.00030518	0
		Decimal Units	+32767	-32768		
		2's Complement Hexadecimal Units	7FFF	8000		
09	-5 V to +5 V	Input Range	+5.0 V	-5.0 V	0.00015259	0
		Decimal Units	+32767	-32768		
		2's Complement Hexadecimal Units	7FFF	8000		
30	+0 mA to +20 mA	Output Range	+20.0 mA	+0.0 mA	0.00061037	0
		Decimal Units	+32767	+0		
		2's Complement Hexadecimal Units	7FFF	0000		
		Gain^{-1} = 1638.35				
33	-10 V to +10 V	Output Range	+10.0 V	-10.0 V	0.00030518	0
		Decimal Units	+32767	-32768		
		2's Complement	7FFF	8000		

Type Code	Type Definitions	Data Format	Max. Value	Min. Value	Gain	Offset
		Hexadecimal Units				
		$\text{Gain}^{-1} = 3276.75$				
80	Mode 0: Pulse/ Direction Counter	Decimal Units	+2147483647	-2147483648	1	0
		2's Complement Hexadecimal Units	7FFFFFFF	80000000		
	Mode 1: Up/Down Counter	Decimal Units	+2147483647	-2147483648	1	0
		2's Complement Hexadecimal Units	7FFFFFFF	80000000		
	Mode 2: Frequency	Decimal Units	450000	0	1	0
		2's Complement Hexadecimal Units	6DDD0	00000000		
	Mode 3: Up Counter	Decimal Units	+4294967295	0	1	0
		2's Complement Hexadecimal Units	FFFFFFFF	00000000		