

Modbus Utility User Manual

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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.

Model	I/O Slots	CPU	SRAM	Flash	Memory Expansion	Ethernet	RS-232 /485
I-8430	4						
I-8830	8	40					
I-8431-MTCP	4	MHz					2
I-8331-MTCP	8		512			1	3
I-8431-80-MTCP	4		KB	512	-	(10BASE-T)	
I-8831-80-MTCP	8			KB			
I-8KE4-MTCP-G	4	80					1
I-8KE8-MTCP-G	8	MHz					1
IP-8441-MTCP	4		768		Micro SD	2	1
IP-8841-MTCP	8		KB		MICIO SD	ے (10/100	4
ET-87P4-MTCP	4					(10/100 BASE-Ty)	1
ET-87P8-MTCP	8	-	-	-	-	DASE-IXJ	1
I-7188EX(D)			512				
-MTCP	-	40	KB		-	1	
I-7188E2(D)		MHz	384	512		(10BASE-T)	
-MTCP	-		KB	KB 217	-		2
µPAC-7186EX(D) -MTCP	-	80 MHz	512 KB	ND	-	1 (10/100 BASE Tri)	
						BASE-IXJ	

This manual applies to following controllers and modules.

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(<u>Section 3.2</u>), EZ Data Logger(<u>Section 3.3</u>), Iconics GENESIS32/64, iFIX, InduSoft Web Studio, LabView, Trace Mode, StruxureWare SCADA Expert Vijeo Citect(<u>Section 3.1</u>), 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. <u>http://www.modbus.org</u>

A community for Modbus users.

B. <u>http://www.modbustools.com/modbus_activex.asp</u>

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.

	DI Mappi	ng Ĭ	DO Ma	ipping	Al Ma	apping [AO	Mapping	Summary	D
Slot	Module	DI (1xxx) address	Points	DO (0xxxx) addre	Points	Al (3xxxx) address	Points	AO (4xxx) addre	Points	
1	1-87005	-	-	-	-	-	-	-	-	
2	I-87028		-	-	-	-	-	00 [00]	8	
3	1-87055	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.



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_s http://ftp.icpdas.com/pub/cd/8000cd/napdos/modbus/8000e/document/mbt8_s http://tp.icpdas.com/pub/cd/8000cd/napdos/modbus/8000e/document/mbt8_s

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.



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.

A	Modbus Utility Ver 1.8.1 Window Client Tools	2014/09/10 Settings Help			×
B	ad Save Mor	nitor Log So	cale Trend Help	Exit	irmware: v1.7.2 [Apr 15 2013]
Ľ	1 9921 NotID-1		DIO Settinge		
	192 168 2 213	Connect	DO Power-on	DO Safe	Value
\frown	152.100.2.210	Connect	h0 □ Ch8 □	Ch16 T Ch24	Set DO Power-on Value
C	Online Mode (Ethernet)	Disconnect	n1 □ Ch9 □	Ch17 T Ch25	The Disitel Output will be east to
\mathbf{i}			□ Ch2 □ Ch10 □	Ch18 T Ch26	the Power-on value when the
	1-97041		□ Ch3 □ Ch11 □	Ch19 T Ch27	controller is first powered on.
	1-87041		□ Ch4 □ Ch12 □	Ch20 T Ch28	
Е			□ Ch5 □ Ch13 □	Ch21 T Ch29	
\checkmark			□ Ch6 □ Ch14 □	Ch22 Ch30	
			□ Ch7 □ Ch15 □	Ch23	
	UI Mapping	UU Mapping	AI Mapping	AO Ma	pping Summary
	Analog Output (4xxxx)				
F	Address N	1odule Slot	Channel Va	lue Comment	
	•		Ш		Þ

- 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.

he Modbus Utility applicat pplication and then restart s Administrator'. Alternativ	on is requesting h it by right-clicking ely, right click the	igher privileg the shortcut applicaiton sh	jes. Close the and choosing 'Run hortcut, and choose
Properties'. Click the 'Comp n administrator' checkbox	atibility' tab and th	en click the '	Run this program as
			ОК
Pight-click the	Aodbus Utili	tv shorta	aut

Open

Run as administrator

Unpin from Start Menu

Remove from this list

Pin to Taskbar

Properties

1

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.

Select Controller.... Select Controller.... Wodbus/TCP Modbus/TCP

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.



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.

Update Firmware	Network Sett	ings Y	Date and Time Settings		
C C	<u> </u>	o. Name	Size	Date	
l∰c/		0 m8e17265.exe	117296	2014/3/4 上午 11:05:50	
		1 autoexec.bat	27	2013/9/16 下午 01:56:00	
Modbus_Utility					
- F6000-MTCP	Upload >>				
	Refresh file list				
autoexec.bat					
m8e17265.exe					
readme.txt					
	Erase Disk			•	

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.

Update Firmware	Network Settings	Date	and Time Settings
Ξc	EraseDisk Confirm	Size	Date
(<u>a</u> c)		117296	2014/3/4 上午 11:05:50
	All files will be deleted! Are you sure?	27	2013/9/16 下午 01:56:00
Simware			
- 1-8000-MTCP			
2	Ves No.		
autoexec bat		9	
m8e17265.exe			
readme.txt			
	Erase Disk		
I			•

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.

	Step	Uploading	arch for available
Connect	Stor	C:\/CPDAS\Modbus_Utility\Firmware\i-8000-MTCP\m8e17265.exe,	sh a connection.
Disconnect	Step	81 %	disconnect the INIT
Update	Firmwar		and Time Settings
∎c:			Date
ICPDAS			
Firmware		I plead 22	
		Refrach file liet	
utoexec.bat 8e17265.exe			
utoexec.bat 8e17265.exe adme.txt			

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.



Starting the Modbus Utility

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 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.

Update Firmware	Erase Disk Confirm	Date	and Time Settings
C: C:\ CPDAS Modbus_Utility	All files wil be deleted! Are you sure?	Size 117296 27	Date 2014/3/4上午 11:05:50 2013/9/16 下午 01:56:00
autoexec bat	Yes No		
m8e17265.exe readme.txt			
	Erase Disk		•

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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

Back up Settings	Ctop E: 6	Uploading	connection.
Restore Settings	Step 6: A	C\VCPDAS\Modbus_Utility\Firmware\i-8000-MTCP\m8e17265.exe, Size: 117296 bytes.	connect the INIT
Update F	irmware	58 %	ime Settings
⊒ c:			e
		Cancel	
GModbus_Utility	ļ		
GModbus_Utility GFirmware Firmware	ļ	Upload >>	
Modbus_Utility Firmware Firmware F8000-MTCP		Upload >> Refresh file list	5
Modbus_Utility		Upload >> Refresh file list	5
Modbus_Utility		Upload >> Refresh file list	5

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.

	ols				
Name	Alias	IP Address	Sub-net Mask	Gateway	MAC Address
18KE4:4-0 iPAC8K:4-00 WISE-7126	* ip8000 WISE-7126	192.168.2.212 192.168.2.193 192.168.2.35	255.255.255.0 255.255.255.0 255.255.255.0	192.168.2.1 192.168.2.1 192.168.2.1	00:0d:e0:e0:c8: 00:0d:e0:e0:c4: 00:0d:e0:64:30:
		m			

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
8KE4:4-0	THICO	192 168 2 212	255 255 255 0	192 168 2 1	00:0d:e0:e0:c8
PAUSIN:4-00	ip8000	192.168.2.193	255.255.255.0	192.168.2.1	00:0d:e0:e0:c4
WISE-7126	VISE-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 :	18KE4:4-0			
DHCP:	0: OFF -	Alias:	i-8431	(7 Chars)
IP Address :	192.168.2.212	MAC:	MAC: 00:0d:e0:e0:c8:23	
Sub-net Mask :	255.255.255.0	- Warning!	rning!!	
	192 168 2 1	_ Contact y	onfiguration t	Administrator to

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.



Starting the Modbus Utility

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 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.

AN 1		LAN 2	
IP:	192.168.2.212	IP:	Load Settings
Mask:	255.255.255.0	Health	Save Settings
Gateway	192.168.2.1	Gateway:	Clear All

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 <u>Introduction to the User Interface</u> (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.



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 <u>Introduction to the User Interface</u> (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.

Controller	
СОМ1 -	Connect
Communication Mode	Disconnect

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.

9600 Baud 🔤	✓ Net ID	Search Stop
8 Data bits	•	
None Parity	•	Lonnect to Selected ID
1 Stop bit	-	

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

9600 Baud	▼ Net ID	Search	Stop
8 Data bits	⊡ ├───		
None Parity	•	Lonnect to S	elected I
1 Stop bit			

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

Controller		iP-8411-MRTU NetID=1		
СОМ1 -	Connect	СОМ1	Connect	
Communication Mode	Disconnect	Online Mode (CC	M) Disconnect	

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.



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.



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.

Version: 1.8.1	bus Utility 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]
0	

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



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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.



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

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.

	Ch0 [~] Ch7		\frown		
	Input/Output Range		Offset (Dec)	Power-on (Value	e) 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).



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.



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).



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



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.

	Ch0~Ch7				1
	Input/Output Range	C)ffset (Dec)	Power-on (Value)	Safe (Value)
:h0	+0.0 To +20.0 mA	-	0	2	0.000
Ch1	+0.0 To +20.0 mA	-	0 ÷	0.000	0.000
h2	+0.0 To +20.0 mA		0 ÷	0.000	0.000
h3	+0.0 To +20.0 mA		0 ÷	0.000	0.000
h4	+0.0 To +20.0 mA	-	0 ÷	0.000	0.000
h5	+0.0 To +20.0 mA	•	0 ÷	0.000	0.000
h6	+0.0 To +20.0 mA	-	0 ÷	0.000	0.000
h7	+0.0 To +20.0 mA	-	0 -	0.000	0.000

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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.



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.

	Ch0~Ch7				
	Input/Output Range		Offset (Dec) Power-on (Value	a) 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.



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.

DI Counter	
🗹 Ch0 🔲 Ch8	Set DI Counter
🗹 Ch1 🔲 Ch9	For 87K series modules, the
I Ch2 □ Ch10	Digital Input channels can also be
r en3 r Ch11	used as a Low-speed (<100Hz)
□ Ch4 □ Ch12	displayed in the "AI Mapping"
□ Ch5 □ Ch13	tab. To clear the counter value, write a
□ Ch6 □ Ch14	value to Digital Output in the "DO
Ch7 Ch15	Mapping" tab .

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

DI Mappi	ng ľ DON	/lapping	Al Mapp	oing	AO Mapping	Summary
Analog Input	(3xxxx)	01101-115				
Address	Module	Slot	Channel	Value	Comment	
00] 00]	1-87046	3	0		[40] Low Speed Counter	
01 [01]	1-87046	3	1		[40] Low Speed Counter	
02 [02]	1-87046	3	2		[40] Low Speed Counter	
4			ш			,

43

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 <u>Monitoring</u> function needs to be enabled.

Analog Input (3xxxx) Address Module Slot Channel Value Comment 00 000 1-82046 3 0 27 1401 Low Speed Counter	
Address Module Slot Channel Value Comment	
10 (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	
2 (02) 1-67046 5 2 17 (40) Edw 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.



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2.12. COM Port Settings

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

C8K NetID=1	COM Port Settings COM4 - Set
92.168.2.193 Disconnect Disconnect I-87061	Enable Mode Programming Modbus Timeout 200 Baud Rate 115200 Data Bits 8 Parity None Stop Bits 1
System Settings	Set 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 Set	tings COM1 COM1 COM2	Set
Enable Mode	Modbus/FCOM3	•
Modbus Timeout		
Baud Rate	115200	-
Data Bits	8	Ī
Parity	None	-
Stop Bits	1	Ī

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

System Settings	Set	
	let ID	COM1 = Modbus/RTU Slave
Modbus/TCP	1 📩	COM2 = Modbus/RTU Slave COM3 = Programming Mode
	Stations per COM Port	COM4 = Programming Mode
	10 🛨	

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.



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 <u>Introduction to the</u> <u>User Interface</u> (Item E) to open the WDT Settings panel.



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.



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".

Load Save	Monitor	Val Scale
FIPAC8K Netl	Timer Interval	DIO Set
Modbus Utility		
Enter the required Timer inter The current interval = 1000 ms	val in milliseconds. 3.	OK Cancel
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.

DI Mapping Digital Input (1xxxx)		lapping	Al Map	ping	AO Mapping	Summary
Address	Module	Slot	Channel	Value	Comment	
00 [00]	1-87046	3	0	0	0]Digital Module	0
01 (01)	1-87046	3	1	1	[4]Digital Module	1
02 [02]	1-87046	3	2	0	[4] Digital Module	
03 [03]	1-87046	3	3	0	[40 Digital Module	
04 [04]	1-87046	3	4	0	[40 Digital Module	
05 (05)	1-87046	3	5	0	[4] Digital Module	
06 [06]	1-87046	3	6	0	[4] Digital Module	
07 [07]	1-87046	3	7	0	[J]Digital Module	
ne inei	1.97046	3	9	0	101Dinital Modula	
<			III			•

Starting the Modbus Utility

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.



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.



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.

DI Mappir	ng DOM	lapping	Al Map	oping]	AO Mapping	Summary
Digital Output	(Охххх)					
Address	Module	Slot	Channel	Value	Comment	
10 [00]	1-87061			0	[40]Digital module	
01 [01]	1-87061	0	1	0	[40]Digital module	
02 [02]	1-87061	0	2	0	[40]Digital module	
Double	-click the	row fo	or the re	levant	channel.	
00 [00] 07 [07]	1 07021	ů	7	ő	MOIDigital module	
DI Mappir		Iapping	7 T Al Map	o oping	AO Mapping	mary
DI Mappir	1 07021 1 07021 1g DO M (0xxxx)	n Iapping	7 Al Map	oping	AO Mapping	Imary
DI Mappir Di gital Output Address	107001 107001 10 10 10 10 10 10 10 10 10 10 10 10	n Iapping Slot	7 Al Map	oping Value	AO Mapping	hmary
DI Mappir Di Mappir Digital Output Address	07001 07001 0000	n lapping Slot 0	7 Al Map Channel	opping Value	AO Mapping	hmary
DI Mappir Digital Output Address	07001 07001 000000 (000000) Module 1-87061 1-87061	n Iapping Slot 0	7 Al Map Channel	opping Value	AO Mapping	Imary
DI Mappir Digital Output Address 00 (00) 101 (01) 02 (02)	07001 07001 0000 M 0000 M 0000 M 0000 M 0000 M 000 M 0000 M 0000 M 000 M 00	Iapping Slot 0 0	7 Al Map Channel 1 2	opping Value	AO Mapping Coment 40 Digital module 40 Digital module 40 Digital module [40]Digital module	Imary
DI Mappir Digital Output Address 00 (00) 01 (01) 02 (02) 03 (03)	отост 1 от	n Iapping Slot 0 0 0 0	Al Mar Channel Channel 1 2 3	opping Value	AO Mapping Comment [40]Digital module [40]Digital module [40]Digital module [40]Digital module	Imary
DI Mappir Digital Output Address 0 00 (00) 01 (01) 02 (02) 03 (03) 04 (04)	отост 1 отлен 1 от	apping Slot 0 0 0 0	7 Al Map Channel 1 2 3 4	opping Value 1 0 0 0	AO Mapping Columnt 400Digital module 400Digital module 400Digital module 400Digital module 400Digital module 400Digital module	mary

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.



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.



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.

1/0	Address	Coloi	Frack	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.

) Addres	sl Coloul Fran	ol Visible	•		DO.	Addr	ess: 0
00 00 00	1		-				
00 00 10	2				1		
02 102	3						
0 00 [00]	2				1		1 1
0 02 [02]	3				On	Off	Inverse
DI 01 [01]	3			r		-	

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.



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.



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.



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.



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.



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



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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.



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 <u>Appendix B:</u> <u>Function Codes (FC)</u>

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 <u>Section 2.12 COM Port Settings</u>.

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.



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	
110001	Send Command
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.

Commands	Responses	
01 01 00 00 00 01 FD CA	01 01 01 00 51 88	*
Commands	Responses	÷

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.

ſ	B MBTCP Ver. 1.1.5
Ċ	ModbusTCP 192.168.255.1 ort 502 Connect Disconnect Data Log
Ċ	olling Mode (No Waiting) Statistic Clear Statistic Start Stop Difference In Packet mer Mode (Fixed Period) Total Packet Size (Bytes) 0 Packet Quantity nterval 100 ms Set Start Stop Stop Time Stop Time
6	teU] [Byte1] [Byte2] [Byte3] [Byte4] [Byte5] 0006 1 4 0 0 0 40 [teO] [Byte1] [Byte2] [Byte3] [Byte4] [Byte5] [Byte0] [Byte1] [Byte2] [Byte3]
	Clear Lists EXIT Program

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 <u>Appendix B: Function Codes</u> <u>(FC)</u>.

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.

-Mod	busTCP
IP	192.168.2.193
Port	502
(Connect Disconnect
	🔲 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]	
120006 120005	Send Command

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.



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.



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

Example - Citect Explo	orer							
File View Tools Hel	p							
Example	- 🔁	9 🦉 🐔	V	5 6		l 🖭 📰 🛛		
Project List	Contents of E	xample						
Ø My Projects ⊕ ि Example	Graphi G	Equ	Tags	Alarms	System	Com	Cicode Files	Citec Files
Ready								1.

Linking to SCADA Software via Modbus **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.

ew Project	— X
Name:	Modbus Demo
Description:	
Location:	C:\ProgramData\Schneider Ele Browse
Create p	roject based on starter project
Starter pr	oject selection
Project:	SxW_Style_1_HD1080_titleb
	OK Cancel Help

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.
< Back Next > Cancel Help

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.

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. C Create a new I/O Server Name: ModbusServer C Use an existing I/O Server IOServer 1
< Back Next > Cancel Help

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.

	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.	
<u> </u>	< Back Next > Cancel Help	

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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 1/0 bevice.
	External I/O Device
	C Persisted Memory I/O Device
	C Disk I/O Device
	I/O Device name:
1	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	Premium Quantum Modbus/ASCII Modbus/RTU Modbus/RTU Modbus/RTU Modbus/CP (Ethernet) Modbus/TCP (Ethernet) Modbus/TCP (Ethernet)
I/O Device Manufacturer:	Selected driver
Model: Communications:	Quantum Modbus/TCP (Ethernet)

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.

TCP/IP pro	selected a device which communicates using the otocol, Enter the TCP/IP information here.
IP address	s: 192 . 168 . 2 . 199
Port:	502
Use prot	tocol
(• TCF	Protocol Help
Selected driver	Madison
Manufacturer:	Modeon
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.

1222	Select this option if you want this I/O Devic external tag database.	e to link to an	
	Link I/O Device to an external tag data	oase	
	Database type:		
1	Unity SpeedLink to OFS	*	
	External tag database:		
×		Browse	
	Connection		
No.	lacksquare Add prefix to externally linked tags		
	Tag prefix:		
1-1-1	Automatic refresh of tags		
	🗖 Live Update		

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

Using new I/O Server 'ModbusServer'.	<u>^</u>	
Using Board Settings: + Memory address: 0 + I/O address: + Interrupt: Using Port Settings: + Baud Rate: + Data Bits:		
4	Þ	
Press Finish to save this	Print	

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.

🔓 Citect Project Edit	or [Modbus Demo] - UNO	COMPILED				X
File Edit Equipme	ent Tags Alarms Syster	m Communicatio	n Servers	Tools \	Window	Help
	* 11 1 4 4 2 2					
I/O Server [Mo	odbus Demo]			×		
Cluster Name		•		^		
Server Name	ModbusServer					
Network Addresses		▼ Port 50	2	5		
Comment						
Add	Replace Delete	Help	1			
Record : 2			J			
			Record 2	of 2		
			Record 2	01 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 <u>Section 3.1.1</u> above.

le Edit Equipment Tags Alarms System	Communication Servers Tools Window Help	
🗐 🚺 🐨 🕼 🖄 🚺 🗐	Express Wizard	
	Boards	
	Ports	
	Modems	
	I/O Devices	
	Remapping	

Step 2: Once the "I/O Devices [Modbus Demo]" dialog box is displayed, find the "Dev_8000" device that was created in <u>Section 3.1.1</u>. 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.

I/O Devices	[Modbus Demo]			
Server Name	ModbusServer			*
Name	Dev_8000	Number	2	>
Address	1	>		
Protocol	MODNET20	Port Name	PORT1_BOARD1	•
Startup Mode	2	 Priority 		
Memory		•		
Comment]	
Add	Replace	Delete	Help	III
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.

	nent Tags Alarms System C	Communication Servers	fools Window	/ Help	
I <u>I</u> V PI					_
🔳 Variable Ta	ags [Modbus Demo])
Equipment				•	
Item Name		Cluster Name		•	
Comment					
Tag Name	DO_0	I/O Device	Dev_8000	•	
Tag Name Address	DO_0 00001	I/O Device Data Type	Dev_8000 DIGITAL	•	
Tag Name Address	DO_0 00001 Eng Zero Scale	I/O Device Data Type Eng Full Scale	Dev_8000 DIGITAL	•	
Tag Name Address	DO_0 00001 Eng Zero Scale Replace Delete	I/O Device Data Type Eng Full Scale Help	Dev_8000 DIGITAL		

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	•
F Address	30001	Data Type	INT	•
	Eng Zero Scale 0	Eng Full Scale	10	

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	Х
DI_0	Dev_8000	DIGITAL	10001	Х
A0_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.

Г	Page Create a new graphics page	Cancel
	using a pre-defined template.	Help
	Template	
ß	Create your own template to use a for similar graphics pages.	s a base
	Symbol	
\$	Create a new symbol for objects the often.	at you use
	- Genie	
ð	Create a new genie for groups of o have common attributes.	bjects that
	Super Genie	
3	Create a new super genie that can	be

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.

nplate: norm	al			Style:	_	ОК
				equipment standard sxw_style_1		Cancel
file_rtf	hardware	meanmeaart	normal	tab_style_1 top version2		Edit
			·	<	Þ	
poppa	rangechart	rightpanel	singlepa		wing title bar	
- +				Resolution:	-	

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.

pe	Font:	Style:	Size:
Text	Arial	Regular	8
Target XP Style Custom Fill Color Fill Color Up:	@Arial Unicode MS @Batang @BatangChe @Dotum @DotumChe @Fixedsys @Gulim	Regular Italic Bold Bold Italic	* 8 * 9 10 11 12 14 14 •
Fill Color Down:	Alignment Effects - C Left Strike C Right Under C Centre	out DO Button	*
	Foreground:		

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.

0_0)			^ <u>~</u>	
			1	Keyt
ige:				ceud Commands
		C	Clear Property	
	ge:	ge:	ge:	clear Property

Mod bus

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.



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.

✓ Appearance ✓ Mover	nent < Scaling < Fill < ON symbol when	´Input] ∞ Slider] ∞	Access ⊬ Me	etadata	✓ Geneual
C Array C Animated	OFF symbol:	ON symbol:	Set Clear		Visibility
	light_1_black	light_1_red		Clear Property	

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.



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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.

Font:		Style:	Size:	
Arial		Regular	11	
@Arial Unicode MS @Batang @BatangChe @Dotum @DotumChe @Fixedsys @Gulim	• •	Regular Italic Bold Bold Italic		
Alignment Eff C Left C Right C Centre	fects Strikeout Underline	DO LED	*	
Foreground:				

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.



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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 "##.##".



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	
	Security Same area as object Command area: <all areas=""> Privilege <<none></none></all>	
Add Delete Edit	Logging Log message:	
	Clear Property	

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.



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

Citect Graphics Builder - Citect Graphics Builder - Citect Graphics Builder -	[Modbus Demo - Untit jects Text Arrange	led2] Tools Window He	elp	
		1 0 44888	R R R 0	-
DO LED DO Button	DI LED	AO Value ##.##	AI Value ##.##	
< [1 0×	0 🕂 491,15	

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.

Page]	Template	Symbol	Genie	Super Genie
age:	Pro	ject:	Preview:	ОК
page 1	Mod	dbus Demo	🔽 Enable	
Alarm ControlInhibit Disabled		V_Include & ample clude		Cancel
Hardware ManualOverride ProcessAnalvst		rary_Controls rary_Equipment odbus Demo	E	New
Soe	+ Sx	W_Style_Include h_Style_Include	÷	Delete
*	+ («		Þ	
				Help

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

File View Tools Help	10 01					
Modbus Demo 💌	1	1 🕈 🖉	- D 🗄	16 1	<u>a</u> 🛃 👳	
Project List	Contents of N	Aodbus Demo				
My Projects Example Modbus Demo Graphics Equipment Tags Alarms System Communications Cicode Files	Graphics	Equipment	Tags	Alarms	System	Communic

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

Citect Computer Setup V	Vizard	
	This wizard will assist you in setting up and customizing your computer for use with Citect. Select the type of setup you require.	
	Custom Setup	
	< Back Next > Can	icel Help

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	
	< Back Next > Cancel	Help

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



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



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.

Server Authentication		
	Running a server process requires the configuration of server password. Setting this password allows server authenticate each other and creates a trusted netwo between server machines.	ofa sto rk
	Configure Server Password	
	Configure Server Password	
A	Password:	
	Confirm Password: ••••	
8 5		
	< Back Next >	Cancel Help

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

Citect 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.
	< Back Finish Cancel Help

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.

CADA Exp Vijeo Cit	ert	▲ () ▼ ▲ ▲ ■		
age1 x				
	DI LED	AO Value	Al Value	
9 O Button	•	3.50	0.88	
	CADA Exp Vijeo Cit nge1 x O LED	CADA Expert Vijeo Citect	CADA Expert Vijeo Citect	CADA Expert Vijeo Citect

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 <u>Section 2.4 Net ID (Station Number) Setting</u> for more information).

3.2.1. Adding an Analog Input Channel

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

1	DASYLab 12.0	Configurator 12.0
	National Instruments	DASYLab 12.0 K
	×	😰 Help

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.

odbus Analog	Input				
Module name:	Modbus Ana	00 S	hort description	κ. [
Interfaces —				A	
Interface:	TCP/IP	✓ IF	address:	10.0.0.69	
	2 3 4	5 6	7 8 9		3 14 15
Channel name:	AI 0				ОК
Unit:	V	~		_	Cancel
Device	В			D	Help
Address:	1 (0x1)	- R	egister. 30	✓ 0	>
Register star	ts at 0				
Data type		E)ata range —		
Short			Scaling	F	
Signed 16-bit in	teger		linimum:	-10.0000	
		м	laximum:	10.0000	/
, V Big Endian					Test
Swap word	order				Interferer
Swap word	order				Interface

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 1	[est		
10	ModBus module : Address: 1 Raw data: 812 Scaled data: 0.24	response: 7959	OK Cancel
(0x1	ОК		Help
	Data range -		
	Minimum:	-10.0000	
	Maximum.	10.0000	Test
)			Interface

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

Windows Cl	Ver 1.7.2 2012A03/14 Sent tools Gatting Help Monitor Log	Scale - Trend	e - E	Status Firmwo	re: v1.7.2 (Jan	03 2012)
- 8431 N 10.0.0.68	etID=1	Range C	Code 0~Ch7	-		Set All
On-line Mode	e (Ethernet) Disconnect	Input/	Output Range	Offse	t (Dec)	
	Lange and the second se	Ch0 +/- 10	0.0 V			
		Ch1 +/- 10	J.0 V		0	
	L0017H/0017HC	Ch2 +/- 1	0.01/			
	routingoutins	Ch3 +/- 10	0.0 V			
Contraction of the second		04	0.0 V		<u> </u>	
		Ch 4/ 1	0.0 V		<u> </u>	
		ch7 +/-10	0.0V	Ī	0	
DI Map	ping DO Mapp	ing Al	Mapping	AO Ma	apping	Summary
Analog Inpu	t (3xxx)		M			
Address	Module	Slot Channel	Valse	Comment		
00 [00]	1-8017H/8017HS	2 0	0.248	08] +/- 10.0 V		
02 (02)	I-8017H/8017HS	2 2	2.754	1081 +/- 10.0 V		
03 [03]	I-8017H/8017HS	2 3	1.201	[08] +/- 10.0 V		
	1-8017H/8017HS	2 4	0.000	[08] +/- 10.0 V		
04 [04]	1.0017U/0017UC	2 5	0.001	[08] +/- 10.0 V		
04 [04] 05 [05]	1-001717/0017115		1 220	1081+7-10.0V		
04 [04] 05 [05] 06 [06]	1-8017H/8017HS	2 6	1,520	1001 +/ 10.0 +		
04 [04] 05 [05] 06 [06] 07 [07]	1-8017H/8017HS 1-8017H/8017HS 1-8017H/8017HS	2 6 2 7	-1.331	[08] +/- 10.0 V		

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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.



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.

	<u>D</u> elete Module
	Delete Input Connections
	Delete Output Connections
	<u>R</u> eplace Module
	Cut
	Сору
	Delete
	Search for Module
	Module Default Settings
	Module Documentation
C	Module Properties

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 Ana0	0	Short description	n:		
Interfaces —			IP address:	Α	10.0.0.68.50	,
menace.	TOP/II		n audiess.		10.0.0.00.00	
	2 3 4	5 6	7 8 9	10 11		15
Channel name:	A0 0					ОК
Unit:	V	~				Cancel
Device	В			D		Help
Address:	1 (0x1)	~	Register:	0		
Register start	s at o		2.3			
Data type			Data range —		F	
Unsigned 16-bit	integer 🗖		Minimum:	-10.	0000	
			Maximum:	10.0		
🕑 Big Endian						
Swap word o	rder					Interface

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.



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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.

Module name: S	lider00	Short descriptio	n:	
	2 3 4 5	6 7 8 9		3 14 15
Channel name: Unit: Output	Slider 0			OK Cancel Help
Minimum value: Resolution:	0.0000	Maximum value:	5.0000	Options
Change start val Output in real time	ue ne	Start value:	+++	Font
ale Slider00				
ale Slider00	3 4 5 6	7 8 9 10	11 12 13	14 15
ale Slider00	3 4 5 6	7 8 9 10 Labels Ticks: Miniticks:	11 12 13 5 1	14 15 0K Cancel
ale Slider00	3 4 5 6	7 8 9 10 Labels Ticks: Miniticks: Decimals:	11 12 13 5 1 2	14 15 OK Cancel Help

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.



The value can also be checked using the Modbus Utility.



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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.

<u>D</u> elete Mo	dule
Delete Inp	ut Connections
Delete <u>O</u> u	tput Connection
<u>R</u> eplace M	fodule
Cut	
Copy	
Delete	
Search for	Module
Module D	efault Settings
<u>Module D</u>	ocumentation
Module P	roperties

Linking to SCADA Software via Modbus **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.

Module name:	Modbus Dig00	Short description	n: [
Device settings			Α	
pterface:	TCP/IP	IP address:	10.0.0.68	
Address:	1 (0x1)	Start byte:	0	Test
<u></u>				
Channel name:	DI 0]	ОК
Unit:	V 💌			Cancel
				Help

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.

fodbus Utility					
Windows Client	t tools Catting Help				
d - Save	Monitor Log	- Val - Scale -	Trend 400 -	Exit Status	lan 03 2012]
8431 Net	ID=	81	K/87K Digital Power On Value	Safe Value	Set
10.0.0.00	C.COMPCT	r	Ch0		
On-line Mode (E	Ethernet) Disconnet	at r	Ch1		
		- r	Ch2		
	200		Ch3		
1-805	54		Ch4		
and the second se	and the second se				
COMME I			Ch5		
2			Ch5		
2			- Ch5 - Ch6 - Ch7		
DI Mappi		spping	Ch5 Ch6 Ch7 Al Mapping	AO Mapping	Summary
DI Mappi		store 1	Ch5 Ch6 Ch7 Al Mapping	AO Mapping	Summary
DI Mappi Digita Trapart (Address 00 (00) 01 (01) 02 (02) 03 (03) 04 (04) 05 (05)	Module 1-8054	spping	Ch5 Ch6 Ch7 Al Mapping Channel V 0 1 2 3 4	AO Mapping alue Domment 0 [40 Digital Module 0 [40] Uigital Module	Summary
DI Mappi Digita Input Address 00 [00] 01 [01] 02 [02] 03 [03] 04 [04] 05 [05] 06 [06]	Module 1-8054 1-8054 1-8054 1-8054 1-8054 1-8054 1-8054 1-8054 1-8054 1-8054 1-8054 1-8054	spping	Ch5 Ch6 Ch7 Al Mapping Channel V 0 1 2 3 4 5 6	AO Mapping alue Domment 0 [40 Gighal Module 0 [40] ighal Module 0 [40] ighal Module 0 [40] ighal Module 0 [40] ighal Module 0 [40] Dighal Module 0 [40 Dighal Module	Summary
DI Mappi Digitaringua (Address 00 [00] 01 [01] 02 [02] 03 [03] 04 [04] 05 [05] 06 [06] 07 [07] 09 [09]	Module 1-8054	xpping	Ch5 Ch6 Ch7 Al Mapping Channel V 0 1 2 3 4 5 6 7 7	AO Mapping alue Doment 0 [40 gigtal Module 0 [40 gigtal Module 0 [40] gigtal Module 0 [40] gigtal Module 0 [40] gigtal Module 0 [40 gigtal Module	Summary

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.

D	elete Module
D	elete Input Connections elete Output Connection
R	eplace Module
C	ut
C	opy
D	<u>e</u> lete
Se	earch for Module
М	odule Default Settings
М	odule Decumentation
M	odule Properties

Linking to SCADA Software via Modbus
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.

Device settings A oterface: TCP/IP IP address: 10.0.0.68 Address: 1 (0x1) Start byte: 0 B C C 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 1	
Interface: TCP/IP IP address: 10.0.0.68 Address: 1 (0x1) Start byte: 0 B C C 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 1	
Address: 1 (0x1) Start byte: 0 B C 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 1	
B 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 1	
	5
Channel name: D0 0	OK
Unit: V 💌	Cancel

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.

Modbus Utility Ver 1.7.	2 2012/03/14				
ad - Save Month		Val - M	🧼 - 🐙	Status Firmware: v1.7.2 [J	an 03 2012]
-8431 NetID=1 10.0.0.68 On-line Mode (Ethernet)	Connect Disconnect	8K/87K Di Power Or Ch0 Ch1 Ch2	aital n Value ⊂ Safe	Value DI Config	Set
1-8054		□ Ch2 □ Ch3 □ Ch4 □ Ch5 □ Ch6 □ Ch7			
DI Mapping	D0 Марр		lapping	AO Mapping	Summary
Address M	odule	Slot Channel	Value	Comment	
00 [00]	8054 8054 8054 8054 8054 8054 8054 8054	1 0 1 1 1 2 1 3 1 4 1 5 1 6 1 7		40Digital module 40Digital module 40Digital module 40Digital module 40Digital module 40Digital module 40Digital module 40Digital 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 <u>Section 2.4 Net ID (Station number) Setting</u> for more information).

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

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".

E Bar	Z Data Logger I	Professional Editi	ion V4	1.5.7 2013/04/2	5 C:\ICPDAS\EZ	Dat	a_Logger\Projec	t\MyProject.ini	
Pro	Start Execute	Simulation	Pai	use Ri	ecord Syste	Sem C	onfig Group	Setup Open D	Itabase Exit About
	Work	group1	p1 Workgroup2 Workgroup3		Device State				
	Gauge	Trend		Gauge	Trend		Gauge	Trend	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 set 04/10 17:42:46 Connect to contact 04/10 17:42:47 Close contact mess
	Layout			Layout			Layout		04/10 17:42:47 Load project settin: 04/10 17:42:47 Load main form ok. ■ 04/10 17:42:47 Load layout 0 04/10 17:42:47 Load layout 0 04/10 17:42:47 Load gauge 0 04/10 17:42:47 Load gauge 0 04/10 17:42:47 Load gauge 1 04/10 17:42:47 Load layout 1 04/10 17:42:47 Load layout 1 04/10 17:42:47 Load layout 2 04/10 17:42:47 Load layo
Save	a Interval(Sec):1	Record Time(Hour):	1			Ĩ			4/10/2014 5:47:44 PM Admin login //

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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.

anize 💌 New fold	ler				855 •
🕌 HP Universa 🔦	Name	Date modified	Туре	Size	
LICPDAS	Demo	4/10/2014 5:34 PM	File folder		
DCON_Uti	📕 demo_1	1/21/2014 10:45 AM	File folder		
leLogger	💄 dummy	12/24/2013 4:28 PM	File folder		
EZ_Data_L	MyProject	4/10/2014 5:42 PM	File folder		
🅼 config 🦳	STX Weekend Special 72hr Charge	12/24/2013 4:06 PM	File folder		
J. Help	JestForManual	4/10/2014 2:36 PM	File folder		
Languag	Demo.ini	4/10/2014 5:57 PM	Configuration sett	17 KB	
Layout	🔄 demo_1.ini	4/10/2014 7:18 PM	Configuration sett	26 KB	
iog	🗿 dummy.ini	1/20/2014 5:42 PM	Configuration sett	32 KB	
Project	MyProject.ini	4/10/2014 5:42 PM	Configuration sett	3 KB	
Demo	STX Weekend Special 72hr Charge.ini	12/24/2013 1:15 PM	Configuration sett	32 KB	
Ja demo_ +	T-47-4411-1	1 MA 10:101 4 5:37 DE4	C E	0.00	
File name: Dem	o				
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.

Install Modify Delete Add Modify Delete Channel List Al List DI List DO List Al Channels Al Channel Control Logic Control Logic DI Channels DI Channels Contact List Web Camera Web Camera DO Channels DO Channels Nickname Tag Location Gain Offset Hight Alarm Low Alarm Description High Alar Virtual Channels Webcam Webcam Webcam Webcam	Driver List MailNotifier VirtualChannel		_ 🥑 Device List VirtualChannel		Group Group1 Add kgroup2 Delet prope
Al List DI List DO List Counter List Freq List Virtual Channel Control Logic Contact List Web Camera DO Channels DO Channels Nickname Tag Location Gain Offset Hight Alarm Low Alarm Description tigh Alar Virtual Channels Virtual Channels Virtual Channels Virtual Channels	Channel List	II Modify Delete	e]	Add Modify Delete	Al Channels
Counter List Freq List Virtual Channel Control Logic Contact List Web Camera DO Channels Nickname Tag Location Gain Offset Hight Alarm Low Alarm Description High Alar Virtual Channels Virtual Channels Virtual Channels Virtual Channels	Al List	AO List	DI List	DO List	AO Channels
Contact List Web Camera Vickname Tag Location Gain Offset Hight Alarm Location Gain Offset Hight Alarm Location Gain Web Camera Counter Channels Freq Channels Virtual Channels Webcam Browsers Webcam Browsers	Counter List	Freq List	Virtual Channel	Control Logic	
	Vickname Tag	Location Gain Of	fset Hight Alarm Low Alan	m Description High Alar	Freq Channels Virtual Channels Webcam Browsers

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

•	Driver List MailNotifier VirtualChannel				
Driver	er Mode DCON - Out (ms) 200	Device List	Modi		×
C	OM Port 1 - audRate 115200 - hecksum Disable -				
	Modify Install	Search	+Device	Close	Help

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	Delete	
Driver Mode Modbus TCP	Device List	
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		
Modify	Search +Device	Close Help

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

MTCP 192.168.2.1	199.P502	
VirtualChannel		
vii tuaionamier		

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

Driver	X
Driver Mode Modbus TCP	Device List
Time Out (ms) 1500	
Host can be IP or hostname:ie 59.120.56.99 or h1.ddns.com	
Port 502	
Modify	Search +Device se Help
Device	
Modbus/TCP	
Select Driver MTCP 192,168,2,193,P50)2 Vickname
Module -Choose one module-	Description
Slave ID 1	Tag
Address Format Base Address	
Oec Protocol Addres O PLC Address	ess (Base 0) (Base 1)
Address Range Definition	
1xxxx Discrete Input (DI)	
3xxxx Input Registers (AI)	To Integer
4xxxx Holding Registers (AO)	To Integer
	<< Add Close Help

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.

	192.100.2.199.P3	502 -	Nickna	ame	87017W	
Module Enter n	numbers by yourse	lf	Descrip	tion		
Slave ID 1						
Address Format	Base Address					
Dec	Protocol Add	ress (Base	0)			
⊂ Hex	PLC Address	(Base 1)				
-			1			
Address Range De	efinition					
0xxxx Coils (DO)		To				
1xxxx Discrete Inpu	ut (DI) 🗆 🗌	То				
			7	nteger	-	
3xxxx Input Registe	ers (AI)					

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

				1				
	Al List	A	O List		DI Li	st	DO List	
Co	unter List	Fre	eq List		Virtual Ch	nannel	Control Log	
Co	ntact List	Web	Camera					
Nickname	Tag	Location	Gain	Offset	Hight Alarm	Low Alarm	Description	
THURSDAY HER							Description	
37017W_30001	87017W_30001	87017W Ch0	1	0	100	-10	30001	
87017W_30001 87017W_30002	87017W_30001 87017W_30002	87017W Ch0 87017W Ch1	1	0	100 100	-10 -10	30001 30002	
87017W_30001 87017W_30002 87017W_30003	87017W_30001 87017W_30002 87017W_30003	87017W Ch0 87017W Ch1 87017W Ch2	1 1 1	0 0 0	100 100 100	-10 -10 -10	30001 30002 30003	
87017W_30001 87017W_30002 87017W_30003 87017W_30004	87017W_30001 87017W_30002 87017W_30003 87017W_30004	87017W Ch0 87017W Ch1 87017W Ch2 87017W Ch3	1 1 1	0 0 0 0 0 0	100 100 100 100 100	-10 -10 -10 -10	30001 30002 30003 30004	
87017W_30001 87017W_30002 87017W_30003 87017W_30004 87017W_30005	87017W_30001 87017W_30002 87017W_30003 87017W_30004 87017W_30004	87017W Ch0 87017W Ch1 87017W Ch2 87017W Ch3 87017W Ch3 87017W Ch4	1 1 1 1	0 0 0 0	100 100 100 100 100 100	-10 -10 -10 -10 -10	30001 30002 30003 30004 30005	
37017W_30001 37017W_30002 37017W_30003 37017W_30004 37017W_30005 37017W_30005	87017W_30001 87017W_30002 87017W_30003 87017W_30004 87017W_30005 87017W_30005	87017W Ch0 87017W Ch1 87017W Ch2 87017W Ch3 87017W Ch3 87017W Ch4 87017W Ch5	1 1 1 1 1	0 0 0 0 0	100 100 100 100 100 100 100	-10 -10 -10 -10 -10 -10	30001 30002 30003 30004 30005 30006	
37017W_30001 37017W_30002 37017W_30003 37017W_30003 37017W_30005 37017W_30005 37017W_30006 37017W_30007	87017W_30001 87017W_30002 87017W_30003 87017W_30004 87017W_30005 87017W_30005 87017W_30006 87017W_30007	87017W Ch0 87017W Ch1 87017W Ch2 87017W Ch3 87017W Ch4 87017W Ch4 87017W Ch5 87017W Ch6	1 1 1 1 1 1 1	0 0 0 0 0 0 0	100 100 100 100 100 100 100	-10 -10 -10 -10 -10 -10 -10	30001 30002 30003 30004 30005 30006 30006	

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)			То			
1xxxx Discrete Input (DI)			То			
3xxxx Input Registers (AI)			То		Integer	•
4xxxx Holding Registers (A		0	То	7	Integer	•
Address Range Definition						
0xxxx Coils (DO)			То			
1xxxx Discrete Input (DI)	~	0	To 🔽	16	>	
3xxxx Input Registers (AI)			То		Integer	•
4xxxx Holding Registers (AO))		То		Integer	•
Address Range Definition						
0xxxx Coils (DO)	~	0	To 🔽	8	>	
1xxxx Discrete Input (DI)			To			
3xxxx Input Registers (AI)			То		Integer	•
4xxxx Holding Registers (AO)			То		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.



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/ezdl 1-003-03 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".

Man Internet A	
Vorkgroup1 Vorkgroup2	Add
Vorkgroup3	Delete
	Property
	Reset

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.



Linking to SCADA Software via Modbus

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.



Linking to SCADA Software via Modbus

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.



3.3.2. Designing the Layout and Acquiring Data

Once the configuration process described in Section 3.3.1 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.



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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.



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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.



Appendix A: Backing Up and Restoring the EEPROM Settings 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.

	🖪 Back up EEPROM file	
	Downloading.Please wait	
	Modbus_Utility	
o	ackup_setting	
- Connect & Configure -		
COM1 -		
Connect		
Disconne		
Disconne		
Back up Settings		
Destaus Cattings	File Name 18000 Save	
	File Type: .eep Cancel	

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

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

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.

	Select an EEPROM file to Restore
	Load from C:\ICPDAS\Modbus_Utility\backup_setting\i8000.eep
	34
	■ c:
	Modbus_Utility
Connect & Configure	the setting στη s
Connect	(8000.eep
Discor	
Back up Settings	
Dack up Octaings	Open File Name i8000 eep
Restore Settings	Write Block 1 + to 7 + Cancel

Restoring the EEPROM Settings ppendix A: Backing Up and

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

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 writt	en to the EEPROM.
	ОК

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)

Request										
H	Byte		0		1	2	3	4	5	
			Net ID	FC	FC=01 Starting Ad			dress Bit Count		
Example: Net ID = $20^{(*1)}$, H			14		1	0	11	0	D	
Read Coils 18-3	nmand	14 1 0 11 0 D								
			Respo	nse						
Byte	0	1	2			3	~Byt	e Cou	nt+2	
	Net ID	FC=01	Byte Cou	ınt	Bits Values					
Response	14	01	2(*3)		5C (Coils 25-18)		B) 1B (C	1B (Coils 30-26)		
Binary		0101 1100(*4) 0001 10						1 101	1(*5)	

Function Code 01=Read Coil Status

*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)

Request										
H	Byte		0		1 2		3	4	5	
	Net ID	FC	FC=02 Starting A		Address	Bit Count				
Example: Net ID = 1, Read Hex			1		2	0	0	0	8	
the status of in	nmand	12	120008							
			Respo	nse						
Byte	0	1	2			3 ~Byte		e Count+2		
	Net ID	FC=02	Byte Cou	ınt	Bits Values					
Response	1	2	1		FF (Coils 8-1)					
Binary					1111 1111(*2)					

Function Code 02=Read Input Status

*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)

Request												
В	yte		0	0 1		2		3		4	5	
		Net ID	FC=03		Starting Addre		ess Word		Count			
Example: Net I	D = 25,	Hex	19	3		0		14	ł	0	2	
Read registers	Com	Command 2		19 3 0 1A 0 2								
			Resp	onse								
Byte	0	1	2			3			~Byte Count+2			
	Net ID	FC=03	Byte Co	ount			Re	giste	r Val	lues		
Response	19	3	4			2	-	17		0	C8	
Register			· ·				40027(*2)			40028(*2)		

Function Code 03=Read Holding Registers

*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 <u>Appendix C: Range Codes for Analog Modules</u>.

4. Read AI (3xxxx)

Request											
В	yte		0 1			2		3	4	5	
			Net ID FC=0)4	4 Starting Addr		ess	Word	Count	
Example: Net I	D = 2,	Hex	2	4		0		0	0	2	
Read registers Comr			and	40002							
30001-30002(*1)										
			Resp	onse							
Byte	0	1	2			3			~Byte Count+2		
	Net ID	FC=04	Byte Count			F	legist	er Val	r Values		
Response	2	4	4			0	0		0	64	
Register				30001(*2)				30002(*2)			

Function Code 04=Read Input Registers

*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 <u>Appendix C:</u> <u>Range Codes for Analog Modules</u>.

5. Write Single DO (0xxxx)

Request											
Byt	e		0		1	2	3		4		5
			Net ID		FC=05	Write Address		ess	s FF 00=ON,		
									00 0	00	=OFF
Example: Net I	D = 1,	Hex	1		5	0	4		FF		0
set coil 5 to ON ^(*1) Comr			nand	nd 1504FF0							
					Respons	e					
Byte	0		1		2	3			4		5
	Net I	D FC	=05		Write A	Address		FF 00=0N,		00	00=0FF
Response	1		5	0 4 FF 0					0		
If the request is successful, the function will return an echo of the request.											

Function Code 05=Write Single Coil

*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)

Request											
Byte			0	1	2	3	4	5			
			Net ID	FC=06	Write A	r Value					
Example: Net ID =		Hex	1	6	0	2	0	9B			
1, set register 40003 ^(*1) to 155 ^(*2)		Command		1602	1 6 0 2 0 9B						
Response											
Byte	0		1	2	3	4		5			
	Net I	D FC	=06	Write A	Address	Re	Register Value				
Response	1		6	0	4	0		9B			
If the request is successful, the function will return an echo of the request.											

Function Code 06= Write Single Register

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

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

7. Write DO (0xxxx)

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		e Written	
Hex	1	F	0	0	0	С		2	FE(*2)		05(*2)	
Example: Net ID = 1,									1	111	0000	
write coils 1 to 12 ^(*1)										110	0101	
Command			1 F 0 0 0 C 2 FE 5									
Response												
By	yte	0	1	2	2	(T)	3	4			5	
		Net ID	FC=15 Write Address					Bi	Bit Count			
Resp	onse	1	F	()	()	0			С	

Function Code 15=Write Multiple Coils

*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)

Request												
Byte	0	1	2	3	4	5	6	6 7		~Byte Count+6		
	Net ID	FC=16	Write Address		Word Count		Byte Count	te Count R		legister Values		
Hex	1	10	0	0	0	2	4	() 19	0	64	
Example: Net ID = 1, write registers $40001-40002^{(*1)}$			Command 1 10 0 0 0 2 4 0 19 0 64									
Response												
E	Byte	0	1		2	3	4	4		5		
		Net ID	FC=16		Write Address			Word Count				
Res	ponse	1	10		0	0	0	0		2		

Function Code 16= Write Multiple Registers

*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 <u>Monitoring</u>.

The formula shown below provides details of the conversion process.



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

Gain = $\frac{Y_1 - Y_2}{x_1 - x_2}$, 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) = 0.000488296Step2. Calculate the Offset value. Offset = 4-(0*0.000488296) = 4Step3. 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 I	nput Modul	es		
		Input Range	+15.0 mV	-15.0 mV	0.00030518	0
00	-15 mV to	Decimal Units	+32767	-32768		
00	+15 mV	2's Complement Hexadecimal Units	7FFF	8000		
		Input Range	+50.0 mV	-50.0 mV	0.001525902	0
01	-50 mV to	Decimal Units	+32767	-32768		
01	+50 mV	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		
		Input Range	+500.0 mV	-500.0 mV	0.015259022	0
03	-500 mV to +500 mV	Decimal Units	+32767	-32768		
00		2's Complement Hexadecimal Units	7FFF	8000		
		Input Range	+1.0 V	-1.0 V	0.000030518	0
04	-1 V to +1V	Decimal Units	+32767	-32768		
01	1 / 10 / 1/	2's Complement Hexadecimal Units	7FFF	8000		
		Input Range	+2.5V	-2.5V	0.025	0
05	-2.5 V to	Decimal Units	+32767	-32768		
05	+2.5 V	2's Complement Hexadecimal Units	7FFF	8000		
06*1	-20 mA to	Input Range	+20.0 mA	-20.0 mA	0.00061036	0
00 1	+20 mA	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		
		Input Range	+20.0 mA	+4.0 mA	0.00024414	+4
07*2	+4 mA to	Decimal Units	+65535	+0		
07	+20 mA	2's Complement Hexadecimal Units	FFFF	0000		
		Input Range	+10.0 V	-10.0 V	0.00030518	0
08	-10 V to	Decimal Units	+32767	-32768		
00	+10 V	2's Complement Hexadecimal Units	7FFF	8000		
09		Input Range	+5.0 V	-5.0 V	0.00015259	0
	-5 V to +5 V	Decimal Units	+32767	-32768		
		2's Complement Hexadecimal Units	7FFF	8000		
		Input Range	+1.0 V	-1.0 V	0.000030518	0
0A	-1 V to +1V	Decimal Units	+32767	-32768		
		2's Complement Hexadecimal Units	7FFF	8000		
		Input Range	+500.0 mV	-500.0 mV	0.015259022	0
0B	-500 mV to	Decimal Units	+32767	-32768		
	+500 mV	2's Complement Hexadecimal Units	7FFF	8000		
		Input Range	+150.0 mV	-150.0 mV	0.004577706	0
0C	-150 mV to	Decimal Units	+32767	-32768		
	+150 mV	2's Complement Hexadecimal Units	7FFF	8000		
	-20 mA to	Input Range	+20.0 mA	-20.0 mA	0.00061036	0
	+20 mA (with 125 ohm resistor)	Decimal Units	+32767	-32768		
0D*3						

Type Code	Type Definitions	Data Format	Max. Value	Min. Value	Gain	Offset
		Input Range	+20.0 mA	+0.0 mA	0.00030518	0
1 Δ*2	+0 mA to	Decimal Units	+65535	+0		
111	+20 mA	2's Complement Hexadecimal Units	FFFF	0000		
		Input Range	+150.0 V	-150.0 V	0.0045777	0
1B	-150 V to	Decimal Units	+32767	-32768		
10	+150 V	2's Complement Hexadecimal Units	7FFF	8000		
		Input Range	+50.0 V	-50.0 V	0.0015259	0
10	-50 V to	Decimal Units	+32767	-32768		
10	+50 V	2's Complement Hexadecimal Units	7FFF	8000		
	Digital	Input/Output, Coun	ter, Frequer	ncy, Encodei	r 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 O	utput Modu	les		
		Output Range	+20.0 mA	+0.0 mA	0.00061037	0
0,30	+0 mA to	Decimal Units	+32767	+0		
,	+20 mA	2's Complement Hexadecimal Units	7FFF	0000		

Type Code	Type Definitions	Data Format	Max. Value	Min. Value	Gain	Offset	
			Gain ⁻¹ =	1638.35			
		Output Range	+20.0 mA	+4.0 mA	0.000488296	+4	
	1 A m A to	Decimal Units	+32767	+0			
1, 31	+4 mA to +20 mA	2's Complement Hexadecimal Units	7FFF	0000			
			Gain ⁻¹ = 2	047.9375			
		Output Range	+10.0 V	+0.0 V	0.000305185	0	
	10 V to	Decimal Units	+32767	+0			
2, 32	+0 V to +10 V	2's Complement Hexadecimal Units	7FFF	0000			
			Gain ⁻¹ =	3276.7			
		Output Range	+10.0 V	-10.0 V	0.00030518	0	
	-10 V to +10 V	Decimal Units	+32767	-32768			
3, 33		2's Complement Hexadecimal Units	7FFF	8000			
		Gain ⁻¹ = 3276.75					
		Output Range	+5.0 V	+0.0 V	0.00015259	0	
		Decimal Units	+32767	0			
4, 34	+0 v to +5 V	2's Complement Hexadecimal Units	7FFF	0000			
			Gain ⁻¹ =	6553.4			
		Output Range	+5.0 V	-5.0 V	0.00015259	0	
	E V to	Decimal Units	+32767	-32768			
5, 35	+5 V	2's Complement Hexadecimal Units	7FFF	8000			
			Gain ⁻¹ =	6553.4			
		Output Range	+20.0 V	+0.0 V	0.00061037	0	
6 36	+0 V to	Decimal Units	+32767	0			
0,00	+20 V	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-8 a	7017RC has current sour	built-in 125 Ohms res ce, no add any externa	sistors for ea al resistors r	ch channel. equired.	When connecti	ng to		
*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.								

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Type Code	Thermocouple Type	Data Format	Max. Value	Min. Value	Gain	Offset
		Input Range (Celsius)	+760.0	-210.0	0.023194089	0
0E	Ј Туре	Decimal Units	+32767	-9054		
		2's Complement Hexadecimal Units	7FFF	DCA2		
		Input Range (Celsius)	+1372.0	-270.0	0.0418717327	0
0F	К Туре	Engineer Units	+32767	-6448		
		2's Complement Hexadecimal Units	7FFF	E6D0		
		Input Range (Celsius)	+400.0	-270.0	0.0122073426	0
10	Т Туре	Decimal Units	+32767	-22118		
		2's Complement Hexadecimal Units	7FFF	A99A		
		Input Range (Celsius)	+1000.0	-270.0	0.030518575	0
11	Е Туре	Decimal Units	+32767	-8847		
		2's Complement Hexadecimal Units	7FFF	DD71		
		Input Range (Celsius)	+1768.0	+0.0	0.0539567247	0
12	R Type	Decimal Units	+32767	+0		
		2's Complement Hexadecimal Units	7FFF	0000		
		Input Range (Celsius)	+1768.0	+0.0	0.0539567247	0
13	S Туре	Decimal Units	+32767	+0		
		2's Complement Hexadecimal Units	7FFF	0000		

1.2. Thermocouple Type Definitions

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

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

1.3. RTD (Resistance Temperature Detector) Type Definitions

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Type Code	RTD Type	Data Format	Max. Value	Min. Value	Gain	Offset
	Platinum 100	Input Range (Celsius)	+100.0	+0.0	0.0030518509	0
25	a =	Decimal Units	+32767	+0		
25	0.003916 0°C to	2's Complement Hexadecimal Units	7FFF	0000		
	100°C	Ohm	+139.16	+100.0		
	Platinum 100	Input Range (Celsius)	+200.0	+0.0	0.0061037018	0
26	a =	Decimal Units	+32767	+0		
20	0.003916 0°C to	2's Complement Hexadecimal Units	7FFF	0000		
	200°C	Ohm	+177.13	+100.0		
	Platinum 100	Input Range (Celsius)	+600.0	+0.0	0.01831110568	0
27	a =	Decimal Units	+32767	+0		
27	0.003916 0°C to	2's Complement Hexadecimal Units	7FFF	0000		
	600°C	Ohm	+317.28	+100.0		
		Input Range (Celsius)	+100.0	-80.0	0.0030518302	0
28	Nickel 120	Decimal Units	+32767	-26214		
20	100°C	2's Complement Hexadecimal Units	7FFF	999A		
		Ohm	+200.64	+120.6		
		Input Range (Celsius)	+100.0	+0.0	0.0030518509	0
20	Nickel 120	Decimal Units	+32767	+0		
29	0°C to 100°C	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	(Celsius)				
	а	Decimal Units	+32767	-10922		
	=0.00385 -200°C to 600°C	2's Complement Hexadecimal Units	7FFF	D556		
		Ohm	+3137.1	+185.2		
	Cu 100	Input Range (Celsius)	+150.0	-20.0	0.0045777	0
2 D*1	a -0.00421	Decimal Units	+32767	-4369		
2D 1	-0.00421 -20°C to 150°C	2's Complement Hexadecimal Units	7FFF	EEEF		
		Ohm	+163.17	+91.56		
	Cu 100 a =0.00421 0°C to 200°C	Input Range (Celsius)	+200.0	+0.0	0.0061037	0
2C *1		Decimal Units	+32767	+0		
201		2's Complement Hexadecimal Units	7FFF	0000		
		Ohm	+167.75	+90.34		
	Cu 1000	Input Range (Celsius)	+150.0	-20.0	0.0045777	0
1*ח	a -0.00421	Decimal Units	+32767	-4369		
20 -	-20°C to 150°C	2's Complement Hexadecimal Units	7FFF	EEEF		
		Ohm	+1631.7	+915.6		
	Pt 100	Input Range (Celsius)	+200.0	-200.0	0.0061036	0
2 E*2	a -0.00295	Decimal Units	+32767	-32768		
2E*2	E ^{*2} =0.00385 -200°C to 200°C	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

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Type Code	RTD Type	Data Format	Max. Value	Min. Value	Gain	Offset
	=0.003916	Decimal Units	+32767	-32768		
	-200°C to 200°C	2's Complement Hexadecimal Units	7FFF	8000		
		Ohm	+177.14	+17.14		
	Pt 100	Input Range (Celsius)	+600.0	-200.0	0.018311	0
00 *2	a =0.00385 -200°C to 600°C	Decimal Units	+32767	-10922		
80 -		2's Complement Hexadecimal Units	7FFF	D556		
		Ohm	+313.59	+18.49		
	Pt 100	Input Range (Celsius)	+600.0	-200.0	0.018311	0
01 *2	a -0.002016	Decimal Units	+32767	-10922		
812	=0.003916 -200°C to 600°C	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
	Precon	Input Range (Fahrenheit)	+240.0	-30.0	0.0073244	0
(0)	ST-A3	Decimal Units	+32767	-4096		
60	-30 to 240 degree Fahrenheit	2's Complement Hexadecimal Units	7FFF	F000		
		Ohm	+539.4	+173600.0		
	Type U	Input Range (Celsius)	+150.0	-50.0	0.004577	0
61	Fenwell	Decimal Units	+32767	-10922		
61	-50 to 150 degree Celsius	2's Complement Hexadecimal Units	7FFF	D556		
		Ohm	+37.2	+134020.0		
	Type U Fenwell 0 to 150 degree Celsius	Input Range (Celsius)	+150.0	+0.0	0.004577	0
62		Decimal Units	+32767	+0		
02		2's Complement Hexadecimal Units	7FFF	0000		
		Ohm	+37.2	+6530.0		
		Input Range (Celsius)	+100.0	-80.0	0.0030518	0
62	YSI L Mix	Decimal Units	+32767	-26214		
03	100	2's Complement Hexadecimal Units	7FFF	999A		
		Ohm	+14.3	+14470.0		
		Input Range	+100.0	-80.0	0.0030518	0
	YSI I Miv	Decimal Units	+32767	-26214		
64	300 300	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		
	YSI B Mix 2252	Input Range (Celsius)	+150.0	-50.0	0.004577	0
66		Decimal Units	+32767	-10922		
66		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		
	YSI B Mix 5000	Input Range (Celsius)	+150.0	-40.0	0.004577	0
68		Decimal Units	+32767	-8738		
00		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		
	YSI H Mix 10K	Input Range (Celsius)	+150.0	-30.0	0.004577	0
6 P		Decimal Units	+32767	-6553		
68		2's Complement Hexadecimal Units	7FFF	E667		
		Ohm	+237.0	+135200.0		
	YSI H Mix 30K	Input Range (Celsius)	+200.0	-10.0	0.0061037	0
60		Decimal Units	+32767	-1638		
UC.		2's Complement Hexadecimal Units	7FFF	F99A		
6B 6C 70- 77		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
		Input Range	+2.5 V	-2.5 V	0.000076295	0
05	-2.5 V to	Decimal Units	+32767	-32768		
05	+2.5 V	2's Complement Hexadecimal Units	7FFF	8000		
		Input Range	+20.0 mV	-20.0 mV	0.00061036	0
06	-20 mV to	Decimal Units	+32767	-32768		
00	+20 mV	2's Complement Hexadecimal Units	7FFF	8000		
		Input Range	+1.25 V	-1.25 V	0.000038147	0
07	-1.25 V to +1.25 V	Decimal Units	+32767	-32768		
		2's Complement Hexadecimal Units	7FFF	8000		
		Input Range	+10.0 V	-10.0 V	0.00030518	0
08	-10 V to	Decimal Units	+32767	-32768		
00	+10 V	2's Complement Hexadecimal Units	7FFF	8000	alueGainV0.0000762956800.00061036mV0.000610366800.0000381476800.0000305186800.000152596800.000610376800.00061037000.00061037000.000305186800.00061037000.00030518000.00030518000.00030518000.000305186800.000305186800.000305186800000000000000000000000000000000 <td></td>	
		Input Range	+5.0 V	-5.0 V	0.00015259	0
09	-5 V to +5 V	Pype initionsData FormatMax. ValueMin. ValueInput Range+2.5 V-2.5 VDecimal Units+32767-327682.5 V2's Complement Hexadecimal Units7FFF80000 mV to 20 mVDecimal Units+32767-3276820 mV2's Complement Hexadecimal Units+32767-3276820 mV2's Complement Hexadecimal Units7FFF800020 mV2's Complement Hexadecimal Units+32767-3276825 V to 10 Decimal Units+32767-327682's Complement Hexadecimal Units7FFF80000 V to 10 V to 10 V to 2's Complement Hexadecimal Units+32767-3276810 V2's Complement Hexadecimal Units7FFF800010 V2's Complement Hexadecimal Units7FFF800010 V2's Complement Hexadecimal Units7FFF800010 V2's Complement Hexadecimal Units-32768-327682's Complement Hexadecimal Units7FFF80002's Complement Hexadecimal Units-32767-327682's Complement Hexadecimal Units-32767-327682's Complement Hexadecimal Units-32767-327682's Complement Hexadecimal Units-32767-327682's Complement 	-32768			
0,	5 V to 15 V	2's Complement Hexadecimal Units	7FFF	8000		
		Output Range	+20.0 mA	+0.0 mA	0.00061037	0
	+0 mA to +20 mA	Decimal Units	+32767	+0		
30		2's Complement Hexadecimal Units	7FFF	0000		
			Gain ⁻¹ =	1638.35	Gain 0.000076295 0.00061036 0.000038147 0.000038147 0.00030518 0.00015259 0.0000101 0.00001001 0.00001000 0.00000000	
	10.11	Output Range	+10.0 V	-10.0 V	0.00030518	0
30	-10 V to +10 V	Decimal Units	+32767	-32768		
	. 10 V	2's Complement	7FFF	8000	Value Gam 5 V 0.000076295 768	

Type Code	Type Definitions	Data Format	Max. Value	Min. Value	Gain	Offset	
		Hexadecimal Units					
		$Gain^{-1} = 3276.75$					
80	Mode 0: Pulse/ Direction Counter	Decimal Units	+2147483 647	-2147483 648	1	0	
		2's Complement Hexadecimal Units	7FFFFFFF	80000000			
	Mode 1: Up/Down Counter	Decimal Units	+2147483 647	-2147483 648	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	+4294967 295	0	1	0	
		2's Complement Hexadecimal Units	FFFFFFFF	00000000			