Industrial Computer Products

Data Acquisition System

ET-7019Z/PET-7019Z

User Manual

Version 1.0.0, Sep. 2011

Warranty

All products manufactured by ICP DAS are under warranty regarding defective materials for a period of one year, beginning from the date of delivery to the original purchaser.

Warning

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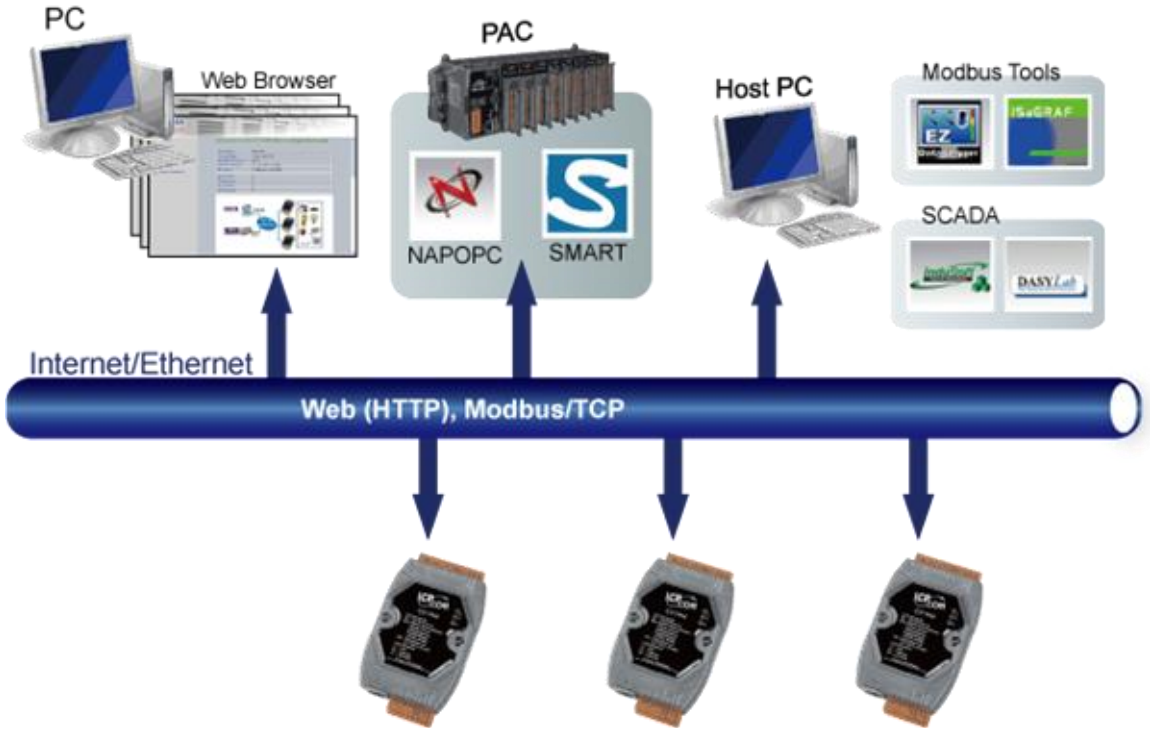
1. Introduction



The ET-7019Z/PET-7019Z is a web-based Ethernet I/O module that features a built-in web server, which allows remote configuration, I/O monitoring and I/O control simply by using a regular web browser. Remote control is as easy as surfing the Internet. In addition, the web HMI function means that programming or HTML skills are no longer required so creating dynamic and attractive web pages for I/O monitoring and I/O control purposes will be more fun for engineers in the future. The ET-7019Z/PET-7019Z offers easy and safe access for users at anytime and from anywhere, and also supports the Modbus/TCP protocol that ensures perfect integration with SCADA software. Furthermore, the PET-7019Z features "PoE", meaning that not only is data transmitted through an Ethernet cable but also power making installation of the PET-7019Z a piece of cake. Imagine no more unnecessary wires with only an Ethernet cable being required to take care of everything in the field.

The "Z" version is another milestone in the development of the thermocouple series and is a testament to the excellence of ICP DAS products. The ET-7019Z/PET-7019Z is specifically designed for extremely accurate thermocouple measurement and features automatic cold-junction compensation for each channel to ensure temperature output consistency and stable temperature output in the field. Current input and voltage input are both supported. An intuitive design is kept in this model; choosing to measure current or voltage is simply by a jumper. An external resistor is no longer needed.

Another feature is that its ten input channels can be individually be configured for different kinds of analog input. Open thermocouple detection and ESD/EFT/Surge protection mechanisms are also included.

The Comparison between ET-7019Z and PET-7019Z

The PET-7019Z has some unique features differ from the ET-7019Z

- **PET-7019Z = Power over Ethernet + ET-7019Z**

The PET-7019Z has integrated Power-over-Ethernet (PoE), it allows power and data to be carried over a single Ethernet cable, so a device can operate solely from the power it receives through the data cable. This innovation allows greater flexibility in office design, higher efficiency in systems design, and faster turnaround time in set-up and implementation. The PET-7019Z feature true IEEE 802.3af-compliant (classification, Class 1) Power over Ethernet (PoE) using both Ethernet pairs (Category 5 Ethernet cable). The PET-7019Z can receive power from an auxiliary power sources like AC adapters and battery in addition to the PoE enabled network. This is a desirable feature when the total system power requirements exceed the PSE's load capacity. Furthermore, with the auxiliary power option, the PET-7019Z can be used in a standard Ethernet (non-PoE) system.

- **Industrial PoE Solution**

When using PET-7019Z module, you can choose ICP DAS “PoE” Switch – “NS-205PSE” as the power source, NS-205PSE automatically detects the connected devices whether they are PoE devices or not. This mechanism ensures NS-205PSE to work with both PoE and non-PoE devices coordinately at the same time.

Being as a power source for PoE devices, NS-205PSE requires its power input ranging from +46 ~ +55V_{DC}.

➢ More information about PET-7019Z

There are two ways for PET-7019Z getting the power. One is through Ethernet by a PoE Switch; the other is as usual through wiring by an external power. External power should range from +12 V_{DC} to 48 V_{DC}. The reason we keep the second way is because it might be useful if someday or somehow you have different applications. The PET-7019Z is equipped with a LED, which indicates whether the power is supplied by a PoE Switch.

1.1. Features

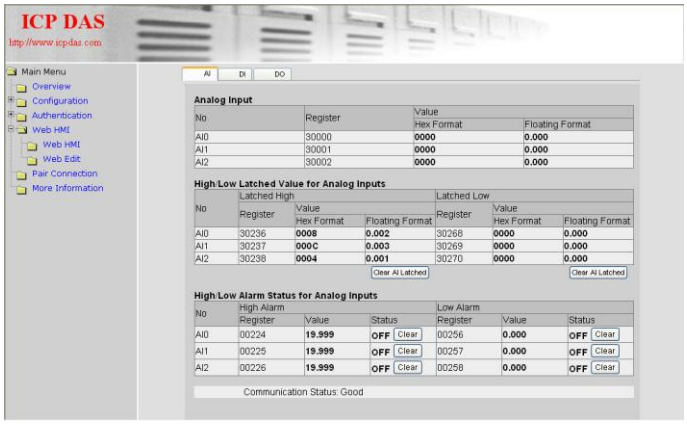
The ET-7019Z/PET-7019Z module offers the most comprehensive configuration to meet specific application requirements. The following list shows the features designed to simplify installation, configuration and application.

Built-in Web Server

Each ET-7019Z/PET-7019Z module has a built-in web server that allows users to easily configure, monitor and control the module from a remote location using a regular web browser.

Web HMI

The Web HMI function allows the users to create dynamic and attractive web pages to monitor and control the I/O points. Users can upload specific I/O layout pictures (bmp, jpg, gif format) and define a description for each I/O point. No HTML or Java skills are needed to create the web pages.



Communication Security

Account and password are required when logging into the ET-7019Z/PET-7019Z web server. An IP address filter is also included, which can be used to allow or deny connections with specific IP addresses.

Modbus/TCP, Modbus/UDP Protocol

The Modbus/TCP, Modbus/UDP slave function on the Ethernet Port can be used to provide data to remote HMI/SCADA software built with Modbus/TCP driver. ICP DAS also provides NAPOPC_ST DA Server for Modbus/TCP to integrate ET-7019Z/PET-7019Z I/O real-time data value with OPC client enabled software.

Built-in Multi-function I/O

Various I/O components are mixed with multiple channels in a single module, which provides the most cost effective I/O usage and enhances performance of the I/O operations.

Automatic MDI / MDI-X Crossover for Plug-and-play

RJ-45 Port supports automatic MDI/MDI-x that can automatically detect the type of connection to the Ethernet device without requiring special straight or crossover cables.

Built-in Dual Watchdog

The Dual Watchdog consists of a Module Watchdog and a Host Watchdog. The action of DO is also associated to the Dual Watchdog.

Module Watchdog is a built-in hardware circuit that monitors the operating status of the module and will reset the module if a failure occurs in the hardware or the software.

Host Watchdog is a software function that monitors the operating status of the host, and is used to prevent network communication problems or host failures. When a host watchdog timeout occurs, the module will reset all outputs to safe states in order to prevent any erroneous operations of the controlled target.

Highly Reliable Under Harsh Environment

ET-7019Z/PET-7019Z is housed in a plastic-based shell/case with a column-like ventilator that helps to cool the working environment inside the shell/case.

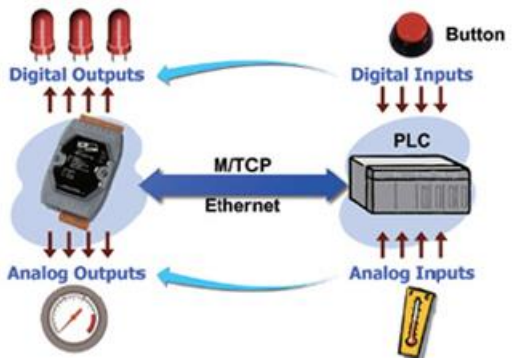
Operating Temperature: -25 ~ +75 °C

Storage Temperature: -30 ~ +80 °C

Humidity: 10 ~ 90% RH (non-condensing)

I/O Pair Connection

This function is used to create a DI to DO pair through the Ethernet. Once the configuration is completed, the ET-7019Z/PET-7019Z module can poll the status of remote DI devices using the Modbus TCP protocol and then continuously write to a local DO channels in the background.



1.2. Specifications

1.2.1. System Specifications

The table below summarizes the specifications of the ET-7019Z/PET-7019Z.

Models	ET-7019Z	PET-7019Z
Software		
Built-in Web Server	Yes	
Web HMI	Yes	
I/O Pair Connection	Yes	
Communication		
Ethernet Port	10/100 Base-TX with Auto MDI/MDI-X	
PoE	-	Yes
Protocol	Modbus/TCP, Modbus/UDP	
Security	ID, Password and IP Filter	
Dual Watchdog	Yes, Module (0.8 second), Communication (Programmable)	
LED Display		
L1 (System Running)	Yes	
L2 (Ethernet Link/Act)	Yes	
L3 (Ethernet 10/100 M Speed)	Yes	
PoE Power	-	Yes
2 Way Isolation		
Ethernet	1500 V_{DC}	-
I/O	2500 V_{DC}	
EMS Protection		
ESD (IEC 61000-4-2)	4 kV Contact for each terminal and 8 kV Air for random point	
EFT (IEC 61000-4-4)	+/-4 kV for Power	
Surge (IEC 61000-4-5)	+/-3 kV for Power	

Power Requirements		
Reverse Polarity Protection	Yes	
Powered from Terminal Block	Yes, 10 ~ 30 V_{DC}	Yes, +12 ~ +48 V_{DC}
Powered from PoE	-	Yes, IEEE 802.3af, Class1
Consumption	2.5W	3.5 W
Mechanical		
Dimensions (W x H x D)	72 mm x 116 mm x 35 mm	
Installation	DIN-Rail or Wall Mounting	
Environment		
Operating Temperature	-25 ˚C ~ +75 ˚C	
Storage Temperature	-30 ˚C ~ +80 ˚C	
Humidity	10 ~ 90 % RH, non-condensing	

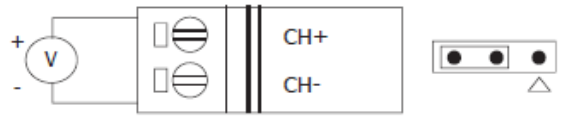
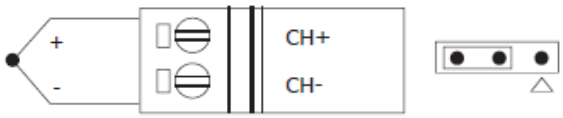
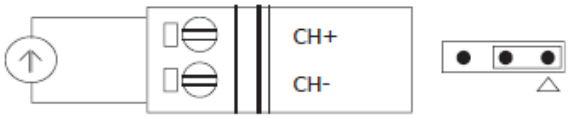
1.2.2. I/O Specifications

Analog Input	
Channels	10 (Differential)
Sensor Type	+/-15 mV, +/-50 mV, +/-100 mV, +/-150 mV, +/-500 mV, +/-1 V, +/-2.5 V, +/-5 V, +/-10 V
	+/-20 mA, 0 ~ 20 mA, 4 ~ 20 mA (Jumper Selectable)
	Thermocouple (J, K, T, E, R, S, B, N, C, L, M, and LDIN43710)
Individual Channel Configuration	Yes
Resolution	16-bit
Sampling Rate	10 Samples/Sec. (Total)
Accuracy	+/- 0.1 % of FSR or better
Zero Drift	+/-0.5 μV/˚C
Span Drift	+/-25 ppm/˚C
Over voltage Protection	240 Vrms
Input Impedance	> 300 kΩ
Common Mode Rejection	86 dB Min.
Normal Mode Rejection	100 dB
Temperature Output Consistency	Yes
Stable Temperature Output in the Field	Yes
Open Wire Detection	Yes
Digital Output	
Channels	6
Type	Isolated Open Collector
Sink/Source (NPN/PNP)	Sink
Max. Load Current	700 mA/Channel
Load Voltage	5 V_{DC} ~ 50 V_{DC}
Overvoltage Protection	60 V_{DC}
Overload Protection	+4 V_{DC} max.
Short-circuit Protection	Yes
Power-on Value	Yes, Programmable
Safe Value	Yes, Programmable

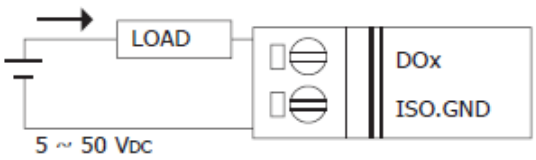
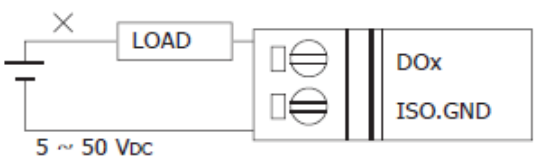
1.2.3. Wiring Specifications

The wiring diagram of the ET-7019Z/PET-7019Z is illustrated on the following figure.

Analog Input

Voltage Input (Default)	Thermocouple Input (Default)
	
Current Input	
	

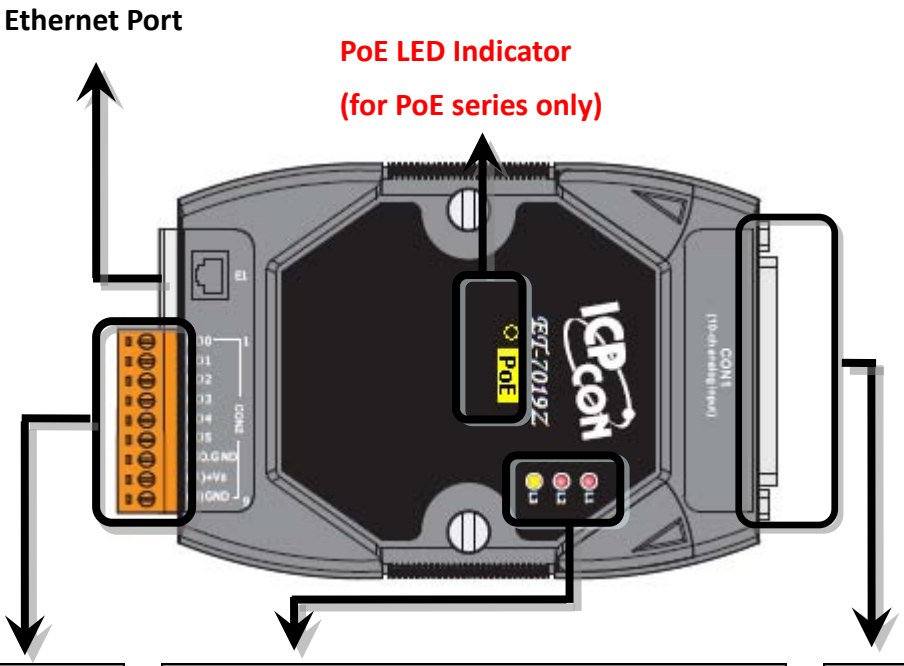
Digital Output

Open Collector (Sink)	
ON State Readback as 1	OFF State Readback as 0
	

1.3. Overview

1.3.1. Front Panel

The ET-7019Z/PET-7019Z front panel contains the Ethernet Port, connectors and LEDs.



CON2	
Pin #	**Function**
1	DO0
2	DO1
3	DO2
4	DO3
5	DO4
6	DO5
7	ISO.GND
8	(R)+Vs
9	(B)GND

L3 LED Indicator	
LED Status	**Function**
On	Speed 100 Mbps
Off	Speed 10 Mbps

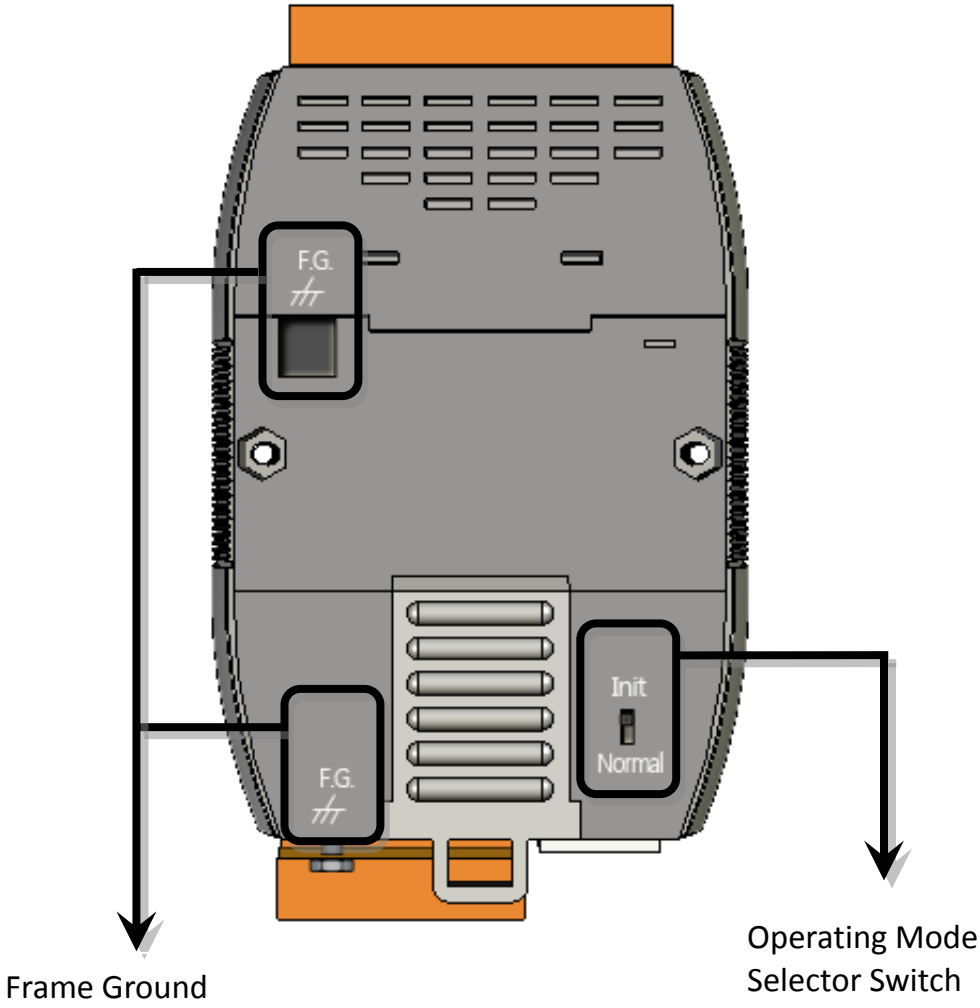
L2 LED indicator	
LED Status	**Function**
On	Ethernet link detected.
Off	No Ethernet link detected.
Flashing	Ethernet packet received.

L1 LED Indicator	
LED Status	**Function**
Flashing	The ET-7019Z/PET-7019Z is turned on and is ready for use.

CON1
Connects to the DB-1820/DN-1822 daughter board directly

1.3.2. Back Panel

The ET-7019Z/PET-7019Z back panel contains the frame ground and Init/Normal switch.



Operating Mode Selector Switch

Init mode: MiniOS7 configuration mode

Normal mode: Firmware running mode

In the ET-7019Z/PET-7019Z, the switch is always in the Normal position. Only when updating the ET-7019Z/PET-7019Z firmware or OS, the switch can be moved from the Normal position to the Init position.

Move the switch to the Normal position after the upgrade is complete.

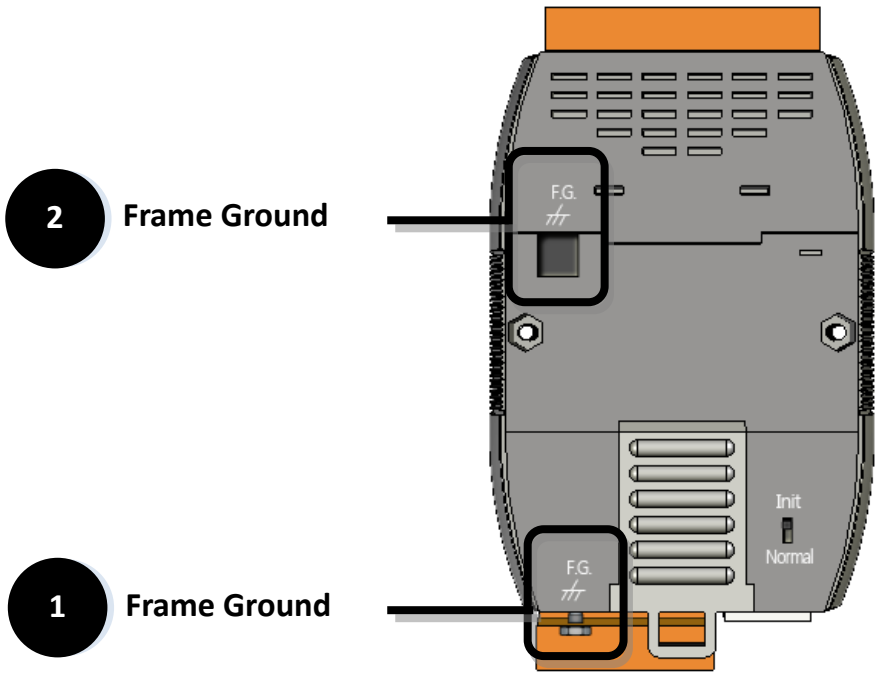
Frame Ground

Electronic circuits are constantly vulnerable to Electro-Static Discharge (ESD), which become worse in a continental climate area. ET-7019Z/PET-7019Z features a new design for the frame ground, which provides a path for bypassing ESD, allowing enhanced static protection (ESD) capability and ensures that the module is more reliable.

The following options will provide a better protection for the module:

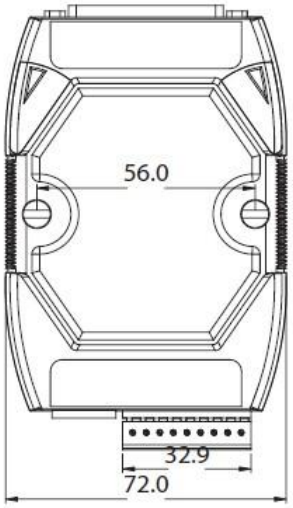
The ET-7019Z/PET-7019Z has a metallic board attached to the back of the plastic basket as shown in the figure below, point 1.

When mounted to the DIN-Rail, connect the DIN-Rail to the earth ground because the DIN-Rail is in contact with the upper frame ground as shown in the figure below, point 2.

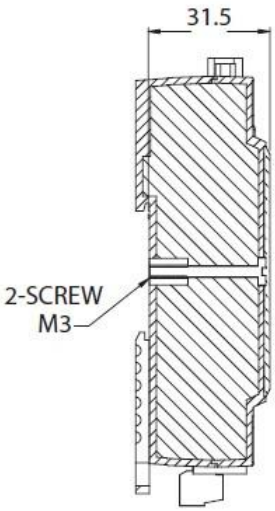


1.4. Dimensions

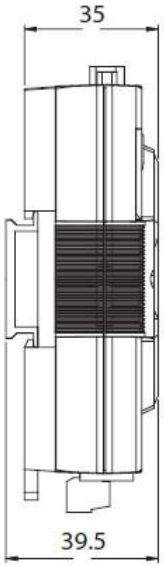
The diagrams below provide the dimensions of the ET-7019Z/PET-7019Z to use in defining your enclosure specifications. All dimensions are in millimeters.



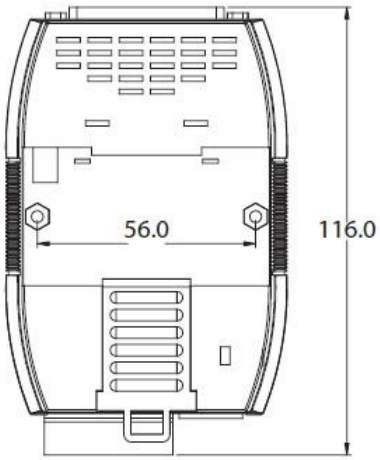
Front View



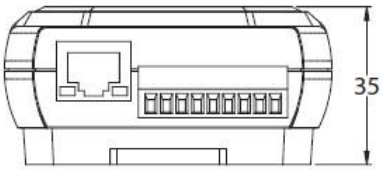
Right Side View



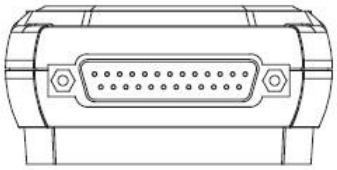
Din Rail Mounting Bracket



Rear View



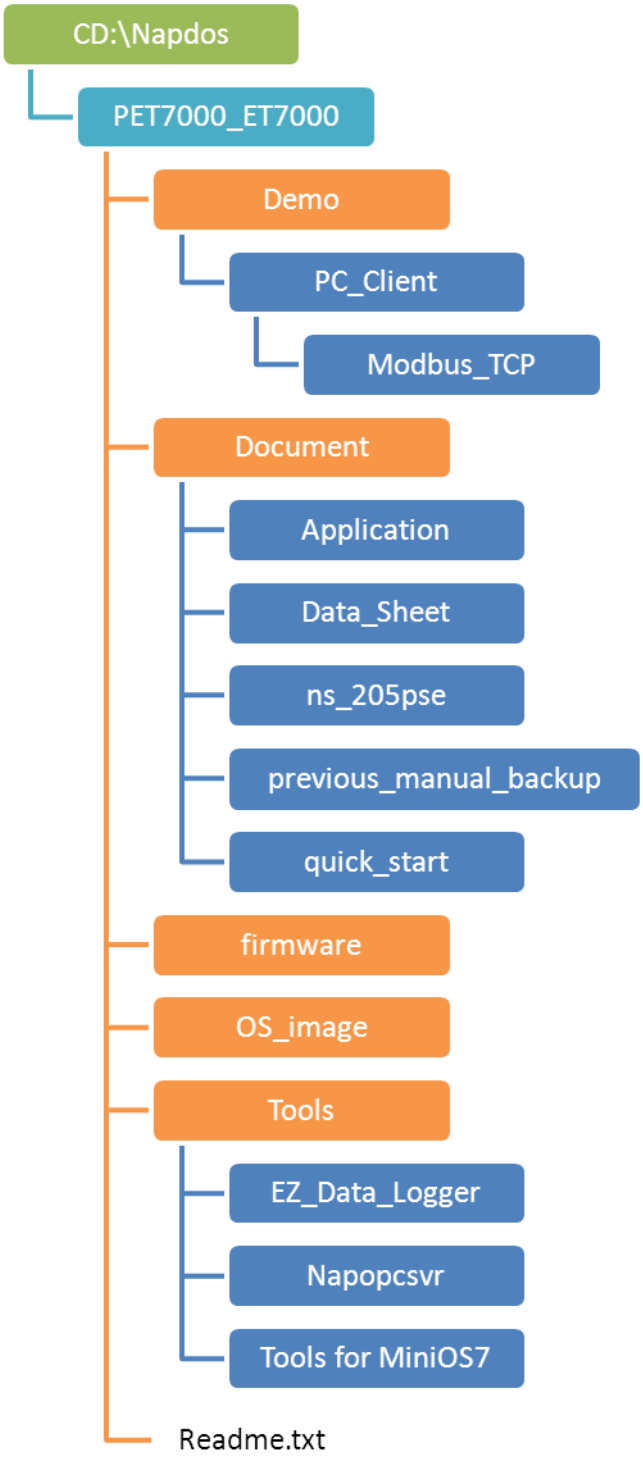
Bottom View



Top View

1.5. Companion CD

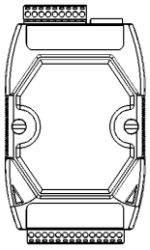
This package comes with a CD that provides drivers, software utility, all of the required documentations, etc. All of them are listed below.



2. Getting Started

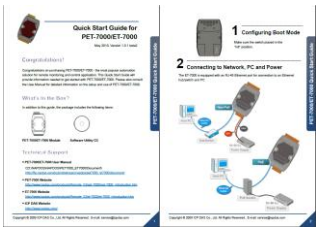
If you are a new user, begin with this chapter, it includes a guided tour that provides a basic overview of installing, configuring and using the ET-7019Z/PET-7019Z.

Before starting any task, please check the package contents. If any of the following package contents are missing or damaged, contact your dealer on distributor.



ET-7019Z/PET-7019Z

Software Utility CD



Quick Start Guide

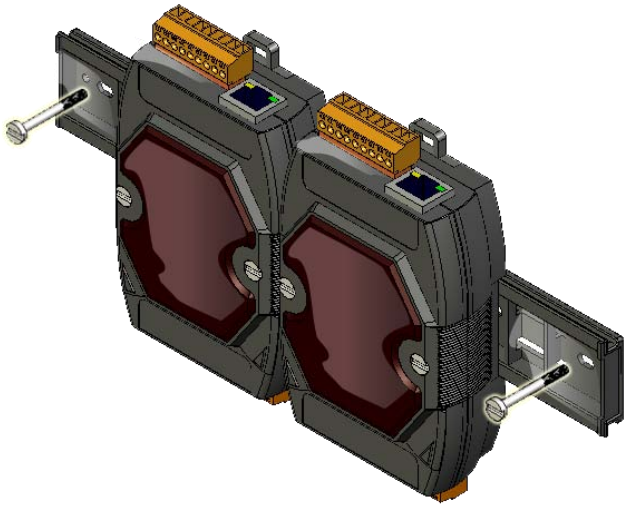
Before you work with the ET-7019Z/PET-7019Z, you should have a basic understanding of hardware specification, such as the dimensions, the usable input-voltage range of the power supply, and the type of communication interfaces.

For more information about the hardware details, please refer to “1.2. Specifications”

For more information about the hardware dimensions, please refer to “1.4. Dimensions”

2.1. Mounting the Hardware

The ET-7019Z/PET-7019Z can be mounted with bottom of the chassis on the DIN-Rail, the wall or piggyback.



DIN-Rail Mounting

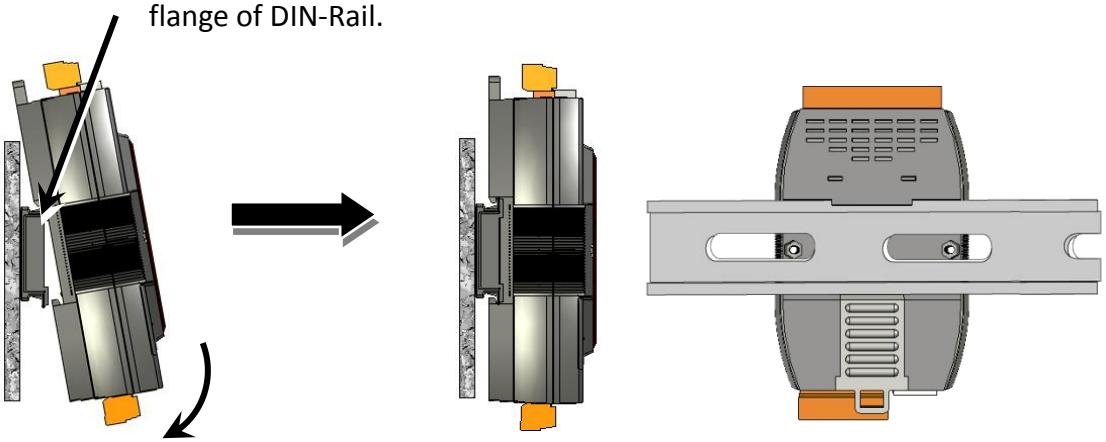
The ET-7019Z/PET-7019Z has simple rail clips for mounting reliably on a standard 35 mm DIN-Rail.

Mount the Chassis on a DIN-Rail

i. Hook upper tab over upper flange of DIN-Rail.

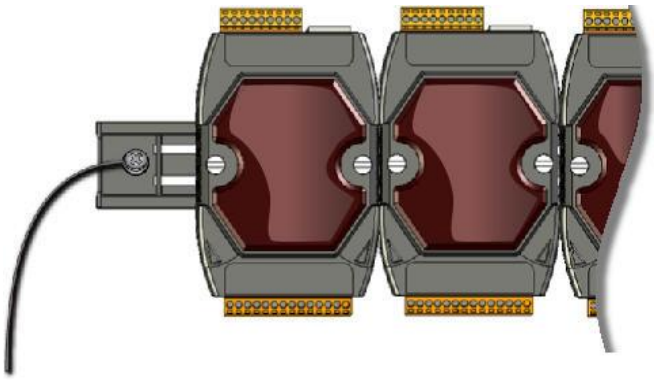
ii. Tilt the module toward DIN-Rail until it snaps securely to DIN-Rail.

1. Hook upper tab over upper flange of DIN-Rail.



2. Tilt the module toward DIN-Rail until it snaps securely to DIN-Rail.

DIN-Rail Accessories



Part number	Number of modules	Dimensions
DRS-125	2	125 mm x 35 mm
DRS-240	3	240 mm x 35 mm
DRS-360	5	360 mm x 35 mm

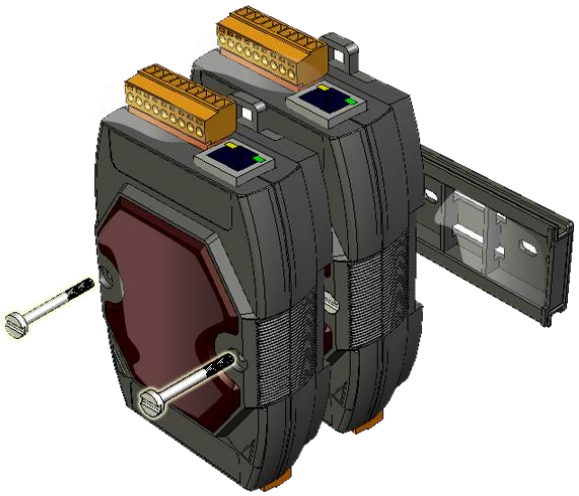
Three DIN-Rail mountable models are available to mount a variety of ICP DAS devices. Each is made of stainless steel and has a ground wire at the end.

For more information, please refer to

http://www.icpdas.com/products/Accessories/din_rail/drs-125.htm

Piggyback Mounting

The ET-7019Z/PET-7019Z has two holes on both sides for piggyback mounting.

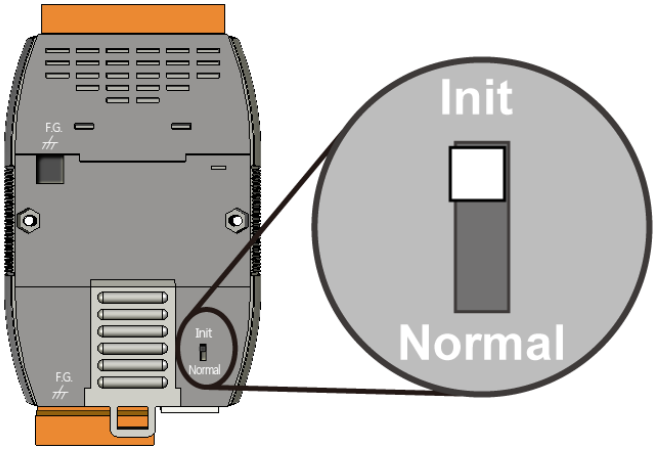


2.2. Configuring the Boot Mode

The ET-7019Z/PET-7019Z has the following two operating modes that can be determined by the switch mechanism on the chassis.

Init Mode

Init mode is a way to use MiniOS7 configuration mode.

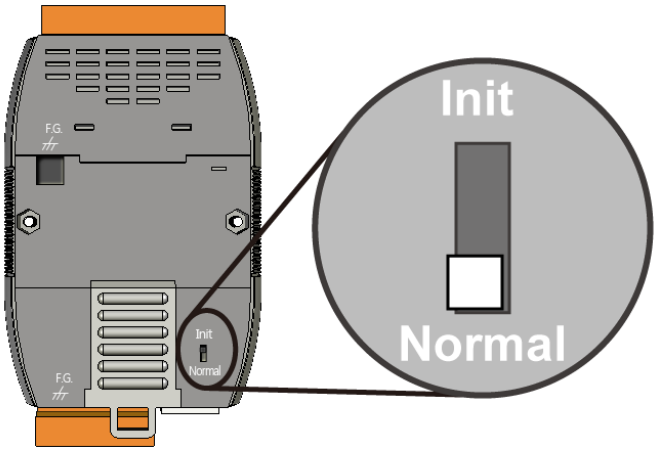


Tips & Warnings

Init mode is a method to use MiniOS7 configuration mode and update the program. After the update is completed, set the switch to the Normal position.

Normal Mode

Normal mode is the default mode of operation and the one you will use most of the time. Use this mode for more tasks and configurations. Programs also are executed in this mode.



2.3. Deploying a Basic ET-7019Z/PET-7019Z Application

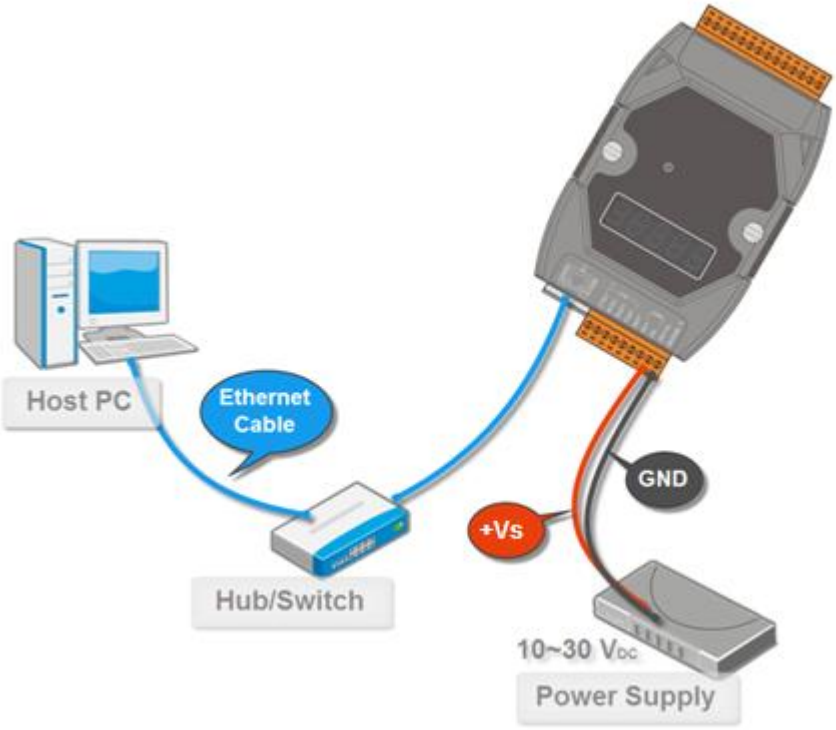
The ET-7019Z/PET-7019Z provides a variety of communication interface to suit a range of applications. Here is a simple application for using the ET-7019Z/PET-7019Z that is shown below.

Non-PoE

i. Connect PC to the Ethernet Port via the Hub/Switch.

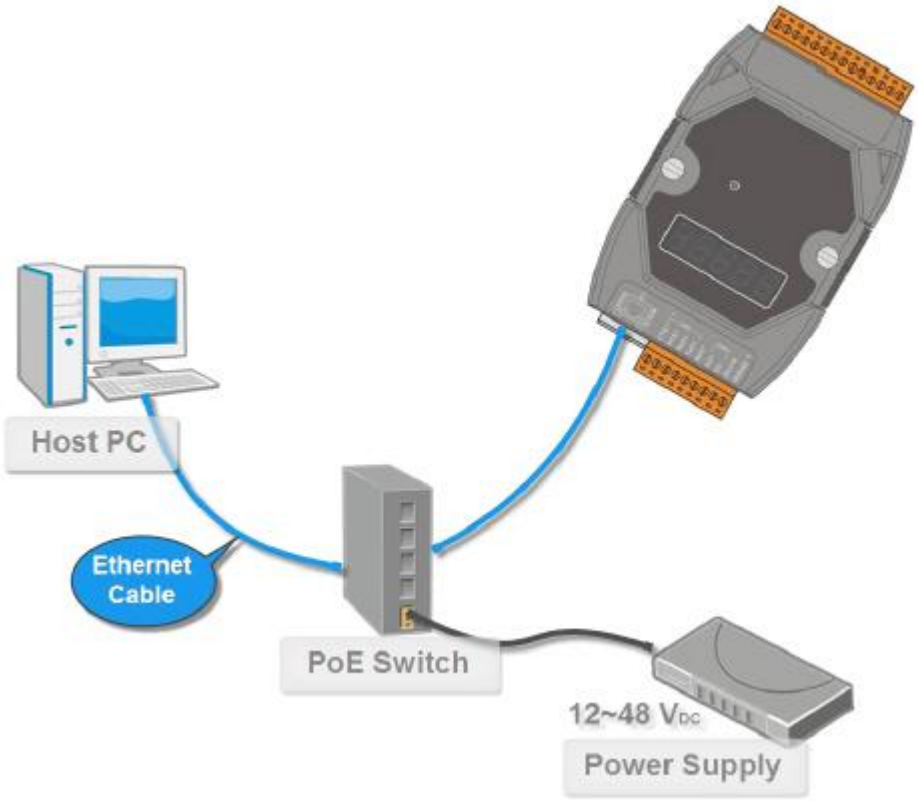
ii. Connect the positive of the power supply to the terminal marked (+Vs)

Connect the negative of the power supply to the terminal marked (GND)



i. Connect PC to the Ethernet Port via the PoE Switch.

ii. Connect the power supply to the PoE Switch, which supplies power to the PET-7019Z



2.4. Installing the MiniOS7 Utility

The MiniOS7 Utility is a useful tool that provides a quick and easy way to update OS image or firmware, configure Ethernet settings, and download files to ET-7019Z/PET-7019Z from PC.

Step 1 Get the MiniOS7 Utility tool

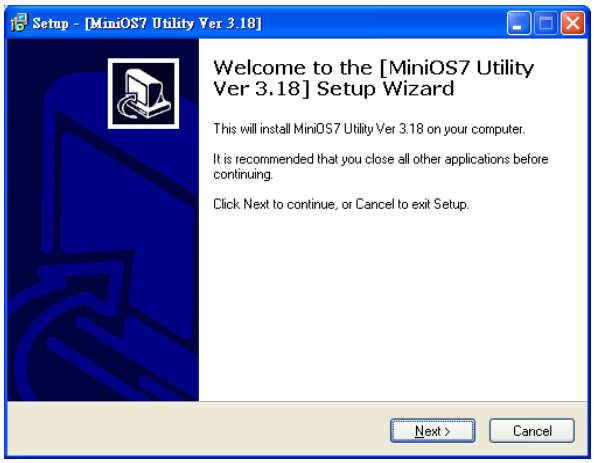
The MiniOS7 Utility can be obtained from companion CD or our FTP site:

CD:\Napdos\minios7\utility\minios7_utility\

http://ftp.icpdas.com/pub/cd/8000cd/napdos/minios7/utility/minios7_utility/

Step 2 Follow the prompts to complete the installation

After the installation has been completed, there will be a new short-cut for MiniOS7 Utility on the desktop.



2.5. Using MiniOS7 Utility to Assign an IP address

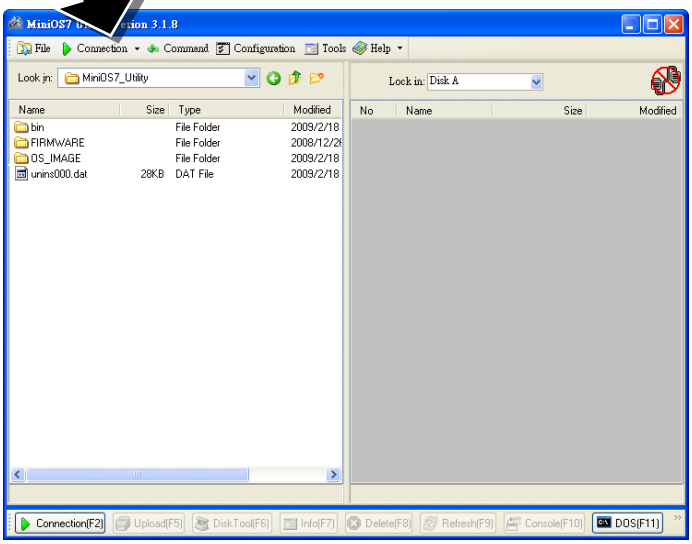
The ET-7019Z/PET-7019Z are web-based devices, which comes with a default IP address, therefore, you must first assign a new IP address to the ET-7019Z/PET-7019Z.

The factory default IP settings are as follows:

Item	Default
IP Address	192.168.255.1
Subnet Mask	255.255.0.0
Gateway	192.168.0.1

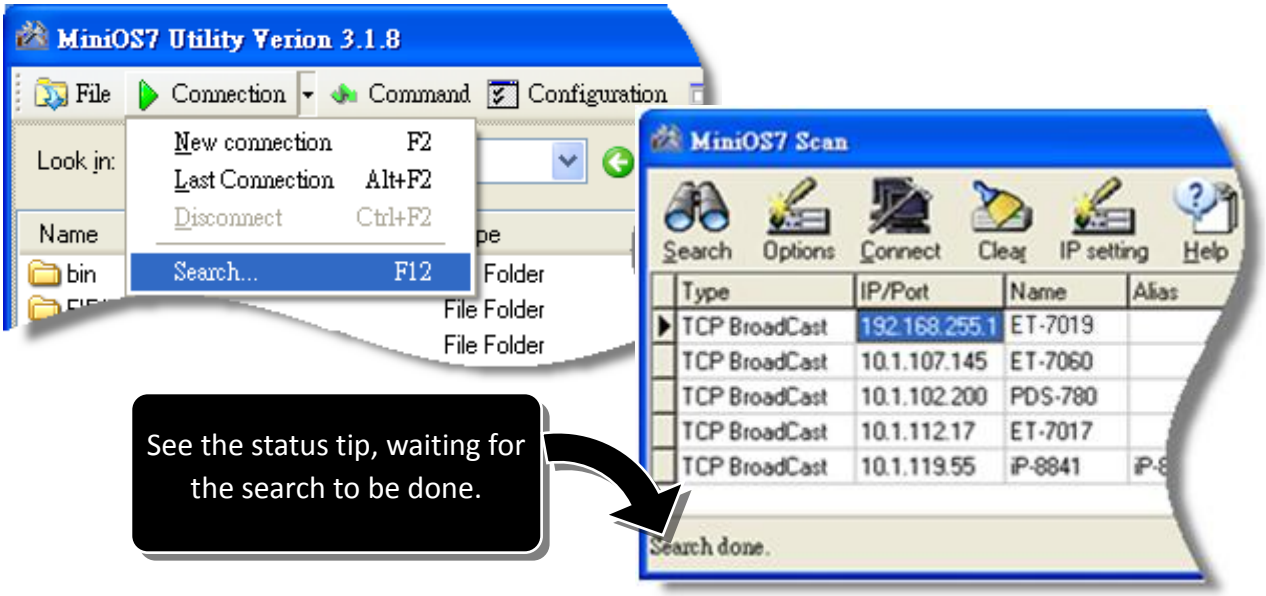
Step 1 Run the MiniOS7 Utility

Double-click the MiniOS7 Utility shortcut on your desktop.



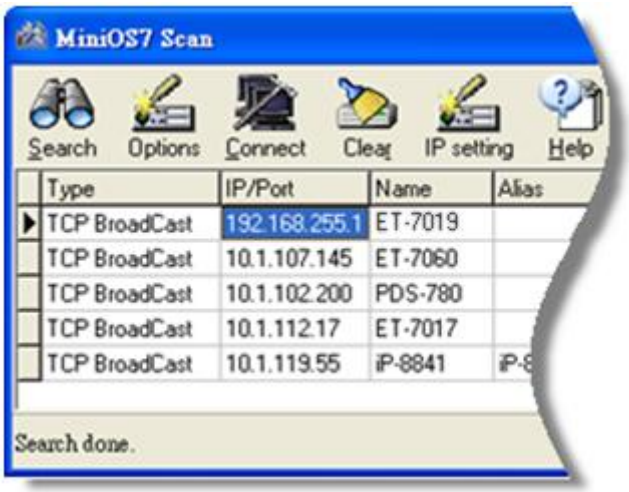
Step 2 Press “F12” or choose “Search” from the “Connection” menu

After pressing F12 or choosing Search from Connection menu, that will search all of the MiniOS7 modules on your network.



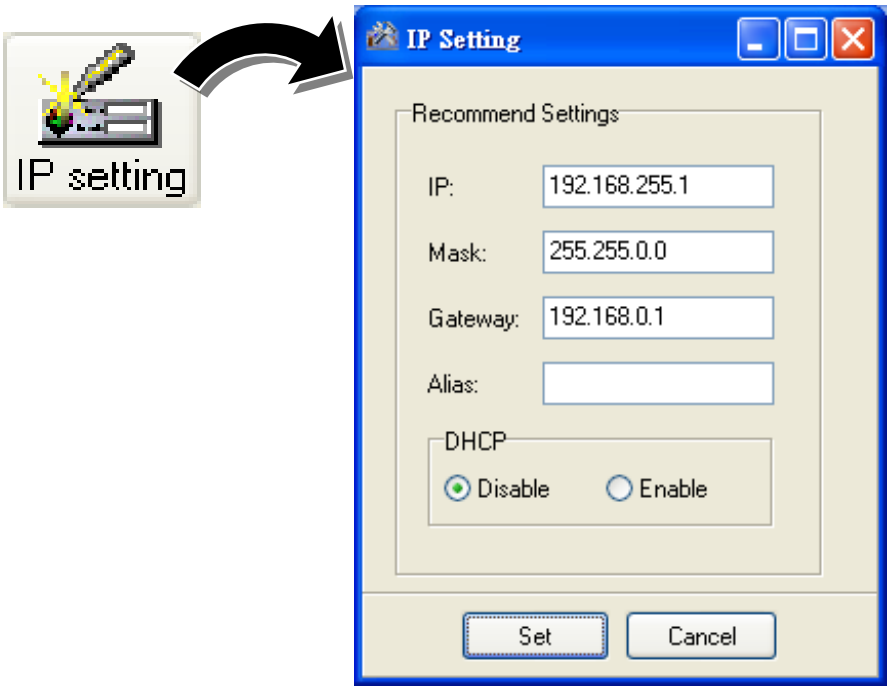
Step 3 Choose the field “192.168.255.1” and then choose “IP setting” from the toolbar

Choose default value “192.168.255.1” for fields in the list, and then choose IP setting from the toolbar.



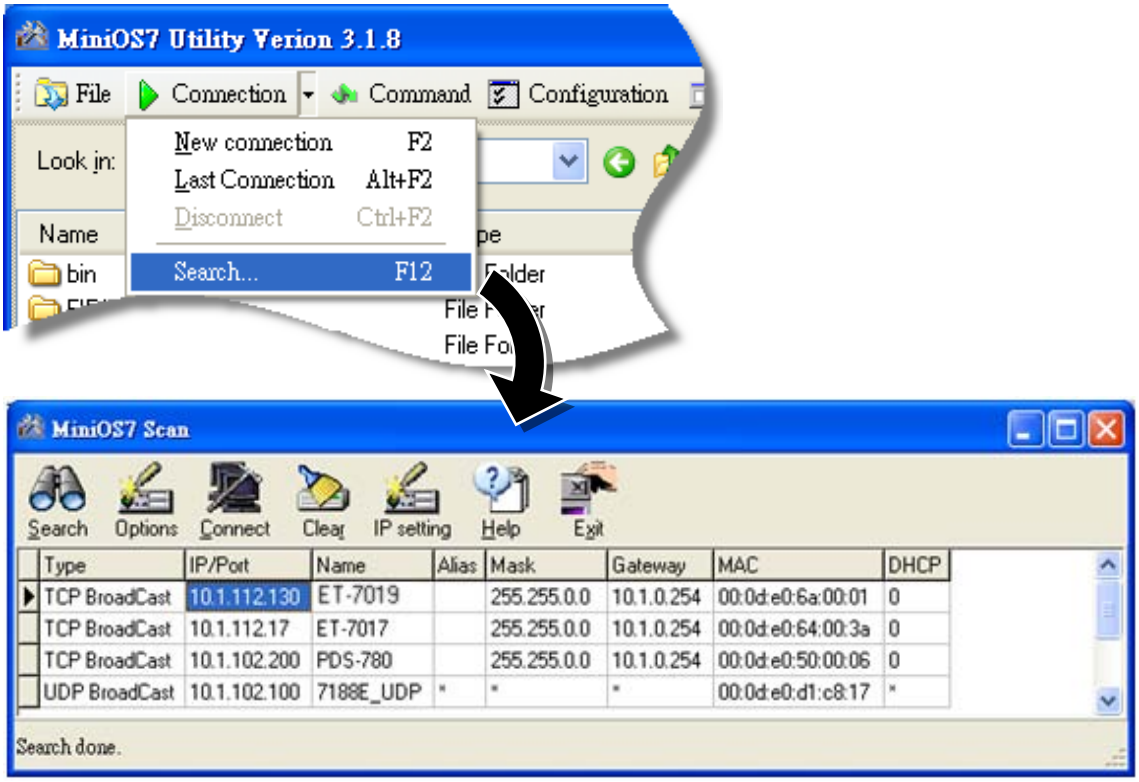
Step 4 Assign a new IP address and then choose “Set” button

You can manually assign an IP address or use DHCP to dynamically assign IP addresses



Step 5 Reboot the module and then press “F12” or choose “Search” from the “Connection” menu to check the IP setting

After completing the settings, you can reboot the module and then using MiniOS7 Utility to search module again for making sure that your IP settings are correct.



2.6. Enabling Adobe Flash Player in Browser

The Web HMI page requires the Adobe Flash Player. The latest version of Adobe Flash Player can be downloaded by accessing the Adobe Systems Incorporated website. The following instructions will help you to install the Adobe Flash Player into your web browser.

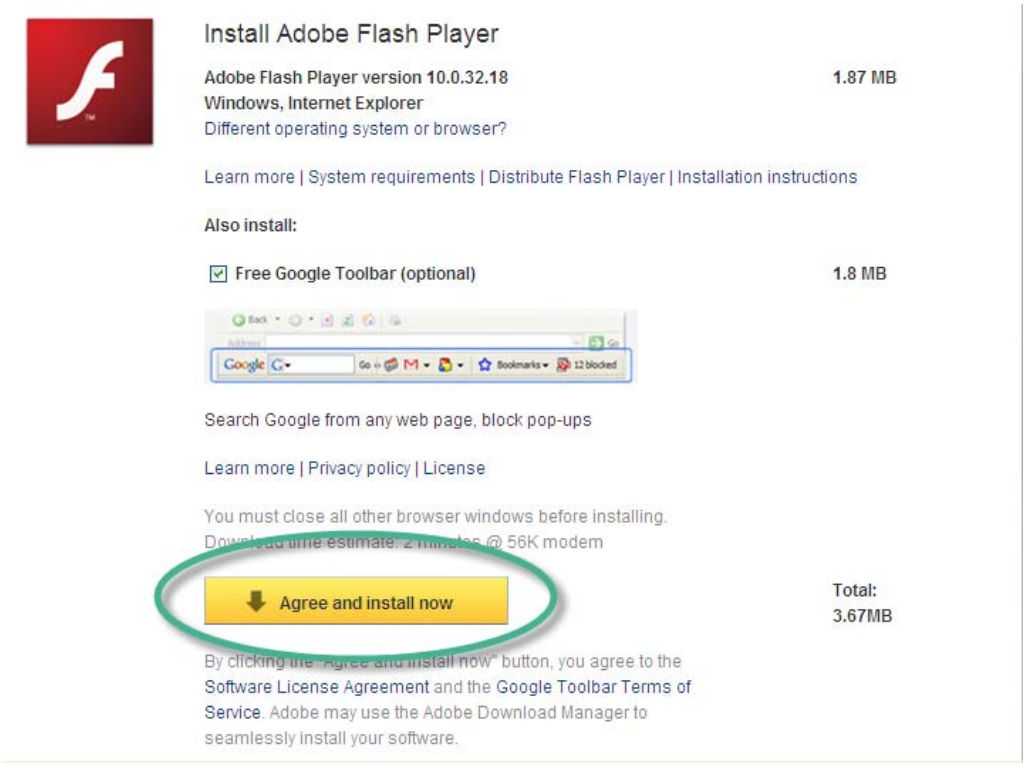
Step 1 Go to the Adobe Flash Player Download Center

The Adobe Flash Player Download Center:

http://get.adobe.com/flashplayer/

Step 2 Follow the prompts to download the installation file

Click the Agree and install now button and follow the instructions to download the installation file



3. Web Applications

The ET-7019Z/PET-7019Z contains an advanced web configuration system that provides users with access ET-7019Z/PET-7019Z applications through a standard web browser.

Logging in to the ET-7019Z/PET-7019Z Web site

You can log in to the ET-7019Z/PET-7019Z web site from any computer that has Internet access.

Step 1 Open a browser

In several browsers, Mozilla Firefox and Internet Explorer are both reliable and popular Internet browsers.

Step 2 Type the URL address of the ET-7019Z/PET-7019Z

If you haven't changed the default IP address of the ET-7019Z/PET-7019Z, please refer section "2.5. Using MiniOS7 Utility to Assign an IP address" to configure it.

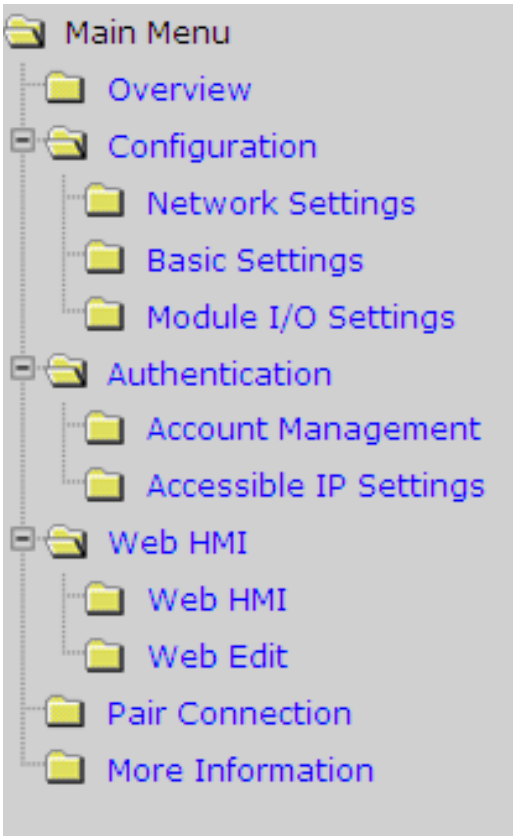
Step 3 Fill out the User name and Password

After entering the IP address, the login dialog box will appear and prompt you to enter your username and password.

The factory default user name and password are as follows:

Step 4 Welcome to ET-7019Z/PET-7019Z web site

After logging into the ET-7019Z/PET-7019Z web site, the welcome page will appear.

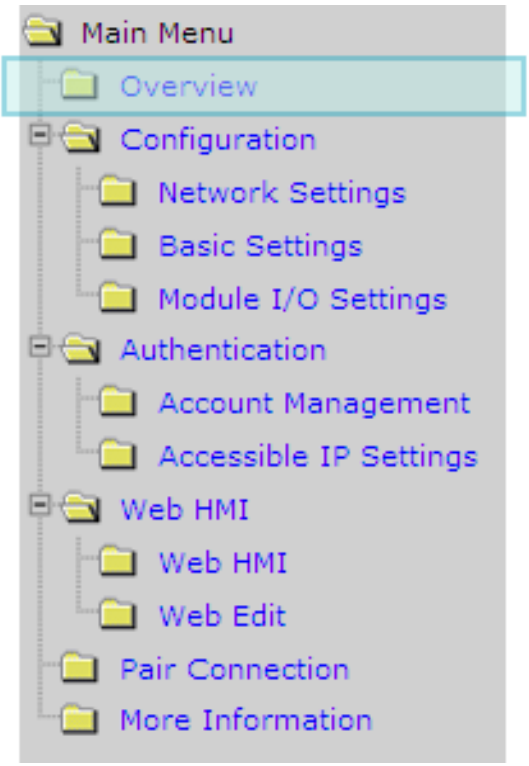


This site serves several functions. You can easily access these functions through the menu on the left side.

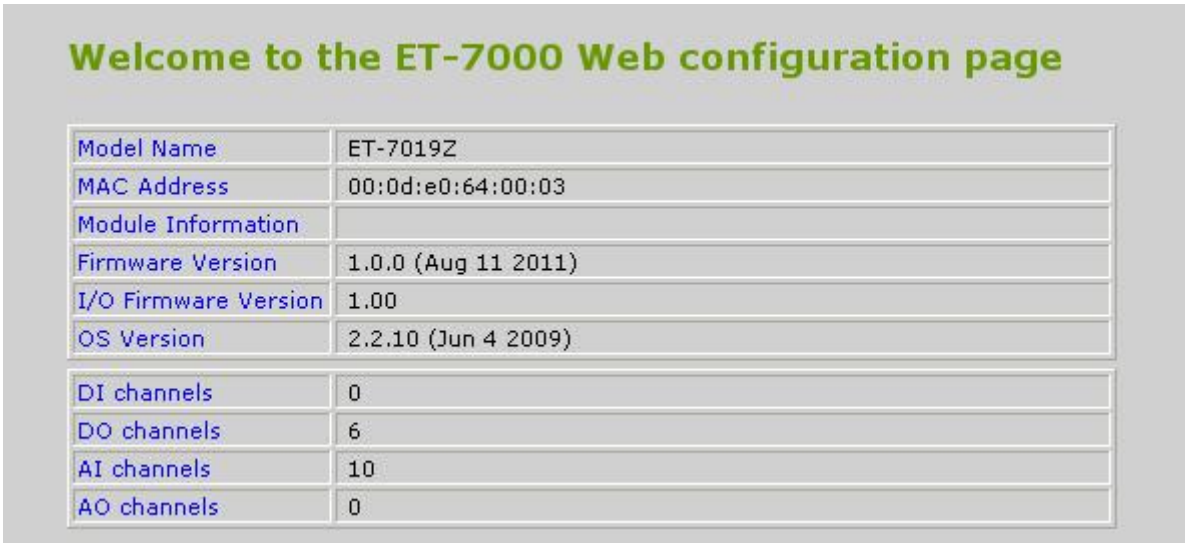
The Overview of the Main menu provides a brief introduction and explanation of this site.

3.1. Overview

The Overview links to the welcome page that determines two message body parts.



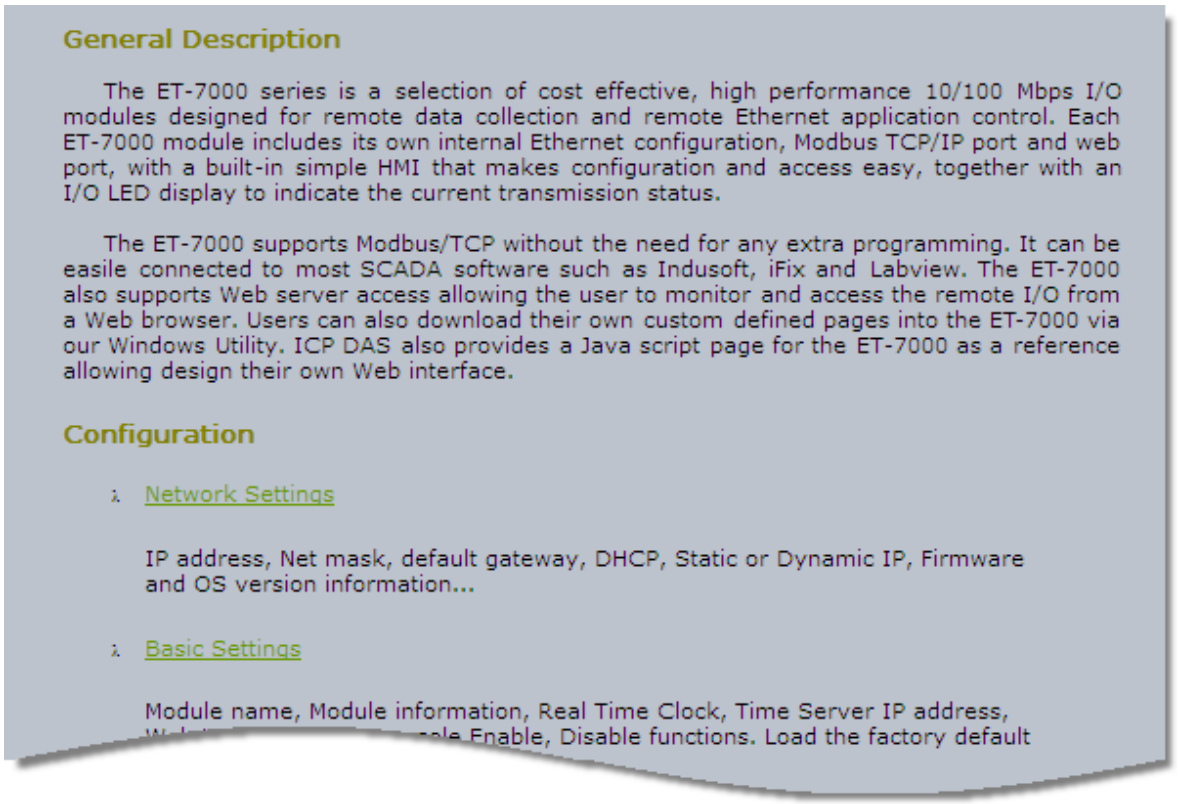
The first part of this page provides basic information about the ET-7019Z/PET-7019Z hardware and software.



Welcome to the ET-7000 Web configuration page

Model Name	ET-7019Z
MAC Address	00:0d:e0:64:00:03
Module Information	
Firmware Version	1.0.0 (Aug 11 2011)
I/O Firmware Version	1.00
OS Version	2.2.10 (Jun 4 2009)
DI channels	0
DO channels	6
AI channels	10
AO channels	0

The second part of this page provides a brief introduction of this web site.



General Description

The ET-7000 series is a selection of cost effective, high performance 10/100 Mbps I/O modules designed for remote data collection and remote Ethernet application control. Each ET-7000 module includes its own internal Ethernet configuration, Modbus TCP/IP port and web port, with a built-in simple HMI that makes configuration and access easy, together with an I/O LED display to indicate the current transmission status.

The ET-7000 supports Modbus/TCP without the need for any extra programming. It can be easile connected to most SCADA software such as Indusoft, iFix and Labview. The ET-7000 also supports Web server access allowing the user to monitor and access the remote I/O from a Web browser. Users can also download their own custom defined pages into the ET-7000 via our Windows Utility. ICP DAS also provides a Java script page for the ET-7000 as a reference allowing design their own Web interface.

Configuration

- Network Settings

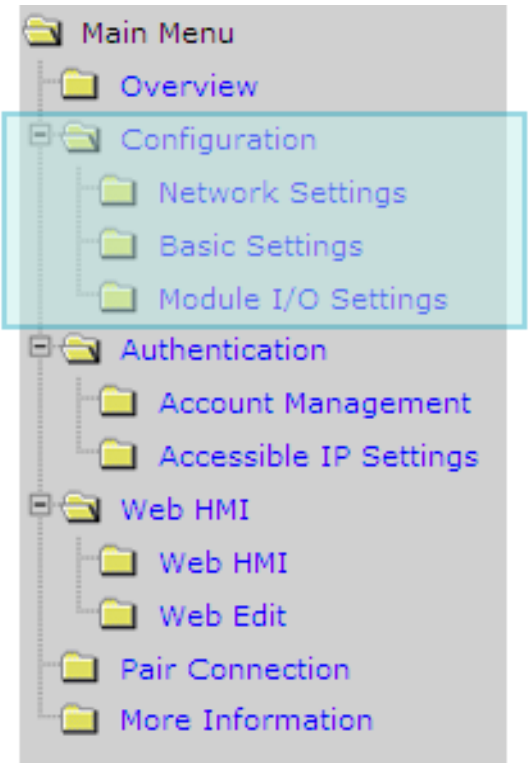
  IP address, Net mask, default gateway, DHCP, Static or Dynamic IP, Firmware and OS version information...

- Basic Settings

  Module name, Module information, Real Time Clock, Time Server IP address, ...ole Enable, Disable functions. Load the factory default

3.2. Configuration

All items below are located under the **Configuration** menu:



Network Settings: Links to the Ethernet Settings page that allows you to access the IP settings and check the software version.

Basic Settings: Links to the Basic Settings page that allows you to configure the basic information of this site.

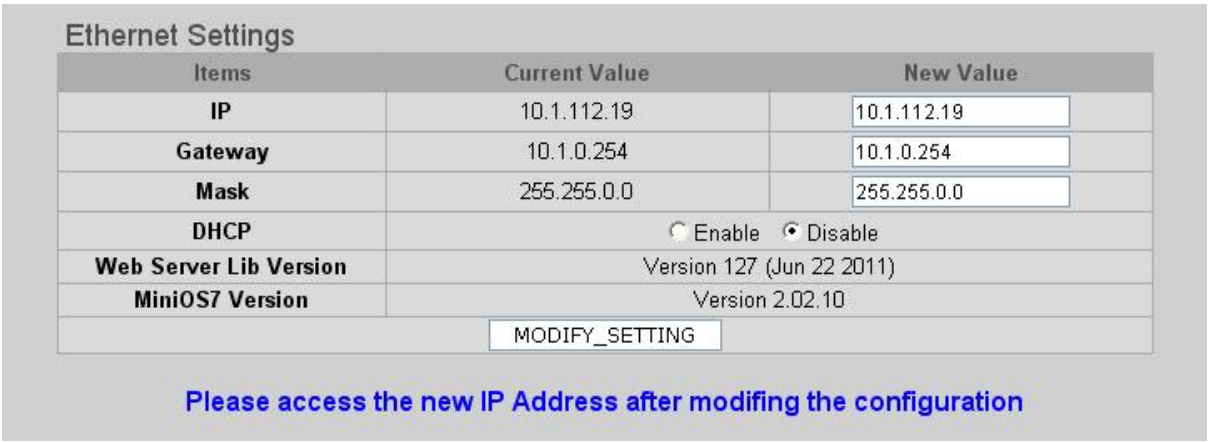
Module I/O Settings: Links to the Common Functions page that allows you to configure the settings of the Modbus I/O.

3.2.1. Network Settings

The Ethernet Settings page provides the following functions:

(A) Configure the network settings

(B) Check the software information



(A) Configure the Network Settings

A generally network setting includes the following parameters:

- **An IP address**: Each ET-7019Z/PET-7019Z on the network must have a unique IP address. It is used to assign an IP address.
- **A default gateway**: A gateway (or router) is a system that is used to connect a network with one or more other networks.
- **A subnet mask**: The subnet mask indicates which portion of the IP address that is used to identify the local network or subnet.

There are two ways to configure the network settings:

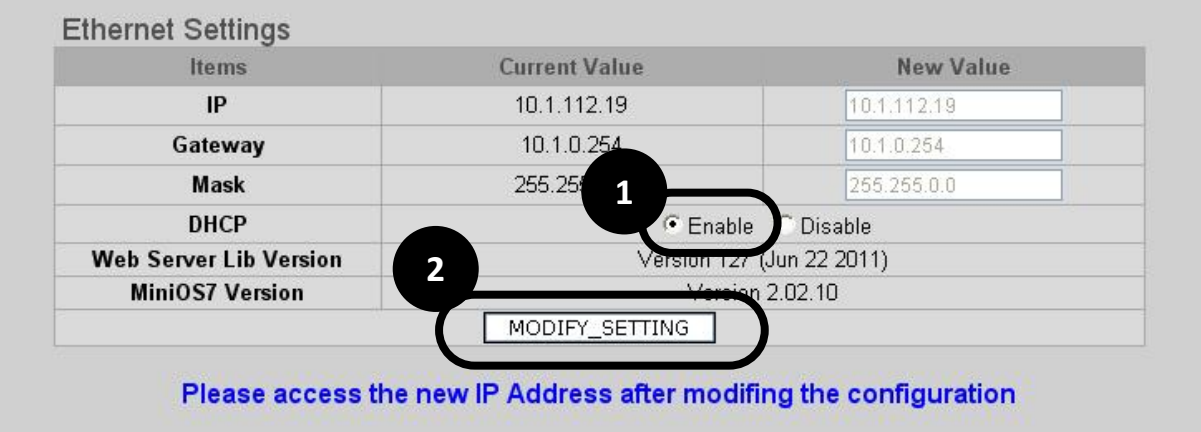
- **Dynamic configuration**: Dynamic Host Configuration Protocol (DHCP) is a network application protocol that automatically assigns IP address to devices.
- **Manually configuration**: In the absence of DHCP, ET-7019Z/PET-7019Z modules can be manually configured with an IP address, mask, and gateway.

(a) Dynamic Configuration

Dynamic configuration is very easy to configure. If you have a DHCP Server, network address can be configured dynamically by following steps:

Step 1 Enable the DHCP.

Step 2 Click “MODIFY_SETTING” to finished configuring the network settings.



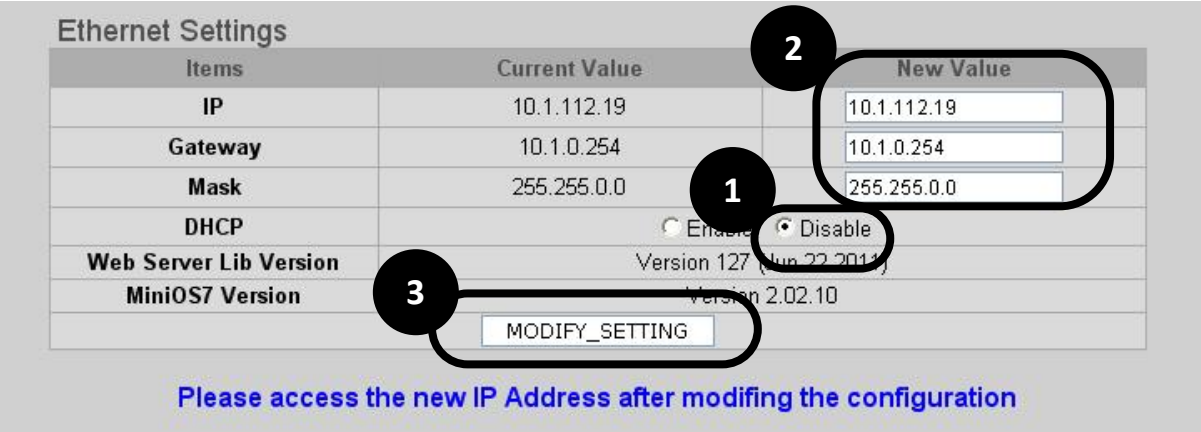
(b) Manually Configuration

In manual configuration, you have to assign all the network settings manually. To configure network settings manually, follow the following steps:

Step 1 Disable the DHCP.

Step 2 Enter the network settings.

Step 3 Click “MODIFY_SETTING” to finished configuring the network settings.



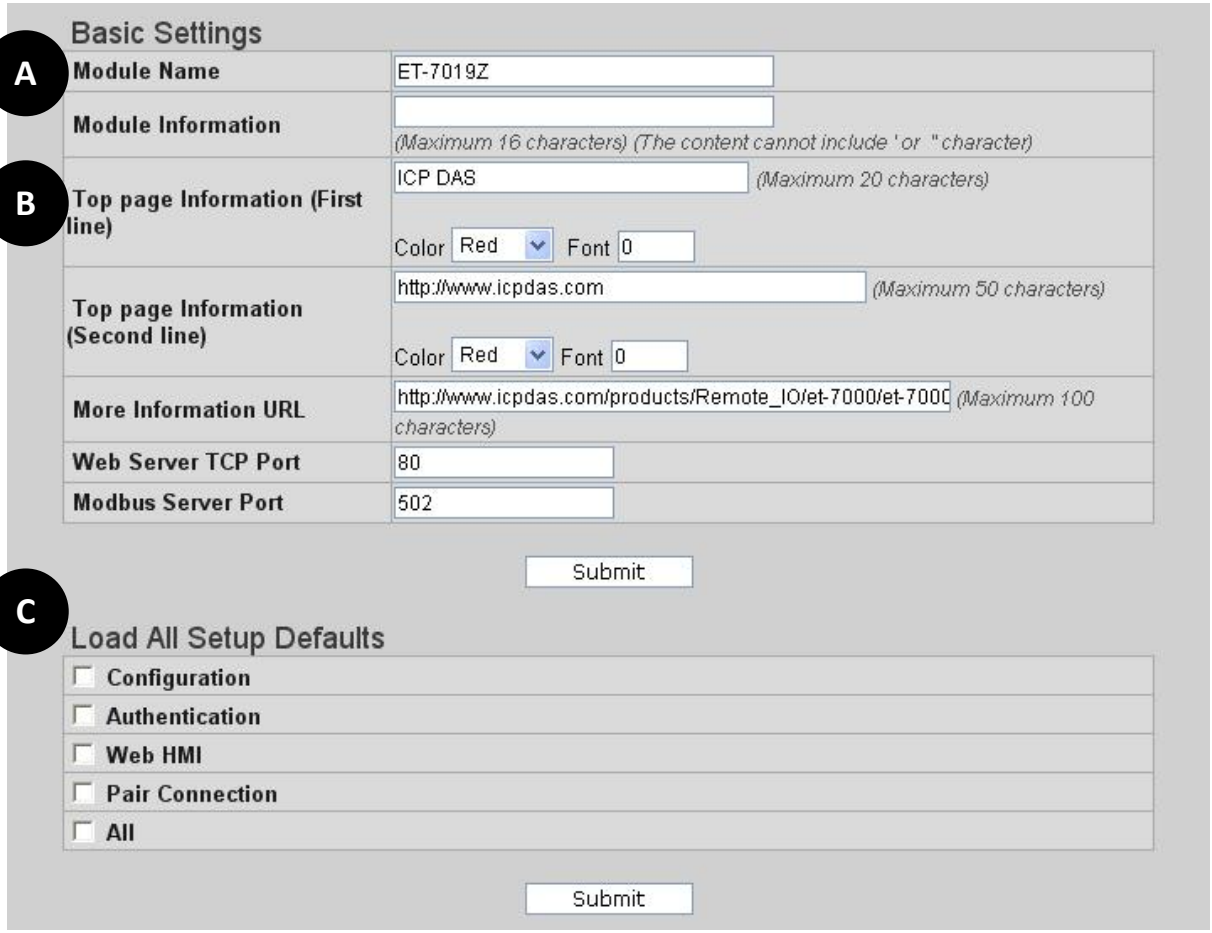
3.2.2. Basic Settings

The Basic Settings page provides the following functions:

(A) Configure the module information

(B) Configure the web site information

(C) Reset all settings to default



(A) Configure the Module Information

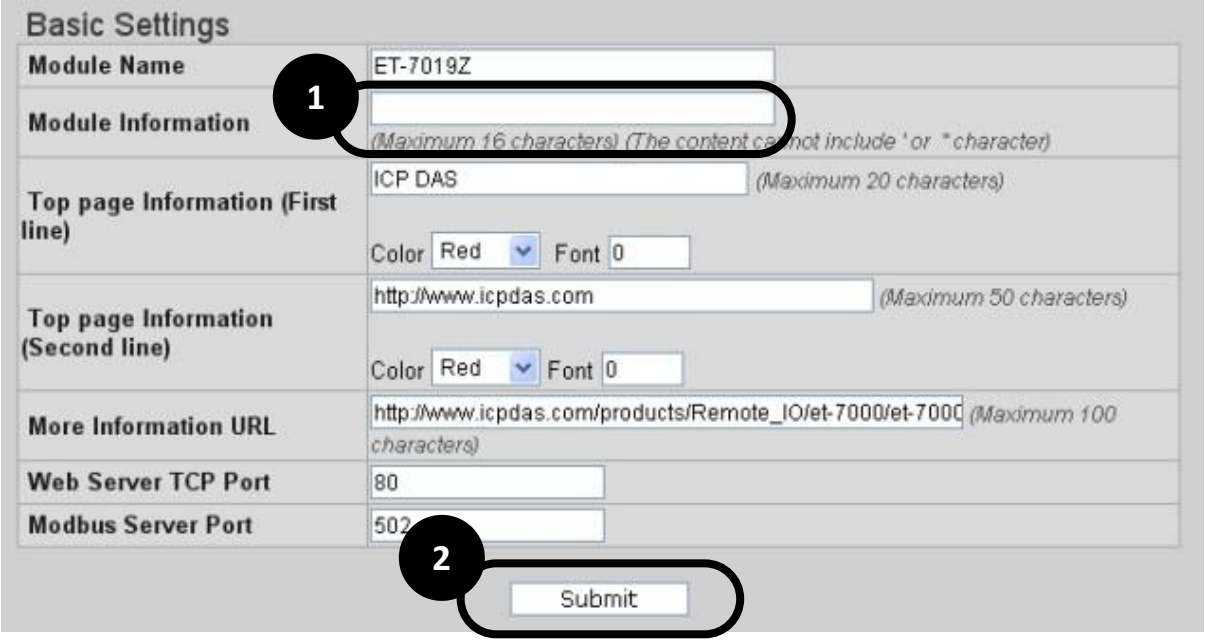
The module information includes the following data items:

- **Module Name**: This field indicates the name of the module. This field does not allow to be modified.
- **Module Information**: The module information indicates the name of the alias that is used to identify the module.

To configure the module information, follow the following steps:

Step 1 Enter the Module information.

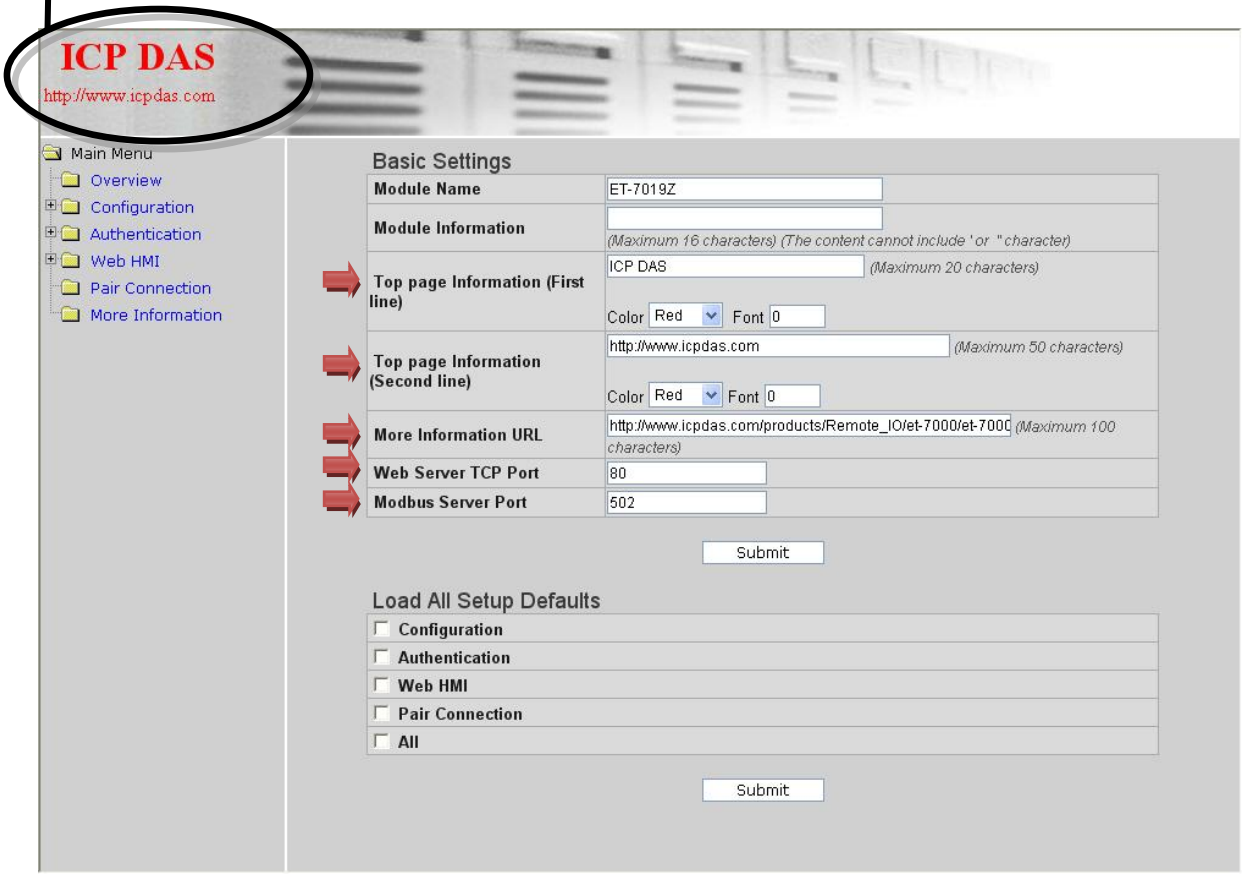
Step 2 Click “Submit” to finished configuring the module information.



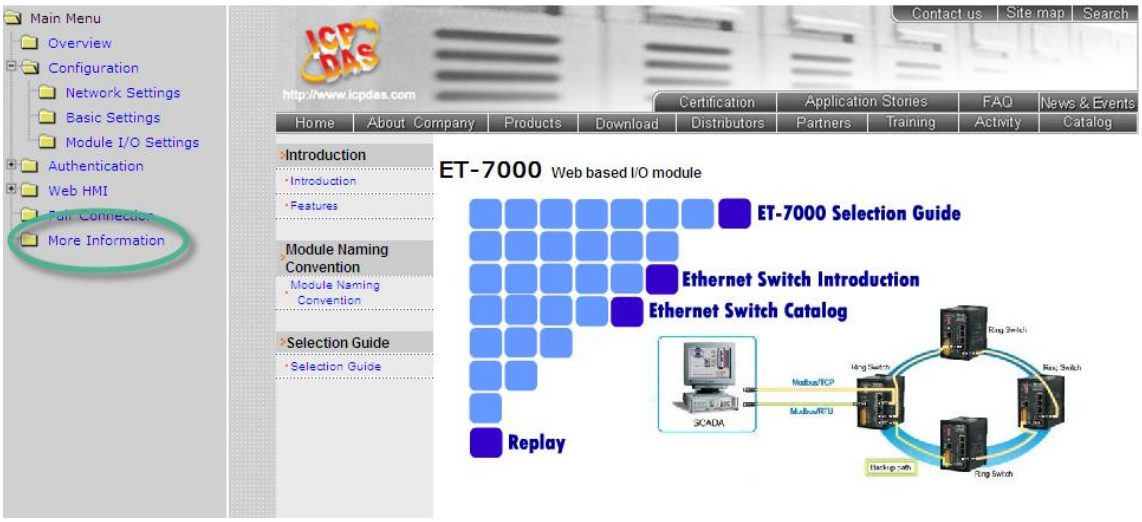
(B) Configure the Web site Information

The module information includes the following data items:

- **Top page Information (First line)** and **Top page Information (Second line)**:
  The title of the website that can be modified; you can view the title information in the top-left corner. The title information can be determined as follows:



- **More Information URL**: The URL of the more information menu that can be modified, you can specify the URL for getting additional ET-7019Z/PET-7019Z supports.

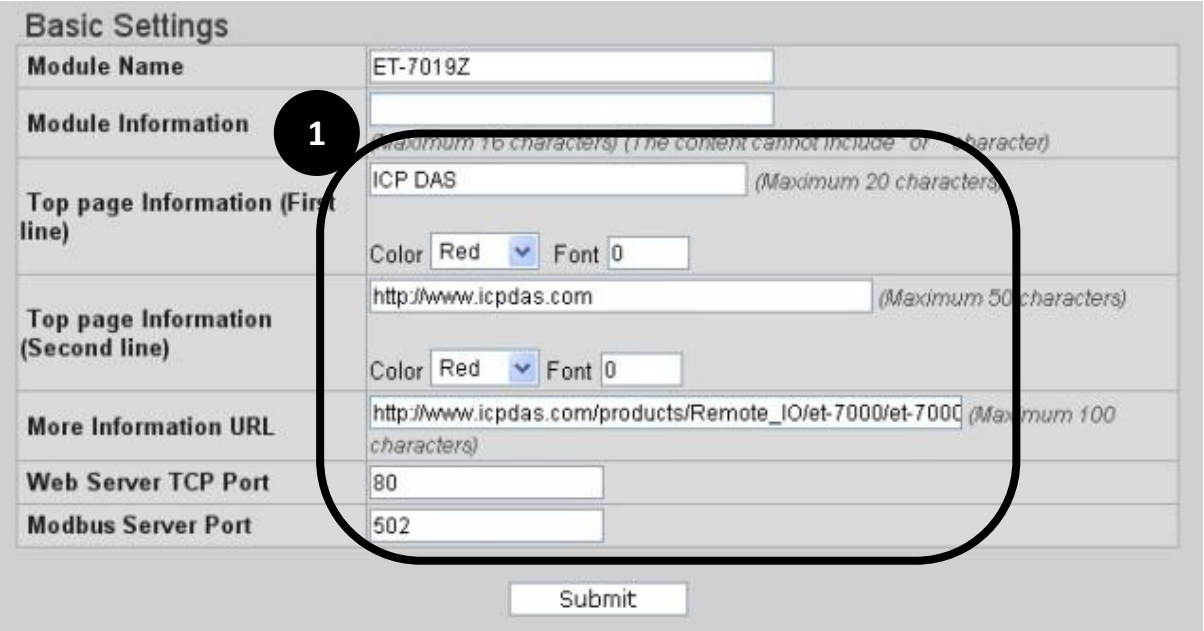


- **Web Server TCP Port**: By default, TCP/IP uses Port 80.
- **Modbus Server TCP Port**: By default, TCP/IP uses Port 502.

To configure the web site information, follow the following steps:

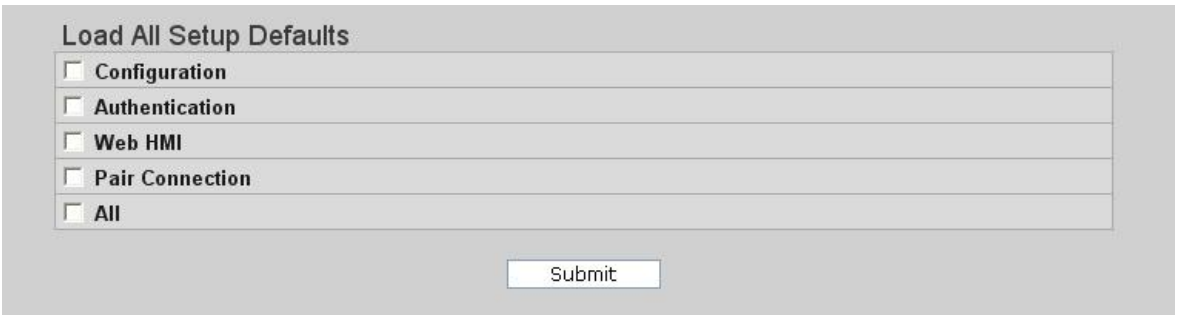
Step 1 Enter the web site information.

Step 2 Click “Submit” to finished configuring the module information.



(C) Reset All Settings to Default

According to the menu selection of this web, the reset function can be divided into the following categories. You can use this function to reset the settings to their factory default.



(a) Configuration

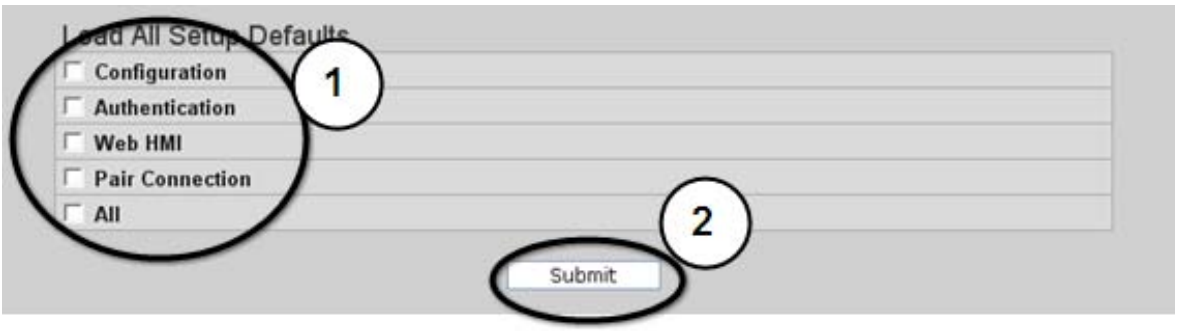
(b) Authentication

(c) Web HMI

(d) Pair Connection

(e) All

To reset the settings to their factory default, follow the following steps:



Step 1 Enable the reset selection.

Step 2 Click “Submit” to finished resetting the settings to their factory default.

(a) Factory Default Settings for “Configuration” Menu Service

The table below lists the factory default settings of the “Configuration” menu.

Network Settings

Data Item	Factory Default Settings
IP	192.168.255.1
Gateway	192.168.0.1
Mask	255.255.0.0
DHCP	Disable

Basic Settings

Data Item	Factory Default Setting
Module Name	Depending on the module name
Module Information	Empty
Top page Information (First line)	ICP DAS
Top page Information (Second line)	http://www.icpdas.com
More Information URL	http://www.icpdas.com/products/Remote_IO/et-7000/et-7000_introduction.htm
Web Server TCP Port	80
Modbus Server TCP Port	502

Module I/O Settings

Common Function	
Function	Factory Default Setting
Host WDT Timeout	0 (Disable)
Modbus NetID	1

Digital Output	
Function	Factory Default Setting
Power-on Value	OFF
Safe Value	OFF

Analog Input		
Function		Factory Default Setting
Mode		Enable
Analog Input Type		Type 05, +/- 2.5V
AI Data Format		2’s complement hexadecimal
50/60 Hz Rejection for AI		60 Hz rejection
Open Wire Detection		Enable
AI High Alarm	**Alarm Value**	2.5 V
	Enable	OFF
	Alarm Mode	Momentary
AI Low Alarm	**Alarm Value**	-2.5 V
	Enable	OFF
	Alarm Mode	Momentary

Cold Junction Compensation (CJC)	
Function	Factory Default Setting
CJC	ON
CJC Total Offset	0
CJC Update Setting	Start
CJC Offset	ON

(b) Factory Default Settings for “Authentication” Menu Service

The table below lists the factory default settings of the “Authentication” menu.

Account Management

Factory Default Setting
A default user account consists of an account name “Admin” and a password “Admin”.

Accessible IP Settings

Factory Default Setting
Empty, there is no limit to allow any outgoing access.

(c) Factory Default Settings for “Web HMI” Menu Service

The table below lists the factory default settings of the “Web HMI” menu.

Web HMI

Factory Default Setting
Depending on the Modbus setting function of the ET-7019Z/PET-7019Z.

Web Editing

Factory Default Setting
0 Page

(d) Factory Default Settings for I/O Pair Connection

The table below lists the factory default settings of the “Pair Connection” menu.

Pair Connection

Factory Default Setting
Empty

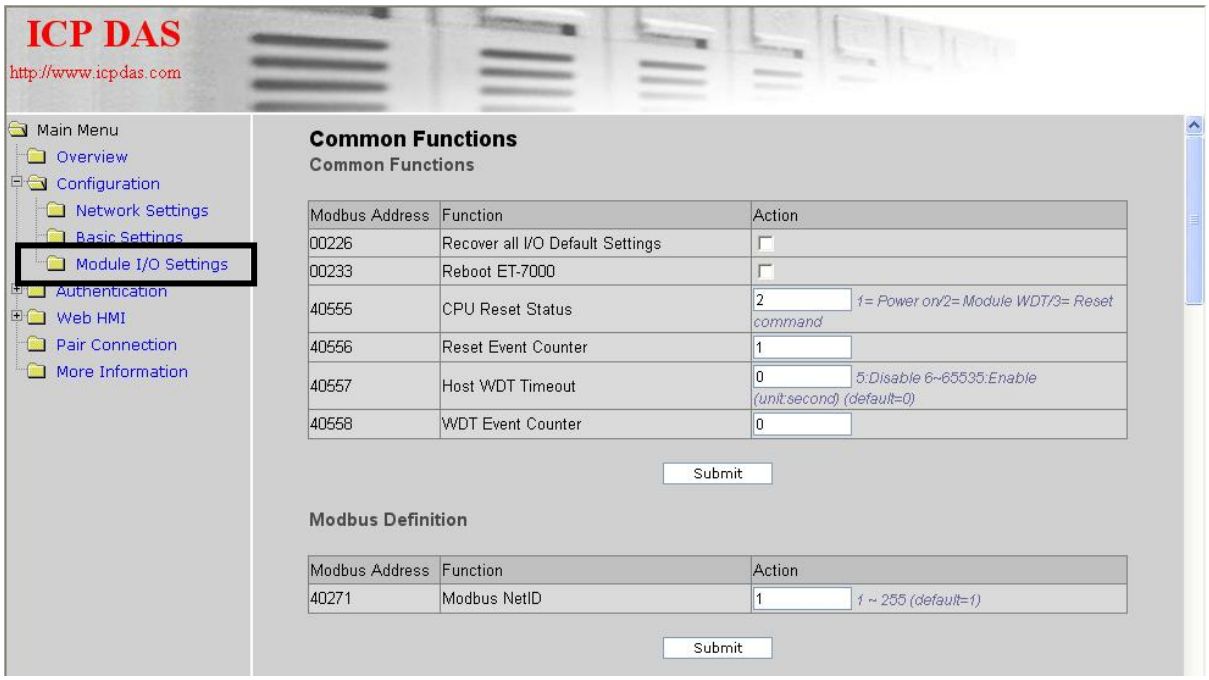
3.2.3. Module I/O Settings

After you have completed all general configuration of ET-7019Z/PET-7019Z module described in previous section, then you need to configure setting for input and output channel such as channel range and alarm.

Common Functions

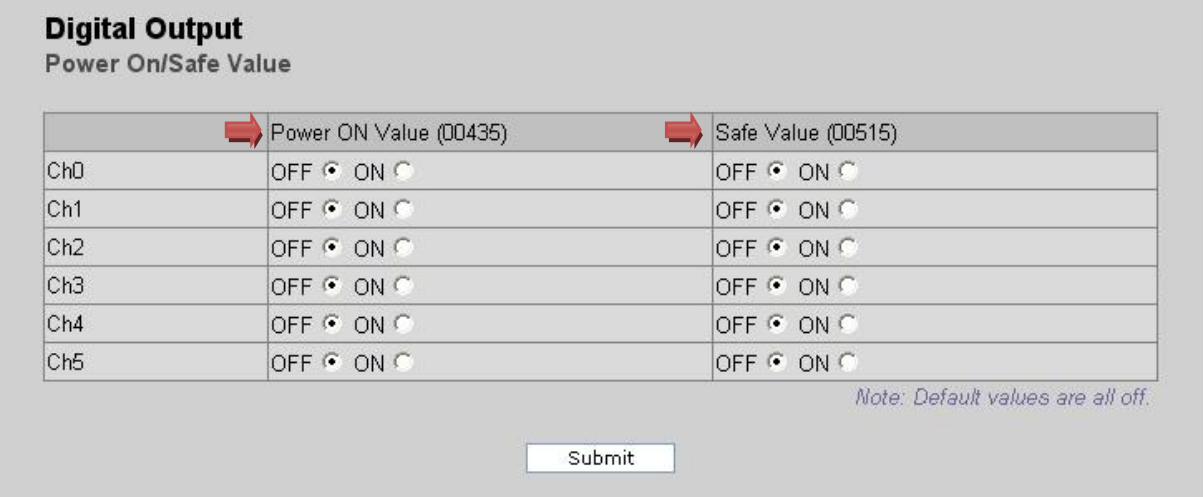
The Common Function area provides options to configure the settings of the Modbus functions.

The figure below shows the Modbus settings for the ET-7019Z/PET-7019Z module.



Digital Output Settings

You can read configuration setting for all digital output channels on the Digital Output area.



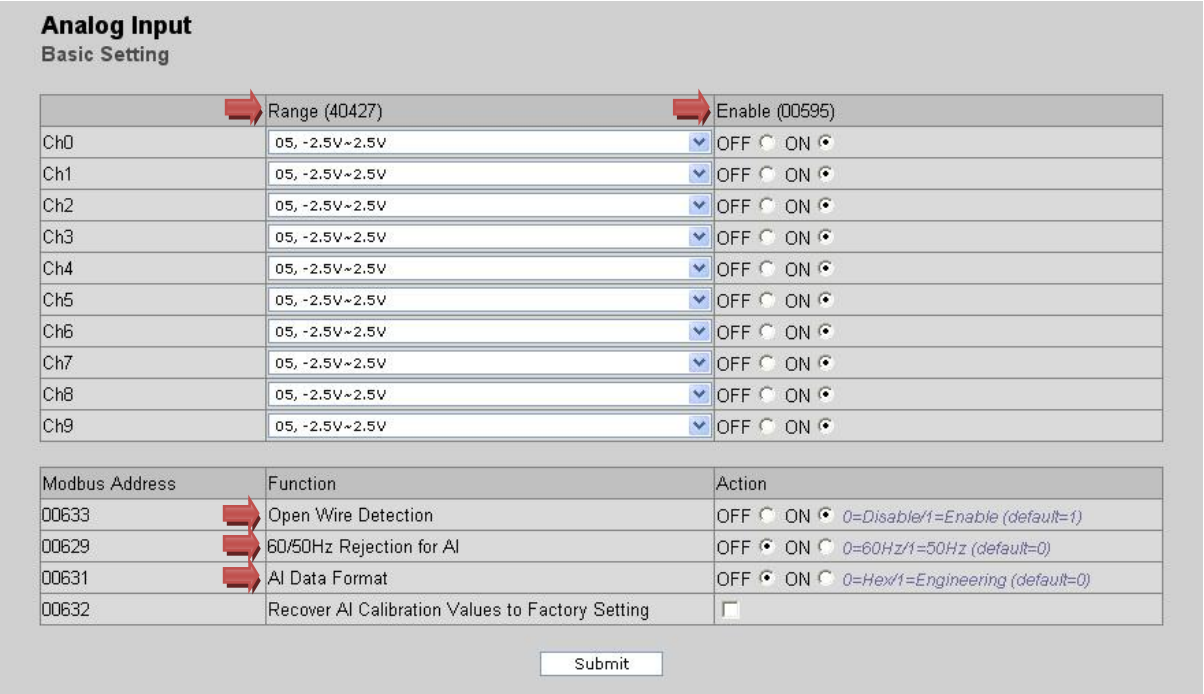
Power-on Value: You can set the power-on value of the specific digital output channel. The digital output channel will generate the start-up value output.

Safe Value: When the communication between host PC and ET-7019Z/PET-7019Z modules is broken, the digital output channels can generate a predefined value. You can enable or disable this function by configuring the Host WDT Timeout setting.

For a more detailed description of these Modbus function, please refer to section "Appendix B. Modbus Application Notes".

Analog Input Settings

There are two parts on the Analog Input Settings area.



Range: ET-7019Z/PET-7019Z module provides programmable input range on all analog inputs. You can set different range for each analog input channel. In the Range options, select the range in the combo box.

For more detailed technical specifications on input range of each analog input, please refer to "Appendix C. Analog Input Type and Data Format Table".

Enable: Each analog input channel can be switched on and off.

Open Wire Detection: Enable/Disable the open-wire detection for thermocouple measurement.

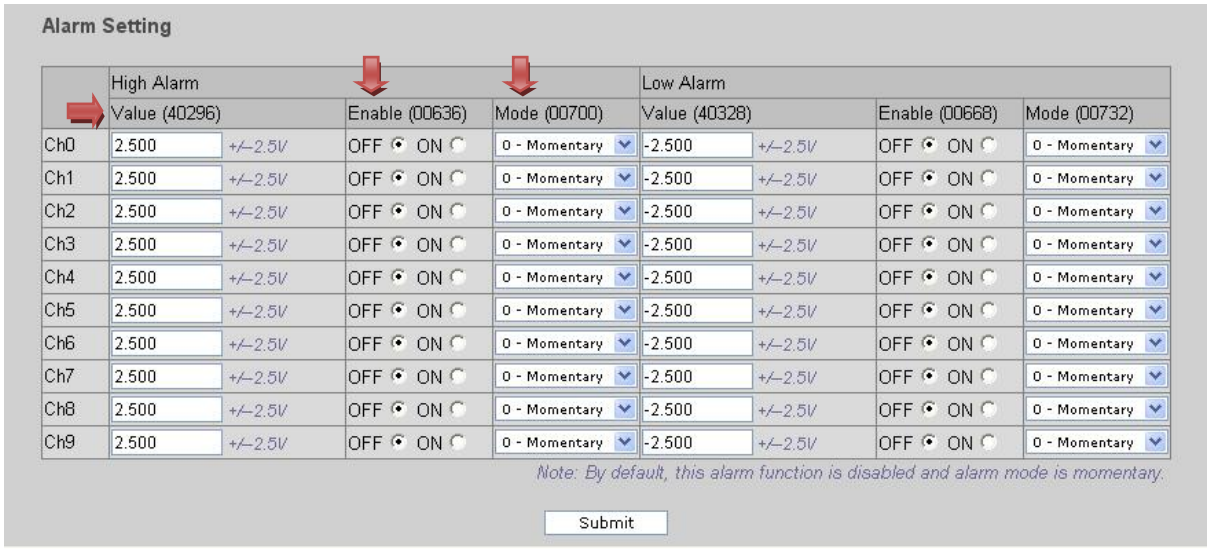
50/60Hz Rejection for AI: In order to remove the noise from the power supply, these analog input modules feature built-in filter. Two filters with different frequencies are provided to remove noise generated from different power supplies.

AI Data Format: ET-7019Z/PET-7019Z allows selection of hexadecimal or engineering unit display.

For more detailed technical specifications on input range of each analog input, please refer to "Appendix C. Analog Input Type and Data Format Table".

Analog Input Alarm Configuration

ET-7019Z/PET-7019Z modules feature built-in alarm function. There are two parts to configure the high alarm and low alarm for the specific channel: High alarm and Low alarm.



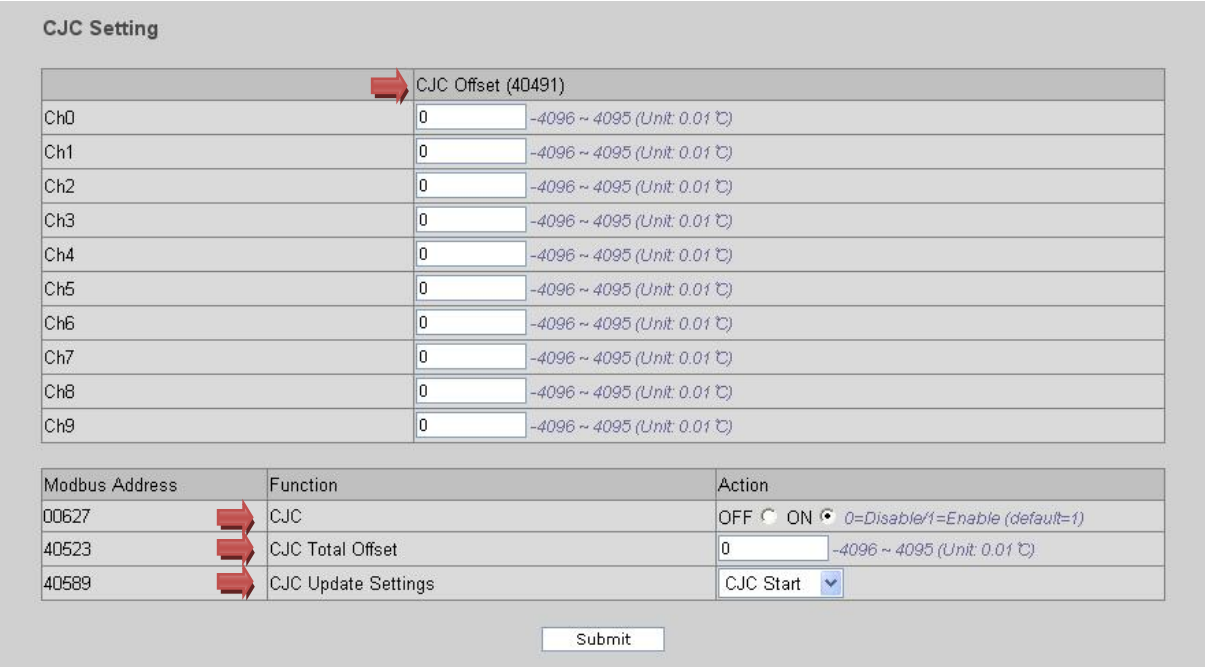
Value: You can define the high alarm value or low alarm value in Alarm Value text box. When the analog input value is higher than the high alarm value, or lower than the low alarm value, the alarm occurs. Then the alarm status will be activated to on.

Enable: Each analog input alarm can be switched on and off.

Mode: ET-7019Z/PET-7019Z allows selection of Momentary and Latch mode. You can select the alarm mode by the Alarm Type combo box for the low alarm and high alarm respectively.

- **Latch mode:** Once the alarm occurs, the alarm status will be activated to logic high level and will keep the value until the alarm is clear manually.
- **Momentary mode:** The alarm status will dynamically change depends on if the alarm occurs. If the alarm occurs, the alarm status will be on. If the alarm disappears, the alarm status will be off.

CJC Settings



CJC Offset: Set the CJC offset of the specified channel individually.

This feature behaves the same as the CJC Total Offset, except that it only affects a single channel. By default, this offset value is zero. The CJC offset can be any in the range of -4096 to +4095, and each count is 0.01°C.

CJC:

Enable/Disable the CJC (cold-junction compensation) of ET-7019Z/PET-7019Z.

CJC Total Offset: Set the CJC offset value for all AI channels.

The offset value is used to add or subtract a temperature measured by the CJC sensor. By default, this offset value is zero. Change of this value does not affect calibration, but will affect the displayed temperature. If an offset error is occurring with the CJC sensor, this feature may be used to reduce or eliminate that error. The CJC offset can be any in the range of -4096 to +4095, and each count is 0.01°C.

CJC Update Setting: Set the CJC temperature update setting.

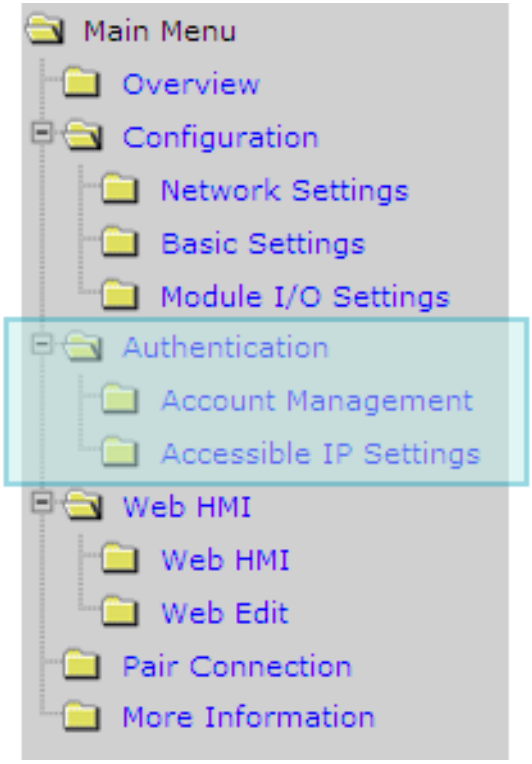
Start: Start the CJC temperature update (default value).

Stop: Stop the CJC temperature update.

Once: Update the CJC temperature once after receiving the command.

3.3. Authentication

All items below are located under the **Authentication** menu:



Account Management: Links to the Privilege management page that allows you to manage the user accounts and their privileges.

Accessible IP Settings: Links to the IP filter Settings page that allow you to control access to the web site.

3.3.1. Account Management

The Account Management page provides the following functions:

(A) Configure the user accounts

(B) Load the factory default user account

(A) Configure the User Accounts

The ET-7019Z/PET-7019Z web site supports up to 5 user accounts.

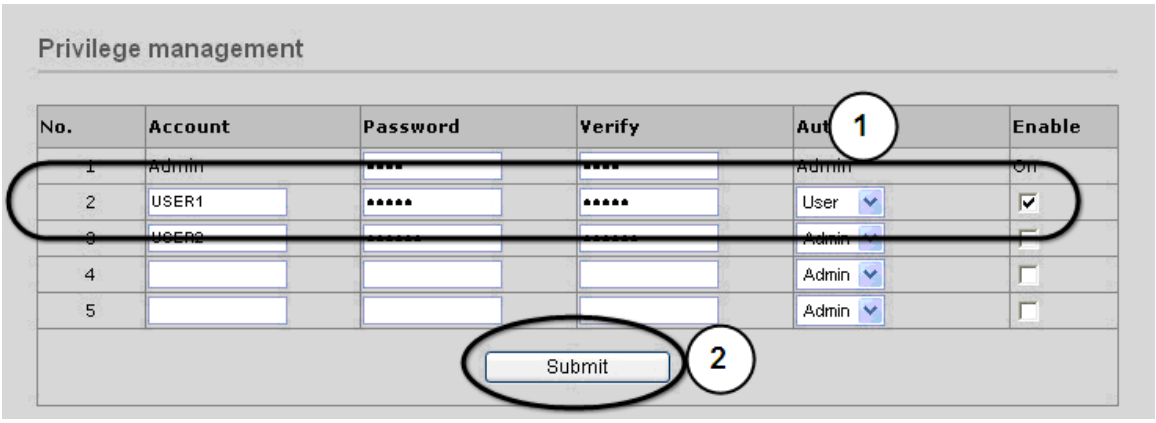
- A built-in Administrator Account
  The built-in Administrator is basically a setup and disaster recovery account that can be deleted. You can change the administrator account's password.
- Four User-defined Accounts

Each user account consists of the account name, password and authority.

The authority has the following roles to determine what operations the user is allowed to perform.

- **Admin**: Enables access to all ET-7019Z/PET-7019Z website features, functions, and commands.
- **User**: Enables limited access to ET-7019Z/PET-7019Z website features, functions, and commands. In general, operators cannot change configuration settings.

When you create user accounts, you can Enable or Disable user accounts.



Step 1 Enter the user account information, and then select the “Enable” checkbox.

Step 2 Click “Submit” to finished configuring the user accounts.

(B) Load the Factory Default User Accounts

The ET-7019Z/PET-7019Z has a built-in administrator account named Admin that is created when it is installed by default. The default account cannot be deleted.

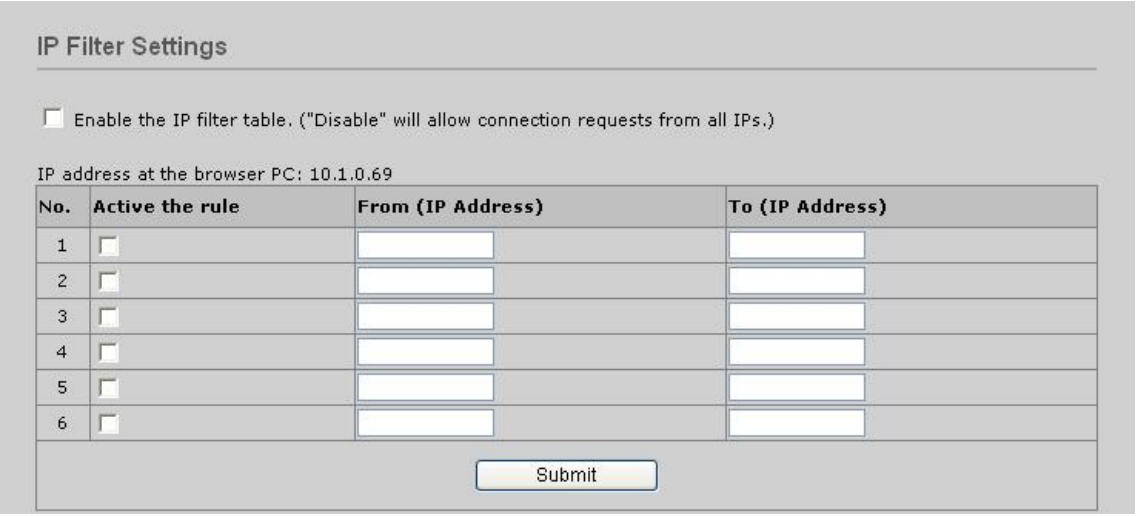
Step 1 Select the “Load Setup Default” checkbox.

Step 2 Click “Submit” to finished configuring the user accounts.

3.3.2. Accessible IP Settings

The IP filter Settings page provides the following functions:

● Configure connection filtering



(A) Configuring IP Filter

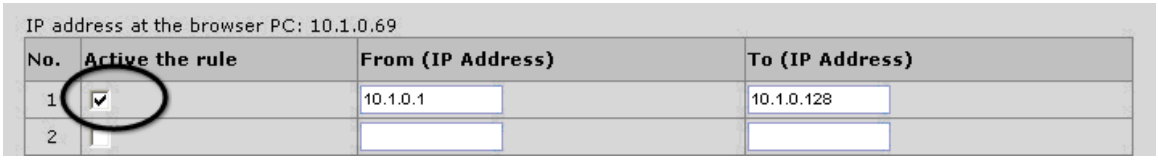
The ET-7019Z/PET-7019Z with an IP filter that enables you to restrict or grant user access based an IP filter list you create.

The filter can be enabled by selecting the “Enable the IP filter table” checkbox.

Tips & Warnings

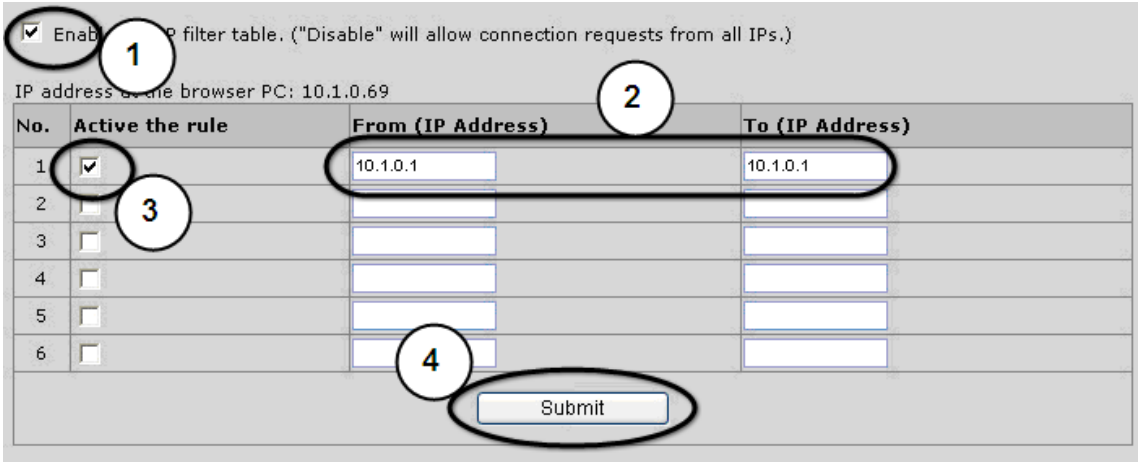
By default, there is no limit to allow any outgoing access.

Each list entry can be active or inactive by clicking its “Active the rule”.



(B) Configure the User Accounts

Here we provide two basic methods for configuring the IP filter.



Method 1: Allows access from a single IP address

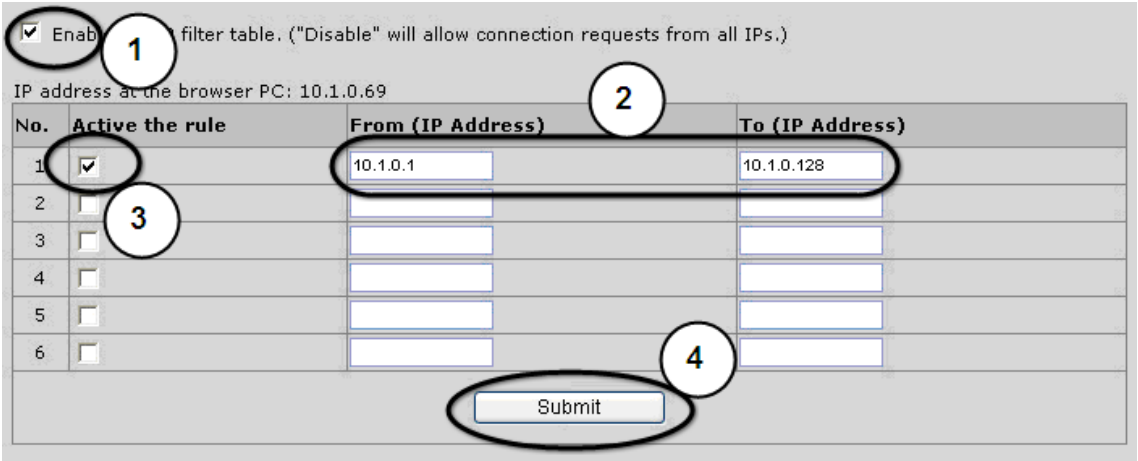
Step 1 Select the “Enable the IP filter” table checkbox.

Step 2 Enter the same IP address in the “From (IP Address)” and “To (IP Address)” text boxes.

Step 3 Select the “Active the rule” checkbox.

Step 4 Click “Submit” to finished configuring the IP filter list.

Method 2: Allow access from a group of IP addresses



Step 1 Select the “Enable the IP filter table” checkbox

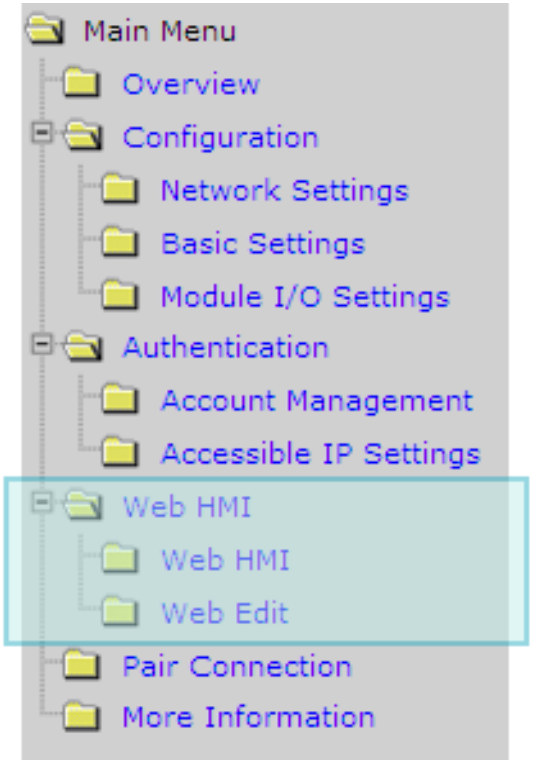
Step 2 Enter a range of IP addresses in the “From (IP Address)” and “To (IP Address)” text boxes.

Step 3 Select the “Active the rule” checkbox.

Step 4 Click “Submit” to finished configuring the IP filter list.

3.4. Web HMI

All items below are located under the **Web HMI** menu:

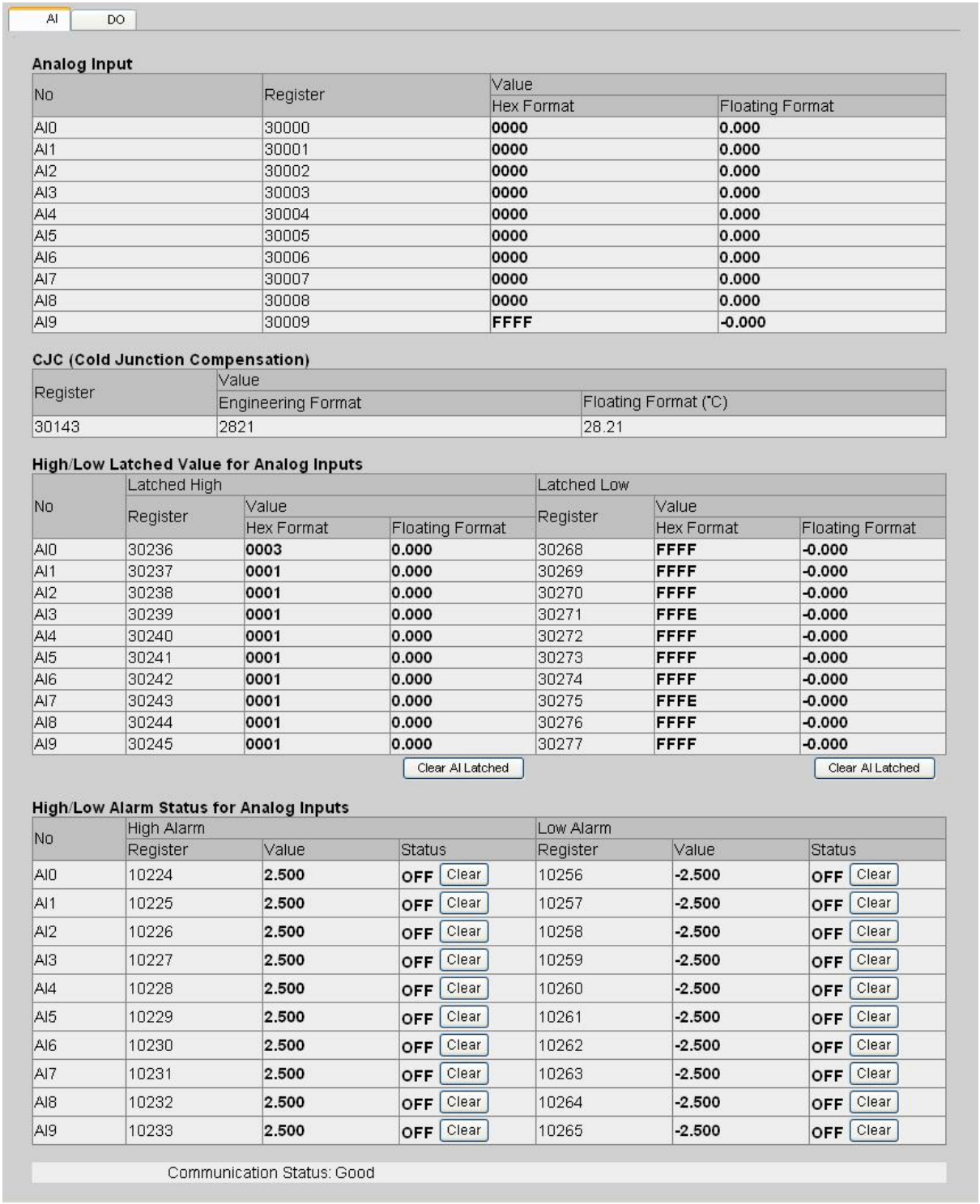


Web HMI: Links to the I/O monitor page that allows you to monitor and control the I/O status on ET-7019Z/PET-7019Z module remotely.

Web Edit: Links to the Web Page Configuration page that allows you to create dynamic web HMI pages.

3.4.1. Web HMI

ET-7019Z/PET-7019Z module features a Web HMI web page to display real-time I/O data values and alarms thru LAN or Internet. Through any Internet browser, users can monitor real-time I/O data values and alarms at local or remote sites. Then, the Web HMI is completed immediately without any programming.


AI DO

Analog Input

No	Register	Value	
		Hex Format	Floating Format
AI0	30000	**0000**	**0.000**
AI1	30001	**0000**	**0.000**
AI2	30002	**0000**	**0.000**
AI3	30003	**0000**	**0.000**
AI4	30004	**0000**	**0.000**
AI5	30005	**0000**	**0.000**
AI6	30006	**0000**	**0.000**
AI7	30007	**0000**	**0.000**
AI8	30008	**0000**	**0.000**
AI9	30009	**FFFF**	**-0.000**

CJC (Cold Junction Compensation)

Register	Value	
	Engineering Format	Floating Format (°C)
30143	2821	28.21

High/Low Latched Value for Analog Inputs

No	Latched High			Latched Low		
	Register	Value		Register	Value	
		Hex Format	Floating Format		Hex Format	Floating Format
AI0	30236	**0003**	**0.000**	30268	**FFFF**	**-0.000**
AI1	30237	**0001**	**0.000**	30269	**FFFF**	**-0.000**
AI2	30238	**0001**	**0.000**	30270	**FFFF**	**-0.000**
AI3	30239	**0001**	**0.000**	30271	**FFFE**	**-0.000**
AI4	30240	**0001**	**0.000**	30272	**FFFF**	**-0.000**
AI5	30241	**0001**	**0.000**	30273	**FFFF**	**-0.000**
AI6	30242	**0001**	**0.000**	30274	**FFFF**	**-0.000**
AI7	30243	**0001**	**0.000**	30275	**FFFE**	**-0.000**
AI8	30244	**0001**	**0.000**	30276	**FFFF**	**-0.000**
AI9	30245	**0001**	**0.000**	30277	**FFFF**	**-0.000**

Clear AI Latched Clear AI Latched

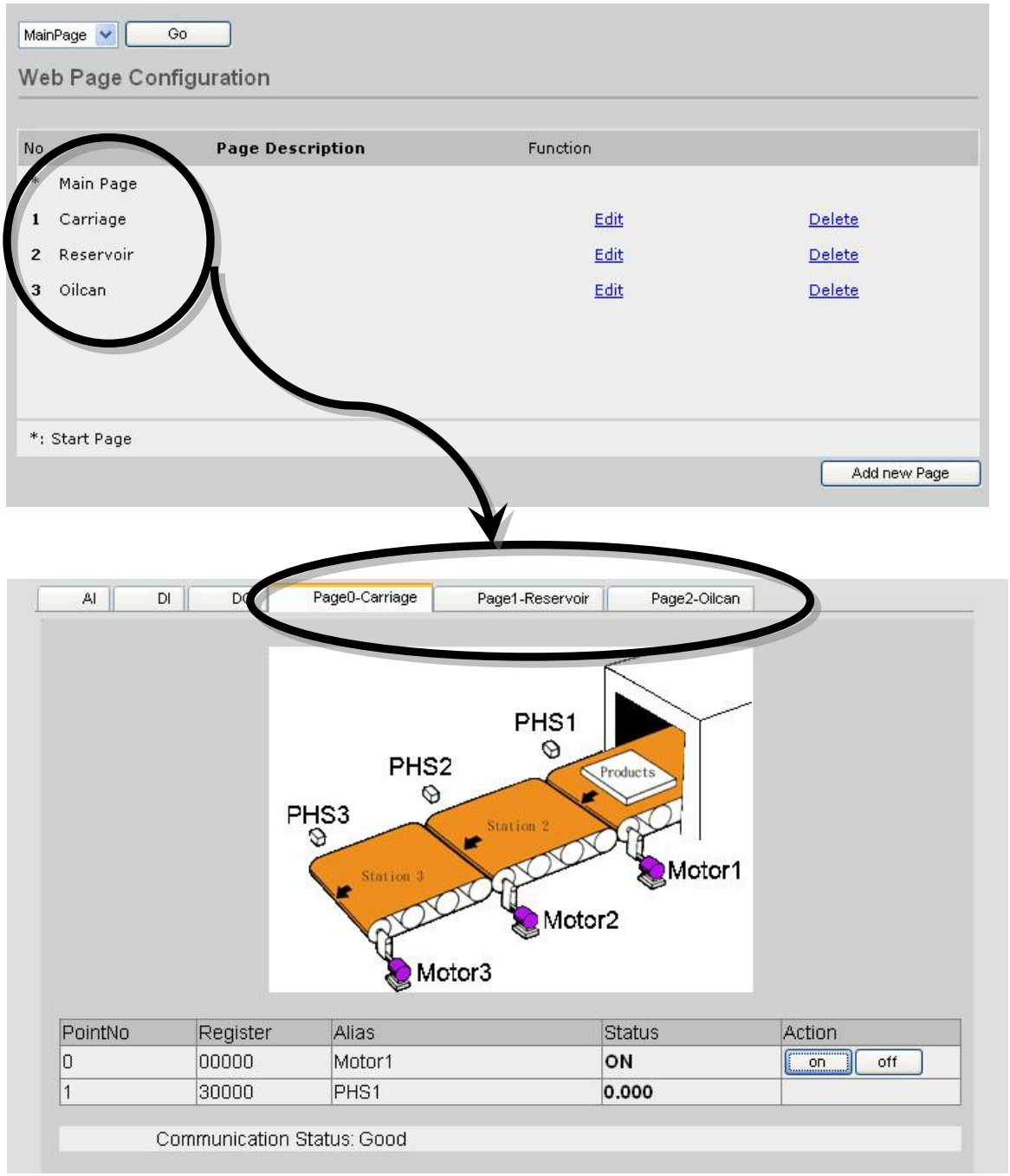
High/Low Alarm Status for Analog Inputs

No	High Alarm			Low Alarm		
	Register	Value	Status	Register	Value	Status
AI0	10224	**2.500**	**OFF** Clear	10256	**-2.500**	**OFF** Clear
AI1	10225	**2.500**	**OFF** Clear	10257	**-2.500**	**OFF** Clear
AI2	10226	**2.500**	**OFF** Clear	10258	**-2.500**	**OFF** Clear
AI3	10227	**2.500**	**OFF** Clear	10259	**-2.500**	**OFF** Clear
AI4	10228	**2.500**	**OFF** Clear	10260	**-2.500**	**OFF** Clear
AI5	10229	**2.500**	**OFF** Clear	10261	**-2.500**	**OFF** Clear
AI6	10230	**2.500**	**OFF** Clear	10262	**-2.500**	**OFF** Clear
AI7	10231	**2.500**	**OFF** Clear	10263	**-2.500**	**OFF** Clear
AI8	10232	**2.500**	**OFF** Clear	10264	**-2.500**	**OFF** Clear
AI9	10233	**2.500**	**OFF** Clear	10265	**-2.500**	**OFF** Clear

Communication Status: Good

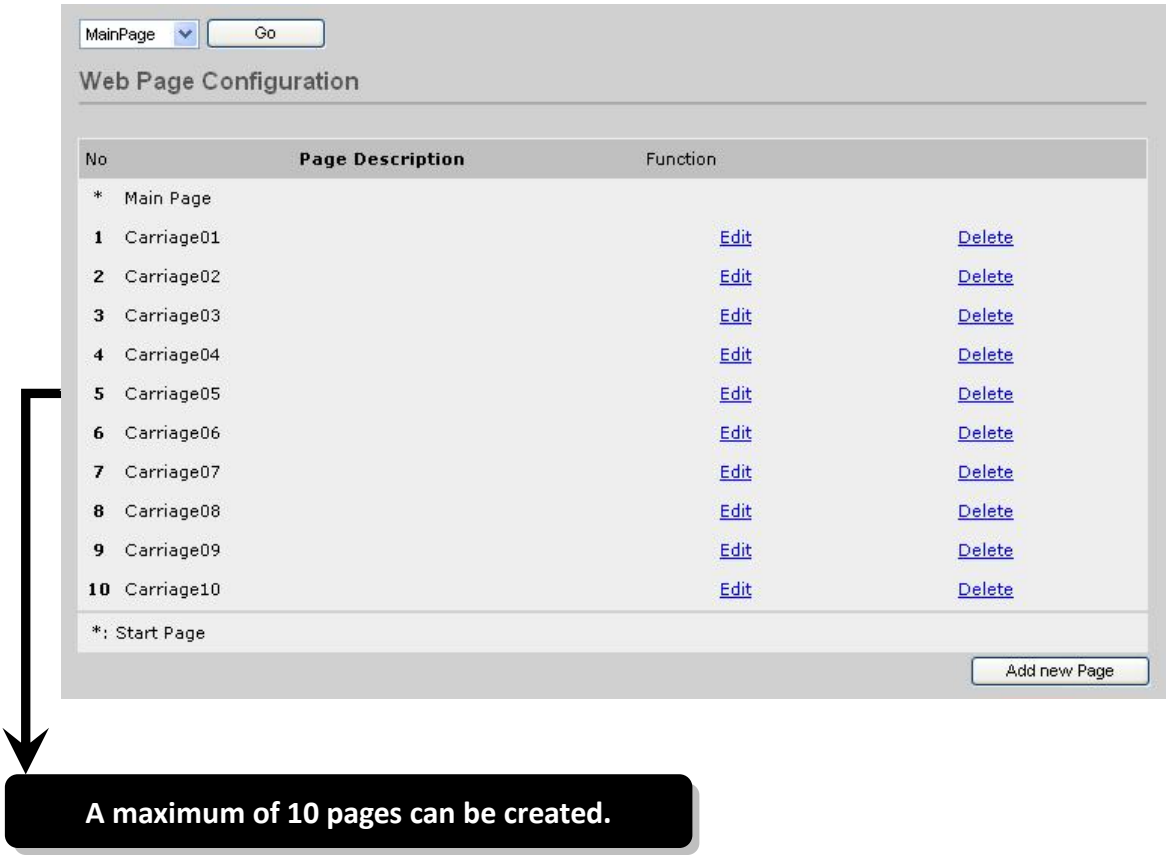
3.4.2. Web Edit

ET-7019Z/PET-7019Z module provides functions to create the user-defined web pages. Users can upload specific I/O layout pictures (bmp, jpg, gif format) and define a description for each I/O point. No HTML or Java skills are needed to create the web pages.



By defaults, there are no pages to be listed in the **Web Page Configuration** form.

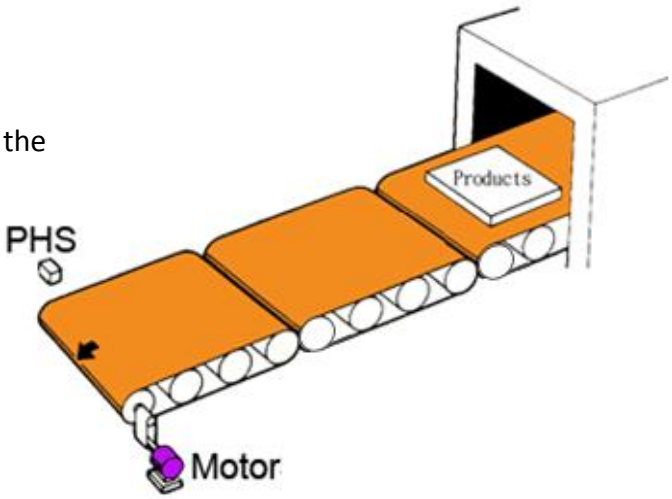
The ET-7019Z/PET-7019Z supports up to 10 user-defined web pages



Below is an example of how to create your own page.

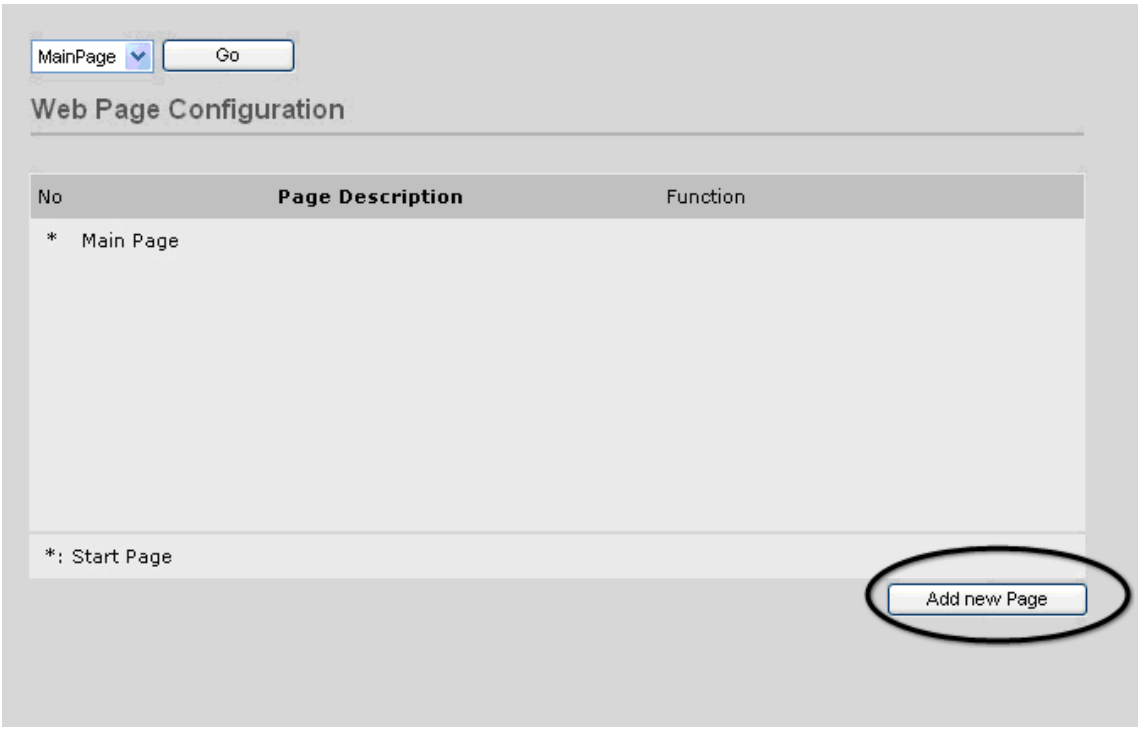
Example

Create a Web page to monitor the I/O of the conveyer system shown below. The I/O system contains a sensor that is used to detect the products, and a switch that are used to turn the conveyer motor on and off.



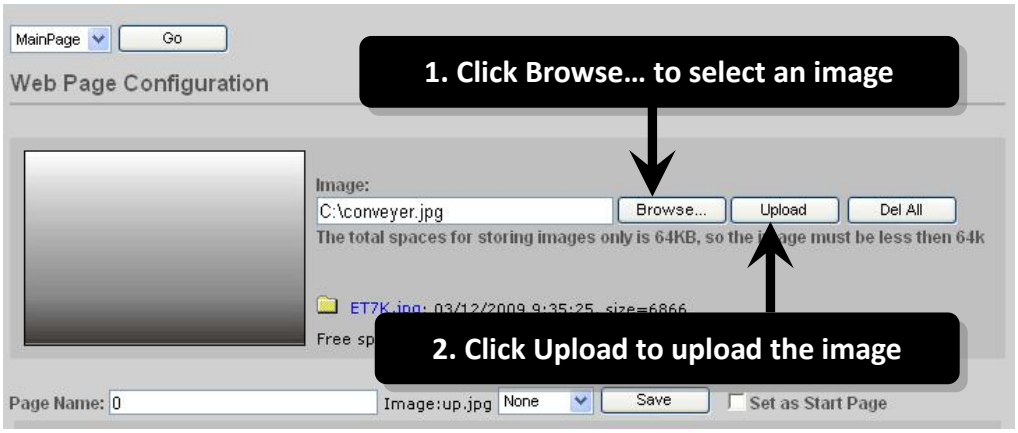
Step 1 Add a new page

Click **Add new Page** to add a new page.



Step 2 Upload a diagram

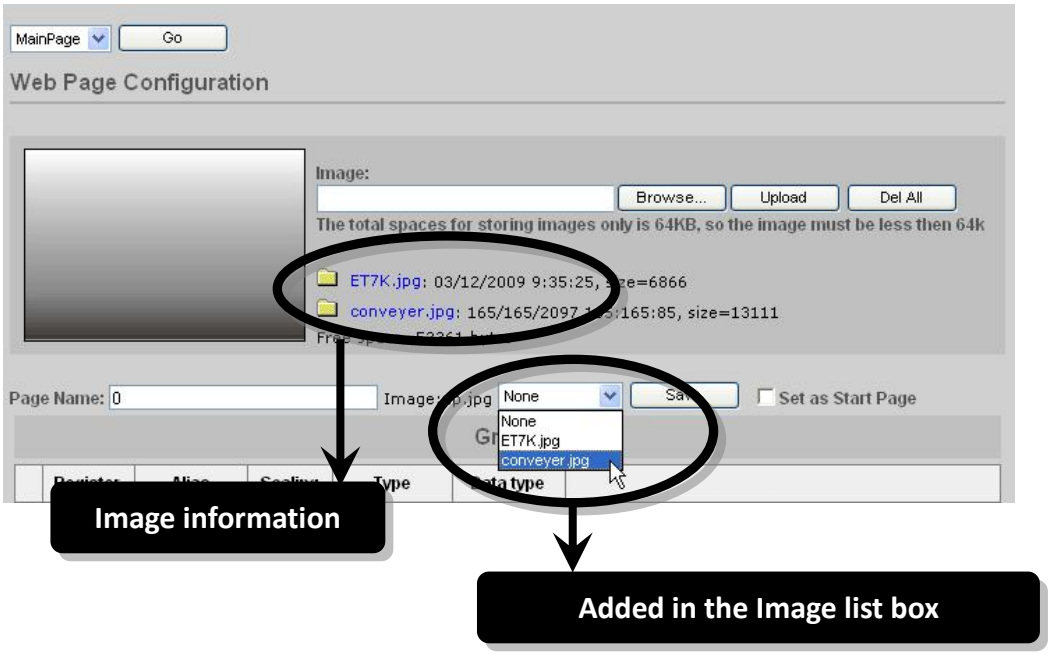
Click **Browse…** to select an image, and then click **Upload** to upload images to the ET-7019Z/PET-7019Z module.



Tips & Warnings

The file type of images can be either of .jpg, .gif, or .bmp. The recommended resolution for the image to be displayed on the editing Web page is 340 * 250 pixels.

After the upload is completed, the image information will be displayed and the image will be added in the **Image** list box as below shown.

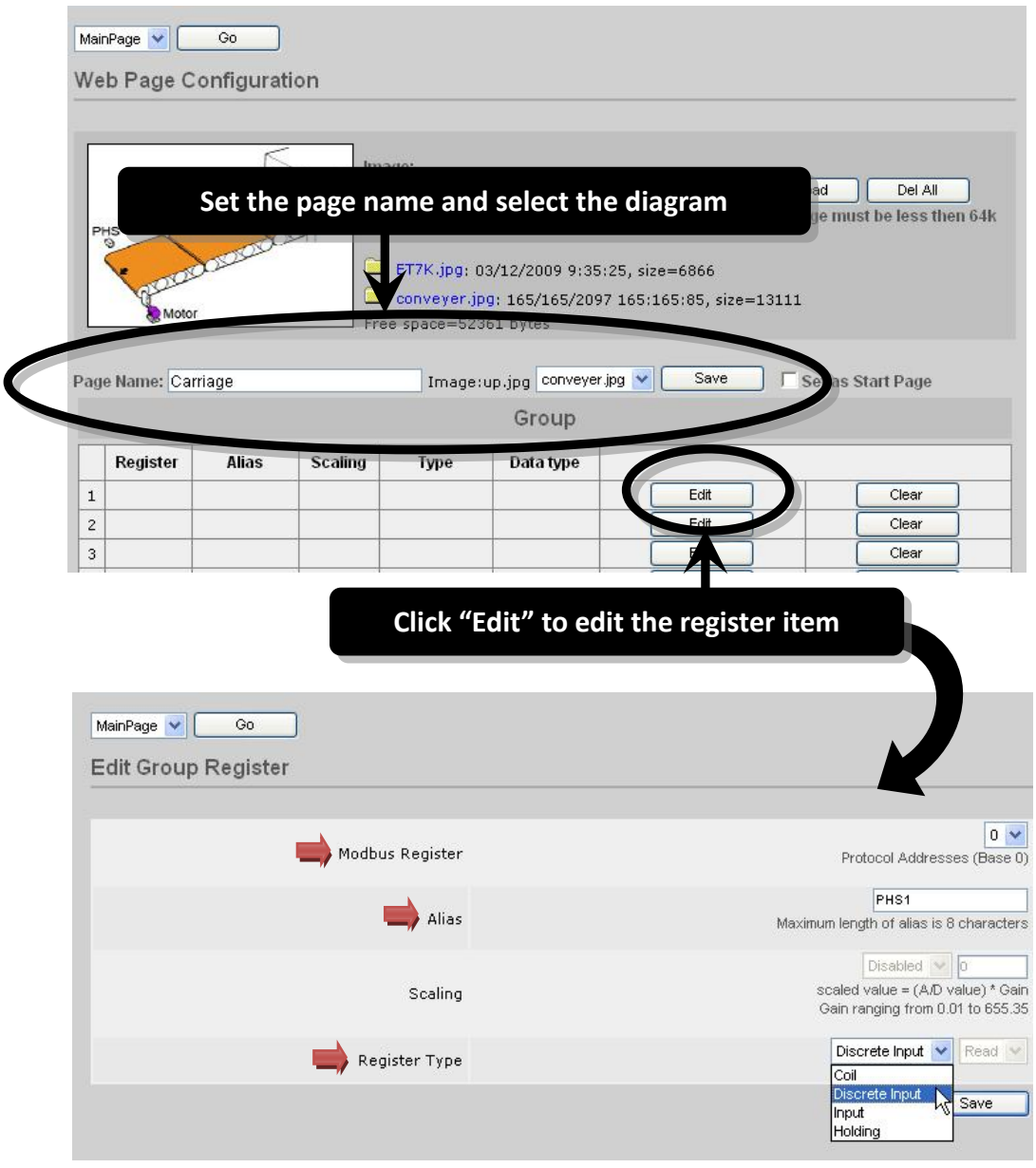


Step 3 Set the page name and select the diagram

Type the page name in the **Page Name** field and then select the diagram from the Image list box. (After selecting the diagram, the diagram will be shown in the Preview window)

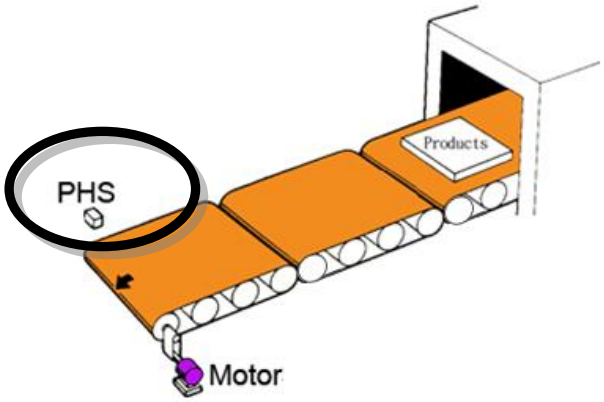
Step 4 Add the register item for reading selected sensor input

Click **Edit** in the first row of the Group table and then the **Edit Group Register** window will be displayed.



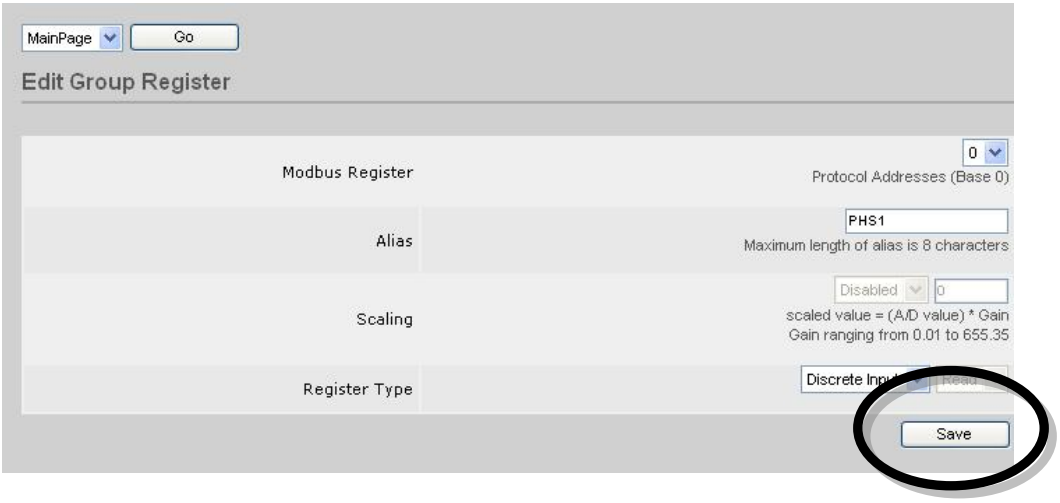
Step 5 Add a DI for reading “PHS1” input

Set PHS1 to be an input, you can use the **Modbus Register 0**, and then select **Discrete Input** as the **Register Type** and type **PHS1** as the **Alias**.



Step 6 Save selected sensor settings

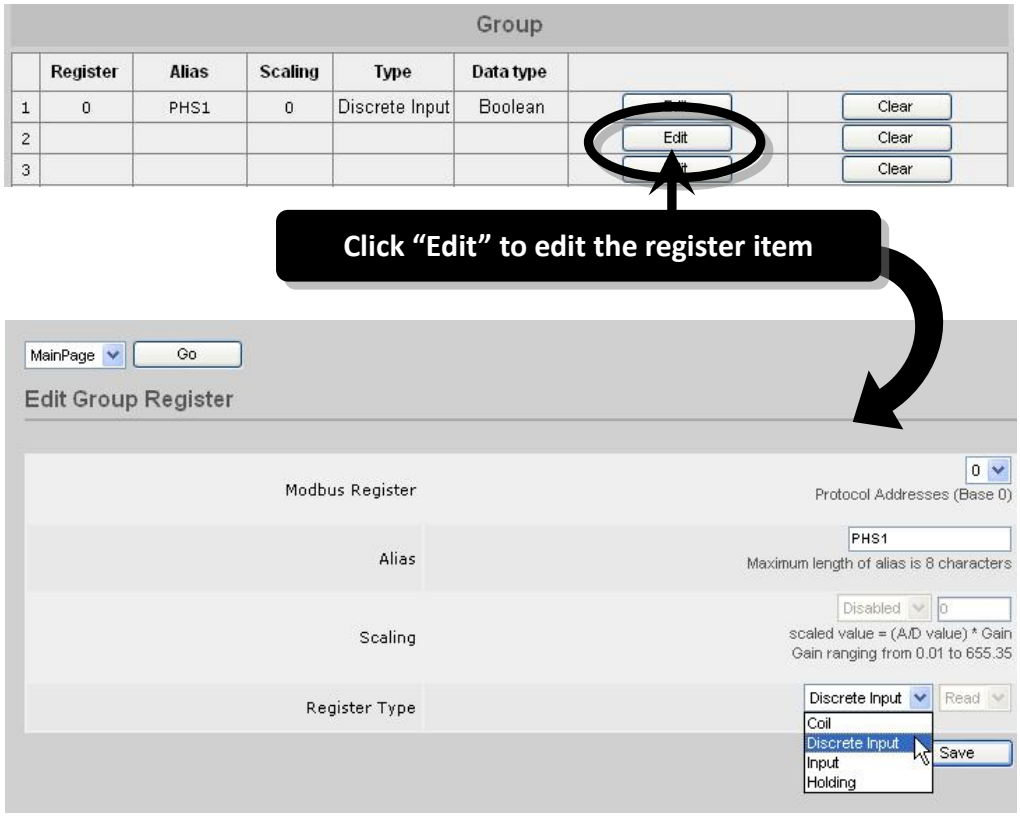
Click **Save** button to complete set up.



Step 7 Add the register item for writing selected motor output

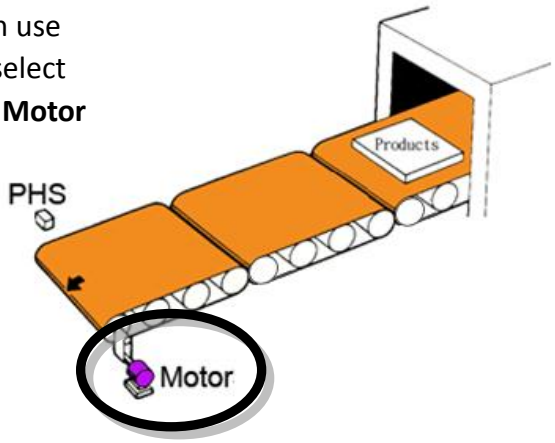
After saving the register settings, the new register item will be displayed in the Group table.

Step 8 Click "Edit" in the second row of the Group table and then the "Edit Group Register" window will be displayed



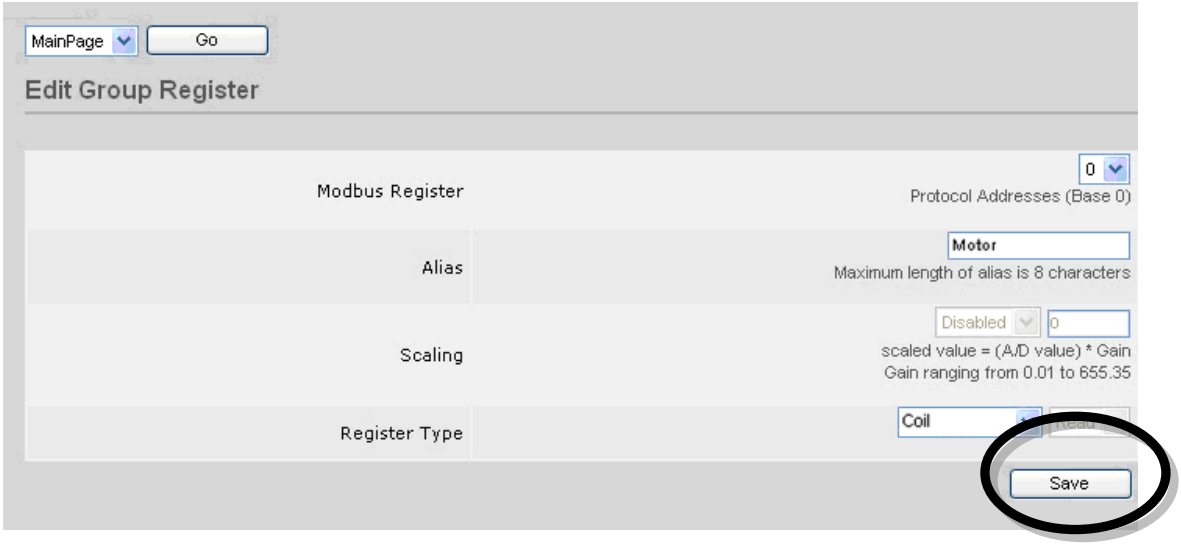
Step 9 Add a DO for writing "Motor" output to turn the conveyer motor on and off

Set Motor to be an output, you can use the **Modbus Register 0**, and then select **Coil** as the **Register Type** and type **Motor** as the **Alias**.



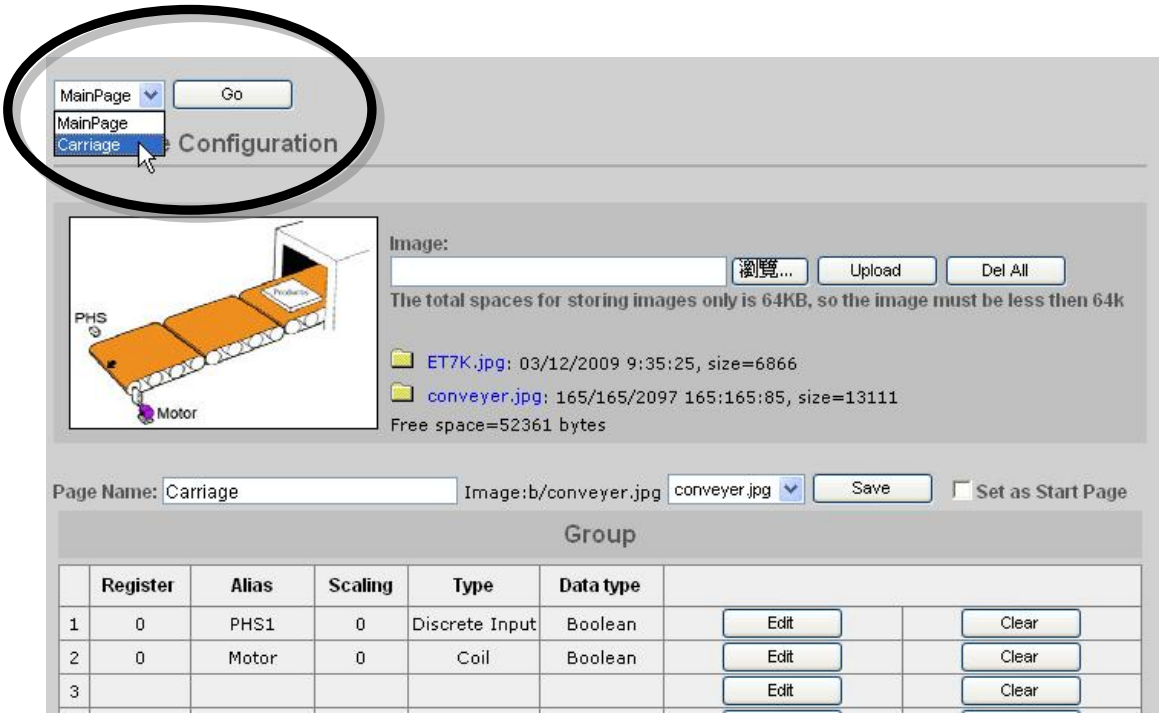
Step 10 Save selected sensor settings

Click **Save** to complete set up

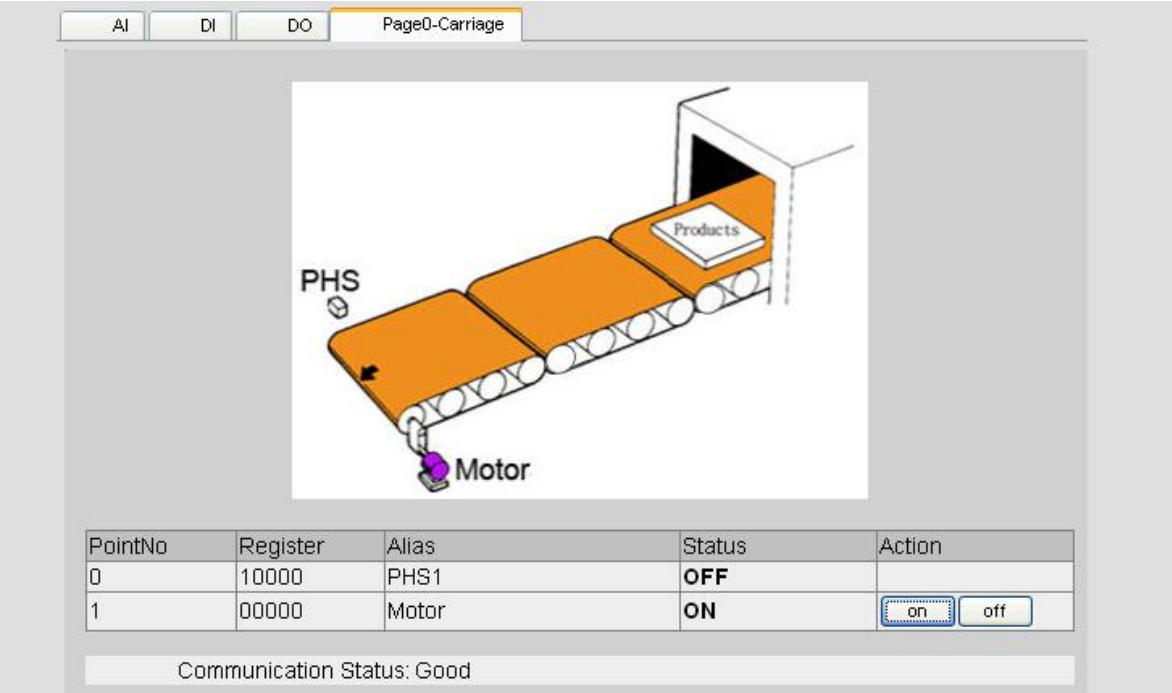


Step 11 Browse the "Carriage" web page.

After saving the editing page, the editing page named as **Carriage** has been added to the list box on the top-left hand side of the **Web Page Configuration** window. Then select the **Carriage** item and click **Go** to browse to the **Carriage** web page.

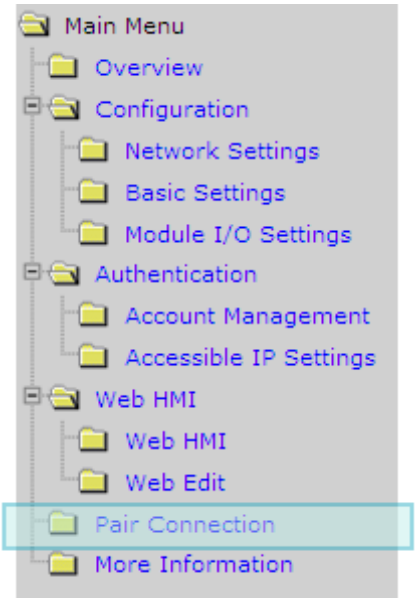


The conveyer image file and all register items will be displayed on the **Carriage** web page.

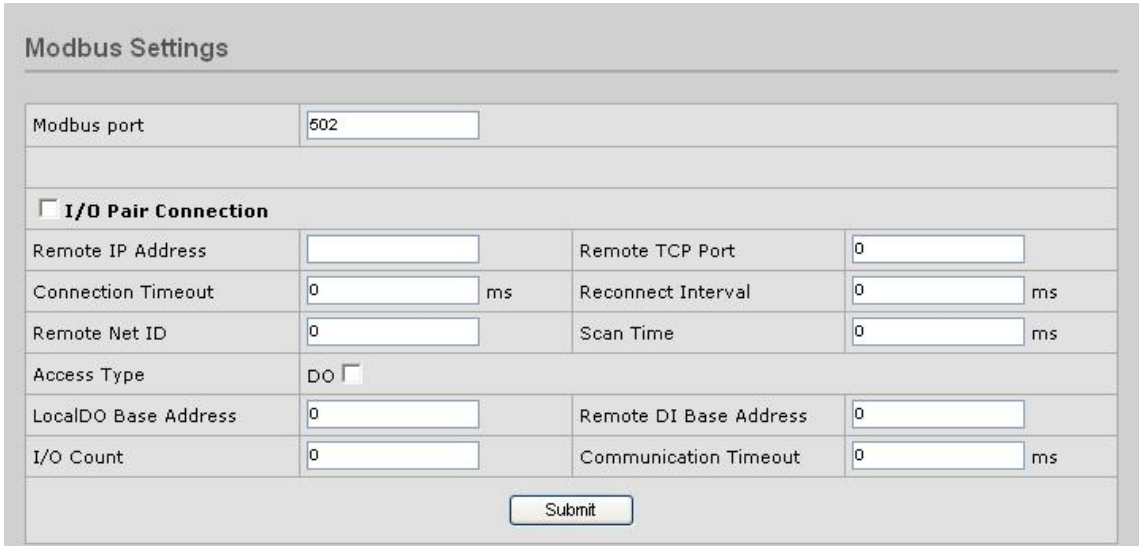


3.5. I/O Pair Connection

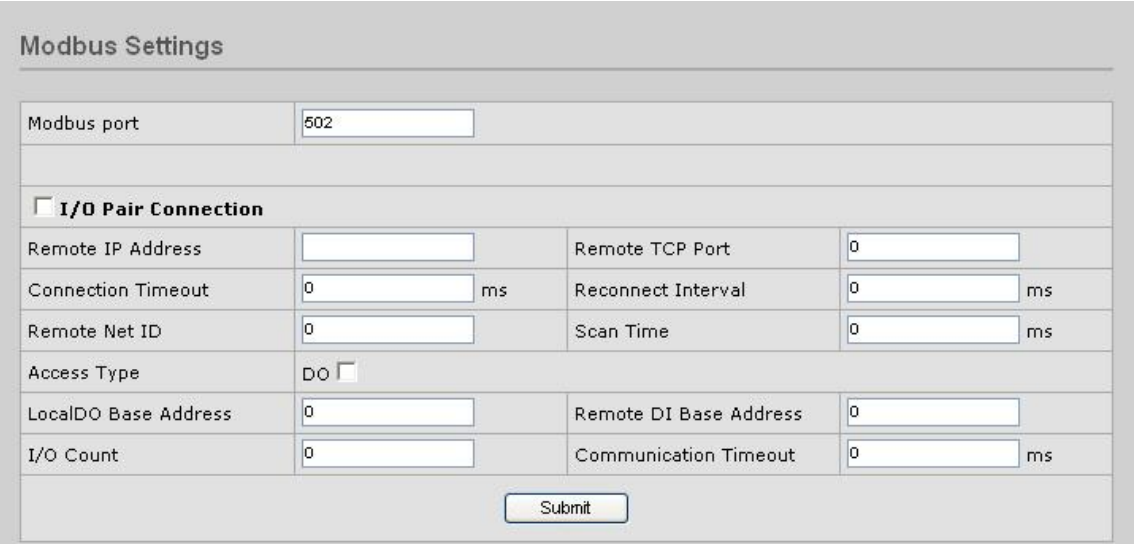
The Pair Connection links to the configuration page of the pair connection function.



This pair connection function is a particular feature of ET-7019Z/PET-7019Z that can enable a pair of DI-to-DO via Modbus/TCP. With pair connection function enabled, ET-7019Z/PET-7019Z modules can poll the status of remote DI devices using the Modbus/TCP protocol and then continuously write to its DO channels in the background.



The Pair Connection consists of the following parameters:



I/O Pair Connection: Enable/Disable I/O pair connection.

Remote IP Address: IP address of remote DI device.

Remote TCP Port: Modbus/TCP Port of remote DI device.

Connection Timeout: The length of time to wait for a connection to the remote DI device.

Reconnect Interval: The reconnect interval is the amount of time between attempts by the ET-7019Z/PET-7019Z to reconnect with the remote DI device.

Remote Net ID: Modbus Net ID of remote device

Scan Time: The frequency with the remote DI device will be polled

Access Type: Enable/Disable the DI-to-DO pair connection.

Local DO Base Address: DO base address of local DO register will be mapped to remote DI device.

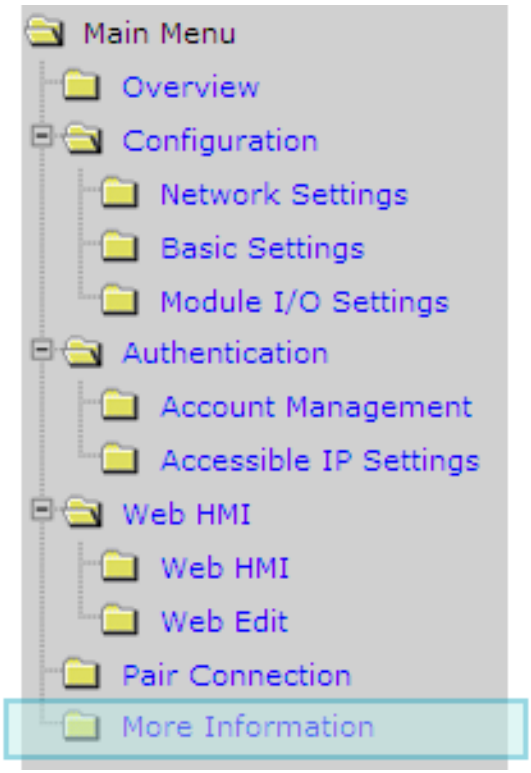
Remote DI Base Address: DI base address of Remote DI device that will be mapped to local DO register.

I/O Count: I/O count mapped from the base address.

Communication Timeout: The period of which the ET-7019Z/PET-7019Z is waiting for a response from the remote DI device.

3.6. More Information

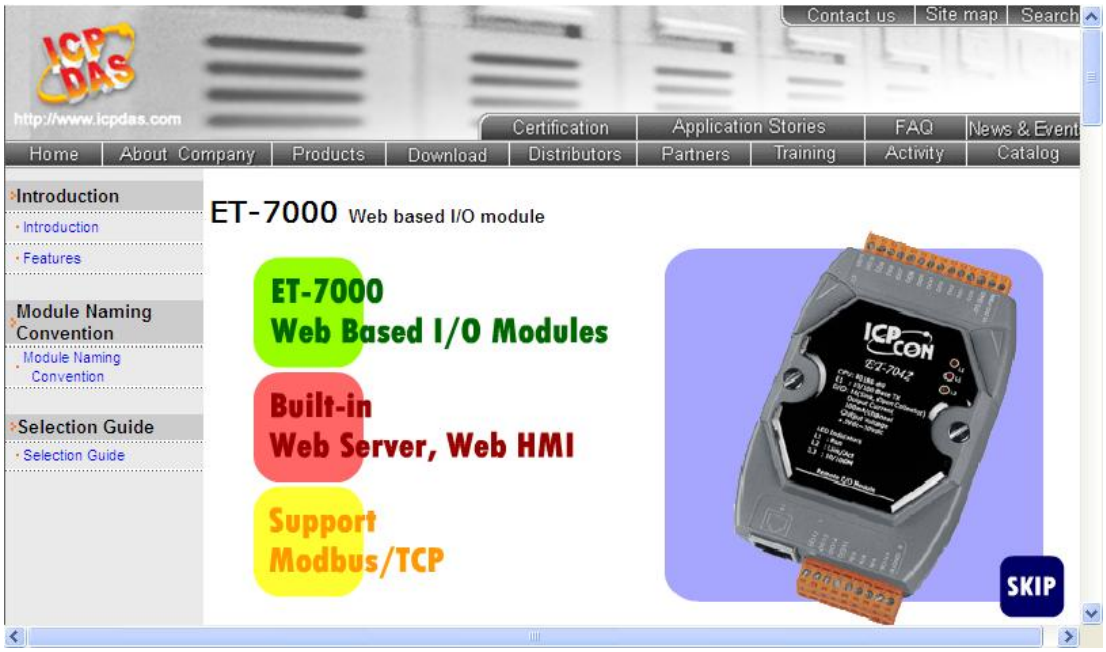
The More Information links to the ET-7019Z/PET-7019Z web site that provides more detailed information related to ET-7019Z/PET-7019Z.



You can change the URL of this link by simply editing the URL, for more details, please refer to the section 3.2.2 “Configure the Web site Information”

The default URL of the More Information item is:

http://www.icpdas.com/products/Remote_IO/et-7000/et-7000_introduction.htm



4. Overview of Modbus over TCP/IP Protocol

Modbus/TCP is a form Modbus that uses the TCP/IP layers as a base layer for controlling the communications between different devices.

The Modbus/TCP option allows the ET-7000/PET-7000 series module to communicate with PC-based applications such as SCADA (Supervisor Control And Data Acquisition) and HMI programs. The Modbus/TCP information is only available over the Ethernet interface.

The Modbus/TCP messaging service provides a Client/Server communication between devices connected on a TCP/IP network. The ET-7000/PET-7000 module is a Modbus Server, meaning that it is only capable of responding to requests from the Modbus client device. Note that Modbus/RTU requires a serial interface, not Ethernet, and therefore is not directly compatible with the ET-7000/PET-7000 module.

The Modbus protocol, as well as the TCP extension, is well documented in the specifications which are available at http://www.modbus.org, a website established by the Modbus Organization for supporting and organizing the Modbus protocol. Only the use of the protocol is documented here.

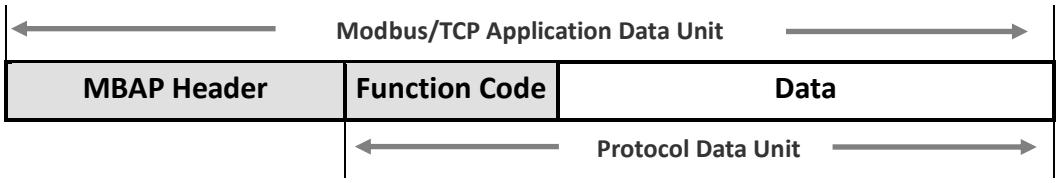
4.1. TCP/IP Interface

The Modbus/TCP interface is attached to the TCP/IP stack that is implemented within the ET-7000/PET-7000 module, and will listen to all communications that come in on Modbus/TCP registered Port 502.

The Modbus/TCP client uses the standard TCP method for communicating with the ET-7000/PET-7000 module. UP to 12 connections are possible at one time. If there are 12 active connections, any attempt at any more connections is ignored.

4.2. Protocol Description

The Modbus protocol defines a simple protocol data unit independent of the underlying communication layers. The mapping of Modbus protocol on network can introduce some additional fields on the application data unit.



MBAP

The Modbus/TCP extension includes 7 additional bytes to the original Modbus protocol, which allows for transport over the TCP/IP layers.

A dedicated header is used on TCP/IP to identify the Modbus Application Data Unit. It is called the MBAP Header (MODBUS Application Protocol Header). The MBAP Header consists of 7bytes of information:

Fields	Length	Description
Transaction Identifier	2 bytes	Identification of Request/Response transaction – Copied from request to response
Protocol Identifier	2 bytes	0 = Modbus protocol
Length	2 bytes	Number of following bytes - Includes the Unit Identifier
Unit Identifier	1 byte	Identification of remote slave

Function Code

The function code field of a Modbus data unit is coded in one byte. Valid codes are in the range of 1 ... 255 decimal (the range 128 - 255 is reserved and used or exception responses). When a Modbus request is sent from a Modbus Client to a Server device the function code field tells the server what kind of action to perform.

The Modbus/TCP feature of ET-7000/PET-7000 series module supports 8 function codes, which allows the reading and writing of data contents of registers.

Function Code	Descriptions
01 (0x01)	Read Coil Status
02 (0x02)	Read Input Status
03 (0x03)	Read Holding Registers
04 (0x04)	Read Input Registers
05 (0x05)	Force Single Coil
06 (0x06)	Preset Single Register
15 (0x0F)	Force Multiple Coils
16 (0x10)	Preset Multiple Registers

Any other function code request will be returned with an error response indicating the function code is not supported, as well as a request for too much data or data at a register address that not present.

Data

The data field of Modbus request sent from a client to server devices contains additional information that the server uses to take the action defined by the function code. This can include items like discrete and register addresses, the quantity of items to be handled, and the count of actual data bytes in the field.

The data field may be nonexistent (of zero length) in certain kinds of requests; in this case the server does not require any additional information. The function code alone specifies the action.

Response

If no error occurs related to the Modbus function requested in a properly received Modbus ADU (Protocol Data Unit) the data field of a Modbus response from a server to a client contains the data requested. If an error related to the Modbus function requested occurs, the field contains an exception code that the server application can use to determine the next action to be taken.

For example a client can read the ON/OFF states of a group of digital input or output or it can read/write the data contents of a group of registers.

When the server responds to the client, it uses the function code field to indicate either a normal response or that some kind of error occurred (called an exception response). For a normal response, the server simply echoes to the request the original function code.

For an exception response, the server returns a code that is equivalent to the original function code from the request PDU with its most significant bit set to logic 1.

4.3. Data Encoding

Modbus uses a “big-endian” representation for address and data items. This means that when a numerical quantity larger than single byte is transmitted, the most significant byte is send first. The following sub-topics describe the different the different byte of encoding and show how the data is encoded as it is within the Modbus/TCP packet.

4.3.1. Binary

A binary item is represented as a single bit within a data word. All binary is packed into 16-bits data words, which are accessed using function code 01 and 02. Therefore, a single register contains 16 bits of binary data, each having a specific meaning.

Value	1st	2nd
0xAA55 (1010101001010101)	0xAA (10101010)	0x55 (01010101)

4.3.2. 16-bits Word

A 16-bits word item is transmitted with the most significant byte first. Function code 03 and 04 read 16-bits items at a time; therefore, each of these data items will fit within one register that is read.

Value	1st	2nd
0x1234	0x12	0x34

4.4. Data Model

Modbus bases its data model on a series of tables that have individual characteristics. The four primary tables are:

Primary table	Data type	Type of access
Discrete Input	Single bit	Read-Only
Coils	Single bit	Read-Write
Input Registers	16-bits word	Read-Only
Holding Registers	16-bits word	Read-Write

To access each entry in to the four primary tables, a starting address (0 indicates the first entry in the table) is required as well as the number of registers that are requested.

For each of the primary tables, the protocol allows individual selection of 65535 data items, and the operations of read or write of those items are designed to span multiple consecutive data items up to a data size limit which is dependent on the transaction function code.

Once the data is stored within the local tables, the driver does not differentiate what is stored in them. The Modbus/TCP client needs to know what data is stored in which register locations to be able to retrieve it, process it, and/or display it.

4.5. Function Code Descriptions

4.5.1. 01 (0x01) Read Coils

This function code is used to read the status of coils in an ET-7000/PET-7000 module. The Request PDU specifies the starting address, i.e. the address of the first coil specified, and the number of coils. In the PDU Coils are addressed starting at zero.

The coils in the response message are packed as one coil per bit of the data field. Status is indicated as 1=ON and 0=OFF. The LSB of the first data byte contains the output addressed in the query. The other coils follow toward the high order end of this byte, and from low order to high order in subsequent bytes.

If the returned output quantity is not a multiple of eight, the remaining bits in the final data byte will be padded with zeros (toward the high order end of the byte). The Byte Count field specifies the quantity of complete bytes of data.

Here is an example of a request to read digital outputs of ET-7026/PET-7026 module:

Request		Response	
Field Name	(Hex)	Field Name	(Hex)
MBAP Header	01	MBAP Header	01
	02		02
	00		00
	00		00
	00		00
	06		04
Unit Identifier	01	Unit Identifier	01
Function Code	01	Function Code	01
Starting Address Hi	00	Byte Count	01
Starting Address Lo	00	Outputs status 0-1	02
Quantity of Outputs Hi	00		
Quantity of Outputs Lo	02		

The status of outputs 0-1 is shown as the byte value 02 hex, or binary 0000 0010. DO1 is in the seventh bit position from the left, and DO0 is the LSB of this byte. The six remaining high order bits are zero filled.

4.5.2. 02 (0x02) Read Discrete Inputs

This function code is used to read status of discrete inputs in an ET-7000/PET-7000 module. The Request PDU specifies the starting address, i.e. the address of the first input specified, and the number of inputs. In the PDU Discrete inputs are addressed starting at zero.

The discrete inputs in the response message are packed as one input per bit of the data field. Status is indicated as 1=ON and 0=OFF. The LSB of the first data byte contains the input addressed in the query. The other inputs follow toward the high order end of this byte, and from low order to high order in subsequent bytes.

If the returned input quantity is not a multiple of eight, the remaining bits in the final data byte will be padded with zeros (toward the high order end of the byte). The Byte Count field specifies the quantity of complete bytes of data.

Here is an example of a request to read digital inputs of ET-7026/PET-7026 module:

Request		Response	
Field Name	(Hex)	Field Name	(Hex)
MBAP Header	01	MBAP Header	01
	02		02
	00		00
	00		00
	00		00
	06		04
Unit Identifier	01	Unit Identifier	01
Function Code	02	Function Code	02
Starting Address Hi	00	Byte Count	01
Starting Address Lo	00	Digital Inputs status 0-1	03
Quantity of Inputs Hi	00		
Quantity of Inputs Lo	02		

The status of Inputs 0-1 is shown as the byte value 03 hex, or binary 0000 0011. DI1 is in the seventh bit position from the left, and DI0 is the LSB of this byte. The six remaining high order bits are zero filled.

4.5.3. 03 (0x03) Read Holding Registers

This function code is used to read the contents of a contiguous block of holding registers in an ET-7000/PET-7000 module. The Request PDU specifies the starting register address and the number of registers. In the PDU Registers are addressed starting at zero.

The register data in the response message are packed as two bytes per register, with the binary contents right justified within each byte. For each register, the first byte contains the high order bits and the second contains the low order bits.

Here is an example of a request to read analog outputs of ET-7026/PET-7026 module:

Request		Response	
Field Name	(Hex)	Field Name	(Hex)
MBAP Header	01	MBAP Header	01
	02		02
	00		00
	00		00
	00		00
	06		07
Unit Identifier	01	Unit Identifier	01
Function Code	03	Function Code	03
Starting Address Hi	00	Byte Count	04
Starting Address Lo	00	Register value Hi (AO0)	02
Quantity of Outputs Hi	00	Register value Lo (AO0)	2B
Quantity of Outputs Lo	02	Register value Hi (AO1)	00
		Register value Lo (AO1)	64

The contents of AO0 are shown as the two byte values of 02 2B hex, or 555 decimal. The content of AO1 are 00 64, or 100 decimal.

4.5.4. 04 (0x04) Read Inputs Registers

This function code is used to read input registers in an ET-7000/PET-7000 module. The Request PDU specifies the starting register address and the number of registers. In the PDU Registers are addressed starting at zero.

The register data in the response message are packed as two bytes per register, with the binary contents right justified within each byte. For each register, the first byte contains the high order bits and the second contains the low order bits.

Here is an example of a request to read analog inputs of ET-7026/PET-7026 module:

Request		Response	
Field Name	(Hex)	Field Name	(Hex)
MBAP Header	01	MBAP Header	01
	02		02
	00		00
	00		00
	00		00
	06		07
Unit Identifier	01	Unit Identifier	01
Function Code	04	Function Code	04
Starting Address Hi	00	Byte Count	04
Starting Address Lo	00	Register value Hi (AII)	00
Quantity of Inputs Hi	00	Register value Lo (AI0)	0A
Quantity of Inputs Lo	02	Register value Hi (AI1)	00
		Register value Lo (AI1)	64

The contents of AI0 are shown as the two byte values of 00 0A hex, or 10 decimal. The content of AI1 are 00 64, or 100 decimal.

4.5.5. 05 (0x05) Write Single Coil

This function code is used to write a single digital output to either ON or OFF in an ET-7000/PET-7000 module. The requested ON/OFF state is specified by a constant in the request data field. A value of FF 00 hex requests the output to be ON. A value of 00 00 requests it to be OFF. All other values are illegal and will not affect the output.

The normal response is an echo of the request, returned after the coil state has been written.

Here is an example of a request to write DO1 of ET-7026/PET-7026 ON:

Request		Response	
Field Name	(Hex)	Field Name	(Hex)
MBAP Header	01	MBAP Header	01
	02		02
	00		00
	00		00
	00		00
	06		06
Unit Identifier	01	Unit Identifier	01
Function Code	05	Function Code	05
Output Address Hi	00	Output Address Hi	00
Output Address Lo	01	Output Address Lo	01
Output Value Hi	FF	Output Value Hi	FF
Output Value Lo	00	Output Value Lo	00

4.5.6. 06 (0x06) Write Single Register

This function code is used to write a single analog output in an ET-7000/PET-7000 module. The Request PDU specifies the address of the register to be written. Registers are addressed starting at zero.

The normal response is an echo of the request, returned after register contents have been written.

Here is an example of a request to write AO1 of ET-7026/PET-7026 to 55 FF hex:

Request		Response	
Field Name	(Hex)	Field Name	(Hex)
MBAP Header	01	MBAP Header	01
	02		02
	00		00
	00		00
	00		00
	06		06
Unit Identifier	01	Unit Identifier	01
Function Code	06	Function Code	06
Register Address Hi	00	Register Address Hi	00
Register Address Lo	01	Register Address Lo	01
Register Value Hi	55	Register Value Hi	55
Register Value Lo	FF	Register Value Lo	FF

4.5.7. 15 (0x0F) Write Multiple Coils

This function code is used to force each coil in a sequence of coils to either ON or OFF in an ET-7000/PET-7000 module. The Request PDU specifies the coil references to be forced. Coils are addressed starting at zero.

The requested ON/OFF states are specified by contents of the request data field. A logical '1' in a bit position of the field requests the corresponding output to be ON. A logical '0' requests it to be OFF.

The normal response returns the function code, starting address, and quantity of coils forced.

Here is an example of a request to write a series of 2 digital outputs starting at DO0:

The request data content is one byte: 02 hex (0000 0010 binary). The binary bits correspond to the outputs in the following way:

Bit	0	0	0	0	0	0	1	0
Output	-	-	-	-	-	-	DO1	DO0

Request		Response	
Field Name	(Hex)	Field Name	(Hex)
MBAP Header	01	MBAP Header	01
	02		02
	00		00
	00		00
	00		00
	06		06
Unit Identifier	01	Unit Identifier	01
Function Code	0F	Function Code	0F
Starting Address Hi	00	Starting Address Hi	00
Starting Address Lo	00	Starting Address Lo	00
Quantity of Outputs Hi	00	Quantity Value Hi	00
Quantity of Outputs Lo	02	Quantity Value Lo	02
Byte Count	01		
Outputs Value Lo	02		

4.5.8. 16 (0x10) Write Multiple Registers

This function code is used to write a block of contiguous registers in an ET-7000/PET-7000 module. The requested written values are specified in the request data field. Data is packed as two bytes per register.

The normal response returns the function code, starting address, and quantity of registers written.

Here is an example of a request to write two AO registers starting at AO0:

Request		Response	
Field Name	(Hex)	Field Name	(Hex)
MBAP Header	01	MBAP Header	01
	02		02
	00		00
	00		00
	00		00
	06		06
Unit Identifier	01	Unit Identifier	01
Function Code	10	Function Code	10
Starting Address Hi	00	Starting Address Hi	00
Starting Address Lo	00	Starting Address Lo	00
Quantity of Registers Hi	00	Quantity Value Hi	00
Quantity of Registers Lo	02	Quantity Value Lo	02
Byte Count	04		
Registers Value Hi	00		
Registers Value Lo	0A		
Registers Value Hi	01		
Registers Value Lo	02		

4.6. Modbus Demo Programs

nModbus is a C# 3.0 implementation of the Modbus protocol. It is developed and maintained on a voluntary basis and provided free of change.

ICP DAS verified and improved the DLL based on the official releases from http://nmodbus.googlecode.com. Programmer can use the DLL released by ICP DAS to develop a Modbus application for regular Windows based PCs.

The relevant Modbus demo and SDK can be obtained from the following ICP DAS website.

- DLL and Documents:

http://ftp.icpdas.com/pub/cd/8000cd/napdos/modbus/nmodbus/

- Demo:

http://ftp.icpdas.com/pub/cd/8000cd/napdos/modbus/nmodbus/demo/

4.7. Modbus Register Table

4.7.1. Coils Table

Address	Points	Description	Register per Point	Range	Access Type
00000	6	Digital Output	1	0=Off 1=On	R/W
00162	10	Clear AI Latched High (single channel)	1	1=Clear	W (Pulse)
00194	10	Clear AI Latched Low (single channel)	1	1=Clear	W (Pulse)
00226	1	Restore all I/O Settings to default	1	1=Perform	W (Pulse)
00233	1	Reboot ET-7000	1	1=Reboot	W (Pulse)
00431	1	Write DO Power-on Value to EEPROM	1	1=Write	W (Pulse)
00432	1	Write DO Safe Value to EEPROM	1	1=Write	W (Pulse)
00435	6	Power-on Value for DO	1	0=Off 1=On	R/W/E
00515	6	Safe Value for DO	1	0=Off 1=On	R/W/E
00595	10	Enable/Disable AI Channel	1	0=Disable 1=Enable	R/W/E
00629	1	60/50 Hz Rejection for AI	1	0=60 Hz 1=50 Hz	R/W/E
00631	1	AI Data Format	1	0=Hex 1=Engineering	R/W/E
00632	1	Restore the AI Calibration to Default	1	1=Perform	W (Pulse)
00634	1	Clear AI Latched High (all channels)	1	1=Clear	W (Pulse)
00635	1	Clear AI Latched Low (all channels)	1	1=Clear	W (Pulse)
00636	10	Enable/Disable AI High Alarm	1	0=Disable 1=Enable	R/W/E

Address	Points	Description	Registers per Point	Range	Access Type
00668	10	Enable/Disable AI Low Alarm	1	0=Disable 1=Enable	R/W/E
00700	10	AI High Alarm Mode	1	0=Momentary 1=Latched	R/W/E
00732	10	AI Low Alarm Mode	1	0=Momentary 1=Latched	R/W/E
00764	10	Clear AI High Alarm Status	1	1=Clear	W (Pulse)
00796	10	Clear AI Low Alarm Status	1	1=Clear	W (Pulse)
00830	1	Enable/Disable Calibration	1	0=Disable 1=Enable	R/W
00831	1	Zero Calibration for Channel 0	1	1=Perform	W (Pulse)
00832	1	Span Calibration for Channel 0	1	1=Perform	W (Pulse)

4.7.2. Discrete Input Table

Address	Points	Description	Registers per Point	Range	Access Type
10224	10	AI High Alarm Status	1	0=Normal 1=Alarm	R
10256	10	AI Low Alarm Status	1	0=Normal 1=Alarm	R

4.7.3. Input Register Table

Address	Points	Description	Registers per Point	Range	Access Type
30000	10	Analog Input	1	0~65535 or -32768 ~ 32767	R

Address	Points	Description	Registers per Point	Range	Access Type
30236	10	AI Latched Value (High)	1	0~65535 or -32768 ~ 32767	R
30268	10	AI Latched Value (Low)	1	0~65535 or -32768 ~ 32767	R
30310	1	DO (Channel Number)	1	6	R
30311	1	Power-on Value for DO (Channel Number)	1	0~6	R
30312	1	Safe Value for DO (Channel Number)	1	0~6	R
30320	1	AI (Channel Number)	1	10	R
30350	1	OS Image Version	1	123 means version =1.2.3	R
30351	1	Firmware Version	1	123 means version =1.2.3	R
30352	1	CPU Library Version	1	123 means version =1.2.3	R
30353	1	I/O Firmware Version	1	123 means version =1.2.3	R
30354	1	MFW Library Version	1	123 means version =1.2.3	R
30355	1	TCP/IP Library Version	1	123 means version =1.2.3	R
30356	1	Modbus Library Version	1	123 means version =1.2.3	R
30357	1	Web Library Version	1	123 means version =1.2.3	R
30360	1	Pair Connection Status	1	0=Normal 1=Timeout 2=Disconnected	R

4.7.4. Holding Register Table

Address	Points	Description	Registers per Point	Range	Access Type
40174	1	Enable/Disable AI Channel	1	0x0000~0x003F	R/W/E
40271	1	Modbus NetID	1	1~255	R/W/E
40296	10	AI High Alarm Value	1	-32768~32767	R/W/E
40328	10	AI Low Alarm Value	1	-32768~32767	R/W/E
40427	10	AI Type Code	1	Refer to the range code table	R/W/E
40555	1	CPU Reset Status	1	1: Power-on 2: Module Watchdog 3: Reset Command	R
40456	1	Reset Event Counter	1	When module is reset by one of the situations described in register 555, the event counter will be increased by one.	R
40557	1	Enable/Disable the host watchdog and set the host watchdog timeout value	1	<5: Disable 6~65535: Enable (Unit: second)	R/W/E
40558	1	WDT Event Counter	1	When a host watchdog timeout occurs, the host watchdog event counter will be increased by one.	R
40559	1	Module Name	1	0x7019	R

5. Calibration

Tips & Warnings

It is not recommended that calibration be performed until the process is fully understood.

Analog Input Calibration Requirement for ET-7019Z/PET-7019Z

Connect the calibration voltage/current source to channel 0 and only the channel 0 should be enabled during calibration.

Type Code	00	01	02	03	04	05	06	07
Zero Input	0 mV	0 mV	0 mV	0 mV	0 V	0 V	0 mA	0mA
Span Input	+15 mV	+50 mV	+100 mV	+500 mV	+1 V	+2.5 V	+20 mA	+20 mA

Type Code	08	09	0A	0B	0C	0D	1A	0B
Zero Input	0 V	0 V	0 V	0 mV	0 mV	0 mA	0 mA	0 V
Span Input	+10V	+5 V	+1 V	+500 mV	+150 mV	+20 mA	+20 mA	+10V

The calibration procedure is as follows:

Step 1 Warm up the module for 30 minutes.

Step 2 Enable the channel 0 to calibrate and disable other channels.

Refer to Sections 3.2.3. Module I/O Settings.

Step 3 Set the type code to the type you want to calibrate.

Refer to Sections 3.2.3. Module I/O Settings for details.

Step 4 Enable calibration.

Step 5 Apply the zero calibration voltage/current to channel 0.

Step 6 Send zero calibration command.

Step 7 Apply the span calibration voltage/current to channel 0.

Step 8 Send the span calibration command.

Step 9 Disable calibration.

Modbus Address for Calibration

Register	Points	Description	Access Type
00830	1	Enable/Disable Calibration 0=Disabled 1=Enabled	R/W
00831	1	Zero calibration command of ch0, 1 = run	W (Pulse)
00832	1	Span calibration command of ch0, 1 = run	W (Pulse)

Note: When calibrating current type (i.e. type 06, 07 and 1A), the jumper of the corresponding channel should be short. Refer to Section 1.2.3. for details.

6. Tools

There are several tools and utilities can be used for the ET-7019Z/PET-7019Z.

6.1. MiniOS7 Utility

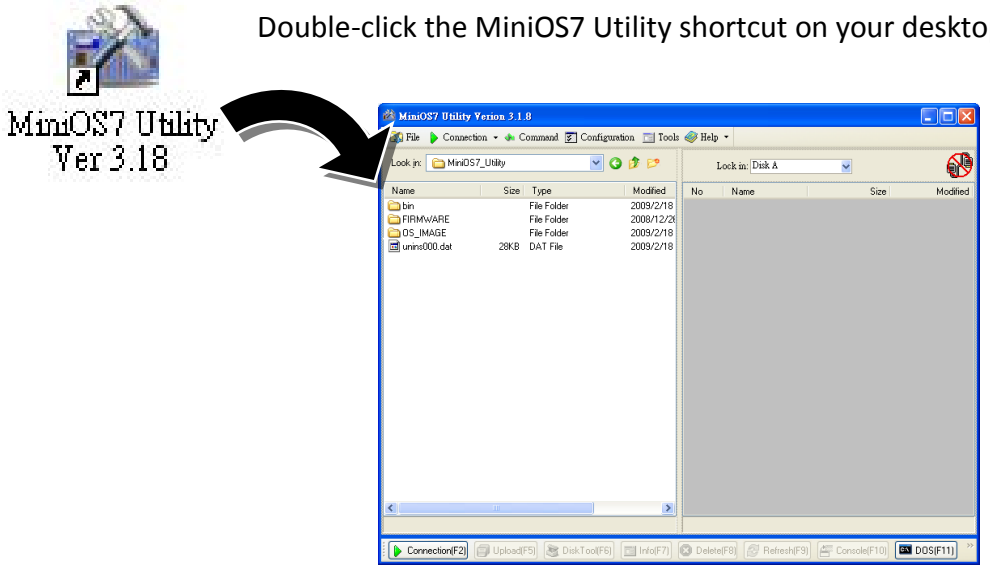
MiniOS7 Utility is a tool for uploading firmware to flash memory and updating the OS to ET-7019Z/PET-7019Z module embedded with ICP DAS MiniOS7 with easiness and quickness.

If you don't have the MiniOS7 Utility installed on your system, installation of the MiniOS7 Utility should be the first step. Please refer to section "2.4. Installing the MiniOS7 Utility" to install it.

6.1.1. Establishing a Connection

To upload firmware or update the OS to ET-7019Z/PET-7019Z module, you must first establish a connection between PC and the ET-7019Z/PET-7019Z module.

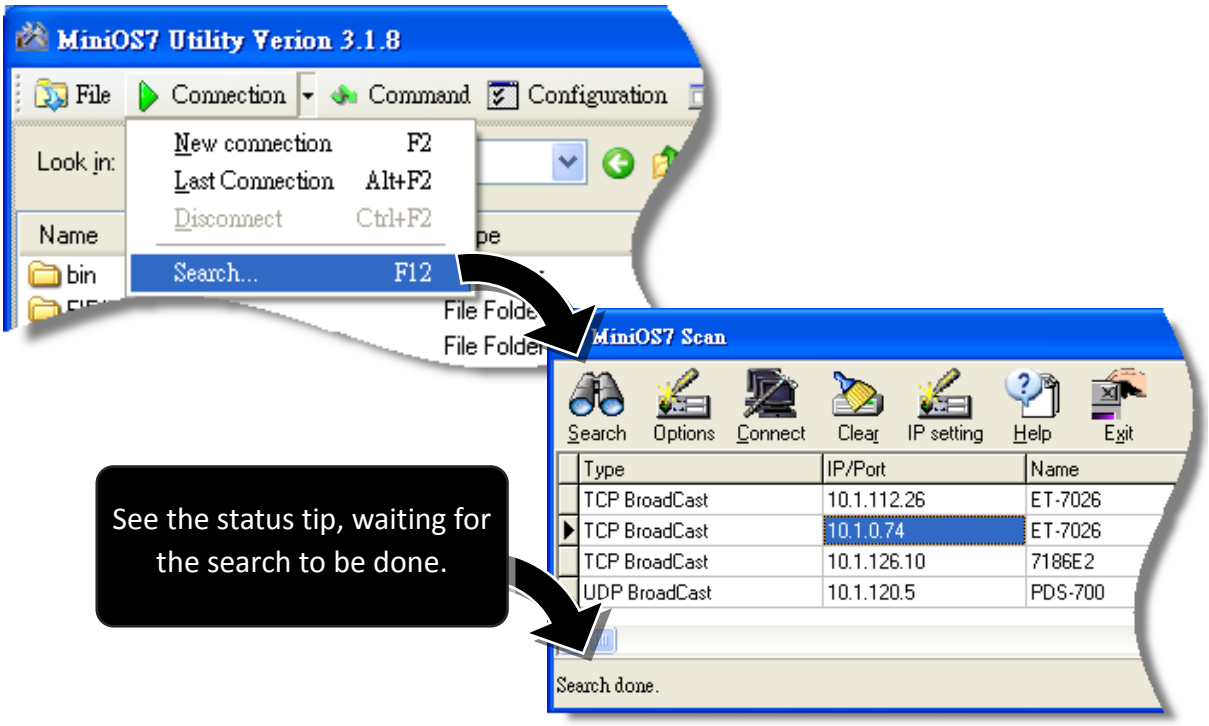
Step 1 Run the MiniOS7 Utility.



Double-click the MiniOS7 Utility shortcut on your desktop.

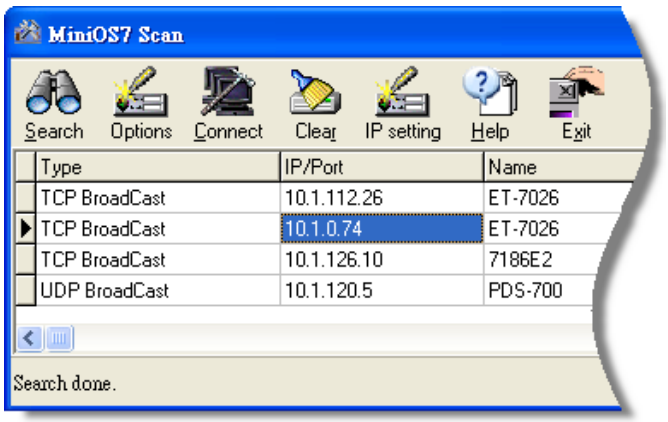
Step 2 Press “F12” or choose “Search” from the “Connection” menu.

After pressing F12 or choosing Search from Connection menu, that will search all of the MiniOS7 modules on your network.



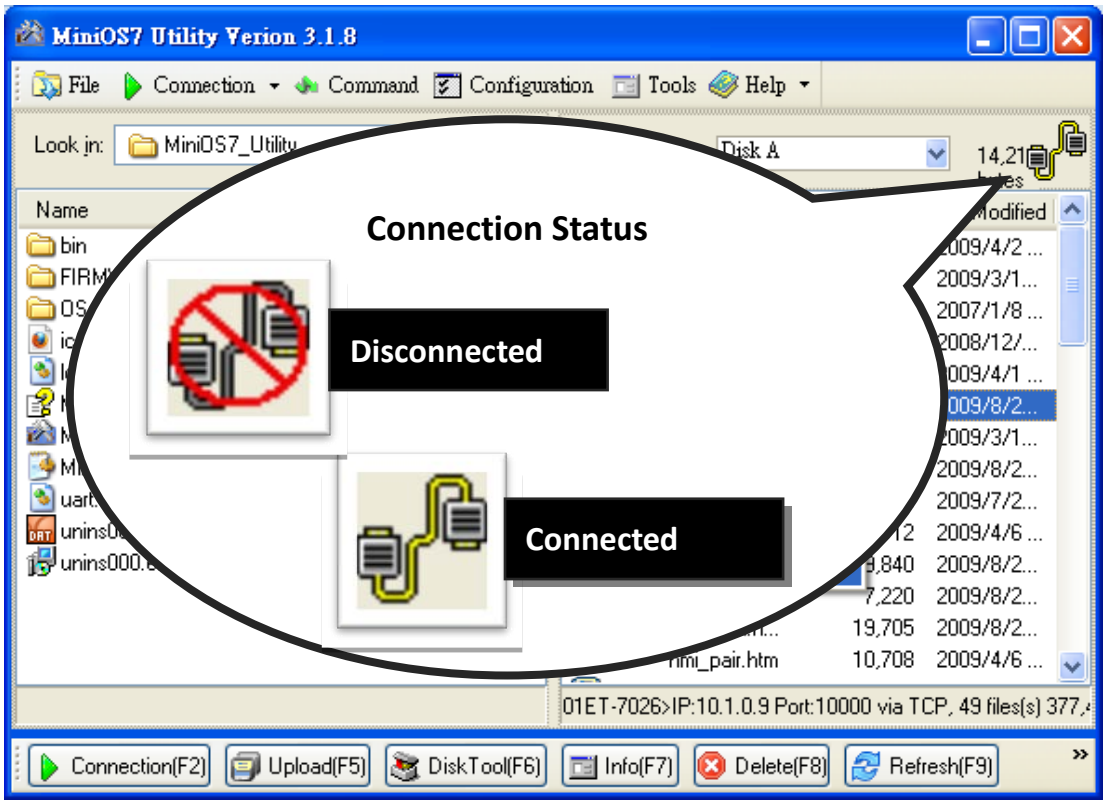
Step 3 Double-Click the field of your ET-7019Z/PET-7019Z module.

Double-Click the field of your ET-7019Z/PET-7019Z module in the list to connect to your ET-7019Z/PET-7019Z.



Step 4 The connection has ready been established.

Check the connection status in the top right side to make sure the connection has been established



6.1.2. Exchanging the Protocol (TCP/IP to UDP)

MiniOS7 Utility supports both UDP and TCP protocols.

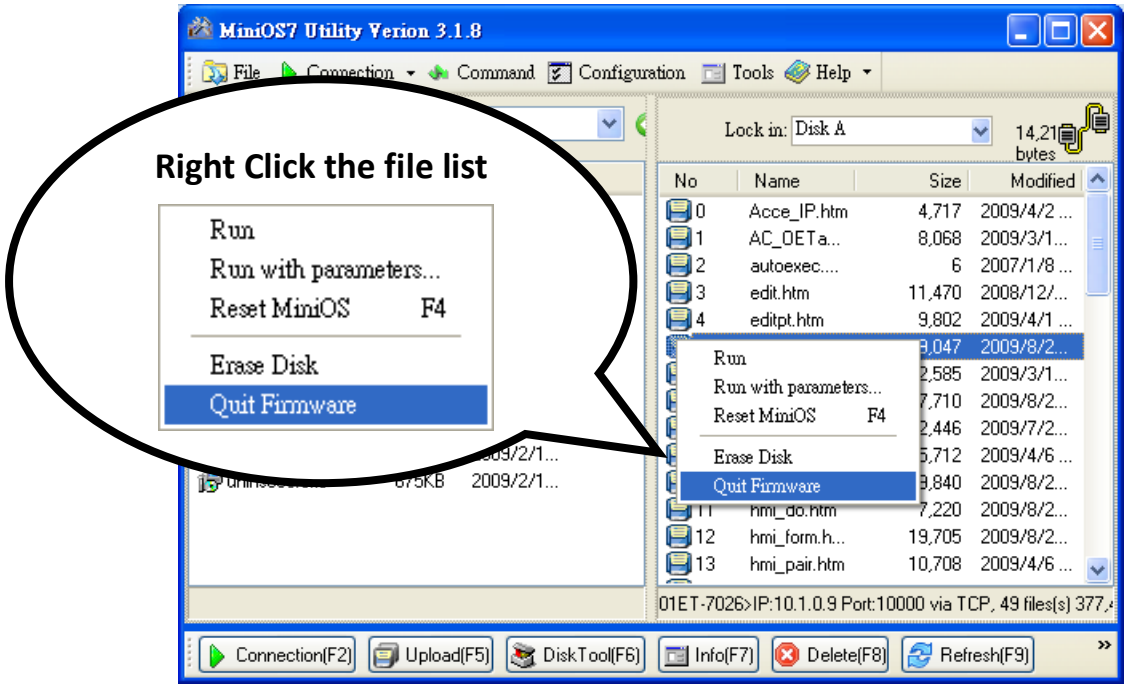
For MiniOS7 Utility, the TCP/IP is the default protocol for communicating with ET-7019Z/PET-7019Z, and the UDP is used to update the OS. Therefore, if you want to update the OS, you might need to change protocols to support them.

Step 1 Establish a connection to ET-7019Z/PET-7019Z.

For more detailed about this process, please refer to section “6.1.1. Establishing a Connection” to establish a connection.

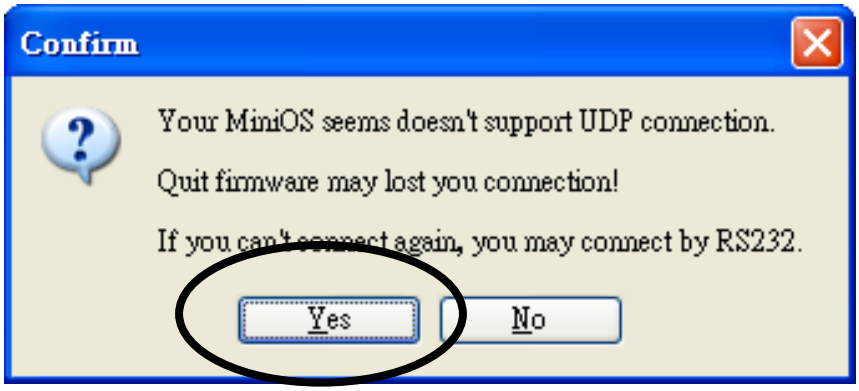
Step 2 Right Click the file list of the right side window, and then choose “Quit Firmware” to stop the firmware running.

Right click the file list of the right side windows, and then choose “Quit Firmware” to stop the firmware running and exchange TCP/IP protocol to UDP protocol.



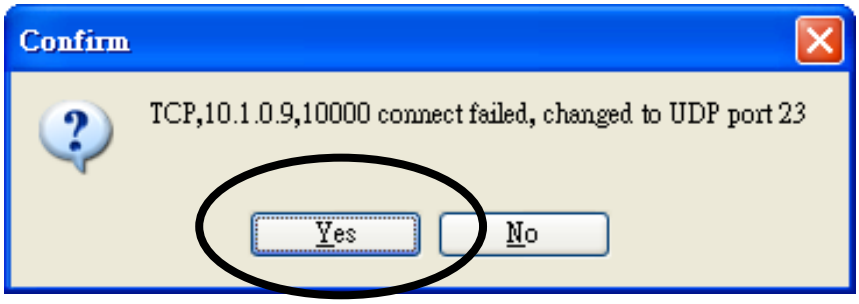
Step 3 Click “Yes” to continue.

After executing the Quick Firmware command, the “Confirm” dialog will appear, and then click “Yes” button to continue and stop the firmware running.



Step 4 Click “Yes” to continue.

After confirming the command, the “Confirm” dialog will appear, and then click “Yes” button to exchange UDP protocol for TCP protocol.

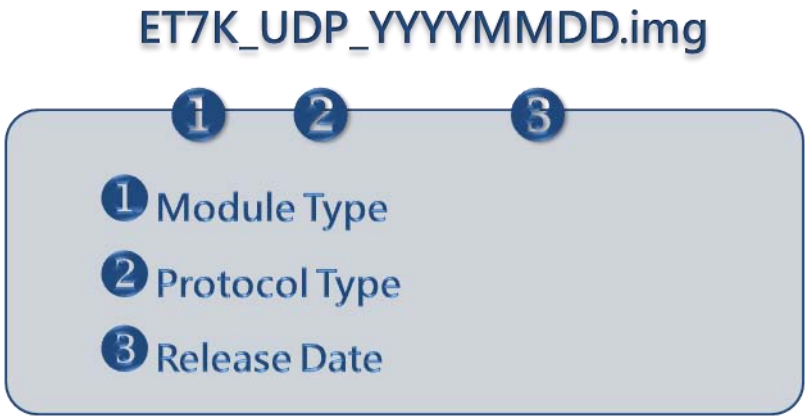


Step 5 The changes have been affected

6.1.3. Updating the ET-7019Z/PET-7019Z OS

ICP DAS will continue to add additional features to ET-7019Z/PET-7019Z OS in the future, so we advise you to periodically check the ICP DAS web site for the latest updates.

Step 1 Get the latest version of the MiniOS7 OS image.



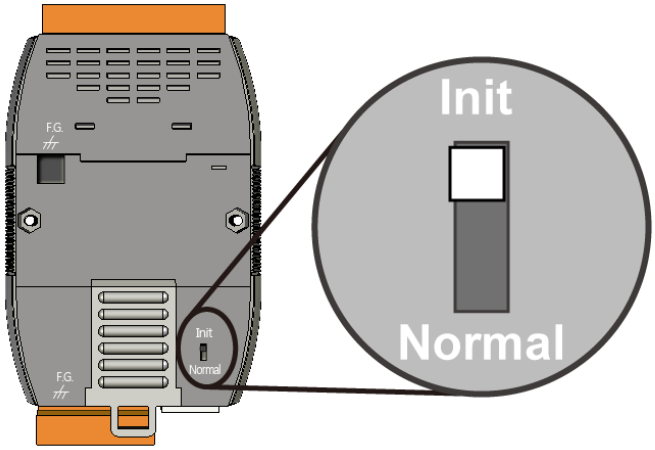
The latest version of the MiniOS7 OS image can be obtained from:

CD:\NAPDOS\ET7000\OS_image\

http://ftp.icpdas.com/pub/cd/6000cd/napdos/et7000/os_image/

Step 2 Turn the switch to “Init” position and reboot the module.

Turn the Init/Normal switch to “Init” position.

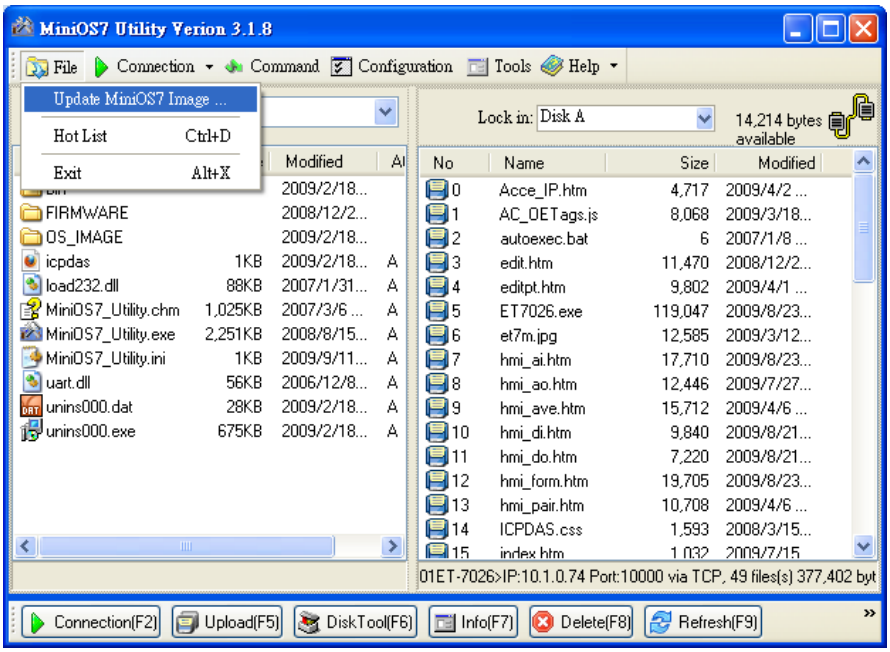


Step 3 Establish a connection to ET-7019Z/PET-7019Z.

For more detailed about this process, please refer to section “6.1.1. Establishing a Connection” to establish a connection.

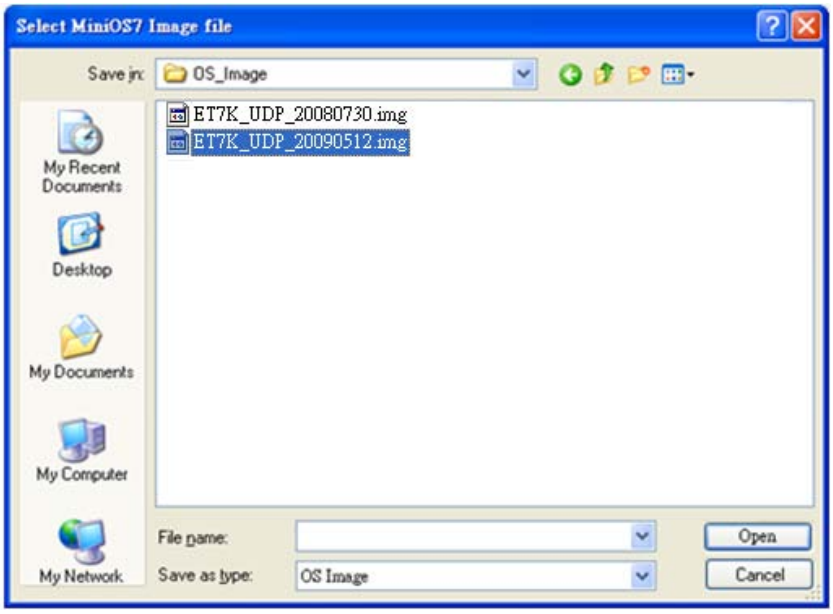
Step 4 Choose “Update MiniOS7 Image” from the “File” menu.

Choose “Update MiniOS7 Image” from File menu to start the update procedure.



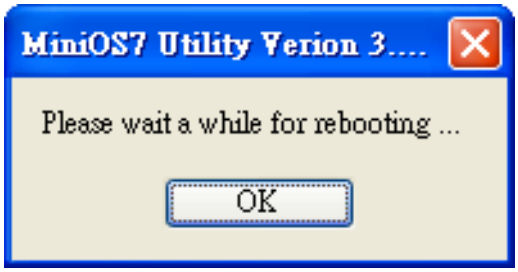
Step 5 Select the latest version of the MiniOS7 OS image.

After choosing the update MiniOS7 Image command, the Select MiniOS7 Image file will appear, and then select the latest version of the MiniOS7 OS image.



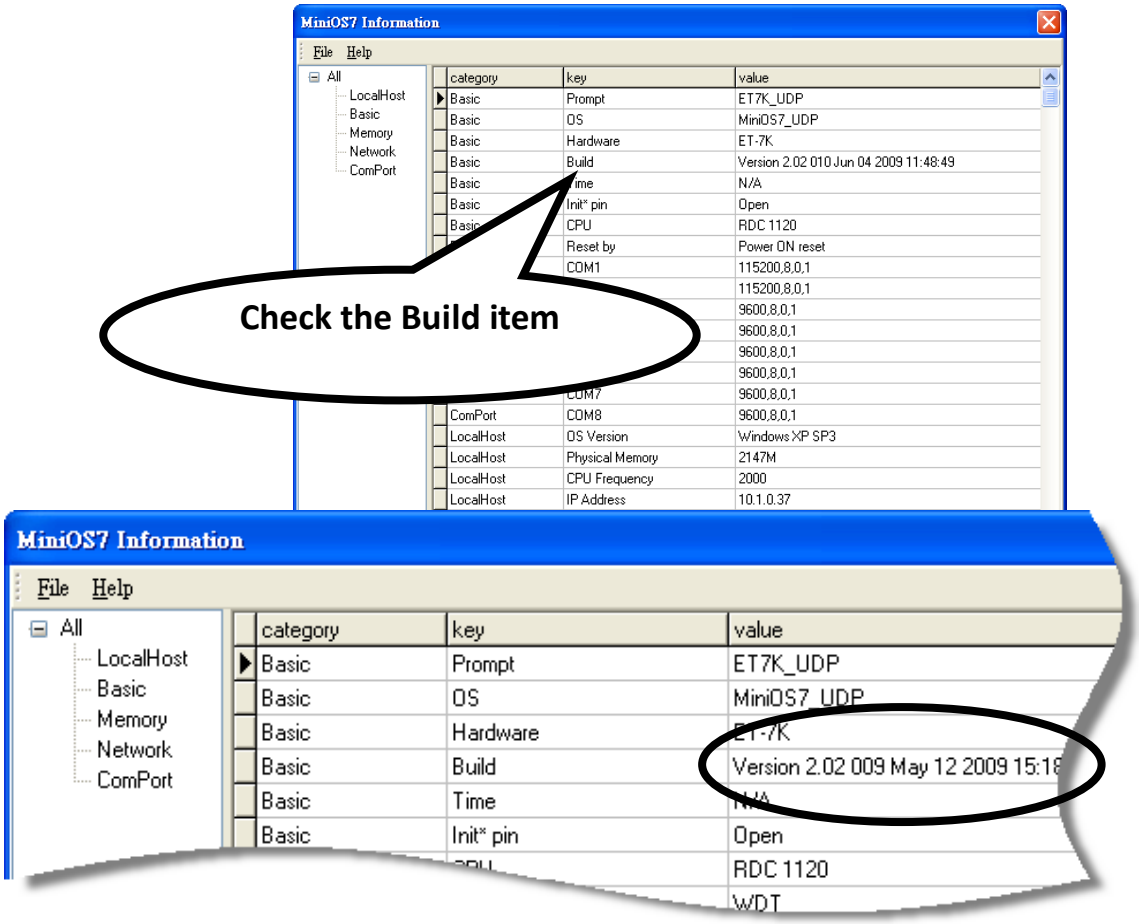
Step 6 Click "OK" to finish the procedure.

After confirming the command, you just need to wait awhile until the following dialog appear, and then click "OK" button to finish the procedure.



Step 7 Press “F7” or choose “Info” from the “Command” menu to check the OS version.

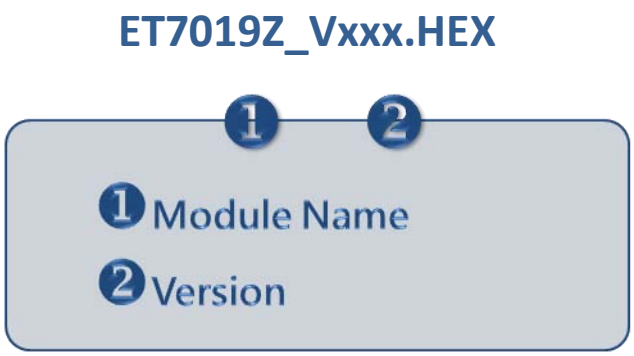
After pressing “F7” or choosing info from “Command” menu to check the OS version.



6.1.4. Uploading the ET-7019Z/PET-7019Z Firmware

The firmware is stored in flash memory and can be updated to fix functionality issues or add additional features, so we advise you to periodically check the ICP DAS web site for the latest updates.

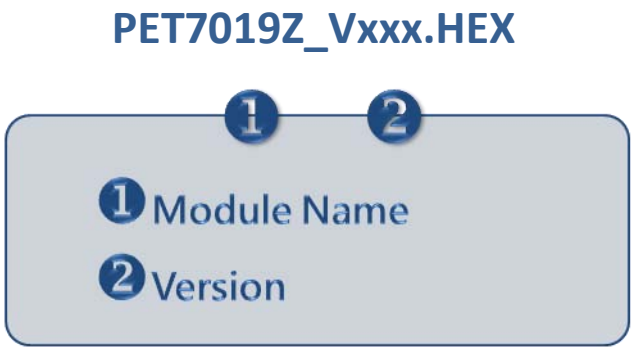
Step 1 Get the latest version of the firmware



The latest version of the firmware can be obtained from:

CD:\NAPDOS\ET7000\Firmware\

ftp://ftp.icpdas.com/pub/cd/6000cd/napdos/et7000/firmware/

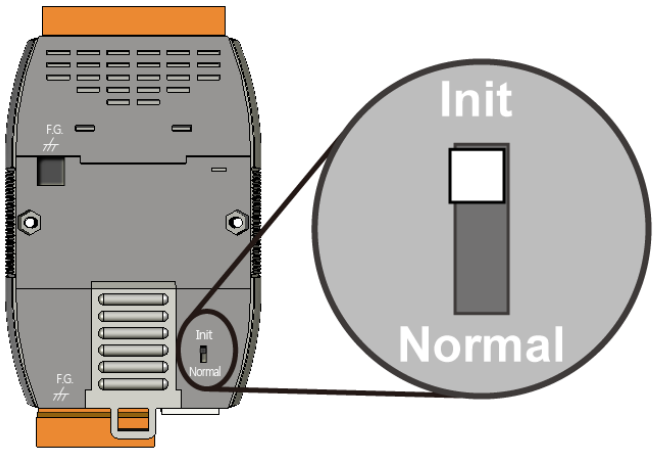


The latest version of the firmware can be obtained from:

CD:\NAPDOS\PET7000\Firmware\

ftp://ftp.icpdas.com/pub/cd/6000cd/napdos/pet7000/firmware/

Step 2 Make sure the switch placed in the "Init" position. Then reboot module.

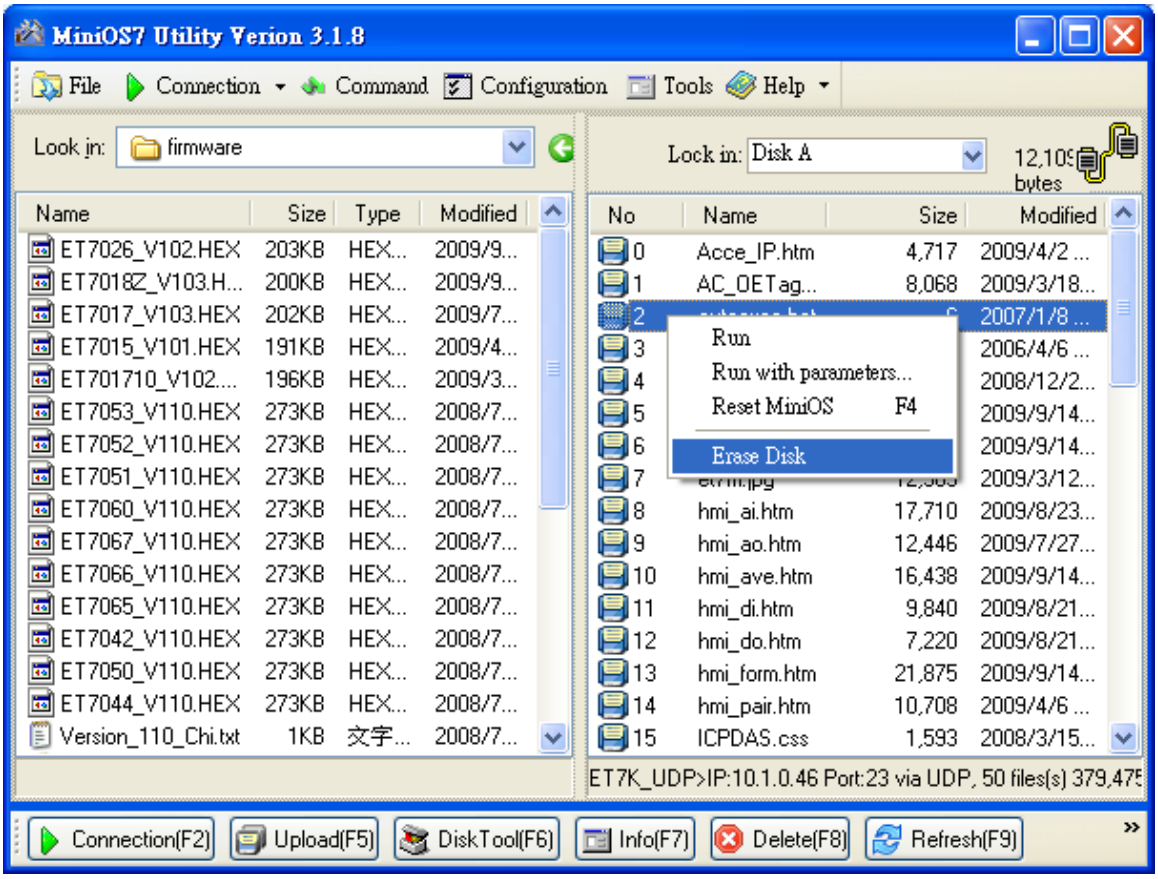


Step 3 Establish a connection to ET-7019Z/PET-7019Z.

For more detailed about this process, please refer to section “6.1.1. Establishing a Connection” to establish a connection.

Step 4 Choose “Erase Disk” from the “Command” menu.

After establishing a connection, then choose “Erase Disk” from Command menu to erase the contents of the flash memory.

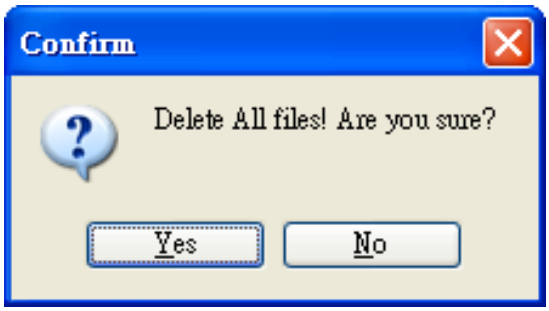


Tips & Warnings

You have to delete all files existed on the ET-7019Z/PET-7019Z before uploading the firmware.

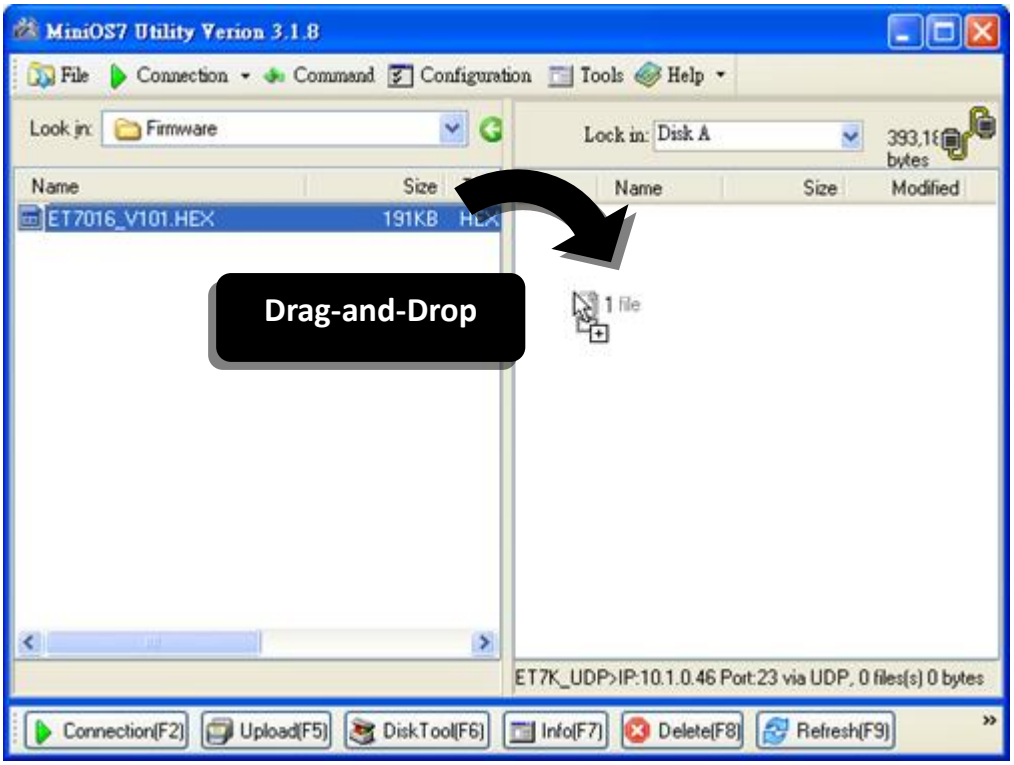
Step 5 Click "Yes" to continue.

After executing the Erase Disk command, the Confirm dialog will appear, and then click "Yes" button to continue erasing the memory contents.



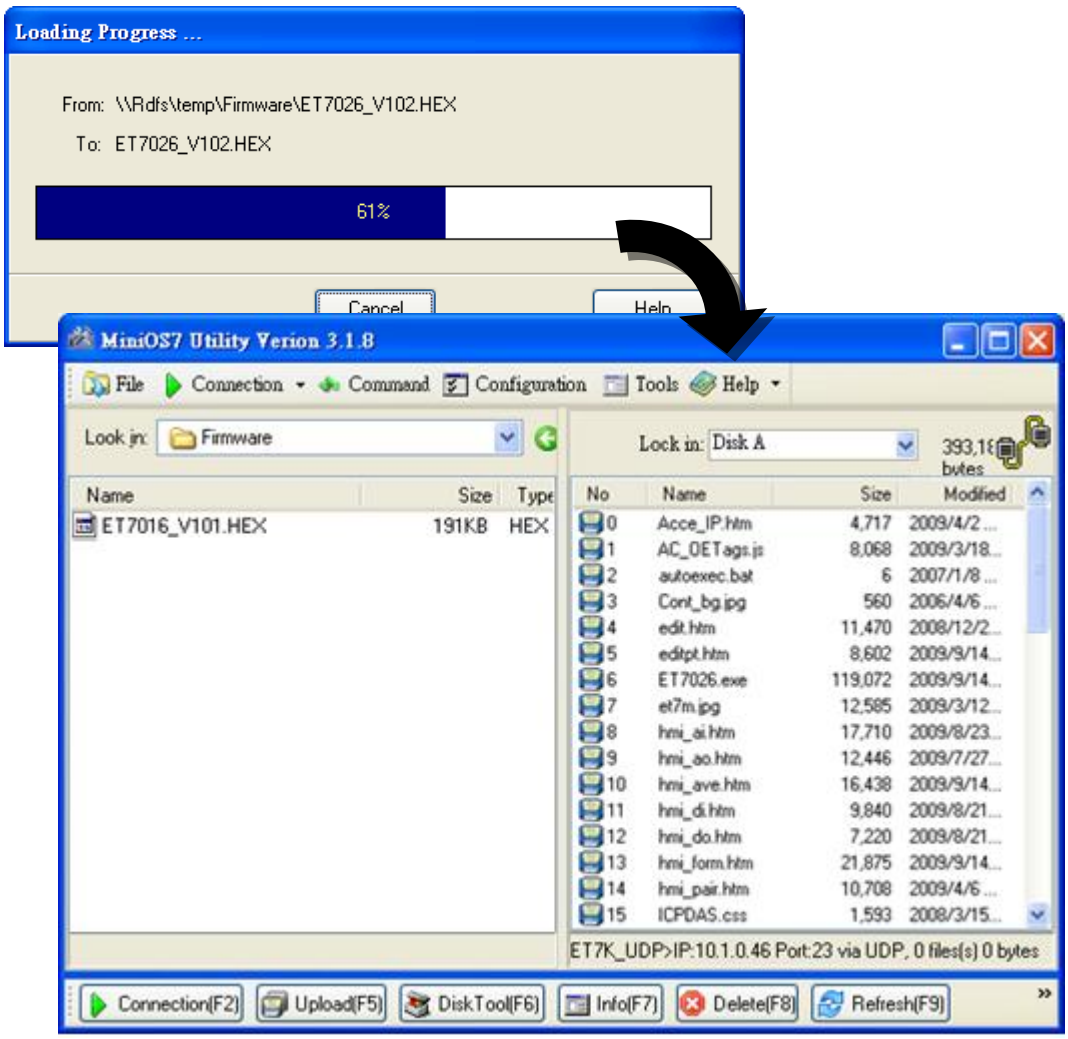
Step 6 Select the latest version of the firmware.

Upload the last version of the firmware to the ET-7019Z/PET-7019Z using drag-and drop operation.



Step 7 Click “OK” to finish and reboot the module.

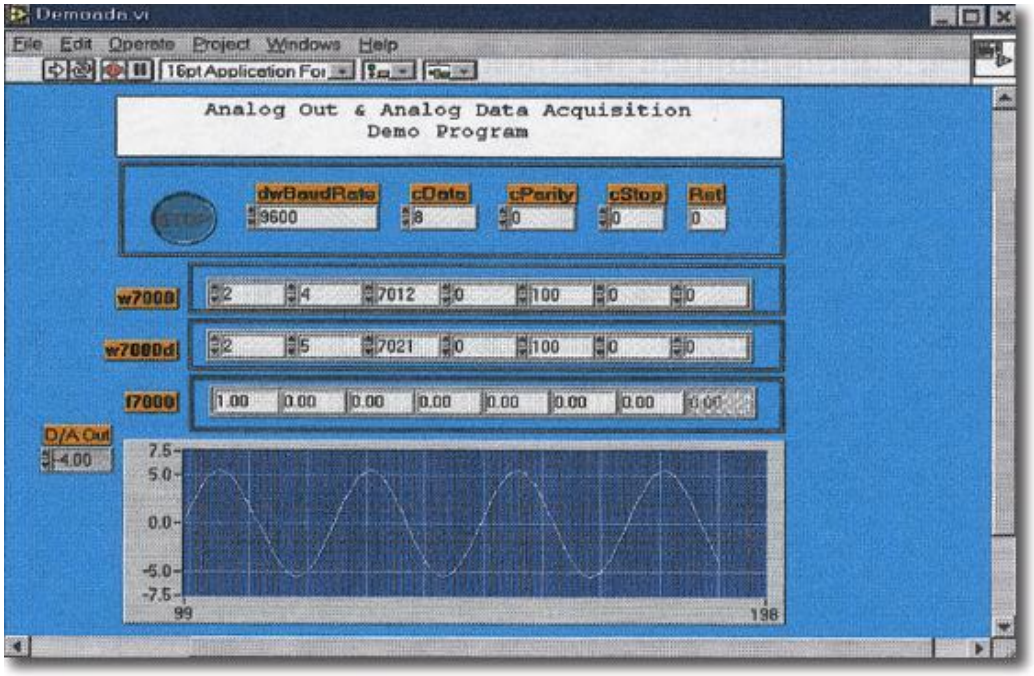
After confirming the command, you just need to wait awhile until the following dialog appear, and then click “OK” button to finish the procedure. After the update is completed, set the switch to the "Normal" position.



6.2. External Tools and Tasks

ET-7019Z/PET-7019Z supports a number of external tools to aid in developing your applications

6.2.1. LabVIEW



LabVIEW is the best way to acquire, analyze, and present data. LabVIEW delivers a graphical development environment that can be used to quickly build data acquisition quickly, instrumentation and control systems, boosting productivity and saving development time. With LabVIEW, it is possible to quickly create user interfaces that enable interactive control of software systems. To specify your system functionality, simply assemble block diagram – a natural design notation for scientists and engineers.

The document containing the detailed instructions for linking to the ET-7019Z/PET-7019Z using the Modbus protocol is located on the shipped

CD:\NAPDOS\PET7000_ET7000\Document\Application\LabVIEW\ or

ftp://ftp.icpdas.com/pub/cd/6000cd/napdos/et7000/document/application/labview

6.2.2. OPC Server

OPC (OLE for Process Control) is the first standard resulting from the collaboration of a number of leading worldwide automation suppliers working in cooperation with Microsoft. Originally based on Microsoft's OLE COM (Component Object Model) and DCOM (Distributed Component Object Model) technologies, the specification defines a standard set of objects, interfaces and methods for use in process control and manufacturing automation applications to facilitate interoperability.

There are many different mechanisms provided by various vendors that allow access to a variety of devices via specific applications. However, if an OPC Server is provided for the device, other applications will be able to access the OPC Server via the OPC interface.

6.2.3. SCADA

SCADA stands for Supervisor Control and Data Acquisition. It is a production automation and control system based on PCs.

SCADA is wildly used in many fields e.g. power generation, water systems, the oil industry, chemistry, the automobile industry. Different fields require different functions, but they all have the common features:

- Graphic interface
- Process mimicking
- Real time and historic trend data
- Alarm system
- Data acquisition and recording
- Data analysis
- Report generator

Accessing ET-7019Z/PET-7019Z module

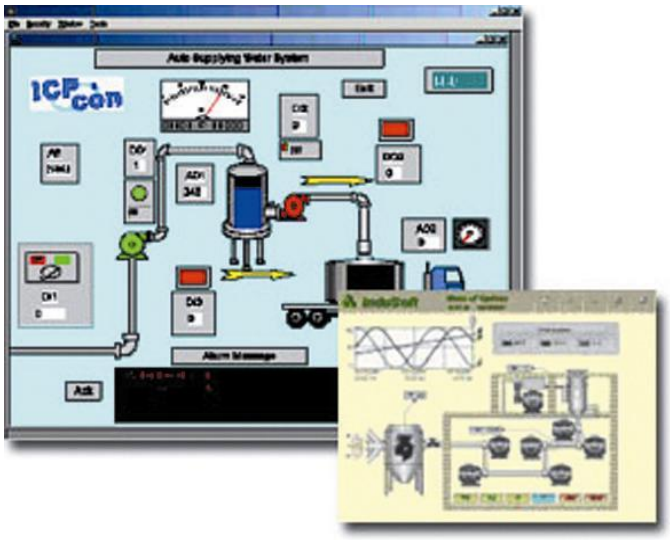
SCADA software is able to access ET-7019Z/PET-7019Z devices using Modbus communication protocols, and can communicate without the need for other software drivers.

Famous SCADA software

Citect, ICONICS, iFIX, InduSoft, Intouch, Entivity Studio, Entivity Live, Entivity VLC, Trace Mode, Wizcon, Wonderware ... etc

In the following sections 3 popular brands of SCADA software are introduced together with the detailed instructions in how use them to communicate with ET-7019Z/PET-7019Z module using the Modbus/TCP protocol.

(A) InduSoft



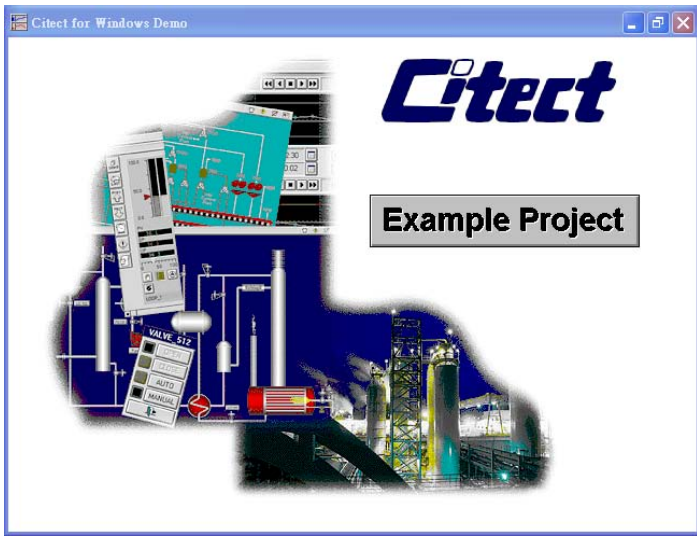
InduSoft Web Studio is a powerful, integrated collection of automation tools that includes all the building blocks needed to develop modern Human Machine Interfaces (HMI), Supervisory Control and Data Acquisition (SCADA) systems, and embedded instrumentation and control applications. InduSoft Web Studio's application runs in native Windows NT, 2000, XP, CE and CE .NET environments and conforms to industry standards such as Microsoft .NET, OPC, DDE, ODBC, XML, and ActiveX.

The document containing detailed instructions for linking to the ET-7019Z/PET-7019Z module using the Modbus protocol is located on the shipped

CD:\NAPDOS\PET7000_ET7000\Document\Application\InduSoft\

ftp://ftp.icpdas.com/pub/cd/6000cd/napdos/et7000/document/application/indusoft/

(B) Citect



CitectSCADA is a fully integrated Human Machine Interface (HMI) / SCADA solution that enables users to increase return on assets by delivering a highly scalable, reliable control and monitoring system. Easy-to-use configuration tools and powerful features enable rapid development and deployment of solutions for any size application.

The document containing detailed instructions for linking to the ET-7019Z/PET-7019Z module using the Modbus protocol is located on the shipped

CD:\NAPDOS\PET7000_ET7000\Document\Application\Citect\

ftp://ftp.icpdas.com/pub/cd/6000cd/napdos/et7000/document/application/citect/

(C) iFix

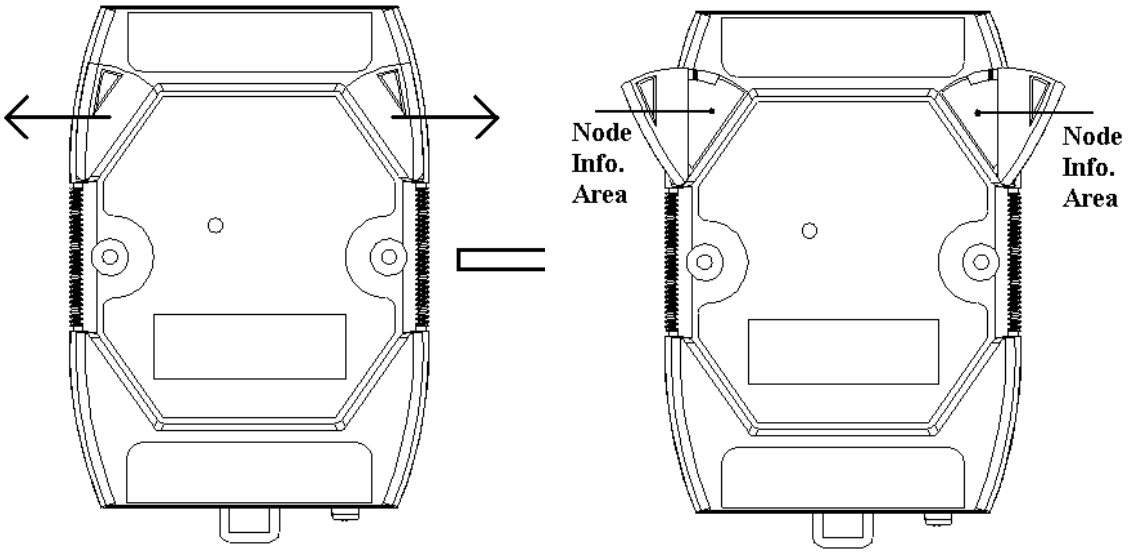
The document containing detailed instructions for linking to the ET-7019Z/PET-7019Z module using the Modbus protocol is located on the shipped

CD:\NAPDOS\PET7000_ET7000\Document\Application\iFix\

ftp://ftp.icpdas.com/pub/cd/6000cd/napdos/et7000/document/application/ifix/

Appendix A. Node Information Area

Each ET-7019Z/PET-7019Z module has a built-in EEPROM to store configuration information such as IP address, type code, etc. One minor drawback is that there are no visual indications of the configuration of the module. New ET-7019Z/PET-7019Z modules include node information areas that are protected by a cover, as shown below, and can be used to make a written record of the node information, such as IP address, etc. To access the node information areas, first slide the covers outward, as shown in the figure below.



A.1. Thermocouple

When two wires composed of dissimilar homogeneous metals are joined at one end, a thermoelectric electromotive force (emf) appears that depends only on the metals and the junction temperature. This is called the Seebeck effect. A pair of different metals with a fixed junction at one end constitutes a thermocouple. For small changes in temperature, the emf is linearly proportional to the temperature. This implies that the temperature reading can be obtained by measuring the emf.

We cannot measure the emf, V1, directly because when a voltmeter is connected to the thermocouple, another emf, V2, is created at the (cold) junction of the thermocouple and the voltmeter. The cold junction compensation method is used to resolve the problem. Using another sensor, e.g. a thermistor, to measure the cold junction temperature, T2, we can calculate the emf, V2, which corresponds to T2. The thermocouple emf, V1, can be obtained by adding V2 to that measured by the voltmeter and then the temperature.

Appendix B. Modbus Application Notes

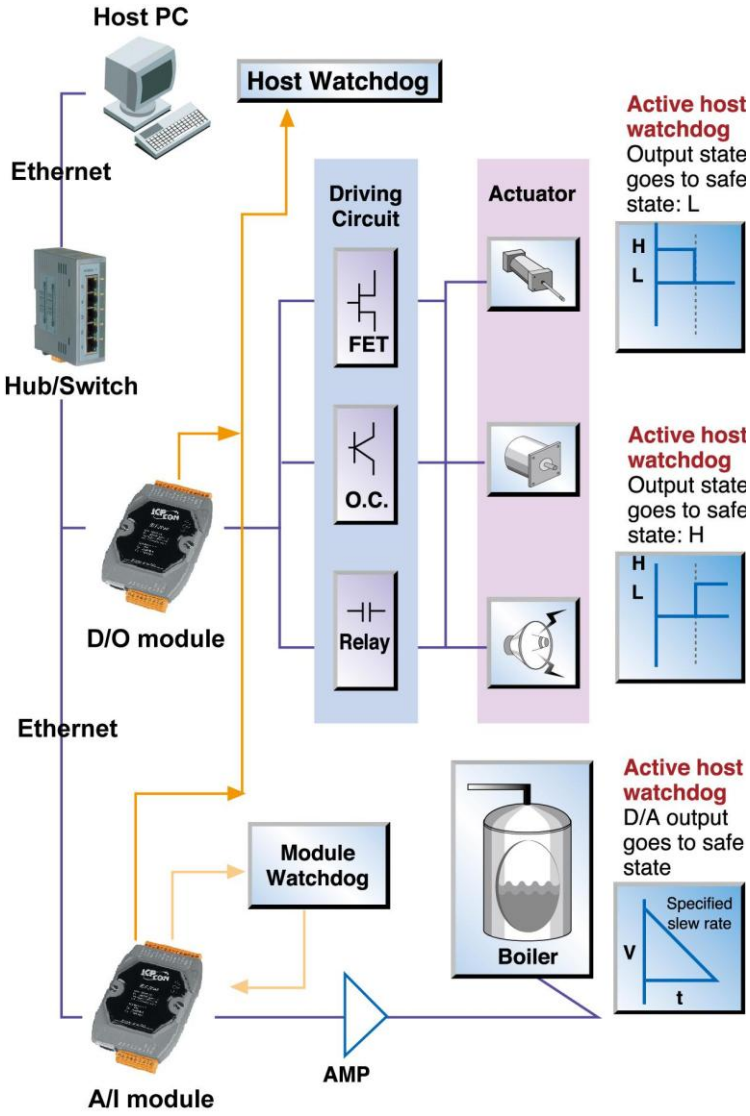
B.1. Dual Watchdog

Dual Watchdog consists of Module Watchdog and Host Watchdog.

1. The Module Watchdog is a built-in hardware circuit that will reset the CPU module if a failure occurs in either the hardware or the software. If the application does not refresh the watchdog timer within 0.8 seconds, the watchdog circuit will initiate a reset of the CPU.

2. The Host Watchdog is a software function that can be used to monitor the operating status of the host. Its purpose is to prevent network communication problems or a host failure. If the Watchdog timeout interval expires, the module will return all outputs to a predefined Safe value (Refer to the Safe Value application note), which can prevent the controlled target from unexpected situation.

   AO address 40557 of the ET-7019Z/PET-7019Z Modbus register is the address of the Host Watchdog timer, and will be stored in EEPROM. The WDT function will be disabled if the value is set to less than 5 seconds.



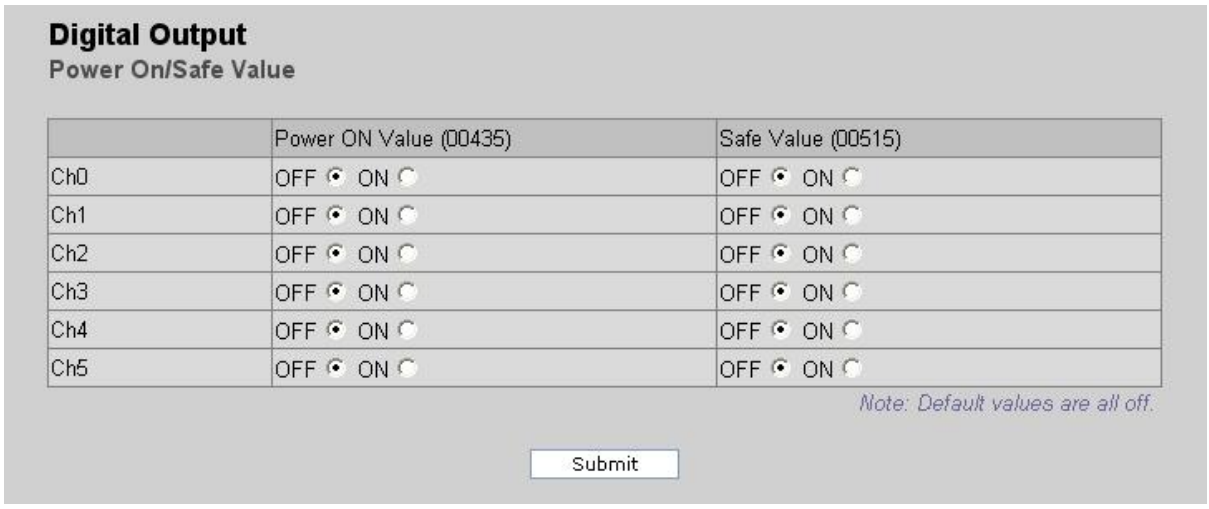
B.2. Power-on Value

If the ET-7019Z/PET-7019Z module is reset, the output of the module is set to the predefined Power-on Value for the DO channels. DO address 00435 of the ET-7019Z/PET-7019Z Modbus register is the first address of the Power-on value, and the total number of channels depend on the type of module.

Be careful to set the ON value to DO address 00431 to write the DO Power-on value to the EEPROM of the ET-7019Z/PET-7019Z module after using Modbus commands (05 or 15) to change the Power ON value.

Configuration via Web page

Browse to the homepage of the ET-7019Z/PET-7019Z, and click the “Modbus I/O Settings” link in the Configuration Section of the Main Menu tree.



Click the “ON/OFF” radio box to set the power-on value and then click the “Submit” button to enable the settings to take effect.

B.3. Safe Value

If the time of the Host PC losing Modbus/TCP communication with the module is greater than the host WatchDog timer setting (called WDT timeout), the output of the Digital and Analog channels is set to the Safe Value, and the count of the host WDT events is increased by one.

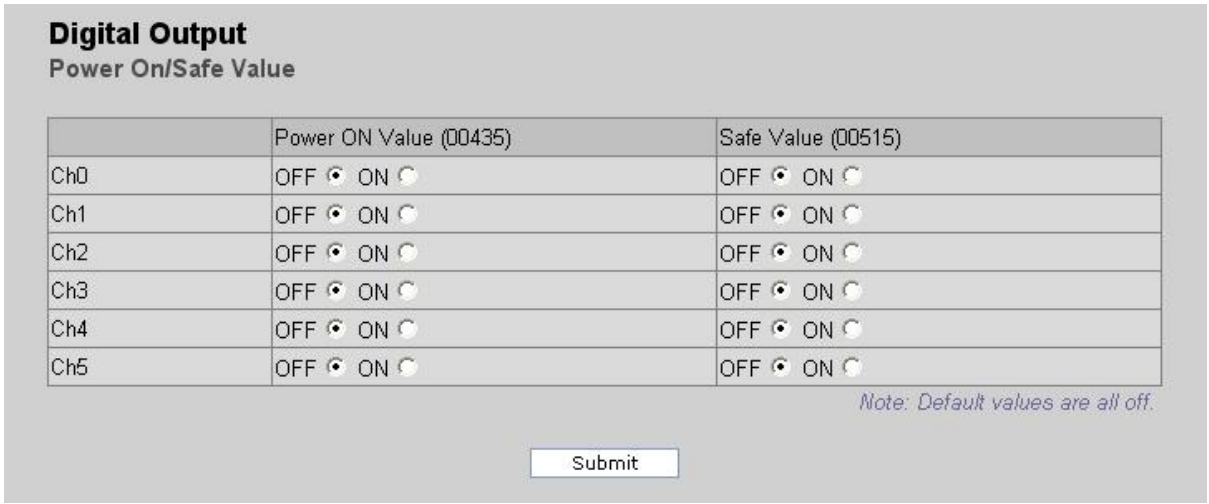
AO address 40558 is the address of the Host WDT events. The value of the WDT events will be not stored into EEPROM, and will return to 0 after the module is rebooted. DO address 00515 is the first address of the Safe value and the total number of channels depends on the type of module.

Be careful to set the ON value to DO address 00432 to write the DO Safe value to the EEPROM of the ET-7019Z/PET-7019Z module after using Modbus commands (05 or 15) to change the Power ON value.

While the WDT timeout is set, the module can also receive the Modbus/TCP commands (05, 06, 15 and 16) to change the DO or AO value without needing to clear the host watchdog timeout value.

Configuration via Web page

Browse to the homepage of the ET-7019Z/PET-7019Z, and click the “Modbus I/O Settings” link in the Configuration Section of the Main Menu tree.



Click the “ON/OFF” radio box to set the Safe value and then click the “Submit” button to enable the settings to take effect.

B.4. AI High/Low Alarm

ET-7019Z/PET-7019Z module equip with the High/Low Alarm function. When the alarm function is enabled, the specific registers are the alarm indicator. The alarm function is to compare the analog input value with given high alarm value and low alarm value.

Address 00636 to 00645 can be used to enable/disable the AI High Alarm function.

Address 00668 to 00677 can be used to enable/disable the AI Low Alarm function.

AI High/Low Alarm Switch Table

Channel Number	AI High Alarm		AI Low Alarm	
	Register	Description	Register	Description
AI0	00636	0: Disable/1: Enable	00668	0: Disable/1: Enable
AI1	00637	0: Disable/1: Enable	00669	0: Disable/1: Enable
AI2	00638	0: Disable/1: Enable	00670	0: Disable/1: Enable
AI3	00639	0: Disable/1: Enable	00671	0: Disable/1: Enable
AI4	00640	0: Disable/1: Enable	00672	0: Disable/1: Enable
AI5	00641	0: Disable/1: Enable	00673	0: Disable/1: Enable
AI6	00642	0: Disable/1: Enable	00674	0: Disable/1: Enable
AI7	00643	0: Disable/1: Enable	00675	0: Disable/1: Enable
AI8	00644	0: Disable/1: Enable	00676	0: Disable/1: Enable
AI9	00645	0: Disable/1: Enable	00677	0: Disable/1: Enable

Address 40296 to 40305 records the High Alarm value. Address 40328 to 40337 records the Low Alarm value. By defaults, the High Alarm value is +32767 (0x7FFF) and the low alarm value is -32768 (0xFFFF).

AI High/Low Alarm Value Table

Channel Number	High Alarm Value of AI		Low Alarm Value of AI	
	Register	Description	Register	Description
AI0	40296	-32768 ~ 32767	40328	-32768 ~ 32767
AI1	40297	-32768 ~ 32767	40329	-32768 ~ 32767
AI2	40298	-32768 ~ 32767	40330	-32768 ~ 32767
AI4	40300	-32768~32767	40332	-32768~32767
AI5	40301	-32768~32767	40333	-32768~32767
AI6	40302	-32768~32767	40334	-32768~32767
AI7	40303	-32768~32767	40335	-32768~32767
AI8	40304	-32768~32767	40336	-32768~32767
AI9	40305	-32768~32767	40337	-32768~32767

The analog input High/Low Alarm contains two alarm types, Momentary Alarm and Latch Alarm. Address 00700 of Modbus register can be used to set the High Alarm type of channel 0 and the total number of channels depends on the type of module. Address 00732 of Modbus register can be used to set the Low Alarm type of channel 0.

AI High/Low Type Value Table

Channel Number	AI High Alarm Type		AI Low Alarm Type	
	Register	Description	Register	Description
AI0	00700	0: Momentary Mode 1: Latch Mode	00732	0: Momentary Mode 1: Latch Mode
AI1	00701	0: Momentary Mode 1: Latch Mode	00733	0: Momentary Mode 1: Latch Mode
AI2	00702	0: Momentary Mode 1: Latch Mode	00734	0: Momentary Mode 1: Latch Mode
AI3	00703	0:Momentary 1: Latched	00735	0:Momentary 1: Latched
AI4	00704	0:Momentary 1: Latched	00736	0:Momentary 1: Latched
AI5	00705	0:Momentary 1: Latched	00737	0:Momentary 1: Latched
AI6	00706	0:Momentary 1: Latched	00738	0:Momentary 1: Latched
AI7	00707	0:Momentary 1: Latched	00739	0:Momentary 1: Latched
AI8	00708	0:Momentary 1: Latched	00740	0:Momentary 1: Latched
AI9	00709	0:Momentary 1: Latched	00741	0:Momentary 1: Latched

The following are the descriptions for two alarm types.

Momentary Alarm

The alarm status is cleared while the analog input is not exceeding the alarm value.

For example:

If analog input value of channel 0 (30000) > High Alarm value (40296), the address 10224 is 1, else it is 0.

If analog input Value of channel 0 (30000) < Low Alarm value (40328), the address 10256 is 1, else it is 0.

The address 10224 to 10233 is the high alarm indicator. If a high alarm occurred, the value of register is 1. In normal condition, it will be 0. The address 10256 to 10265 is the low alarm indicator. If a low alarm occurred, the value of register is 1. In normal condition, it will be 0.

Latch Alarm

When the Latch Alarm mode is enabled, the register stays latched until the specified registers are cleared.

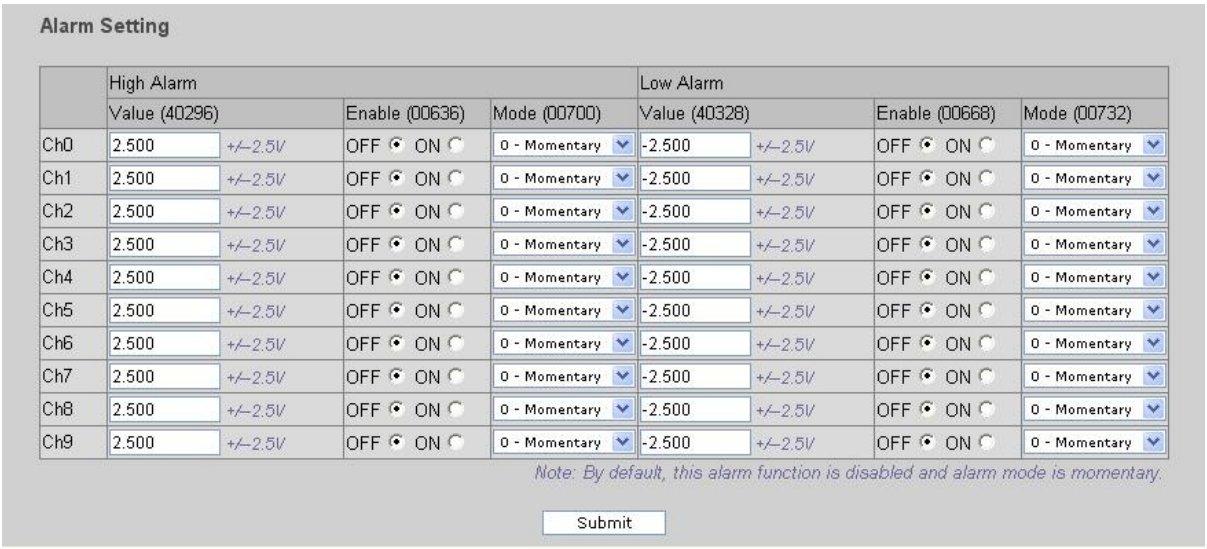
For example:

If analog input value of channel 0 (30000) > High Alarm value (40296), the address 10224 is 1, else if analog input value of channel 0 (30000) < Low Alarm value (40328), the address 10256 is 1.

The address 10224 to 10233 is the high alarm indicator. In normal condition, the value of register is 0. If a High alarm occurred, the value of register stays 1 until the address 00764 to 00773 is cleared. The address 10256 to 10265 is the low alarm indicator. In normal condition, the value of register is 0. If a low alarm occurred, the value of register stays 1 until the address 00796 to 00805 is cleared.

Configuration via Web page

Browse to the homepage of the ET-7019Z/PET-7019Z, and click the “Modbus I/O Settings” link in the Configuration Section of the Main Menu tree.



Alarm Setting

	High Alarm			Low Alarm		
	Value (40296)	Enable (00636)	Mode (00700)	Value (40328)	Enable (00668)	Mode (00732)
Ch0	2.500 +/–2.5V	OFF ON	0 - Momentary	-2.500 +/–2.5V	OFF ON	0 - Momentary
Ch1	2.500 +/–2.5V	OFF ON	0 - Momentary	-2.500 +/–2.5V	OFF ON	0 - Momentary
Ch2	2.500 +/–2.5V	OFF ON	0 - Momentary	-2.500 +/–2.5V	OFF ON	0 - Momentary
Ch3	2.500 +/–2.5V	OFF ON	0 - Momentary	-2.500 +/–2.5V	OFF ON	0 - Momentary
Ch4	2.500 +/–2.5V	OFF ON	0 - Momentary	-2.500 +/–2.5V	OFF ON	0 - Momentary
Ch5	2.500 +/–2.5V	OFF ON	0 - Momentary	-2.500 +/–2.5V	OFF ON	0 - Momentary
Ch6	2.500 +/–2.5V	OFF ON	0 - Momentary	-2.500 +/–2.5V	OFF ON	0 - Momentary
Ch7	2.500 +/–2.5V	OFF ON	0 - Momentary	-2.500 +/–2.5V	OFF ON	0 - Momentary
Ch8	2.500 +/–2.5V	OFF ON	0 - Momentary	-2.500 +/–2.5V	OFF ON	0 - Momentary
Ch9	2.500 +/–2.5V	OFF ON	0 - Momentary	-2.500 +/–2.5V	OFF ON	0 - Momentary

Note: By default, this alarm function is disabled and alarm mode is momentary.

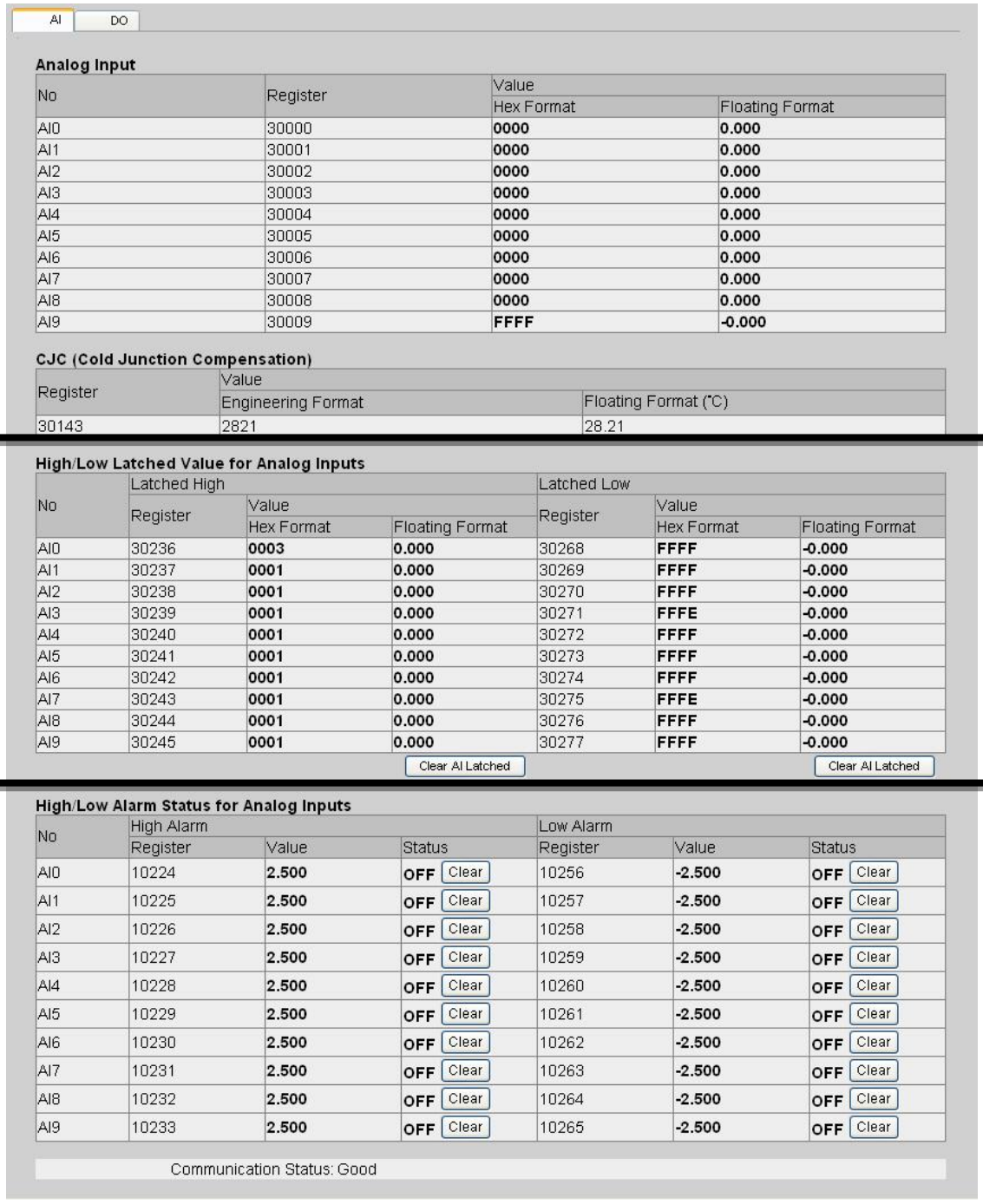
Submit

B.5. AI High/Low Latch

The address 30236 to 30245 records the maximum value of analog inputs and stays the value until another maximum input enters. The address 30268 to 30277 records the minimum value of analog inputs and stays the value until another minimum input enters.

View the AI High/Low latch value via Web page

Click the “Web HMI” link in the Web HMI Section of the Main Menu tree.



AI | DO

Analog Input

No	Register	Value	
		Hex Format	Floating Format
AI0	30000	0000	0.000
AI1	30001	0000	0.000
AI2	30002	0000	0.000
AI3	30003	0000	0.000
AI4	30004	0000	0.000
AI5	30005	0000	0.000
AI6	30006	0000	0.000
AI7	30007	0000	0.000
AI8	30008	0000	0.000
AI9	30009	FFFF	-0.000

CJC (Cold Junction Compensation)

Register	Value	
	Engineering Format	Floating Format (°C)
30143	2821	28.21

High/Low Latched Value for Analog Inputs

No	Latched High			Latched Low		
	Register	Value		Register	Value	
		Hex Format	Floating Format		Hex Format	Floating Format
AI0	30236	0003	0.000	30268	FFFF	-0.000
AI1	30237	0001	0.000	30269	FFFF	-0.000
AI2	30238	0001	0.000	30270	FFFF	-0.000
AI3	30239	0001	0.000	30271	FFFE	-0.000
AI4	30240	0001	0.000	30272	FFFF	-0.000
AI5	30241	0001	0.000	30273	FFFF	-0.000
AI6	30242	0001	0.000	30274	FFFF	-0.000
AI7	30243	0001	0.000	30275	FFFE	-0.000
AI8	30244	0001	0.000	30276	FFFF	-0.000
AI9	30245	0001	0.000	30277	FFFF	-0.000

Clear AI Latched | Clear AI Latched

High/Low Alarm Status for Analog Inputs

No	High Alarm			Low Alarm		
	Register	Value	Status	Register	Value	Status
AI0	10224	2.500	OFF Clear	10256	-2.500	OFF Clear
AI1	10225	2.500	OFF Clear	10257	-2.500	OFF Clear
AI2	10226	2.500	OFF Clear	10258	-2.500	OFF Clear
AI3	10227	2.500	OFF Clear	10259	-2.500	OFF Clear
AI4	10228	2.500	OFF Clear	10260	-2.500	OFF Clear
AI5	10229	2.500	OFF Clear	10261	-2.500	OFF Clear
AI6	10230	2.500	OFF Clear	10262	-2.500	OFF Clear
AI7	10231	2.500	OFF Clear	10263	-2.500	OFF Clear
AI8	10232	2.500	OFF Clear	10264	-2.500	OFF Clear
AI9	10233	2.500	OFF Clear	10265	-2.500	OFF Clear

Communication Status: Good

Appendix C. Analog Type and Data Format Table

Type Code	Input Range	Data Format	+F.S	-F.S
00	-15 to +15 mA	Engineering Unit	+15000	-15000
		2's comp HEX	7FFF	8000
01	-50 to +50 mA	Engineering Unit	+5000	-5000
		2's comp HEX	7FFF	8000
02	-100 to +100 mV	Engineering Unit	+10000	-10000
		2's comp HEX	7FFF	8000
03	-500 to +500 mV	Engineering Unit	+5000	-5000
		2's comp HEX	7FFF	8000
04	-1 to +1 V	Engineering Unit	+10000	-10000
		2's comp HEX	7FFF	8000
05	-2.5 to +2.5 V	Engineering Unit	+25000	-25000
		2's comp HEX	7FFF	8000
06	-20 to +20 mA	Engineering Unit	+20000	-20000
		2's comp HEX	7FFF	8000
07	+4 to +20 mA	Engineering Unit	+20000	+4000
		2's comp HEX	FFFF	0000
08	-10 to +10 V	Engineering Unit	+10000	-10000
		2's comp HEX	7FFF	8000
09	-5 to +5 V	Engineering Unit	+5000	-5000
		2's comp HEX	7FFF	8000
0A	-1 to +1 V	Engineering Unit	+10000	-10000

		2’s comp HEX	7FFF	8000
0B	-500 to +500 mV	Engineering Unit	+5000	-5000
		2’s comp HEX	7FFF	8000
0C	-150 to +150 mV	Engineering Unit	+15000	-15000
		2’s comp HEX	7FFF	8000
0D	-20 to +20 mA	Engineering Unit	+20000	-20000
		2’s comp HEX	7FFF	8000
1A	0 to +20 mA	Engineering Unit	+20000	0
		2’s comp HEX	FFFF	0000
0E	Type J Thermocouple -210 ~ 760°C	Engineering Unit	+7600	-2100
		2’s comp HEX	7FFF	DCA2
0F	Type K Thermocouple -270 ~ 1372°C	Engineering Unit	+13720	-2700
		2’s comp HEX	7FFF	E6D0
10	Type T Thermocouple -270 ~ 400°C	Engineering Unit	+4000	-2700
		2’s comp HEX	7FFF	DCA2
11	Type E Thermocouple -270 ~ 1000°C	Engineering Unit	10000	-2700
		2’s comp HEX	7FFF	DD71
12	Type R Thermocouple 0 ~ 1768°C	Engineering Unit	+17680	0
		2’s comp HEX	7FFF	0000
13	Type S Thermocouple 0 ~ 1768°C	Engineering Unit	+17680	0
		2’s comp HEX	7FFF	0000
14	Type B Thermocouple 0 ~ 1820°C	Engineering Unit	+18200	0
		2’s comp HEX	7FFF	0000

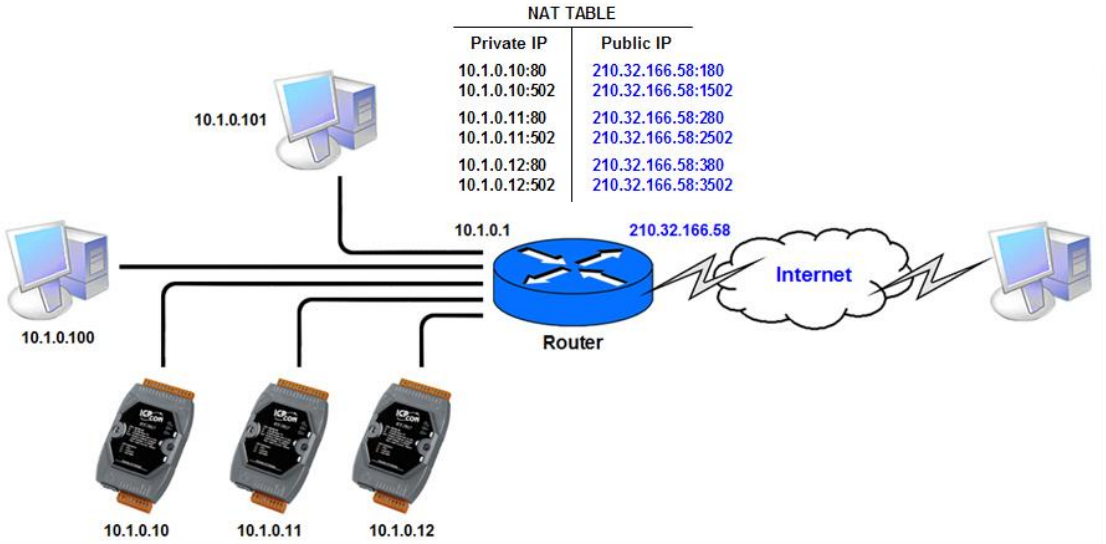
15	Type N Thermocouple -270 ~ 1300°C	Engineering Unit	+13000	-2700
		2's comp HEX	7FFF	E56B
16	Type C Thermocouple 0 ~ 2320°C	Engineering Unit	+23200	0
		2's comp HEX	7FFF	0000
17	Type L Thermocouple -200 ~ 800°C	Engineering Unit	+8000	-2000
		2's comp HEX	7FFF	E000
18	Type M Thermocouple -200 ~ 100°C	Engineering Unit	+10000	-20000
		2's comp HEX	4000	8000
19	Type L DIN43710 Thermocouple -200 ~ 800°C	Engineering Unit	8000	-2000
		2's comp HEX	FFFF	E38E

Appendix D. Network Address Translation

For a computer to communicate with ET-7019Z/PET-7019Z modules on the Internet, ET-7019Z/PET-7019Z modules must have a public IP address. Basically, it works like your street address - as a way to find out exactly where you are and deliver information to you.

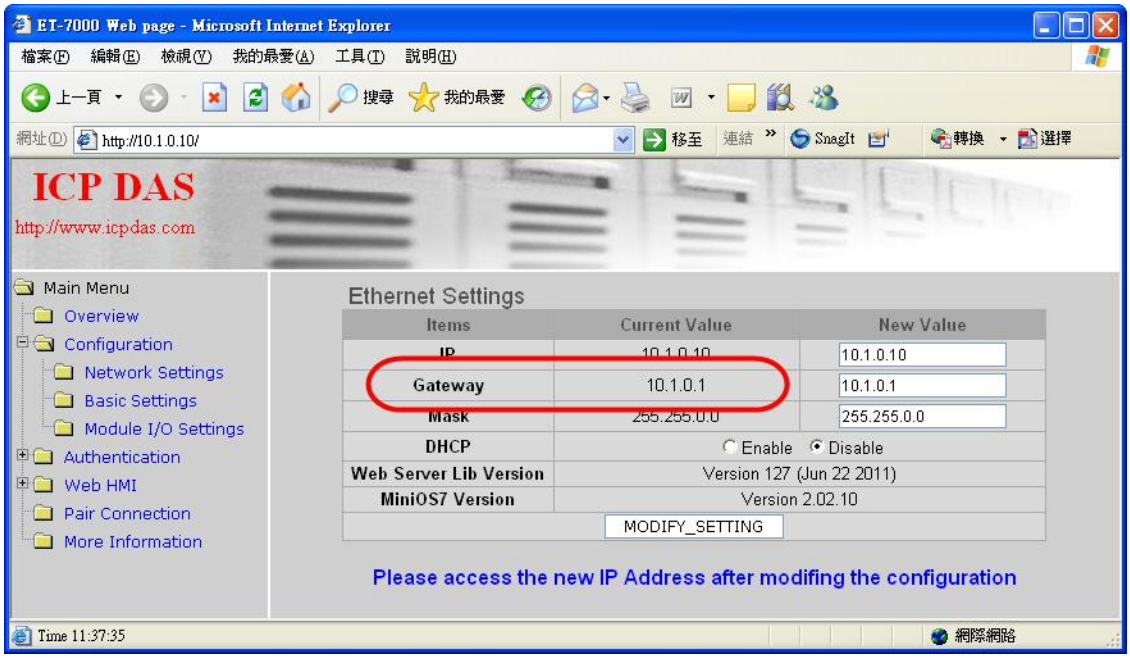
Network Address Translation (NAT) allows a single device, such as a router, to act as an agent between the Internet (or "public network") and a local (or "private") network. This means that only a single, unique IP address is required to represent an entire group of computers.

A type of NAT in which a private IP address is mapped to a public IP address, where the public address is always the same IP address (i.e., it has a static address). This allows an internal host, such as an ET-7019Z/PET-7019Z module, to have an unregistered (private) IP address and still be reachable over the Internet.



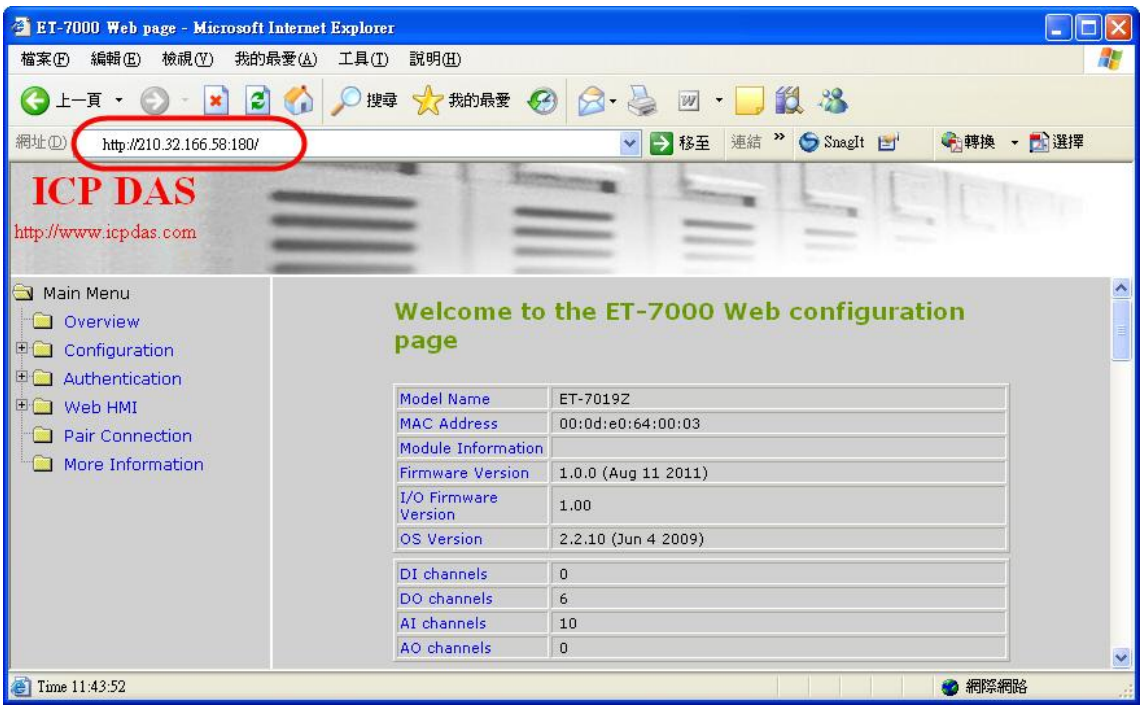
Step 1 Configure the Ethernet settings of ET-7019Z/PET-7019Z module.

The Gateway must be set to the IP address of router (i.e., 10.1.0.1)



Step 2 Connect to the web server of ET-7019Z/PET-7019Z module with the public IP address on the Internet

For accessing the web page, the access URL will need to include the port number as shown below: http://210.32.166.58:180



Appendix E. Troubleshooting

A number of common problems are easy to diagnose and fix if you know the cause.

Symptom/Problem	Possible cause	Solution
The Run LED doesn't light	Internal power has failed	Return the module for repair.
The Run LED indicator is ON (light), but not flashing.	The module has possibly crashed.	Reboot the module
Cannot communicate via the Ethernet port, but the ET-7019Z/PET-7019Z is still operating.	The IP/Mask/Gateway address isn't within the IP address range of the LAN.	Change the IP/Mask/Gateway address to match the LAN, or ask the MIS administrator for assistance.
	The IP address has restricted by the IP filter settings	Check the IP filter setting using the Web configuration.
	There are more than 30 TCP/IP connections.	Reboot the module.
Able to explore the web page through Port 80 using a web browser, but the Web HMI and Modbus/TCP program cannot access the module through Port 502.	Port 502 has been restricted by the firewall.	Consult your MIS administrator for assistance.
The Web HMI and Modbus/TCP program can access the module through Port 502, but Web browser cannot explore the web page through Port 80 using a web browser.	The Port 502 has restricted by the firewall.	Consult your MIS administrator for assistance.
	The Web Configuration function has been disabled. (Shown on the Basic Settings page)	Enable the Web Configuration function using either the SMMI or the console.
	The Web server TCP Port has been changed from Port 80 (Shown on the Basic Settings page)	Change the TCP Port to 80 or reconnect the ET-7019Z/PET-7019Z using the specific TCP Port.