ET-7H16M Series
User Manual

Version 1.0.1, December 2018

Written by Sean Hsu

Edited by Anna Huang

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

ICP DAS assumes no liability for any damage resulting from the use of this product. ICP DAS reserves the right to change this manual at any time without notice. The information furnished by ICP DAS is believed to be accurate and reliable. However, no responsibility is assumed by ICP DAS for its use, not for any infringements of patents or other rights of third parties resulting from its use.

Copyright

Trademark

The names used for identification only may be registered trademarks of their respective companies.

Contact US

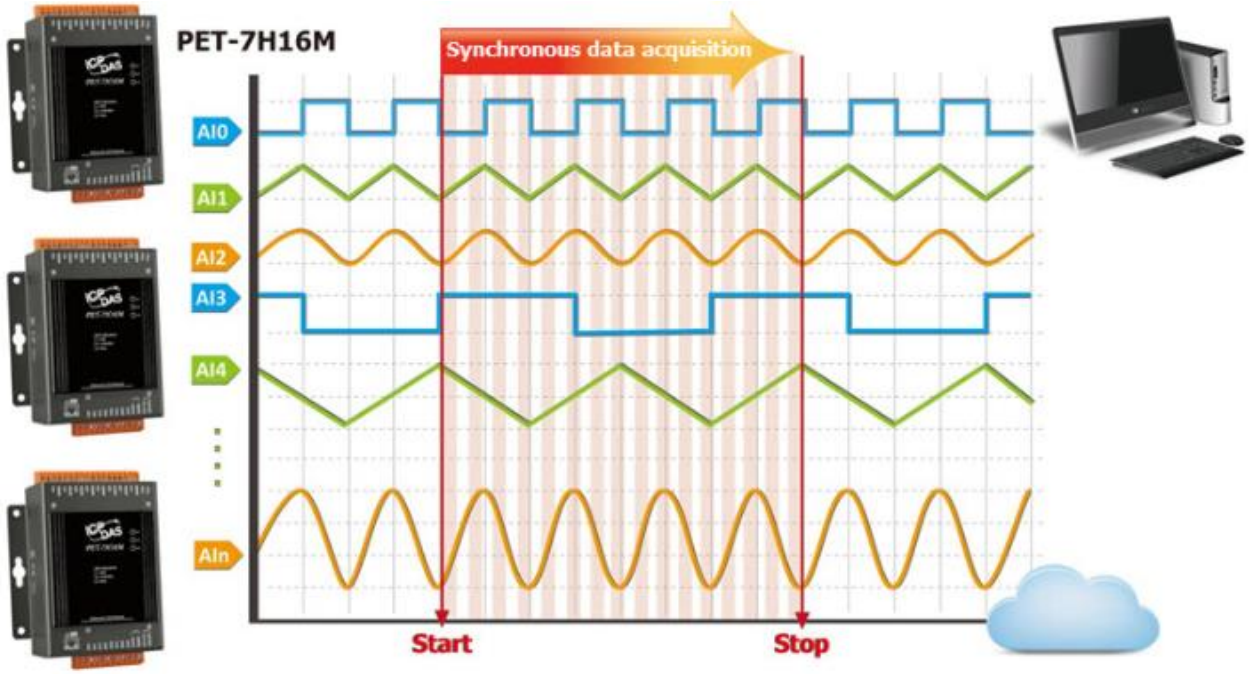
If you have any problem, please feel free to contact us.
You can count on us for quick response.

Email: service@icpdas.com

Table of Contents

1. Introduction

The PET-7H16M is an high speed data acquisition devices built-in a Ethernet communication port for data transfer over the network and it includes a high speed 16-bit single-ended analog inputs (200 KHz sample and hold for 8 channels), 4-channel digital inputs and 4-channel digital outputs. With a FIFO of 2048 samples, the maximum sampling rate is up to 200 kS/s with 8 channels 16-bit A/D converters simultaneously sampling on each channel.



It provides programmable input range on all analog channels (±5 V and ±10 V), digital output can be set output with Short-circuit protection and overload protection. PET-7H16M also has qualification for 4 kV ESD protection as well as 2500 VDC intra module isolation.

PET-7H16M supports more kinds of trigger modes for A/D conversion: software trigger, external clock trigger and external digital trigger (Post-trigger/Pre-trigger). The software trigger can acquire a sample whenever needed, while the internal pacer saves CPU loading by triggering the sampling at pre-programmed frequency. An external clock trigger can be used for triggering by external frequency source.

1.1. Features

The PET-7H16M series family offers the most comprehensive configuration to meet specific application requirements. The following list shows the features designed to simplify installation, configuration and application.

➤ Data transmission mode

1. Continuous transmission (Maximum sampling rate of 30 kHz per channel)

   After starting A/D acquisition, data is continuously transmitted to the Host PC.

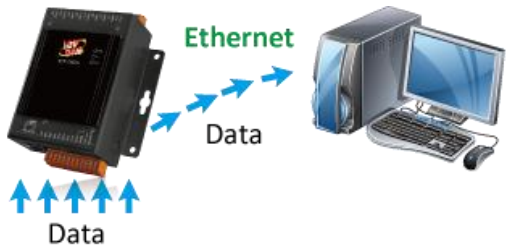
2. After collecting N data samples, the data is transferred to the Host PC (Maximum sampling rate of 200 kHz per channel)

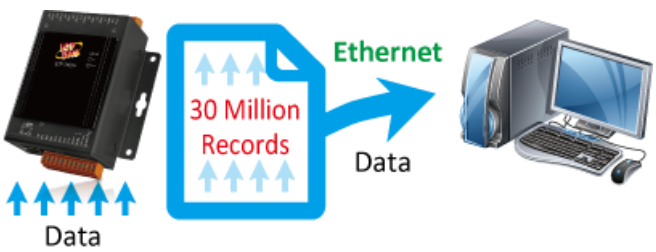
   a. After starting A/D acquisition, the data will be temporarily stored in the memory on the PET-7H16M module, and wait until a command is received from the Host PC, before transferring the collected data to the Host PC.

   b. The memory capacity allows temporary storage of up to 30 million data samples, Storage time:

      (b1) 125 seconds at a sampling rate of 30 kHz

      (b2) 19.6 seconds at a sampling rate of 200 kHz





➢ A/D trigger mode

1. Software A/D Data Acquisition mode

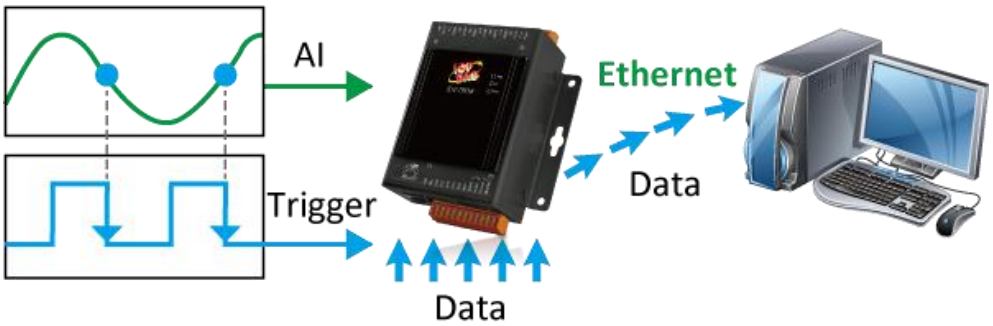
The A/D acquisition parameters are configured via a command from the Host PC. The continuous A/D acquisition or the acquisition of N data samples begins after the command is triggered.

2. External Digital Signal Event Trigger mode

The A/D acquisition parameters are configured via a command from the Host PC, and then triggered via an external electrical signal. The A/D acquisition of the N data samples is then started.

3. External Clock Signal Synchronization A/D Conversion Data Acquisition mode

The speed of the A/D acquisition and the amount of data acquired are controlled by external electrical signals. A falling edge for each output waveform triggers an AD conversion



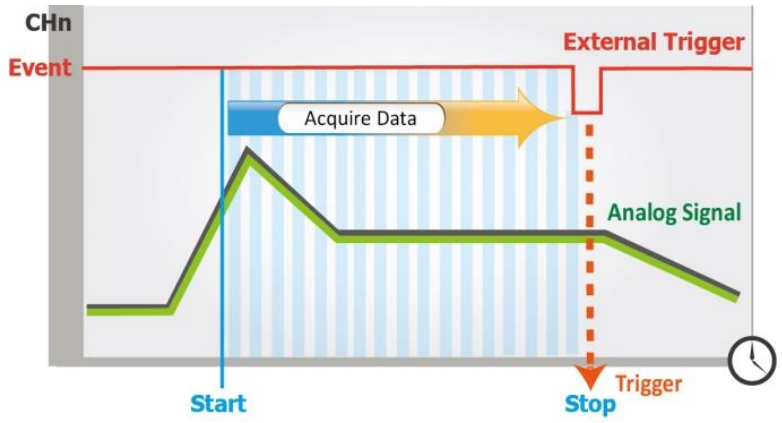
External Clock Signal Synchronization A/D Acquisition Mode

➤ External Digital Signal Event Trigger mode

A/D acquisition is performed in external digital event trigger mode (triggering the electrical signal is the falling edge trigger). The maximum sampling rate per channel is 200 kHz, and A/D acquisition of N data samples is performed. The acquisition mode can be categorized into two types

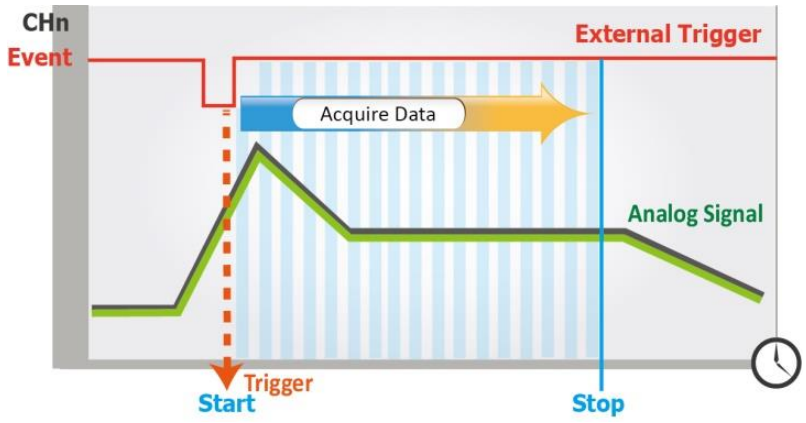
Pre-Trigger (acquisition of N data samples)

The A/D data is continually collected and is temporarily stored in the memory on the PET-7H16M until the trigger signal is received. Once the trigger signal is received, the collected N data samples are then transferred to the Host PC.



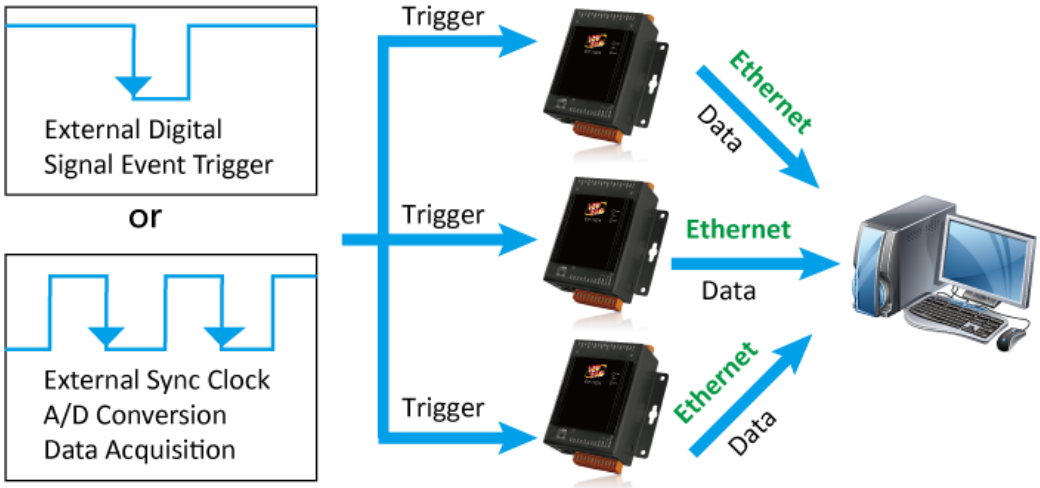
Post-Trigger (acquisition of N data samples)

In this mode, the A/D acquisition of the N data samples is started once the trigger signal is received.



A/D sync trigger between multiple modules

The A/D acquisition parameters are configured via a command from the Host PC, and are triggered by an external digital signal event, the A/D acquisition of N data samples, or A/D acquisition via the synchronization of an external clock signal.



Built-in Web Server

Each PET-7H16M 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.

Communication Security

Account and password are required when logging into the PET-7H16M web server. An IP address filter is also included, which can be used to allow or deny connections with specific IP addresses.

Modbus/TCP Protocol

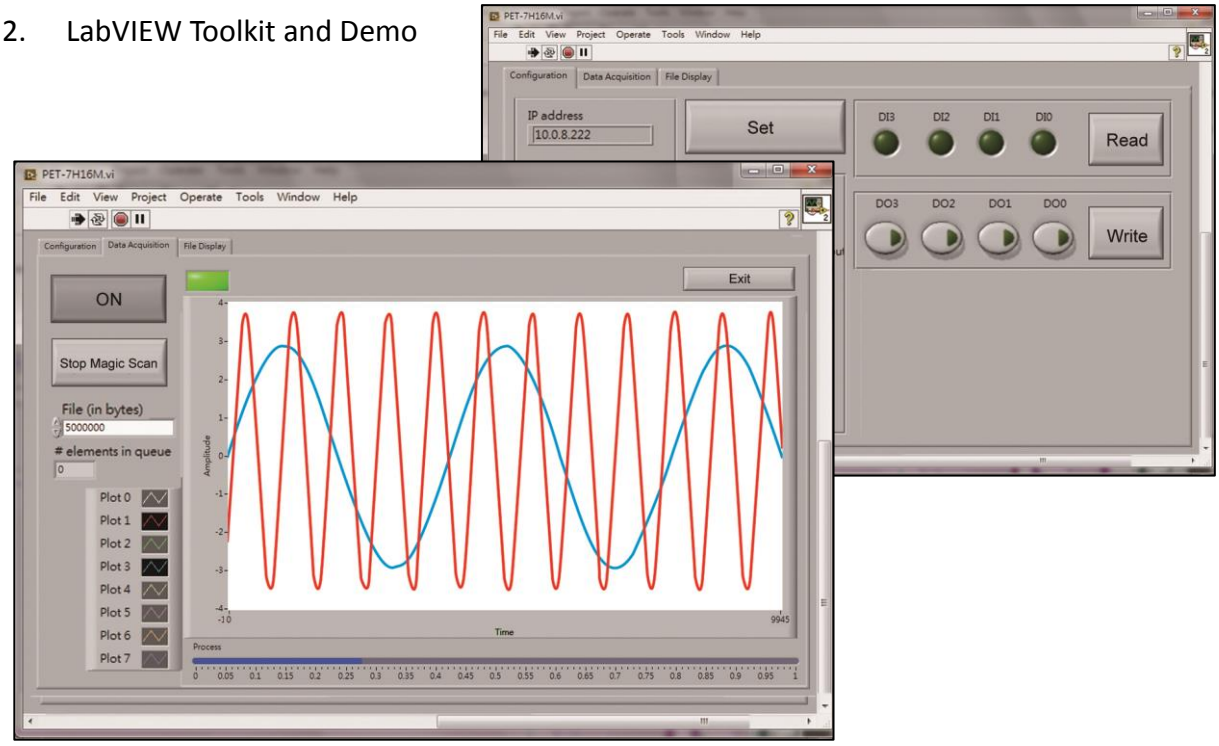
The Modbus/TCP slave function on the Ethernet port can be used to provide data to remote HMI/SCADA software built with Modbus/TCP driver.

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.

Software Support

1. VC, C#, VB.NET API and Demo
2. LabVIEW Toolkit and Demo



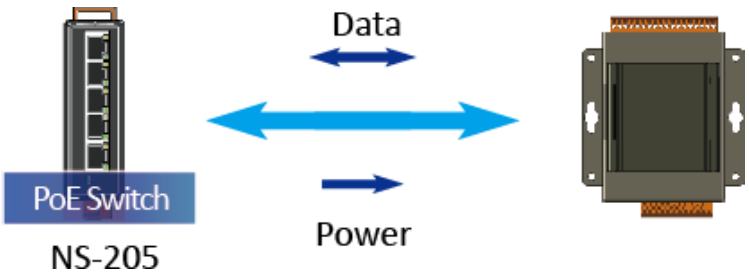
Highly Reliable Under Harsh Environment

PET-7H16M is housed in a metal 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)

PoE

The PET-7H16M module 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-7H16M module feature true IEEE 802.3af-compliant (classification, Class 1) Power over Ethernet (PoE) using both Ethernet pairs (Category 5 Ethernet cable). The PET-7H16M module 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(power sourcing equipment) load capacity. Furthermore, with the auxiliary power option, the PET-7H16M module can be used in a standard Ethernet (non-PoE) system.



When using PoE devices like PET-7H16M, 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 ~ +55VDC.

1.2. Specification

The table below summarizes the specifications of the PET-7H16M.

System Specification

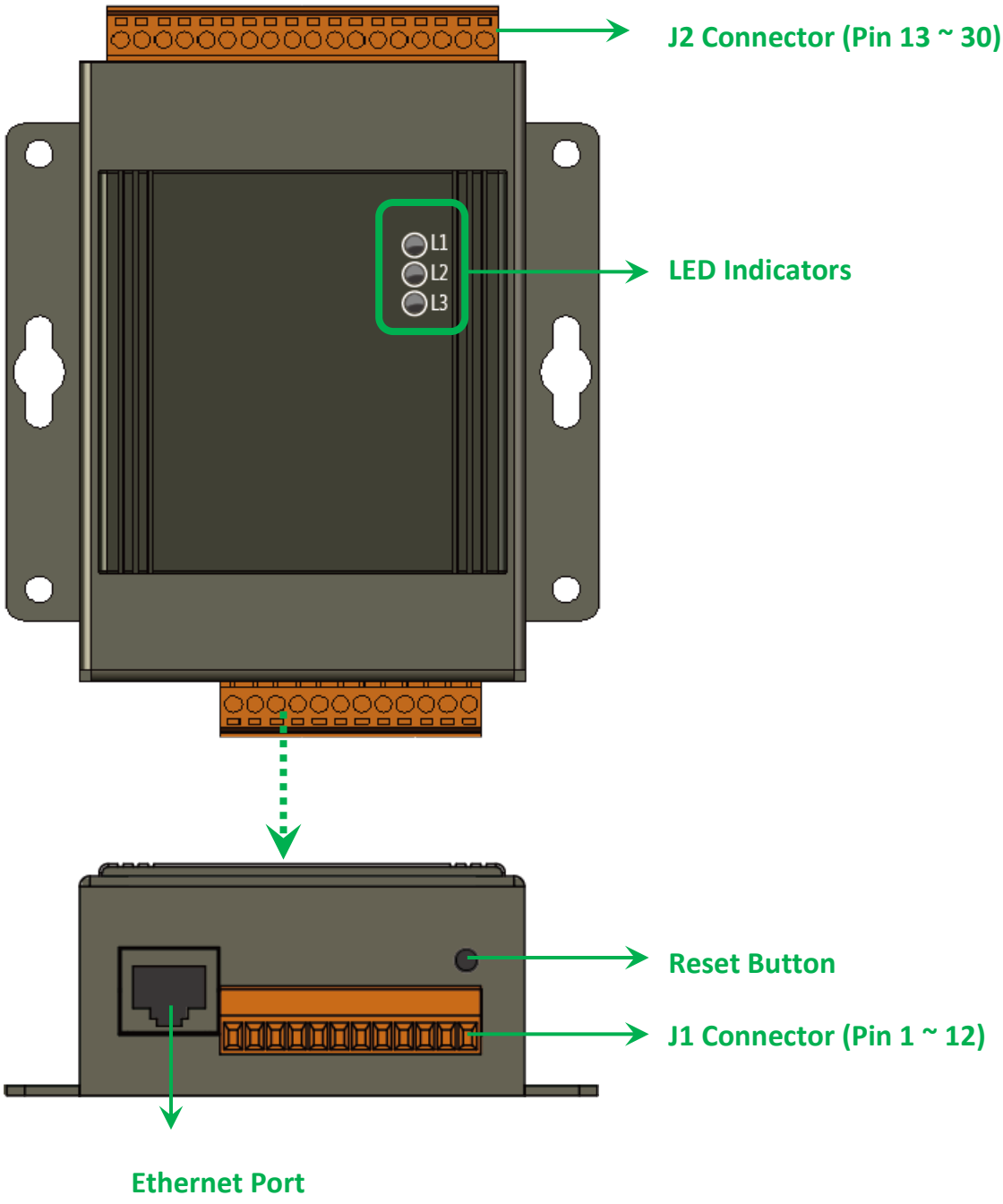
Communication	
Ethernet Port	1 x RJ-45, 10/100 Base-TX
PoE	Yes
Security	ID, Password and IP Filter
LED Indicators	
for System Running	Yes
for Ethernet Link/Act	Yes
for POE Power	Yes
2-Way Isolation	
Ethernet	1500 VDC
I/O	2500 VDC
EMS Protection	
ESD (IEC 61000-4-2)	4 kV Contact for Each Terminal and 8 kV Air for Random Point
EFT (IEC 61000-4-4)	+/-4 kV for Power
Power	
Reverse Polarity Protection	Yes
Powered from Terminal Block	+12 ~ +48 VDC
Consumption	2.6 W
Mechanical	
Dimensions (W x L x H)	76 mm x 120 mm x 38 mm
Installation	DIN-Rail or Wall Mounting
Enclosures	Metal
Environment	
Operating Temperature	-25 ~ +75 °C
Storage Temperature	-30 ~ +80 °C
Humidity	10 ~ 90 % RH, Non-condensing

I/O Specification

Analog Input	
Channels	8 Single-ended
Resolution	16-bit
Sampling Rate	200 KS/s (Each Channel)
Bipolar Input (Programmable)	+/- 10 V, +/- 5 V
FIFO Size	2 K Sample
Accuracy	0.05 % of FSR +/-1 LSB @ 25 °C, +/- 10V
AD Trigger Mode (Programmable)	Software/External clock trigger/Digital trigger (Post/Pre-trigger)
Digital Input	
Channels	4
Contact	Wet Contact
Sink/Source (NPN/PNP)	Sink/Source
On Voltage Level	+5 VDC ~ 30 VDC
Off Voltage Level	1 VDC Max.
Digital Output	
Channels	4
Type	Isolated Open Collector
Sink/Source(NPN/PNP)	Sink
Load Voltage	+5 VDC ~ 30 VDC
Load Current	100 mA
Short-circuit Protection	Yes
Overload Protection	1.3A
External Clock Trigger	
Clock Rate	30KHz Max. (for continuous acquisition mode)
External Digital Trigger	
Trigger Pulse Width	1.5μs Min.
Trigger Type	Falling edge
On Voltage Level	+5 VDC ~ 5.5 VDC @ 15 mA
Off Voltage Level	<0.8 VDC

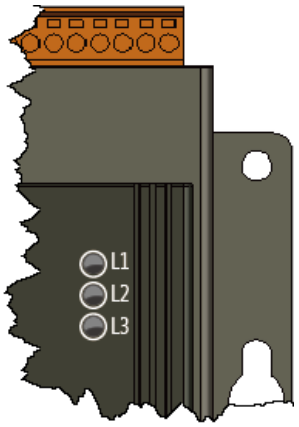
1.3. Overview

PET-7H16M is equipped with several interfaces and peripherals that can be integrated with external systems. Here is an overview of the components and its descriptions.



➢ LED Indicators

The PET-7H16M has 3 LED indicators shown as below.



LED Indicator		LED Action	Meaning
L1	PoE	ON	When unit power is supplied via PoE.
L2	Link/ACT	ON	Ethernet link detected
		OFF	No Ethernet link detected
		Flashing	Ethernet packet received
L3	RUN	Flashing	Firmware is running

Tips & Warnings

If the Run LED does not display the information as above, the following steps should be taken:

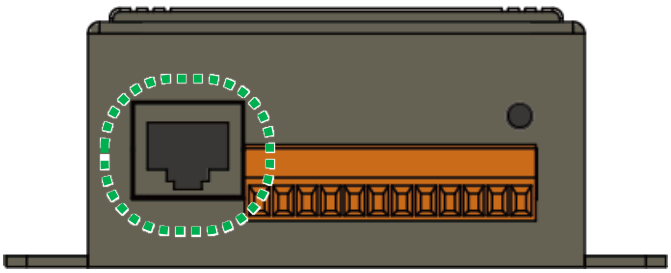
Step 1: Switch the power off

Step 2: Switch the power on and double-check the LED indicators

➢ Ethernet Port

The PET-7H16M has an Ethernet port that can be connected to a computer or device via an Ethernet cable.

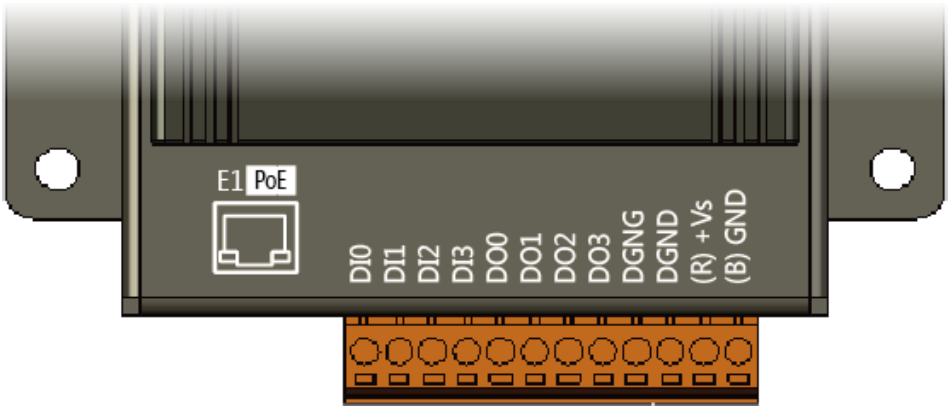
The L2 indicators display the status of the Ethernet port.



➢ JP1 Connector

The JP1 connector has 12 pins arranged in 1 row. For more detailed information regarding the pin assignments of the J1 Connector, please refer to “1.2. Specification”

The pin assignments of the connector are as follows:

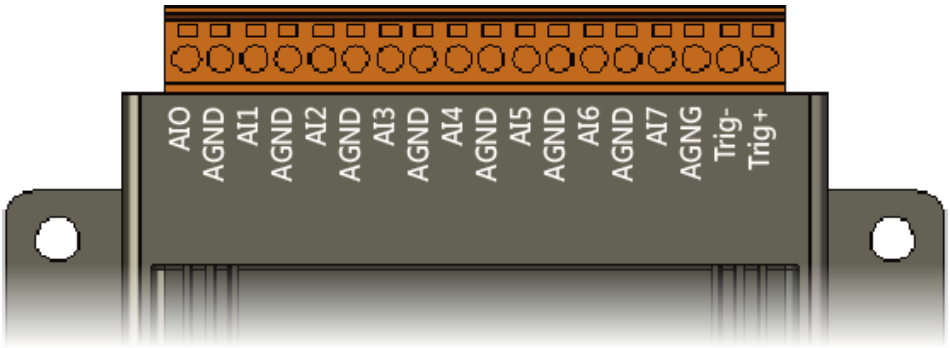


Signal	Direction	Description
DI0 ~ DI3	Input	Digital Input channels 0 to 3.
DO0 ~ DO3	Output	Digital Output channels 0 to 3.
DGND	-	Digital Ground.
(R) +Vs	(R) +Vs	Power Input (+12 ~ +48 VDC)
(B) GND	(B) GND	

➢ JP2 Connector

The JP2 connector has 18 pins arranged in 1 row. For more detailed information regarding the pin assignments of the J2 Connector, please refer to “1.2. Specification”

The pin assignments of the connector are as follows:

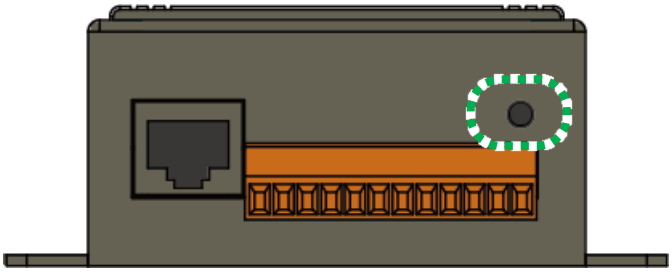


Signal	Direction	Description
AI0 ~ AI7	Input	Analog Input channels 0 to 7. For single-ended measurements, each signal is an Analog Input voltage channel.
AGND	-	Analog Input Ground. These terminals are reference point for single-ended AI measurements.
Trig+	Input	One external trigger(Support for external clock trigger/digital trigger)
Trig-		

➢ Reset Button

The Reset button provides user with a quick and easy way to resort the default setting.

Press the Reset button continuously for 5 seconds, and then release it. The device will restore to factory default settings.



The table below lists the default settings after pressing reset button.

Network Settings

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

Gain/offset value of AI calibration

Factory Default Setting
Original factory calibration value

Account Management

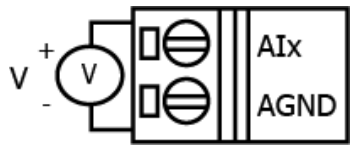
Factory Default Setting
A default user account consists of an account name “Admin” and a password “Admin”.

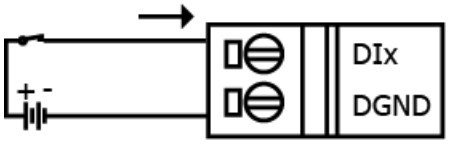
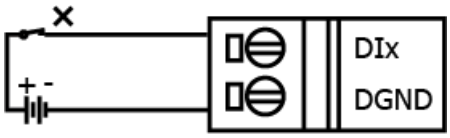
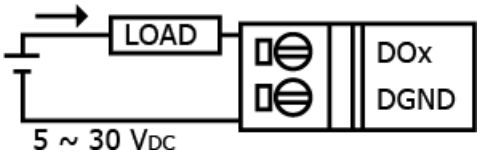
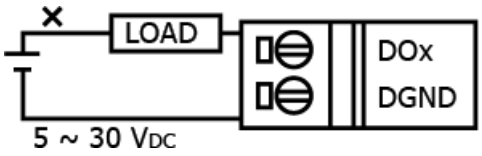
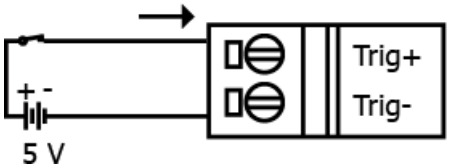
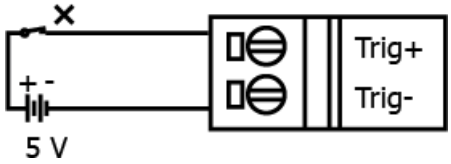
Accessible IP Settings

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

1.4. Wiring Diagram

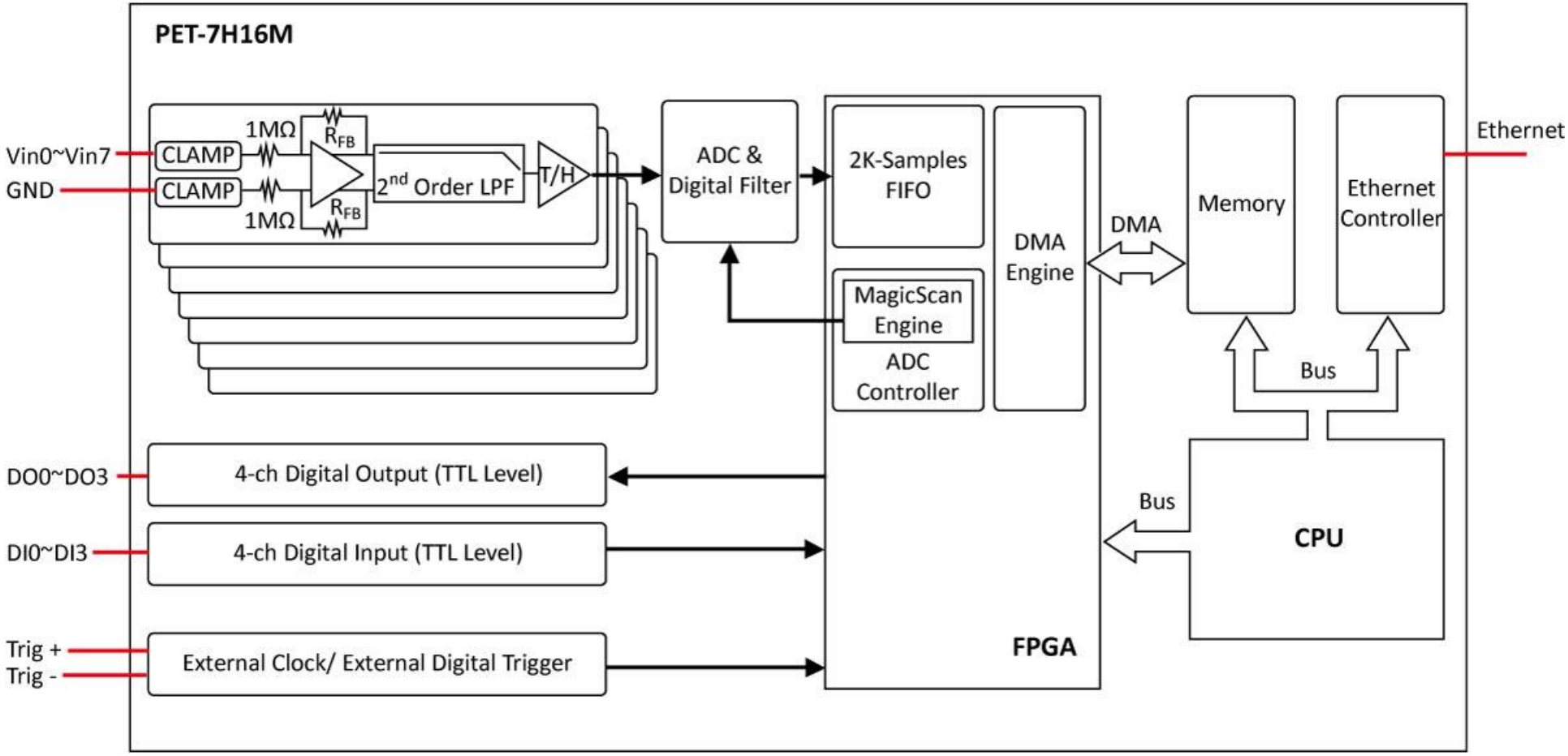
The wiring diagram of the PET-7H16M is illustrated on the following figure.

Analog Input (Voltage)


Digital Input/Counter	ON State Readback as 1	OFF State Readback as 0
Wet Contact (Sink)		
Digital Output	**ON State Readback as 1**	**OFF State Readback as 0**
Open Collector (Sink)		
External Clock Trigger/Digital Trigger	**ON State Readback as 1**	**OFF State Readback as 0**
Wet Contact (Sink)		

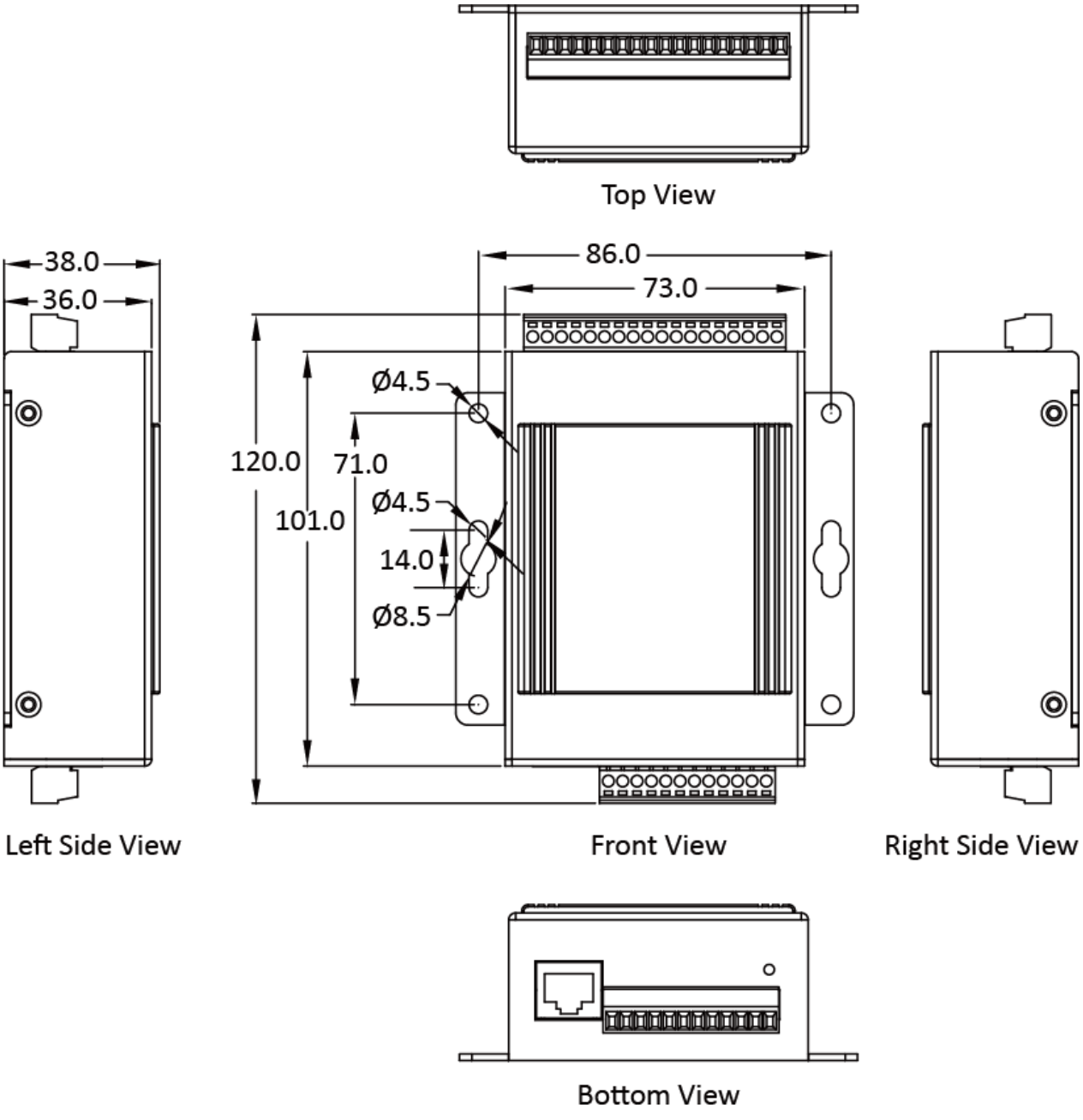
1.5. Block Diagram

PET-7H16M functions are illustrated in the block diagram shown here.



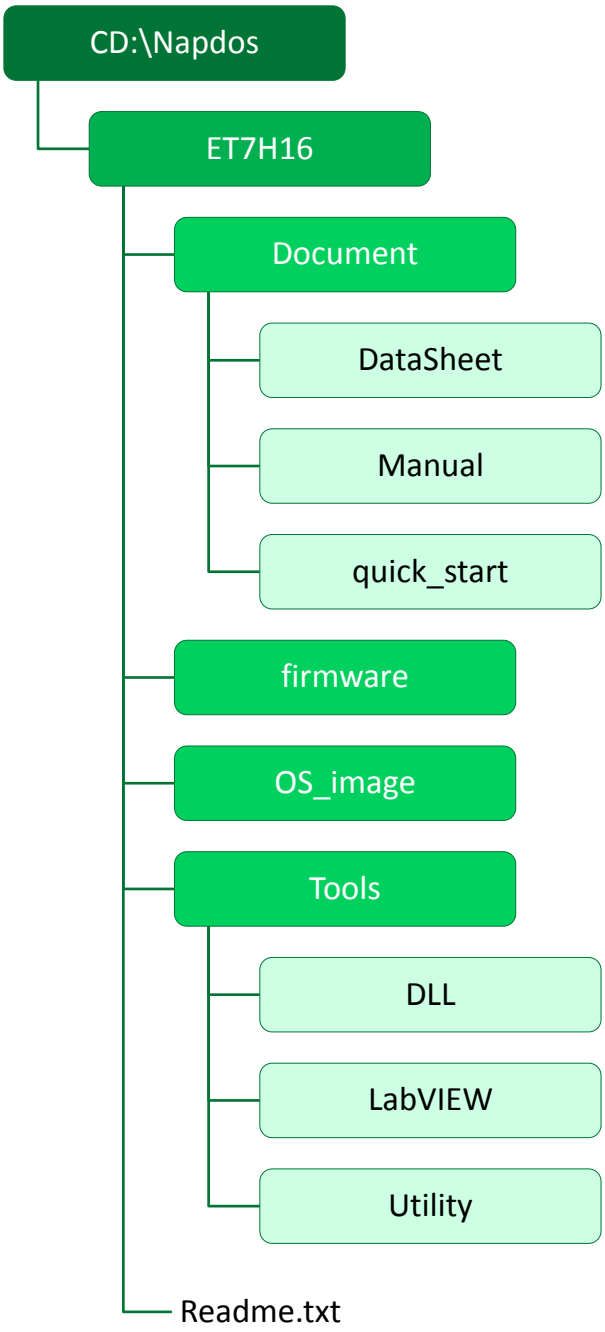
1.6. Dimension

The diagrams below provide the dimensions of the PET-7H16M to use in defining your enclosure specifications. All dimensions are in millimeters.



1.7. Companion CD

This package comes with a CD that provides a collection of the software utility, documentation, drivers, demo program and application. All of them are listed below.



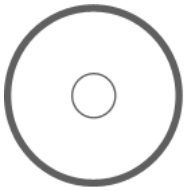
2. Getting Started

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 PET-7H16M.

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.

PET-7H16M

Quick Start Guide



Software Utility CD

44 mm DIN-Rail Clip

M3 x 6L Screw * 4

2.4 mm Screw Driver

Before you work with the PET-7H16M, 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.

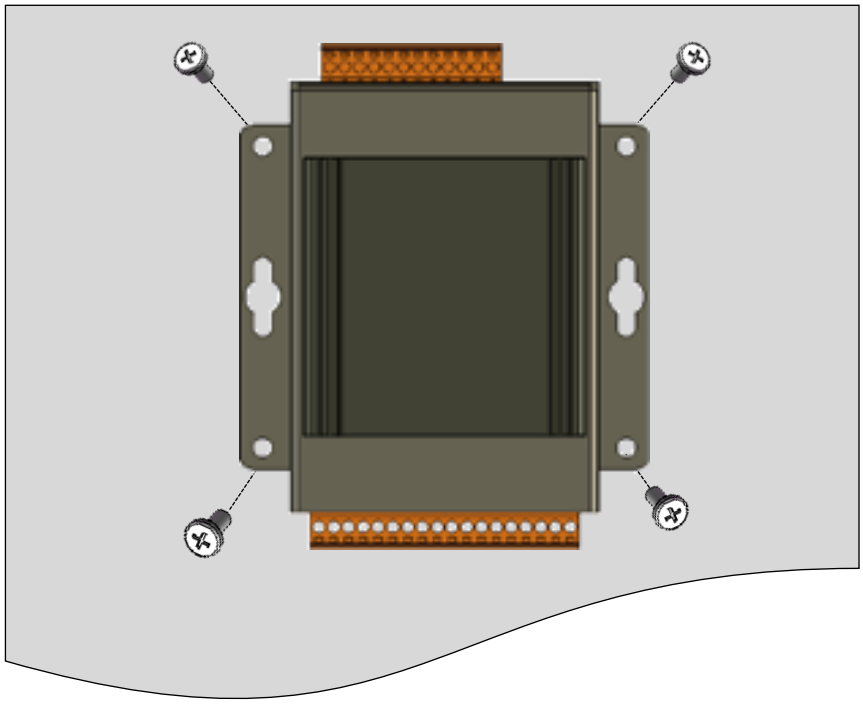
For more information about the hardware details, please refer to “1.2. Specification”
For more information about the hardware dimensions, please refer to “1.6. Dimension”

2.1. Mounting the Hardware

The PET-7H16M can be mounted either directly to a wall/panel.

Step 1: Use the included screws and a screw driver to attach the PET-7H16M to the wall/panel

Step 2: Fasten the screws securely



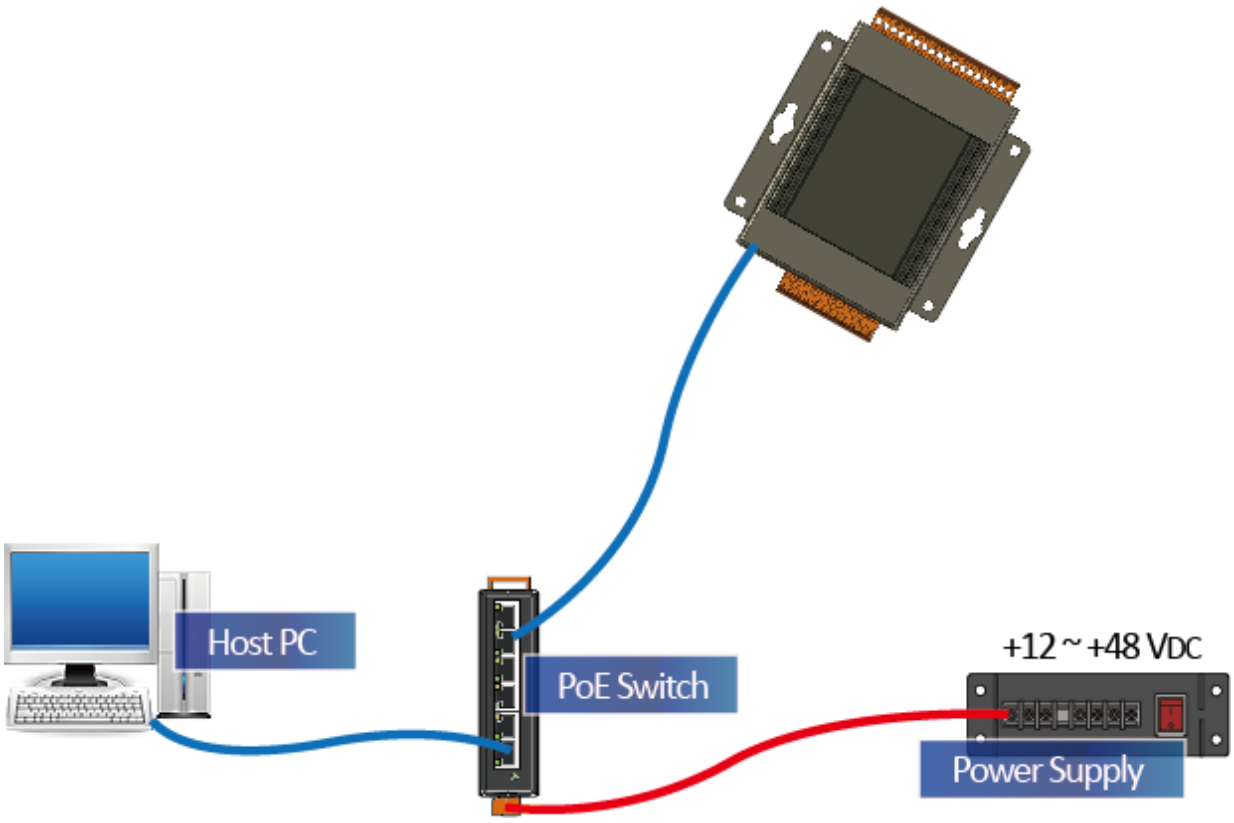
2.2. Deploying a Basic PET-7H16M System

Here is a simple application for using the PET-7H16M that is shown below.

There are two ways for the PET-7H16M module 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 VDC to 48 VDC. The reason we keep the second way is because it might be useful if someday or somehow you have different applications. PET-7H16M module is equipped with a LED, which indicates whether the power is supplied by a PoE switch.

➢ PoE

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-7H16M.

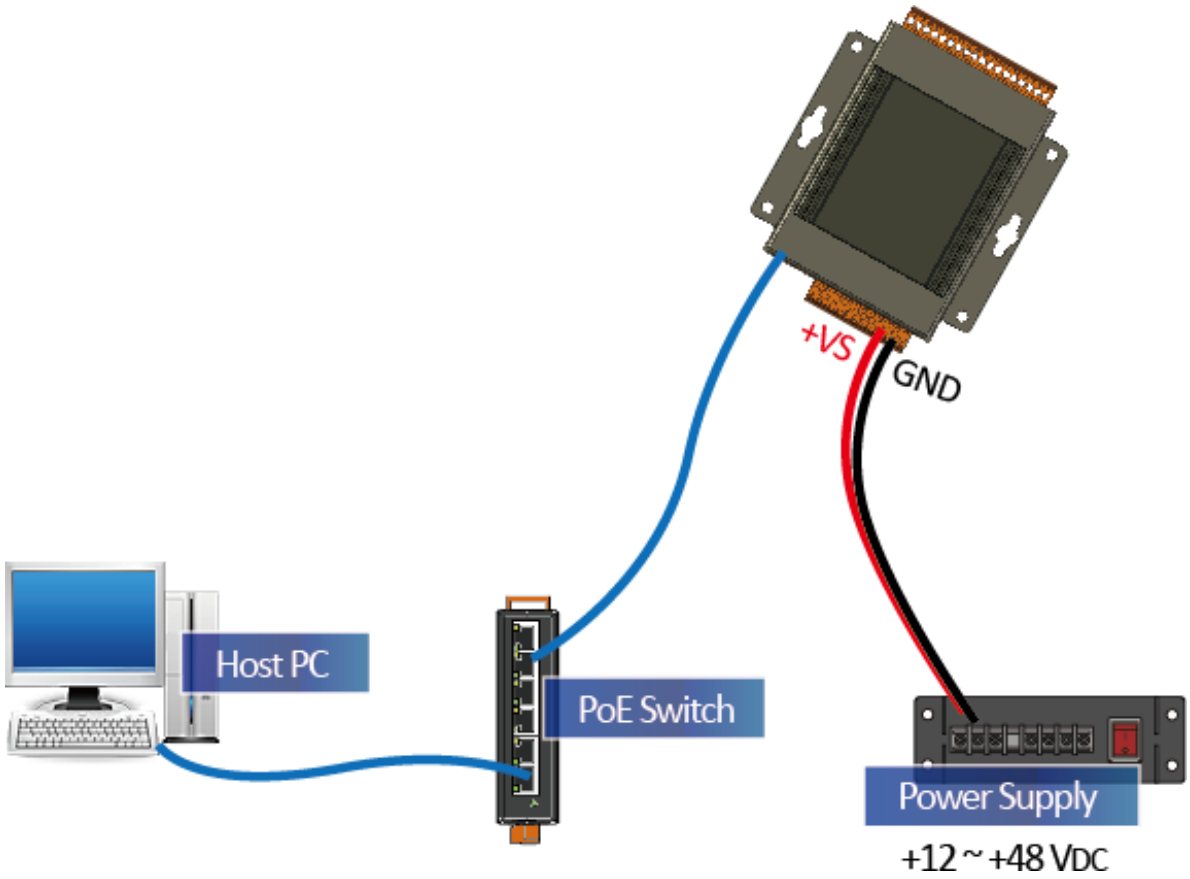


2

➢ External Power supply

i. Connect PC to the Ethernet port via the Ethernet switch.

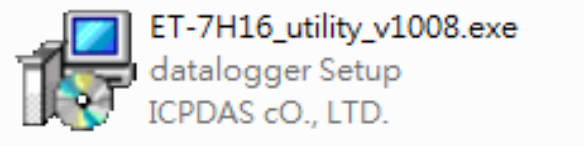
ii. Connect the power supply to the switch and PET-7H16M.



2.3. Installing the ET-7H16 Utility

The ET-7H16 Utility is a useful tool that provides a quick and easy way to update firmware, configure Ethernet settings, and download files to PET-7H16M from PC.
Refer to chapter 4.2. ET-7H16 Utility for more details..

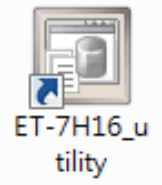
Step1: Get the ET-7H16 Utility tool

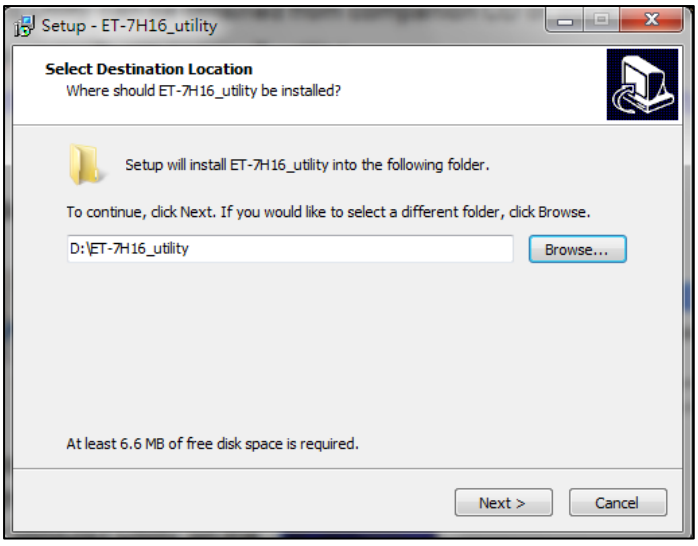


The ET-7H16 Utility can be obtained from companion CD or our FTP site:
CD:\Napdos\ET7H16\tools\utility\
http://ftp.icpdas.com/pub/cd/6000cd/napdos/et7h16/tools/utility

Step 2: Follow the prompts to complete the installation

After the installation has been completed, there will be a new short-cut for ET-7H16 Utility on the desktop.





2.4. Using ET-7H16 Utility to Assign an IP address

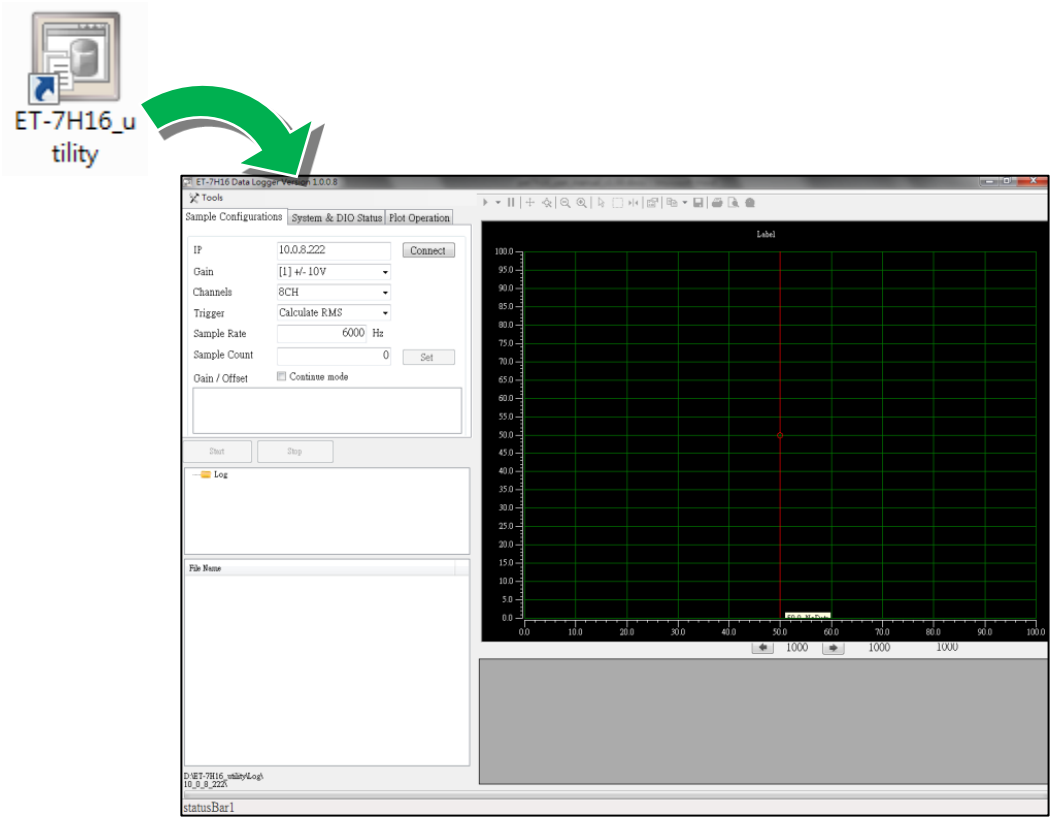
The PET-7H16M is an Ethernet device, which comes with a default IP address, therefore, you must first assign a new IP address to the PET-7H16M.

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

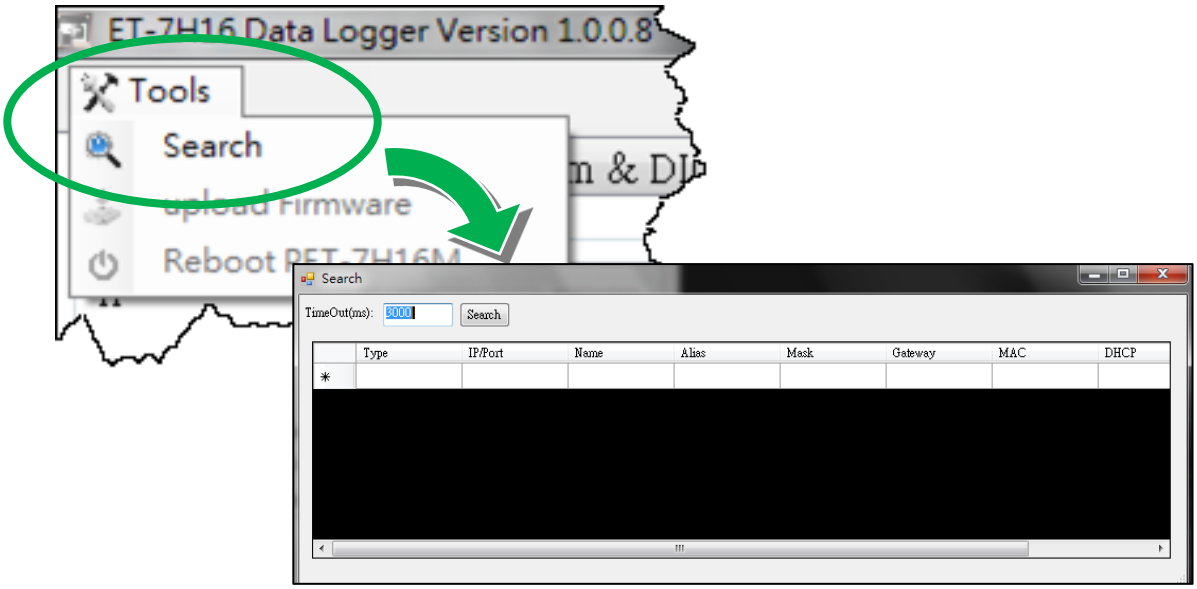
Step 1: Run the ET-7H16 Utility

Double-click the ET-7H16 Utility shortcut on your desktop.



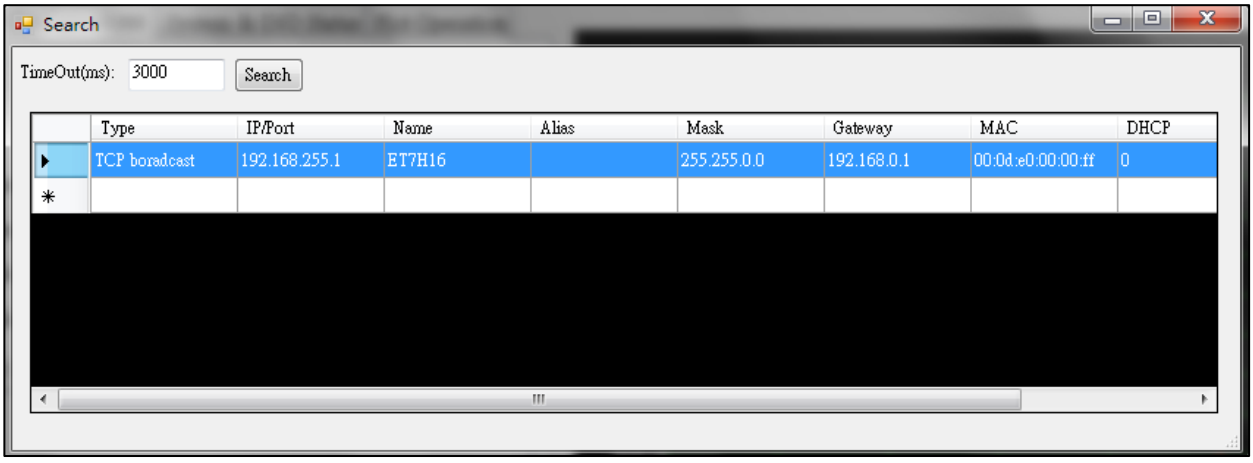
Step 2: Press choose “Search” from the “Tools” menu

After choosing Search from Tools menu, that will search all of the PET-7H16M modules on your network.



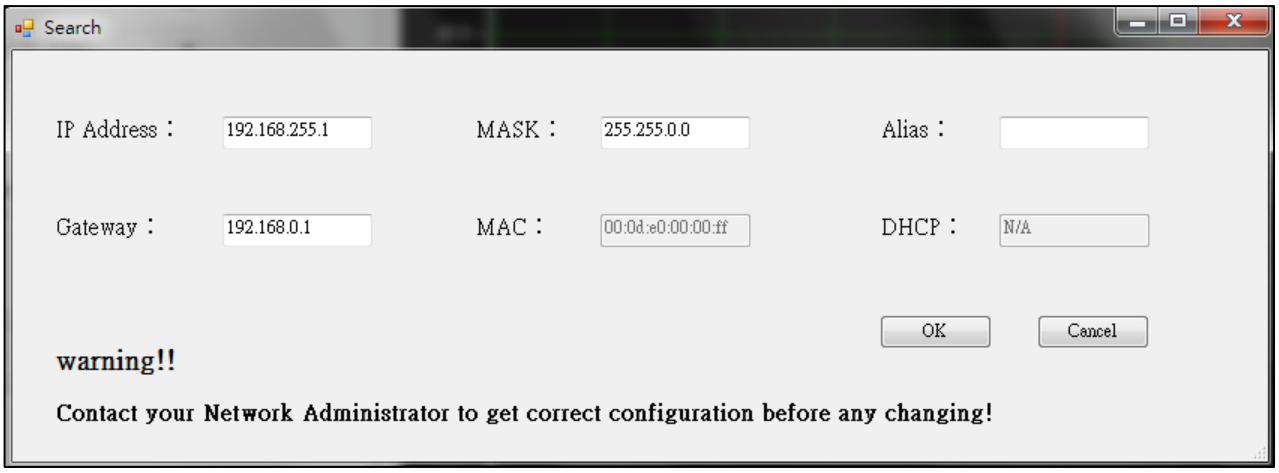
Step 3: Choose the field “192.168.255.1” and then choose “IP setting” from the toolbar

Choose default value “192.168.255.1” for fields in the list and double-click.



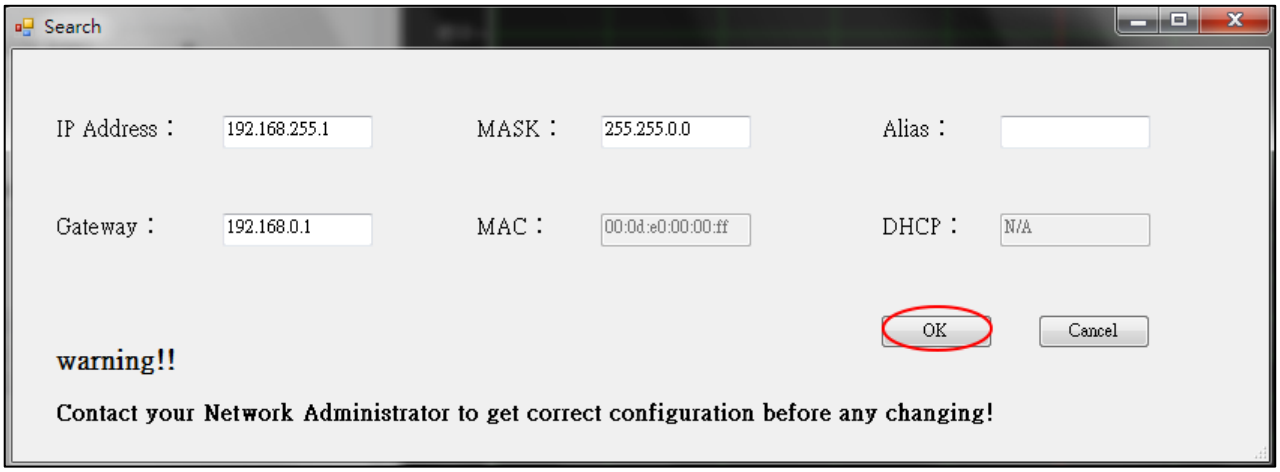
Step 4: Assign a new IP address and then choose “Set” button

You only can manually assign an IP address.



Step 5: Click “OK” button

When the setup is completed, click the "OK" button.



Step 6: Wait for PET-7H16M reboot

3. Operation

Once connected to the network, the PET-7H16M module can be remotely accessed and configured through software from anywhere on the network and the sampling data only can be acquired by software over Ethernet. So far, the device doesn't operate as a stand-along data logger. The only one connection at a time is allowed to acquire data from PET-7H16M.

There are two different data acquisition modes and several trigger modes of analog input operation.
The following chart shows the acquisition and trigger modes and their operation frequency of each combination.

Trigger / Acquisition	Continuous	N Sample
Software AD	1~30KHz	1 Hz ~ 200 KHz
External CLK AD	1~30KHz	-
Post-Trigger	-	1 Hz ~ 200 KHz (110KHZ)
Pre-Trigger	-	1 Hz ~ 200 KHz (110KHZ)

Tips & Warnings

Maximum 30,000,000 records in N Sample Mode

125 sec (30 KHz), 19.6 sec (200 KHz) of 30,000,000 records in software AD trigger.

3.1. Continuous Acquisition

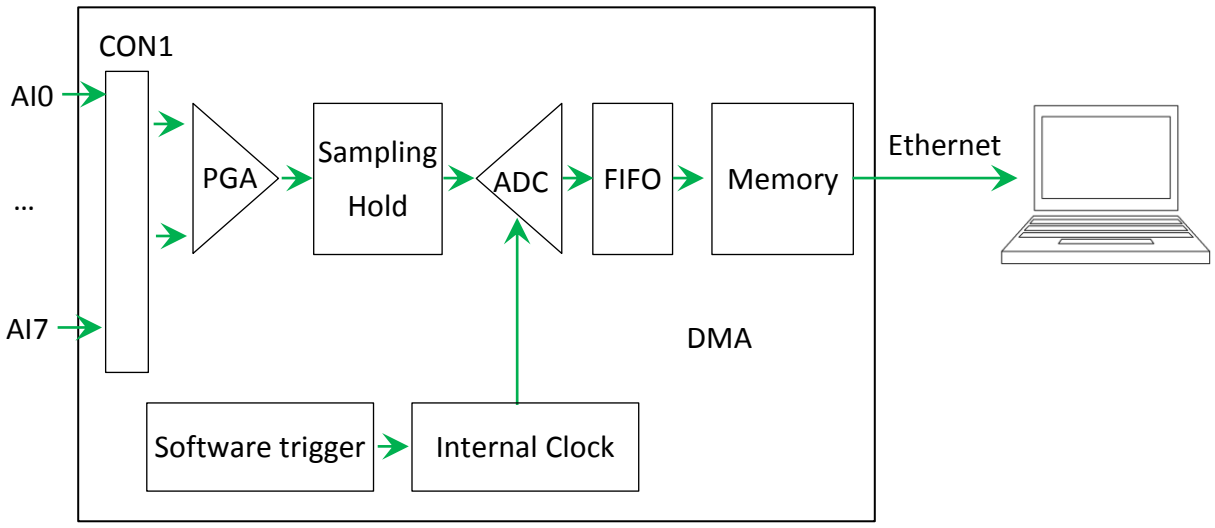
3.1.1. Software AD Trigger

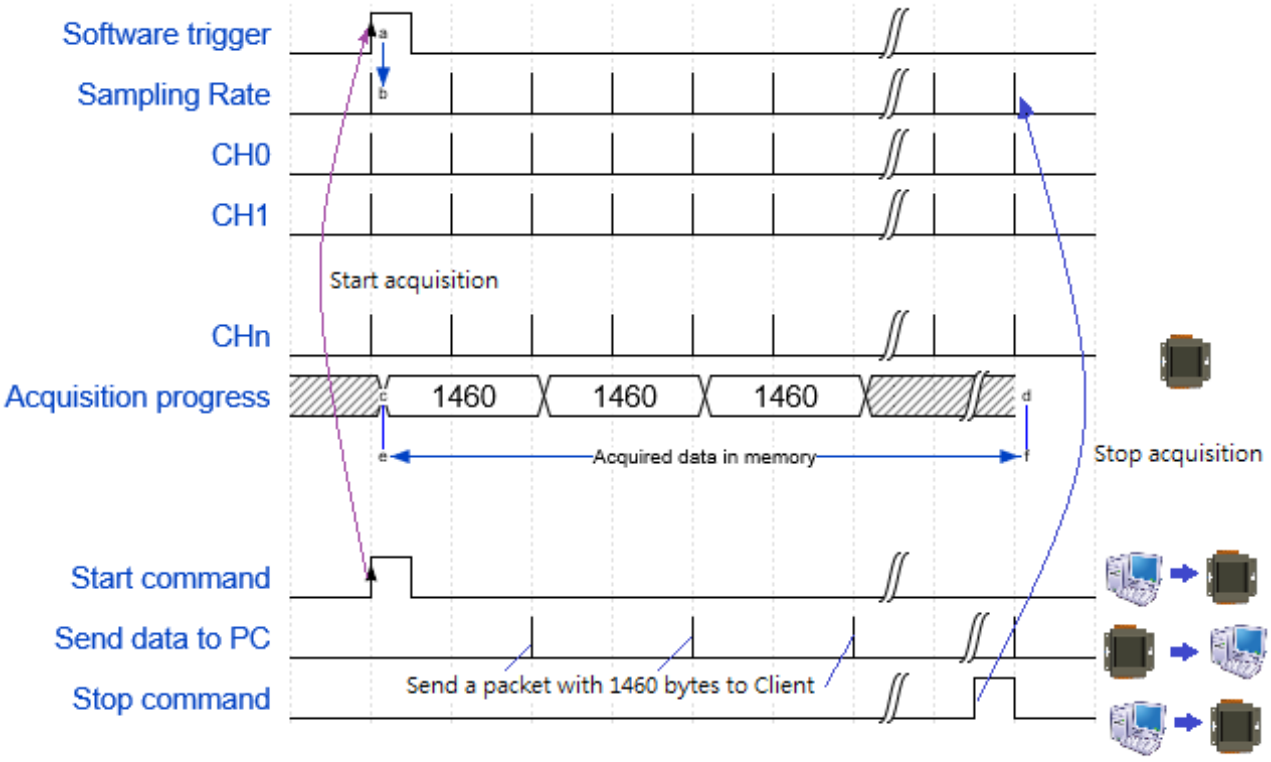
In continuous acquisition and software AD trigger, Send a start command from PC over the Ethernet to PET-7H16M to start the AD conversion. The analog input value is continuously acquired and converted to digital data. The data accumulated to a network packet size returns to the PC. The process of acquiring data is continuous until a stop command is sent over the Ethernet.

The sample rate can range from 1 to 30K Hz on local networks. (Lower over the Internet or wireless networks).

There are parameters below that need to be specified:

- Sampling rate (1~30KHz)
- Scan channels
- The trigger mode is software AD trigger




Software trigger
Sampling Rate
CH0
CH1
CHn
Acquisition progress
Start command
Send data to PC
Stop command
a
b
c
d
e
f
Start acquisition
1460
1460
1460
Acquired data in memory
Stop acquisition
Send a packet with 1460 bytes to Client

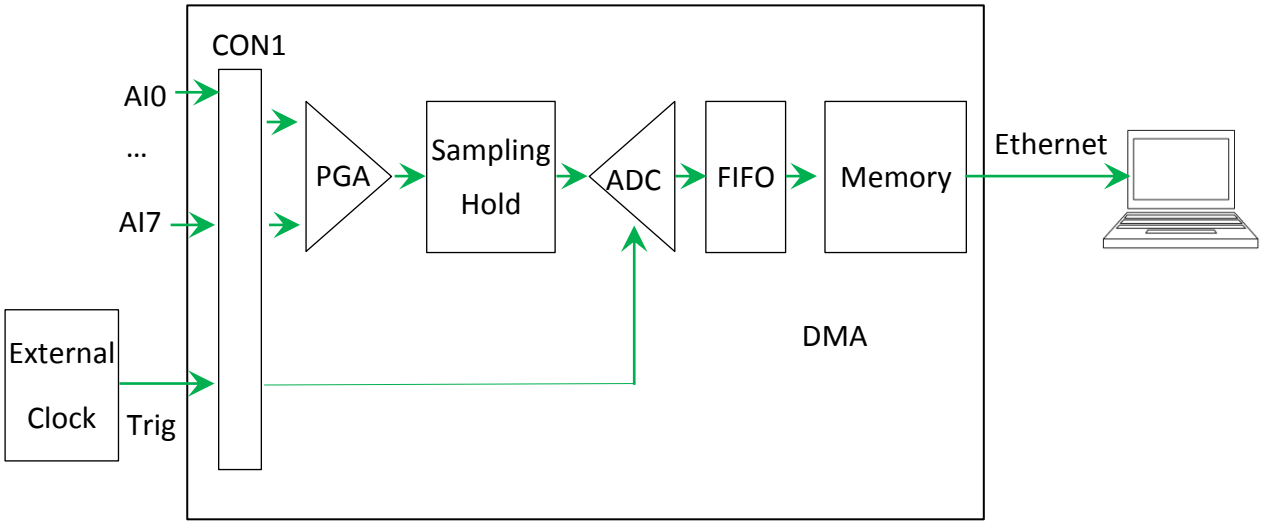
3.1.2. External clock AD trigger

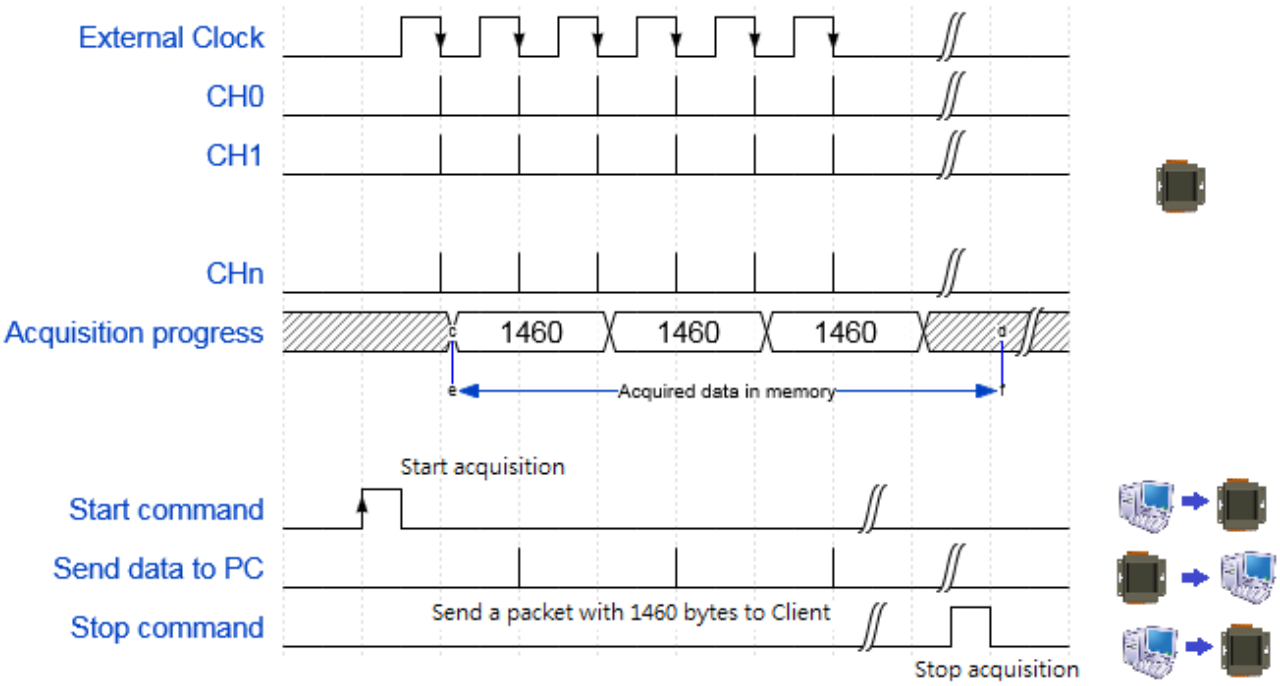
In this trigger, send a start command from PC over the Ethernet to PET-7H16M to start the acquisition. The A/D conversion is started actually when the external clock signal is input. The AI value converted to digital data followed the external clock sampling rate and the data accumulated to a network packet size returns to the PC. The process is stopped until a stop command is sent over the Ethernet.

The frequency of the external clock can range from 1~30K Hz.

There are parameters below that need to be specified:

- Scan channels
- The trigger mode is external clock AD trigger




External Clock
CH0
CH1
CHn
Acquisition progress
c
1460
1460
1460
d
e
Acquired data in memory
f
Start acquisition
Start command
Send data to PC
Send a packet with 1460 bytes to Client
Stop command
Stop acquisition

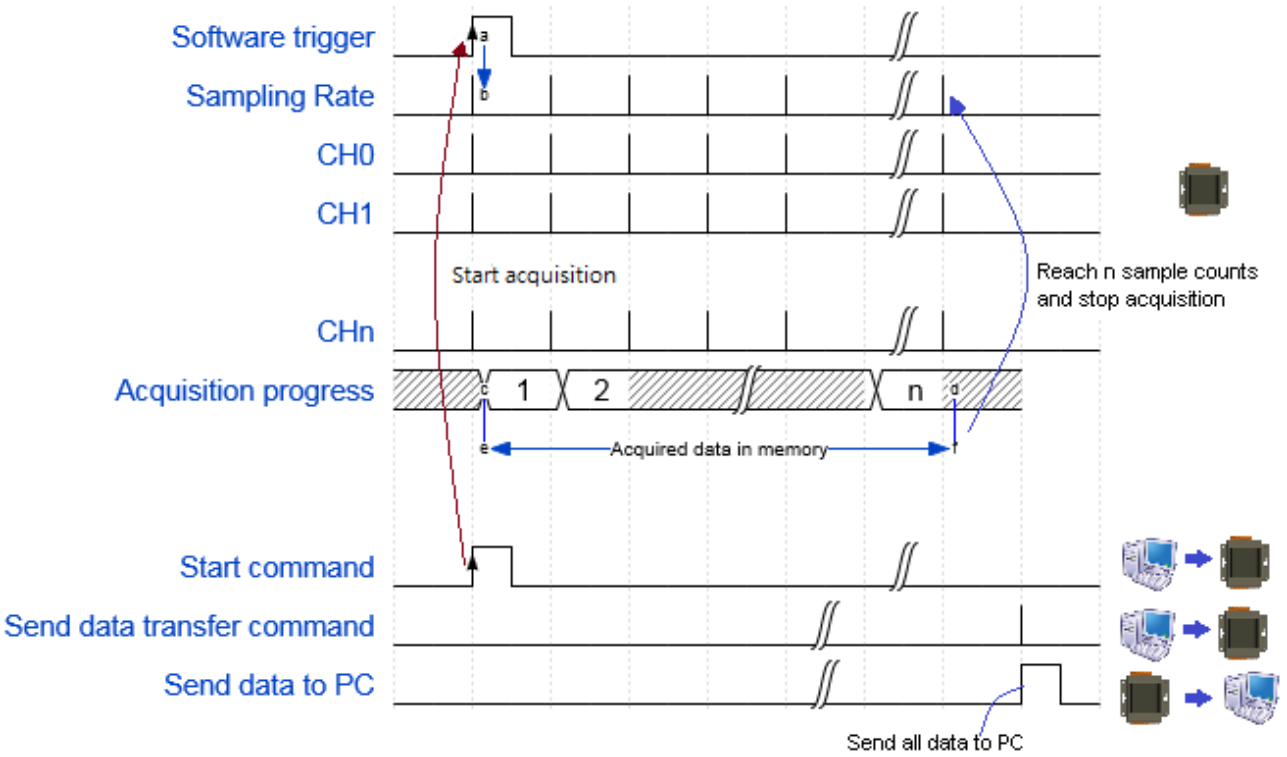
3.2. N Sample Acquisition

3.2.1. Software AD Trigger

In N sample acquisition and software AD trigger, Send a start command from PC over the Ethernet to PET-7H16M to start the AD conversion. The analog input value is continuously acquired and converted to digital data until the total number of samples reaches. Send a command to get the all acquisition data over the Ethernet.
The sample rate can range from 1 Hz to 200K Hz.

There are some parameters that need to be specified:

- Sampling rate
- Scan channels
- Sampling Count (Maximum 30,000,000 records)
- The trigger mode sets to the software AD trigger.



3.2.2. External Digital Trigger

There are two external digital trigger, Pre-trigger and Post-trigger.

Pre-trigger

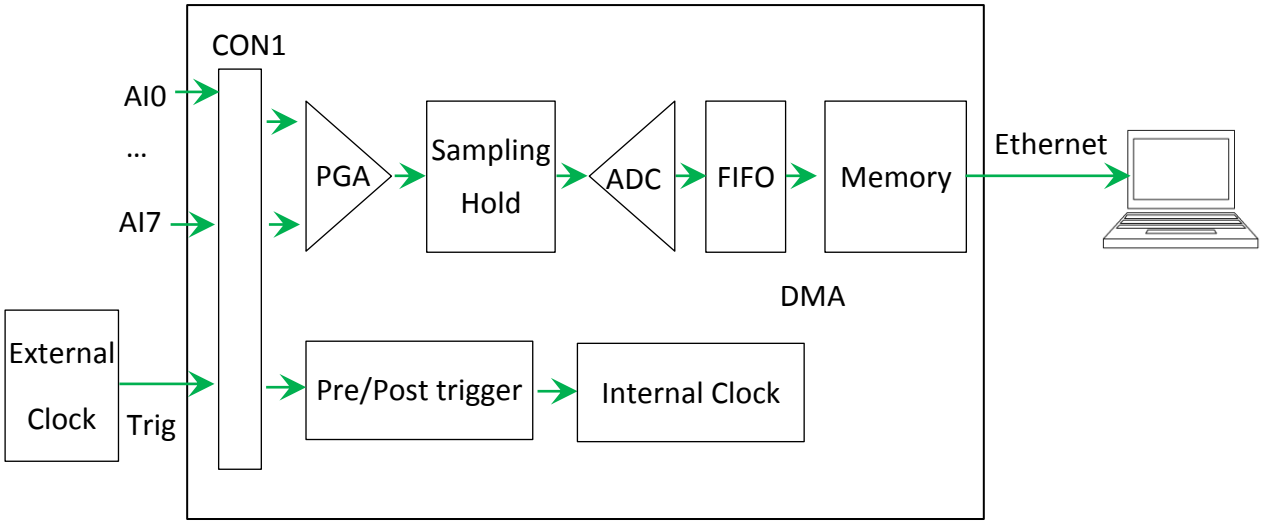
This trigger type is used when you want to collect data before an external trigger event. Send a start command from PC over the Ethernet to PET-7H16M to start the AD conversion. The analog input value is continuously acquired and converted to digital data. When the trigger event occurs, the AD conversion is stopped Send a command to get the specified sampling counts of data over the Ethernet.

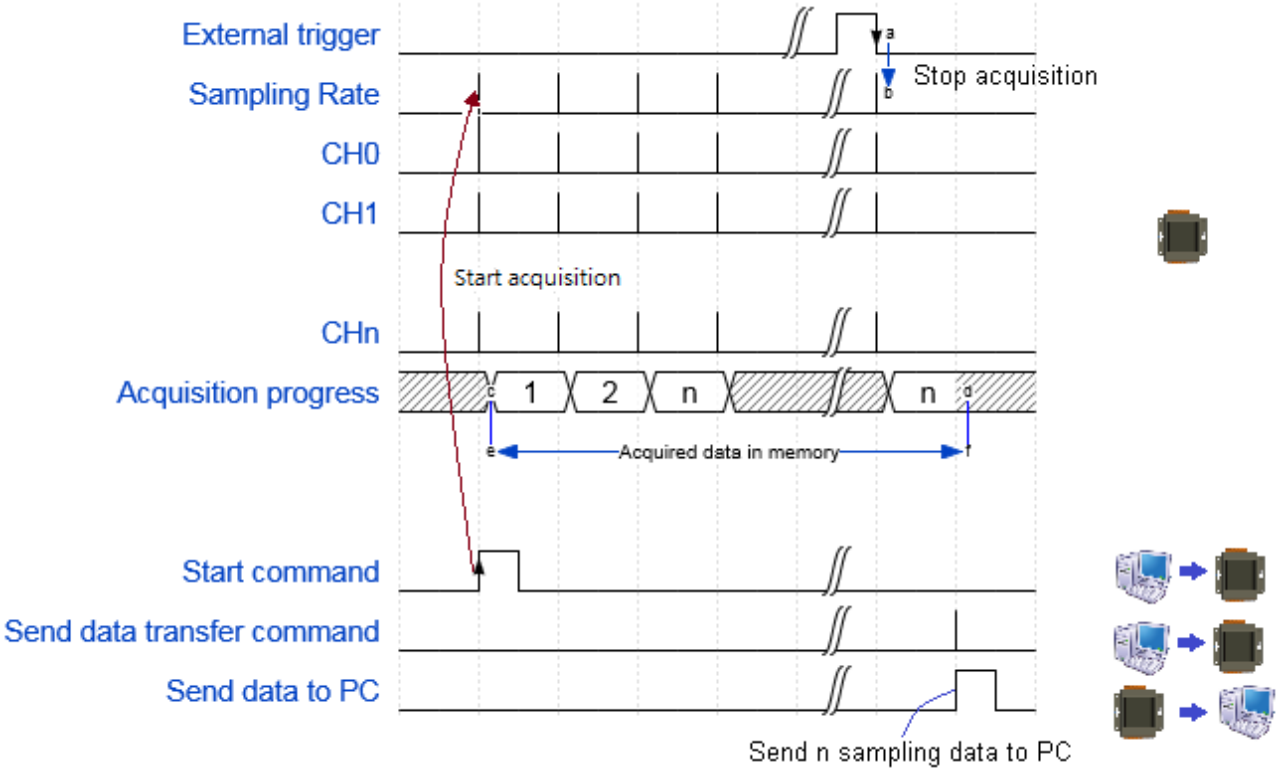
Post-trigger

This trigger is used in application when you want to collect data after an external trigger event. Send a start command from PC over the Ethernet to PET-7H16M to start the acquisition. The A/D conversion is started actually when the external digital signal is input. The analog input value is continuously acquired and converted to digital data until the total number of samples reaches. Send a command to get the all acquisition data over the Ethernet.

There are some parameters that need to be specified:

- Sampling rate (1 to 200K Hz)
- Scan channels
- Sampling Count (Maximum 30,000,000 records)
- The trigger mode can be set to Post-trigger or Pre-trigger.
- The negative condition is allowed in digital trigger. It is used when a falling edge is detected on the digital signal. The negative condition is used when it triggers from high to low.

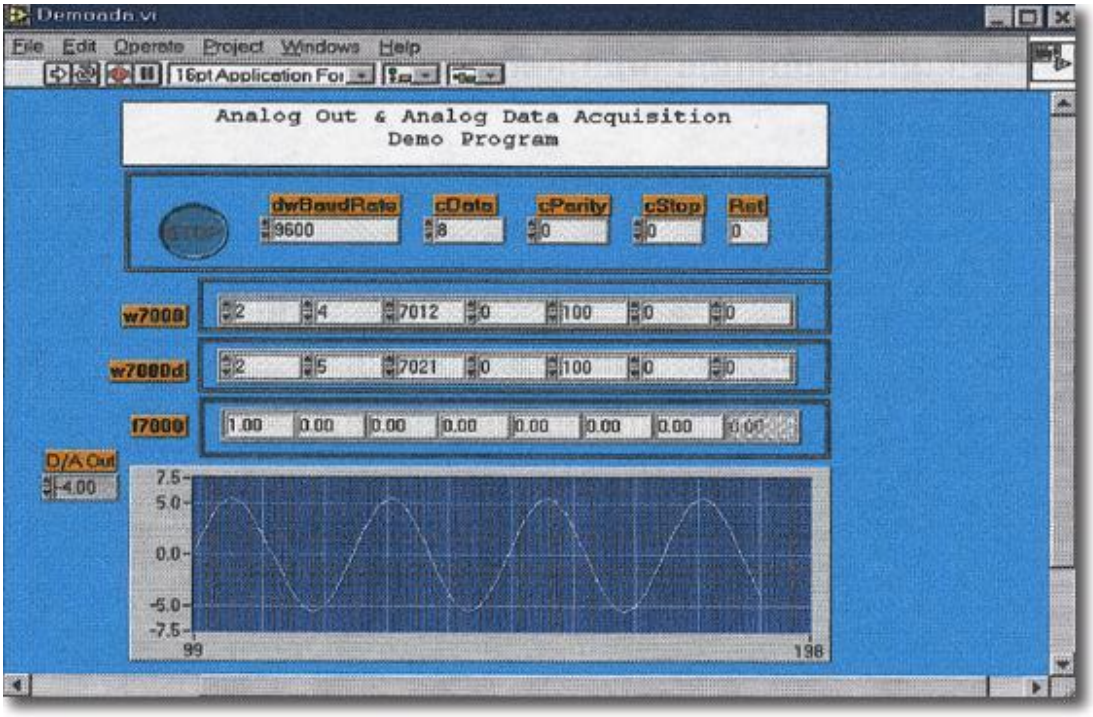

CON1
AI0
...
AI7
External
Clock
Trig
PGA
Sampling
Hold
ADC
FIFO
Memory
Ethernet
DMA
Pre/Post trigger
Internal Clock


External trigger
Sampling Rate
CH0
CH1
CHn
Acquisition progress
Start command
Send data transfer command
Send data to PC
a
b
Stop acquisition
Start acquisition
c
1
2
n
n
d
e
Acquired data in memory
f
Send n sampling data to PC

4. Tools and SDKs

PET-7H16M supports a number of external tools to aid in developing your applications

4.1. 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 PET-7H16M using the Modbus protocol is located on the shipped CD:\Napdos\ET7H16\Document\Application\LabVIEW\ or http://ftp.icpdas.com/pub/cd/6000cd/napdos/et7h16/document/application/labview/

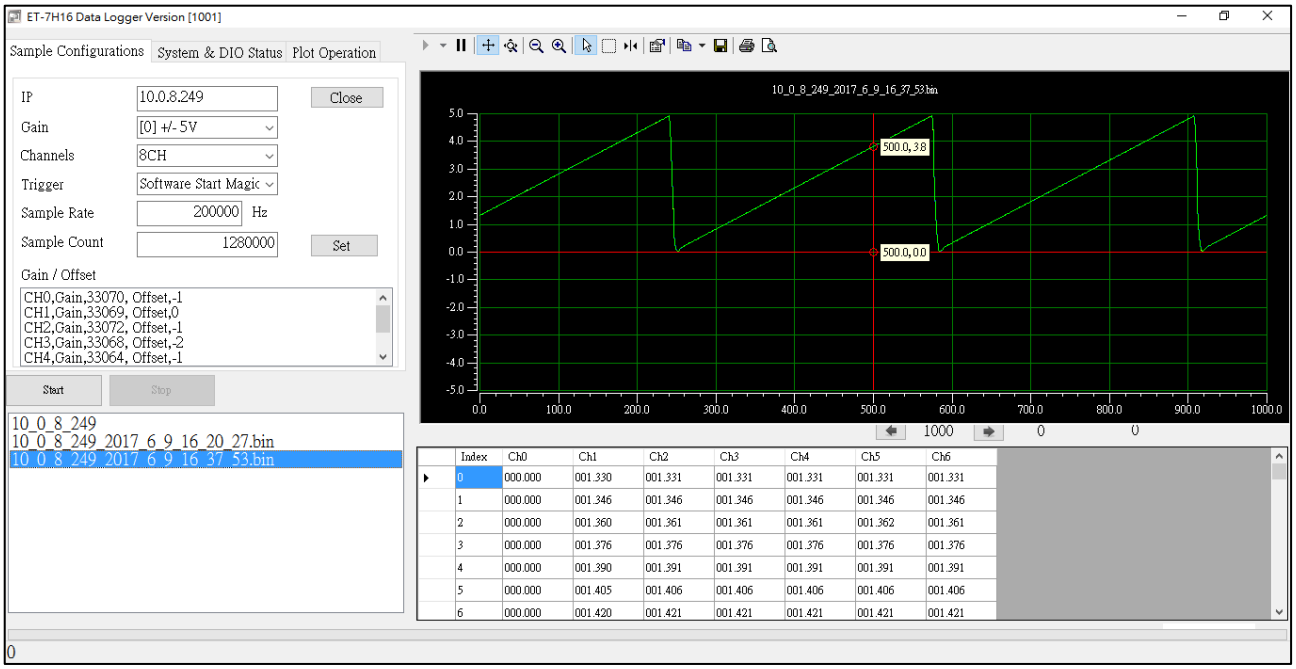
4.2. ET-7H16 Utility

ET-7H16 utility is used to graphically display and easily data logging for ET-7H16 module.

ET-7H16 Utility tool as ET-7H16 Data Logger

ET-7H16 Data Logger provides a single ET-7H16 connect as Data Logger function.

1. When connect to ET-7H16, it will get the parameters of gain and offset for calibration, they are used to calibrate the raw data from ET-7H16.
2. It also gets the configurations for sampling, set the new configurations for application then start, it will begin to get the sampling data from ET-7H16 and save the data to files.
3. After finish sampling data or stop data logger, it can show the sampling result as plot view.



System requirement

Minimum system requirements for ET-7H16 utility are given below:

- 266MHz 32-bit(x86) or 64-bit(x64) processor
- 64 MB of system memory
- Support for Super VGA graphics
- At least 20 MB of available space (Need more)
- Microsoft Windows 2000 or later(32-bit or 64-bit Windows Operating System)

Operating system of Windows requirement

- 32-bit(x86) 64-bit(x64)
- Microsoft Windows 2000 -
- Microsoft Windows XP 32-bit Microsoft Windows XP 64-bit
- Microsoft Windows 2003 32-bit Microsoft Windows 2003 64-bit
- Microsoft Windows Vista 32-bit Microsoft Windows Vista 64-bit
- Microsoft Windows 7 32-bit Microsoft Windows 7 64-bit
- Microsoft Windows 2008 32-bit Microsoft Windows 2008 64-bit
- Microsoft Windows 8 32-bit Microsoft Windows 8 64-bit
- Microsoft Windows 2012 64-bit

4.3. SDK API

This chapter provides a brief overview of ET-7H16 APIs that have been designed for ET-7H16. ET-7H16 SDK library supports 32/64 bit Windows 2003/Vista/7/8/10.

Get the latest version of ET-7H16 SDK library at the location below.
The latest version of the installation package from FTP site listed as following FTP:
ftp://ftp.icpdas.com/pub/cd/6000cd/napdos/et7h16/tools/dll

File	Description
HSDaq.dll	Used for VC programs
HSDaqNet.dll	Used for .Net programs

For full usage information regarding the description, prototype and the arguments of the functions, please refer to the “ET-7H16 Standard API User Manual”
ftp://ftp.icpdas.com/pub/cd/6000cd/napdos/et7h16/document/sdk_document

The following API functions are used to access ET-7H16 module.

SDK Functions	.NET Functions	Description
AddCmdClient	ET7HLogger.AddCmdClient	Create a connection to set/get parameters.
AddDataClient	ET7HLogger.AddDataClient	Create a connection for transferring data.
RemoveCmdClient	ET7HLogger.SetPWMFrequency	Close the TCP connection of command port.
RemoveDataClient	ET7HLogger.GetPWMFrequency	Close the TCP connection of data transmission port.
GetScanParam	ET7HLogger.SetPWMMode	Get scan parameter from ET-7H16
SetScanParam	ET7HLogger.GetPWMMode	Set scan parameter to ET-7H16
StartLogger	ET7HLogger.StartLogger	Set data path and start a log thread for saving the sampling data
StopLogger	ET7HLogger.StopLogger	Stop log thread for saving the data.
GetTCPReceivedCnt	ET7HLogger.GetTCPReceivedCnt	Read the total data count that thread received from TCP data port
TransmitData	ET7HLogger.TransmitData	Notify ET-7H16 to send data to PC from data port
GetTotalReadCnt	ET7HLogger. GetTotalReadCnt	Read total data count of ET-7H16's magic scan
ReadGainOffset	ET7HLogger.ReadGainOffset	Read the gain/offset values for application to calibrate 8 channel's analog data
ReadDIO	ET7HLogger. ReadDIO	Read the DI and DO status
WriteDO	ET7HLogger.WriteDO	Write DO output
WriteDOBit	ET7HLogger. WriteDOBit	Write DO output channel by channel
ReadAI	ET7HLogger.ReadAI	Read the calibrated analog input (Engineering format).

➢ C# Samples

The ET-7H16 C# demo includes the following samples that demonstrate the use of the ET-7H16 Standard APIs in a C# language environment. The following samples can be found on the CD that was provided with the package or by downloading the latest version from ICP DAS web site.

For C# applications, these demo programs can be obtained from:
CD:\Napdos\ET7H16\tools\DLL\Demo\C# or
http://ftp.icpdas.com/pub/cd/6000cd/napdos/et7h16/tools/dll/demo/c#

➢ Visual C++ Samples

The ET-7H16 VC demo includes the following samples that demonstrate the use of the ET-7H16 Standard APIs in a Visual C++ language environment. The following samples can be found on the CD that was provided with the package or by downloading the latest version from ICP DAS web site.

For Visual C++ applications, these demo programs can be obtained from:
CD:\Napdos\ET7H16\tools\DLL\Demo\VC or
http://ftp.icpdas.com/pub/cd/6000cd/napdos/et7h16/tools/dll/demo/vc

5. Web Applications

The PET-7H16M contains an advanced web configuration system that provides users with access PET-7H16M applications through a standard web browser.

Note: The web page function is only suitable for configuration settings. Do not enable this TCP communication when the module is acquitting the data via Ethernet.

Logging in to the PET-7H16M Web site

You can log in to the PET-7H16M 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 PET-7H16M

If you haven't changed the default IP address of the PET-7H16M, please refer section "2.4. Using ET-7H16 Utility to Assign an IP address" to configure it.

Step 3 : Fill out the User name and Password

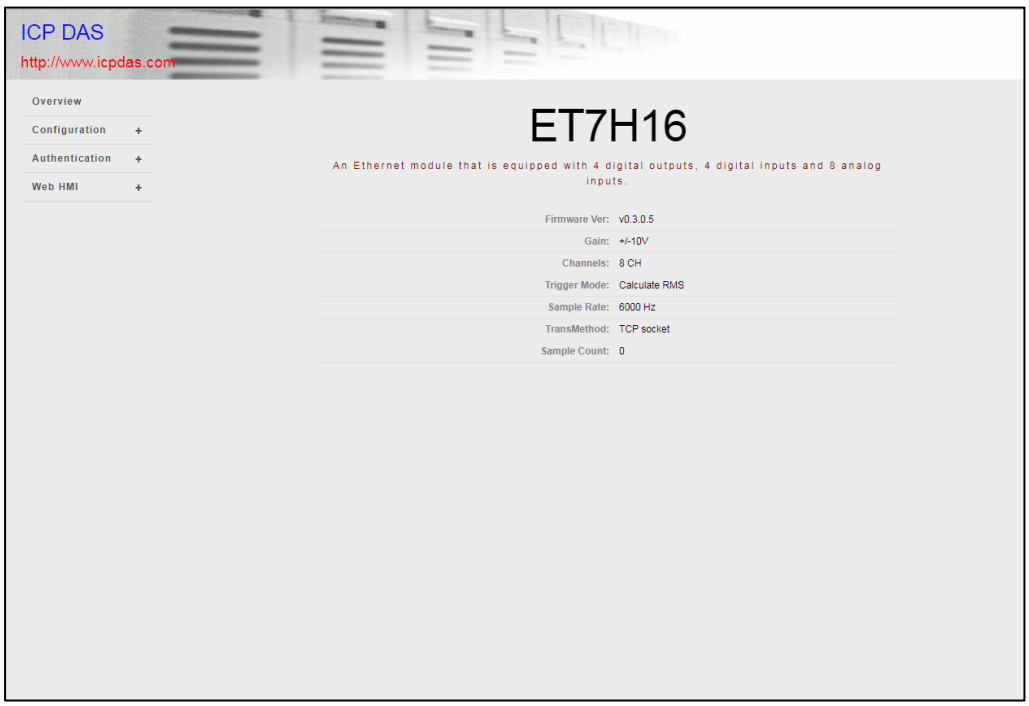
After entering the IP address, the login dialog box will appear and prompt you to enter your username and password.

The factory default user name and password are as follows:

Item	Default
User name	Admin
Password	Admin

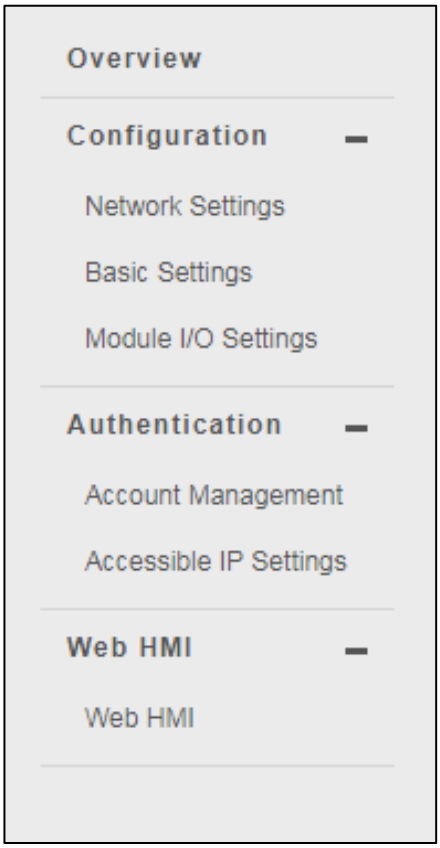
Step 4 : Welcome to PET-7H16M web site

After logging into the PET-7H16M web site, the welcome page will appear.



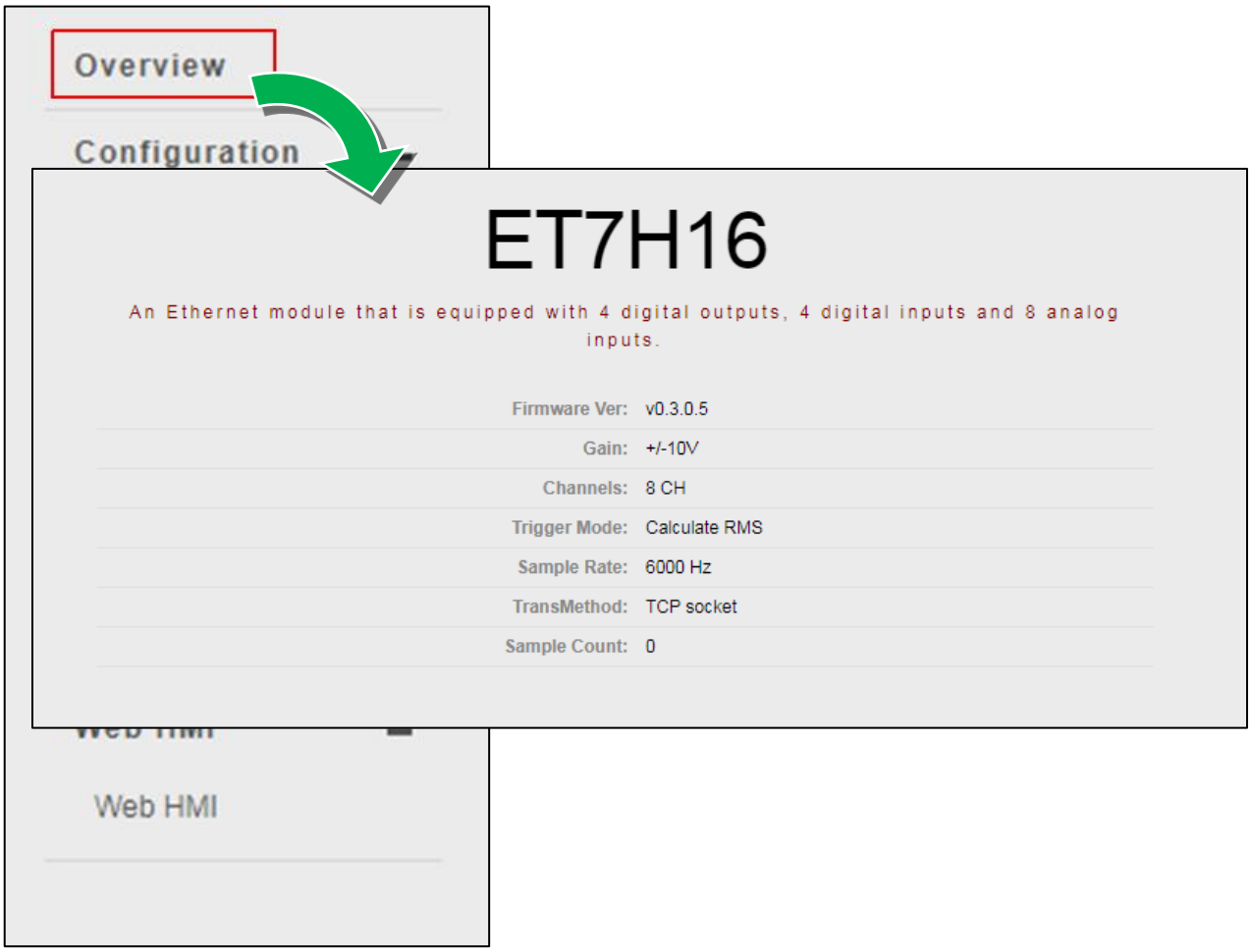
This site serves several functions. You can easily access these functions through the menu on the left side.

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



5.1. Overview

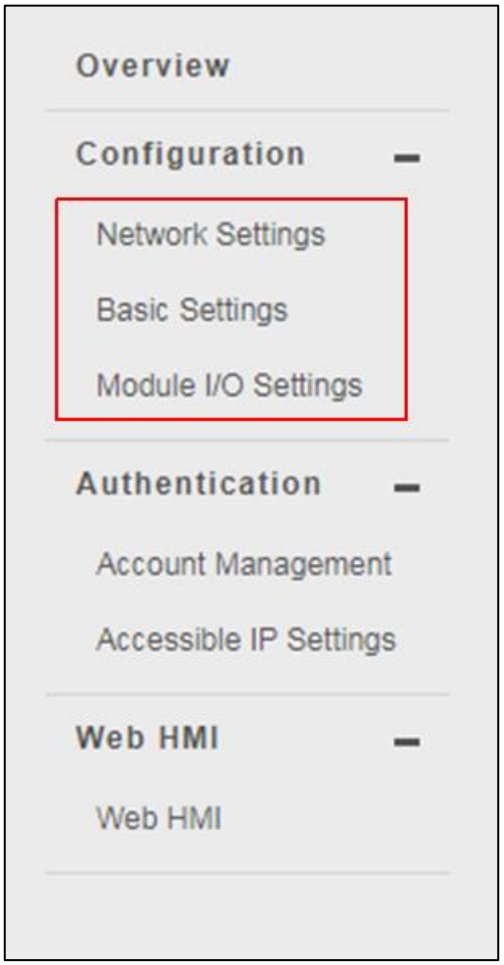
The Overview links to the welcome page that provides functions to monitor necessary system information of PET-7016M. The information is the most important note of version control for upgrading system.



This page provides basic information about the PET-7H16M.

- Firmware Ver: Current firmware version
- Gain: Current input type
- Channels: Current trigger channels
- Trigger mode: Current trigger mode
- Sample Rate: Current sample rate
- TransMethod: Current transfer method
- Sample Count: Current sample count

5.2. Configuration



The **Configuration** menu consists of the following menu:

- **Network Settings**: This menu links to the Network Settings page that allows you to access the IP settings.

- **Basic Settings**: This menu links to the Basic Settings page that allows you to configure the basic information of this site.

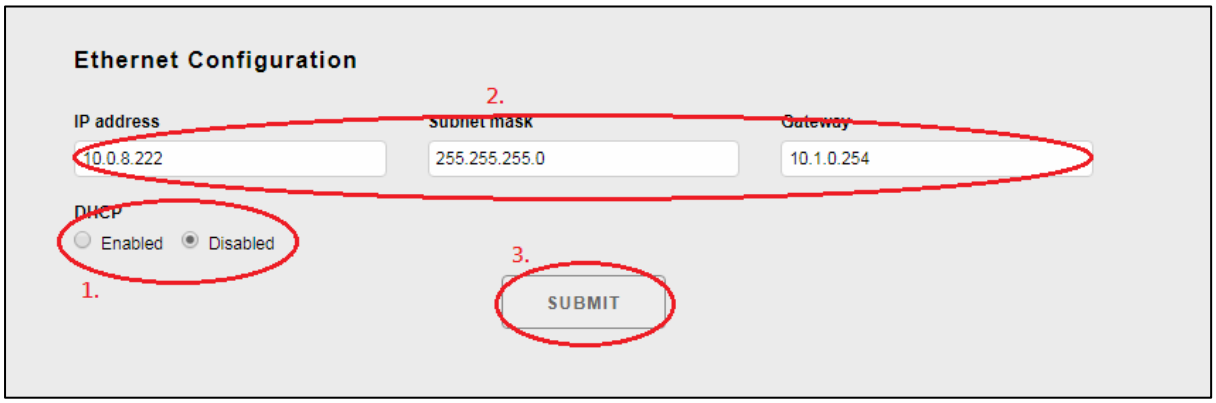
- **Module I/O Settings**: This menu links to the Common Functions page that allows you to configure the settings of the Modbus

5.2.1. Network Settings

The Network Settings page provides functions to configure either DHCP (Roaming) or manually configured (Static) network settings.

Manually Configured Network Settings

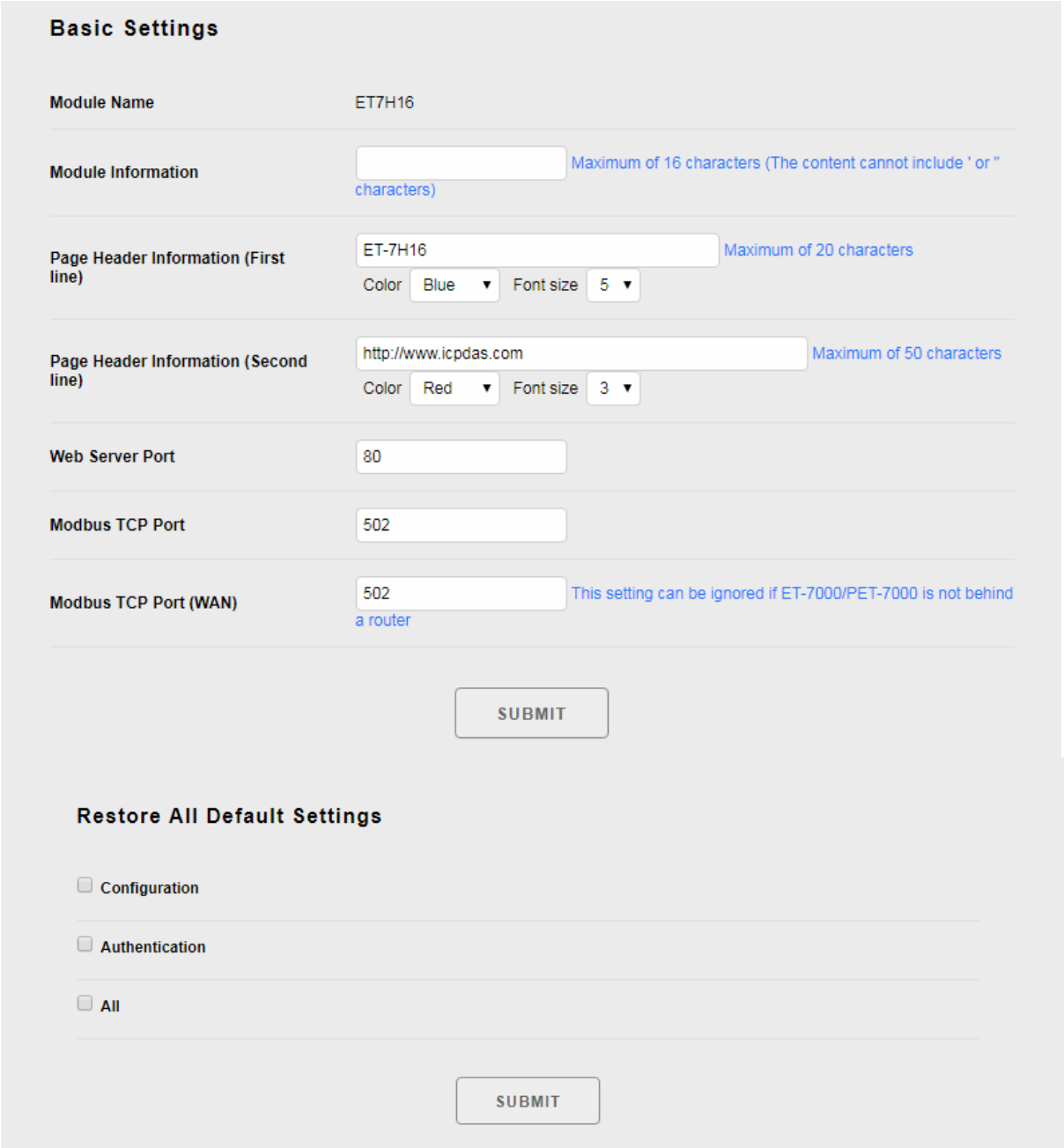
1. Disable the DHCP
2. Assign an IP address
3. Click **SUBMIT** to finished configuring the network settings



5.2.2. Basic Settings

The Basic Settings page provides the following functions:

- Configure the module information
- Configure the web site information
- Reset all settings to default



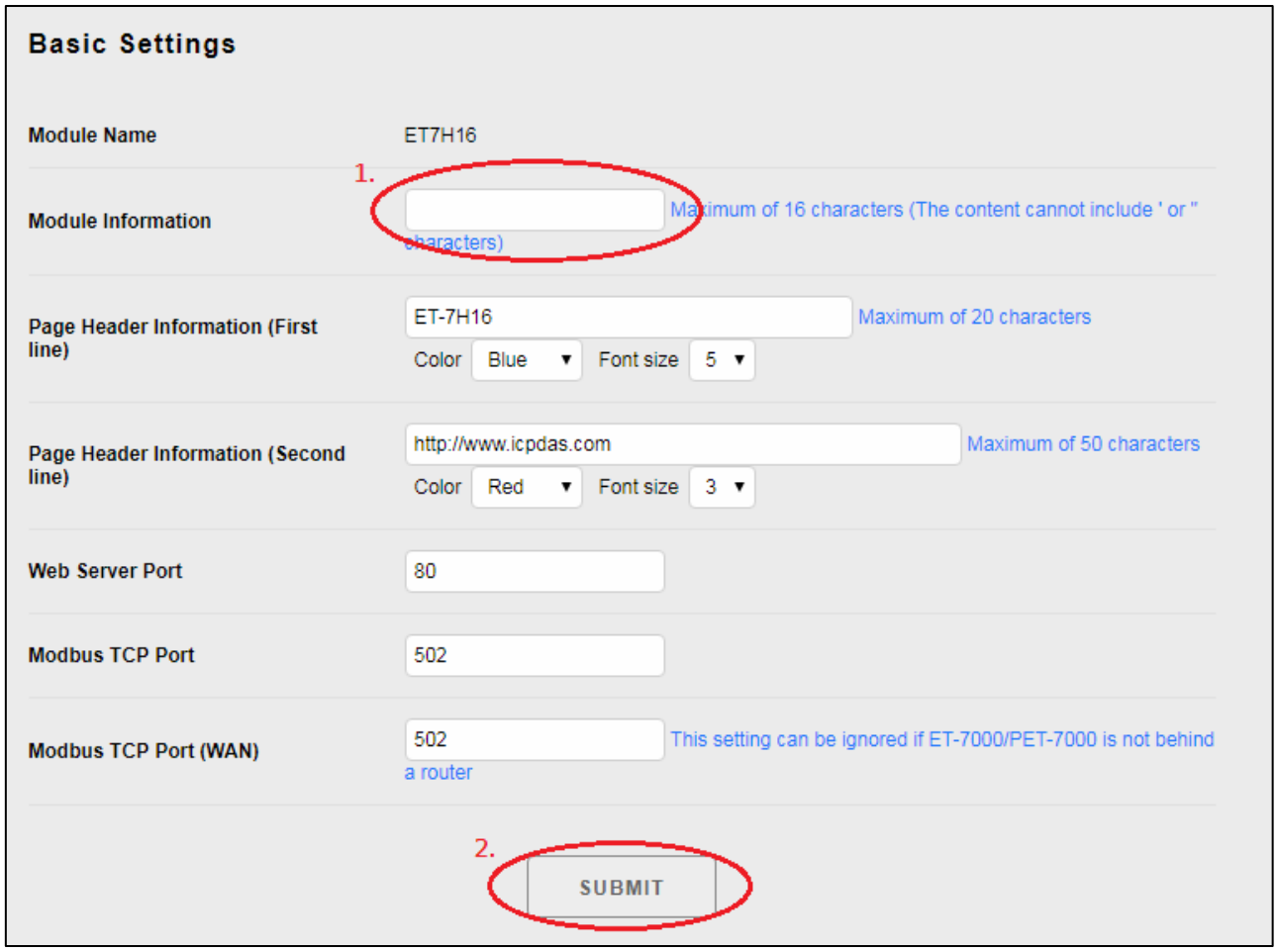
5.2.2.1. Configuring the Module Information

The module information includes the following data items:

- **Module Name**: The name of the module that can be modified. It has an initial value depending on the name of the module.
- **Module Information**: The module information indicates the name of the alias that is used to identify the module.

To configure the module information

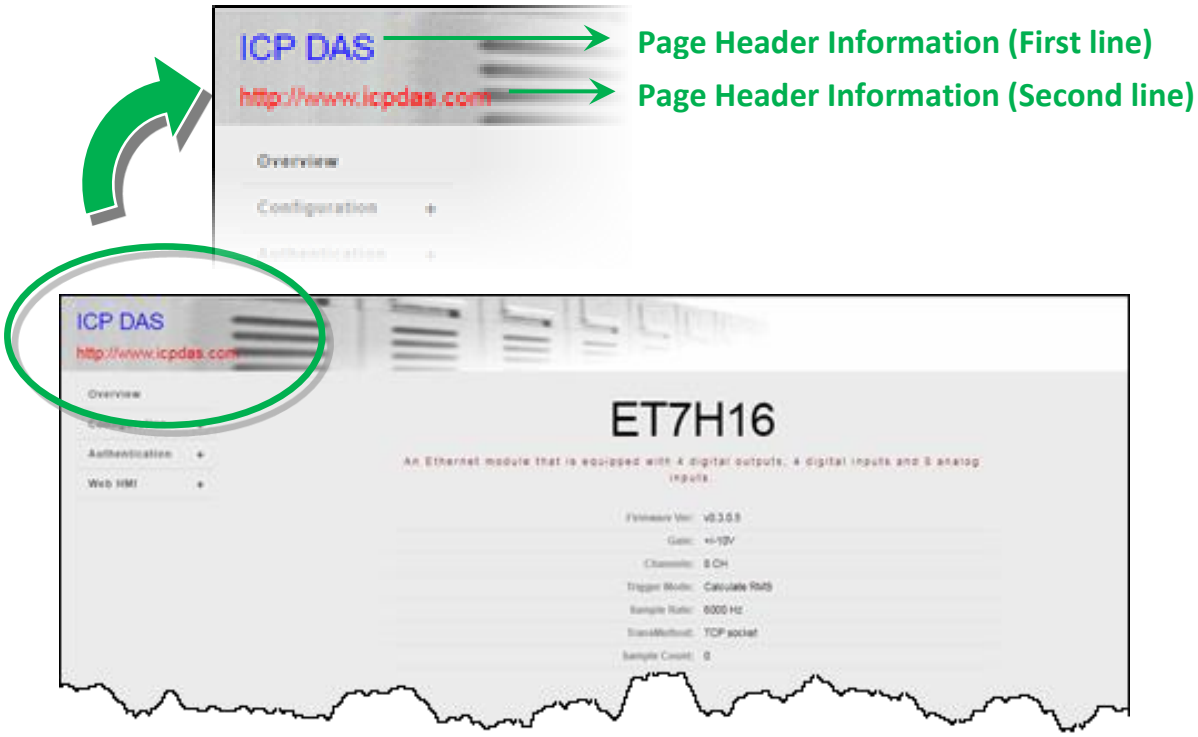
1. Enter the Module information
2. Click **SUBMIT** to finish configuring the module information



5.2.2.2. Configuring the Web site Information

The module information includes the following data items:

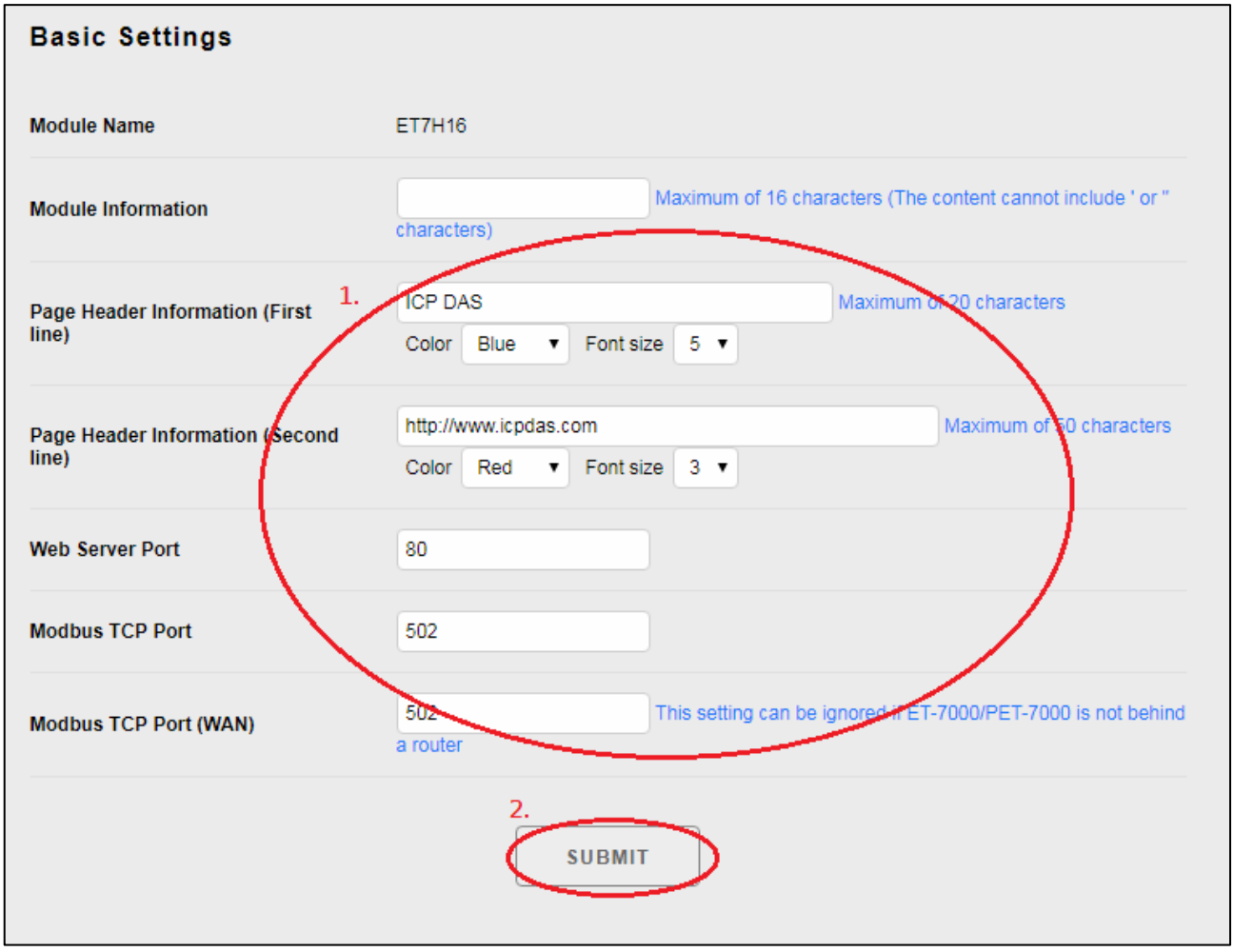
- **Page Header Information (First line)** and **Page Header Information (Second line)**: The title of the website that can be modified; you can view the title information in the top-left corner. The title information can be determined as follows:



- **Web Server TCP Port**: A port number of the TCP/IP port. By default, TCP/IP uses port 80.

To configure the web site information

1. Enter the web site information
2. Click **Submit** to finish configuring the module information



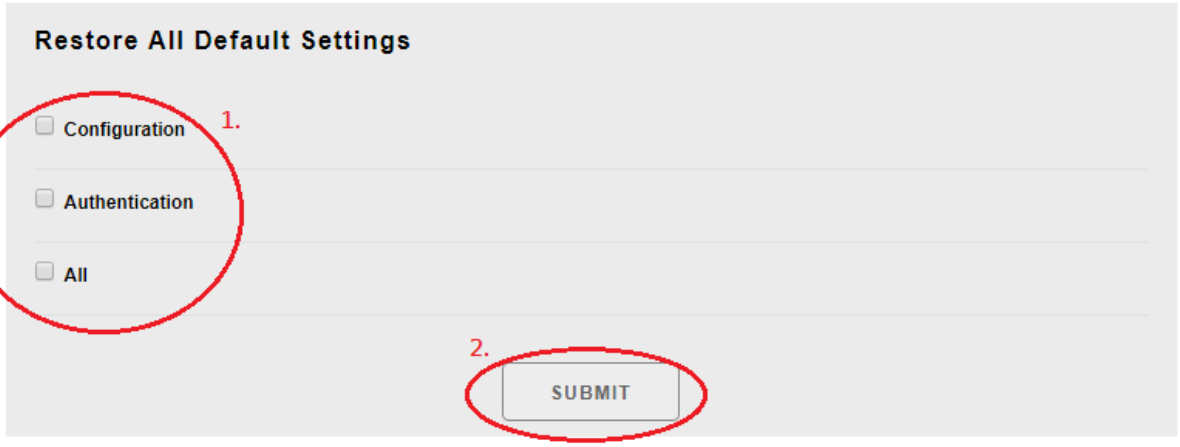
5.2.2.3. Resetting All Settings to the Factory Default

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.

- Configuration
- Authentication
- All

To reset the settings to their factory default

1. Enable the reset selection
2. Click **SUBMIT** to finish resetting the settings to their factory default



Factory Default Settings for Configuration Menu

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

Factory Default Settings for Authentication Menu

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.

5.3. Authentication

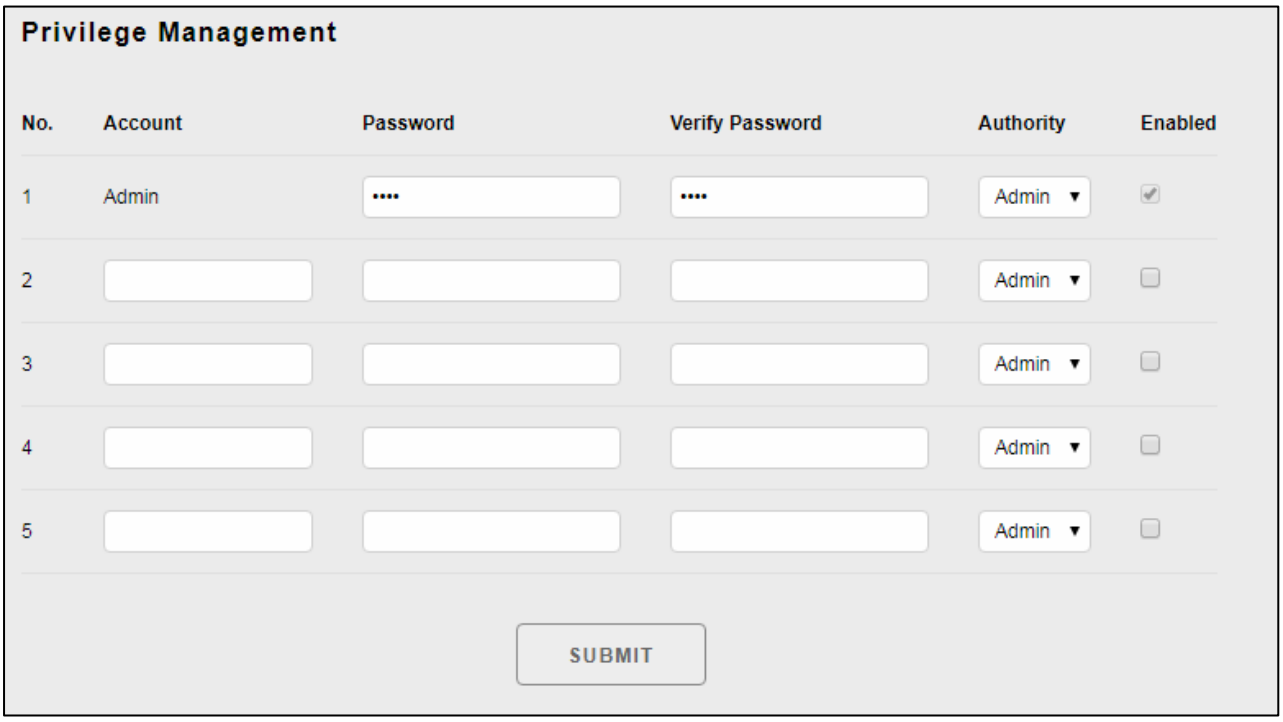
The **Authentication** menu consists of the following menu:

- **Account Management**: This menu links to the Privilege management page that allows you to manage the user accounts and their privileges.
- **Accessible IP Settings**: This menu links to the IP filter Settings page that allow you to control access to the web site

5.3.1. Account Management

The Basic Settings page provides the following functions:

- Configure the user accounts
- Load the factory default user account



5.3.1.1. Configuring the user accounts

The PET-7H16M 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

- **An account name**: Specifies the name of This can be your name or another alias
- **A password**: The system will ask you to type this in twice to ensure it is correct.
- **The authority**: that determines what operations the user is allowed to perform.

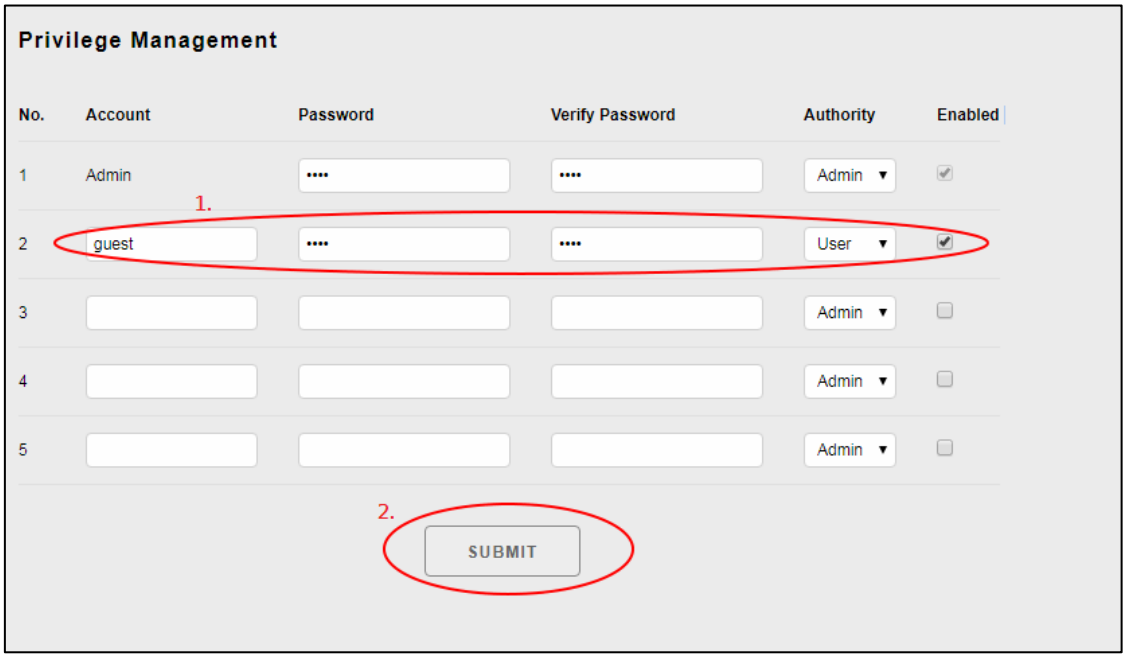
The authority has the following roles to determine what operations the user is allowed to perform.

- **Admin**: Enables access to all PET-7H16M website features, functions, and commands.
- **User**: Enables limited access to PET-7H16M website features, functions, and commands. In general, operators cannot change configuration settings.

To Create an User Account

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

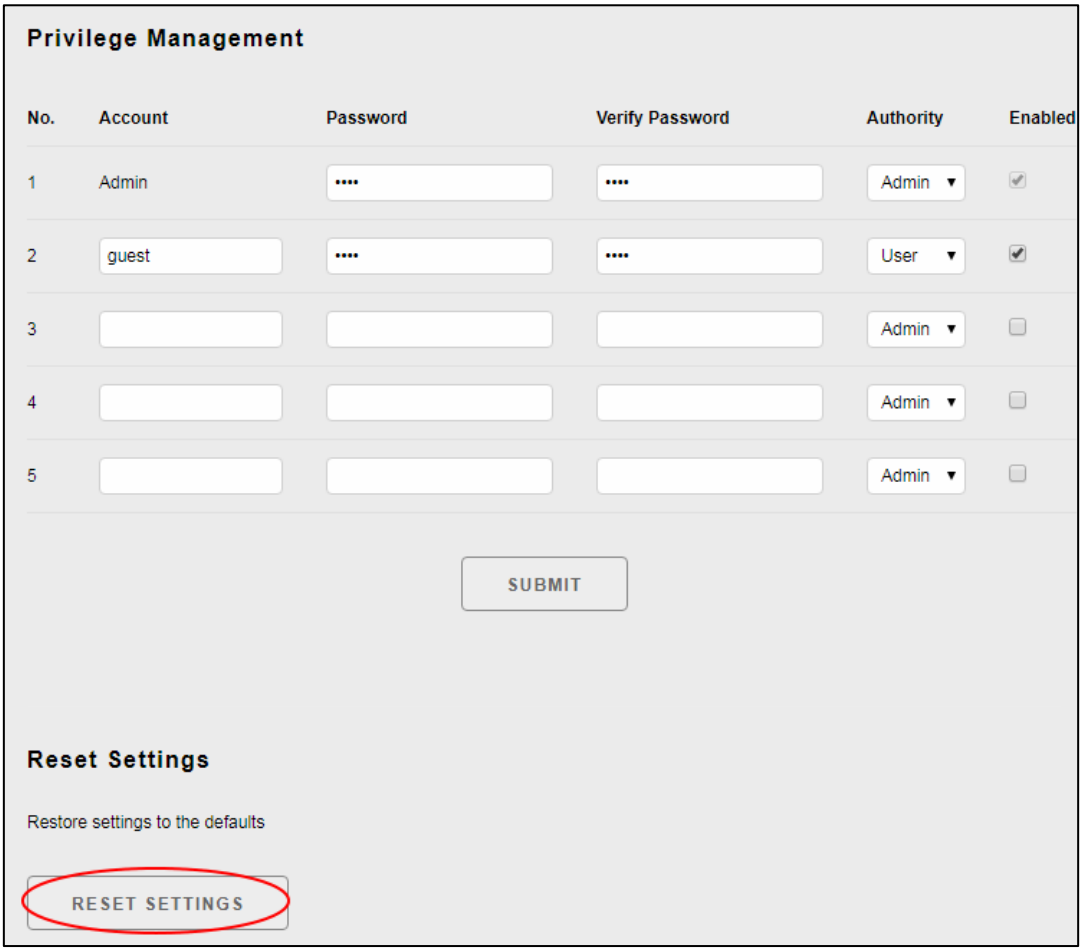
1. Enter the user account information, and then select the enable checkbox
2. Click **SUBMIT** to finish configuring the user accounts



5.3.1.2. Loading the factory default user accounts

The PET-7H16M has a built-in administrator account named Admin that is created when it is installed by default. The default account cannot be deleted.

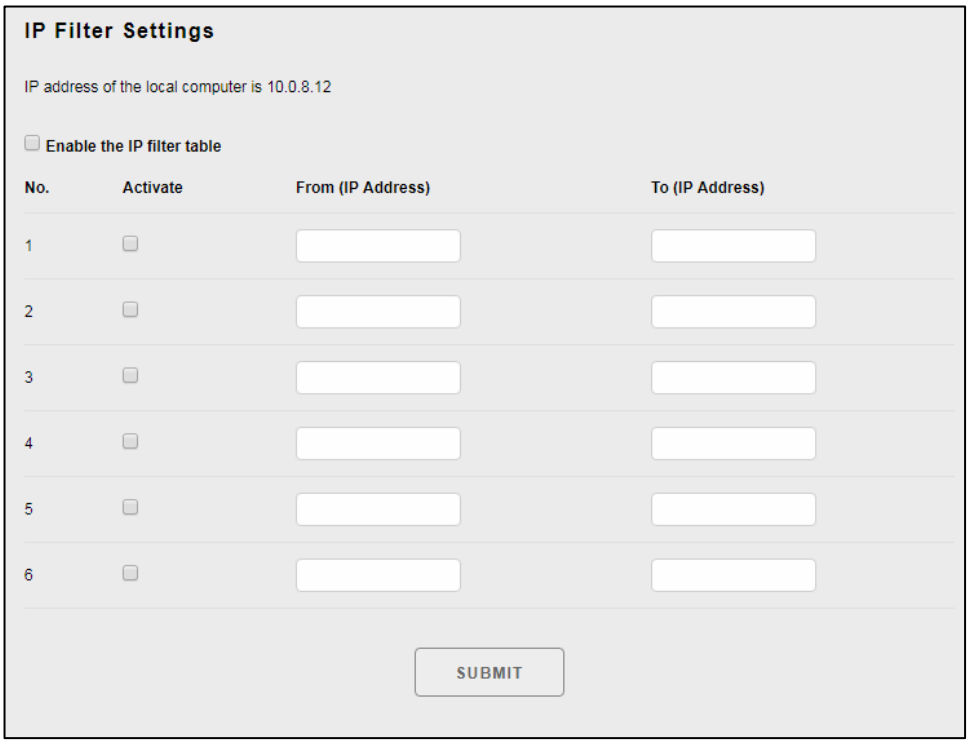
Click **RESET SETTINGS** to configure the user account to the factory default settings.



5.3.2. Accessible IP Settings

The IP filter Settings page provides the following functions:

- Configure IP filtering



To Configure the IP filter

The PET-7H16M 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 or disable by selecting the Enable the IP filter table checkbox

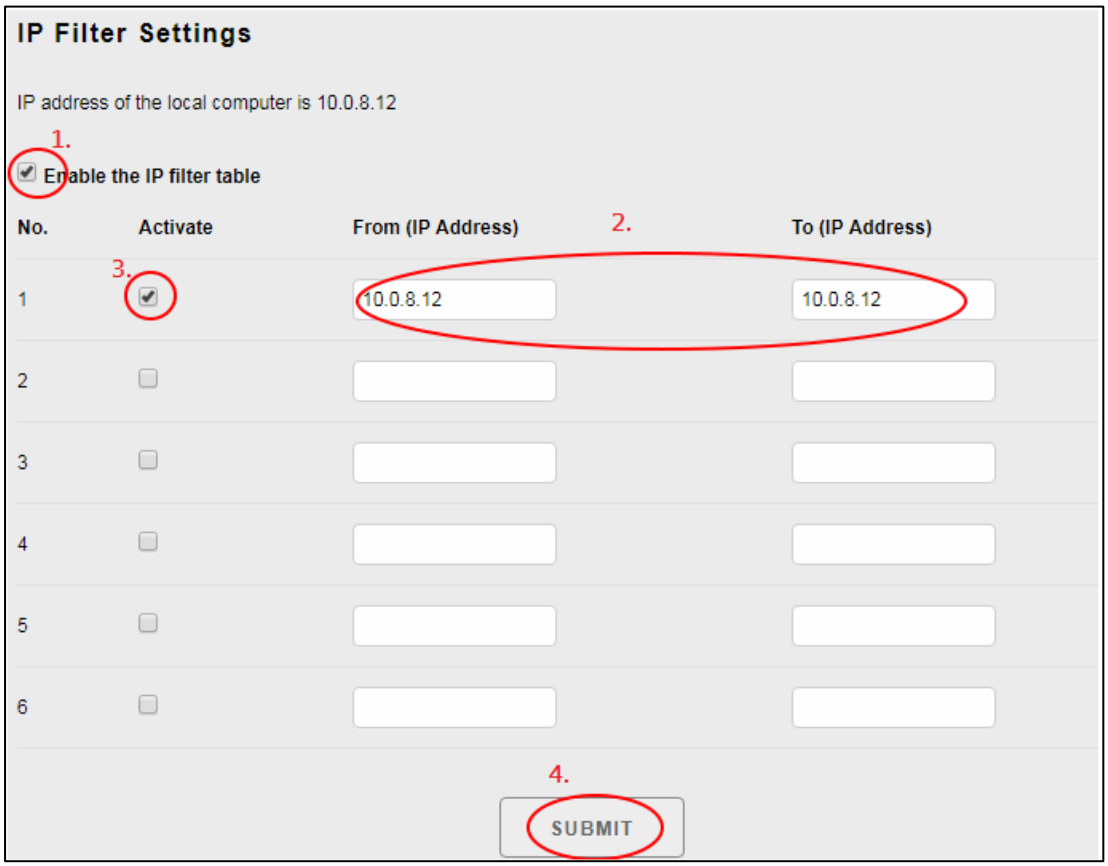
Tips & Warnings

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

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

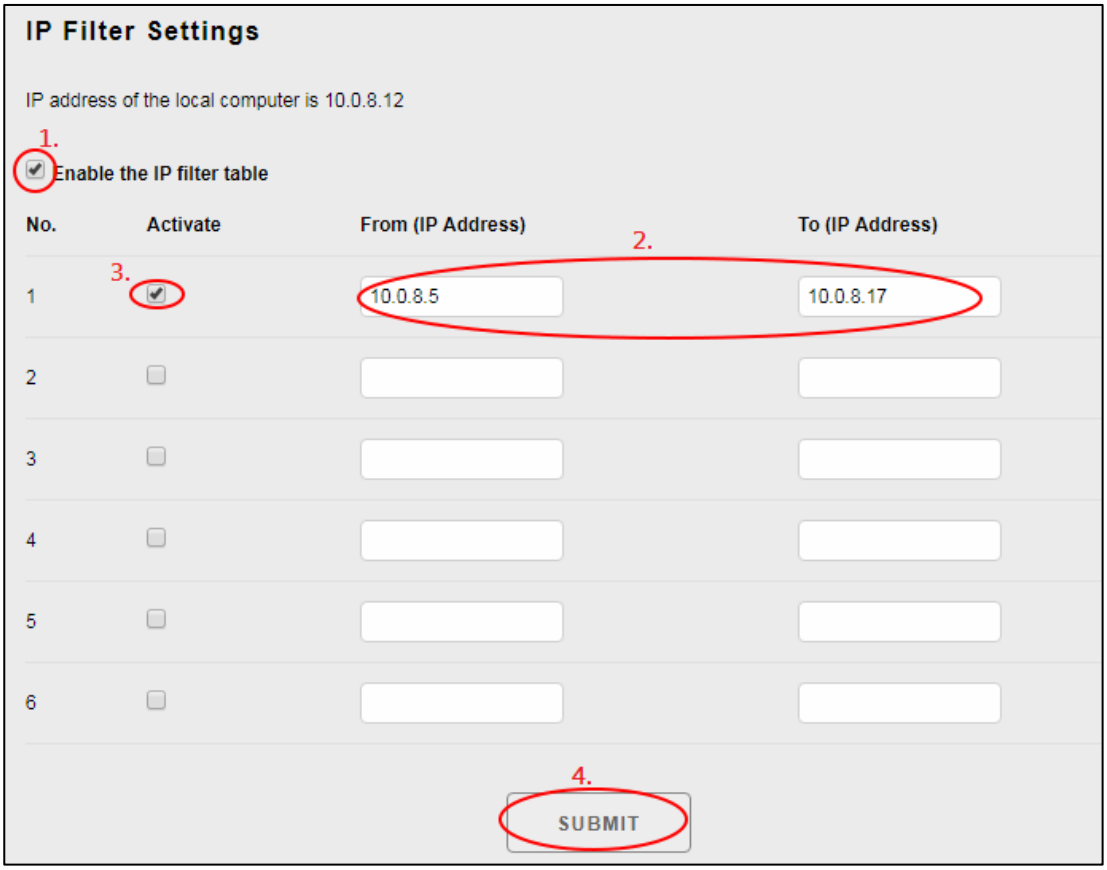
Method 1 : Allows access from a single IP address

1. Select the **Enable the IP filter table**
2. Enter the same IP address in the **From (IP Address)** and **To (IP Address)**
3. Select the **Active** the rule checkbox
4. Click **SUBMIT** to finish configuring the list of IP filter



Method 2: Allow access from a group of IP addresses

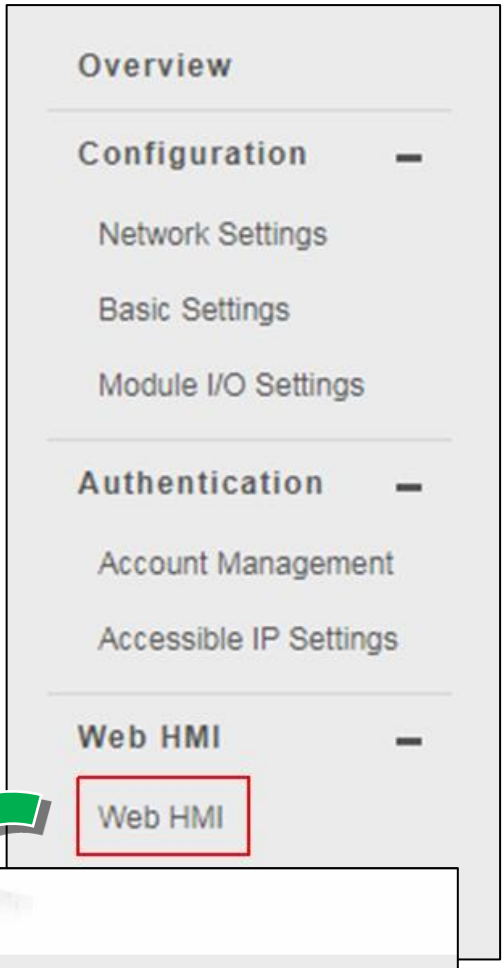
1. Select the **Enable the IP filter table**
2. Enter a range of IP addresses in the **From (IP Address)** and **To (IP Address)**
3. Select the **Active** the rule checkbox
4. Click **SUBMIT** to finish configuring the IP filter list



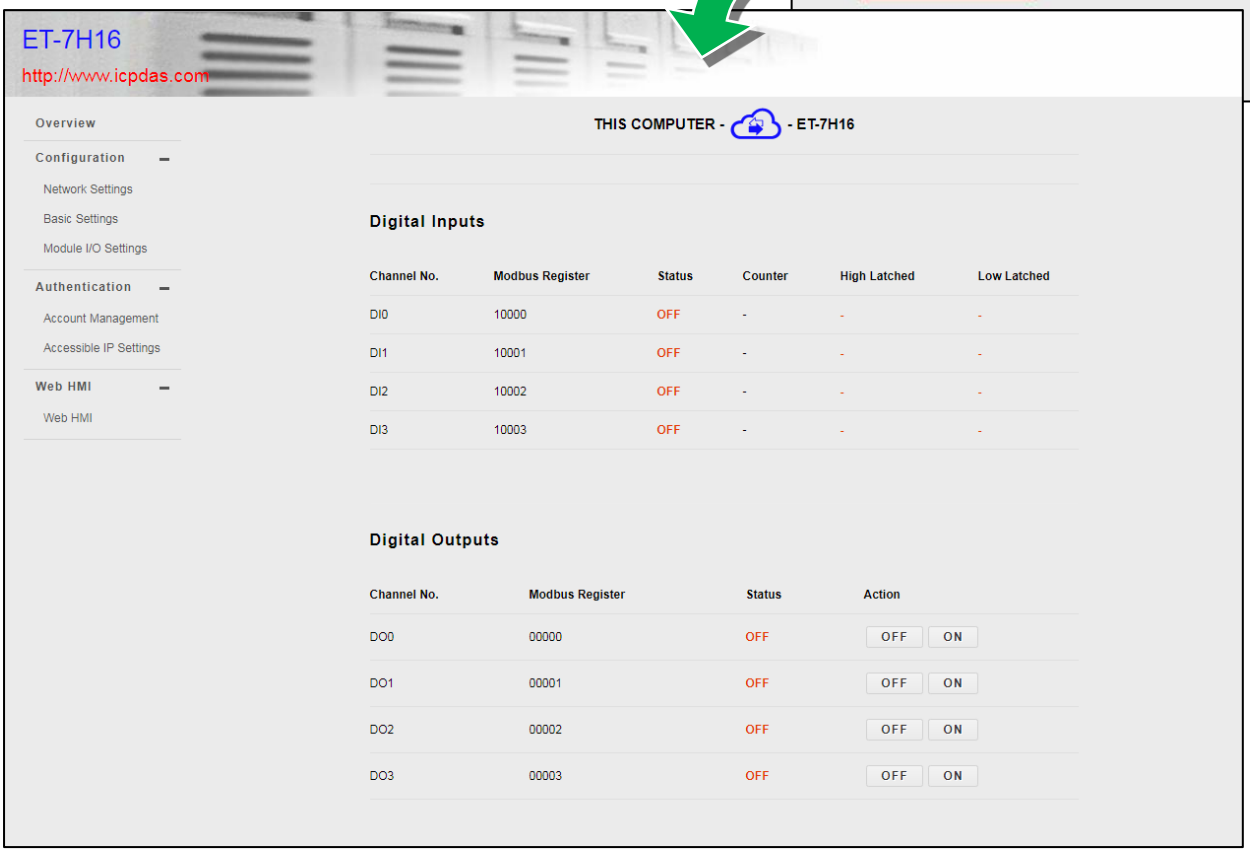
5.4. Web HMI

The **Web HMI** menu consists of the following menu:

- **Web HMI:** This menu links to the I/O monitor page that allows you to monitor and control the I/O status on PET-7H16M module remotely.

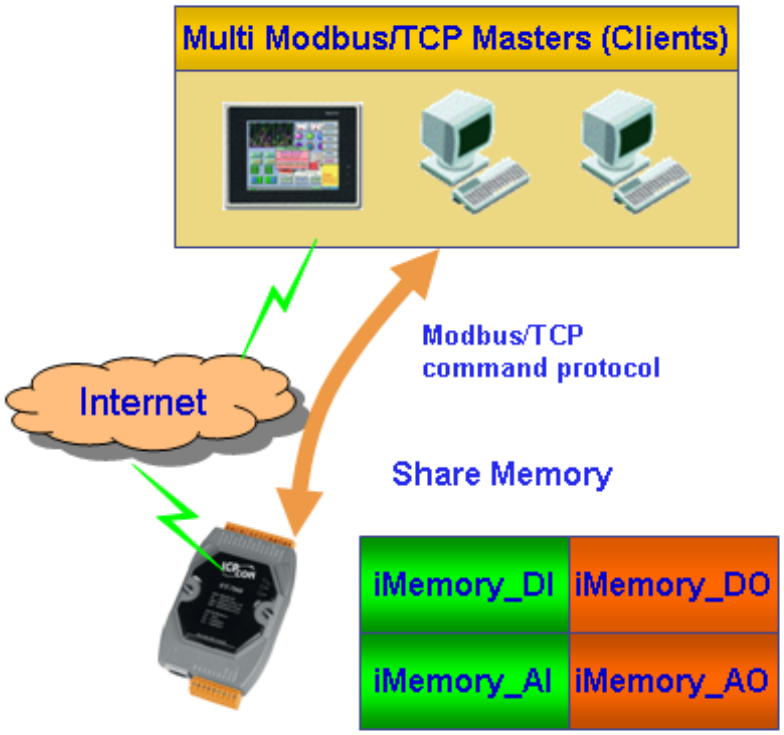


By default, this page displays summary information about I/O channels that are classified according to the module type.



6. Modbus Applications

The PET-7H16M is a Modbus device that allows you to access terminals data via Ethernet and communicates using a master-slave technique in which only one device (the master) can initiate transactions (called queries). The other devices (slaves) respond by supplying the requested data to the master, or by taking the action requested in the query.



Register Map

Modbus devices usually include a Register Map. Modbus functions operate on register map registers to monitor, configure, and control module I/O. The users should refer to the register map for the PET-7H16M to gain a better understanding of its operation.

- **0xxxx address table**

Begin address	Points	Description	Registers per Point	Range	Access Type
0	4	Digital Out	1	0 = off 1 = on	R/W
34	1	The data order of long value to Modbus register	1	0: low byte, high byte 1: high byte, low byte	R/W
36	1	Reset the I/O settings to the factory default state	1	1: Reset	W (Pulse)
37	1	Reset the web settings to the factory default state	1	1: Reset	W (Pulse)
112	1	Reboot the module	1	1: Reboot	W (Pulse)

- **1xxxx address table**

Begin address	Points	Description	Registers per Point	Range	Access Type
0	4	Digital input value	1	0 = off 1 = on	R

- **3xxxx address table**

Begin address	Points	Description	Registers per Point	Range	Access Type
0	8	Analog Input	word	-32768 ~ +32767	R
16	8	Use Channel Gain Value	word	0 ~ 65535	R
32	8	Use Channel Offset Value	word	-32768 ~ +32767	R
80	1	Number of the DI channel	word	0 ~ 65535	R
81	1	Number of the DO channel	word	0 ~ 65535	R
82	1	Number of the AI channel	word	0 ~ 65535	R
90	1	OS image version	word	0 ~ 65535	R
91	1	Firmware version	word	0 ~ 65535	R
92	1	ET7H16 Library version	word	0 ~ 65535	R
94	1	TCP library version	word	0 ~ 65535	R
95	1	Web server library version	word	0 ~ 65535	R
100	1	Read module name	word	0 ~ 65535	R

- **4xxxx address table**

Begin address	Points	Description	Registers per Point	Range	Access Type
32	1	Set AI type	word	0: +/- 5V 1: +/- 10V	R/W/E
33	1	Scan Channel Count	word	1 ~ 8	R/W
34	1	Trigger Type	word	0: Software start 1: External Trigger 2: Post-Trigger 3: Pre-Trigger …	R/W/E
35	2	Sample Rate	word		R/W/E
37	2	Target Count	word		R/W/E
50	1	Read the boot count of the module	word		R/W/E
60	1	The factory default value is 0 when the settings are set to the factory default values	word	0 ~ 65535	R/W/E

7. Updates

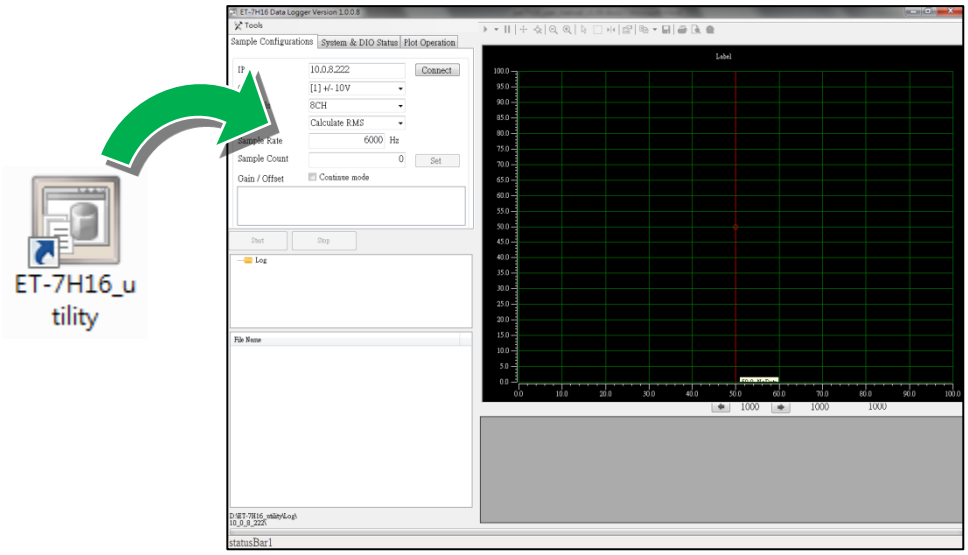
The firmware is stored in flash memory and can be updated to fix functionality issues or add additional features, so we advise you to periodically check the ICP DAS web site for the latest updates.

Step 1 : Get the latest version of the firmware and the autoexec.bat file

The latest version of the PET-7H16M firmware and autoexec.bat file can be obtained from:
CD:\NAPDOS\ET7H16\Firmware\
http://ftp.icpdas.com/pub/cd/6000cd/napdos/et7h16/firmware/

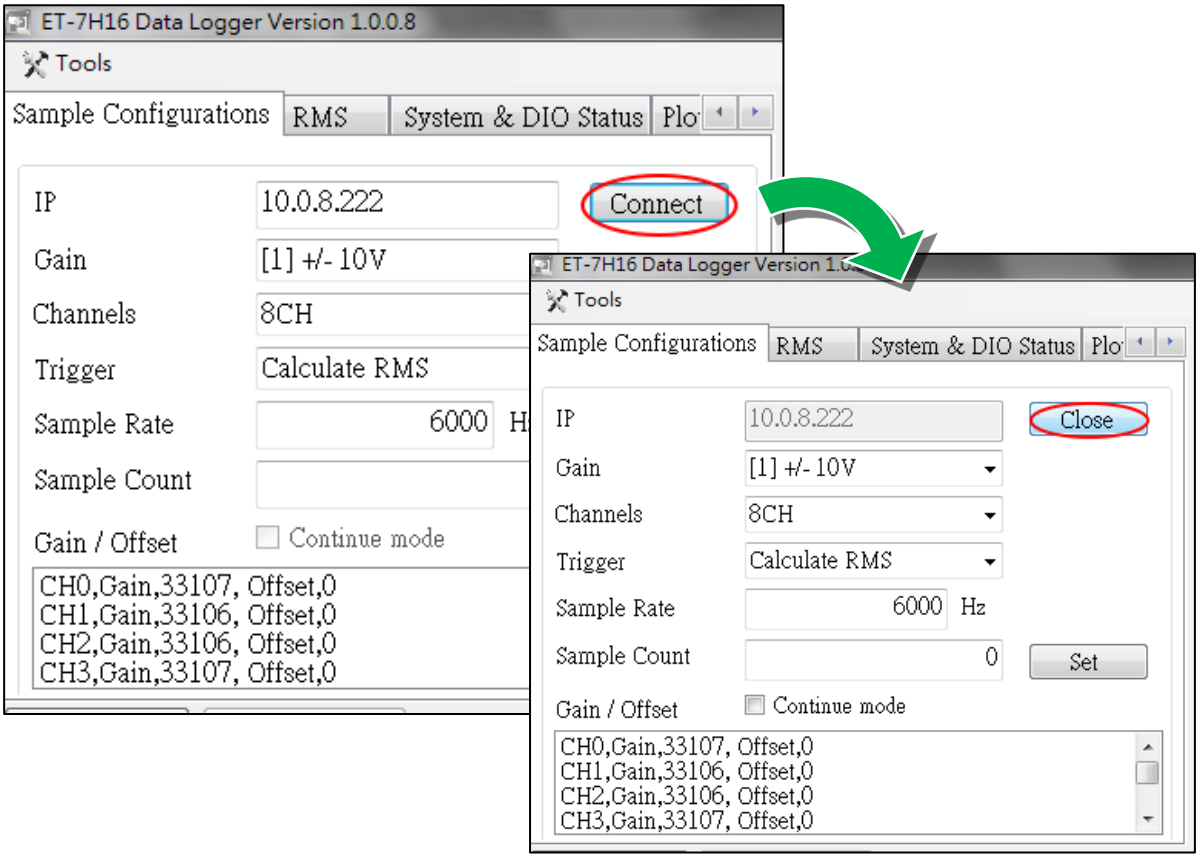
Step 2 : Run the ET-7H16 Utility

Double-click the ET-7H16 Utility shortcut on your desktop.



Step 3 : Establish a connection to PET-7H16M

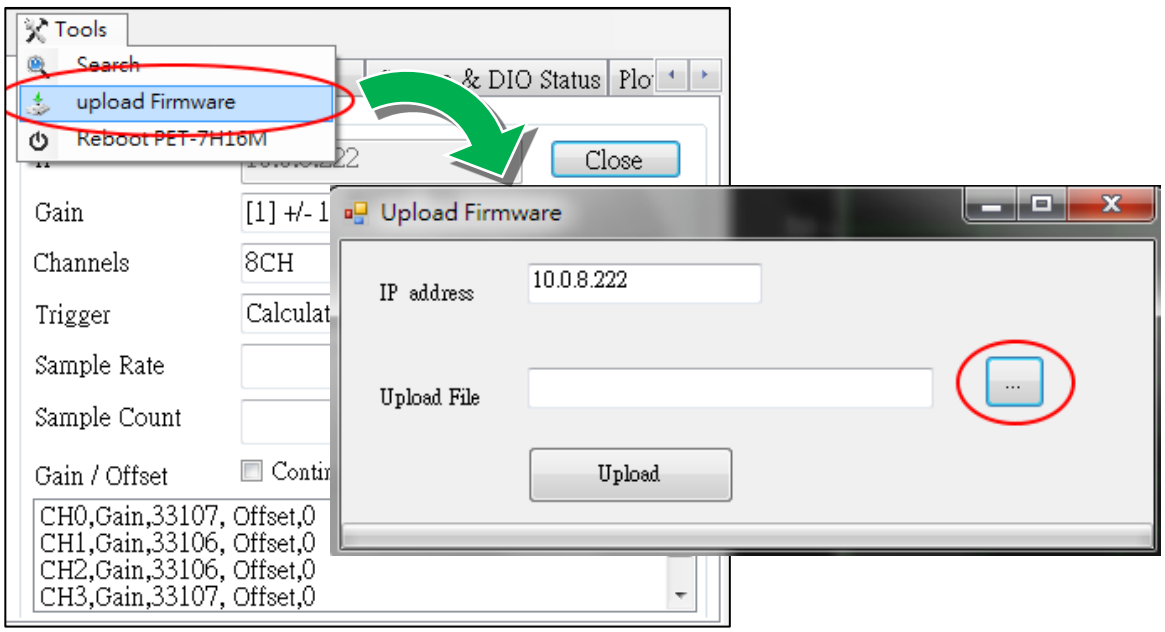
Click “Connect” button



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

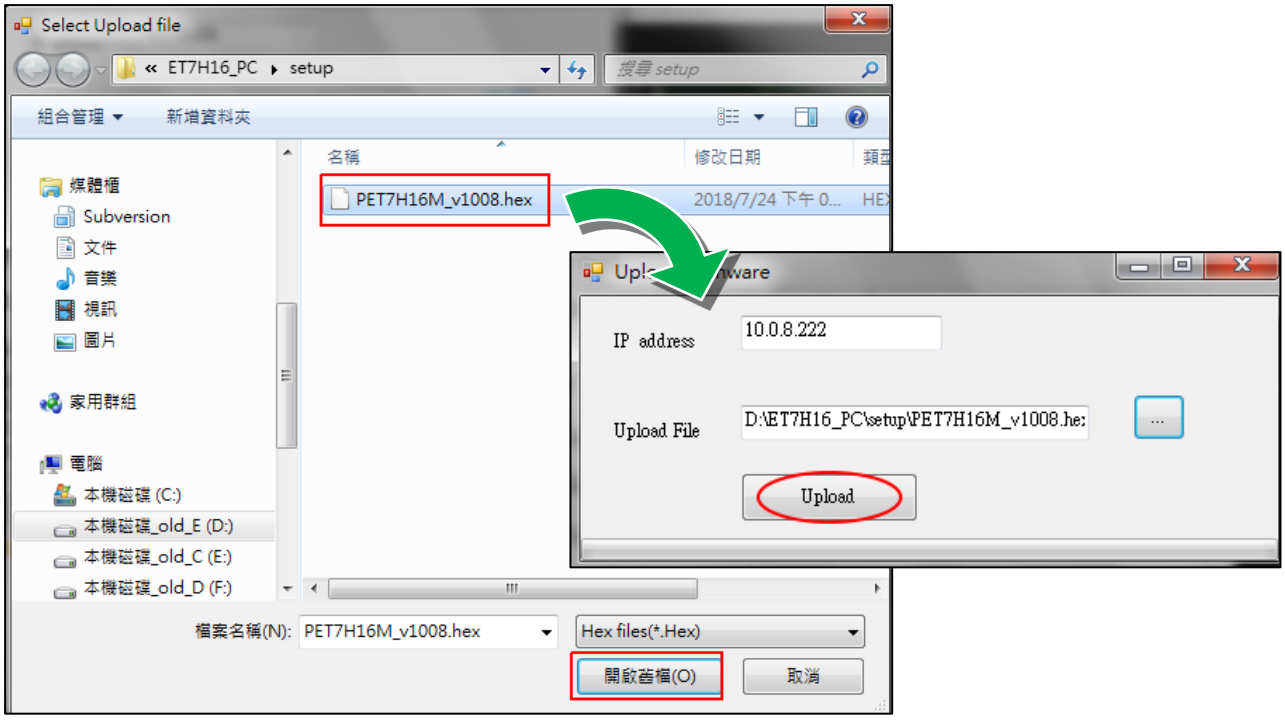
After establishing a connection, then choose upload Firmware from Tools menu.

Then confirm the IP of PET-7H16M, then click “…” button.



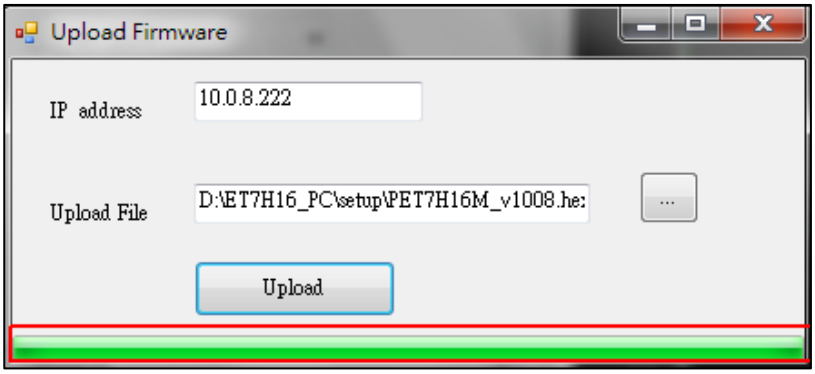
Step 5 : Choose the PET7H16M_VXXXX.hex to upload

Select PET7H16M_VXXXX.hex to upload, then click "Open File" and then click "Upload".



Step 6 : End of upload

After uploading the file, the progress bar will be as shown below..



Tips & Warnings

You have to reboot the PET-7H16M after uploading the firmware.

8. Calibration

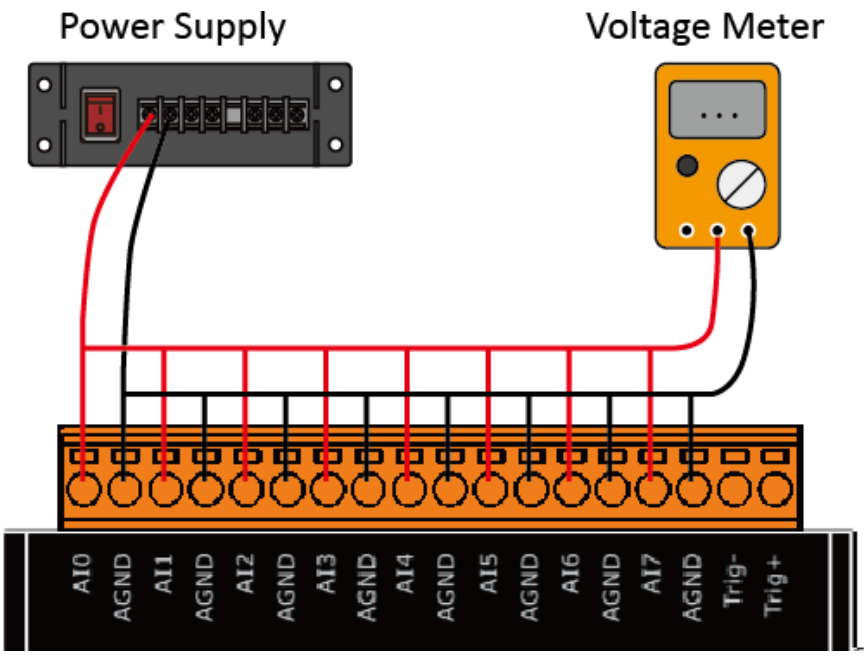
When shipped from the factory, PET-7H16M is already fully calibrated, including the calibration coefficients that are stored in the onboard EEPROM. For a more precise application of voltages in the field, the procedure described below provides a method that allows the board installed in a specific system to be calibrated so that the correct voltages can be achieved for the field connection. This calibration allows the effects of voltage drops caused by IR loss in the cable and/or the connector to be eliminated.

At first the user has to prepare the equipment for calibration

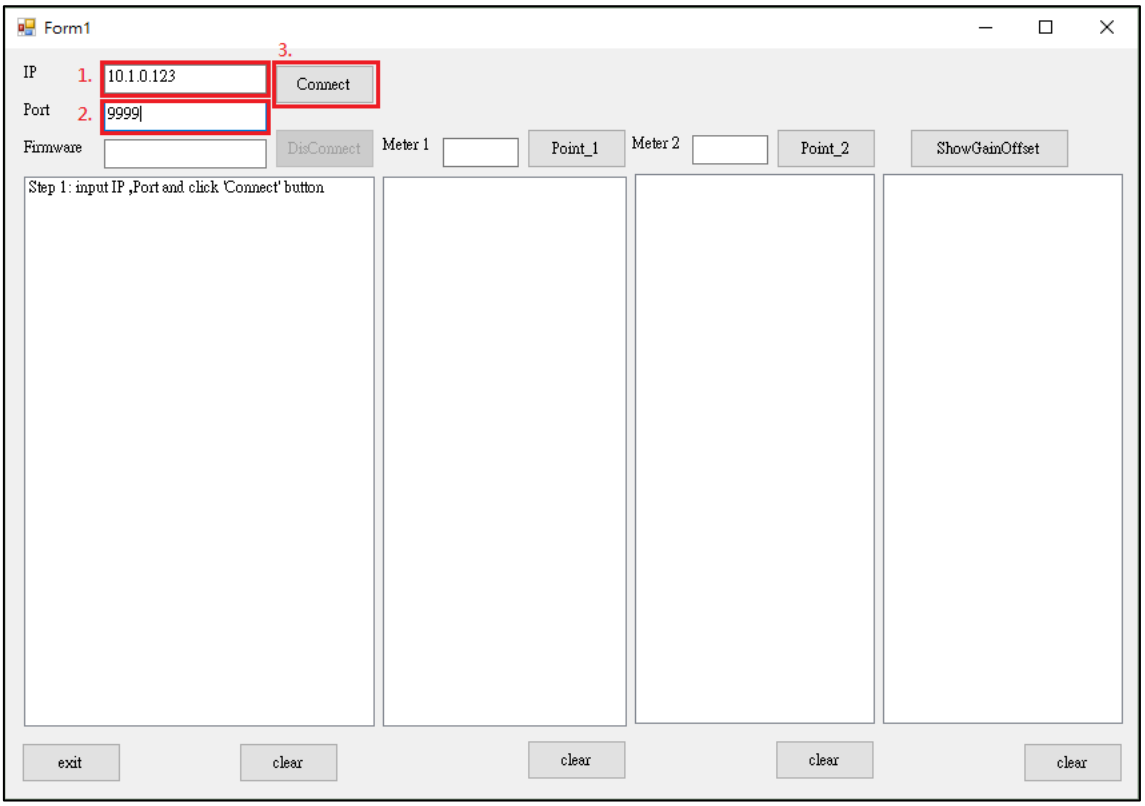
- Precise multi-meter (The more precise meter is better)
- Stable power supply
-

The calibration procedure will be described in detail in the following.

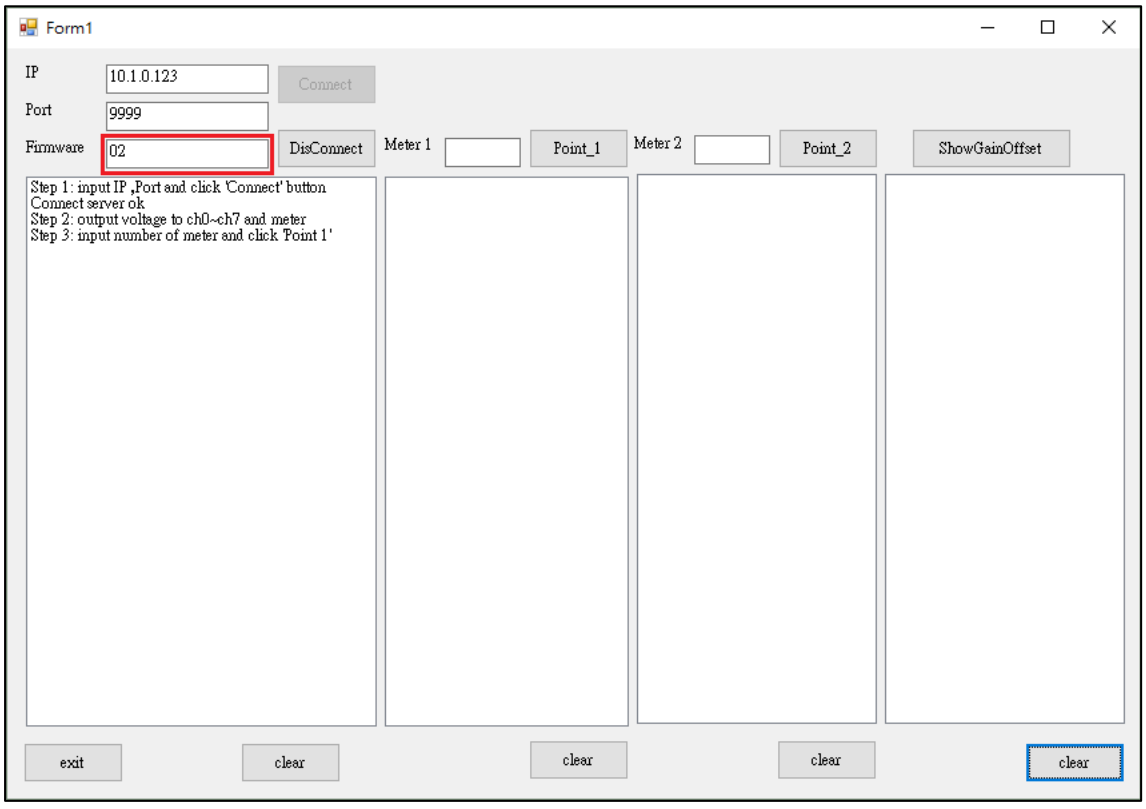
Connect the AI channels to the meter and power supply, as shown below:



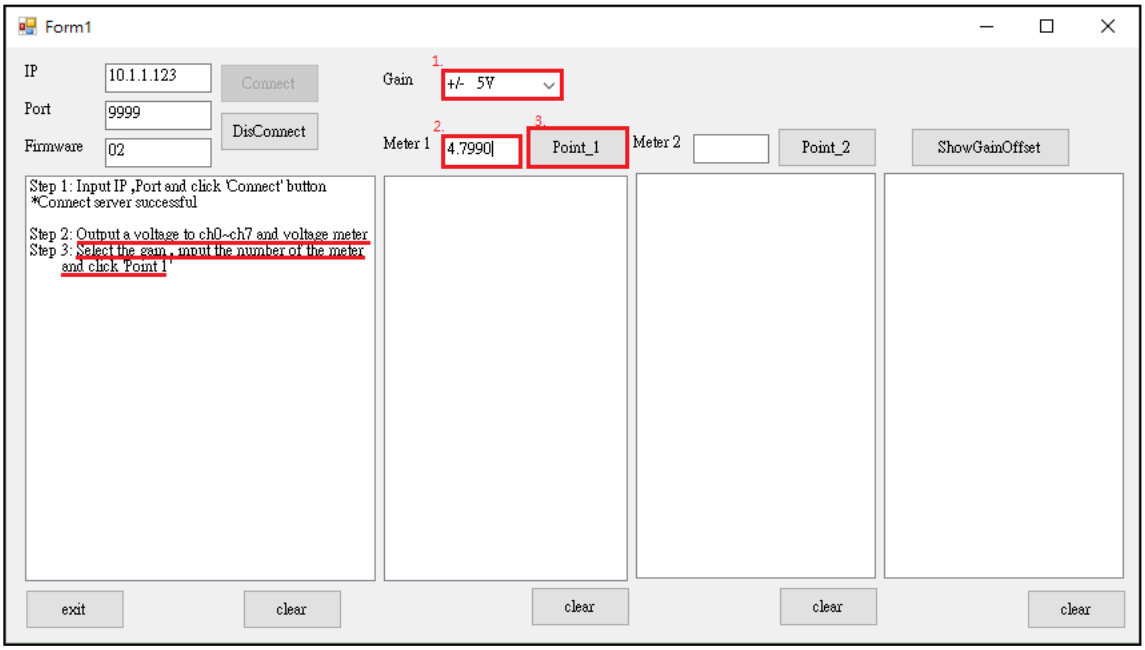
Step 1: Entering the IP and Port, and click Connect



After the connection is successful, the firmware version will be read back.



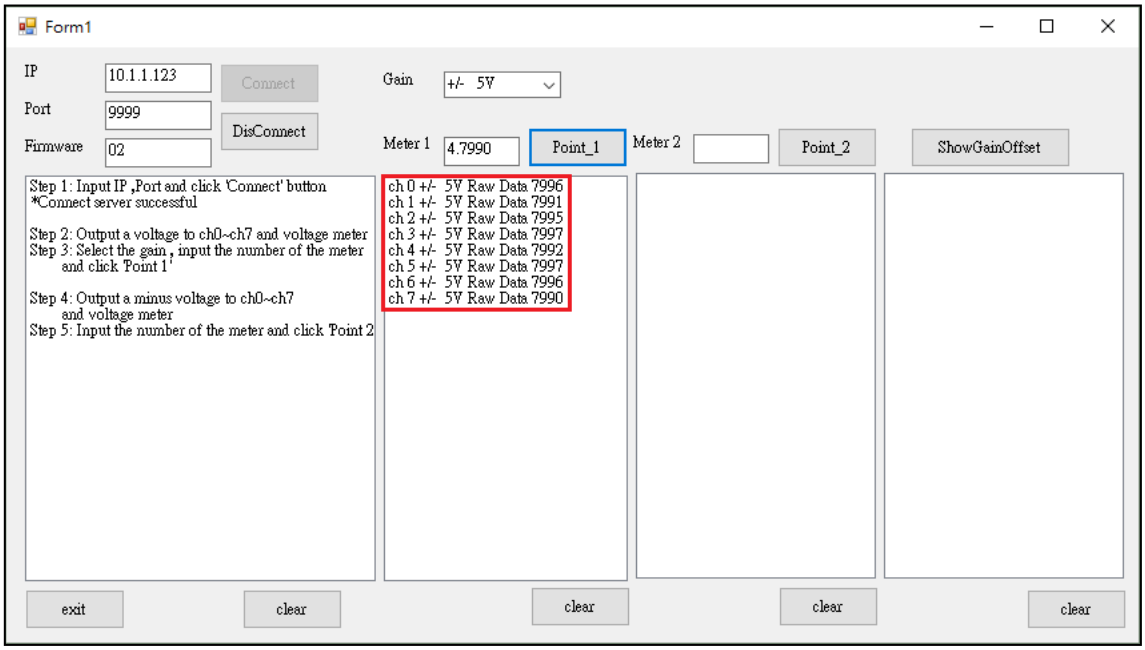
Step 2 : Output voltage 4.8V to ch0 ~ ch7 and the meter, and select +/-5V in Gain combo box. Enter the value reading from the meter in Meter 1 textbox (the following example is 4.7990)



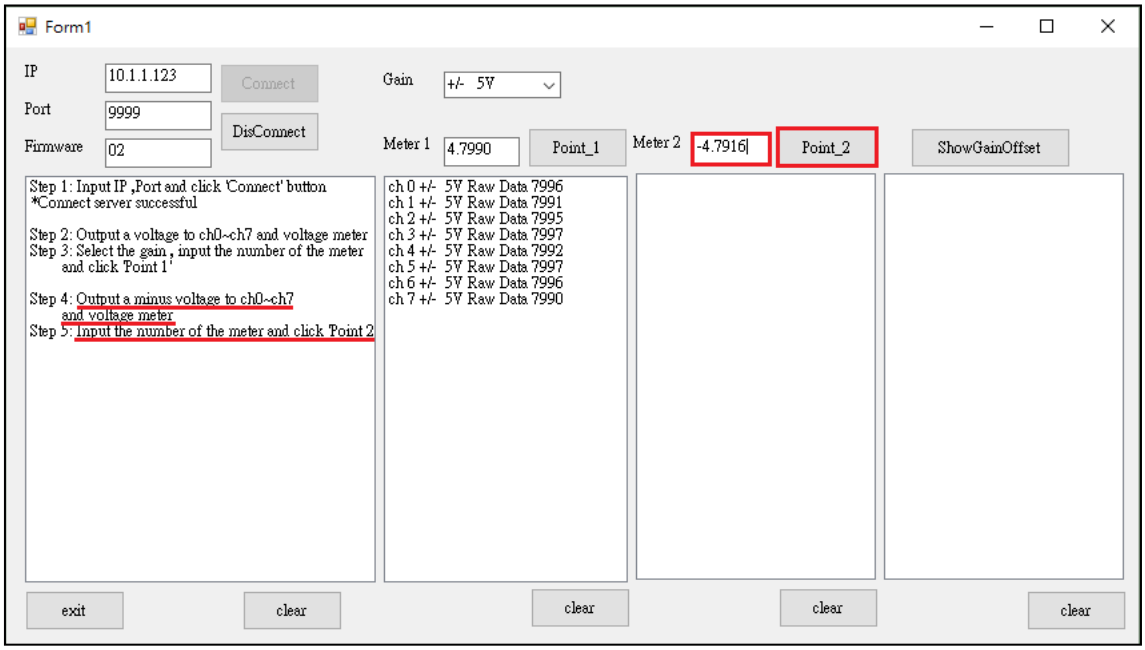
Tips & Warnings

The range of output voltage is 5V~0V and it's better to output voltage value near to 5V.

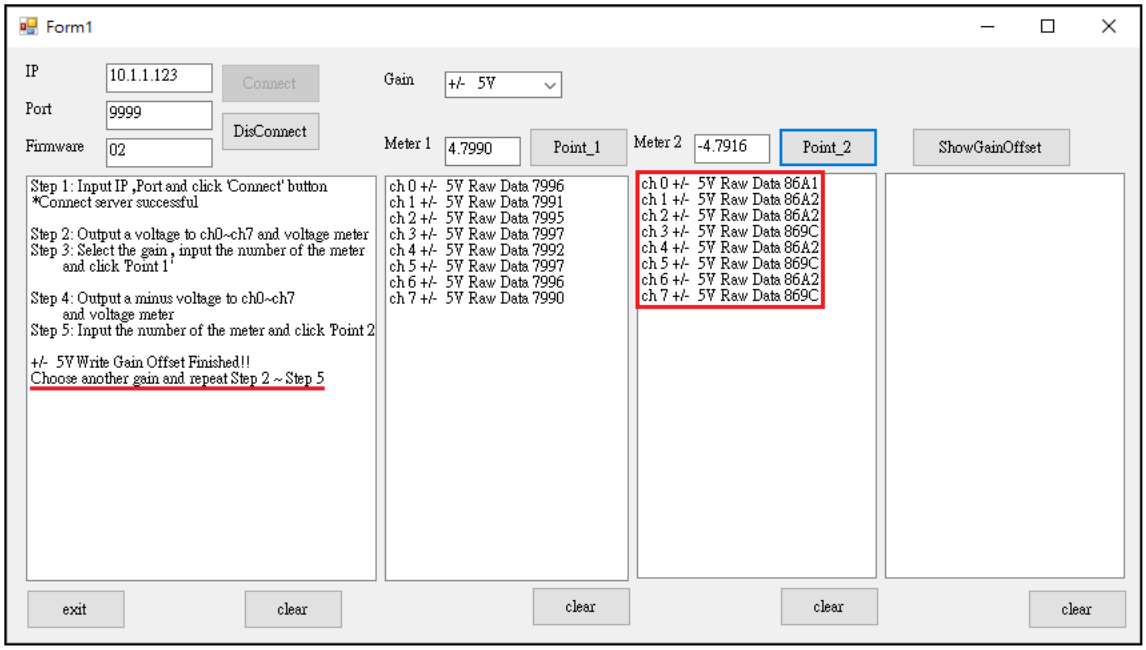
Step 3: Click Point_1 button and get the raw data of each channel as following



Step 4：Output a voltage, -4.8V to ch0 ~ ch7 and the meter, enter the value reading from meter in Meter 2 textbox (the following example is -4.7916)



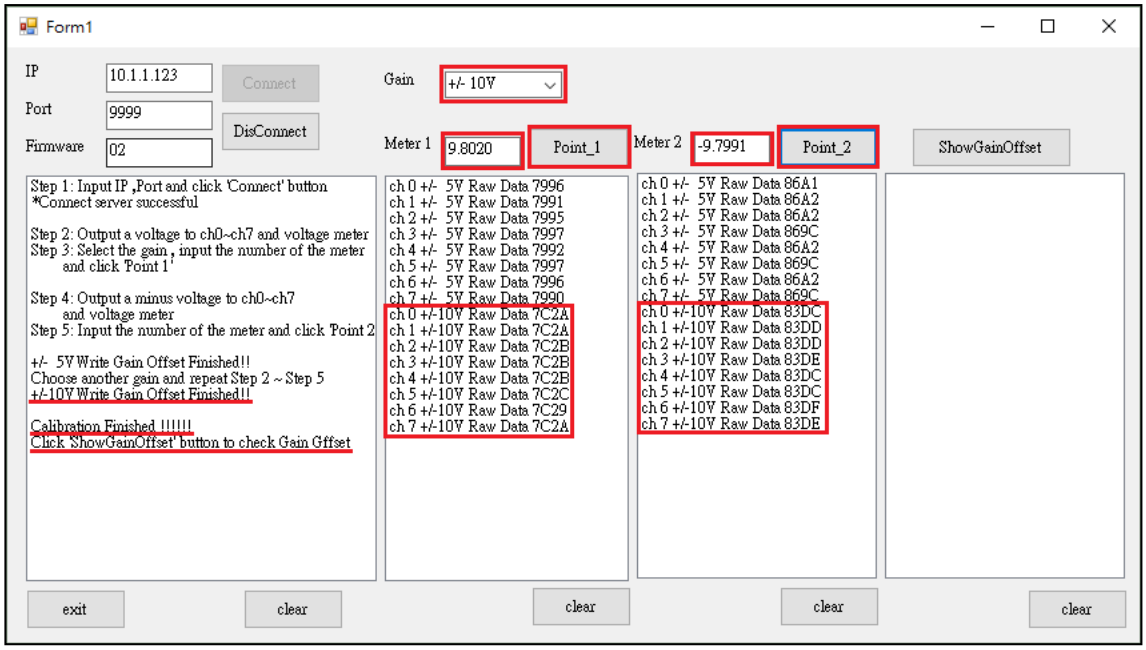
Step 5: Click Point_2 button and get the raw data of each channel as following



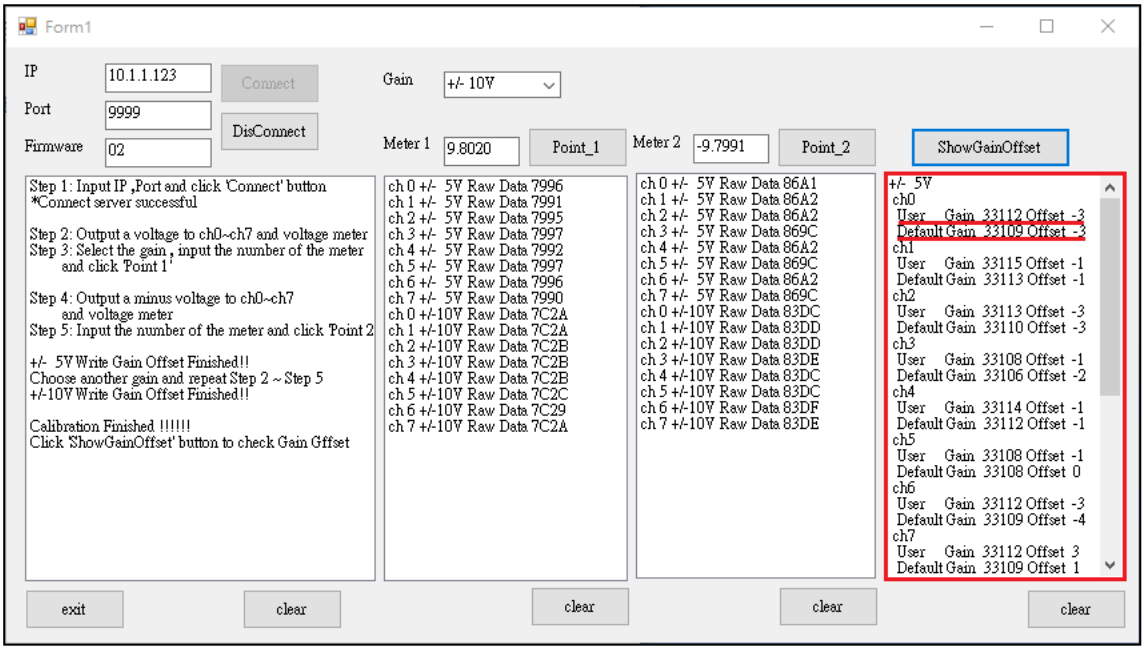
Step 6: Select +/- 10V in Gain combo box.

Step 7: Repeat the Step2 ~ Step5, and the upper limit voltage outputs 9.8V in Step 2 and the lower limit voltage outputs -9.8V in Step 5.

The calculated Gain Offset will be stored in the EEPROM. The calibration is completed after the message appears “Calibration Finished!!!”



Step 8: After completing the calibration, click on ShowGainOffset button to read Gain and Offset value.



Appendix A. What is Modbus TCP/IP?

Modbus is a communication protocol developed by Modicon in 1979.

Different versions of Modbus used today include Modbus RTU (based on serial communication like RS485 and RS232), Modbus ASCII and Modbus TCP, which is the Modbus RTU protocol embedded into TCP packets.

Modbus TCP is an Internet protocol. The protocol embeds a Modbus frame into a TCP frame so that a connection oriented approach is obtained thereby making it reliable. The master query's the slave and the slave responds with the reply. The protocol is open and hence highly scalable.

Modbus Message Structure

Modbus devices communicate using a master-slave (client-server) technique in which only one device (the master/client) can initiate transactions (called queries). The other devices (slaves/servers) respond by supplying the requested data to the master, or by taking the action requested in the query.

A master's query will consist of a slave address (or broadcast address), a function code defining the requested action, any required data, and an error checking field. A slave's response consists of fields confirming the action taken, any data to be returned, and an error checking field.

Address	Function Code	Data	Checksum
1 byte	1 byte	0 to 252 bytes	2 bytes

- Address specifies the address of the receiver.
- Function Code specifies the message type.
- Data is the data block.
- Checksum specifies the numerical check value for testing the validity of the protocol.

A.1. Address

The first byte of information in the message structure of Modbus is the receiver's address. The valid addresses are in the range of 0 to 247. Addresses from 1 to 247 are given to individual Modbus devices and 0 is used for broadcast.

Reference	Description
0xxxx	Read/Write Discrete Outputs or Coils. A 0x reference address is used to device output data to a digital output channel.
1xxxx	Read Discrete Inputs. The ON/OFF status of a 1x reference address is controlled by the corresponding digital input channel.
3xxxx	Read Input Registers. A reference register contains a 16-bit number received from an external source --- e.g. an analog signal.
4xxxx	Read/Write Output or Holding Registers. A 4x register is used to store 16-bits of numerical dada (binary or decimal), or to send the data from the CPU to an output channel.

A.2. Function Codes

The second byte in the frame structure is the function code. The function code describes what the slave is required to do. Valid function codes are between 1 and 255. The slave uses the same function code as the request to answer it. Only when error occurs in the system, the highest bit of the function code will be made '1'. Hence the master will know if the message has been transmitted correctly or not.

Code	Function	Reference
01 (01H)	Read Coils (Output) Status	0xxxx
02 (02H)	Read Input Status	1xxxx
03 (03H)	Read Holding Registers	4xxxx
04 (04H)	Read Input Registers	3xxxx
05 (05H)	Force Single Coil (Output)	0xxxx
06 (06H)	Preset Single Register	4xxxx
15 (0FH)	Force Multiple Coils (Outputs)	0xxxx
16 (10H)	Preset multiple Registers	4xxxx

A.3. Data Field

The data field consists of messages sent between master and slave. The messages contain additional information about the action to be taken by the slave or any information requested by the slave. When the slave does not require this information the data field can be nonexistent.

A.4. Error Check

The error check performed in Modbus/RTU is Cyclic Redundancy Check (CRC). Both the transmitting device and the receiver compute CRC. Two bytes are used for this purpose and generally one bit errors are detected by this method.

Appendix B. Analog Input Type and Data Format Table

Type Code	Input Range	Data Format	+F.S	-F.S
02	-10 to +10V	Engineering Unit	+10000	-10000
		2's comp HEX	7FFF	8000
01	-5 to +5V	Engineering Unit	+5000	-5000
		2's comp HEX	7FFF	8000

Appendix C. 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 PET-7H16M 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 Modbus/TCP program cannot access the module through port 502.	Port 502 has been restricted by the firewall.	Consult your MIS administrator for assistance.
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 PET-7H16M using the specific TCP port.

Appendix D. Revision History

This chapter provides revision history information to this document.

The table below shows the revision history.

Revision	Date	Description
1.0.1	December 2018	Initial issue